



**Public Works and
Government Services Canada**

Requisition No. **R.105805.001** EZ899-220255/A

DRAWINGS & SPECIFICATIONS
for

**SMITHERS BOILER
REPLACEMENT
SMITHERS B.C.**

for

Tender Submission 2021-03-05

ISSUED FOR TENDER

APPROVED BY:

Robertson, Ian

Regional Manager

Digitally signed by: Robertson, Ian
DN: CN = Robertson, Ian C = CA O = GC OU = PWGSC-TPSGC
Date: 2021.03.23 15:29:22 -07'00'

Date

Kingsley, Jeff

Construction Safety Coordinator

Digitally signed by: Kingsley, Jeff
DN: CN = Kingsley, Jeff C = CA O = GC OU = PWGSC-TPSGC, GTIS-SGT1
Date: 2021.03.22 10:18:31 -07'00'

Date

Fung, Philip

Project Manager

Digitally signed by: Fung, Philip
DN: CN = Fung, Philip C = CA O = GC OU = PWGSC-TPSGC
Date: 2021.03.23 13:18:47 -07'00'

Date

**Real Property Services Branch, Professional and Technical Services,
Pacific Region**

Room 219 - 800 Burrard Street, Vancouver, B.C.

V6Z 0B9

Mechanical Engineer:



Electrical Engineer:



Prime Consultant/ Architect

Barry Cosgrave Architect AIBC
NumberTen Architectural Group
200 1619 Store St
Victoria, B.C. V8W 3K3



SPECIFICATION

<u>Section Number</u>	<u>Section Title</u>	<u>Page Count</u>
Division 00		
00 01 07	Seals Page	01
00 01 10	Table of Contents	03
Division 01 – General Requirements		
01 11 00	Summary of Work	04
01 14 00	Work Restrictions	04
01 32 00	Construction Progress Schedule	02
01 33 00	Submittal Procedures	04
01 35 30	Health and Safety Requirements	11
01 35 35	Fire Safety Requirements	05
01 35 43	Environmental Procedures	03
01 41 00	Regulatory Requirements	01
01 45 00	Quality Control	02
01 51 00	Temporary Utilities	02
01 52 00	Construction Facilities	02
01 61 00	Common Product Requirements	03
01 74 11	Cleaning	02
01 74 19	Construction Waste and Disposal	03
01 77 00	Closeout Procedures	02
01 78 10	Closeout Submittals	03
01 91 13	Commissioning Requirements	09
01 91 31	Commissioning (Cx) Plan	10
01 91 33	Commissioning Forms	03
01 91 41	Commissioning Training	03
Division 02 – Existing Conditions		
02 41 99.01	Demolition for Minor Works	03
02 81 01	Hazardous Materials Use and Abatement	07
Division 22 – Plumbing		
22 11 16	Domestic Water Piping	06
22 13 17	Drainage, Waste and Vent Piping	03
22 42 01	Plumbing Specialties and Accessories	04
Division 23 – Heating, Ventilating and Air Conditioning (HVAC)		
23 05 00	Common Work Results – Mechanical	06
23 05 01	Use of Mechanical Systems During Construction	01
23 05 05	Installation of Pipework	03

23 05 21	Thermometers & Pressure Gauges – Piping Systems	03
23 05 29	Hangers & Supports for Piping & Equipment	05
23 05 48	Vibration & Seismic Controls for Ductwork Piping & Equipment	04
23 05 53	Mechanical Identification	06
23 05 93	Testing, Adjusting & Balancing for HVAC	04
23 07 19	Thermal Insulation for Piping	07
23 08 00	Commissioning of Mechanical Systems	03
23 08 02	Cleaning & Start-up of Mechanical Piping Systems	04
23 11 23	Gas Piping	03
23 21 14	Hydronic Specialties	04
23 21 16	Hydronic Systems: Steel	05
23 21 23	Hydronic Pumps	05
23 25 00	HVAC Water Treatment Systems	05
23 52 00	Heating Boilers	07
23 90 00	Mechanical Schedule	03

Division 25 – EMCS

25 05 01	EMCS: General Instructions	13
25 30 11	EMCS: Building Controllers	04
25 30 12	EMCS: Field Control Devices	05
25 90 11	EMCS: Sequences of Operation	03

Division 26 – Electrical

26 05 00	Common Work Results - Electrical	19
26 05 03	Commissioning	05
26 05 20	Wire and Box Connectors (0 – 1,000 V)	03
26 05 21.01	Wires and Cables (0 – 1,000 V)	03
26 05 28	Grounding Secondary	03
26 05 29	Hangers and Supports for Electrical Systems	03
26 05 31	Splitters, Junction, Pull Boxes and Cabinets	03
26 05 32	Outlet Boxes, Conduit Boxes and Fittings	03
26 05 34	Conduits, Conduit Fastenings and Conduit Fittings	05
26 27 26	Wiring Devices	03
26 28 16.02	Moulded Case Circuit Breakers	02
26 28 23	Disconnect Switches – Fused and Non-Fused	02
26 29 03	Control Devices	05
26 29 10	Motor Starters to 600 V	04

Appendices

Appendix A	– Pre-Renovation Hazardous Building Materials Assessment, Roof Replacement Project E0551- Smithers B.C. Stantec Feb 13 2020	16
Appendix B	- Asbestos-Containing Materials Survey Project E0551 Smithers B.C. Arcadis, March 24 2019	30

Appendix C – Project-Specific Pre-Renovation Hazardous Building Materials Summary Report Project E0551 Smithers B.C. Stantec-January 21 2021	09
--	----

Drawings:

ARCHITECTURAL

A1.01	COVER SHEET
A1.02	SITE PLAN AND ROOF PLAN

MECHANICAL

M-1	MECHANICAL LEGEND
M-2	MECHANICAL ROOM PLAN AND SCHEMATICS

ELECTRICAL

E-1	ELECTRICAL SCHEDULES AND PLANS
-----	--------------------------------

END OF TABLE OF CONTENTS

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises replacement of the existing boiler system located in rooftop penthouse and upgrades to the heating and piping systems.

1.2 DESCRIPTION OF WORK

- .1 Removal of existing mechanical equipment from the rooftop penthouse.
 - .1 Associated demolition and patching of assemblies.
- .2 Installation of two new boilers with a manifold and hydro-separator.
 - .1 Upgrades to heating and piping systems.
 - .2 Associated electrical connections.
 - .3 Commissioning of new system.
 - .4 Provision of temporary heating and cooling equipment as required during construction.

1.3 CONTRACT DOCUMENTS

- .1 The Contract documents, drawings and specifications are intended to complement each other, and to provide for and include everything necessary for the completion of the work.
- .2 Drawings are, in general, diagrammatic and are intended to indicate the scope and general arrangement of the work.

1.4 DIVISION OF SPECIFICATIONS

- .1 The specifications are subdivided in accordance with the current 6-digit National Master Specifications System.
- .2 A division may consist of the work of more than 1 subcontractor. Responsibility for determining which subcontractor provides the labour, material, equipment and services required to complete the work rests solely with the Contractor.
- .3 In the event of discrepancies or conflicts when interpreting the drawings and specifications, the specifications govern.

1.5 TIME OF COMPLETION

- .1 Complete all work associated with the project and have the facility ready for use within 36 Weeks after Contract Award.
- .2 The contractor to work full 8.5 hour shifts, 5 days a week in order to complete the project within the allotted time.
- .3 Time is of the essence. Completion of the work on schedule is of the utmost importance to the Departmental Representative.

1.6 HOURS OF WORK

- .1 Construction work will occur during normal working hours.

1.7 SECURITY CLEARANCES

- .1 Contractors working on this project must obtain a Facility Access Level (FA3) clearance.
- .2 Refer to Section 01 14 00 Work Restrictions.

1.8 SITE MEETINGS

- .1 Site meetings between PWGSC Departmental Representatives and the Contractor will be arranged on a bi weekly basis to review project progress and upcoming work.
- .2 Contractor to arrange project meetings and to be responsible for arranging times and location.
 - .1 Departmental Representative will be responsible for recording and distributing meeting minutes.

1.9 COST BREAKDOWN

- .1 Before submitting the first progress claim, submit a breakdown of the Contract lump sum prices in detail as directed by the Departmental Representative and aggregating Contract price.

1.10 CONTRACTORS USE OF PREMISES

- .1 Contractor to maintain lines of security at all times.
- .2 Ensure construction site is safe, secure and properly separated from areas accessible to the public.
- .3 Minimize service disruptions. Coordinate any required service shutdowns to occur outside occupied/operational hours.

1.11 OWNER OCCUPANCY

- .1 Co-operate with Departmental Representative in scheduling operations to minimize interference with facility operation.
 - .1 Facility will be in continuous use during the work of this contract.

1.12 ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to building operations, occupants, public and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

1.13 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 notice for necessary interruption of mechanical or electrical

service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to tenant operations.

- .3 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .4 Provide temporary services as directed, to maintain critical existing systems.
- .5 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .6 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .7 Record locations of maintained, re-routed and abandoned service lines.

1.14 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy of each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as required as submittals in individual specification sections.

1.15 AS-BUILT DOCUMENTS

- .1 The Departmental Representative will provide 2 sets of drawings, 2 sets of specifications, and 2 copies of the original AutoCAD files for “as-built” purposes.
- .2 As 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 Refer to Section 01 78 10 Closeout Procedures.

1.16 ADDITIONAL DRAWINGS

- .1 The Departmental Representative may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included with plans referred to in the Contract documents.

1.17 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 is fully conversant with all conditions.

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 FACILITY OPERATIONS AND SECURITY PROCEDURES

- .1 All construction staff shall become thoroughly familiar with and abide by all provisions and requirements of the facility, Safety and Security Procedures and Restrictions.
 - .1 The parking area(s) to be used by construction employees will be designated by the Departmental Representative. Parking in other locations will be prohibited and vehicles may be subject to removal.
 - .2 Speed limits are posted on site. Failure to abide by site speed limits may result in removal of employee and vehicle from site.

1.2 FACILITY POWER AND MECHANICAL SERVICES SHUT-DOWN REQUIREMENTS

- .1 All construction staff shall become thoroughly familiar with and abide by all provisions and requirements for the shut-down of power services and/or mechanical services to the facility.
 - .1 All power services and/or mechanical services (water, gas, drain, heat, ventilation and fire protection) shut-downs (building-wide or partial) shall be confirmed and coordinated with the users (e.g. RCMP detachment commander) at minimum 72 hours prior to the start of work.
 - .2 All building-wide power shut-downs must occur outside of regular working hours of the facility.
 - .3 At no time during regular working hours of the facility, the building will be without power. If a building-wide power shut-down needs to occur during regular working hours of the facility, the contractor shall provide a temporary generator to accommodate the entire facility for the duration of the work.
 - .4 If a building-wide mechanical services shut-down needs to occur during regular working hours of the facility, the contractor shall provide temporary heat and services to accommodate the entire facility for the duration of the work.
 - .5 Partial building shutdowns may occur during regular hours of the facility if the duration of the shutdown is less than 90 minutes. If the duration of the shutdown is more than 90 minutes, it shall be done as per item 2 above.
 - .6 RCMP at any time may cancel a pre-scheduled power and/or mechanical services shut-down due to operation situations that may arise. The Contractor shall always contact users (e.g. RCMP detachment commander) immediately before any shut-down and confirm if a pre-scheduled shut-down may proceed as planned.

1.3 SITE ACCESS REQUIREMENTS

.1 General

- .1 To ensure that the security of the project construction and RCMP operation is maintained at all times.
- .2 All personnel engaged in the execution of the work on the interior or exterior of an RCMP occupied building shall have at a minimum, the requisite RCMP Facility Access Level 3 (FA3) clearance in order to be allowed access to the site. Individuals who do not have RCMP FA3 clearance will not be allowed on site.
- .3 Immediately upon contract award, Contractor shall prepare and submit all the requisite forms and documents for all the personnel engaged in the project and submit to RCMP to obtain RCMP FA3 clearance. Ensure all necessary forms and documents are completed as required by RCMP to prevent any delays in the review process.
- .4 Once the required RCMP clearances are obtained, Contractor and his employees will have as much freedom of action and movement as is possible and as determined by RCMP to perform the Work
- .5 It is the responsibility of the general contractor to ensure that the RCMP security requirements are met throughout the performance of the work.

.2 Restrictions

- .1 A 72-hour notice is required for any access to security and high security zones within the premises to allow RCMP to arrange for a staff member to accompany the Contractor. Security and high security areas include Cell Block, Record Rooms, Exhibit Rooms, Special Project Rooms, IT Room, Comm. Room and Security Room.
- .2 Entry to the RCMP Property will be refused to any person there may be reason to believe to be a security risk.
- .3 Construction activities and all related movement of personnel and vehicles will be subject to surveillance and inspection by RCMP staff members to ensure that established security requirements are met.
- .4 RCMP site staff may request at any time that the contractor, his employees, sub-contractors and their employees not enter the site or leave the work site immediately due to a security situation occurring within the RCMP property. The contractor's site supervisor will note the name of the staff member giving the instruction, the time of the request and obey the order as quickly as possible.

1.4 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant Federal, municipal, provincial and other regulations.
- .2 Provide hoarding, and scaffolding plan for Departmental Representative to review 5 business days prior to installation.

1.5 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work, provide temporary means to maintain security as per Departmental Representatives direction.
- .4 Closures: protect work temporarily until permanent enclosures are completed.
- .5 Coordinate with Departmental Representative in scheduling operations to minimize conflict and to facilitate use of space.

1.6 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to Facility operations, occupants, and normal use. Arrange with Departmental Representative to facilitate execution of work.

1.7 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 3 working days of notice for necessary interruption of civil, mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
 - .1 Optimize and plan shut-downs so that services are restored in time for normal facility operation hours. Coordinate all shut-downs with utility providers and facility users.
 - .2 Contractor shall be held responsible for damages to facility equipment as the result of service shut-downs.
 - .3 Contractor shall be held responsible for any and all unscheduled shut-downs of building utilities and services.
 - .4 Contractor will not be allowed to connect to Departmental existing data and communication services.
 - .5 Submit a "Fire Alarm Bypass" request to Departmental Representative 3 working days in advance for approval.
 - .6 Obtain permission from Departmental Representative for access to restricted areas outside the construction zones 3 working days in advance.
- .3 Provide for personnel and vehicular traffic.
- .4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.8 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions.

1.9 NOISE CONTROL

- .1 Comply with applicable provincial by-law for noise control.

1.10 DUST CONTROL

- .1 Comply with applicable government regulations, provincial and or city by-law, WCB, Work Safe BC for dust control in the construction and affected areas.

END OF SECTION

Part 1 General

1.1 SCHEDULES REQUIRED

- .1 Construction Schedule

1.2 SCHEDULE FORMAT

- .1 Prepare schedule in form of a horizontal bar chart. (Gantt)
- .2 Provide a separate bar for each major operation
- .3 Provide horizontal time scale identifying first Working Day of each week.
- .4 Identification of listings
- .5 By specific task
- .6 Identify work by phase
- .7 Include all milestones and identify critical paths

1.3 SCHEDULE SUBMISSION.

- .1 Submit initial schedule within seven working days after award of Contract.
- .2 Submit schedules in electronic format, forward through e-mail - .pdf files.
- .3 Departmental Representative will review schedule and return review copy within three days after receipt.
- .4 Resubmit finalized schedule within three days after return of review copy.
- .5 Submit revised progress schedule with each application for payment.
- .6 Distribute copies of revised schedule to:
 - .1 Subcontractors.
 - .2 Other concerned parties.
- .7 Instruct recipients to report to Contractor within five working days, any problems anticipated by timetable shown in schedule.

1.4 SCHEDULING

- .1 Show complete sequence of construction by activity, identifying Work of separate stages and final completion of the entire project within the time period required by the Contract documents. The schedule must clearly show completion of each phase. Indicate the following:
 - .1 Submission of Shop Drawings, product data, MSDS sheets and samples
 - .2 Indicate estimated percentage of completion for each item of Work at each submission.
 - .3 Indicate the anticipated date of substantial completion.
 - .4 Indicate final completion date within the time period required by the contract documents.

- .5 Indicate projected percentage of completion of each item as of first day of the week.
- .6 Indicate progress of each activity to date of submission schedule.
- .7 Indicate changes occurring since previous submission of schedule:

1.5 PROGRESS REPORTS

- .1 Maintain an accurate record of the Construction work. Submit progress report when requested by the Departmental Representative and with each Request for Progress Payment.
- .2 Include in reports, the dates of commencement and percentage of work completed for different aspects of the work.

1.6 CHANGES IN THE SCHEDULE

- .1 Whenever proposing a change in the construction schedule, submit proposed revised schedule to the Departmental Representative, together with such analyses thereof as are required to clearly indicate the purpose and anticipated results of such changes.
- .2 If, in the opinion of the Departmental Representative, any proposed change in construction scheduled is inadequate to secure completion of the Work within the specified time, or is otherwise not in accordance with the specifications, or if the Work is not being adequately or properly prosecuted in any respect, the Departmental Representative reserves the right to require a revised schedule together with such analyses thereof as are required to indicate the anticipated results of such revision.
- .3 Claims for additional compensation or extension of Contract Time on account of such requirements will not be considered.

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 co-ordinated 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 co-ordinated.
- .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.

1.2 HEALTH AND SAFETY PLAN

- .1 Submit site specific Health and Safety Plan, MSDS and WHMIS documents requested in Section 01 35 30 - Health and Safety Requirements

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow 5 days for Departmental Representative's review of each submission.

- .4 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.
- .5 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.
- .6 Accompany submissions with electronic transmittal, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Indicate the specification section and paragraph number that applies to the shop drawing that is being submitted.
 - .1 Ensure that each shop drawing clearly refers to the requirements of the stated specification section.
 - .5 Identification and quantity of each shop drawing, product data and sample.
 - .6 Other pertinent data.
- .7 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title, number and applicable specification section.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .8 After Departmental Representative's review, distribute copies.
- .9 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

- .10 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 3 years of date of contract award for project.
- .11 Submit electronic copies of manufacturers 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.
- .12 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative
- .13 Submit 2 hard copies and electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .14 Delete information not applicable to project.
- .15 Supplement standard information to provide details applicable to project.
- .16 If upon review by Departmental Representative no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .17 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that PWGSC 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 co-ordination of Work of sub-trades.

1.4 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid, one of each sample to Departmental Representatives office.
- .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 become standard of workmanship and material against which installed Work will be verified.

1.5 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of digital photography in jpg format, standard resolution as directed by Departmental Representative.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints: 4 locations.
 - .1 Viewpoints and their location as determined by Departmental Representative.
- .4 Frequency of photographic documentation: weekly and as follows
 - .1 Upon completion of: excavation, foundation, framing and services before concealment.

1.6 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, and with each progress draw, submit Workers' Compensation Board status.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1 GENERAL

PWGSC Update on Asbestos Use

Effective April 1, 2016, all Public Works and Government Services of Canada (PWGSC) contracts for new construction and major rehabilitation will prohibit use of asbestos-containing materials.

COVID 19

All contractors shall follow Canadian Construction Association COVID-19 - Standardized Protocols for All Canadian Construction Sites.

1.1 REFERENCES

- .1 Government of Canada.
 - .1 Canada Labour Code - Part II (as amended)
 - .2 Canada Occupational Health and Safety Regulations. (as amended)
- .2 National Building Code of Canada (NBC): (as amended)
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 The Canadian Electrical Code (as amended)
- .4 Canadian Standards Association (CSA) as amended:
 - .1 CSA Z797-2018 Code of Practice for Access Scaffold.
 - .2 CSA S269.1-2016 Falsework for Construction Purposes.
 - .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures.
 - .4 CSA Z1006-10 Management of Work in Confined Spaces.
 - .5 CSA Z462-18 Workplace Electrical Safety Standard
- .5 National Fire Code of Canada 2015 (as amended)
 - .1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.
- .6 American National Standards Institute (ANSI): (as amended)
 - .1 ANSI/ASSP A10.3-2013, Operations – Safety Requirements for Powder-Actuated Fastening Systems.

.7 Province of British Columbia:

.1 Workers Compensation Act Part 3-Occupational Health and Safety. (as amended)

.2 Occupational Health and Safety Regulation (as amended)

1.2 RELATED SECTIONS

.1 Refer to the following current NMS sections as required:

.1 Section 01 11 00 – Summary of Work

.2 Section 01 74 19 – Construction Waste and Disposal

.3 Section 02 81 01 - Hazardous Materials Use and Abatement

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 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, 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 Submittal Procedures.

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

.3 Submit the following:

.1 Organizations Health and Safety Plan.

.2 Site Specific Safety Plan or Health and Safety Plan (SSSP or HASP)

.3 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.

- .4 Copies of incident and accident reports.
- .5 Complete set of Material Safety Data Sheets (SDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
- .6 Emergency Response Procedures.
- .4 The Departmental Representative will review the Contractor's Site Specific Safety Plan or Health and Safety Plan (SSSP/HASP) and emergency response procedures and provide comments to the Contractor within 5 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 Site Specific Safety Plan or 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 and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 HEALTH AND SAFETY COORDINATOR

- .1 Assign a competent and qualified Health and Safety Coordinator who shall:
 - .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 Safety Plan (SSSP) or Health and Safety Plan (HASP)
- .3 Be on site during execution of work.
- .4 Have minimum two (2) years' site-related working experience
- .5 Have working knowledge of the applicable occupational safety and health regulations.

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 or provide security guard as deemed necessary to protect site against entry.

1.9 PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Multi-employer work site.
 - .2 Federal employees and general public.
 - .3 Energized electrical services.
 - .4 Working from heights.
 - .5 Persons incarcerated in the federal institutional system.
 - .6 Hazards - PSPC Preliminary Hazard Assessment included as an Appendix to Specifications

1.10 UTILITY CLEARANCES

- .1 The Contractor is solely responsible for all utility detection and clearances prior to starting the work.
- .2 The Contractor will not rely solely upon the Reference Drawings or other information provided for Utility locations.

1.11 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.

1.12 WORK PERMITS

- .1 Obtain specialty permit(s) related to project before start of work.

1.13 FILING OF NOTICE

- .1 The General Contractor is to file Notice of Project with Provincial authorities prior to commencement of work. (All construction projects require a Notice of Work)
- .2 Provide copies of all notices to the Departmental Representative.

1.14 SITE SPECIFIC 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 the Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP) based on the required 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.
- .11 COVID 19 Protocols and 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. SDS required for all products.
- .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 Site Specific Safety Plan (SSSP) and/or Health and Safety Plan (HASP) as required, and re-submit to the Departmental Representative.
- .5 Departmental Representative's review: the review of Site Specific Safety Plan and/or 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 Site Specific Safety Plan and/or Health and Safety Plan of responsibility for meeting all requirements of construction and Contract documents and legislated requirements.

1.15 EMERGENCY PROCEDURES

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an emergency response and emergency 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.
- .5 A route map with written directions to the nearest hospital or medical clinic.
- .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.
- .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.
- .6 Contractors must not rely solely upon 911 for emergency rescue in a confined space, working at heights, etc.

1.16 HAZARDOUS PRODUCTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS 2015) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Safety Data Sheets (SDS) 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 SDS and WHMIS 2015 documents as per Section 01 33 00 Submittal Procedures.
 - .2 In conjunction with Departmental Representative schedule to carry out work during "off hours" when tenants have left the building.
 - .3 Provide adequate means of ventilation in accordance with Section 01 51 00.
 - .4 The contractor shall ensure that the product is applied as per manufacturers recommendations.
 - .5 The contractor shall ensure that only pre-approved products are bought onto the work site in an adequate quantity to complete the work.

1.17 ASBESTOS HAZARD

- .1 Carry out any activities involving asbestos in accordance with current applicable Federal and Provincial Regulations.
- .2 Removal and handling of asbestos will be in accordance with current applicable Provincial / Federal Regulations.

1.18 PCB REMOVALS

- .1 Mercury-containing fluorescent tubes and ballasts which contain polychlorinated biphenyls (PCBs) are classified as hazardous waste.
- .2 Remove, handle, transport and dispose of as indicated in Division 2 specifications.

1.19 REMOVAL OF LEAD-CONTAINING PAINT

- .1 All paint containing TCLP lead concentrations above 5 ppm are classified as hazardous.
- .2 Carry out demolition and/or remediation activities involving lead-containing paints in accordance with current applicable Provincial / Territorial Regulations.

- .3 Work with lead-containing paint shall be completed as per Provincial and Federal regulations.
- .4 Dry Scraping/Sanding of any materials containing lead is strictly prohibited.
- .5 The use of Methylene Chloride based paint removal products is strictly prohibited.

1.20 ELECTRICAL SAFETY REQUIREMENTS
(Reference: Worksafe BC OHS Regulation Part 19 – Electrical Safety)

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

1.21 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.

1.22 OVERLOADING

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

1.23 FALSEWORK

- .1 Design and construct falsework in accordance with CSA S269.1-1975 (R2003) (as amended)

1.24 SCAFFOLDING

- .1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA Z797-2009 (as amended) and B.C. Occupational Health and Safety Regulations. (as amended)

1.25 CONFINED SPACES

- .1 Carry out work in compliance with current Provincial / Territorial regulations.

1.26 POWDER-ACTUATED DEVICES

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

1.27 FIRE SAFETY REQUIREMENTS

- .1 Refer to Section 01 35 35 - Fire Safety Requirements.

1.28 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 immediately advise the Departmental Representative verbally and in writing.

1.29 POSTED DOCUMENTS

- .1 Post legible versions of the following documents on site:
 - .1 Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP)
 - .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. Must be posted in a non-inmate access area and locked up when not being used.
 - .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 2015) documents.
- .9 Material Safety Data Sheets (SDS).
- .10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.
- .11 All Hazardous Material and Substance Reports including Lab Analysis
- .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.

1.30 MEETINGS

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

1.31 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 noncompliance 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".

2 PRODUCTS

- .1 Not used.

3 EXECUTION

- .1 Not used.

END OF SECTION

Part 1 General

1.1 CONSTRUCTION FIRE SAFETY

- .1 The Contractor shall provide construction fire safety in accordance with the National Fire Code of Canada.

1.2 REPORTING FIRES

- .1 The Contractor shall inform the Departmental Representative and the Fire Chief of all fire incidents at the construction site, regardless of size.
- .2 Know location of nearest fire alarm pull station and telephone, including emergency phone number.
- .3 Report immediately fire incidents to Fire Department as follows:
 - .1 Activate nearest fire alarm pull station.
 - .2 Telephone, by calling **911**
- .4 Person activating fire alarm pull station will remain at the front entrance to direct Fire Department to scene of fire.
- .5 When reporting fire by telephone, give location of fire, name or number of building and be prepared to verify location.

1.3 FIRE SAFETY PLAN

- .1 Submit a fire safety plan for the construction site prior to commencement of construction work. The fire safety plan shall conform to the National Fire Code of Canada.
- .2 The fire safety plan shall be submitted to the Departmental Representative for review by local fire department. Any comments by local fire department shall be implemented by the Contractor.
- .3 The fire safety plan shall be limited to the area of construction only. Contractor is not responsible for amending fire safety plans in existing buildings.
- .4 Post the fire safety plan at the entrance to the construction site or near the construction site's health and safety board.
- .5 The fire safety plan shall conform to the National Fire Code of Canada, and shall contain, at minimum:
 - .1 Emergency procedures to be used in case of fire, including
 - .1 Sounding the fire alarm;
 - .2 Notifying the fire department;
 - .3 Instructing occupants on procedures to be followed when the fire alarm sounds;
 - .4 Evacuating occupants, including special provisions for persons requiring assistance; and
 - .5 Confining, controlling and extinguishing fires.
 - .2 The appointment and organization of designated supervisory staff to carry out fire safety duties.

- .3 The training of supervisory staff and other occupants in their responsibilities for fire safety.
- .4 The holding of fire drills (where applicable).
- .5 The control of fire hazards in the building.
- .6 The inspection and maintenance of building facilities provided for the safety of occupants.

1.4 FIRE WARNING SYSTEM

- .1 A fire warning shall be provided to notify construction personnel of a fire emergency in the construction area.
- .2 The system used shall be capable of being heard throughout the building.

1.5 EXTERIOR FIRE PROTECTION SYSTEMS

- .1 Do not use Fire hydrants, standpipes or hose systems for other than fire-fighting purposes unless authorized by the Supervisor, Surface and Mobile.

1.6 FIRE PROTECTION SYSTEM IMPAIRMENT

- .1 Notify the Departmental Representative and the Fire Chief 48 hours prior to shutting down any active fire protection system, including water supply, fire suppression, fire detection and life safety systems.
- .2 Implement all fire protection system impairments in accordance with the National Fire Code of Canada and Airport Fire Orders. Fire Orders will be provided at the Pre-Commencement Meeting.

1.7 FIRE EXTINGUISHERS

- .1 In addition to other requirements of this specification, supply fire extinguishers, as scaled by the Fire Chief, necessary to protect work in progress and contractor's physical plant on site.
- .2 Fire extinguishers may be required in the following areas as directed by the Fire Chief
 - .1 Adjacent to hot works;
 - .2 In areas where combustibles are stored;
 - .3 Near or on any internal combustion engines;
 - .4 Adjacent to areas where flammable liquids or gases are stored or handled;
 - .5 Adjacent to temporary oil fired or gas fired equipment; and
 - .6 Adjacent to bitumen heating equipment.
- .3 Extinguishers shall be sized as 4-A:40-B:C (20 lbs) unless otherwise directed by the Fire Chief.
- .4 Extinguishers shall be of the dry chemical type unless otherwise required by the hazard being protected.
- .5 The Contractor may assume the quantity of extinguishers based on a maximum travel distance between extinguishers of 75 feet.

1.8 ACCESS FOR FIRE FIGHTING

- .1 Access for firefighting shall be provided in accordance with the National Fire Code of Canada.

- .2 Advise the Fire Chief of work that would impede fire apparatus response. This includes violation of minimum horizontal and overhead clearance, as prescribed by the Fire Chief, erecting of barricades and digging of trenches.
- .3 Minimum horizontal clearance: clear width of not less than 5m, or as defined by the Chief.
- .4 Minimum vertical clearance: overhead height of not less than 6m, or as defined by the Fire Chief.

1.9 SMOKING PRECAUTIONS

- .1 Smoking is prohibited in all buildings. Observe posted smoking restrictions on entire site. Smoking only in designated areas. Contractor to provide designated area for job.

1.10 RUBBISH AND WASTE MATERIALS

- .1 Keep rubbish and waste materials at minimum quantities.
- .2 Burning of rubbish is prohibited.
- .3 Remove rubbish from work site at end of work day or shift or as directed.
- .4 Storage:
 - .1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
 - .2 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove specified.

1.11 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 Handle, store and use of flammable and combustible liquids in accordance with the National Fire Code of Canada.
- .2 Keep flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use in quantities not exceeding 45 litres provided they are stored in approved safety cans bearing Underwriters' Laboratory of Canada or Factory Mutual seal of approval. Obtain written authorization from Port Hardy Fire Chief for storage of quantities of flammable and combustible liquids exceeding 45 litres.
- .3 Do not transfer flammable or combustible liquids inside buildings or on jetties.
- .4 Do not transfer flammable or combustible liquids in vicinity of open flames or any type of heat-producing devices.
- .5 Do not use flammable liquids having flash point below 38 degrees C such as naphtha or gasoline as solvents or cleaning agents.
- .6 Store flammable and combustible waste liquids, for disposal, in approved containers located in safe ventilated area. Keep quantities to a minimum and notify Port Hardy District Fire Chief when disposal is required.

1.12 HOT WORKS

- .1 The Contractor shall implement a hot works program in accordance with the National Fire Code of Canada and NFPA 51 Standard for Fire Prevention during Welding, Cutting and Other Hot Work.

- .2 The Contractor shall obtain from the Fire Chief a "Hot Work" permit for all hot works in the construction area. Frequency of renewal for hot works permits is at the discretion of the Fire Chief.
- .3 When Work is carried out in dangerous or hazardous areas involving use of heat; provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of the Fire Chief.
- .4 Area of hot works
 - .1 Hot works shall be carried out in an area free of combustible and flammable content.
 - .2 Where 1.14.5.1 is not possible,
 - .1 All flammable and combustible materials within 15m of the hot works shall be protected in accordance with the National Fire Code of Canada;
 - .2 A fire watch shall be provided during the hot work and for a period of not less than 60 minutes unless otherwise directed.
 - .3 A final inspection of the hot work area shall be conducted not less than 4 hours after the completion of hot works unless otherwise directed by the Fire Chief.
 - .3 Where there is a possibility of sparks leaking onto combustible materials in areas adjacent to the areas where the hot work is carried out
 - .1 Openings in walls, floors or ceilings shall be covered or closed to prevent the passage of sparks to such adjacent areas, or
 - .2 Sentence 1.14.5.2 shall apply for those areas.
- .5 Protection of flammable and combustible materials
 - .1 Any combustible or flammable material, dust or residue shall be
 - .1 Removed from the area where hot works is carried out; or
 - .2 Protected from ignition by non combustible materials.
- .6 Fire extinguisher
 - .1 A fire extinguisher shall be provided within 3 m of all hot works. Minimum size shall be 20lbs ABC unless otherwise directed by the Fire Chief.

1.13 HAZARDOUS SUBSTANCES

- .1 Work entailing use of toxic or hazardous materials, chemicals and/or explosives, or otherwise creating hazard to life, safety or health, shall be in accordance with National Fire Code of Canada.
- .2 Provide ventilation where flammable liquids, such as lacquers or urethanes are used. Eliminate all sources of ignition.

1.14 QUESTIONS AND/OR CLARIFICATION

- .1 Direct questions or clarification on Fire Safety in addition to above requirements to the Departmental Representative.
- .2 Departmental Representative is responsible to obtain clarifications from the Fire Chief. The Contractor is not to liaise directly with the Fire Chief for notification, authorization or any requests unless the situation constitutes an immediate emergency.

1.15 FIRE INSPECTION

- .1 Co-ordinate site inspections by the Fire Chief through Departmental Representative.
- .2 Allow the Fire Chief unrestricted access to work site.
- .3 Co-operate with the Fire Chief during routine fire safety inspection of work site.
- .4 Immediately remedy unsafe fire situations observed by the Fire Chief.

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 REFERENCES

- .1 Definitions:
 - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
 - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.
- .2 Reference Standards:
 - .1 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum 2007).
 - .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC Version 1.0-Addendum 2007
 - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
 - .4 LEED Canada 2009 for Design and Construction-2010, LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating System Reference Guide
 - .5 LEED Canada for Existing Buildings, Operations and Maintenance-2009, LEED Canada 2009 Leadership In Energy and Environmental Design Green Building Rating System Reference Guide.
 - .2 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005-92, Storm Water Management for Construction Activities, Chapter 3.
 - .2 EPA General Construction Permit (GCP) 2012.
 - .3 Stormwater Management Manual for Western Washington, Volume II, 2014, Chapter 4

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit WHMIS MSDS in accordance with Section 01 35 30 - Health and Safety Requirements.
- .3 Before commencing construction activities or delivery of materials to site, submit Construction Activity Pollution Prevention Plan for review and approval by Departmental Representative.
- .4 Construction Activity Pollution Prevention Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .5 Address topics at level of detail commensurate with environmental issue and required construction tasks.

- .6 Include in Construction Activity Pollution Prevention Plan:
 - .1 Names of persons responsible for ensuring adherence to Construction Activity Pollution Prevention Plan.
 - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
 - .3 Names and qualifications of persons responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
 - .6 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
 - .7 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
 - .8 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

1.3 FIRES

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

1.4 POLLUTION CONTROL

- .1 Maintain pollution control features installed under this Contract.
- .2 Control emissions from equipment in accordance with local authorities' emission requirements.
- .3 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.5 NOTIFICATION

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Construction Activity Pollution Prevention Plan.
- .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action.
 - .1 Take action only after receipt of written approval by Departmental Representative.
- .3 Departmental Representative may issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .4 Waste Management: separate waste materials for in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

- .1 Perform Work in accordance with National Building Code of Canada (NBC) 2015 including 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 Comply with applicable local bylaws rules and regulations enforced at the location concerned.
- .3 Provide inspection authorities having jurisdiction with plans and information required for issue of acceptance certificates
- .4 Pay fees and obtain certificates and permits required
- .5 Furnish inspection certificates in evidence that the work installed conforms to the requirements of the authority having jurisdiction
- .6 Conform to the Canada Labour Code II, Canada Occupational Safety and Health regulations.
- .7 FCC, Fire Commissioner of Canada.
 - .1 Standard No. 301, "Construction Operations" , June 1982.
- .8 WCB, Worker's Compensation Act, B.C.,Reg. 185/99
- .9 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.2 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and local by-laws.

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 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 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.

1.2 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.

1.3 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 Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents. Departmental Representative will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents.
- .4 In case of dispute, decisions as to standard or quality of work rests solely with the Departmental Representative.

1.4 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies are to be engaged by the contractor to inspect portions of the work, as indicated in individual specification sections.
- .2 Contractor is to allow for the costs of these inspections
- .3 Provide equipment required for executing inspection and testing by appointed agencies.

- .4 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .5 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 reinspection.

1.5 EQUIPMENT AND SYSTEMS

- .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.
- .2 Refer to individual specification sections for definitive requirements.

Part 2 Products

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 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.2 WATER SUPPLY

- .1 Departmental Representative will provide continuous supply of potable water for construction use.
- .2 Exercise conservation. Turn off water when not in use.
- .3 Provide all equipment and temporary hoses to bring water supply to site, at no additional cost to the contract.

1.3 TEMPORARY POWER AND LIGHT

- .1 Electrical power is available for construction purposes at no cost.
- .2 Departmental Representative will determine delivery points and quantitative limits. Departmental Representative written permission is required before any connection is made. Connect to existing power supply in accordance with Canadian Electrical Code.
- .3 Provide all equipment and temporary lines to bring these services to the work, at no additional cost to the contract.
- .4 Exercise conservation whenever using temporary electrical power supply.

1.4 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.

- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .7 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.5 FIRE PROTECTION

- .1 Burning rubbish and construction waste materials is not permitted on site.

Part 2 Products

- 2.1 NOT USED

Part 3 EXECUTION

- .1 NOT USED

END OF SECTION

Part 1 General

1.1 INSTALLATION AND REMOVAL

- .1 Provide construction facilities in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.2 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding ladders and platforms necessary for the performance of the work.

1.3 HOISTING

- .1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists to be operated by B.C. certified personnel.

1.4 SITE STORAGE/LOADING

- .1 Confine work and operations of employees to areas as directed by Departmental Representative unless otherwise identified in Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.5 CONSTRUCTION PARKING

- .1 Parking is permitted on site in areas directed by Departmental Representative.
- .2 Existing roads may be used for access to project site. Maintain construction parking area clean and free of construction-related debris, spillage and soiling.
- .3 Make good damage resulting from Contractor use of parking areas and roads, at no additional cost to the Contract.

1.6 SECURITY

- .1 Contractor is responsible for providing on site security at all times during the construction phases.

1.7 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities where directed by Departmental Representative.

1.8 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.9 CONSTRUCTION SIGNAGE

- .1 No project identification signage allowed
- .2 No other signs or advertisements, other than warning signs, are permitted on site.
- .3 Signs and notices for safety and instruction in both official languages. Graphic symbols to CAN/CSA-Z321.
- .4 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by 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 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.2 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .5 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.3 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Departmental Representative will be paid for by Departmental Representative. Unload, handle and store such products.

1.4 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions. Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.5 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed.
- .2 Do not employ anyone unskilled in their required duties.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative whose decision is final.

1.6 CO-ORDINATION

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.7 CONCEALMENT

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

1.8 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.9 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Departmental Representative of conflicting installation. Install as directed.

1.10 FASTENINGS

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

- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.11 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.12 PROTECTION OF WORK IN PROGRESS

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

1.13 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Maintain public areas adjacent to the worksite in a tidy condition.
- .3 Remove waste materials from site at daily and as directed by the Departmental Representative.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide and use marked separate bins for recycling. Refer to Section 01 74 19 – Construction Waste and Disposal.
- .6 Provide on-site dump containers for collection of waste materials and debris.
- .7 Dispose of waste materials and debris.
 - .1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.
 - .2 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.
 - .3 Remove hazardous materials away from public areas as they are exposed.
- .8 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.
- .9 Clean interior areas prior to start of finishing work. Maintain areas free of dust and other contaminants during finishing operations.

1.2 FINAL CLEANING

- .1 When all of the Work has been 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. 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.
- .5 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .6 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .7 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .8 Remove dirt and other disfiguration from exterior surfaces.

- .9 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .10 Sweep and wash clean paved areas.
- .11 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

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 DEFINITIONS

- .1 Waste Source Separation Program (WSSP): implementation and co-ordination of ongoing activities to ensure designated waste materials will be sorted into pre-defined categories and sent for recycling and reuse, maximizing diversion and potential to reduce disposal costs.
- .2 Separate Condition: refers to waste sorted into individual types.
- .3 Source Separation: act of keeping different types of waste materials separate beginning from the point they became waste.
- .4 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials generated by project. Specifies diversion goals, implementation and reporting procedures, anticipated results and responsibilities.

1.2 DOCUMENTS

- .1 Post and maintain in visible and accessible area at job site, one copy of following documents:
 - .1 Waste Reduction Workplan.
 - .2 Waste Source Separation Plan.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit following prior to project start-up:
 - .1 Completed Waste Reduction Workplan (WRW).
 - .2 Completed Waste Source Separation Program (WSSP) description.
- .3 Prepare and submit at intervals agreed to by Departmental Representative the following:
 - .1 Bills of lading and destination receipts for all waste removed from the site.

1.4 WASTE REDUCTION WORKPLAN (WRW)

- .1 Prepare and submit WRW prior to project start-up.
- .2 WRW identifies strategies to optimize diversion through reduction, reuse, and recycling of materials and comply with applicable regulations, based on information acquired from WA.
 - .1 Destination of materials identified.
 - .2 Deconstruction/disassembly techniques and sequencing where required.
 - .3 Schedule for deconstruction/disassembly where required.
 - .4 Details on materials handling and removal procedures.
 - .5 Quantities of materials to be salvaged for reuse or recycled and materials sent to landfill.

- .6 Names and addresses of proposed recycling and landfill sites
- .3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .4 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .5 Post WRW or summary where workers at site are able to review content.
- .6 Monitor and report on waste reduction by documenting total volume (in tonnes) and cost of actual waste removed from project.
- .7 Outline procedures to be put in place to handle, store and dispose of identified hazardous wastes.

1.5 WASTE SOURCE SEPARATION PROGRAM (WSSP)

- .1 As part of Waste Reduction Workplan, prepare WSSP prior to project start-up.
- .2 WSSP will detail methodology and planned on-site activities for separation of reusable and recyclable materials from waste intended for landfill. Contractor to provide list indicating material types to be diverted from landfill. This list to contain, but is not limited to, the following: metals, glass, concrete, clean untreated wood, plastics, paper.
- .3 Provide sufficient on-site facilities and containers for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers for the deposit of
 - .1 Reuseable and recycleable materials
 - .2 Materials to be sent to landfill
- .5 Collect handle and store on-site and transport off-site recycleable materials in separated condition.
- .6 Locate separated materials in areas which minimizes material damage and with the least interference with day to day activities. Location to be approved by Departmental Representative
- .7 Clearly and securely label containers to identify types/conditions of materials accepted.
- .8 On-site sale of salvaged materials is not permitted.

1.6 USE OF SITE AND FACILITIES

- .1 Execute Work with minimal interference and disturbance to normal use of adjacent property.

1.7 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste into waterways, storm, or sanitary sewers.
- .3 Remove materials on-site as Work progresses.
- .4 Transportation and disposal of hazardous waste must be in accordance with applicable legislation.

- .5 Submit bills of lading and destination receipts for all waste removed from site.

1.8 HAZARDOUS AND TOXIC WASTES

- .1 Dispose of identified Hazardous Materials according to applicable regulations at no cost to the Departmental Representative.
- .2 If suspected unidentified Hazardous Materials are discovered, stop work in the area immediately and inform the 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 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: Contractor and all subcontractors to conduct 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 inspection and submit verification that corrections have been made.
 - .2 Request Departmental Representative's inspection.
 - .2 Departmental Representative's Inspection:
 - .1 Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
 - .3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Certificates required by authorities having jurisdiction have been submitted.
 - .4 Operation of systems have been demonstrated to the Departmental Representative and designated staff.
 - .5 Work is complete and ready for final inspection.
 - .4 Declaration of Substantial Performance: When Departmental Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
 - .5 Commencement of warranty period: Date of Departmental Representatives acceptance of substantial performance to be the date for commencement for warranty period.
 - .6 Payment of Holdback: after issuance of Substantial Performance of work, submit application for payment of holdback amount in accordance with contractual agreement.
 - .7 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by Departmental Representative.
 - .2 If work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.

- .8 Final Payment
 - .1 When Departmental Representative considers final deficiencies and defects corrected and requirements of contract met, make application for final payment.
 - .2 When work deemed incomplete by Departmental Representative complete outstanding items and request re-inspection.

1.2 FINAL CLEANING

- .1 Clean in accordance with section 01 74 11
 - .1 Remove surplus materials, excess materials, rubbish tools and equipment.

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 SECTION INCLUDES

- .1 Closeout submittals
- .2 Operation and maintenance manual format.
- .3 Contents each volume.
- .4 Recording actual site conditions.
- .5 Record (as-built) documents and samples.
- .6 Record documents.
- .7 Final survey.
- .8 Warranties and bonds.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 CLOSEOUT SUBMITTALS

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 Copy will be returned with Departmental Representative's comments.
- .3 Revise content of documents as required prior to final submittal.
- .4 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in Canadian English.
 - .1 One copy of the manual to be provided in digital form on CD rom, in Canadian English.
- .5 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.
- .6 If requested, furnish evidence as to type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .8 Pay costs of transportation.

1.4 OPERATION AND MAINTENANCE MANUAL FORMAT

- .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 "MAINTENANCE MANUAL"; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide both .PDF electronic copy and hard copy submissions
- .10 Coordinate with commissioning specification to include all related close out documentation, warranty and test reports.

1.5 CONTENTS - EACH VOLUME

- .1 Table of Contents: provide title of project;
 - .1 date of submission;
 - .2 names, addresses, and telephone numbers of Contractor and Subcontractors with name of responsible parties; and
 - .3 schedule of products and systems, indexed to content of volume.
- .2 For each product or system, 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. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- .4 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

1.6 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings, and within the Project Manual, provided by Departmental Representative.
- .2 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information.
- .3 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately 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 inspection certifications, field test records, required by individual specifications sections.

1.7 RECORD DOCUMENTS AND SAMPLES

- .1 In addition to requirements in General Conditions, maintain at the site for Departmental Representative, 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 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with section number listings in List of Contents of the Project Manual. Label each document "RECORD DOCUMENTS" 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's.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .2 Acronyms:
 - .1 AFD - Alternate Forms of Delivery, service provider.
 - .2 BMM - Building Management Manual.
 - .3 Cx - Commissioning.
 - .4 EMCS - Energy Monitoring and Control Systems.
 - .5 O M - Operation and Maintenance.
 - .6 PI - Product Information.
 - .7 PV - Performance Verification.
 - .8 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the BMM.
 - .3 Effectively train O M staff.
- .2 Contractor assists in Cx process, operating equipment, and systems, troubleshooting, and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

- .1 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.
- .2 Cx to be a line item of Contractor's cost breakdown.

- .3 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .4 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 systems are 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.
- .5 Departmental Representative will issue Substantial Completion 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 Final O&M and Training Manual received, reviewed and accepted by Departmental Representative.
 - .4 Completion of Training session to all Operational and Maintenance staff.

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

1.5 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 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.6 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.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit no later than 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 4 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 4 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

- .1 Refer to Section 01 91 33 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Departmental Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Departmental Representative.

1.9 COMMISSIONING SCHEDULE

- .1 Provide Cx as separate line in 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.

1.10 COMMISSIONING MEETINGS

- .1 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .2 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .3 At 80 % construction completion stage. Departmental Representative 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 Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .4 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .5 Meeting will be chaired by Consultant's Cx Agent, who will record and distribute minutes.
- .6 Ensure subcontractors and relevant manufacturer representatives are present at 80% and subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

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

1.12 WITNESSING OF STARTING AND TESTING

- .1 Provide 10 working days' notice prior to commencement.
- .2 Departmental Representative to witness of start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for approval by Departmental Representative.
 - .3 Arrange for Departmental Representative to witness tests.
 - .4 Obtain written approval of test results and documentation from Departmental Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.
 - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.

- .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.
 - .3 To report results in clear, concise, logical manner.

1.14 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 after distinct phases have been completed and before commencing next phase.
- .4 Document require 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 Departmental Representative. 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 Departmental Representative.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
 - .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
 - .1 Rejected equipment to be remove 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 Departmental Representative 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 Departmental Representative 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 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 interim acceptance.

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 Departmental Representative at least 15 working days prior to start of Cx to allow for sufficient time to make necessary travel arrangements to site.
- .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 Departmental Representative 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 actual 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 manufacturer's operating instructions.

1.21 WITNESSING COMMISSIONING

- .1 Departmental Representative to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures 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 Departmental Representative within [5] days of test and with Cx report.

1.23 EXTENT OF VERIFICATION

- .1 Number and location to be at discretion of Departmental Representative.
- .2 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .3 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .4 Perform additional commissioning until results are acceptable to Departmental Representative.

1.24 REPEAT VERIFICATIONS

- .1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:
 - .1 Verification of reported results fail to receive Departmental Representative approval.
 - .2 Repetition of second verification again fails to receive approval.
 - .3 Departmental Representative deems Contractor's request for second verification was premature.

1.25 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.

1.26 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Departmental Representative.

1.27 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.

1.28 TRAINING

- .1 In accordance with Section 01 91 41 - Commissioning Training.

1.29 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.30 OCCUPANCY

- .1 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

1.31 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.

1.32 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.

1.33 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

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 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.

1.2 REFERENCES

- .1 ASHRAE Guideline 1.1-2007, HVAC&R Technical Requirements for The Commissioning Process
- .2 ASHRAE Standard 202-2013, Commissioning Process for Buildings and Systems
- .3 CSA Z320-11, Building Commissioning Standard and Check sheets
- .4 CAN/ULC-S1001-11, Integrated Systems Testing of Fire protection and Life Safety Systems

1.3 GENERAL

- .1 Provide a fully functional:
 - .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 O M personnel have been fully trained in aspects of installed systems.
 - .3 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 Departmental Representative 's requirements.
 - .5 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 95% completed by the Departmental Representative and transmit to the Contractor.
- .2 Cx Plan to be 100% completed within 8 weeks of award of contract to consider:
 - .1 Approved shop drawings and product data.
 - .2 Approved changes to contract.
 - .3 Contractor's project schedule.
 - .4 Cx schedule.
 - .5 Contractor's, sub-contractor's, suppliers' requirements.
 - .6 Project construction team's and Cx team's requirements.
- .3 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 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 RESPONSIBILITIES 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 Departmental Representative 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.
 - .6 Verifying the accuracy of report results including Cx documentations
 - .7 Verifying TAB and others tests complete
- .3 Contractor 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 Contractor 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 CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
 - .1 Installation contractor/subcontractor:
 - .1 Equipment and systems except as noted.
 - .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
 - .1 To include performance verification.
 - .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
 - .4 Specialist Cx agency:
 - .1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Cx specialists on this project.
 - .5 Client: responsible for intrusion and access security systems.
 - .6 Ensure that Cx participant:
 - .1 Could complete work within scheduled time frame.
 - .7 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Cx 2 months prior to starting date of Cx for review and approval.

1.8 RISK ASSESSMENT

- .1 Contractor shall ensure that the appropriate risks are identified to the Departmental Representative and implement adequate mitigation methods in conjunction with the Departmental Representative to prevent an emergency situation.

1.9 EXTENT OF CX

- .1 Commission mechanical systems and associated equipment:
 - .1 Plumbing systems:
 - .1 Domestic HWS.
 - .2 Storm water systems.
 - .2 HVAC and exhaust systems:
 - .1 HVAC systems.
 - .2 General exhaust systems.
- .2 Commission electrical systems and equipment:
 - .1 Low voltage below 750 V:
 - .1 Low voltage equipment.
 - .2 Low voltage distribution systems.
 - .3 Electronic data and communications information systems.

- .2 Lighting systems:
 - .1 Lighting equipment.
 - .2 Distribution systems.
 - .3 Emergency lighting systems, including battery packs.
 - .4 Fire exit emergency signage.
- .3 Fire alarm systems, equipment:
 - .1 Annunciators.
 - .2 Control panels.
 - .3 Fire alarm battery banks.
- .4 Other systems and equipment:
 - .1 Intrusion and access security and safety systems.
 - .2 Lightning protection systems.
 - .3 Emergency shower and eyes wash station.

1.10 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.
 - .8 Preventive maintenance program.
 - .9 Standard Operating Procedures (SOP).
 - .10 Contractor's and sub-contractors' as built drawings.

1.11 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 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 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 Departmental Representative to witness and certify tests and reports of results provided by Contractor. Contractor to correct to the satisfaction of the Departmental Representative.
- .5 Departmental Representative to participate.

1.12 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up inspections: by Departmental Representative prior to permission to start up and rectification of deficiencies to Departmental Representative's satisfaction.
 - .2 Departmental Representative to use approved check lists submitted by Contractor.
 - .3 Departmental Representative will monitor some of these pre-start-up inspections.
 - .4 Include completed documentation with Cx report.
 - .5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by Departmental Representative and does not form part of Cx specifications.
 - .6 Departmental Representative will monitor some of these inspections and tests.
 - .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - MECHANICAL:
 - .1 Plumbing systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 Complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

- .2 HVAC equipment and systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 Complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .4 Perform TAB on systems. TAB reports to be approved by Consultant.
- .3 Pre-Cx activities - ELECTRICAL:
 - .1 Low voltage distribution systems under 750 V:
 - .1 Requires independent testing agency to perform pre- energization and post-energization tests.
 - .2 Lighting systems:
 - .1 Emergency lighting systems:
 - .1 Tests to include verification of lighting levels and coverage, initially by disrupting normal power.
 - .3 Fire alarm systems: test after other safety and security systems are completed. Testing to include a complete verification in accordance with ULC requirements. Departmental Representative and Consultant has witnessed and certified report, demonstrate devices to Departmental Representative and Consultant.
 - .4 Low voltage systems: these include:
 - .1 Communications, low voltage lighting control systems and data communications systems.
 - .5 Security, surveillance, and intrusion alarm systems: to include verification by Departmental Representative.
 - .6 Lightning protection systems.

1.13 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.
- .3 Departmental Representative to monitor start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of Departmental Representative.
- .4 Performance Verification (PV):
 - .1 Approved Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to Departmental Representative.
 - .2 Use procedures modified generic procedures to suit project requirements.
 - .3 Departmental Representative to witness and certify reported results using approved PI and PV forms.
 - .4 Departmental Representative to confirm completed PV reports.
 - .5 Departmental Representative reserves right to verify up to 50% 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.

1.14 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Departmental Representative to monitor Cx activities.
- .2 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .3 Departmental Representative to witness, certify reported results of, Cx activities and forward to Consultant.
- .4 Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

1.15 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Cx to be performed by specified Cx specialist, using procedures developed by Contractor and approved by Departmental Representative.
- .2 Tests to be witnessed by Departmental Representative and Contractor. Contractor shall document activities on approved report forms and submit to Departmental Representative.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Consultant and submitted to Departmental Representative for review.
- .4 Departmental Representative reserves right to verify percentage of reported results.

1.16 INSTALLATION CHECK LISTS (ICL)

- .1 Refer to Section 01 91 33 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.17 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Refer to Section 01 91 33 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.18 PERFORMANCE VERIFICATION (PV) REPORT

- .1 Refer to Section 01 91 33 - Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.19 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.

1.20 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 Cx procedures: 1 months after award of contract.
 - .2 Cx Report format: 1 months after contract award.
 - .3 Discussion of heating/cooling loads for Cx: 3 months before start-up.
 - .4 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
 - .5 Notification of intention to start TAB: 21 days before start of TAB.
 - .6 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
 - .7 Notification of intention to start Cx: 14 days before start of Cx.
 - .8 Identification of deferred Cx.
 - .9 Implementation of training plans.
 - .10 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 Departmental Representative.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Consultant, Contractor, and Departmental Representative will monitor progress of Cx against this schedule.

1.21 CX REPORTS

- .1 Submit reports of tests, witnessed and certified by Contractor 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 Consultant.

1.22 ACTIVITIES DURING WARRANTY PERIOD

- .1 Cx activities must be completed before issuance of Substantial Performance, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
 - .1 Fine tuning of HVAC systems.

1.23 TESTS TO BE PERFORMED BY OWNER/USER

- .1 None is anticipated on this project.

1.24 TRAINING PLANS

- .1 Refer to Section 01 91 41 - Commissioning - Training.

1.25 FINAL SETTINGS

- .1 Upon completion of Cx to satisfaction of Departmental Representative, lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

1.26 PAYMENTS FOR CX

- .1 Contractor shall bear all costs associated with Cx activities.

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 Commissioning forms to be completed for equipment, system and integrated system.

1.2 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 Departmental Representative. Check lists will be required during Commissioning.
- .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.

1.3 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 is 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.

1.4 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.

1.5 SAMPLES OF COMMISSIONING FORMS

- .1 Departmental Representative will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
- .2 Develop Commissioning forms to suit project requirements with product manufacturer's involvement. Revise items on Commissioning forms to suit project requirements.
- .3 Develop Commissioning forms to suit project requirements with product manufacturer's involvement. Revise items based on Departmental Representative's review. Revise items on Commissioning forms to suit project requirements.
- .4 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

- .1 When additional forms are required but are not available from Departmental Representative develop appropriate verification forms and submit to Departmental Representative for approval prior to use.
 - .1 Additional commissioning forms to be in same format as provided by Departmental Representative.

1.7 COMMISSIONING FORMS

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
 - .1 Departmental Representative provides Contractor 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 and reviewed and signed off by Contractor.
 - .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.

1.8 LANGUAGE

- .1 To suit the language profile of the awarded contract.

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 This Section specifies roles and responsibilities of systems Training.

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 Consultant 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 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 3 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 Departmental Representative and Contractor will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative and Contractor.

1.8 TRAINING CONTENT

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
 - .1 Review of facility and occupancy profile.
 - .2 Functional requirements.
 - .3 System philosophy, limitations of systems and emergency procedures.
 - .4 Review of system layout, equipment, components and controls.
 - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.

- .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
- .7 Maintenance and servicing.
- .8 Trouble-shooting diagnosis.
- .9 Inter-Action among systems during integrated operation.
- .10 Review of O&M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

1.9 VIDEO-BASED TRAINING (IF APPLICABLE)

- .1 Manufacturer's videotapes to be used as training tool with Departmental Representative's, Contractor's review and written approval 2 months prior to commencement of scheduled training.
- .2 On-Site training videos:
 - .1 Videotape training sessions for use during future training.
 - .2 To be performed after systems are fully commissioned.
 - .3 Organize into several short modules to permit incorporation of changes.
- .3 Production methods to be professional and high quality.

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 74 11 – Cleaning.
- .2 Section 01 74 19 - Construction Waste and Disposal.
- .3 Section 02 81 01 – Hazardous Materials Use and Abatement.
- .4 Appendix A

1.2 REFERENCES

- .1 CSA International
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .2 Canadian Environmental Protection Act (CEPA), 1993, C.33.

1.3 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for demolition of structures, safety of adjacent structures, and disposal.
- .2 Obtain required permits from authorities.

1.4 SITE CONDITIONS

- .1 Take precautions to protect environment and undertake works in conformance with Contract Documents for pollution prevention.
- .2 If material resembling spray or trowel-applied asbestos or other designated substance not listed in the hazardous materials report is 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.
- .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 site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal or recycling.
- .2 Locate and protect utilities.
- .3 Refer to Pre-Renovation Hazardous Materials site review report contained in Appendix A for identified hazardous materials.

3.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Protect existing surfaces and equipment not scheduled for removal.
 - .2 Keep noise, dust, and inconvenience to site occupants to a minimum.
 - .3 Provide temporary protection as required.
 - .4 Do Work in accordance with Section 01 35 30 - Health and Safety Requirements and Section 01 35 35 Fire Safety Requirements.

3.2 DEMOLITION/REMOVAL

- .1 Do demolition work in accordance with CSA S350.
- .2 Disconnect existing equipment scheduled to be removed under the work of this contract.
- .3 Remove and dispose of equipment and materials in accordance with Section 01 74 19 Construction Waste and Disposal.
- .4 Mark the location of these and any previously capped or plugged services on the site and indicate location on the record drawings.
- .5 Coordinate any service disruptions with Departmental Representative for hours of work, duration of shutdown, and emergency procedures in case of prolonged outage.
 - .1 Immediately notify Departmental Representative in case of damage to any utility or service designated to remain in place.
- .6 Remove interior finishes as required to complete the work of this contract.

3.3 REINSTATEMENT

- .1 Repair any penetrations in the adjacent roofing or cladding that result from the removal of existing equipment.
 - .1 Use materials that resemble existing materials in appearance and function.
 - .2 Make all penetrations watertight as required.
 - .3 Restore any vapour barriers that are punctured or compromised.
- .2 Reinstate or repair any interior finishes removed to complete the work of this contract.
 - .1 Repair or replace GWB panels.
 - .1 Restore paint finishes to as close to original condition as possible.
 - .2 If painting is required, paint entire panel effected by the repair.
 - .2 Reinstate or replace any interior trims that are affected by the work of this contract.

3.4 CLEANING

- .1 Restore areas and existing works outside areas of demolition to match condition of adjacent, undisturbed areas or to conditions that existed prior to beginning of Work.
- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work areas clean at end of each day.
- .1 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .2 Remove stockpiles of like materials by alternate disposal option once collection of materials is complete.

- .3 Transport material designated for alternate disposal using approved facilities listed in Waste Reduction Workplan and in accordance with applicable regulations.
 - .1 Disposal facilities must be those approved of and listed in Waste Reduction Workplan.
- .4 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.
 - .1 Disposal facilities must be those approved of and listed in Waste Reduction Workplan.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 01 00 - Summary of Work.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 35 30 – Health and Safety Requirements

1.2 REFERENCES

- .1 Reports:
 - .1 Refer to the Assessment Report in Appendix A
 - .1 Pre- Renovation Hazardous Building Materials Assessment Roof Replacement Smithers B.C.
- .2 Definitions:
 - .1 Dangerous Goods: product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.
 - .2 Hazardous Building Material: component of a building or structure that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when altered, disturbed or removed during maintenance, renovation or demolition.
 - .3 Hazardous Material: product, substance, or organism used for its original purpose; and is either dangerous goods or material that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.
 - .4 Hazardous Waste: hazardous material no longer used for its original purpose and that is intended for recycling, treatment or disposal.
- .3 Reference Standards:
 - .1 Canadian Environmental Protection Act, 1999 (CEPA 1999)
 - .1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).
 - .2 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.
 - .2 Department of Justice Canada
 - .1 Transportation of Dangerous Goods Act, 1992 (TDG Act) [1992], (c. 34).
 - .2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2019-101).
 - .3 Safety Data Sheets (SDS).

- .3 National Research Council Canada Institute for Research in Construction (NRC-IRC)
 - .1 National Fire Code of Canada (2015).
- .4 WorkSafe BC
 - .1 British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97, including amendments to date of work)
 - .2 "Safe Work Practices for Handling Asbestos" (2017)
 - .3 "Lead-Containing Paints and Coatings; Preventing Exposure in the Construction Industry" (2017)
 - .4 "Safe Work Practices for Handling Lead" (2017)
 - .5 "Developing a Silica Exposure Control Plan" (2014)
- .5 British Columbia Hazardous Waste Regulation (BC Reg. 63/88)
- .6 The Federal PCB Regulations (SOR/2008-273).
- .7 The British Columbia Waste Management Act - Ozone Depleting Substances and Other Halocarbons Regulation (BC Reg. 317/2012).
- .8 The Federal Halocarbons Regulation (July 2003).
- .9 The Canada Labour Code, Part II, Canada Occupational Health and Safety Regulations (COHSR)
- .10 Canadian Construction Association
 - .1 Standard Construction Document CCA 82 "Mould Guidelines for the Canadian Construction Industry" (2018)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data to be used by the Contractor to complete the Work:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 35 30 - Health and Safety Requirements to Departmental Representative for each hazardous material required prior to bringing hazardous material on site.
 - .3 Submit Exposure Control Plan (ECP) to Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.
 - .4 Construction Waste Management:
 - .1 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating percentage of construction/demolition wastes were recycled or salvaged
 - .5 Low-Emitting Materials: submit listing of adhesives and sealants used in building, comply with VOC and chemical component limits or restrictions requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle hazardous materials to be used by the Contractor to complete the Work in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver hazardous materials to be used by the Contractor to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.
- .4 Storage and Handling Requirements:
 - .1 Co-ordinate storage of hazardous materials to be used by the Contractor to complete the Work with Departmental Representative and abide by internal requirements for labelling and storage of materials and wastes.
 - .2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.
 - .3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.
 - .4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.
 - .1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.
 - .2 Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the Departmental Representative.
 - .5 Transfer of flammable and combustible liquids is prohibited within buildings.
 - .6 Transfer flammable and combustible liquids away from open flames or heat-producing devices.
 - .7 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.
 - .8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.
 - .9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.
 - .10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:
 - .1 Store hazardous materials and wastes in closed and sealed containers.
 - .2 Label containers of hazardous materials and wastes in accordance with WHMIS.
 - .3 Store hazardous materials and wastes in containers compatible with that material or waste.
 - .4 Segregate incompatible materials and wastes.
 - .5 Ensure that different hazardous materials or hazardous wastes are stored in separate containers.

- .6 Store hazardous materials and wastes in secure storage area with controlled access.
- .7 Maintain clear egress from storage area.
- .8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.
- .9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.
- .10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.
- .11 When hazardous waste is generated on site:
 - .1 Co-ordinate transportation and disposal with Departmental Representative.
 - .2 Comply with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.
 - .3 Use licensed carrier authorized by provincial authorities to accept subject material.
 - .4 Before shipping material obtain written notice from intended hazardous waste treatment or disposal facility it will accept material and it is licensed to accept this material.
 - .5 Label containers with legible, visible safety marks as prescribed by federal and provincial regulations.
 - .6 Only trained personnel handle, offer for transport, or transport dangerous goods.
 - .7 Provide photocopy of shipping documents and waste manifests to Departmental Representative.
 - .8 Track receipt of completed manifest from consignee after shipping dangerous goods. Provide photocopy of completed manifest to Departmental Representative.
 - .9 Report discharge, emission, or escape of hazardous materials immediately to Departmental Representative and appropriate provincial authority. Take reasonable measures to control release.
- .12 Ensure personnel have been trained in accordance with WHMIS requirements.
- .13 Report spills or accidents immediately to Departmental Representative. Submit a written spill report to Departmental Representative within 24 hours of incident.

Part 2 Products

2.1 MATERIALS

- .1 Description:
 - .1 Bring on site only quantities hazardous material required to perform Work.
 - .2 Maintain SDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

Part 3 Execution

3.1 HAZARDOUS MATERIALS ABATEMENT

.1 Scope of Abatement Activities.

- .1 Abatement shall be conducted to handle, alter, remove and/or dispose of hazardous building materials as identified in the Assessment Report in accordance with applicable regulations, guidelines, standards and/or best practices for such work, where such identified hazardous building materials will be impacted (handled, altered, damaged, removed) by the Work.
- .2 Contractor is responsible for reviewing plans, specifications and reports such that they understand the locations and amounts of hazardous materials that will be impacted by the Work of this contract, and such that appropriate plans and budgets can be included in their overall bids.
- .3 The listing below is a summary of the identified hazardous building material categories that may require disturbance, along with their associated removal and disposal regulations, guidelines and/or standards.
 - .1 Asbestos-Containing Materials (ACMs)
 - .1 Refer to the Assessment Reports for identities and locations of ACMs that may require disturbance during the Work.
 - .2 Actions that will disturb identified ACMs are to be conducted in accordance with the requirements of the 2017 WorkSafe BC publication "Safe Work Practices for Handling Asbestos", by appropriately trained personnel.
 - .3 Waste transportation to be conducted in accordance with BC Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.
 - .4 Waste disposal to be conducted in accordance with BC Reg. 63/88.
 - .5 Notify Departmental Representative of suspected ACM discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from Department Representative.
 - .6 From beginning of Work until completion of cleaning operations, Departmental Representative will separately engage an Environmental Specialist to take air samples inside and outside of Asbestos Work Area enclosure[s] in accordance with British Columbia's Occupational Health and Safety Regulation and the current version of the WorkSafeBC Manual entitled "Safe Work Practices for Handling Asbestos".
 - .7 If air monitoring shows that areas outside Asbestos Work Area enclosure[s] are contaminated, enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area, at no additional cost to the Contract
 - .8 Ensure that respiratory safety factors are not exceeded.

- .2 Lead and Lead-Containing Paints (LCPs)
 - .1 Refer to the Assessment Report for identities and locations of lead-containing materials (including LCPs) that may require disturbance during the Work.
 - .2 Although LCPs and items coated with LCPs are present in the facility, unless deemed necessary through risk assessment or cost analysis conducted by the Contractor, comprehensive removal of LCPs from items or surfaces is not expected to be required during the Work.
- .3 Polychlorinated Biphenyls (PCBs)
 - .1 Removal, alteration and/or disposal of PCB-containing equipment is not anticipated to be required during the Work.
 - .2 Should a material suspected to contain PCBs become uncovered during renovation activities (i.e., dielectric fluids, hydraulic fluids), all work in the areas that may disturb the material should be stopped. Samples of the suspect material should be submitted for laboratory analysis to determine if PCBs are present.
- .4 Mould
 - .1 Removal, alteration and/or disposal of mould-impacted materials is not anticipated to be required during the Work.
- .5 Mercury
 - .1 Removal of mercury-containing materials is not anticipated to be required during the Work:
- .6 Ozone-Depleting Substances (ODSs)
 - .1 Removal, alteration and/or disposal of refrigeration or air conditioning equipment with ODS refrigerants is not anticipated to be required during the Work.
- .7 Silica
 - .1 When silica-containing materials are to be disturbed and/or removed (e.g., coring through concrete slabs, demolition of masonry or concrete units), ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated by BC Reg. 296/97 (Cristobalite and Quartz – each 0.025 mg/m³). This would include, but not be limited to, the following:
 - .1 Developing a Silica Exposure Control Plan
 - .2 Providing workers with respiratory protection
 - .3 Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions
 - .4 Providing workers with facilities to properly wash prior to exiting the work area.

3.2 CLEANING

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

- .3 Waste Management: separate waste materials for reuse and recycling.
 - .1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.
 - .2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.
 - .3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.
 - .4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.
 - .5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.
 - .6 Dispose of hazardous wastes in timely fashion in accordance with applicable federal and provincial regulations.
 - .7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.
 - .8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:
 - .1 Hazardous wastes recycled in manner constituting disposal.
 - .2 Hazardous waste burned for energy recovery.
 - .3 Hazardous wastes with economically recoverable precious metals.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 23 05 05 Installation of Pipework
- .3 Section 23 07 19 Thermal Insulation for Piping

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
 - .1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250
 - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - .2 ASTM B 88M, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American Water Works Association (AWWA).
 - .1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .2 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .6 National Sanitation Foundation (NSF).
 - .1 NSF 61, Drinking Water System Components.
- .7 BC Building Code 2018 (BCBC)
- .8 National Building Code of Canada 2015 (NBC)
- .9 Local Authority Having Jurisdiction (AHJ)
- .10 In cases of conflicting requirements, the most stringent shall apply per PSPC requirements.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 Submittal Procedures.
- .2 Provide maintenance data for incorporation into manual specified in Section 01 78 10 Closeout Submittals.

1.4 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health & Safety Requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with 01 74 19 Construction Waste and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .5 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
- .6 Fold up metal banding, flatten and place in designated area for recycling.

1.6 QUALITY ASSURANCE

- .1 All potable water system components shall conform to NSF Standard 61.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and hot recirculation water systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B 88M to NPS 4 size.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSIB16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 to NPS 4: roll grooved to CSAB242.

2.3 JOINTS

- .1 Rubber gaskets, 1.6mm thick: to ANSI/AWWAC111/A21.11.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

- .3 Solder: 95/5 tin copper alloy or brazing.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

2.4 GATE VALVES

- .1 NPS2 and under, soldered:
 - .1 Rising stem: to MSSSP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.
- .2 NPS2 and under, screwed:
 - .1 Rising stem: to MSSSP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.
- .3 NPS2-1/2 and over, in mechanical rooms, flanged:
 - .1 Rising stem: to MSSSP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS & Y bronze trim.
- .4 NPS2-1/2 and over, other than mechanical rooms, flanged:
 - .1 Non-rising stem: to MSSSP-70, Class 125, 860 kPa, flat flange faces, cast- iron body, bronze trim, bolted bonnet.

2.5 GLOBE VALVES

- .1 NPS2 and under, soldered:
 - .1 To MSSSP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet.
 - .2 Lockshield handles: as indicated.
- .2 NPS2 and under, screwed:
 - .1 To MSSSP-80, Class 150, 1MPa, bronze body, screwed over bonnet, renewable composition disc.
 - .2 Lockshield handles: as indicated.

2.6 SWING CHECK VALVES

- .1 NPS 2 and under, soldered:
 - .1 To MSSSP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, re-grindable seat.
- .2 NPS2 and under, screwed:
 - .1 To MSSSP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, re-grindable seat.

- .3 NPS2-1/2 and over, flanged:
 - .1 To MSSSP-71, Class 125, 860 kPa, cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap.

2.7 BALL VALVES

- .1 NPS2 and under, screwed:
 - .1 Class 150.
 - .2 Bronze body, chrome plated brass ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle.
- .2 NPS2 and under, soldered:
 - .1 To ANSI B16.18, Class 150.
 - .2 Bronze body, chrome plated brass ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle, with NPT to copper adaptors.

2.8 DRAIN VALVES

- .1 Drain valves shall be provided with cap and chain.
- .2 Drain and hose valves 20mm (3/4") and smaller:
 - .1 Sediment Faucets.
 - .2 Ball valves.

2.9 PLUMBING PIPING

- .1 Water supply piping under concrete slabs or in walls shall be encased in standard weight flexible polyethylene pipe one size larger than copper tubing. All joints to be wrapped in plastic wrapping tape.

2.10 DIELECTRIC UNIONS

- .1 Insulating dielectric unions and flange unions shall be installed when adapting between dissimilar metallic pipe for domestic water supply piping, and domestic water storage tanks. Elsewhere, unions and adaptors for copper piping shall be cast brass pressure fittings.

2.11 EXPANSION JOINTS

- .1 Domestic and industrial water: Annular close pitch corrugated metal hose with Type 316L stainless steel butt welded tube. Type 304 single stainless steel outer braid, flanged, welded or screwed ends. Suitable for 1034 kPa (150 psi) working pressure and 50mm traverse.

2.12 STRAINERS

- .1 NPS 2 and under: Full pipeline size, 250 lb. SWP bronze, with screwed ends and a removable plug type screen retainer.
- .2 NPS 2-1/2 and over: Full pipeline size, 250 lb. SWP semi-steel, with flanged ends and a bolted screen retainer.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code and local authority having jurisdiction.
- .2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .3 Assemble all piping using fittings manufactured to ANSI standards.
- .4 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- .5 Install CWS piping below and away from HWS and HWR and all other hot piping so as to maintain temperature of cold water as low as possible.
- .6 Connect to fixtures and equipment in accordance with manufacturer's instructions unless otherwise indicated.
- .7 When grooved fittings are used, contractors shall provide proof of training on site by the mechanical coupling manufacturer, or manufacturer's representative prior to the start of installation.

3.2 VALVES

- .1 Isolate equipment, fixtures and branches with gate or ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.3 PRESSURE TESTS

- .1 Test pressure: greater of 1 times the maximum system operating pressure or 860 kPa.

3.4 PRE- START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

3.5 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of Departmental Representative.
- .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative's approval.

3.6 PERFORMANCE VERIFICATION

- .1 Timing: Starts after:
 - .1 Pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .3 Sterilize HWS and HWR systems for Legionella control.
 - .4 Verify performance of temperature controls.
 - .5 Verify compliance with safety and health requirements.
 - .6 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
 - .7 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 23 05 00 Common Work Results for Mechanical
- .3 Section 23 05 05 Installation of Pipework

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B 32, Specification for Solder Metal.
 - .2 ASTM B 306, Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C 564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .2 CAN/CSA-B125, Plumbing Fittings.
- .3 BC Building Code 2018 (BCBC)
- .4 National Building Code of Canada 2015(NBC)
- .5 Local Authority Having Jurisdiction (AHJ)
- .6 In cases of conflicting requirements, the most stringent shall apply per PSPC requirements.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 Submittal Procedures.
- .2 Provide maintenance data for incorporation into manual specified in Section 01 78 10 Closeout Submittals.

1.4 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health & Safety Requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 Construction Waste and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Place materials defined as hazardous or toxic in designated containers.

- .4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .5 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
- .6 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary storm and vent, Copper Type DWV to: ASTM B 306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA-B125.
 - .2 Wrought copper: to CAN/CSA-B125.
 - .2 Solder: tin-lead, 50:50, type 50A or lead free, tin-copper alloy 95:5, type TA to ASTM B 32.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Buried sanitary storm and vent, cast iron (minimum NPS 2) to: CAN/CSA-B70.
 - .1 Joints.
 - .1 Mechanical joints.
 - .1 Neoprene or butyl rubber compression gaskets: to ASTM C 564 or CAN/CSA-B70.
 - .2 Stainless steel clamps.
- .2 Above ground sanitary storm and vent: Cast iron to CAN/CSA-B70.
 - .1 Joints.
 - .1 Mechanical joints.
 - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

2.3 ABS PIPING

- .1 Drainage piping under the building, provided that such piping does not pass through any fire separations, may be as follows, at the contractor's option:
 - .1 Underground sanitary drainage piping under building, 150mm in diameter and smaller shall be certified to the current version of CSA B181.1, ABS Drain, Waste and Vent Pipe and Fittings. Piping shall be solid wall in construction. Cell core piping is not acceptable.

Part 3 Execution

3.1 INSTALLATION

- .1 In accordance with Section 23 05 05 - Installation of Pipework.
- .2 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.
- .3 Install buried pipe on 150 mm bed of clean washed sand, shaped to accommodate hubs and fittings, to line and grade as indicated. Backfill with 150 mm of clean washed sand.
- .4 Install above ground piping parallel and close to walls and ceilings to conserve headroom and space, and to grade as indicated.

3.2 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The supply and installation of Plumbing Specialties and Accessories.
- .2 Products Installed but not Supplied Under this Section:
 - .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
 - .2 Equipment installed by others.
 - .1 Connect with unions.
 - .3 Equipment not installed.
 - .1 Capped for future connection by others.

1.2 RELATED SECTION

- .1 Section 01 78 10 Closeout Submittals
- .2 Section 23 05 00 Common Work Results for Mechanical
- .3 Section 23 08 01 Performance Verification Mechanical Piping Systems

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA)
- .3 Canadian Standards Association (CSA)
 - .1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
 - .2 CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 Plumbing and Drainage Institute (PDI)
 - .1 PDI-WH201, Water Hammer Arresters Standard.
- .5 National Sanitation Foundation (NSF).
 - .1 NSF 61, Drinking Water System Components.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 78 10 Closeout Submittals.
- .2 Indicate, for all plumbing specialties and accessories:
 - .1 Dimensions, construction details, roughing-in dimensions.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data in accordance with Section 01 78 10 Closeout Submittals.
- .2 Include:
 - .1 Description of plumbing specialties and accessories, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.6 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health & Safety Requirements.

1.7 DELIVERY STORAGE AND DISPOSAL

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Division 01 01 74 19 Construction Waste and Disposal.
 - .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
 - .3 Fold up metal banding, flatten and place in designated area for recycling.

1.8 QUALITY ASSURANCE

- .1 All potable water system components shall conform to NSF Standard 61.

Part 2 Products

2.1 CLEANOUTS

- .1 Cleanout plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access covers:
 - .1 Wall access: face or wall type, polished nickel bronze or stainless steel round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor access: round cast iron body and frame with adjustable secured nickel bronze top cast box with anchor lugs and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for unfinished concrete floors: cast iron round gasket, vandal- proof screws.

2.2 WATER HAMMER ARRESTOR

- .1 Copper construction, bellows type: to PDI-WH201.

2.3 BACK FLOW PREVENTER

- .1 To CSA-B64 Series.
- .2 Application: as indicated.

2.4 VACUUM BREAKER

- .1 To CSA-B64 Series.

2.5 PRESSURE REGULATOR

- .1 Capacity and performance:
- .2 Up to NPS1-1/2 bronze bodies, screwed: to ASTM B 62.
- .3 NPS2 and over, semi-steel bodies, Class 125, flanged: to ASTM A 126, Class B.
- .4 Semi-steel spring chambers with bronze trim.

2.6 STRAINERS

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS2 and under, bronze body, screwed ends, with brass cap.
- .3 NPS2 1/2 and over, cast iron body, flanged ends, with bolted cap.

2.7 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.8 CIRCULATION PUMPS

- .1 Provide circulating pumps where indicated, designed for quiet operation and guaranteed by the manufacturer for the intended operation.
- .2 Hot water circulating pumps shall be suitable for pumping 100°C water.
- .3 All pumps shall be fitted with mechanical shaft seals.
- .4 Domestic water pumps shall be all bronze construction.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.2 CLEANOUTS

- .1 In addition to those required by code, and as indicated, install at base of soil and waste stacks, and rainwater leaders.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

3.3 WATER HAMMER ARRESTOR

- .1 Install on branch supplies to each fixture or group of fixtures and where indicated.

3.4 BACK FLOW PREVENTERS

- .1 Install in accordance with CAN/CSA-B64 Series, where indicated and elsewhere as required by code.
- .2 Pipe discharge to terminate over nearest drain and/ or service sink.

3.5 PERFORMANCE VERIFICATION

- .1 General:
 - .1 In accordance with Section 23 08 01 – Performance Verification Mechanical Piping Systems.
- .2 PV procedures:
 - .1 Vacuum breakers, backflow preventers: operation under all conditions.
 - .2 Thermostatic controls: Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Read Division 1 General Instructions in conjunction with these specifications. Division 1 and this section shall form a part of and shall apply to all Mechanical Sections. The most stringent requirements of this and other Mechanical Sections must be adhered to.
- .2 The Mechanical work shall consist of the supply and installation of complete and operable mechanical systems and shall include all necessary labour, plant, materials, and incidentals for the work involved as listed in the following division sections:
 - .1 Section 22 Plumbing
 - .2 Section 23 Heating Ventilation & Air Conditioning

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 Submittal Procedures.
- .2 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter referred to in Section 01 78 10 Closeout Submittals. use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 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 Color coding chart.
- .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
 - .1 Equipment performance verification test results.
 - .2 Special performance data as specified.
- .6 Approvals:
 - .1 Submit an electronic PDF version, complete with search-able text and bookmarks for each section of the of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative. Minimum resolution to be 300 dpi.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
 - .3 For final submission, provide 2 printed copies of the Operational and Maintenance manuals plus the final electronic version in PDF format on a USB drive.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different color waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right-hand corner in letters at least
 - .3 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor)(Date).
 - .4 Submit to Departmental Representative for approval and make corrections as directed.

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

1.3 REGULATIONS

- .1 Comply with most stringent requirements of NBC, Provincial and Municipal regulations and by-laws, specified standards, codes and this specification. Practices contained in these standards or standards suggested or recommended by reference organizations, are to be taken as minimum requirements.
- .2 Furnish certificates confirming work installed conforms to requirements of authorities having jurisdiction.
- .3 The "Authority Having Jurisdiction" is Fire Protection Engineering Services of Human Resources and Skills Development Canada (HRSDC).
- .4 Drawings and specifications should not conflict with these Regulations but where there are apparent discrepancies, notify the Departmental Representative in writing and obtain clarifications before proceeding with the work.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health & Safety Requirements.

1.5 DEFINITIONS

- .1 Definitions used in this Division will have the following meaning:
 - .1 "Concealed": pipes, ducts, etc., in trenches, chases, furred spaces, pipe shafts, or hung ceilings.
 - .2 "Exposed": regarding insulation and painting of piping, ducts, etc., will mean that they are not "concealed", as defined herein.
 - .3 "Piping": includes, in addition to pipe, all fittings, valves, hangers, other accessories which comprise a system.
 - .4 "Provide": to supply and install, complete and ready for use.

1.6 DRAWINGS

- .1 Drawings:
 - .1 Are not intended to show structural details or architectural features.
 - .2 Are not to be scaled.
 - .3 Except where dimensioned, indicate general mechanical layout only.
- .2 Provide field (shop) drawings to indicate relative position of various services when required by Departmental Representative and obtain approval before commencing work.

1.7 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 10 Closeout Submittals and as indicated in the detailed product specification clauses.
- .2 Provide access doors for concealed expansion joints, traps, strainers, cleanouts, balance dampers, fire dampers, other parts requiring accessibility for operating and maintenance.

- .3 In suspended panel ceilings, use panel in place of access door; provide in such panel a button or other means of identification and easy removal when necessary.

1.8 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 19 – Construction Waste & Disposal.

Part 2 Products

2.1 ACCESS DOORS

- .1 Access door size shall be as indicated and where not indicated, make 305mm x 406mm [12" x 16"] minimum or 610mm x 457mm [24" x 18"] where persons have to enter. For acoustical ceilings, conform to architectural panel pattern.
- .2 Unless otherwise indicated, access doors shall be hinged, flush type, steel framed panel, 14 gauge minimum, satin finished galvanized steel or type 304 stainless steel, with anchor straps for wet areas, washrooms, and all walls finished in ceramic tile.
- .3 Hinges shall be concealed, spring hinge to allow door to open 175°. Locking devices shall be flush cam type, master key operated, doors and frames shall have prime coated rust inhibiting paint, unless made of stainless steel.
- .4 Where doors are required in fire rated walls, access doors shall be uninsulated and for all fire rated ceilings and walls where maximum temperature rise limitation is applicable, shall be insulated. All fire rated access doors shall have Warnock Hersey or ULC listed 2 hour fire rating and shall be installed in accordance with NFPA 80 and manufacturer's installation instructions.

Part 3 Execution

3.1 CO-ORDINATION

- .1 Co-ordinate work with work of other sections to avoid conflict.
- .2 Locate distribution systems, equipment, and materials to provide minimum interferences and maximum usable space.
- .3 Where interference occurs, Departmental Representative shall approve relocation of equipment and materials, regardless of installation sequence.

3.2 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 CUTTING AND PATCHING

- .1 Make arrangements with General Contractor for all cutting and patching in this work.

- .2 Minimize cutting and patching. Set sleeves and mark openings in concrete or masonry.

3.4 WATERPROOFING

- .1 Where any work pierces waterproofing including waterproofing concrete, the method of installation shall be as approved by the Departmental Representative before the work is done. Supply and install all necessary sleeves, caulking, roof curbs, and flashing required and make the openings watertight.

3.5 PROTECTION OF WORK

- .1 Protect equipment and material during construction from the weather, moisture, dust, painting, plastering and physical damage. Clean and return to "as new" condition.
- .2 Mask or grease and cover machined surfaces. Firmly secure covers over equipment openings and open ends of piping, conduit and ductwork as work progresses. Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.
- .3 Any equipment that has operating parts, bearings or machined surfaces that show signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finishes to the satisfaction of the Departmental Representative, using equal quality materials.

3.6 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 Where specified, 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.

3.7 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 and as-built drawings as part of instruction materials.

- .4 Instruction duration time requirements as specified in appropriate sections, but shall in no way be less than four (4) hours for the plumbing systems, four (4) hours for the mechanical systems (with the EMCS training time specified separately).

END OF SECTION

Part 1 General

1.1 USE OF SYSTEMS

- .1 Use of new permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:
 - .1 Entire system is complete, pressure tested, cleaned, flushed out.
 - .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
 - .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .4 There is no possibility of damage from any cause.
 - .5 Supply ventilation systems are protected by filters, which shall be inspected daily, changed every week or more frequently as required.
 - .6 Return systems have approved filters over all openings, inlets, outlets.
 - .7 All systems will be:
 - .1 operated as per manufacturer's recommendations or instructions.
 - .2 operated by Contractor.
 - .3 monitored continuously by Contractor.
 - .8 Warranties and guarantees are not thereby relaxed.
 - .9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.
 - .10 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as- new" condition, filters in air systems replaced.
- .2 Filters referred to herein are over and above those specified elsewhere in this specification.
- .3 Exhaust systems are not included in any approvals for temporary heating ventilation.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 74 19 Construction Waste and Disposal
- .2 Section 23 05 00 Common Work Results – Mechanical
- .3 Section 23 08 02 Cleaning and Start-up of Mechanical Piping Systems

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Construction Waste and Disposal
 - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

3.2 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, or components.

3.3 PIPEWORK INSTALLATION

- .1 Protect openings against entry of foreign material.
- .2 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .5 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .6 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 Install globe valves in bypass around control valves.
 - .6 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400mm above floor in Mechanical Rooms.
- .7 Install dielectric coupling between dissimilar metals.

3.4 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and un-insulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
 - .2 Other floors: Terminate 25mm above finished floor.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
 - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.5 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe.

3.6 CLEANING OF PIPING SYSTEMS

- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.7 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.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .6 Conceal work only after approval and certification of tests by Departmental Representative.

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 01 33 00 Submittal Procedures
- .2 Section 23 05 00 Common Work Results – Mechanical
- .3 Section 23 05 53 Mechanical Identification

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.Grade 1A, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
 - .2 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial / Industrial Type.

1.4 SUBMITTAL

- .1 Submittals in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit shop drawings and product data.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health & Safety Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 Construction Waste and Disposal.
- .2 Collect, separate and place in designated containers for packaging in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.
- .4 Place materials defined as hazardous or toxic waste in designated containers.
- .5 Ensure emptied containers are sealed, labelled and stored safely for disposal away from children.

Part 2 Products

2.1 GENERAL

- .1 Design point to be at mid-point of scale or range.
- .2 Ranges: as indicated.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, digital, variable angle type.
 - .1 Display: LCD, operate on 35 lux of illumination. No external power needed. Display in Celsius or Fahrenheit with switch.
 - .2 Casing: High impact ABS plastic.
 - .3 Stem: adjustable angle.
 - .4 Socket: comply with industrial standard dimension, fully interchangeable with liquid-in-glass thermometers.

2.3 THERMOMETER WELLS

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass or stainless steel.

2.4 PRESSURE GAUGES

- .1 100 mm [4.0"] dial type: to ASME B40.100, Grade 1A, phosphor bronze bourdon tube having 1.0% accuracy full scale unless otherwise specified.
 - .1 Casing: Stainless Steel.
 - .2 Reading: S.I., or S.I./Imperial.
 - .3 Range: indicate mid-scale under normal operating conditions.
- .2 Provide:
 - .1 Snubber for pulsating operation.
 - .2 Diaphragm assembly for corrosive service.
 - .3 Gasketed pressure relief back with solid front.
 - .4 Bronze stop cock.

Part 3 Execution

3.1 GENERAL

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

- .1 Install in wells on piping. Provide heat conductive material inside well.

- .2 Install in locations as indicated.
- .3 Install wells as indicated for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

- .1 Install in locations as indicated.
- .2 Use extensions where pressure gauges are installed through insulation.

END OF SECTION

Part 1 General

1.1 RELATED SECTION

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 23 05 00 Common Work Results – Mechanical
- .3 Section 23 05 48 Vibration & Seismic Control for Ductwork, Piping and Equipment

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - .1 Seismic Restraint Manual, Guidelines for Mechanical Systems.
- .2 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME):
 - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM A 125, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - .3 ASTM A 563, Specification for Carbon and Alloy Steel Nuts.
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
 - .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP69, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 National Plumbing Code.

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
 - .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 all 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.
 - .6 Amount of adjustment to be in accordance with MSS SP58.

- .2 Performance Requirements:
 - .1 Design supports and hangers to withstand seismic events as specified Section 23 05 48 – Vibration & Seismic Control for Ductwork Piping and Equipment.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .3 Quality assurance submittals: submit following in accordance with Section 01 45 00 Quality Control.
 - .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.
- .4 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health & Safety Requirements.

1.6 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 01 74 19 Construction Waste and Disposal

Part 2 Part 2 Products

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 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 to MSS SP69.
- .3 Hanger rods: threaded rod material to MSS SP58.
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .4 Pipe attachments: material to MSS SP58.
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .5 Hanger rod attachment: material to MSS SP58.
 - .1 Use expansion anchor on existing concrete structure.
- .6 Adjustable clevis: material to MSS SP 69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems per Section 23 05 48 – Vibration and Seismic Controls for HVAC Ductwork, Piping and Equipment.

- .3 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations. Supporting piping from underside of light weight roof deck (without concrete) is not permitted.

3.2 HANGER SPACING

- .1 HVAC piping: in accordance with table below.
- .2 Plumbing piping: in accordance with the most stringent requirements of the table below as well as the following:
 - .1 National. Plumbing Code.
 - .2 Authority Having Jurisdiction.
- .3 Pipe hanger rods shall be sized in accordance to SMACNA Seismic Restraint Manual based on Seismic Hazard Level (SHL). For SHL, see Section 23 05 48 – Vibration and Seismic Controls for HVAC Ductwork, Piping and Equipment.

MAXIMUM HANGER SPACING						
PIPE DIA. NPS	STEEL SCH.40	COPPER L,K Hard Drawn	CAST.I STD.	GLASS	ABS/PVC	PEX
1/2	1.8 m [6'-	1.8 m [6'-			1.2 m [4'-	0.8 m [2'-
3/4 & 1	2.4 m [8'-	2.4 m [8'-			1.2 m [4'-	0.8 m [2'-
1-1/4	2.4 m [8'-	3.0 m [10'-			1.2 m [4'-	0.8 m [2'-
1-1/2 & 2	2.4 m [8'-	3.0 m [10'-	3.0 m [10'-		1.2 m [4'-	0.8 m [2'-
2-1/2, 3, 4 & 5	2.4 m [8'-	3.0 m [10'-	3.0 m [10'-	2.4 m [8'-	1.2 m [4'-	0.8 m [2'-
6 & 8	3.0 m [10'-	3.0 m [10'-	3.0 m [10'-	2.4 m [8'-	1.2 m [4'-	0.8 m [2'-

3.3 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.4 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 13mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.5 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.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 23 05 00 Common Work Results – Mechanical

1.2 REFERENCES

- .1 BC Building Code 2018 (BCBC)
- .2 National Building Code of Canada 2015(NBC)
- .3 Local Authority Having Jurisdiction (AHJ)
- .4 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - .1 Seismic Restraint Manual, Guidelines for Mechanical Systems.
- .5 In cases of conflicting requirements, the most stringent shall apply per PSPC requirements.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Provide vibration isolation systems shop drawings complete with performance and product data. Shop drawings shall demonstrate compliance with the National Building Code and shall bear the seal of a Professional Engineer.
- .3 Provide detailed drawings of all seismic restraint systems for ductwork, piping and equipment.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Construction Waste and Disposal.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 Products

2.1 VIBRATION ISOLATION SYSTEM – GENERAL

- .1 Performance of vibration isolation systems shall be designed by manufacturer specializing in vibration isolation materials and devices.
- .2 Size and shape of bases type shall be coordinated with submitted equipment.

- .3 Products shall of the same manufacturer unless otherwise noted.

2.2 ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 9 mm [3/8"] minimum thick; 50 durometers; maximum loading 350 kPa [50 psi].
- .2 Type EP2 - rubber waffle or ribbed; 9 mm [3/8"] minimum thick; 30 durometer natural rubber; maximum loading 415 kPa [60 psi].
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm [3/8"] minimum thick neoprene bonded to 1.71 mm [16 gauge] steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa [50 psi].
- .4 Type EP4 - rubber-steel-rubber; 9 mm [3/8"] minimum thick rubber bonded to 1.71 mm [16 gauge] steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa [60 psi].

2.3 HANGERS

- .1 Color coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, molded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with molded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.

2.4 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm [1"] minimum thick heavy duty duck and neoprene isolation material.

2.5 FLEXIBLE PIPE CONNECTORS

- .1 Inner corrugated hose: stainless steel.
- .2 Outer braid: Braided wire mesh stainless steel outer jacket.
- .3 Type of end connection: threaded for 50mm [2"] or smaller; flange for 65mm [2-1/2"] or larger.
- .4 Operating conditions:
- .1 Working pressure: 1379 kPa [200 psi].
 - .2 Working temperature: 4540 °C [850 °F].

2.6 SEISMIC CONTROL MEASURES

- .1 General:

- .1 Design anchorage and attachment methods for all systems and/or equipment as specified herein.
 - .2 Seismic control systems to work in all directions.
 - .3 Fasteners and attachment points to resist same maximum load as seismic restraint.
 - .4 Drilled or power-driven anchors and fasteners not permitted.
 - .5 No equipment, equipment supports or mounts to fail before failure of structure.
 - .6 Supports of cast iron or threaded pipe not permitted.
 - .7 Seismic control measures not to interfere with integrity of firestopping.
 - .8 For equipment mounted on housekeeping pad, specify the minimum distance between anchor bolt and edge of housekeeping pad.
- .2 Static equipment:
- .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
 - .2 Seismic restraints:
 - .1 Cushioning action to be gentle and steady.
 - .2 Shall never reach metal-like stiffness.
- .3 Vibration isolated equipment:
- .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
 - .2 Provide seismic restraints in addition to vibration isolation system to resist complete isolator unloading.
- .4 Piping systems:
- .1 Provide seismic restraints for all piping in accordance to the latest edition of SMACNA Seismic Restraint Manual as described below:
 - .1 All natural gas piping NPS 2 or larger.
 - .2 Seismic restraints may be omitted for the following conditions:
 - .1 All piping suspended by individual hangers 305mm [12"] or less in length, as measured from the top of the pipe to the bottom of the structural support for the hanger.
 - .3 To be compatible with requirements for anchoring and guiding of piping systems.
 - .4 Wet weight of piping shall be to be used for designing seismic restraint systems.
 - .5 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.
 - .6 Where cable is used for restraining vibration isolated piping systems, install cable with sufficient slack to avoid short-circuiting of vibration isolators.
- .5 Bracing methods:
- .1 Approved by Departmental Representative.
 - .2 Structural angles or channels.

- .3 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.
- .2 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and 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.

3.3 FIELD QUALITY CONTROL

- .1 Provide the services of the Professional Engineer(s) who designed the restraint systems for "Field Review" of the installed components, and submit the following to the Departmental Representative:
 - .1 Assurance commitment letter, signed and sealed; provided at the commencement of the project.
 - .2 Signed and sealed shop drawings of seismic restraints for equipment, piping and ductwork; provided prior to installation.
 - .3 Typewritten inspection reports; provided during the construction period.
 - .4 Schedule C-B, signed and sealed; provided after performing "Field Review".

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 23 05 00 Common Work Results – Mechanical

1.2 REFERENCES

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3, Identification of Piping Systems.

1.3 SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 Submittal Procedures.
- .3 Product data to include paint color chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 Submittal Procedures
Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 45 00 – Quality Control.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health & Safety Requirements.

1.5 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 19 - Construction Waste 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 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 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.

2.2 SYSTEM NAMEPLATES

- .1 Colors:
 - .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, matte finish, with square corners, letters accurately aligned, and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

	<u>Sizes (mm)</u>	<u>No. of Lines</u>	<u>Height of Letters (mm)</u>
1	10 x 50	1	3
2	13 x 75	1	5
3	11 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 Identification for the Preventive Maintenance Support System (PMSS):
 - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.

- .2 Equipment in Mechanical Room:
 - .1 Main identifier: Size #9.
 - .2 Source and Destination identifiers: Size #6.
 - .3 Terminal cabinets, control panels: Size #5.
- .3 Equipment elsewhere: Sizes as appropriate.

2.3 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas and propane: to CSA/CGA B149.1.

2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background Color 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 Colors 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 Color marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background Color 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] [vinyl] with protective over-coating, 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 Colors and Legends:
 - .1 Where not listed, obtain direction from Departmental Representative.
 - .2 Colors for legends, arrows: to following table:
Background Color: Legend, arrows:
Yellow BLACK
Green WHITE

Red WHITE

.3 Background Color marking and legends for piping systems:

Contents	Background Color Marking	Legend
Hot water heating supply	Yellow	HEATINGSUPPLY
Hot water heating return	Yellow	HEATINGRETURN
Domestic hot water supply	Green	DOM.HWSUPPLY
Domestic HW recirculation	Green	DOM.HWCIRC
Domestic cold water supply	Green	DOM.CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN.VENT
Natural gas and propane	to Codes	
Fire protection water	Red	FIREPROT.WTR
Sprinklers	Red	SPRINKLERS

2.5 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stenciled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colors: back or coordinated with base Color to ensure strong contrast.

2.6 VALVES, CONTROLLERS

- .1 Plastic tags with 12 mm stamped identification data.
- .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 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 has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to the PMSS.

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 AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .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, galleries, 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, and dampers. 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 non-ferrous chains or closed "S" hooks.

- .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 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 GENERAL

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB COMPANY

- .1 Testing and balancing shall be performed by an agency that specializes in this type of work. Provide proof that the agency has successfully completed five projects of similar size and scope
- .2 All work shall be performed by persons with proven ability and thoroughly versed in the type of testing and balancing. Submit names, complete with experience, record and references for review by the Departmental Representative prior to work being carried out.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate installed equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and installed equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.
- .2 TAB of existing equipment already in operation.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started.
- .2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.9 START OF TAB

- .1 Notify Departmental Representative 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 weather-stripping, sealing, caulking.
 - .3 All pressure, leakage, other tests specified elsewhere Division 23.
 - .4 All provisions for TAB installed and operational.
- .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 Hydronic systems: plus, or minus 10%.

1.11 ACCURACY TOLERANCES

- .1 Measured values to be accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 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.

1.15 TAB REPORT

- .1 Format to be in accordance with Associated Air Balance Council Manual.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit a digital PDF version and six (6) copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results to be at discretion of Departmental Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility.
- .3 Markings not to be eradicated or covered in any way.

1.18 COMPLETION OF TAB

- .1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.19 WATER SYSTEMS (HVAC)

- .1 Water circulating systems shall be balanced by means of balancing fittings and tabulated results shall include the following:
 - .1 Differential head across all circulating pumps.
 - .2 Flow and return water temperature to supply and return header for all zones.
 - .3 Water temperature supplied to and returning from each coil and heating element.
- .2 Contractor shall arrange with balancing technician to have water flow through radiation elements checked prior to installation of radiation enclosure.

1.20 CAD DRAWINGS

- .1 CAD drawing files of the heating and ventilating tender drawings will be made available to the Balancing Contractor if requested. An "Authorization to use CAD Drawing File" agreement restricting the use of the CAD files to the preparation of the project balancing reports must be signed prior to obtaining the files.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 23 05 00 Common Work Results - Mechanical
- .3 Section 23 05 05 Installation of Pipe Work
- .4 Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment

1.2 REFERENCES

- .1 BC Insulation Contractors Association (BCICA)
 - .1 BCICA Standards Manual. <http://www.bcica.org/>
- .2 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1; Energy Standard for Buildings except Low-Rise Residential Buildings.
- .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].
 - .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411, Test Method for Hot-Surface Performance of High- Temperature Thermal Insulation.
 - .4 ASTM C 449/C449M, Standard Specification for Mineral Fiber- Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - .6 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .7 ASTM C 921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .4 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning characteristics of Building Materials and Assemblies.

1.3 DEFINITIONS

- .1 For purposes of this section:

- .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
- .2 "EXPOSED"-will mean "not concealed" as defined herein.
- .2 TIAC Codes:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 Submittal Procedures.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
 - .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 Submittal Procedures.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .1 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 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.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health & Safety Requirements.

1.6 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 10 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .3 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management & Disposal.
 - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
 - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
 - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

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 as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code A-1: Rigid molded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/CGSB-51.9.
 - .2 Maximum "k" factor: to CAN/CGSB-51.9.
- .4 TIAC Code A-3: Rigid molded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/CGSB-51.9.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/CGSB-51.9.
- .5 TIAC Code C-2: Mineral fibre blanket faced [with] [without] factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .2 Jacket: to CGSB 51-GP-52Ma.

- .3 Maximum "k" factor: to CAN/ULC-S702.
- .6 TIAC Code A-6: Flexible unicellular tubular elastomer.
 - .1 Insulation: flexible closed-cell elastomer to ASTM C534.
 - .2 Jacket: to CGSB 51-GP-52Ma. Required for outdoor application.
 - .3 Maximum "k" factor: 0.27.
 - .4 Vapour transmission: 0.08 perm-inch.
 - .5 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants.
- .7 To be formaldehyde free, low VOC; resists mold and mildew.
- .8 Evidence shall be provided to the Departmental Representative on the site of ULC listings of all products being used. Duct insulation adhesives and coatings shall be non-toxic as defined by WCB Regulations.

2.3 INSULATION SECUREMENT

- .1 Tape: Self-adhesive, aluminum, reinforced, 50mm wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5mm diameter stainless steel.
- .5 Bands: Stainless steel, 19mm wide, 0.5mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 To CAN/CGSB-51.12.
 - .2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449.

2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m.

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece molded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.
 - .2 Colors: White.

- .3 Minimum service temperatures: 20°C [68°F].
- .4 Maximum service temperature: 65°C [150°F].
- .5 Moisture vapour transmission: 0.02 perm.
- .6 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching Color.
- .2 Canvas:
 - .1 220 and 120 gm/m cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: Compatible with insulation.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces to be clean, dry and free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 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: PVC.

3.4 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry at all times. Overlaps to manufacturer’s instructions.
- .2 Ensure tight joints.
- .3 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: SS Bands at 300mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: SS Bands at 300mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
 - .1 Seals: lap seal adhesive, lagging adhesive.
 - .2 Installation: TIAC Code: 1501-CA; per manufacturer’s recommendation.
- .5 TIAC Code: C-2 with vapour retarder jacket.
 - .1 Insulation securements: SS Bands at 300mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .6 Thickness of insulation to be as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000mm long.
 - .2 Do not insulate exposed run-outs to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp °C	TIAC Code	Run out	To NPS1	1 ¼-2	2 ½-4	5-6	8 & over
Hot Water Heating	60-94	A-1	25	38	50	50	50	50
Hot Water Heating	< 59	A-1	25	25	38	38	38	38
Domestic HWS/RECIRC		A-1	25	25	38	38	38	38
Domestic CWS		A-3	25	25	25	25	25	25
Refrigerant (hot gas, liquid, suction)	< 4	A-6	25	25	38	38	38	38
RWL and RWP		C-2	25	25	25	25	25	38
Cooling Coil Condensate Drain		A-3	25	25	25	25	25	25

.7 Finishes:

- .1 Exposed indoors: Canvas and/or PVC jacket.
- .2 Exposed in mechanical rooms: Canvas and/or PVC jacket.
- .3 Concealed, indoors: ASJ, no further finish.
- .4 Exposed outdoors: Aluminum jacket.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – 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 RELATED SECTIONS

- .1 Section 01 91 13 Commissioning
- .2 Section 23 05 93 Testing, Adjusting and Balancing for HVAC

1.2 GENERAL

- .1 The Mechanical Subcontractor shall retain a Commissioning Agent, who shall be active in the commissioning process and actively encourage his own forces and subtrades to work together to achieve optimum system performance for the mechanical systems in a timely manner. Refer to Commissioning Authority Plan for responsibilities of Commissioning Agent.
- .2 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 first-class installation in satisfactory working order.
- .3 As part of the final commissioning report, submit a Certificate stating that the commissioning 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 the correction of faults and omissions has been completed and recorded.
- .4 Be responsible for the performance and commissioning of all equipment supplied under the Sections of Division 21, 22, 23. 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.
- .5 In consultation with the General Contractor, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems.

1.3 COMMISSIONING AND DEMONSTRATION

- .1 Submit a schedule for the commissioning phase of the work. This schedule shall show:
 - .1 Equipment start-up schedule.
 - .2 Submission dates for the various documents required prior to substantial completion.
 - .3 Timing of the commissioning, testing, balancing, and demonstration process.
- .2 Commissioning is concluded when the air and water system is balanced and the installation is in full working order and acceptable for use. The work shall include the following:
 - .1 Balancing of the air systems as specified in this section.
 - .2 Set up air diffusers, registers and grilles for optimum distribution/comfort.
 - .3 Plug all air pressure and flow measuring holes.
 - .4 Adjust vibration isolators and earthquake restraints for optimum performance.

- .5 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations. Forms in Section 23 08 02 shall be used for this purpose.
- .6 Verification of water tightness of all roof and exterior wall penetrations.
- .7 Verification that coil drain pan operates.
- .8 Set up all automatic control valves/dampers and automatic temperature control devices.
- .9 Set up and test all alarm and protective devices.
- .10 EMCS:
 - .1 Commissioning of EMCS is primarily responsible by Controls Contractor. Refer to Section 25 05 01 EMCS General Instructions.
 - .2 The Commissioning Agent shall assign one person experienced and qualified in commissioning control systems through practical experience and a comprehensive knowledge of the interactive nature of HVAC systems and DDC controls to verify the performance of the control systems by conducting random tests of the control sequences until the Commissioning Agent is satisfied that the controls are performing according to the intended control sequences.
 - .3 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material.
- .3 In addition to the piping, equipment and systems listed above provide commissioning of all plumbing and fire protection piping, equipment and systems including the following:
 - .1 Domestic cold water including PRV setpoint.
 - .2 Domestic hot water and recirculation including temperature set points.
 - .3 Domestic tempered water including setpoints.
 - .4 Sanitary waste and venting.
 - .5 Plumbing fixtures including adjustments of all flush valves, electronic sensors, solenoid valves, and setting temperature limit stops on shower valves.
 - .6 Compressed air system.
 - .7 Double-Interlocked Electric/Pneumatic Release Preaction Valve (DIPV) fire protection system.
- .4 At the conclusion of commissioning, demonstrate the operation of the systems to the Departmental Representative. For demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to section 25 05 01 EMCS: General Instructions.
- .5 The verification process shall include the demonstration of the following:
 - .1 The ease of access that has been provided throughout for servicing coils, motors, drives, control dampers and damper operators.

- .2 Location of and opening and closing of all access panels.
- .3 Operation of all automatic control dampers and automatic temperature control devices.
- .4 Operation of all alarm and protective devices.
- .5 Operation of all equipment and systems under each mode of operation, and failure.
- .6 At the completion of commissioning, testing, balancing and demonstration submit the following to the Departmental Representative:
 - .1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.
 - .2 Completed copies of all commissioning check lists plus copies of start-up reports from specialty contractors and vendors.
 - .3 "As-Built" record drawings, as specified.
 - .4 A list of all alarm and protective devices tested, with the final operating settings.
- .7 Training
 - .1 During "Substantial Performance" review, the Mechanical Contractor, Control Sub-contractor, and other Sub-contractors designated by the Departmental Representative shall provide training to the operating personnel in the proper operation and maintenance of all systems and equipment installed under the contract.
 - .2 It shall be the Mechanical Contractor's responsibility to have the specified equipment manuals prepared, previously approved by the Departmental Representative, and ready for presentation at this meeting.
 - .3 Convene the meeting with the aforementioned parties at the time called for in the substantial performance review. The arrangements shall include written notices to all the parties concerned. Should the equipment manuals, or system installation not be complete and operable at the proper time, he shall then convene the operating instruction meeting at a later date and pay any additional costs including time and traveling expenses for the personnel involved which are attributable to the delay.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 23 05 00 Common Work Results-Mechanical
- .3 Section 23 05 93 Testing Adjusting and Balancing for HVAC
- .4 Section 23 25 00 HVAC Water Treatment Systems

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with 01 33 00 Submittal Procedures
- .3 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 30 - Health & 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.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse recycling in accordance with 01 74 19 Construction Waste and Disposal

Part 2 Products

2.1 CLEANING SOLUTIONS AND CHEMICALS

- .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.
- .4 Cleaning solutions shall be provided by the supplier of chemicals for water treatment under Section 23 25 00 – HVAC Water Treatment 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 CLEANING OF HYDRONIC SYSTEMS

- .1 Timing:
 - .1 Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning Agency:
 - .1 Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist. Install cross upstream per manufacturer's recommendation. Install plugs in unused connections.
- .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 to be used. Include Material Safety Data Sheets (MSDS).
 - .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 to be used to ensure water will not damage systems or equipment.
- .5 Conditions at time of cleaning of systems:
 - .1 Systems to be free from construction debris, dirt and other foreign material.
 - .2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.
 - .3 Strainers to be 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 System:
 - .1 Fill system with water, ensure air is vented from system.
 - .2 Provide drain connections to drain system in one hour. All drains for chemical treatment shall be piped to the nearest floor drain. After initial flushing has been completed, clean all strainer screens.
 - .3 System pumps may be used for circulating cleaning solution provided that pumps are dismantled and inspected, worn parts repaired with new gaskets and seals install. Submit used seals.
 - .4 Add cleaners and chemicals to closed systems at concentration levels recommended by the Chemical Specialist.
 - .5 For heating hot water systems, apply heat while circulating, raise temperature slowly to 70°C [158°F] and maintain at 70°C [158°F] for a minimum of 12 hours. Remove heat and continue to circulate until temperature is below 38°C [100°F].

3.3 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
 - .1 Establish circulation and expansion tank level, set pressure controls.
 - .2 Ensure air is removed.
 - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
 - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
 - .5 Clean out strainers repeatedly until system is clean.
 - .6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.
 - .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
 - .8 Repeat with water at design temperature.
 - .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
 - .10 Bring system up to design temperature and pressure slowly over a 48 hour period.
 - .11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .12 Adjust pipe supports, hangers, springs as necessary.
 - .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
 - .14 Re-tighten bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

- .15 Check operation of drain valves.
- .16 Adjust valve stem packings as systems settle down.
- .17 Fully open all balancing valves (except those that are factory-set).
- .18 Check operation of over-temperature protection devices on circulating pumps.
- .19 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 Division 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 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 01 91 00 Commissioning
- .3 Section 23 05 05 Installation of Pipe Work

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.5, Pipe Flanges and Flanged Fittings.
 - .2 ASME B18.2.1, Square and Hex Bolts and Screws.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 47/A47M, Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 53/A53M, Specification for Pipe, Steel, Black and Hot- Dipped, Zinc Coated, Welded and Seamless.
- .3 Canadian Standards Association (CSA)
 - .1 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
 - .1 CAN/CGA B149.1, Natural Gas and Propane Installation Code.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 Submittal Procedures
- .2 Indicate on manufacturer's catalogue literature following: valves.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in 01 78 10 Closeout Submittals.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with 01 74 19 Construction Waste and Disposal.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A 53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS 2 1/2 and over, plain end.
- .2 Epoxy coated steel pipe risers designed for connection to plastic service piping for NPS 2 (50mm) size and smaller.

2.2 JOINTING

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.

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 A 47/A47M.
 - .5 Bolts and nuts: to ASME B18.2.1.
 - .6 Nipples: schedule 40, to ASTM A 53/A53M.

2.4 VALVES

- .1 Provincial Code and CSA Standard B-137.1 approved, lubricated type.
- .2 All valves used shall match existing and labeled to match existing nomenclature.
- .3 Provide seismic actuated shut off valve at building wall.

Part 3 Execution

3.1 PIPING

- .1 Install piping in accordance with applicable Provincial Codes.
- .2 Install in piping accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.
- .3 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.

3.2 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.
- .3 Provide shutoff valve and insulated union for di-electric isolation of building gas piping.

3.3 TRACER WIRES:

- .1 All underground plastic gas piping shall have a tracer wire 14-gauge stranded copper wire, mounted on the top surface of the pipe, secured with plastic straps at two meter intervals.
- .2 Wire to be bonded to steel supply main at connection with plastic run.
- .3 Wire to be run up the transition riser and taped to the steel pipe
- .4 Continuity of tracer wire to be checked.

3.4 WARNING TAPE:

- .1 All underground natural gas lines shall have a warning tape. Underground warning tape (plain tape only) buried 300mm below grade above pipe.

3.5 FIELD QUALITY CONTROL

- .1 Test system in accordance with CAN/CGA B149.1, CAN/CGA B149.2 and requirements of authorities having jurisdiction.

3.6 PURGING

- .1 Purge after pressure test in accordance with CAN/CGA B149.1, CAN/CGA B149.2.

3.7 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, entire installation is approved by authority having jurisdiction.

3.8 REPORTS

- .1 In accordance with Section 01 91 31 – Commissioning (CX) Plan.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 01 50 General Instructions
- .2 Section 23 05 00 Common Work Results - Mechanical
- .3 Section 23 05 05 Installation of Pipework
- .4 Section 23 05 93 Testing, Adjusting and Balancing for HVAC
- .5 Section 23 08 02 Cleaning and Start-up of Mechanical Piping Systems

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME, Boiler and Pressure Vessel Code.
- .2 American Society for Testing and Materials, (ASTM).
 - .1 ASTM A 47/A 47M, Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 278M, Specification for Gray Iron Castings for Pressure- Containing Parts for Temperatures up to 650 degrees F (345 degrees C).
 - .3 ASTM A 516/A 516M, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A 536, Specification for Ductile Iron Castings.
 - .5 ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA International).
 - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 10 Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety.
 - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health & Safety Requirements.

1.5 DELIVERY STORAGE AND HANDLING

- .1 Waste Management and Disposal.
 - .1 Separate waste materials for reuse and recycling in accordance with 01 74 19 Construction Waste and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
 - .4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 DIAPHRAGM TYPE EXPANSION TANK

- .1 Steel pressurized diaphragm type expansion tank. Expansion tank shall be vertical or horizontal as indicated.
- .2 Capacity and size as indicated.
- .3 Diaphragm sealed in elastomer suitable for 115°C [240°F] operating temperature.
- .4 Working pressure: 862 kPa [125 PSI] with ASME stamp and certification.
- .5 Air pre-charged to 84 kPa [12 PSI].
- .6 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.

2.2 AUTOMATIC AIR VENT

- .1 Disc vent: with built-in check valve, NPT 1/8 connection. Rated at 345 kPa [50 PSI] working pressure. Pipe to nearest floor drain.
- .2 Float vent: brass body, stainless steel float, NPT 3/4 connection, with built-in check valve. Rated at 1,034 kPa [150 PSI] working pressure and 121°C [250°F] operating temperature.
- .3 High capacity vent: cast iron body, stainless steel float and NPS 3/4 connection. Rated at 1,034 kPa [150 PSI] working pressure and 121°C [250°F] operating temperature.

2.3 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

- .1 Adjustable pressure setting: 206 kPa [30 PSI] relief, 55 to 172 kPa [8 to 25 PSI] reducing.
- .2 Low inlet pressure check valve.
- .3 Removable strainer.

2.4 STRAINER

- .1 NPS 1/2 to 2: Y-type, bronze body to ASTM B 62, screwed connections, 304 stainless steel screen with 20 mesh perforations.

- .2 NPS 2 1/2 to 12: Y-type, cast iron body to ASTM A 126 Class B, flanged connections, 304 stainless steel screen with 20 mesh perforations.
- .3 NPS 2 to 12: T-type, cast iron body to ASTM A126 Class B, flanged connections,
- .4 304 stainless steel screen with 0.063 perforations for NPS 2 to 4, and 0.125 perforations for NPS 6 and larger.
- .5 Working pressure: 1,034 kPa [150 PSI].
- .6 Provide blow-down valve with capped hose adapter fitting and chain.

2.5 PRIMARY/SECONDARY HEADER

- .1 Provide combination air separator and manifold that creates an independent primary and secondary hydronic circuits. Furnished with purge valve at the bottom of the vessel and an air automatic vent at the top of the vessel. Pipe purge valve to nearest floor drain as an indirect connection.
- .2 Construction: steel.
- .3 Connection: ANSI 150 class flange.
- .4 Insulation: polyurethane foam.

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 Departmental Representative's directive.
- .5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 STRAINER

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump unless suction diffuser is provided.
- .4 Install ahead of each automatic control valve and as indicated.

3.3 AIR VENTS

- .1 Install at high points of systems.
- .2 Install gate valves at the inlet of float vents and high capacity float vents.
- .3 Pipe all automatic air vents to nearby drain.

- .4 Applications:
 - .1 Disc vent: radiators and convectors.
 - .2 Float vent: pipe mains.
 - .3 High capacity vent: air separator.

3.4 EXPANSION TANK

- .1 Adjust expansion tank pressure as indicated.
- .2 Install lock-shield type valve at inlet to tank.

3.5 PRESSURE SAFETY RELIEF VALVE

- .1 Run discharge pipe to terminate above nearest drain.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 23 05 00 Common Work Results - Mechanical
- .3 Section 23 05 05 Installation of Pipework
- .4 Section 23 05 93 Testing, Adjusting and Balancing for HVAC
- .5 Section 23 08 02 Cleaning and Start-up of Mechanical Piping Systems

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.3, Malleable Iron Threaded Fittings.
 - .3 ASME B16.5, Pipe Flanges and Flanged Fittings.
 - .4 ASME B16.9, Factory-Made Wrought Butt Welding Fittings.
 - .5 ASME B18.2.1, Square and Hex Bolts and Screws (Inch Series).
 - .6 ASME B18.2.2, Square and Hex Nuts (Inch Series).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A 536, Standard Specification for Ductile Iron Castings.
 - .4 ASTM B 61, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM E 202, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .3 American Water Works Association (AWWA).
 - .1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CAN/CSA W 48, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67, Butterfly Valves.
 - .2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

- .3 MSS-SP-71, Cast Iron Swing Check Valves Flanged and Threaded Ends.
- .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .5 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Health and Safety.
 - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health & Safety Requirements.

1.5 DELIVERY STORAGE AND HANDLING

- .1 Waste Management and Disposal.
 - .1 Separate waste materials for reuse and recycling in accordance with Division 01 74 19 Construction Waste and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
 - .4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.6 MAINTENANCE

- .1 Extra Materials.
 - .1 Provide following spare parts:
 - .1 Valve seats: one for every ten valves, each size. Minimum one.
 - .2 Discs: one for every ten valves, each size. Minimum one.
 - .3 Stem packing: one for every ten valves, each size. Minimum one.
 - .4 Valve handles: two of each size.
 - .5 Gaskets for flanges: one for every ten flanges.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
 - .1 To NPS 10: Schedule 40.
 - .2 NPS 12 and over: 10 mm [3/8"] wall thickness.

2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings to ANSI/ASME B1.20.1.

- .2 NPS 2-1/2 and over: welding fittings and flanges to ANSI/ASME D1.1, ANSI/ASME Section 9 and CAN/CSA W48.
- .3 Pipe thread: taper.
- .4 Flanges: weld neck, raised face to AWWA C111.
- .5 Orifice flanges: slip-on, raised face.
- .6 Flange gaskets: to AWWA C111.
- .7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.
- .8 Nipples: extra heavy black steel.

2.3 FITTINGS

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
 - .1 Cast iron: to ASME B16.1, Class 125.
 - .2 Steel: to ASME B16.5.
- .3 Butt-welding fittings: steel, to ASME B16.9.
- .4 Unions: malleable iron, to ASTM A 47/A47M and ASME B16.3.
- .5 Fittings for roll grooved piping: malleable iron to ASTM A 47/A47M; ductile iron to ASTM A 536.

2.4 VALVES

- .1 Gate valves: to MSS-SP-70 and MSS-SP-80:
 - .1 NPS 2 and under: Class 150 to MSS-SP80. Rising stem, threaded, union bonnet and solid wedge. Body, bonnet and wedge shall be of bronze ASTM B-62. Stem shall be of dezincification-resistant silicon bronze ASTM B-371 or low-zinc alloy B-99.
 - .2 NPS 2-1/2 and over: Class 150 to MSS-SP70. OS&Y, flanged, bolted bonnet, solid wedge, iron body, bronze trimmed, with body and bonnet conforming to ASTM A126 Class B cast iron.
- .2 Drain valves:
 - .1 Ball type, Class 150 to MSS-SP-110, 2-piece cast bronze body, threaded, full port, anti-blowout stem, stainless steel ball and stem, 20mm [3/4"] hose connection with cap and chain.
- .3 Swing check valves:
 - .1 NPS 2 and under: Class 150 to MSS-SP-80. Swing type, Y-pattern, threaded, bronze body to ASTM B-62, renewable TFE seat and disc, regrinding type, dezincification-resistant.
 - .2 NPS 2-1/2 and over: Class 125 to MSS-SP-71. Swing type, flanged, cast iron to ASTM A126 Class B, renewable bronze seat disc.

- .4 Silent check valves:
 - .1 NPS 2 and under: Class 125 to MSS-SP-80. Inline lift type, threaded, bronze body to ASTM B-584, TFE disc, stainless steel stem, spring, disc holder and seat screw, dezincification-resistant.
 - .2 NPS 2-1/2 and over: Class 125 to MSS-SP-71. Globe style, flanged, cast iron to ASTM A126 Class B, renewable bronze seat (bonded with Buna-N) and disc, stainless steel spring.
- .5 Ball valves:
 - .1 NPS 2 and under: Class 150 to MSS-SP-110. Cast bronze, 2-piece body, threaded, full port, anti-blowout stem, 316 stainless steel stem and ball (vented), TFE packing, RTFE thrust washers and seat rings, 50mm [2"] extended blowout stem for insulated piping, lever handle with position indicator.

2.5 STRAINER

- .1 Description: Y-type with strainer baskets of material and perforations suitable for steam or water service, as required. Figure numbers of manufacturers are listed to indicate the types selected for design, performance and standard of quality.
- .2 NPS 2 and under: Full pipeline size, 250 lb. SWP bronze, with screwed ends and a removable plug type screen retainer.
- .3 NPS 2-1/2 and over: Full pipeline size, 250 lb. SWP semi-steel, with flanged ends and a bolted screen retainer.
- .4 Screens: Stainless steel or monel screen with 20 mesh screen opening.
- .5 Provide a blowdown valve with a drain line to discharge above an approved receptor on the blowdown connection of the strainer. Where strainers occur above ceilings, provide a blowdown valve with NPS 3/4 capped hose adapter fitting.

2.6 DIELECTRIC COUPLING

- .1 NPS 2 and under: Screwed, Schedule 40 electro zinc plated ASTM A120/A53 casing with inert self-cleaning thermoplastic liner, 300 PSI WP at 225°F.
- .2 NPS 2-1/2 and over: Flanged with isolation gaskets, washers and sleeves, 300 lb. WOG.

2.7 BALANCING FITTINGS, FOR TAB:

- .1 Sizes: Calibrated balancing valves, as specified this section.
- .2 NPS 2 and under: Globe type, Y-pattern, bronze body, EPDM O-ring and NPT connections.
- .3 Flow measuring valve shall be fitted with meter readout ports with check valves and caps, digital handwheel with memory stop indicator, NPS 20 hose connection, and a nameplate bearing manufacturer's name and calibrated nameplate.
- .4 Furnished with preformed rigid polyurethane insulation.

Part 3 Execution

3.1 PIPING INSTALLATION

- .1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.
- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage and positive venting.
- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .6 Assemble piping using fittings manufactured to ANSI standards.
- .7 Install dielectric couple between dissimilar metals.
- .8 When grooved fittings are used, contractors shall provide proof of training on site by the mechanical coupling manufacturer, or manufacturer's representative prior to the start of installation.

3.2 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install isolation valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .3 Install check valves on discharge of pumps and as indicated. Provide silent check valves in vertical pipes with downward flow and swing check valves horizontal pipes.
- .4 Install chain operators on valves NPS 2-1/2 and over where installed more than 2400mm [8'-0"] above finished floor in mechanical room(s).

3.3 CLEANING, FLUSHING, & START-UP

- .1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.4 BALANCING

- .1 Balance water systems to within plus or minus 5% of design output.
- .2 Refer to Section 23 05 93 - Testing, Adjusting & Balancing for HVAC for applicable procedures.

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 01 33 00 Submittal Procedures
- .2 Section 01 91 00 Commissioning
- .3 Section 23 05 48 Vibration & Seismic Controls for Piping & Equipment
- .4 Section 23 08 00 Commissioning of Mechanical Systems

1.3 REFERENCES

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
 - .1 Standard 90.1 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, Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers Association (NEMA).
 - .1 NEMA MG 1, Motors and Generators.

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 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
- .4 Submit product data of pump curves for review showing point of operation.
- .5 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

- .6 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 – Health & Safety Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management & Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal 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 in accordance with Waste Management Plan.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

1.7 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Furnish following spare parts:
 - .1 One pump seal and casing gasket for each size and type of pump.

Part 2 Products

2.1 EQUIPMENT SELECTION

- .1 Do component selection and sizing to CAN/CSA-B214.

2.2 IN-LINE CIRCULATOR

- .1 Volute: cast iron, radially split, with flanged connection.
- .2 Impeller: cast bronze.
- .3 Shaft: alloy steel with copper or bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical.
- .5 Coupling: flexible self-aligning.
- .6 Design pressure: 860 kPa (125 psi).

2.3 VERTICAL IN-LINE PUMP

- .1 Volute: cast iron, radially split, with tapped openings for draining and gauge connections, complete with vent line or internally flushed. Provide base ring tapping for floor mounted support as specified herein. Flanged connections.
- .2 Impeller: cast bronze, enclosed type, dynamically balanced, keyed to shaft and secured in place.
- .3 Shaft: alloy steel or stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical.
- .5 Coupling: closed coupled. Split coupled where noted.
- .6 Design pressure: 1,200 kPa (175 psi).
- .7 Provide floor mounted support for pumps with 10 HP motor and larger.

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 and per manufacturer's recommendation. Install with bearing lubrication points accessible.
- .3 Vertical in-line pump: provide support for pipe elbows, suction diffuser and pump discharge combination valve at pump suction and discharge. Install floor mounted support where specified in this Section.
- .4 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
- .5 Pipe drain tapping to floor drain.
- .6 Install volute venting pet cock in accessible location.
- .7 Check rotation prior to start-up.
- .8 Install pressure gauge test cocks.

3.2 START-UP

- .1 General
 - .1 In accordance with Section 01 91 31 - Commissioning (CX) Plan, Section 23 08 00 – Commissioning of Mechanical Systems, and supplemented as specified herein.
 - .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 Adjust pump shaft seals, stuffing boxes, glands.
- .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .15 Verify lubricating oil levels.

3.3 PERFORMANCE VERIFICATION

- .1 General
 - .1 In accordance with Section 01 91 00 - Commissioning (CX) Plan, Section 23 08 00 – Commissioning of Mechanical Systems, and supplemented as specified herein.
- .2 Exclusions:
 - .1 This paragraph does not apply to small in-line circulators.
- .3 Assumptions: these PV procedures assume that:
 - .1 Manufacturer's performance curves are accurate.
 - .2 Valves on pump suction and discharge provide tight shut-off.
- .4 Net Positive Suction Head (NPSH):
 - .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
 - .2 Measure using procedures prescribed in the Standard.
 - .3 Where procedures do not exist, discontinue PV, report to Departmental Representative and await instructions.
- .5 Multiple Pump Installations - Series and Parallel:
 - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

- .7 Commissioning Reports: In accordance with Section 01 91 00 - Commissioning (CX) Plan, Section 23 08 00 – Commissioning of Mechanical Systems, 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 Pump performance curves (family of curves).

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials, components, equipment and chemicals for installation of complete HVAC water treatment system.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 23 05 00 Common Work Results-Mechanical.
- .3 Section 23 08 02 Cleaning & Startup of Mechanical Piping Systems.

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Boiler and Pressure Vessel Code, Section VII.
- .2 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.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal 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 Closeout Submittals:
 - .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.
 - .2 Include following:
 - .1 Log sheets as recommended by manufacturer.

1.5 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health & Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse recycling in accordance with 01 74 19 -Construction Waste and Disposal.

Part 2 Products

2.1 MANUFACTURER

- .1 Equipment, chemicals, service provided by one supplier.

2.2 CHEMICAL FEED PIPING

- .1 Schedule 40 black steel.

2.3 SHIPPING/FEEDING CHEMICAL CONTAINERS

- .1 High density molded polyethylene, with liquid level graduations, cover.

2.4 WATER TREATMENT FOR CLOSED SYSTEMS

- .1 Bypass pot feeder: 7.6 L [2 gal] capacity, constructed of heavy duty cast iron or welded steel suitable for 1,380 kPa [200 psi] working pressure, with quick opening cap and complete with NPS 3/4 connections. Isolation valves shall be installed on the inlet, outlet and drain.
- .2 Sidestream filter: Steel construction using a 250mm x 30 micron filter cartridge, with a minimum flow rate of 35 litres/minute. A flow indicator with stainless steel impeller shall be installed in conjunction with the sidestream filter. Connections shall be NPS 3/4 and all isolation valves shall be installed per manufacturer's instructions. Include 10 filter cartridges.
- .3 Totalizing make-up water meter: Cast bronze body, NPS 3/4 connections, thermoplastic rotor and gear train, rated at 1,206 kPa [175 psi] maximum operating pressure. Provide an analog input point and connect to the DDC system for monitoring.
- .4 Provide corrosion coupon, coupon holder and cross.

2.5 CHEMICALS

- .1 Closed System Treatment (Hot Water): Use a Borated Nitrite- Molybdate based corrosion inhibitor. Maintain levels at 200 to 400ppm. The use of Nitrite only, Molybdate only or Sulphite will not be accepted.
- .2 Cleaning solutions: as indicated in Section 23 08 02 - Cleaning Start-up of Mechanical Piping Systems.
- .3 Anti-freeze: Propylene Glycol.
- .4 Provide one year supply.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
- .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.3 CHEMICAL FEED PIPING

- .1 Install crosses at changes in direction. Install plugs in unused connections.

3.4 CLEANING OF MECHANICAL SYSTEM

- .1 Provide copy of recommended cleaning procedures and chemicals for approval by Departmental Representative.
- .2 Thoroughly 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. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.
- .3 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.
- .4 Drain and flush system until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .5 Disposal of cleaning solutions to be approved by authority having jurisdiction.

3.5 WATER TREATMENT SERVICES

- .1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:

- .1 Initial water analysis and treatment recommendations.
- .2 System start-up assistance.
- .3 Operating staff training.
- .4 Visit plant every 30 days during period of operation and as required until system stabilizes and advise on treatment system performance.
- .5 Provide necessary recording charts and log sheets for one year operation.
- .6 Provide necessary laboratory and technical assistance.
- .7 Provide clear, concise, written instructions and advice to operating staff.

3.6 ANTI-FREEZE WATER TREATMENT

- .1 Following the flushing and treatment of the closed loop system, fill heating system with propylene glycol to 50% concentration.
- .2 Sample and test solution concentration.
- .3 Provide copy of test reports and quantity of glycol installed for approval by Departmental Representative.

3.7 FIELD QUALITY CONTROL

- .1 Start-Up
 - .1 Start up water treatment systems in accordance with manufacturer's instructions.
- .2 Commissioning
 - .1 Commissioning Agency: to be installing water treatment sub-contractor.
 - .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 water analysis.
 - .4 Required quality of treated water.
 - .4 Commissioning procedures - applicable to Water Treatment Systems:
 - .1 Establish, adjust as necessary and record automatic controls and chemical feed rates.
 - .2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.
 - .3 Establish test intervals, regeneration intervals.
 - .4 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.

- .5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.
- .6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set.
- .7 during commissioning (more often as required until system stabilizes at required level of performance).
- .8 Advise Departmental Representative in writing on matters regarding installed water treatment systems.
- .5 Commissioning procedures - Closed Circuit Hydronic Systems:
 - .1 Analyze water in system.
 - .2 Based upon an assumed rate of loss approved by Departmental Representative, establish rate of chemical feed.
 - .3 Record types, quantities of chemicals applied.
- .6 Training:
 - .1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.
 - .2 Train O&M personnel in softener regeneration procedures.
- .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 Departmental Representative.
- .9 Commissioning activities during Warranty Period:
 - .1 Check out water treatment systems on regular basis and submit written report to Departmental Representative.

3.8 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, installation and start up for heating boilers.

1.2 RELATED SECTIONS

- .1 Section 01 01 50 General Instructions
- .2 Section 01 91 00 Commissioning
- .3 Section 23 05 48 Vibration & Seismic Controls for HVAC Piping & Equipment
- .4 Section 23 08 00 Commissioning of Mechanical Systems
- .5 Section 23 21 14 Hydronic Specialties

1.3 REFERENCES

- .1 American Boiler Manufacturer's Association (ABMA)
- .2 American National Standards Institute (ANSI)
 - .1 ANSI Z21.13/CSA 4.9, 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.
- .4 Canadian Gas Association (CGA)
 - .1 CAN/CSA-B149.1, Natural Gas and Propane Installation Code.
- .5 Canadian Standards Association (CSA International)
 - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .6 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
- .7 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 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
 - .1 Submit shop drawings and product data in accordance with Section 01 01 50 – General Instructions.

- .2 Indicate the following:
 - .1 General arrangement showing terminal points, instrumentation test connections.
 - .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
 - .3 Foundations with loadings, anchor bolt arrangements.
 - .4 Piping hook-ups.
 - .5 Equipment electrical drawings.
 - .6 Burners and controls.
 - .7 All miscellaneous equipment.
 - .8 Flame safety control system.
 - .9 Breeching and stack configuration.
- .3 Engineering data to include:
 - .1 Boiler efficiency at 100% of design capacity.
 - .2 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 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 – Health and Safety Requirements.

1.6 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 Construction Waste and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction Waste and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

Part 2 Products

2.1 GENERAL

- .1 Packaged boiler:
 - .1 Wall hung boilers complete with burner, controls and boiler trim, hot water connection, fuel connection, electrical hook-up.
 - .2 Factory tested at rated capacity to, and bearing seal or nameplate certifying compliance with, CSA 4.9.
 - .3 Ready for attachment to piping, electrical power, controls, flue gases exhaust.
 - .4 Designed and constructed to ANSI/ASME Boiler and Pressure vessel Code.
 - .5 CRN (Canadian Registration Number), to CSA B51.
 - .6 Boiler/burner package to bear ULC, CGA label.
 - .7 Factory start-up and report.
 - .8 Furnished with condensate neutralizing system.
- .2 Anchor bolts and templates:
 - .1 Anchor bolts to be sized to Section 23 05 48 - Vibration & Seismic Controls for Ductwork Piping & Equipment.
- .3 Temporary use by contractor:
 - .1 Contractor may use boilers only after written approval from Departmental Representative.
 - .2 Monitor and record performance continuously. Keep log of maintenance activities carried out.
 - .3 Refurbish to as-new condition before final inspection and acceptance.

2.2 HIGH EFFICIENCY BOILERS

- .1 Type:
 - .1 Provide hot water boiler suitable for forced draft with insulated jacket, **natural gas** burning system, controls and boiler trim. Provide boiler complete with supply and return headers and flange connections, size as noted on drawings.
 - .2 Heating capacity: 117kW (399MBH) input and 112 kW (383 MBH) output
 - .3 Combustion efficiency: 95% to CSA 4.9
 - .4 Maximum water temperature set point: 88°C (190°F)
 - .5 Weight, empty: 110 kg (240 lbs)
 - .6 Heating Surface Area: 3.40 m² (35.5 ft²)
 - .7 Pressure vessel water content: 25.2 Lv (6.66 US gal)
 - .8 Boiler head loss: 5.98 kPa (2.0 ft hd) at 1.57L/s (25 USgpm)
- .2 Construction:
 - .1 Each heating boiler shall be designed with a vertical combustion chamber and down firing burner. Its heat exchanger is to be manufactured with 439 stainless steel. Heat exchanger performance shall be maximized through a multi-tube, counter-flow fire-tube design.

- .2 The pressure vessel shall be rack or wall mounted with free gravity condensate drainage to ensure proper drainage of all condensate.
 - .3 The boiler shall be constructed in accord with CSA 4.9 and the ASME Boiler and Pressure Vessel Code, Section IV and bear the H stamp as per ASME code. The boiler shall carry a CRN# for the Province of BC installation.
 - .4 Boiler enclosure panels shall be made of stainless steel with black powder coat base. Enclosure panels shall be designed for installation after all piping, insulation, and venting has been completed, provided all recommended clearances are respected.
 - .5 The boiler control shall be built in complete with full outdoor reset, multiple load control with relays for four pumps, variable speed signal for system pump or air handler, clear constantly bright LCD display providing plain English information, and software upgrades by internet or USB port. Altitude compensation shall be available via keypad adjustment, for maintenance of full rating plate output to 3658 m (12,000 ft.) without requirement for orifice changes. The boiler shall offer internal multiple boiler staging and rotation control, for management of up to 24 boilers. The boiler control shall be able to accept an external 0-10 VDC or 4-20 mA input signal. BACnet over IP compatible. Two Interlock connections allowing external devices to effect a boiler safety shut-down. Electronic water pressure sensing, for digital display of system pressure. Alarm dry contact for connection to external device. Error log with detailed conditions capture. Diagnostic pages for fan operation, sensors, boiler network and flame current. Summer shutdown programmable by load. User-defined unoccupied mode. Electronic ΔT fence of 22°C (40°F) to prevent thermal stress to boiler.
 - .6 Wire and cable entry to boiler control shall be universal to provide for cleanest installation.
 - .7 ASME maximum working pressure 30 psig and ASME maximum water temperature 210 F (98.89 C); the boiler will be supplied with a 30 psig Conbraco temperature and pressure relief valve for installation external to the boiler's case, using a 3/4" reducing tee.
 - .8 Combustion air intake:
 - .1 Where direct vent is specified, provide CPVC intake piping.
 - .9 Venting pipe shall be system 636 CPVC piping. Grey (high temperature) shall be used.

The chimney must be designed by a chimney manufacturer including all connector pieces and condensate drain connections.
- .3 Boiler Trim
- .1 Burner:
 - .1 Supplied with a pre-mix automatic burner designed to burn **natural gas**. Burner operation shall be full modulation.
 - .2 Voltage to the combustion air motor shall be 120 V / 1 PH / 60Hz, providing 190 W power at full fire, not including pumps.
 - .3 Stainless steel combustion head capable of withstanding temperatures in excess of 800°C.

- .5 The burner shall fully modulate and have a minimum 5 to 1 turn down ratio for precise load matching.
- .6 Blower noise not to exceed 85 db (A) measured at one meter from the burner intake port.
- .7 Burner shall have a control panel mounted directly on/in the boiler housing containing the following:
 - .1 Burner motor starter
 - .2 Overloads or fused disconnect
 - .3 Start/stop switch (may be in LCD controller)
 - .4 Lo fire hold switch (may be in LCD controller)
 - .5 Flame safe guard control (CSA approved)
- .2 Burner shall come complete with a CGA, and FM approved gas train.
 - .1 Provide combination water pressure and temperature gauge, and ASME rated pressure relief valves.
 - .2 Provide a low water cut-off with manual reset and special retard circuit to automatically prevent burner operation when boiler water falls below safe level. The low water cut off must automatically reset on a resumption of power at the device. The low water cut out shall be a float style device. Probe style low water cut out devices WILL NOT be accepted. Test-N-Check valves shall be installed to the low water cut-offs to enable eased draining of LWCO during annual services checks.
 - .3 All temperature sensors sensing water temperature must be the immersion sensor type. Immersion sensor well shall be filled with heat transfer compound to reduce sensor response lag.
 - .4 Operating temperature controller shall control burner operation to maintain boiler water temperature set point. Controller shall be electronic.
 - .5 Limit temperature controller shall control burner to prevent boiler water temperature from exceeding safe system temperature.
 - .6 Provide a suitable terminal strip point to receive a 0 to 10 Vdc DDC reset signal for each modulating boiler. The provision of the control reset signal shall be supplied under Division 25.
 - .7 Provide boiler air vent tapping.
- .3 Fuel Burning System
 - .1 General: Burner operation shall be modulating with low fire position for ignition.
 - .2 Metal fiber knit burner with direct spark ignition and zero governing 24V gas valve. Brushless DC fan.
 - .3 Controls: Pre-wired, factory assembled electronic controls on control cabinet with flame scanner or detector, programming control, relays and switches. Provide pre-purge and post-purge ignition and shutdown of burner in event of ignition pilot and main flame failure with manual reset. High vent temperature safety limit.
 - .4 Boiler venting shall be System 636 CPVC supplied and installed as recommended by the boiler manufacturer.

- .5 Condensate Handling System
 - .1 The boiler system shall include a condensate neutralizing system that is gravity drain and self-actuating. The neutralizing system shall utilize calcium carbonate (limestone) as its neutralizing agent. The neutralizing system shall be sized to provide one heating season of neutralizing capacity.
 - .2 The system shall neutralize the acidic condensate to a pH level that is safe for copper piping, building concrete, and the city sewer system.
 - .3 The condensate system (tank/container) must be easily removable with the use of flexible couplings and unions. Do not bolt down condensate system.
 - .4 Interface with Building Management System
 - .5 The boiler system shall be capable of being directly controlled through the DDC interface or through the manufacturer supplied control system. Control of the boilers via DDC shall be limited to boiler module enable/disable, supply water temperature set point control, and alarm monitoring. The control of the boiler module burner, combustion mixture, firing rate, and pump command shall be by the manufacturer's supplied control system.
 - .6 Each module shall receive a hardwired 0 10 VDC reset signal that resets the module supply water temperature set point. The reset signal is to be supplied under Division 25.

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 authority having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.
- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .4 The low water cut-outs shall be installed using ASME approved cross tees. The use of standard piping elbows and/or tees will NOT be accepted.
- .5 Pipe hot water relief valves full size to nearest drain.

- .6 Natural gas fired installations - in accordance with CAN/CSA-B149.1.

3.3 FIELD QUALITY CONTROL

- .1 Commissioning:
 - .1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.
 - .2 Manufacturer to:
 - .1 Certify installation.
 - .2 Start up and commission installation.
 - .3 Carry out on-site performance verification tests.
 - .4 Demonstrate operation and maintenance.
 - .3 Provide Departmental Representative at least 48 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

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 CONDENSING BOILERS

Mark	B-1		B-2	
Location	Mech Room		Mech Room	
Service	Heating Water		Heating Water	
Input kW (MBH)	117	339	117	339
Output kW (MBH)	112	383	112	383
Efficiency-Combustion (% at 40°C EWT)	96		96	
Max. Pressure kPa (psi)	550	80	550	80
Relief Pressure kPa (psi)	55	8	55	8
Gas Input (Max.) kPa (in wc)	3.4	14	3.4	14
LWT °C (°F)	85	185	85	185
EWT °C (°F)	74	165	74	165
Flow Rate L/s (Usgpm)	1.6	25	1.6	25
Water P.D. kPa (ft hd)	5.98	2	5.98	2
Voltage / Phase	120/1		120/1	
POWER (W)	345		345	
Gas Connection mm Ø(in Ø)	20	3/4	20	3/4
Water Connection mm Ø(in Ø)	40	1-1/2	40	1-1/2
Flue Vent Outlet mm Ø(in Ø)	100	4	100	4
Combustion Air Supply mm Ø(in Ø)	100	4	100	4
Width mm (in)	495	19.5	495	19.5
Height mm (in)	1016	39.9	1016	39.9
Length mm (in)	685	27	685	27
Notes	All		All	

- .1 Provide low water cut-off.
- .2 Provide acid neutralizer tank.
- .3 Boiler to be complete with manual damper and controller.
- .4 Boiler to be provided with boiler controller package with BACnet IP interface to existing BAS System.
- .5 Provide manufacturer's floor mounted stand for wall mounted boilers to be mounted back to back.
- .6 Provide propylene glycol to 50% solution following installation.

1.2 PUMPS

Mark	P-B1		P-B2		P-3		P-5		P-6	
Location	Mech Room		Mech Room		Mech Room		Mech Room		Mech Room	
Service	Primary for boiler B-1		Primary for boiler B-2		Heating Water Circulation		Secondary Loop		Secondary Loop	
Flow - L/sec (usgpm)	1.58	25	1.58	25	0.53	8	0.63	10	0.38	6
Head - kPa (ft.)	36	12	36	12	45	15	84	28	84	28
Pump Conn. Size - mm (in.)	40	1-1/2	40	1-1/2	25	1	25	1	25	1
Power (W)	178		178		106		106		106	
Notes	1,3		1,3		1,3		1,3		1,3	

- .1 Pumps to be connected to the BAS system.
- .2 Motor to be suitable for 230/1/60 power and 1800 rpm unless noted otherwise.
- .3 Motors to be suitable for 120/1/60 power and 1800 rpm unless noted otherwise.

1.3 HYDRONIC SEPARATOR

Mark	HS-1	
Location	Mech Room	
Service	Heating Water	
Glycol Content	40%	
Orientation	Vertical	
Min. Pressure kPa (psi)	275	40
Max. Pressure kPa (psi)	861	125
Diameter mm (in)	610	24
Height mm (in)	965	38
Operating Weight kg (lbs)	295	650
Notes	All	

- .1 ASME rated.
- .2 Triple duty- hydronic separator, air separator and dirt separator.
- .3 Provide insulation on separator.

1.4 EXPANSION TANK

Mark	EXT-1	
Location	Mech Room	
Service	Heating Water	
Orientation	Vertical	
Orientation	Vertical	
Acceptance Volume L (US gal)	162	43
Tank Volume L (US gal)	350	92
Min. Operating Pressure kPa (psi)	83	12
Max. Operating Pressure kPa (psi)	241	35
Diameter mm (in)	610	24
Height mm (in)	574	62
Operating Weight kg (lbs)	241	330
Notes		

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 01 78 00 Closeout Submittals
- .3 Section 01 91 00 Commissioning
- .4 Section 23 08 00 Commissioning of Mechanical Systems

1.2 GENERAL

- .1 Provide, install, program and commission a BACnet-based DDC control system to achieve the performance specified in the following clauses.
- .2 The existing DDC control system is a Delta Controls system. The proposed DDC system shall be fully compatible with the existing system in all manor, form and function, successfully integrated with the existing DDC system.
- .3 Work covered by sections referred to above consist of fully operational EMCS, including, but not limited to, following:
 - .1 Building Controllers.
 - .2 Control devices as listed in I/O Summaries.
 - .3 Data communications equipment necessary to effect an EMCS data transmission system including gateway and LAN hardware and software for connection to incumbent BACnet network.
 - .4 Field control devices.
 - .5 Software and graphics package complete with full documentation for software.
 - .6 Complete operating and maintenance manuals and field training of operators, programmers and maintenance personnel for upgrades done in the boiler replacement project.
 - .7 Acceptance tests, technical support during commissioning, full documentation.
 - .8 Wiring interface co-ordination of equipment supplied by others.
 - .9 Miscellaneous work as specified in these sections and as indicated.

1.3 METRIC REFERENCE

- .1 Conform to CAN/CSA-Z234.1.
- .2 Provide required adapters between Metric and Imperial components.

1.4 STANDARD COMPLIANCE

- .1 All equipment and material to be 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. 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 and specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

1.5 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2 Provide digital copies of schematic control diagrams for review. Each valve, actuator and instrument shall be given an identification label which will refer directly to control diagram.
- .3 Provide damper shop drawings which include data such as arrangement, velocities, and static pressure drops for each system on shop drawings.
- .4 Provide shop drawings including complete operating data, system drawings, wiring diagrams, and type written detailed operational description of sequences, and description and engineering data on each control system component.
- .5 At completion of work, make detailed check of automatic control system and submit written report to the Departmental Representative.
- .6 Provide sufficient copies of complete parts and repair manuals for binding in O&M Manuals.
- .7 Provide "record" control drawings and schedules; incorporate into O&M Manuals.
- .8 The submittals shall be prepared using the dynamic graphics software normally provided with system and be incorporated into the dynamic graphics system for on- line reference. Provide original, registered software disks of Windows, the Graphics Software package, the Operating System software, and the project graphic schematics, floor plan layouts, and control drawings.

1.6 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 10 Closeout Submittals.

1.7 PRELIMINARY DESIGN REVIEW MEETING

- .1 Convene a Preliminary Design Review 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 Control Description Logic prior to software finalization without cost to Departmental Representative.

1.8 MONITORING AND CONTROL FEATURES

- .1 Operator defined digital and analogue alarms and automatic alarm condition reporting.
- .2 Direct keyboard override of all inputs and outputs, with an indication on the display for any point that is operating under keyboard override.
- .3 Addition, deletion, definition and modification of all points from operator keyboard.
- .4 Trend log graphing and reporting of user selected points at user defined intervals.
- .5 Run time logging of digital points.
- .6 Ability to accept a variety of standard analogue and digital input signals.
- .7 Ability to generate a variety of standard analogue and digital output signals.

1.9 OFFLINE STORAGE

- .1 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.
- .2 An off-line disk storage device shall be utilized to provide software backup and reload. Backup and verification of the entire system, with full applications software, shall be less than TWO (2) seconds per real point. Use site laptop PC for off-line storage.

1.10 POWER SURGE PROTECTION

- .1 The DDC system shall be protected from power line surges and voltage transients by installation of a power line filter.

1.11 POWER FAILURE PROTECTION

- .1 The DDC system shall have automatic protection from any power failure of at least TWENTY-FOUR (24) hours duration.
- .2 This protection shall at a minimum include continuous real-time clock operation and automatic system restart upon power return.
- .3 Outputs shall have the option of being set to “staggered start” upon power reset.

1.12 ELECTRICAL COMPONENTS, AND CONDUIT

- .1 Provide all control system components, except those supplied as part of packaged equipment controls, but including all auto sequencing devices, electric relays, safety devices and electrical interlocks required to accomplish specified sequences. Refer to the electrical motor schedule in the electrical drawings and/or specification, which delineate the limits of electrical work in Division 26 (Electrical) serving mechanical systems.

- .2 Provide all control circuit transformers required for control systems and not supplied by Division 26 including line voltage power connection from indicated outlets shall be included by Division 25.
- .3 All line voltage wiring shall be copper with RW90 X-Link P.E. insulation #12 minimum size. AWG wire shall be sized to meet code.
- .4 Wiring is to be in conduit in all wall spaces and exposed locations as well as in pipe chases, service spaces, attics, and crawl spaces which are entered for service access. Wiring in suspended ceiling spaces does not require conduit but shall be neatly installed parallel to building lines using bridle rings. All wiring installed under this contract shall be plenum rated FT-6 or FT-4, if approved by all authorities having jurisdiction. Locate wiring away from top or bottom of ceiling joists or trusses to minimize possibility of accidental damage. Number 18 gauge wire may be used in Class 2 circuits unless voltage drops are excessive. THHN wire will not be acceptable. Twisted shielded wiring, minimum of 22 gauge wire shall be used for all DDC or co-axial communication wiring. Line voltage alternating current wiring shall not be run in the same conduit, or cabling as DDC wiring.
- .5 Use 1m of flexible conduit for all connections to vibrating equipment. Use liquid tight flex cable and connections where required.
- .6 The Control Contractor shall locate magnetic starters from the electrical drawings. All electrical work provided by this Contractor shall comply with all requirements of the Division 26 electrical specification, the Canadian Electrical Code and Local Codes and Ordinances.
- .7 Wire all line voltage thermostats, pressure switches or aquastats for single phase equipment.
- .8 Division 26 has been requested to provide specific devices, including magnetic starters supplied with 120 volt holding coils, HOA switching and space for the addition of auxiliary contacts. The Control Contractor shall provide all necessary normally open and normally closed contacts, wired to a terminal strip within the starter enclosure, required to achieve the specified control interlocking and sequencing. Manual starters for 120 volt equipment are to contain On-Off selector, external H.O.A., integral overload protection and pilot lights. The Controls Contractor shall provide control wiring interlocks from the control contacts provided on the automatic branch lines of the assembly, which will be contained within the associated Motor Control or Starter Assembly.
- .9 Refer to Division 26 Specifications and Motor Schedule for the scope of work to be provided by the Electrical Contractor. Division 25 shall supply and install all components, in addition to those outlined within the Division 26 documents, as may be deemed necessary to provide all interlocks or sequences as called for elsewhere within the specifications. Include for the supply and installation of Cat 6 Ethernet, plenum rated cables from the hub location to the communications backboard. Coordinate with Division 26 and the Departmental Representative for interconnection of the hub or switch to the site network, provided by the Control Contractor.
- .10 All power supplies for controls are this Contractor's responsibility unless otherwise specified in the Electrical Specifications. All control transformers to be located in fan rooms or mechanical rooms only and are to be mounted in serviceable locations.

- .11 Line voltage will not be run with signal or trunk wiring or be present in the same junction box.
- .12 All shielded wiring will be grounded at the BMS panels and prevented from grounding at the terminal end.
- .13 Run all wiring parallel to building lines. All wiring to be installed in a neat, workmanlike manner.
- .14 Support wiring independent of piping, ductwork, and equipment. Keep wiring clear of hot piping, ductwork/equipment.
- .15 Identify all junction boxes with control company label.
- .16 There are to be no splices in any of the control wiring except at devices or control panels.

1.13 IDENTIFICATION, CALIBRATION AND PROGRAMMING

- .1 Provide a written sequence of operation for each piece of equipment or system being controlled that does not require knowledge of DDC programming. Provide a print out of the complete data base, including program listings, inputs, outputs, controllers, virtual points, trend logs, alarm points, etc. Provide in an organized manner, separated for each panel.
 - .1 Procedures for daily operation of the system.
 - .2 Theory of operation of the equipment.
 - .3 Theory of operation of the control program.
- .2 Mount an input/output layout sheet within each controller. This sheet shall include the name of the points connected to each controller channel.
- .3 Identify all controllers and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:
 - .1 Point descriptor.
 - .2 Point type and channel number.
 - .3 Corresponding controller number.
- .4 Program each controller immediately following installation. Setup and tune all control loops during the initial start-up of the systems. Submit a well documented print out of the controller program for review.
- .5 At the time of the Departmental Representative's Demonstration and Instruction Period:
 - .1 Demonstrate and confirm that all systems are programmed and operating correctly. Submit trend logs, 1 week in duration, that confirm systems are operating as designed and follow the internal building loads in an energy efficient manner.
 - .2 Submit CD's containing up to date copies of the programs in each controller.
 - .3 Submit (4) CD's with printed PDF copies of the final programs that include all point definitions, weekly and annual schedule settings, controller setpoints and tuning parameters, and documented general control language programs. (As Built control shop drawings)

- .4 Provide the original software CD's and the users manuals for all software programs provided as part of this contract. Provide one set of original disks for each notebook, laptop, and laptop computer the software has been installed on. The controls contractor shall be responsible for registering all software with the manufacturer in the Departmental Representative's name. Provide copies of the registration of all software to the Departmental Representative as part of the final inspection.
- .6 Check sensor calibration and control system operation twice during the first year of operation including the first heating season and prior to the first cooling season. Include all parts and labour in service. Following each visit submit:
 - .1 A report indicating all work performed.
 - .2 Printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each controller.
 - .3 Update printed and diskette copies of any changes made to programs for any controller.
- .7 Provide one day of on-site instruction to the Departmental Representative during the first year of operation, scheduled as requested by the Departmental Representative, during one or more of the 2 visits.

1.14 CONTROLLER SOFTWARE

- .1 Each standalone control panel shall contain a complete software development system in each panel. The software development system shall consist of a menu driven, prompted programming language containing complete libraries of control algorithms for DDC, Energy Management, and Facilities Management functions. These resident libraries of algorithms shall be drawn from for the creation of the application specific programming of each individual standalone control panel.
- .2 Four user access levels shall be provided with a user access code available at each level. Each level shall permit identifiable multiple user access.
- .3 Point names shall be defined using a minimum of 128 alphanumeric characters to provide an English language description of the point function.
- .4 The standalone control panel shall be capable of generating sorted alarm, trend log, energy management, maintenance time remainder, and exception log reports on a prioritized basis. Segregated report generation shall be invoked by manual request, time of day, calendar, accumulated run time, or event occurrence.
- .5 DDC Control:
 - .1 The network of standalone control panels shall individually perform setpoint reset, ramping functions, 2-position ON/OFF control, PID loop control, linear sequencing, rotating sequencing, binary sequencing, /LO/AVE selection, energy dead band, and thermostat controls as required to control their connected systems of equipment.

- .6 Energy Management Control:
 - .1 The network of standalone control panels shall individually perform time of day scheduling, optimum start/stop, enthalpy optimization, trend logging, demand limiting and all control optimization strategies, such as supply air reset, and soft ramp-up, for their connected systems of equipment.
 - .2 Coordination of strategies involving multiple systems of equipment shall be performed by sharing of necessary data between the stand-alone control panels on the communicating network.
- .7 Facilities Management Control:
 - .1 The Departmental Representative shall be provided the ability to read out temperatures and other values and to adjust specific items from localized, as well as remote centralized location. Every controller shall provide the following reports:
 - .2 Facility Diagnostics
 - .1 The facilities management system shall provide diagnostic reports for selected systems of equipment as specified.
 - .3 Alarm Occurrence Status
 - .1 When specified alarm conditions occur, provide a report available to printout, listing the status of specific items associated with the equipment generating the alarm. Report shall be routed through auto dial out feature to a specific printer or combination of printers. Report shall record the time the status information was taken, and shall allow operational personnel to use this information to diagnose the alarm situation.
- .8 SAC and Micro Controller Trend Logs:
 - .1 Controllers shall be capable of storing up to twenty-five (25) full trend logs with a minimum of 200 data samples each. They shall be able to collect and store samples of the value of any system variable (i.e. temperature). The operator shall be able to create a trend log, with each trend log containing up to 4 points. The sample frequency shall be selectable for each trend log between 1 second and 24 hours. The ability to graphically display to 4 points on the screen simultaneously, print a log, or store a log on disk in an ASCII format that can be imported into a standard spreadsheet program shall be provided. This capability shall be provided for all forms of access.

- .9 Network communication/controllers Trend Logs:
 - .1 Trend logs shall be provided to collect and store samples of the value of a point i.e., temperature. The network communication/controllers shall have sufficient memory to create and store 200 full trendlogs. Each BacNet trendlog shall be capable of monitoring 1 I/O or virtual point from any controller or combination of controllers across the network, and storing a minimum of 2000 data samples for each trended point. The sample frequency shall be selectable for each trend log between 1 second and 24 hours. The network communication/controllers shall be capable of archiving the trended data to the Host computer or dialing out to a remote trend computer and downloading the data automatically. The ability to indefinitely retain the contents of a trend log in the controller or automatically transfer the contents of a trend log to disk storage, printer or remote site and restart the log shall be provided.
- .10 Host Level Trending:
 - .1 Shall be provided to collect and store samples of the value of any system variable (i.e. temperature Trend Logs: Shall be provided to collect and store samples of the value of any system variable. The operator shall be able to create a BACnet trend log, with each trend log containing 1 point. The sample frequency shall be selectable for each trend log between 1 second and 99 hours. The ability to link multiple single point BACnet trend logs to be displayed on an 8 point Multi-trend log for comparative analysis shall be provided. Ability to print a log, or store a log on disk in an ASCII format that can be imported into a standard spreadsheet program shall be provided. This capability shall be provided for all forms of access.
- .11 The Ethernet interface with the remote operator's terminal shall provide all features listed above.

1.15 COMPUTER GRAPHICS SOFTWARE

- .1 Incorporate the following standards for the required host capabilities and installed features:
 - .1 The host computer operator interface, network interface and graphical interface software shall be Microsoft Windows based.
 - .2 Provide one licensed copy of the complete HOST software package complete with operating manuals, installation manuals, setup manuals, programming manuals, and original diskettes.
 - .3 Host operator interface.
- .2 The following functionality shall be available to the operator from either the onsite host, remote host, or Color laptop connected to anywhere on the network inside the building. These workstations shall operate as graphic interface devices. Attention must be paid to developing an interface to the system using a minimum of user keystrokes. The primary user interface must be the mouse.
- .3 Provide functionality such that any of the following may be performed simultaneously, at either workstation and in any combination, via user-sized windows.
 - .1 Dynamic color graphics and graphic control

- .2 Alarm management and control
- .3 Time of day scheduling
- .4 Trend data definition and presentation
- .5 Graphic definition
- .6 Graphic construction
- .7 Database functions
- .4 Graphic generation and design:
 - .1 Provide a default graphic consisting of a visual overview of the entire control system. The display shall be in a tree format. Indicate the various branches of graphic access available from the tree for each mechanical system and building zone. The site plan of the facility should be used as a reference tree to show the relationship of each system to a particular building zone. Graphic links for each zone must be available to allow the user to link directly to the desired graphic or step systematically forward or backward through the tree to each graphic associated with the mechanical system. The operator must be able to return directly to the default from any level of graphic menu penetration.
 - .2 As a minimum, provide the following graphic screens and dynamic linking:
 - .1 A default graphic to be used as a central starting point for penetrating the menu of available graphic screens.
 - .2 Zone summary graphic. Dynamically indicate zone high select (Hsel) and low select (Lsel) temperatures, AHU supply air temperatures and setpoints, and status of the air handling units serving the zone.
 - .3 Dynamic graphic floor plans for each building zone, scaled appropriately to be readable from a laptop. Indicate room temperatures, architectural room number, control valve position, supply fan system serving the area, and any associated equipment such as exhaust fans, fume hoods, etc. From this screen the operator shall be able to command the control valve, adjust the room setpoint, access the graphic screen for the supply fan system, view a trend log of the room temperature, or access a graphic for associated mechanical equipment.
 - .4 A schematic of each mechanical system. As a minimum, each graphic will indicate all DDC I/O points and software variables associated with each system. Indicate the DDC point names, current status value, and operator priority.

All graphic screens shall be created using the same software supplied to the Departmental Representative. Provide the graphic data files in a format suitable for inclusion into the graphical operator interface and for direct loading into the graphic editor. The graphic data files shall be the sole property of the Departmental Representative.

DEFAULT GRAPHIC COLORS			
Normal On	GREEN	Text Arial 12 pt	BLACK
Heating Equipment	RED	Normal Off	BLACK
Background	WHITE	Cooling Equipment	BLUE
Ducts	BLACK	ALARM	RED

DEFAULT GRAPHIC COLORS			
Sensors	BLUE		

.5 Graphical links:

- .1 All system graphical links will be located in the upper left corner of the screen. These links will be displayed in sequential order representative of the menu tree.

1.16 RELATED WORK

- .1 The following incidental work shall be furnished by the mechanical sub-contractor under the supervision of the controls subcontractor:
 - .1 Installation of control dampers including duct transitions, assembly and interconnection of multiple section dampers.
 - .2 Supply and installation of sheet metal baffles as required to eliminate air stratification.
 - .3 Supply and installation of access panels for service and installation of control equipment.
 - .4 Installation of automatic valves, wells, flow switches, and other pipe related control devices.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 GENERAL

- .1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats and temperature sensors 1.5m above floor.
- .2 Install damper motors on outside of ducts. Do not locate in outside air stream.
- .3 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.
- .4 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.
- .5 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.
- .6 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.

- .7 Permanently identify each wire, cable, conduit and tube at each terminal.
- .8 Wiring and tubing shall be identified at each DDC panel by termination number. Wiring and tubing shall be identified at terminal device by termination and DDC panel numbers.
- .9 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.
- .10 Freeze protection devices shall be hard wired and also wired to alarm through DDC system.
- .11 All wall mounted devices in new finished space shall be mounted on a wall box. The wall box shall be connected to the ceiling space by a conduit stub. On renovations, when sensors are mounted in existing finished walls, wiring or tubing may be fished into the walls without conduit.

3.2 ENCLOSURE AND CONDUIT

- .1 Relays, transformers, and I/O devices and peripherals shall be installed in separate enclosures and not in the enclosures containing the controllers.
- .2 All wires penetrating the enclosure that are not required to be in conduit must be neatly bundled and strapped in place.
- .3 All Building Controllers will be installed in CSA rated enclosures that are complete with hinged and key-locked doors. The door will be painted and labeled suitably bearing the manufacturer's system name/logos, the controller address, and the installing contractor's contact information. This enclosure will be mounted at a height that provides easy access without the need of a ladder.
- .4 A hard points list shall be affixed on the inside of the door/cover of the enclosure.
- .5 The inside bottom of the enclosure shall be clean of dirt, metal shavings, and debris.
- .6 Provide EMT conduit with set screw metal fittings where wiring is exposed and in all mechanical rooms. All conduit will be piped smoothly and neatly following building lines. Wiring above accessible ceilings and in wall cavities may be run free-air.
- .7 Liquid-tight flexible conduit to be used for rooftop unit wiring c/w liquid-tight fittings. Provide spun aluminum roof jack where control wiring penetrates roof unless penetration is within waterproof rooftop unit curb.
- .8 All junction boxes will have covers properly and firmly affixed after installation completion.

3.3 I/O WIRING

- .1 All input/output device wiring will use #18-2 solid core cable with individually jacked conductors and jacketed sheath over the pair.
- .2 Use plenum cable where required.
- .3 All I/O wiring passing near or within the enclosure of a VFD will be shielded, with the shield terminated at the device end.
- .4 All I/O wiring will be identified using Panduit adhesive wire-marker at the controller and end device ends. Description of point to include point mnemonic, point type and network location.

- .5 All I/O wiring within controller enclosure shall be neat and tidy and suitably bundled and strapped or contained in plastic wire duct or equivalent.
- .6 All I/O wiring that requires a transition to a different conductor to meet electrical code requirement shall be executed using a terminal strip.
- .7 Low voltage I/O wiring may be mixed together within a conduit. Low and line voltages may not be mixed together within a conduit.

3.4 POWER WIRING

- .1 Provide power wiring and transformers and grounding to each controller and transducer as per the manufacturer's specification.
- .2 Each Building Controller will have its own dedicated power supply. No other controller or I/O device will be powered from this supply.
- .3 Power wiring shall not be mixed with I/O wiring in a conduit.

3.5 LAN WIRING

- .1 Provide LAN wiring as per manufacturer's specification.
- .2 For EIA-485 LAN wiring, use low capacitance shielded #18-2 or #22-2 cable. Ensure that each contiguous section of shield is terminated at a single point.

3.6 CONTROL SYSTEM COMMISSIONING

- .1 Upon completion of the installation of the controls system and the calibration of all sensors, this Subcontractor shall carry out all required testing, debugging, and revision of operations to suit the intent of the Sequence of Operation and to the review of the Departmental Representative.
- .2 The contractor is to supply digital point and non-digital checkout data sheets for all controlled components installed in this contract, including components supplied by others. The data sheets shall indicate each components physical installation is complete, End to End, identification, tagged, the result of the functional test, calibration deviation recorded, setpoints and set-up of each device, digital and non-digital.
- .3 Each digital input or control device shall be checked by physical operation of the monitored device in the field with the result noted. Each digital output or controlled device shall be commanded or tested On/Off, Open/Close as required and the corresponding field device checked for correct operation with the result and comments noted.
- .4 Each analog input or control device shall have its field values measured with a calibrated test instrument, with the deviation recorded and adjusted, if necessary, at the AI set up. The field measurement and analog point deviation must be reported. A hard copy of the set up for each digital and non-digital controller with adjustments is required. Field set up and setpoints of other devices shall be reported.
- .5 Each analog output, control or controlled device shall be field tested. The physical test data sheet is to indicate each controlled device function through its range 0, 25, 50, 75, 100% and 1 to 100% as required with no leakage or bypass of the controlled medium.

- .6 Submit copies of all test data sheets intended to be used to the Departmental Representative and Commissioning Authority prior to the contractor's verification at least three months before the scheduled substantial completion of the project.
- .7 The controls contractor shall provide sequence of operation check sheets, to the Departmental Representative, Commissioning Agent and Commissioning Authority, in standard letter size for each DDC and non DDC system sequence. Each sequence to be verified with each item/page signed off with comments noted.
- .8 The commissioning contractor is not to commence controls checks until the above documentation is received. The Temperature Control Supplier and Installer shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Control Supplier in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Temperature Control Supplier for the purchase price of the material.
- .9 All documentation, tagging, identification, as-builts, software, instruction manuals, special control connection to access all devices and panels must be in place before the granting of substantial performance.
- .10 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material. The Temperature Control Supplier shall cooperate fully with the Commissioning Agent to work together to obtain a fully operating system, providing additional technicians and trades people to assist the designated commissioning person as required. Refer to Section 01 91 31 – Commissioning (CX) Plan.
- .11 The controls contractor is to provide the technicians for field checks, calibration, checkouts, and commissioning necessary for a complete and fully operational system. Provide two 2-way portable radios for the commissioning period.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 25 05 01 EMCS: General Instructions

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 C22.2 No.205, Signal Equipment.
- .2 Institute of Electrical and Electronics Engineers
 - .1 IEEE C37.90.1, Surge Withstand Capabilities Test for Protective Relays and Relays Systems.

1.3 MAINTENANCE PROCEDURES

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 01 01 50 – General Instructions and 25 05 01 – EMCS: General Instructions.

1.4 SUBMITTALS

- .1 In accordance with Section 01 33 00 Submittal Procedures and 25 05 01 – EMCS: General Instructions. Submit product data sheets for each product item proposed for this project.

Part 2 Products

2.1 SYSTEM DESCRIPTIONS

- .1 Provide the required building controllers required for the replacement of the boiler and associated equipment. The following requirements are provided for reference and are deemed the minimum acceptable requirements for the replacement controllers.
- .2 Provide a fully networked system of controllers which use LAN communications to support the distributed control features as specified herein. Each controller shall be connected directly to the LAN. Each controller shall have equal LAN access priority and shall NOT REQUIRE A SEPARATE GATEWAY or interface controller to accomplish normal, network communications.
- .3 Provide a means to ensure communication integrity. At a minimum indicate for each controller in system: on-line/off-line status, residence of program or no program, the scan rate (frequency at which the controller updates all I/O and runs all programs), the number of network points imported and exported.
- .4 The system will display an error message, in the event of a communication error.
- .5 To prevent damage to the system, each connection to the LAN shall be provided with a means of isolation, either optically or fast-blow fuse or by some other means.

- .6 Upon failure of the LAN to communicate information, each controller will retain the last legitimate value of its imported network points and continue to control the systems based on those values. Failure of any controller, or any part of a controller on the LAN, shall not affect the ability of the LAN to communicate among the remaining controllers.
- .7 Each hard point and soft point shall have a user-definable, unique, system-wide logical point mnemonic. The format of the point mnemonic shall conform to the naming convention of the incumbent system.

2.2 MEMORY

- .1 Each controller shall have enough random access memory for all of the following:
 - .1 Variables - ONE (1) for each hard point connected to the controller.
 - .2 PID Controllers - TWO (2) for each analogue output point connected to the controller.
 - .3 Weekly Schedules - ONE (1) for every major system connected to the controller.
 - .4 Annual Schedule - ONE (1) for the entire LAN.
 - .5 Trend Logs - ONE (1) for each pair of hard points connected to the controller with 100 samples each.
 - .6 Runtime Logs - ONE (1) for each digital hard and softpoint.
 - .7 Programs - ONE (1) for each output point connected to the controller. Each program must contain enough memory for TWENTY (20) syntactically correct lines of OCL with at least four operators.

2.3 PROCESSING SPEED

- .1 Scan Rate - The maximum permissible scan rate is ONE (1) second. The scan rate is defined as the time it takes to controller CPU to sample all inputs, calculate all variables, update all timers and PID controllers, check all schedules, update all trend logs and runtime logs execute all OCL programs and assign values to all outputs.
- .2 Provide a peer to peer high speed local area network (LAN) capable of supporting as many controllers as required to meet the minimum point capacity of the system as specified elsewhere. The network shall permit synchronization of all real time clocks, and the automatic transferring of the value of points from one controller. All BACnet MSTP system LANs shall operate at a communication speed in excess of 76K baud. Provide Bacnet Ethernet communication backbone operating at 10 mega baud. Provide a minimum of 1 [one] BACnet Building Controller [B- BC] for each main mechanical room Network communication/controllers shall be provided in sufficient numbers and memory configurations to meet the specified operational trending and system network access and performance requirements without utilizing the Host Computer.

2.4 BUILDING CONTROLLERS

- .1 Building Controllers shall reside on the main LAN or highest level of communication.
- .2 The controller shall communicate on the main LAN using either Ethernet (IEEE.802.3) with TCP/IP and/or EIA-485.
- .3 In addition to main LAN communications, the controller shall support EIA-485 subLANs, PC, modem and intelligent thermostat communications.

- .4 The controller shall have at least one port (other than the PC port) which can be configured to BACnet conformance class 3 using EIA-232 point-to-point communications for interface to other BACnet products.
- .5 The controller must be modular in design with removable I/O device terminations on separate I/O cards for ease of expansion and replacement.
- .6 Controllers will accommodate a maximum of 160 universal I/O points on board using a single address.
- .7 All I/O points must be universal (i.e. user definable as digital or analogue).
- .8 Dedicated analogue/digital points will not be accepted.
- .9 All outputs must have optional HOA on board for easy override by non DDC users.

2.5 LOCAL TERMINAL CAPABILITY

- .1 The Local Operator's P.C. shall have full access to the entire system including programming and shall interface at any primary or micro controller point in the system. Provide remote floor location connections so that all points are within 50m maximum of a terminal access point. The system shall be capable of supporting multiple local operator terminals. The operator's terminal shall be capable of performing the following functions:
 - .1 continuous display of labelled, system variables
 - .2 network wide, password controlled access
 - .3 setpoint and parameter adjustment
 - .4 setting and clearing of timed and permanent overrides
 - .5 acknowledging system alarms
 - .6 standalone controller program uploads, and downloads.
 - .7 viewing alarm and exception logs
 - .8 graphical and textual display of all physical points
 - .9 graphical and textual display of trended data
 - .10 dynamic system schematics
 - .11 full system programming revisions/changes including database modifications

2.6 REMOTE OPERATOR TERMINAL COMMUNICATION

- .1 Provide a TCP/IP 100 MB Ethernet interface between the EMCS and the Site's Ethernet Network. Supply and install all necessary hardware and software necessary to provide operator interface from any remote building on the site. Final connection to Ethernet network will be by the Departmental Representative.

2.7 VAV CONTROLLER

- .1 VAV Controller (BACnet overview): A VAV Controller is VAV terminal unit controller with integral damper actuator and on-board differential pressure based flow measurement.
 - .1 Data Sharing - Ability to provide the values of any of its BACnet objects and Ability to allow modification of some or all of its BACnet objects by another device.

- .2 Device and Network Management - Ability to respond to information about its status.
- .2 VAV Controllers shall be used for dual duct mixing boxes and single duct air terminal units.
- .3 VAV Controllers shall communicate on the main LAN or subLAN using EIA-485 (MSTP). In addition to main or subLAN communications, the controller shall support PC and/or modem communications and intelligent thermostat communications.
- .4 Programming the controller shall be accomplished over the LAN or directly via PC and will not require the mandatory use of any other special interface hardware or a Building Controller. Firmware based programming will be accepted.
- .5 Provide 120v-24vac transformers for controls.

Part 3 Execution

3.1 GENERAL

- .1 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.
- .2 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.
- .3 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.
- .4 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 25 05 01 EMCS: General Instructions

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C12.7, Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13, Requirements for Instrument Transformers.
- .2 National Electrical Manufacturer's Association (NEMA)

1.3 SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures and 25 05 01 – EMCS: General Instructions.
- .2 Include:
 - .1 Information as specified for each device.
 - .2 Manufacturer's detailed installation instructions.
- .3 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.
- .4 Manufacturer's Instructions
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit operating and maintenance data for inclusion in operation and maintenance manual in accordance with Section 01 78 10 Closeout Submittals and 25 05 01 – EMCS: General Instructions.

Part 2 Products

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer and to match the existing building system.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.

- .3 Operating conditions: 0 - 32 °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 to be unaffected by external transmitters (e.g. 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 3R enclosures.
- .8 Devices to be installed in user occupied space must not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 IMMERSION SENSORS

- .1 Shall be complete with a brass immersion well.
- .2 Shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.
- .3 Accuracy: plus or minus 0.05°C at 21°C.
- .4 Minimum sensing range: -40°C to 40°C.

2.3 DIFFERENTIAL PRESSURE SENSORS (DPS)

- .1 Shall vary the output voltage with changes in differential pressure.
- .2 End to end accuracy: not less than +1% of span including non-linearity, repeatability and hysteresis.
- .3 Application: building pressurization control shall have auto-zeroing feature.

2.4 CURRENT SENSORS (CT)

- .1 Shall vary the output voltage with a change in current.
- .2 Provide actual analog current indication for status of all motors 1 horsepower and larger.
- .3 In software provide multiple switch points to determine both motor status and belt breakage. Size for inrush and F.L.A.
- .4 Provide alarm indication for high and low current.
- .5 Provide digital current indication for all motors 3/4 HP and smaller by using current switches (CS) which shall open or close a contact from motor induced current to indicate motor status.

2.5 CARBON DIOXIDE SENSOR (CDS)

- .1 Shall be non-dispersive, infrared type, duct mount or wall mount as required.
- .2 Accuracy: 3% or 50ppm, whichever is greater over typical conditions of 0-50C and 0-95% RH non-condensing.
- .3 Shall automatically calibrate to compensate for drift.

- .4 Shall have a five year calibration guarantee.
- .5 Shall not require any additional software/hardware for configuration or diagnosis.

2.6 CONTROL VALVES AND ACTUATORS

- .1 Provide automatic temperature control valves as scheduled and indicated on drawings. Sufficient clearance above control valves shall be provided to allow removal of superstructure without removing body from line. All valve stems shall be vertical. All electric valves, including zone valves, scheduled for modulating service shall be fully proportional (no floating control) suitable for 0-10 volt, or 4-20 mA input signal.
- .2 Control valves, both 2 and 3 way configuration, shall have the following minimum characteristics:
 - .1 Body shall be brass meeting ANSI Standard B16.15 Class 250 for all valves 50 mm and smaller. Larger valves shall be cast iron, Class 125, meeting ANSI Standard B16.15.
 - .2 Valve stem shall be 316 stainless steel.
 - .3 Valves shall have brass plug, composition seat with maximum seat leakage of 0.01% of flow rating per ANSI B16.104, and equal percentage flow characteristic.
 - .4 Valves for terminal zone coils, fan coils and radiation shall have EPT or TFE packing material and NPT, union or flare connections.
 - .5 Valves for primary equipment sized 50 mm and smaller shall have screwed connections. Valves sized 65 mm and larger shall have flanged connections.
 - .6 Ball Valves are not acceptable for control applications.
- .3 When more than one control valve is used for temperature or pressure control on a system, or equipment item they shall be sequenced. e.g. two valves on a heating coil or pressure reducing station; heating and cooling coil valves on an air handling system.
- .4 Valves on hazardous services shall fail to a safe position. e.g. Valves controlling heating to domestic hot water shall fail closed to heating when not powered.
- .5 Actuators shall be of the rotary or piston type for either modulating or two position control. Actuators shall be powered by an overload-proof synchronous motor. Control voltage shall be either 120 VAC, 24 VAC, 10 VDC, or 4-20 mA with spring return on power failure, where required. (ie outdoor air dampers and HVAC primary heating valves). Actuators (motors) shall have repair kits available and be re-buildable in the field. Provide proportional actuator position feedback on all primary equipment (air handling units) to prove actuator position.
- .6 All control valves shall have replaceable bonnets, and packing. The packing shall be replaceable in the field without having to remove the valve from the piping network.
- .7 All control valves shall be sized to deliver the specified flow rate in the 100% open position. Control valves using a "limited stroke" to achieve the proper flow coefficient shall not be used.

2.7 DAMPERS AND ACTUATORS

- .1 All control dampers not furnished with packaged equipment shall include an end switch, be supplied by the controls subcontractor and installed by the sheet metal subcontractor. Provide damper actuators for all dampers shown or specified.
- .2 All dampers in a mixing application shall be parallel blade with direction of closing producing opposed air streams for optimal mixing. Return air dampers shall be a tight closing, low leakage type with replaceable blade and edge seals.
- .3 Actuators shall be electronic, direct coupled. Control voltage shall be 0-10 VDC, or 4-20 mA with an internal spring return on power failure. Provide a 2-10 VDC proportional actuator position feedback signal on all primary equipment (air handling units, relief air and emergency generators) to prove actuator position. Actuators shall permit manual positioning of damper when actuator is not powered.

Part 3 Execution

3.1 GENERAL

- .1 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.
- .2 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.
- .3 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.
- .4 Freeze protection devices shall be hard wired and also wired to alarm through DDC system.
- .5 All wall mounted devices in new finished space shall be mounted on a wall box. The wall box shall be connected to the ceiling space by a conduit stub. On renovations, when sensors are mounted in existing finished walls, wiring or tubing may be fished into the walls without conduit.

3.2 SENSORS

- .1 Sensors provided shall be installed in accordance with the Manufacturer's prescribed procedures.
- .2 Sensors shall be rigidly mounted, and mountings shall be adequate for the environment within which the sensor operates.
- .3 Averaging type temperature sensors shall be used wherever mixed air or stratified temperature is to be monitored. They shall be installed in a serpentine configuration with adequate provision for the mechanical protection of the sensor and such that it is supported as required along its entire length.
- .4 Duct type Thermistors shall be used for the monitoring of all uniform air temperature. Length shall be such that the sensing element is installed to not less than one third of the duct width or duct diameter from the duct wall.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 25 05 01 EMCS: General Instructions

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 SEQUENCE OF OPERATION

- .1 Boiler and Circulating Pump Control
 - .1 Provide an outdoor temperature sensor to be mounted on the north side of the building away from the exhaust air outlets from the building. When the outdoor air temperature is above 17°C, the boiler plant shall be disabled.
 - .2 When the outdoor air temperature is below 17°C, sequence the boilers (B-1 and B-2) and the associated primary pumps (P-B1 and P-B2) to maintain water supply temperature set point. Enable the space heating distribution pumps (P-1, P-3, P-5 and P-6) when there is demand for space heating.
 - .3 The supply water temperature to the space heating loop shall reset based on the following schedule (adjustable):

<u>Outdoor Air Temp.</u>	<u>Supply Water Temp.</u>
17°C (62.6°F)	60 C (140 F)
-20 C (-4 F)	82 C (180 F)
 - .4 Controls shall be wired through a Hand-Off-Auto DDC interface panel to permit manual override operation of each boiler. In the Hand position the boilers shall bypass any DDC control. In "Auto" setting, DDC control shall enable each boiler in sequence.
 - .5 Provide a minimum 10 minute (adjustable) delay between staging the boilers. Provide a time delay on pump shutdown to remove residual heat from boiler before stopping.
 - .6 Boilers shall operate on lead / lag basis. Alternate lead boiler and associated primary pump on a weekly basis. Provide override at the DDC.
 - .7 Provide current transformers to monitor status of pumps.

- .8 Monitor and alarm low water level, flame failure, low water temperature and high water temperature for each boiler. Water temperature sensors shall be installed at each boiler's outlet and at the four (4) connections to the hydraulic separator low loss header. Provide a separate hot water supply temperature sensor on the secondary side outlet of the hydraulic separator low loss header for the master boiler control. Refer to piping schematic and Points List for additional information.
- .9 The gas usage of the boilers shall be monitored by the DDC. The make-up water meter shall be monitored by the DDC.
- .10 The boilers shall be shut down when the emergency shut down switch is engaged.

3.2 POINT LIST

- .1 The following point lists are typical of the Analog and Digital output and input points required to achieve the intended sequence of operation and provide the required level of monitoring and control. They are intended to set a minimum level of acceptability. All additional points required to achieve the specified features and sequence of operation shall be provided by the control contractor.

BOILER AND DOMESTIC WATER HEATER PLANT CONTROLS							
POINT DESCRIPTION	POINTS				ALARM/INDICATION		
	AI	AO	DI	DO	HI	LO	FAIL
BOILERS							
OUTDOOR AIR TEMPERATURE	OTS						
PRIMARY HOT WATER PUMPS (P-B1, P-B2) START/STOP/STAT	CT			CR			X
BOILER HWS TEMP. (TYP. 2)	WTS				X	X	
BOILER LWCO (TYP. 2)			DCI			X	
BOILER FLAME FAILURE (TYP. 2)			DCI / R-ST				X
BOILER ENABLE/DISABLE (TYP. 2)				CR			
BOILER SUPPLY WATER TEMPERATURE SETPOINT (TYP. 2)		X					
SPACE HEATING LOOP							
BUILDING DISTRIBUTION PUMPS (P-1, P-3, P-5, P-6) START/STOP/STAT	CT			CR			X
SUPPLY WATER TEMPERATURE	WTS				X	X	
SUPPLY TEMPERATURE SETPOINT		X					
RETURN WATER TEMPERATURE	WTS				X	X	

BOILER AND DOMESTIC WATER HEATER PLANT CONTROLS							
POINT DESCRIPTION	POINTS				ALARM/INDICATION		
	AI	AO	DI	DO	HI	LO	FAIL
METERING							
GAS METER (TYP. 2)	X				X		
BOILER MAKE-UP WATER METER	X				X		
BUILDING DOMESTIC WATER METER	X				X		
EMERGENCY SHUT-DOWN SWITCH			CR				

.2 NOTE: POINT COUNT IS APPROXIMATE. CONTROLS CONTRACTOR SHALL VERIFY EXACT QUANTITY AND PROVIDE ADDITIONAL POINTS AS REQUIRED TO ACHIEVE THE SEQUENCE OF OPERATION DESCRIBED IN THE CONTRACT DOCUMENT.

ATS	Averaging Temperature Sensor	DPS	Diff. Press. Switch (Analog)	OTS	Outdoor Air Temp. Sensor
ASD	Adjustable Speed Drive	DTS	Duct Temperature Sensor	POT	Potentiometer
CDS	Carbon Dioxide Sensor	R-ST	Relay Status	DHS	Duct
CS	Current Switch	ES	End Switch	RHS	Room Humidity Sensor
CR	Digital Relay	FSA	Flow sensor - Air	RTS	Room Temperature Sensor
CT	Analog Current Transformer	LTS	Low Temperature Switch	FSW	Flow sensor-Water
DCI	Dry Contact Input	MOP	Proportional A.O. (4-20 ma)	VMD	Valve Motor
(Digital) DHS	Duct Humidity Sensor	MD	Motion Detector	VPM	Variable pump
DMA	Damper Motor (Analog)	O-SW	Override Switch	WTS	Water Temperature Sensor
DMD	Damper Motor Digital				

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .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 Division 1. Where there is conflict between these documents listed, the more stringent shall apply.
- .2 Provide materials, equipment and plant, or 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.
- .3 The most stringent requirements of this and other electrical sections shall govern.
- .4 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.
- .5 Provide seismic restraints for all required equipment, piping and ductwork.
- .6 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.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1 (current edition), Safety Standard for Electrical Installations.
 - .2 Comply with all electrical CSA standards and electrical bulletins.
 - .3 CAN3-C235 (current edition), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1 (current edition), Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122- (current edition), The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 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.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

- .3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.4 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.
- .2 The “Contractor” is defined as the supplier of the Scope of Work as defined in the Electrical Specifications sections in Division 26 (Division 16).
- .3 “Provide” is defined as “supply, install, test and commission.”
- .4 “Install” is defined as all work and materials necessary to place the specified item into full operation, securely fastened, and to give a presentable finished appearance. “Install” also includes all necessary connections and conductors.
- .5 “Coordinate” is defined as: to make all arrangements directly with agencies and individuals, confirm schedules, be in attendance at the time work is being carried out, and take full responsibility for having the work carried out correctly and in a timely manner to meet the construction schedule.

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures
- .2 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of British Columbia, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Submit number of copies indicated in Submittals Section 01 33 00 of drawings and product data to the authority having jurisdiction.
 - .6 If changes are required, notify Departmental Representative of these changes before they are made.
 - .7 Submit a detail schedule of all shop drawings prior to the first progress draw. Schedule shall include specification section, equipment name, manufacturer’s name, distance from site to final manufacturing location, percent recycled content and delivery date.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and materials are not available, submit such equipment and material to inspection authorities for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.

- .5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .4 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Contractor license in accordance with authorities having jurisdiction.
 - .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.
- .3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule of all materials within 2 weeks after award of Contract. Progress claims will not be reviewed until updated schedules are provided.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction Waste and Disposal.

1.8 SYSTEM START-UP

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service Departmental Representative to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with 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 PERMITS AND FEES

- .1 Submit to Electrical Review Department, Local Fire Authorities and 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 review of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.11 EQUIPMENT RESTRAINT

- .1 It is the entire responsibility of the 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.

1.12 SEISMIC ANALYSIS AND PROVISIONS

- .1 Install electrical systems with adequate structural support to withstand seismic forces in accordance with Section 4.1.8 of the National Building Code, and Province, Territory or Municipality of the project.
- .2 Retain a structural specialty engineer licensed in the Province or Territory of the project to perform a review of the proposed electrical installation and prepare installation documents indicating all required seismic supports, bracings and fastenings. These documents shall be sealed and signed by the structural specialty engineer and submitted as part of the shop drawing package prior to rough-in work commencing on site.
- .3 Equipment to be indicated in the structural design documents shall include but not be limited to: suspended transformers, bus ducts, cable trays, suspended conduit runs, free standing distribution equipment such as switchboards and motor control centres, and suspended lighting fixtures.
- .4 Verify the Facility is classified as "Normal" with an "Importance Factor of 1.0" as referenced in 4.1.8.5 (1) of the National Building Code and Province, Territory or Municipality of the project.
- .5 Refer to seismic risk reduction of operational and functional components (OFCs) of building S832-06 and meet all requirements.
- .6 Provide confirmation in writing, signed and sealed by the structural Departmental Representative, at completion of project that the electrical installation is in general compliance with the structural installation drawings submitted with the shop drawing package.

- .7 All light fixtures shall be provided with independent chain supports that are fastened to the structure of the Building.
- .8 The Contractor shall be solely responsible for the full scope of this work. Include all costs of structural design, materials and site review in Bid Price.

1.13 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 Architectural and Structural drawings.
- .2 Consult the Architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Departmental Representative 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.

1.14 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 from the design intent involving extra cost to the Departmental Representative without the Departmental Representative'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 headroom 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 Architect and Departmental Representative 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 Departmental Representative of space problems before installing any material or equipment. Demonstrate to the Departmental Representative on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.15 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 do not clearly indicate the future expansion requirements but known services are required, provide written “request for information” to the Departmental Representative before making assumptions as to intent.

1.16 SPRINKLER PROOF REQUIREMENTS

- .1 All equipment and wiring systems shall be sprinkler proof standard where sprinkler fire protection systems are installed.
- .2 In rooms where electrical equipment is installed surface-mounted, electrical equipment contained in these rooms is to be protected by non-combustible drip hoods, shields and gasketed doors as applicable to inhibit water ingress into electrical equipment. Exposed conduits connected to equipment to utilize water-tight 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.

1.17 PHASE CONSTRUCTION

- .1 See Architectural 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.
- .3 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

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 pre-fabricated (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.
- .4 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

1.19 TENDER INQUIRIES

- .1 All Contractor queries during the tender period shall be made in writing. No queries shall be directly sent to the design team. No verbal information will be considered valid or issued by the Departmental Representative’s office during tender. No telephone queries will be answered.

1.20 EXAMINATION

- .1 Visit the site before preparing the tender and examine all existing conditions. No extra cost will be considered for any misunderstanding of the 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 Departmental Representative 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.

1.21 RESPONSIBILITIES

- .1 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practices.
- .2 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Departmental Representative 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 conduits, piping and pull boxes 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 Departmental Representative 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 to drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, and 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 the Contractor of the responsibility of properly completing his trade to the approval of the Departmental Representative.

1.22 STANDARD OF ACCEPTANCE

- .1 Standard of Acceptance means that the item named and specified by the manufacturer and/or catalogue number forms part of the specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a reference 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.

1.23 FACILITY COMMISSIONING

- .1 The Contractors are obliged to comply with the supporting commissioning documentation prepared by the BMS Contractor. The Contractor is to provide all required manpower, testing, equipment, documentation and staff training in order to meet the Building Integration requirements.

1.24 PROGRESS CLAIM AND CHANGE ORDER BREAKDOWNS

- .1 Contractor to submit price breakdowns showing material and labour costs for the project.
- .2 In particular cases, more detail may be necessary to properly assess a change order or progress claims. This additional information could include all suppliers and all Contractors when requested by the Departmental Representative. Provide details for each section of the electrical work listed for each separate electrical change order.
- .3 Mark-up information is required for change orders but is optional on the original tender price.
- .4 Progress claims will not be certified nor payment made beyond 90% of the overall Electrical contract until commissioning and verification of the systems are complete. This procedure is to allow for any necessary deficiency holdbacks on items which do not become apparent until the systems are commissioned.

1.25 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period, as specified in Division 1. Where there is conflict between these documents, the more stringent shall apply.
- .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.

1.26 PROJECT DOCUMENTATION

- .1 Shop Drawings
 - .1 Refer to Section 26 05 00 1.6 Submittals
 - .2 Notwithstanding the above, submit PDF of all shop and setting drawings or diagrams to the Departmental Representative sufficiently in advance of requirements to allow time for review and comment. The print will be retained by the Departmental Representative will be marked and returned to the Contractor for correction if necessary, further reproduction, and distribution as required.
 - .3 Shop drawings shall be neatly drafted and shall be complete and detailed and shall be provided as stipulated elsewhere in these Specifications. This requirement is mandatory for such items as switchboards; custom-fabricated equipment panels, consoles, or racks; and custom-fabricated lighting fixtures and communication systems.
 - .4 All shop drawings shall use metric dimensions. Scaled drawings shall use metric scale.

- .5 Shop drawings shall bear specific names for each and every unit assembly defined thereon, the name of the project where installation is to take place, the name of the manufacturer, and the date of the drawing including notation of latest revision, if any.
 - .6 Except as may be necessary to indicate operation of switchgear and similar apparatus and to show field interconnections, detailed wiring diagrams of component assemblies need not be included with shop drawings unless requested by the Departmental Representative. However, such wiring diagrams shall be included as part of the Maintenance Manual as required by these Specifications.
 - .7 Indicate details of construction, dimensions, locations of cable pits and trenches, capacities, weights and electrical performance characteristics of equipment and materials.
 - .8 Shop drawings may be prepared by the Contractor, or manufacturer's drawings will be accepted. All drawings required for one and the same system shall be submitted as a complete package. Incomplete system packages will not be reviewed and will be returned unmarked.
 - .9 Shop drawings shall be reviewed by the Contractor prior to submission to the Departmental Representative. Shop drawings not bearing Contractor's approval stamp, approval date, signature, and project name will be returned without comment.
 - .10 Manufacturers' brochures (product data) submitted as shop drawings shall clearly indicate type (i.e., lighting fixture Type AD, intercom station Type B, etc.) and all features as specified as part of the unit(s).
 - .11 Facsimile shop Drawings will not be accepted.
 - .12 Review of shop drawings by the Departmental Representative is for the sole purpose of ascertaining conformance with the general design intent. The review shall not mean approval of the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub-trades.
 - .13 Ensure that copies of all shop drawings are available at the job site.
 - .14 An electronic copy of all shop drawings shall be incorporated as part of electronic Operation and Maintenance Manual.
- .2 Maintenance Manual
- .1 Submit one electronic copy in PDF format on USB Key as part of final submission.
 - .2 Cooperate with the Agency; provide all data, after making all necessary corrections. Provide final shop drawings, wiring diagrams, equipment brochures, etc., required for inclusion with the Manuals. Include all costs in the tender price associated with assisting the Agency and in providing all data, drawings, diagrams, brochures, etc.

- .3 The partial copy referred to above shall include only descriptions of the systems, together with operating and maintenance instructions, and shall be delivered to the Departmental Representative for review and comment no later than one (1) month prior to the date of substantial completion. This copy may be in a loose-leaf ring binder.
- .4 Final Maintenance Manuals shall include:
 - .1 Sturdy black hard cover expandable post binder(s) with stamped white letters on the binding of the cover showing the following:
 - .1 Name of Project
 - .2 Type of Manual (i.e., Maintenance Manual for Electrical Systems)
 - .3 Listing (Company names only) of Departmental Representative, Electrical Consulting Departmental Representative, Electrical Contractor, and name of Agency that prepared the Manual
 - .2 Introduction Page
 - .1 Name of Project
 - .2 Type of Manual (i.e., Maintenance Manual for Electrical Systems)
 - .3 Listing (Company names, addresses, and telephone numbers) of Departmental Representative, Electrical Consulting Departmental Representative, General Contractor, Electrical Contractor, including his Subcontractors (i.e., Communication Systems Contractor, Testing Agency, etc.), and name of Agency that prepared the Manual
 - .3 Instruction Page
 - .1 Step-by-step instructions on how to use the Manual
 - .4 Index Page
 - .1 List all equipment, systems and special references such as conduit colour coding schedule, applicable Test Reports, Certificates, etc. The Index shall be arranged in the same order as the Specifications.
 - .2 List all "As-Built" drawings including drawings issued during the tender period and the construction stage.
 - .5 Equipment/System Pages
 - .1 Provide, between each piece of equipment/system, divider pages complete with plastic tabs with large numbers corresponding to the Index listing
 - .2 After each divider page, include a "local" Index sheet as per the following example. (Provide "local" divider pages complete with smaller plastic tabs corresponding to the "local" Index sheet.)

LIGHTING AND POWER PANELS INDEX NAME OF PROJECT

Bulletin/Drawings

Pages

A Description - A1

B Maintenance Instruction - B1

C Renewal Parts - C1

D Shop Drawings/Brochures

E Identification/Colour Coding

F Supplier/Manufacturer/Distributor

- .6 The above Index sheet shall be used for all equipment/systems.
- .7 Under Description include a brief description and sequence of operation of equipment/systems and manufacturers' published technical literature. For major pieces of equipment such as generator, switchgear, communication systems, etc., include complete parts/component lists. Include revised and updated typewritten copy of all Schedules (motor, panelboard, feeder, lighting fixtures, receptacles, switchboard, equipment, etc.) in the applicable section of the Maintenance Manual.
- .8 Under Maintenance Instruction describe manufacturer's recommended maintenance program. (Describe on Index sheet if space permits.)
- .9 List Renewal Parts if applicable. (List on Index sheet if space permits.)
- .10 Under Shop Drawings/Brochures include a copy of reviewed and corrected shop drawings (reduced scale) and brochures. Also include final and detailed wiring diagrams (reduced scale) when applicable. If space permits, show listing of drawing numbers and brochures in the Index sheet; otherwise, include the list in the front part of the drawings and brochures. Shop drawings shall be so arranged that they can be removed directly from the Manual without undoing the pin-bars.
- .11 Under Identification/Colour Coding outline method used for identifying equipment [i.e., LP "E2A" stands for "Lighting Panel" (LP), connected to emergency load (E), operating on 208/120 V (2), last space (A) denotes sequential order of panel]. Colour coding used for identification of outlet boxes, raceways, etc., shall be shown with a coloured label glued to the page. All identification and colour coding information may be shown on the Index sheet if space permits.
- .12 Under Supplier/Manufacturer/Distributor list source of supply for replacement parts, including name, address, and telephone number. This information may be shown on the Index sheet if space permits.

- .13 Guarantees and Warranties
 - .1 Include all applicable guarantee and warranty information.

- .14 Test Reports and System Demonstration
 - .1 Include copies of all applicable Test Reports (refer to Section 26 05 00 Testing and Adjusting) and manufacturers' letters verifying test completion.
 - .2 Include signed statement from Departmental Representative regarding systems' demonstrations (refer to Section 26 05 00 Demonstration).

- .15 Certificates
 - .1 Include a copy of Final Certificates from Electrical Inspection Department, Fire Chief, and other authorities having jurisdiction over the work.

- .16 Schedules
 - .1 All schedules included in the Specifications (Motor Schedules, Lighting Fixture Schedules, Panel Schedules, CCTV Schedules, Equipment Schedules, etc.) shall be updated to reflect all changes made during tender and construction periods.

- .17 Drawings
 - .1 Include all small-format drawings issued during Tender and Construction periods.

- .5 A holdback will be effected until all required copies of approved Maintenance Manuals have been delivered to the Departmental Representative .

- .6 A sample copy of a typical Maintenance Manual is available for inspection at the Departmental Representative's office.

- .3 “As-Built” Drawings
 - .1 Refer to Division 1 of these Specifications. Where there is conflict between these documents, the more stringent shall apply.
 - .2 Notwithstanding the above, maintain in the job site office in up-to-date condition, one (1) complete set of whiteprints of each of the Electrical Contract Drawings and one (1) set of Specifications, including Revision Drawings, marked clearly and indelibly in red, indicating "As-Built" conditions where such conditions deviate from the original directions of the Contract Documents, and indicating final installation of feeders and branch circuits.
 - .3 "As-Built" drawing markings shall include but shall not be limited to the following:
 - .1 All changes in circuiting.
 - .2 Size and routing of all conduits for all branch circuits including power, lighting, and systems. Note that branch circuit wiring is generally not shown on Drawings. Accurately record on "As-Built" drawings the size and routing of all installed raceways and cables.
 - .3 Number and size of conductors (#10 AWG and larger) in raceways and cables

- .4 Location of all junction and pullboxes
 - .5 Location of all access panels
 - .6 Location of all conduit or duct stubs, installed equipment, devices, and fixtures
 - .7 All changes to electrical installation resulting from Addenda, Change Orders, and Field Instructions (Architectural Instructions)
 - .8 Exact location of all services left for future work
 - .9 Location by accurate horizontal and vertical dimensions of the routes and terminations of all raceways and cables installed underground beyond the building.
- .4 At completion of construction, transfer all of the above to the original CAD format drawing files of contract drawings. Contractor shall contract Integral Group to update electrical CAD plans at a cost of \$1,000.
 - .5 Where extensive changes have been made to an area to the point where it is not practical to update the original tender drawing, the area in question shall be enclosed with a heavy dotted line and reference made to the applicable Change Order, Architectural Instruction, and/or associated Revision Drawing.
 - .6 For each and every "As-Built" drawing, reference shall be neatly drawn inside the framed space above the title block, listing all Contemplated Change Orders, Architectural Instructions, and Revision Drawing Numbers applicable to the particular "As-Built" drawing in question.
 - .7 Each "As-Built" drawing as defined above shall bear the Contractor's identification and signature, the date of record, and the notation: "We hereby certify that these Drawings represent the building as built."
 - .8 All Addenda and Revision Drawings not having their details transferred onto the submitted "as-built" drawings shall be included in the submission using the same drawing format as previously described.
 - .9 Deliver one (1) set of "As-Built" drawings, plus, one (1) set of "As-Built" electronic PDF, and updated Specification Schedules to the Departmental Representative at 'Substantial Completion' of the Contract for review and comment and, if necessary, revision, before ultimate transmittal to the Departmental Representative. The Departmental Representative will effect a holdback until "Record" drawings are delivered in good order as required herein. Refer also to Division 1 of these Specifications.

1.27 SUBSTANTIAL PERFORMANCE REQUIREMENTS

- .1 Refer to each section in specifications for detailed requirements.
- .2 Before the Departmental Representative is requested to make an review 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 Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion review will not be performed.

- .3 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 the Departmental Representative.
 - .5 All demonstrations to the Departmental Representative have been completed.
- .4 Departmental Representative’s Letters of Assurance will not be issued until the following requirements have been met:
 - .1 All items listed in .1 above have been completed or addressed.
 - .2 Certificate of Penetrations through Separations
 - .3 Provincial or City Electrical Review – Certificate of Review.
 - .4 Seismic Departmental Representative’s Letter of Assurance and Final Review Report.
 - .5 Signed off copy of Departmental Representative’s Final Review Report.

1.28 DEFICIENCY HOLDBACK AND DEFICIENCY REVIEWS

- .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 work have been met and verified.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory-assemble control panels and component assemblies.

2.2 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

2.3 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, matte white finish face, black core, lettering accurately aligned and engraved into core and mechanically attached with self tapping screws.
 - .2 Sizes as follows:

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

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. ___" as directed by Departmental Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

2.5 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered and 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 coding: to CSA C22.1 (current edition).
- .4 Use colour coded wires in communication cables, matched throughout system.

2.6 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
120/208 V	Blue	
347/600 V	Orange	

2.7 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

2.8 FIRE-STOPPING

- .1 Contractor to Include Labor, materials and equipment necessary to complete the installation required for Firestopping of Through Penetrations in Fire Rated Assemblies. Utilize product which will meet the wall fire rating (ULC Listed).

2.9 BASES SUPPORTS

- .1 Where conduit and equipment is located on walls or slabs which will not permit the support of equipment, provide suitable supports to the building structure. Supports shall be constructed of steel members or of steel pipe and fittings designed to safely support the equipment.

2.10 INSERTS, SLEEVES AND CURBS

- .1 Provide all inserts, sleeves and curbs required for the work of this contract.
- .2 Use only factory-made threaded or toggle type inserts as required for support and anchors, properly sized for the load to be carried. Place inserts only in portions of the main structure and not in any finishing material.
- .3 Use factory-made expansion shields where inserts cannot be placed, but only where approved by the Departmental Representative and only for loads of 50 kg or less.
- .4 Do not use powder-activated tools unless with written permission of the Departmental Representative.
- .5 Supply and locate all inserts, holes, anchor bolts and sleeves in time when walls, floors and roof are erected.
- .6 Size sleeves to provide 25 mm clearance all around.
- .7 Use the following sleeving materials:
 - .1 Through all interior walls, use Schedule 40 steel pipes, machine cut, flush with finished structure. Check room finish schedules.
 - .2 Through all exterior walls above grade, use Schedule 40 steel pipes, machine cut, flush with finished structure inside and to suite flashing on outside.
 - .3 Through all exterior walls below grade and all other waterproof walls, use wrought iron pipes. Check flashing details for further information.
 - .4 Through all waterproof floors, through washrooms, janitor's closets, boiler rooms, mechanical rooms, kitchen and through roofs, use wrought iron sleeves, machine cut. Extend sleeves 100 mm above finished floor upward and cut flush with underside of floor.
 - .5 Approved type plastic sleeves, conduit sleeves or 18-gauge galvanized steel sleeves may be used as an alternative for Schedule 40 steel sleeves in interior areas.
 - .6 Provide 100 mm high, 100 mm wide water-tight concrete curbs with 20 mm chamfered edges around all sleeves passing through waterproof floors except where furred in.
 - .7 Sleeves are not required in walls and dry area floors where conduit is installed ahead of wall construction.

- .8 Pack all sleeves between the conduit or cable passing through the sleeve and the sleeve and all spare sleeves with loose fibreglass insulation. Seal the annular space on both sides as follows:
 - .1 For all horizontal sleeves in exposed areas, use a seal of equal or better fire rating than the wall to be sealed.
 - .2 For all horizontal concealed sleeves through firewalls and through walls separating areas of different air pressure, use a permanently resilient silicone base or equal sealing compound.
 - .3 For all vertical sleeves through roofs, washrooms, janitor closets, equipment rooms, use permanently resilient silicone base or equal compound, non-flammable and waterproof. Ensure that the seal is compatible with floor and ceiling finishes. Check the room finishes schedules for further information.
 - .4 The Contractor to provide sleeving diagrams/drawings to the structural Departmental Representative for review and approval prior to any work commencing.

2.11 CUTTING AND PATCHING

- .1 The Contractor shall employ the particular trades to do all required cutting and patching and the repairing of surfaces for his work.
- .2 Supporting members of any floor, wall or the building structure shall be cut only in such a location and manner as directed by the Departmental Representative or the Structural Departmental Representative.
- .3 Provide fire barriers around all components in holes which penetrate fire separations. The fire barrier medium provided shall make the fire separation equal to or better than the one which was cut away. All materials shall be CSA approved and UL listed.

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.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 LOCATION OF DEVICES

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

- .3 Change location of devices at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
- .5 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.4 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 specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise on the drawings.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 457 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 152 mm.
 - .4 In mechanical rooms: 1400 mm.

3.5 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.6 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests:
 - .1 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.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 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 review of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .5 Reports:
 - .1 Provide written reports in a timely manner upon completion of testing and load balance. Indicate date and hour tested.

3.7 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION 26 05 00

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installations for Commissioning.

1.2 RELATED SECTIONS

- .1 This section of the specification forms part of the contract documents is to be read, interpreted and coordinated with all other parts.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1
 - .2 Guidelines for Commissioning Systems, ASHRAE (Current Edition).

1.4 OPERATING AND MAINTENANCE MANUALS

- .1 Provide operating and maintenance manuals in accordance with the requirements of this section and Section 26 05 00 - Common Work Results - Electrical.
- .2 Submit the number of manuals as indicated.
- .3 Provide the services of electricians, manufacturer's representatives and technicians required to provide information which is necessary for the manuals. Note that a substantial completion certificate will not be issued until such a time as the manuals have been submitted in their final accepted form.
- .4 Operating and maintenance data shall be submitted to the Departmental Representative for review. A list of comments will be generated and returned to the Contractor as necessary. This process will continue until the manuals are acceptable to the Departmental Representative.
- .5 The manuals shall be set up by the specification section. Provide all information appropriate for each section.
 - .1 Review Certificates.
 - .2 Letter of Guarantee.
 - .3 List of Suppliers and Contacts.
 - .4 Wiring Devices.

1.5 DATA FOR OPERATING AND MAINTENANCE MANUALS

- .1 Only data associated with actually installed systems should be included in Operating and Maintenance Manuals.
- .2 Include in operations and maintenance data:
 - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

- .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature is not acceptable.
- .3 Wiring and schematic diagrams and performance curves.
- .4 Names and addresses of local suppliers for items included in maintenance manuals.
- .5 Copy of reviewed shop drawings.
- .6 Copies of all certificates including:
 - .1 Electrical Safety Authority (ESA) final certificate,
 - .2 Life safety systems verification certificate and test,
 - .3 Commissioning reports.

1.6 GENERAL TESTS

- .1 Conduct and pay for tests of the following systems:
 - .1 Power distribution systems.
 - .2 Motors, heaters and associated control equipment.
 - .3 All systems.
- .2 Give sufficient prior notice to the Departmental Representative of the proposed time of the tests so that he can be represented at the tests if he so decides. Submit all test reports in triplicate to the Departmental Representative for his review and records.
- .3 Submit test results with all operation and maintenance data.
- .4 Test all systems in accordance with details in appropriate sections.
- .5 Testing methods and test results shall be in accordance with CSA, the Electrical Code and regulations of the supply authority, other authorities having jurisdiction and in accordance with other sections of these Specifications.
- .6 Remove and replace with new materials all conductors that are found to be shorted or grounded.
- .7 With the systems completely connected and lamped, the following tests shall be made:
 - .1 Control and Switching: Test all circuits for the correct operation of devices, switches and controls.
 - .2 Polarity Tests: Test all circuits for the correct operation of devices, switches and controls.
 - .3 Voltage Tests: Make a voltage test at the last outlet of each circuit. The maximum drop in potential permitted will be 3% on 120 V, 208 V and 600 V branch circuits, 2% on 208 V and 600 V feeder circuits and 2% on feeder circuits serving Motor Control Centres. Correct any deficiency in this regard.
 - .4 Phase Balance: Measure the load on each phase at each switchboard, splitter, distribution panel, lighting panel and power panel and report the results in writing to the Departmental Representative. Re arrange phase connections as necessary to balance the load on each phase as instructed by the Departmental Representative, with the re arrangement being restricted to the exchanging of connections at the distribution points mentioned in this paragraph. After making any such changes, update the record drawings and as-built drawings to show the modified connections.

- .5 Supply Voltage: Measure the line voltage of each phase at the load terminals of the main breakers and report the results in writing to the Departmental Representative. This test shall be carried out with the majority of electrical equipment in use.
- .6 Motor Loading: Measure the line current of each phase of each motor with the motor operating under load and report the results in writing to the Departmental Representative. Upon indication of any imbalance or overload, thoroughly examine the electrical connections and rectify any defective parts or wiring. If electrical connections are correct, overloads due to defects in the driven machines shall be reported in writing to the Departmental Representative.
- .7 General Operations: Energize and put into operation each and every electrical circuit and item. Make repairs, alterations, replacements, tests and adjustments necessary for a complete and satisfactory operating electrical system.
- .8 Test all systems and obtain written confirmation from the manufacturer of each system that all components have been installed correctly and that the system is functioning properly.
- .9 When the tests are performed, the Departmental Representative may require that equipment, outlets, devices, etc., be opened and/or removed from their housings and/or outlet boxes in order that the interior of the equipment and wiring terminations and connections may be examined. Provide all labour and tools for this purpose.
- .10 The testing of motors shall be coordinated with the trades providing the equipment driven by the motors so that they are carried out at the time the driven equipment is put on test. In addition to the tests called for in motor loading above, provide labour and instruments to take and record all motor load readings required to supplement the tests on the driven equipment through various load sequences, as required by the trades involved.

1.7 BUILDING TURN OVER

- .1 Provide labour, material, tools, etc., required to building turn over the electrical systems in the presence of the Departmental Representative and the Departmental Representative.
- .2 Operate all systems and demonstrate how they conform with specifications. Under supervision, make adjustments and fine tune systems.

1.8 CARE, OPERATION, START-UP AND TRAINING OF DEPARTMENTAL REPRESENTATIVE'S PERSONNEL

- .1 Instruct operating personnel in operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service representative to supervise start-up of installation, check, adjust, balance and calibrate components.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 TRAINING OF DEPARTMENTAL REPRESENTATIVE PERSONNEL

- .1 General:
 - .1 Detailed information regarding contents, duration and instructors for any particular building system is included in Specification Section 01 91 41 – Commissioning – Training.

- .2 Contractor:
 - .1 The Contractor shall have the following training responsibilities:
 - .1 Provide the Departmental Representative with a training plan two weeks before the planned training according to the outline described in Section 01 91 41 – Commissioning – Training.
 - .2 Provide designated Departmental Representative Representative with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
 - .3 Training shall start with classroom sessions, if necessary, 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.
 - .6 The training sessions shall follow the outline in the Table of Contents of the O&M Manual and illustrate wherever possible the use of the O&M Manual for reference.
 - .7 Training shall include:
 - .1 Use the printed installation, operation and maintenance instruction material included in the O&M Manuals.
 - .2 Include a review of the written O&M manual 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, shutdown, seasonal changeover and any emergency procedures.
 - .3 Discuss relevant health and safety issues and concerns.
 - .4 Discuss warranties and guarantees.
 - .5 Cover common troubleshooting problems and solutions.
 - .6 Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
 - .7 Discuss any peculiarities of equipment installation or operation.
 - .8 Classroom sessions shall include the use of overhead projections, slides, and video and audio taped materials as might be appropriate.
 - .8 Hands-on training shall include start-up; operation in all modes possible, including manual; shutdown; and any emergency procedures and maintenance of all pieces of equipment.

- .9 The Contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
- .10 Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.
- .2 Duration of Training:
 - .1 The Contractor shall provide training on each piece of equipment.

END OF SECTION 26 05 03

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

- .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 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CAN/CSA-C22.1 (current edition), Canadian Electrical Code, Part 1.
 - .2 CAN/CSA-C22.2No.18 (current edition), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .3 CSA C22.2No.65 (current edition), Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC):
 - .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1,200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA).

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Handle materials with suitable lifting equipment.
- .4 Store materials in heated, dry, weather-protected enclosure

Part 2 Products

2.1 MATERIAL

- .1 Pressure type wire connectors shall be in accordance with CSA C22.2 No.65, with current carrying parts of copper, copper alloy, aluminum, aluminum alloy sized to fit copper/aluminum conductors as required.
- .2 Fixture type splicing connectors shall be in accordance with CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors shall be NEMA to consist of:
 - .1 Connector body and stud clamp for stranded, round, copper, aluminum, conductors, tube, bar.
 - .2 Clamp for stranded, round, copper, conductors, bar.
 - .3 Clamp for stranded aluminum, ACSR, conductors, round aluminum bar.
 - .4 Stud clamp bolts.
 - .5 Bolts for copper conductors or bar.
 - .6 Bolts for aluminum conductors or bar.
 - .7 Sized for conductors, tubes, bars as indicated.
- .4 Clamps or connectors for armoured cable, flexible conduit, as required shall be in accordance with CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
 - .3 Install fixture type connectors and tighten. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with NEMA.

3.2 MAINTENANCE – CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

Job No. 105805.001
Smithers Boiler Replacement

Section 26 05 20
WIRE AND BOX CONNECTORS
(0 – 1,000 V)
Page 3 of 3

END OF SECTION 26 05 20

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for Wires and Cables (0 – 1,000 V)

1.2 RELATED SECTIONS

- .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 05 00 - Common Work Results - For Electrical
- .3 Section 26 05 30 - Wire and Box Connectors - 0 - 1000 V.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1 (current edition), Canadian Electric Code, Part 1.
 - .2 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.
 - .3 CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK 90 Cable.

1.4 SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Utilize minimum size 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of chemically cross linked thermosetting polyethylene material rated RW90. Conduit and wire to be used for feeders to panelboards and switchgear. Cable sizing shall utilize the 75 degree column.
- .3 Size conductor for maximum 2% voltage drop to the furthest outlet on each branch circuit.
- .4 The following shall be used with respect to branch circuit wire sizing for voltage drop from the circuits associated panel board.
 - .1 #12 AWG to be used from 0 to 25 m, maximum length of branch circuit run from panel board.
 - .2 #10 AWG to be used from 25 m to 40 m, maximum length of branch circuit run from panel board.
 - .3 #8 AWG to be used from 40 m to 65 m, maximum length of branch circuit run from panel board.

2.2 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90 (BX).
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: anti short connectors.

2.3 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath: cotton braid.
- .2 Type: low energy 300 V control cable: solid annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: PVC.
 - .2 Shielding: tape-coated with paramagnetic material.
 - .3 Overall covering: PVC jackets.
- .3 Type: 600 V stranded annealed copper conductors, sizes as indicated:
 - .1 Insulation: RW90 (x-link).
 - .2 Shielding: magnetic tape.
 - .3 Overall covering: thermoplastic jacket.

Part 3 Execution

3.1 GENERAL CABLE INSTALLATION

- .1 The Electrical Contractor shall up-size feeder and branch circuit wiring and associated conduit as required to meet the requirements of the code with respect to acceptable voltage drop.
- .2 All wiring to be run in conduit raceway with the allowance of flexible armoured cabling (maximum 1500mm in length) for the connection to the mechanical equipment.
- .3 Terminate cables in accordance with Section 26 05 30 - Wire and Box Connectors - (0 - 1,000 V).
- .4 Cable Colour Coding shall be in accordance with Section 26 05 00 Common Work Results for Electrical.
- .5 Conductor length for parallel feeders to be identical.
- .6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .7 Wiring in walls shall be typical drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

- .8 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be two-wire circuits only, i.e. common neutrals not permitted.
- .9 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.2 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 In wireways and auxiliary gutters in accordance with Division 26.

3.3 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.
- .2 Cable shall only be used for luminaire feeds from ceiling and within walls (no AC90 installed at corners of walls).

3.4 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit, under floor raceways, cable troughs, underground ducts.
- .2 Ground control cable shield.

3.5 FIELD QUALITY CONTROL

- .1 Perform two (2) tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .2 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .3 Perform tests before energizing electrical system.

END OF SECTION 26 05 21.01

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for secondary grounding.

1.2 RELATED SECTIONS

- .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 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Departmental Representatives (IEEE).
- .2 Canadian Standards Association, (CSA International).

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Handle materials with suitable lifting equipment.
- .4 Store materials in heated, dry, weather-protected enclosure

Part 2 Products

2.1 MATERIAL

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated.
- .3 Grounding conductors: bare stranded copper as indicated.
- .4 Insulated grounding conductors: green, type RWU90 XLPE.
- .5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION – GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .8 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

3.2 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.3 MECHANICAL EQUIPMENT GROUNDING

- .1 Ground wires are to be installed in all conduits serving motor feeder circuits and are to extend to ground screws on junction and outlet boxes for bonding.

3.4 FIELD QUALITY CONTROL

- .1 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator during tests.

3.5 MAINTENANCE – CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION 26 05 28

Part 1 General

1.1 SECTION INCLUDES

- .1 Material and installation for hangers and supports.

1.2 RELATED SECTIONS

- .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 REFERENCES

- .1 Canadian Standards Association (CSA International)
- .2 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.

1.4 SUBMITTALS

- .1 Submittals: in accordance with section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Handle materials with suitable lifting equipment.
- .4 Store materials in heated, dry, weather-protected enclosure

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended or set in poured concrete walls and ceilings.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.2 MAINTENANCE – CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

Job No. 105805.001
Smithers Boiler Replacement

Section 26 05 29
HANGERS AND SUPPORTS FOR
ELECTRICAL SYSTEMS

Smithers, B.C.

Page 3 of 3

END OF SECTION 26 05 29

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for splitters, junctions, pull boxes and cabinets.

1.2 RELATED SECTIONS

- .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 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1, 20th Edition.
 - .2 CSA C22.2 No. 76, Splitters.
 - .3 CSA C22.2 No. 40, (Cutout), Junction and pull boxes.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Handle materials with suitable lifting equipment.
- .4 Store materials in heated, dry, weather-protected enclosure

Part 2 Products

2.1 SPLITTERS

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Construction-welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

2.3 CABINETS

- .1 Construction: welded sheet steel hinged door, handle, latch and catch
- .2 Type E Empty: flush overlapping sides, mounting as indicated.
- .3 Type T Terminal: flush overlapping sides mounting as indicated containing 19 mm plywood backboard.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Mount plumb, true and square to building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

- .1 Identification Labels: size 2 indicating system name, voltage and phase, or as indicated.

3.4 MAINTENANCE – CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

Job No. 105805.001
Smithers Boiler Replacement

Section 26 05 31
SPLITTERS, JUNCTION, PULL BOXES
AND CABINETS

Smithers, B.C.

Page 3 of 3

END OF SECTION 26 05 31

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for outlet boxes, conduit boxes and fittings.

1.2 RELATED SECTIONS

- .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 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1, 20th Edition.
 - .2 CSA C22.2 No. 18, Outlet boxes, conduit boxes and fittings.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Handle materials with suitable lifting equipment.
- .4 Store materials in heated, dry, weather-protected enclosure

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES - GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.

- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang 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 CONDUIT BOXES

- .1 Cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.6 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.7 SERVICE FITTINGS

- .1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for two duplex receptacles. Bottom plate with two knockouts for centered or offset installation. 12 x 102 mm extension piece as indicated.
- .2 Pedestal type 'low tension' fitting made of 2 piece die cast aluminum with brushed aluminum housing finish to accommodate two amphenol jack connectors.

Part 3 Execution

3.1 INSTALLATION

- .1 Refer to drawings for additional installation details.
- .2 Support boxes independently of connecting conduits.
- .3 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain the integrity of the vapour barrier and insulation to prevent condensation through boxes.
- .4 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

-
- .5 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
 - .6 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
 - .7 Vacuum clean interior of outlet boxes before installation of wiring devices.
 - .8 Identify systems for outlet boxes as required.

3.2 MAINTENANCE – CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION 26 05 32

Part 1 General

1.1 SECTION INCLUDES

- .1 Material and installation for conduits, conduit fastenings and conduit fittings.

1.2 RELATED SECTIONS

- .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 05 00 – Common Work Results - For Electrical
- .3 Section 26 05 21 – Wires And Cables (0-1000 V)
- .4 Section 26 05 31 – Splitters, Junction, Pull Boxes And Cabinets
- .5 Section 26 05 32 – Outlet Boxes, Conduit Boxes And Fittings

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18 (current edition), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45 (current edition), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56 (current edition), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83 (current edition), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2 (current edition), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3 (current edition), Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.4 SUBMITTALS

- .1 Submittals: in accordance with Division 1- Submittal Procedures. Where there is conflict between these documents, the more stringent shall apply.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Delivery, Storage and Handling
- .3 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .4 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .5 Handle materials with suitable lifting equipment.
- .6 Store materials in heated, dry, weather-protected enclosure

Part 2 Products

2.1 CABLES AND REELS

- .1 Provide cables on reels or coils.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.

2.2 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Rigid PVC conduit: to CSA C22.2 No. 211.2.
 - .1 PVC underground telecommunication cable ducting: to CSA B196 3.
 - .2 Plastic underground power cable ducting: to CSA B196.1.
 - .3 Plastic underground power cable ducting: to CSA B196.1, DB-2 or Sceptre encased in concrete (outside of the building)
 - .4 Main communication rigid PVC ducts to be 100mm, type DB-2, Orange in color and shall be jointed and cemented in a Utility approved manner.
 - .5 Subcircuit ducting, (sub feeds to landscape and parking lot lighting, etc.) may be rigid PVC (equal to 'Scepter') bedded in sand with plank and cable marker above.
- .5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.3 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Rigid PVC solvent welded type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .3 Expansion joints as required. Refer to geotechnical report for allowance of suitable linear expansion distance.
- .4 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

.5 Watertight connectors and couplings for EMT.

.1 Set screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

.1 6mm stranded nylon pull rope tensile strength 5 KN.

.2 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal all conduits except in mechanical and electrical service rooms. No exposed conduits in space.

.3 Use rigid hot dipped galvanized steel threaded conduit in the Hose Tower and where exposed conduit is susceptible to mechanical damage.

.4 Use epoxy coated conduit in corrosive areas.

.5 Use electrical metallic tubing (EMT) except in cast concrete.

.6 Use of electrical non-metallic tubing (ENT) is only permitted in concrete slabs. ENT shall not be used in ceiling or wall cavities and/or any plenum rated spaces. Contractor is responsible to protect the tubing and is responsible to repair any damages during construction.

.7 Use rigid PVC conduit underground. Contractor to ensure adequate expansion joints and slack to account for building settlement on site. Allow minimum 200mm of linear expansion. Refer to latest Geo-technical report for estimated settlements.

.8 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.9 Use explosion proof flexible connection for connection to explosion proof motors.

.10 Install conduit sealing fittings in hazardous areas.

.1 Fill with compound.

.11 Minimum conduit size for lighting and power circuits: 21 mm. Contractor shall size conduit to have minimum 20% spare capacity.

.12 Install EMT conduit from branch circuit panel to outlet boxes located in sub floor.

- .13 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .14 Mechanically bend steel conduit over 19 mm diameter.
- .15 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .16 Install fish cord in empty conduits.
- .17 Run two 25 mm spare conduits up to ceiling space and two 25 mm spare conduits down to ceiling space from each flush panel.
 - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete type box.
- .18 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .19 Dry conduits out before installing wire.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.3 SURFACE CONDUITS

- .1 Surface conduits shall only be installed in mechanical and electrical rooms.
- .2 Run parallel or perpendicular to building lines.
- .3 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .4 Run conduits in flanged portion of structural steel.
- .5 Group conduits wherever possible on suspended channels.
- .6 Do not pass conduits through structural members except as indicated.
- .7 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 MAINTENANCE – CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION 26 05 34

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for Wiring Devices.

1.2 RELATED SECTIONS

- .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 05 00 – Common Work Results - Electrical

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1
 - .2 CSA C22.2 No.42 (current edition), General Use Receptacles, Attachment Plugs and Similar Devices.
 - .3 CAN/CSA C22.2 No.42.1 (current edition), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .4 CSA C22.2 No.55 (current edition), Special Use Switches.
 - .5 CSA C22.2 No.111 (current edition), General-Use Snap Switches (Bi-national standard, with UL 20).

1.4 SUBMITTALS

- .1 Submit in accordance with Division 1 - Submittal.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Division 1 - Common Product Requirements.

Part 2 Products

2.1 SWITCHES

- .1 20 A, 120V, single-pole switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White Decora, unless otherwise noted in the Drawings.
- .3 Toggle-operated, fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads and heating loads.
- .4 Switches of one manufacturer throughout project.

- .5 Provide specification-grade switches.

2.2 RECEPTACLES

- .1 Specification grade.
- .2 Duplex receptacles, CSA type 5-15 R/5-20 R, 125V, 15 A/20 A, U ground, with following features:
 - .1 White nylon molded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Double wipe contacts and riveted grounding contacts.
- .3 Other receptacle with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Install all receptacles in the vertical plane unless otherwise noted.
- .6 All other single outlet and special purpose receptacles are to be similar to the specification grade. Confirm ampacity, voltage and pin configuration prior to installation.
- .7 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES

- .1 Provide cover plates for all wiring devices from one manufacturer throughout project.
- .2 Coverplates shall be stainless steel in all areas of the building unless otherwise noted. Confirm requirement prior to ordering material.
- .3 Sheet utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Cast "FS" type cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof double lift spring-loaded cast aluminium cover plates, in use cover, complete with gaskets for duplex receptacles as indicated.
- .6 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results.

- .4 Install switches in millwork as required. Coordinate installation with millwork supplier.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated.
 - .5 Install receptacles in millwork as required. Coordinate installation with millwork supplier.
- .3 Speciality Wiring Device
 - .1 All wall mounted occupancy sensors shall be set to have 15-minute time delay and shall be Auto OFF, Manual ON.
 - .2 All ceiling mounted occupancy sensors shall be set to have 15-minute time delay and shall be Auto ON/OFF.
- .4 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
 - .3 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .4 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
 - .5 Provide blank cover plates for all empty unused boxes.
 - .6 Provide engraved lamacoid name plates with the circuit number indicated on it for all receptacle and light switches. Located circuit number name plate above the receptacle and light switch cover plate.

3.2 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION 26 27 26

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials for moulded-case circuit breakers, circuit breakers, and ground-fault circuit-interrupters, fused circuit breakers.

1.2 RELATED SECTIONS

- .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 05 00 – Common Work Results - Electrical

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include time-current characteristic curves for breakers with ampacity of 150 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 All breakers larger than 150A shall be Electronic type with adjustable trip settings
- .2 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters
Fused circuit breakers to CSA C22.2 No. 5
- .3 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .4 Plug-in moulded case circuit breakers Shall not be accepted.
- .5 Common-trip breakers with single handle for multi-pole applications.
- .6 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from three to eight times current rating.
- .7 Circuit breakers with interchangeable trips as indicated.
- .8 Circuit breakers to have minimum 14,000 symmetrical RMS interrupting capacity rating and shall meet or exceed interrupting capacity rating of the panel boards or switchboards in which they are mounted.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 ACCEPTABLE MANUFACTURERS

- .1 For new breakers the manufacturer is to be same as the panelboard, switchboard, or etc. that the breaker is being installed in.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated, use electronic breakers for breakers larger than 150A.

END OF SECTION 26 28 16.02

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for fused and non-fused disconnect switches.

1.2 RELATED SECTIONS

- .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 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4 (current edition), Enclosed Switches.
 - .2 CSA C22.2 No.39 (current edition), Fuseholder Assemblies.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sample:
 - .1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.
- .4 Closeout Submittals:
 - .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Data necessary for maintenance of materials.
 - .3 Manufacturers recommended list of spare parts.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Handle materials with suitable lifting equipment.
- .4 Store materials in heated, dry, weather-protected enclosure

1.6 ACCEPTABLE MANUFACTURES

- .1 Shall match building electrical distribution .

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No.4 size as indicated.
- .2 Provision for padlocking in off switch position by locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuseholders: to CSA C22.2 No.39 suitable without adaptors, for type and size of fuse indicated.
- .5 Quick-make, quick-break action.
- .6 ON-OFF switch position indication on switch enclosure cover.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

3.2 MAINTENANCE – CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION 26 28 23

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for Control Devices.

1.2 RELATED REQUIREMENTS

- .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 05 00 - Common Work Results - Electrical.

1.3 REFERENCES

- .1 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

1.4 SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

1.6 SCOPE OF WORK

- .1 In general, motors will be provided under Divisions M25 (M - Mechanical) and P25 (P – Plumbing). Refer to specification and drawings for exact locations and requirements.
- .2 Provide the following components.
 - .1 All disconnect switches required by Canadian Electrical Code.
 - .2 All starters, contactors, control transformers, except supply by Division 25 is noted in the Mechanical Schedule.
- .3 Provide all power wiring from power distribution centre to motors.
- .4 Thermostats, solenoid valves, pressure switches, aquastats, flow switches, timeclocks are generally provided by Division 25 except, as noted in the Motor Schedule.
- .5 Refer to Motor Schedule for details of motor controls and devices.

1.7 CONTROLS – INTERWIRING AND INTERLOCKING GENERAL

- .1 Division 25, M25 (Mechanical) and P25 (Plumbing) differ both in regard to the particulars of drives, motors, etc. specified, and in that Division M25 includes a major section on controls. Because of these variations the demarcation between the work of Division 26 and Division M25
- .2 Generally for drives, equipment, etc., detailed in Division M25, the work of Division 26 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 Division M25.

- .3 Division P25 supply some packaged drives and special controls. Division 26 includes provision of all wiring, devices, etc. as required to complete each system electrically and leave it in a functional form requiring only minor adjustments of settings, etc. by Division P25.

1.8 CONTROLS FOR H.V.A.C. DIVISION M25 (MECHANICAL) PROVIDED BY THIS DIVISION

- .1 Provide a ten point terminal block for each starter or contactor.
- .2 Provide interwiring between starters or contacts and terminal blocks using Class II Type C wiring. Starter to be entirely factory-wired.
- .3 Terminals to be as follows:
 - .1 120 V line frm control transformer.
 - .2 Terminals for remote 3 wire stop/start.
 - .3 HOA or other control.
 - .4 120 V neutral.
 - .5 Normally open dry contact.
 - .6 Common.
 - .7 Normally closed by contact.
 - .8 Normally open dry contact.
 - .9 Common.
 - .10 Normally closed dry contact.
- .4 Except where indicated, the work of Division 26 shall not extend beyond the control terminal blocks. Division M25 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 Division 26 require supplementation in any way, e.g. by supplying additional N.O. or N.C. contacts, these facilities are included in Division M25.
- .5 Division M25 shall provide the mechanical control consoles complete with pilot controls, indicating lights, etc., as outlined in the specifications.
- .6 When an item provided under Division M25 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, this work is included in Division M25.
- .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 controllers are included in Division M25. Power wiring to and from the controllers is included in Division 26.
- .8 When electrical characteristics of a controlled item exceed the capacity of a specified controller, provision of a contactor and the required wiring is included in Division M25.

1.9 CONTROLS FOR DIVISION P25 (PLUMBING) PROVIDED BY THIS DIVISION

- .1 When a drive, motor, etc. provided under Division P25 is factory supplied with a starter, contactor, alternator, pressure switch, etc., the installation of this item is including in Division 26.
- .2 All connections, control wiring, and conduit between factory supplied equipment and necessary electrical equipment provided by Division 26 is also included in Division 26.
- .3 Ten point terminal blocks similar to those specified under Controls-Division M25 (Mechanical) are not mandatory.
- .4 Division 26 shall provide stop/start or HOA controls as specified for each item except where these stations are factory supplied.
- .5 Division 26 shall leave each system fully functional and requiring only minor final adjustments (such as pressure or vacuum settings) by Division P25.

Part 2 Products

2.1 AC CONTROL RELAYS

- .1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.
- .2 Convertible contact type: contacts field convertible from NO to NC, electrically held.
- .3 Sealed contact type: electrically held, multiple poles and front mounted contact block to provide additional poles.
- .4 Universal pole type: electrically held multiple poles, convertible from NO to NC by changing wiring connections.
- .5 Fixed contact plug-in type, general purpose, low coil current, heavy duty with multiple poles.

2.2 RELAY ACCESSORIES

- .1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

2.3 SOLID STATE TIMING RELAYS

- .1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.
- .2 Operation: on-delay or off-delay.
- .3 Potentiometer: self-contained to provide time interval adjustment.
- .4 Supply voltage: 120 V, AC, 60 Hz.
- .5 Temperature range: minus 20 degrees C to 60 degrees C.
- .6 Output contact rating: maximum voltage 300 V AC or DC. Current: NEMA ICS 1.
- .7 Timing ranges: minimum 1.0 s, maximum 60 s.

2.4 INSTANTANEOUS TRIP CURRENT RELAYS

- .1 Enclosure: CSA Type 1 open type

- .2 Contacts: NO, NC automatic reset with adjustable tripping point.
- .3 Control: 3 wire, with provision for shorting contacts during accelerating period of motor.
- .4 Contact rating: NEMA ICS 1.

2.5 OPERATOR CONTROL STATIONS

- .1 Enclosure: CSA Type 1, surface mounting:

2.6 PUSHBUTTONS

- .1 Heavy duty, Oil tight. Operator flush or mushroom type or as indicated. Colour as indicated with 2-NO and 2-NC contacts rated at 10 A, AC, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position.

2.7 SELECTOR SWITCHES

- .1 Maintained, 3 position labelled “H-O-A” as indicated, heavy duty, oil tight, operators knob, contact arrangement as indicated.

2.8 INDICATING LIGHTS

- .1 Heavy duty, Oil tight, full voltage, LED type, push-to-test, lens colour as indicated, voltages as indicated, labels as indicated.

2.9 CONTROL AND RELAY PANELS

- .1 CSA Type 1 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.10 CONTROL CIRCUIT TRANSFORMERS

- .1 Single phase, dry type.
- .2 Primary: 208 or 600 V, 60 Hz ac.
- .3 Secondary: 120 V, AC.
- .4 Rating: size according to load, minimum 250 VA.
- .5 Secondary Fuse: size according to load.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

2.11 THERMOSTAT (LINE VOLTAGE)

- .1 To be supplied by Mechanical Contractor.

Part 3 Execution

3.1 INSTALLATION

- .1 Install pushbutton stations, control and relay panels, control devices and interconnect.
- .2 Provide all line voltage disconnects, starters, contactors and relays unless otherwise noted.
- .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.

3.2 COMMISSIONING

- .1 Provide all voltage disconnects, starters, contactors and relays unless otherwise noted.
- .2 Terminate all line voltage wiring to the designated equipment terminals.
- .3 Obtain a full set of HVAC control shop drawings and have a full understanding of the scope before commencing installation.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

END OF SECTION 26 29 03

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for Motor Starters to 600 V.

1.2 RELATED REQUIREMENTS

- .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 05 00 – Common Work Results - Electrical
- .3 Section 26 05 03 – Commissioning.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1
- .2 International Electrotechnical Commission (IEC)
 - .1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.

1.4 SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

Part 2 Products

2.1 MATERIALS

- .1 Starters: to IEC 947-4 with AC4 utilization category.

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.
- .2 Accessories:
 - .1 H-O-A selector switch, heavy duty, oil tight labelled as indicated.
 - .2 Indicating light: heavy duty, oil tight type and colour as indicated.
 - .3 Locking tab to permit padlocking in "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
 - .5
- .2 Combination type starters to include circuit breaker with operating lever on outside of enclosure to control circuit breaker, and provision for:
 - .1 Locking in "OFF" position with up to three padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
 - .1 Selector Switches: Heavy duty labelled as indicated.
 - .2 Indicating Lights: Heavy duty type and colour as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 MULTI-SPEED STARTERS

- .1 Two speed starters of size, type, rating and enclosure type as indicated. Starter suitable for constant torque type motor and with components as follows:
 - .1 One 3-pole contactor for each winding for separate winding motors.
 - .2 One 3-pole and one-5 pole contactor for each reconnectable winding for consequent pole type motors.
 - .3 Three overload relays with 3 heater elements and manual reset for each speed.
- .2 Accessories:
 - .1 Selector Switches: Heavy duty labelled as indicated.
 - .2 Indicating Lights: Heavy duty type and colour as indicated.
 - .3 Auxiliary control devices as indicated.
 - .4 Low speed compelling relay relays for each speed.

2.5 MAGNETIC STARTER REDUCED VOLTAGE PART WINDING

- .1 Two-step reduced voltage, part winding starter of size, type, rating and enclosure type as indicated, with components as follows:
 - .1 Two 3-pole contactors.
 - .2 Adjustable pneumatic timer.
 - .3 Six manual reset overload relays. Three step reduced voltage part winding starter of size, type, rating and enclosure type as indicated, with components as follows:
 - .4 Three 3-pole contactors.
 - .5 One set starting resistors.

- .6 Six manual reset overload relays.
- .2 Accessories:
 - .1 Selector Switches: Heavy duty labelled as indicated.
 - .2 Indicating Lights: Heavy duty type and colour as indicated.
 - .3 Auxiliary control devices as indicated.
- 2.6 VARIABLE SPEED DRIVES**
 - .1 Variable speed drives to be supplied by Division 25.
- 2.7 CONTROL TRANSFORMER**
 - .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
 - .2 Size control transformer for control circuit load plus 20% spare capacity.
- 2.8 ACCESSORIES**
 - .1 Pushbutton: Heavy duty, oil tight as required.
 - .2 Selector Switches: Heavy duty, oil tight as required.
 - .3 Indicating Lights: Heavy duty, oil tight, type and colour as indicated.
- 2.9 FINISHES**
 - .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.
- 2.10 EQUIPMENT IDENTIFICATION**
 - .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
 - .3 Magnetic starter designation label, white plate, black letters, size 1 engraved as indicated.
- Part 3 Execution**
 - 3.1 GENERAL**
 - .1 Coordinate all final control and starter requirements with the final mechanical drawings and specifications.
 - 3.2 INSTALLATION**
 - .1 Install starters and control devices in accordance with manufacturer's instructions.
 - .2 Install and wire starters and controls as indicated.
 - .3 Install all variable speed switches, provide required connections to the unit and to the mechanical equipment. Provide bonding as required. Coordinate installation with the mechanical contractor. Drives shall be located within 25-FT of the equipment that it is serving.

- .4 Ensure correct fuses installed.
- .5 Confirm motor nameplate and adjust overload device to suit.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and 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 26 29 10

APPENDIX A

Pre-Renovation Hazardous Building Materials Assessment, Roof Replacement Project E0551- Smithers B.C.

PROJECT-SPECIFIC HAZARDOUS BUILDING MATERIALS ASSESSMENT SITE REVIEW REPORT

Client:	PSPC on behalf of RCMP	PSPC Contract #	R.109467.001
Stantec Site Assessor:	Zack Kranjec	Stantec Project #:	123221493
		Date of Site Visit:	October 7, 2019
Location:	E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC	Date of Issue:	February 13, 2020

Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC

Stantec was retained by Public Services and Procurement Canada (PSPC) on behalf of the Royal Canadian Mounted Police (RCMP) to provide a pre-renovation hazardous building materials assessment within E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC (subject building), which was reportedly constructed in 1975.

Stantec understands that information pertaining to the identity, location and approximate extent of hazardous building materials (if any) within the subject building is preliminary in nature. Stantec further understands that a renovation project is planned, which may impact various building materials as summarized below (the Project):

- Roof replacement
 - The existing roofing materials (asphalt sheeting) present on the detachment's flat roof area will be replaced with new roofing materials.

PSPC commissioned this assessment on behalf of the RCMP as a measure of diligence in maintaining compliance with the following, as they pertain to identifying hazardous building materials in support of renovation projects:

- Canada Labour Code, Part II Canada Occupational Health and Safety Regulations (COHSR)
- British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97)
- WorkSafeBC 2017 publication *Safe Work Practices for Handling Asbestos* (BC Asbestos Guide)
- PSPC June 5, 2017 Asbestos Management Standard (AMS) and Asbestos Management Directive (AMD)

The information provided herein is to be considered supplemental to the information regarding hazardous building materials within the subject building as provided in the following report:

- Arcadis Report No. 102907.000 entitled *Asbestos-Containing Materials Survey, RCMP Buildings—E Division, E0551, Detachment, Smithers, British Columbia*, dated March 24, 2019, prepared for Public Works and Government Services Canada (Previous Report)

BACKGROUND, STANDARDS, SCOPE AND METHODOLOGY

Site work was conducted in general compliance with the requirements of the COHSR, BC Reg. 296/97, the BC Asbestos Guide, the PSPC AMS and AMD, and Stantec's Safe Work Practices (SWPs).

Mechanical systems, structures and finishes within the subject building were visually examined to determine the suspected presence of the following potential hazardous building materials, specific to those building materials anticipated to be impacted by the Project:

**Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project
E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC**

- Asbestos-containing materials (ACMs)
- Lead, including lead-containing paints (LCPs)
- Other hazardous building materials including electrical equipment containing polychlorinated biphenyls (PCBs); building materials impacted by mould; electrical items containing mercury; equipment that may contain ozone-depleting substances (ODSs); and materials presumed to contain silica.

Applicable standards for each hazardous building material considered during this assessment are summarized below, along with the scope and methodology completed pertaining to those materials, during this assessment.

- Asbestos
 - Asbestos is a naturally occurring form of fibrous silicate that is durable and flexible; has high thermal and tensile strength; is resistant to heat, chemical corrosion and friction; does not conduct electricity; and insulates well against condensation, heat and noise. Due to these properties, asbestos was used in over 3,000 commercial products, and it is estimated that approximately 70% of the asbestos that was used in North America was used in building materials.
 - Undisturbed asbestos within building materials poses no health risks. Asbestos poses a risk when building materials containing asbestos are impacted, or disturbed, thereby releasing the asbestos fibres into the air.
 - Asbestos-related diseases are caused when suspended airborne asbestos fibres are inhaled and the fibres settle into various regions of the lungs and remain for extended periods. Once embedded in the lungs the asbestos fibres cause scarring within the lung tissue, ultimately leading to impaired lung function (asbestosis) and/or various cancers (lung cancer; mesothelioma).
 - The presence of asbestos in federal workplaces and pertaining to federally regulated workers is governed by the COHSR. According to the COHSR, ACM means:
 - o Any article that is manufactured and contains 1% or more asbestos (by weight) at the time of manufacture, or any material that contains 1% or more asbestos when tested in accordance with accepted methods.
 - The presence of asbestos in the workplace in British Columbia pertaining to provincially regulated workers is governed by BC Reg. 296/97. According to the current version of BC Reg. 296/97, ACM means:
 - o Any material containing at least 0.5% asbestos, or vermiculite insulation with any asbestos
 - As both federally regulated workers and provincially regulated workers (e.g., contractors) are expected to carry out work activities within the subject building, and as the provincial regulations have a more stringent definition of ACM, and generally include the requirements noted in the COHSR, this assessment was conducted to meet the requirements of BC Reg. 296/97.
 - Where observed, samples were collected from each “homogenous application” of suspected ACMs (materials suspected to contain asbestos that are uniform in material type, colour, texture application and estimated installation date) and submitted to EMSL Canada Inc. (EMSL) in Burnaby, British Columbia for analysis of asbestos content using polarized light microscopy (PLM) with dispersion staining, in accordance with the United States Environmental Protection Agency (EPA) 600/R-93/116 analytical method “Asbestos (bulk) by PLM.” EMSL’s analytical laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).
 - The number of samples collected for each homogenous application of a suspected ACM was based on the recommendations provided in the BC Asbestos Guide along with the assessor’s experience and understanding of the consistency of the observed building material applications.
 - o When asbestos is detected in concentrations greater than 0.5% in one of the samples within a set that was collected to represent a “homogenous application” of a particular material (or detected in any concentration, in a set of samples collected for applications of vermiculite), the entire sample set, and the entire application of that material is then considered to be an ACM.

**Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project
E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC**

- Lead
 - Lead is commonly found in buildings in items such as the solder used on copper domestic pipes; the caulking on bell fittings of cast iron drainage pipes; electrical equipment/wiring; batteries (e.g., emergency exit signage batteries); lead sheeting (e.g., x-ray rooms); vent and pipe flashings; and paints and ceramic tile glazes.
 - Elemental lead and inorganic lead compounds are absorbed through ingestion or inhalation and can incorporate into the bone marrow, nerve tissue, brain, and kidneys, causing a variety of health effects.
 - Excessive airborne lead and surface contamination can be transferred to employees' hands and may result in lead inhalation or ingestion. Typically, regimented work practices are developed and implemented to minimize airborne and surface lead concentrations during work that may impact lead and lead-containing coatings.
 - Under the COHSR and BC Reg. 296/97, a regulatory limit has been established for occupational exposure to airborne lead that may be present in a workplace. The occupational exposure limit (OEL) for airborne lead dust or fumes per both regulatory instruments should not exceed the time-weighted average value of 0.05 milligram per cubic metre of air (mg/m³). The OEL represents the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse health effects.
 - WorkSafeBC has published the following document, which is intended to provide guidelines for managing lead exposures within applicable limits during renovation or demolition work, and which would meet the requirements of both the COHSR and BC Reg. 296/97:
 - o WorkSafeBC 2017 publication entitled *Safe Work Practices for Handling Lead (BC Lead Guide)*
 - Lead in paint:
 - o In Canada, the *Surface Coating Materials Regulations (SOR/2005-109)* under the federal *Hazardous Products Act* provides a concentration of lead that must not be exceeded in surface coatings that are presently sold in this country (90 parts per million, or "ppm"). However, it is important to note that this regulation does not comment on the potential occupational exposure if the material is disturbed.
 - o With respect to potential lead exposures associated with disturbance to surfaces coated with lead-containing products:
 - The 2011 WorkSafeBC manual titled *Lead-Containing Paint and Coatings: Preventing Exposure in the Construction Industry*, indicates the following:
 - Improper removal of lead paint containing 600 mg/kg (equivalent to "parts per million" or "ppm") lead results in airborne lead concentrations that exceed half of the exposure limit
 - o Potential for exposure exceeding half of the occupational exposure limit would be the trigger for implementation of an exposure control plan
 - Lead concentrations as low as 90 mg/kg may present a risk to pregnant women and children
 - o Any risk assessment should include for the presence of high risk individuals within the workplace
 - The BC Lead Guide indicates the following:
 - Unlike for asbestos-containing material, WorkSafeBC does not numerically define what would be considered a lead-containing paint or coating. All suspected paints or coatings should be tested for lead because, depending on the nature of the work, even a small amount could pose a risk to workers. In order to determine which controls and personal protective equipment would be required for a particular job, a qualified person must consider this information as part of the risk assessment.

Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC


- When reviewing the above, “high risk” individuals are not expected to be present in the workplace associated with this building/structure/site during building material alteration activities (i.e., renovation or demolition) that would create significant disturbance to paint with such individuals present. As such, paints containing 600 ppm lead or more will be considered “lead-containing” for the purpose of this report, such that appropriate risk assessments can be completed for demolition planning. However, information regarding the lead content of all paints tested is provided herein, for reference and risk assessment should the consideration of high risk individuals be necessary, based on the requirements of a particular situation
 - o Samples of potential lead-containing paints (LCPs) were collected from major paint applications on building materials expected to be disturbed during the Project. The sampling of paint applications involved the collection of paint chip samples of paint layers to the substrate, where possible. Samples collected were submitted to EMSL in Mississauga, Ontario for analysis of total lead content using EPA Method SW 846 3050B*/7000B. EMSL’s analytical laboratory is also accredited by the AIHA Environmental Lead Laboratory Approval Program (ELLAP).
- Other hazardous building materials:
 - Various other hazardous building materials may be present that would have special management requirements, and/or requirements for appropriate handling and/or disposal if they were to be impacted by renovation activities
 - Assessment for the presence of other hazardous building materials, specific to those building materials anticipated to be impacted by the Project, was completed through visual means, as follows:
 - o Visual review for the presence of PCBs in electrical equipment was completed. Equipment that is generally suspected of containing PCBs includes lamp ballasts, transformers, hydraulic systems, compressors, switchgear and capacitors. No sampling of dielectric fluids was undertaken as part of this assessment.
 - o The presence of suspect visible mould and/or animal waste was assessed through visual observations. Material observed with dark-coloured staining and/or a textured and discoloured appearance is described as “suspected mould”. Mould identified visually is defined as “suspected mould” unless it is confirmed as mould by laboratory analysis.
 - o Assessment for equipment likely to contain ODSs was completed. Information on the type of equipment, manufacturer and type and quantity of refrigerants was recorded, where available.
 - o Assessment for equipment that is likely to contain mercury was completed visually. Information on the type of equipment (i.e., gauges, switches, batteries, thermometers, etc.), model and serial numbers and quantities was recorded, where such information was available.
 - o Assessment for the presence of silica was conducted. The presence of silica in building materials such as concrete, masonry, stone, terrazzo, refractory brick, ceramic tile, ceiling tile etc. was noted.

RESULTS

Table 1 below summarizes the findings of the assessment and sampling activities undertaken within the subject building. A floor plan drawing indicating the locations of samples collected and other pertinent information related to identified hazardous building materials (where practical) is attached to this document, for reference.



**Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project
E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC**

Table 1 Assessment Summary

Location	Hazardous Building Material Observations	Photo	Samples Collected?	Analytical Results
Main Floor	<p>The following ACMs that were identified in the Previous Report ARE NOT anticipated to be impacted by the Project:</p> <ul style="list-style-type: none"> • Tan vinyl sheet flooring in Room 7, 13, 17b, 20 and 21 • Wrap with black mastic in Room 6b • Black vinyl stair tread in Room 21 • Solid light grey with grey vinyl sheet flooring in Room 22 • Grey firestop putty in Room 25 <p>In addition, and although not anticipated to be impacted by the Project potential ACM vermiculite insulation MAY be present in masonry block wall cavities (not confirmed).</p>	No photo	None	Previously confirmed ACMs
Room 50 (Mechanical Penthouse)	<p>The following ACM that was identified in the Previous Report IS NOT anticipated to be impacted by the Project:</p> <ul style="list-style-type: none"> • Drywall joint compound on walls and ceiling <p>Observed to be in good condition in general with some minor areas of localized damage</p>		None	Previously confirmed ACM



**Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project
E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC**

Table 1 Assessment Summary

Location	Hazardous Building Material Observations	Photo	Samples Collected?	Analytical Results
Throughout Roof Area	<p>“Roofing, felts and tar” were listed in the Aracdis Report as presumed ACMs. These materials are expected to be impacted by the Project.</p> <p>Two core samples were collected; one on the west side and one on the east side of the flat roof area.</p> <p>Roofing materials were observed to be in good condition in general with some areas of damage (bubbling)</p>		<p>3351-RS1-L1 3351-RS1-L2 3351-RS1-L3 (core sample—west side)</p> <p>And</p> <p>3351-RS2-L1 3351-RS2-L2 3351-RS2-L3 (core sample—east side)</p>	<p>No Asbestos Detected</p>
Throughout Roof Area	<p>Additional suspected ACM that is expected to be impacted by the Project:</p> <ul style="list-style-type: none"> Brown caulking applied to flashing on the flat roof area <p>Observed to be in good condition in general</p>		<p>3351-FS-01A 3351-FS-01B 3351-FS-01C</p>	<p>0.31% Chrysotile <0.25% Chrysotile 0.31% Chrysotile (NOT considered ACM see note below table)</p>


**Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project
E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC**

Table 1 Assessment Summary

Location	Hazardous Building Material Observations	Photo	Samples Collected?	Analytical Results
Room 50 (Mechanical Penthouse)	<p>Additional suspected ACM that is expected to be impacted by the Project:</p> <ul style="list-style-type: none"> White caulking applied to metal roofing joints <p>Observed to be in good condition in general</p>		<p>3351-RC-01A 3351-RC-01B 3351-RC-01C</p>	<p>No Asbestos Detected</p>
Throughout Roof Area	<p>Presumed lead-containing light brown paint on metal roof flashing on the detachment's flat roof area is expected to be impacted by the Project.</p> <p>Not sampled due to lack of safe access to roof perimeter, and as it is unlikely that destructive action that would create fine particulate from paint will be undertaken as part of the project (flashing expected to be disconnected and removed primarily intact—potentially re-used)</p> <p>Observed to be in good condition in general</p>		<p>None</p>	<p>Presumed LCP</p>

**Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project
E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC**

Table 1 Assessment Summary

Location	Hazardous Building Material Observations	Photo	Samples Collected?	Analytical Results
Throughout Roof Area	Lead roof vents are present throughout the roof area.		N/A	N/A
Throughout Roof Area	Silica is expected to be present in asphalt sheeting (roofing material) throughout the roof area.	No photo	N/A	N/A
Throughout Roof Area	ODS-containing equipment was not observed. HVAC equipment located on the roof was reported to be charged with non-ODS refrigerant.	No photo	N/A	N/A
Throughout Roof Area	Equipment and/or items expected to contain or be contaminated with the following were NOT observed: <ul style="list-style-type: none"> • PCBs • Mould/animal waste • Mercury 	No photo	N/A	N/A

PROJECT-SPECIFIC HAZARDOUS BUILDING MATERIALS ASSESSMENT SITE REVIEW REPORT

The certificates of analysis for the samples submitted as part of this assessment, as provided by EMSL, are attached to this document, for reference.

NON-FRIABLE MATERIALS CONTAINING LESS THAN 0.5% ASBESTOS

Three samples of brown caulking applied to flashing along the perimeter of the flat roof area were collected. The sample results indicate asbestos content to be 0.31%, less than 0.25% and 0.31% chrysotile asbestos in each of the samples. The number of samples collected for this material would be adequate to appropriately characterize its asbestos content based on its extent and published standards for sampling of homogenous applications of suspected ACMs (e.g., the Asbestos Guide). Given the analytical results (all samples contain <0.5% asbestos) and the non-friable nature of this material, it would not be considered an ACM.

CONCLUSIONS AND RECOMMENDATIONS

In summary, the following limited hazardous building materials that are anticipated to be impacted by the Project were identified through this assessment:

- LCPs
 - Presumed lead-containing light brown paint on metal roof flashing throughout the roof area is expected to be impacted by the Project
- Lead roof vents are present throughout the roof area
- Silica is expected to be present in asphalt sheeting (roofing material) throughout the roof area

Based on the above, the following recommendations are provided as they pertain to the Project:

- Asbestos
 - No ACMs that are anticipated to be impacted by the Project were identified through this assessment. If encountered during Project activities, any suspected ACMs not accessible during this assessment should be considered as asbestos-containing and handled as such, unless proven otherwise, through analytical testing.
- Lead
 - When paints or other lead-containing equipment/materials within the subject building are to be disturbed and/or removed, including in instances where paint chip debris is removed and/or paint debris is created (e.g. preparing surfaces for re-painting), ensure compliance with the following:
 - o Exposure protection requirements of the COHSR and BC Reg. 296/97, including the provisions of the Lead Guideline.
 - o Transportation and disposal requirements of the British Columbia Hazardous Waste Regulation (BC Reg. 63/88) or BC Reg. 63/88.
 - o Transportation requirements of the Federal Transportation of Dangerous Goods Regulation.
 - Corrective action or remedial work on paint applications containing any concentration of lead should be undertaken in a manner so as to avoid generating fine particulate matter or dust (i.e., avoid sanding). Airborne lead dust or fumes should not exceed the COHSR and BC Reg. 296/97 eight-hour occupational exposure limit (OEL) of 0.05 mg/m³ during the removal of paints and products containing any concentration of lead. The use of personal protective equipment is recommended to reduce the potential for over-exposure to lead dust. This can be achieved by:
 - o Providing workers with protective clothing and personal protective equipment or devices as necessary to protect them against the hazards to which the worker may be exposed
 - o Providing workers with adequate and training in the care and use of clothing, equipment or device before wearing or using such items

**Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project
E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC**

- o Wetting the surface of the materials to prevent dust emissions
- o Providing workers with washing facilities with clean water, soap and individual towels to properly wash prior to exiting the work area
- To avoid the inhalation of lead, it is essential to have the following control methods in place:
 - o Engineering controls
 - o Work practices and hygiene practices
 - o Respirators and personal protective equipment
 - o Training
- Ultimately, the Contractor is responsible to review the work tasks required and the ways in which materials (including those coated with paints that may contain lead in varying concentrations) will be impacted, as well as the individuals that will be present in the immediate vicinity of the work (i.e., potential for high-risk individuals) in order to determine the appropriate personal protective equipment (PPE—including respirators and protective clothing), containment and/or decontamination measures and work procedures that should be followed to protect workers from lead exposure.
- Using an arc welder or oxyacetylene torch on steel that is coated with lead-containing paint can create hazardous lead fumes and is prohibited by section 12.115 of BC Reg. 296/97. In addition, the following information is provided in the BC Lead Guide:
 - o Welding or torch cutting of paints or coatings on metal can create very high concentrations of airborne lead fumes. Torch cutting structural steel, coated with paint containing as little as 130 mg/kg (equivalent to ppm) lead, can release airborne levels of lead as high as 0.8 mg/m³ (16 times the exposure limit).
 - o Given this information and that the analytical detection limit for lead paint analysis is in the order of 90 ppm (not significantly different than 130 ppm, which, per above, may release airborne lead levels 16 times the exposure limit), any paint coating on a metal surface to be welded, burned or torch-cut must be removed prior to that action being undertaken, unless a project-specific or tasks-specific risk assessment and safe work practices are developed by a qualified person.
- Silica
 - When silica-containing materials are to be disturbed during the renovation activities, ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated by the COHSR and BC Reg. 296/97 (cristobalite and quartz—each 0.025 mg/m³). This would include, but not be limited to, the following:
 - o Providing workers with respiratory protection
 - o Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions
 - o Providing workers with facilities to properly wash prior to exiting the work area
- Other hazardous building materials
 - Other hazardous building materials as indicated herein were not identified. As such, no additional recommendations have been developed.

LIMITATIONS

This report has been prepared for general information purposes to support the Project. This report does not necessarily constitute an assessment that would be sufficient to support other renovation projects or building demolition, which would typically require destructive removal of building finishes to observed concealed conditions. Prior to any other renovation or demolition work within the subject building, this report should be reviewed by an appropriately qualified professional (with education and experience associated with the management of hazardous building materials) to determine what, if any, additional assessment is necessary.

In preparation of this report, Stantec used professional judgment based on experience. The work was conducted in accordance with generally accepted professional standards. Stantec relied on information gathered during the site investigation and laboratory analytical reports.

**Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project
E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC**

This report reflects the observations made within accessible and accessed areas of the subject building, and the results of analyses performed on specific materials sampled during the current. Analytical results reflect the sampled materials at the specific sample locations.

This report has been prepared for the exclusive use of PSCP on behalf of the RCMP, for the purpose of assessing general conditions in the subject building, only as they pertain to the Project. Any use that a third party makes of this report, or reliance on, or decisions to be made on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

PHYSICAL AND SAMPLING LIMITATIONS

Assessment for hazardous building materials was conducted pertaining to readily visible surfaces within accessible spaces only, and only pertaining to those building materials anticipated to be impacted by the Project. Our understanding of the building materials that would be impacted by the Project was based on the information provided by PSCP and the RCMP only, which was general in nature. Stantec did not design the planned renovations, nor do we have intimate knowledge of the specific tasks that will be required to implement the work tasks.

Due to limitations on the agreed to scope of work for this project as well as physical limitations in accessing concealed areas, there are specific limitations to the information that can be provided regarding the hazardous building materials considered in this assessment, as outlined below.

- Building materials that may contain asbestos and that may be impacted by the Project, but were not accessible for visual review and/or sampling include, but are not limited to the following:
 - Concealed layers of roofing materials beneath what appeared to be plywood at the lowest extreme of the roof cores collected
 - Woven tape inside duct connection joints
 - Mechanical (e.g., piping and ducting) insulation within wall cavities, crawlspaces tunnels or other concealed spaces
 - Heating, ventilation and air conditioning (HVAC) unit's mechanical inner linings and/or insulation on the interior side of ducts
 - Heat protection materials inside mechanical installations and light fixtures
- Although they may also be present in other items in limited amounts (e.g., plastics, molded rubber parts, applied dried paints, coatings or sealants, caulking, adhesives, paper, sound-deadening materials, insulation, or felt and fabric products such as gaskets), PCBs are not expected to be present in those materials in concentrations that would necessitate the requirement for PCB-specific handling procedures, separate removal and/or disposal considerations for demolition. As such, these items were not considered in our assessment.
- Visual assessment for the presence of suspected visible mould and/or suitable conditions for mould growth (e.g., moist and/or water-stained building materials) was conducted only pertaining to areas and materials expected to be impacted by the Project. The conclusions made in this report provide description(s) of the potential source(s) of moisture that may have led to suitable conditions for mould growth, only in those cases where potential source(s) of moisture were identified. The conclusions provided herein will not necessarily identify all sources of moisture leading to suitable conditions for mould growth within the impacted area(s).
 - This assessment does not constitute a building envelope/building systems assessment, which would include an intrusive investigation to assess the internal condition, potential moisture sources, and expected remaining service life of the various components and systems comprising the envelope of a building.

**Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project
E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC**

- The potential presence of mercury or mercury-containing equipment in inaccessible areas or as internal parts of HVAC mechanisms or other equipment was not assessed.
 - Although limited amounts of mercury may be present in paints and adhesives, mercury is not expected to be present in those materials in concentrations that would necessitate the requirement for mercury-specific handling procedures, separate removal and/or disposal considerations for demolition. As such, these items were not considered in our assessment.
- Investigation was limited to a visual review in accessed areas of readily accessible building-related cooling and refrigeration equipment which could contain ODSs and that may be impacted by the Project. Testing was not conducted. Equipment or materials that were not assessed but that may contain ODSs included, but were not limited to, portable equipment (including domestic-type refrigerators and water coolers, occupant-owned refrigeration equipment), flexible plastic foam or rigid insulation foam, solvents, aerosol spray propellants and portable fire extinguishing equipment.
- In general, the assessment for the presence of hazardous building materials was visual in nature and was conducted pertaining to readily visible surfaces within accessible accessed spaces only, and only pertaining to building materials anticipated to be impacted by the Project. Additional hazardous building materials are potentially present in inaccessible areas not assessed including, but not limited to: ceiling spaces, wall cavities and crawlspace areas not accessed, as well as buried materials.

**Project Name: Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project
E0551—RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC**

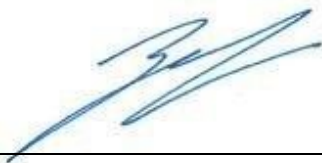
CLOSING

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this document, we request that we be notified immediately to reassess the information provided herein.

We trust that the document meets your current requirements. Should you have any questions or concerns regarding the above, please do not hesitate to contact the undersigned.

Regards,

Stantec Consulting Ltd.



Zack Kranjec Dipl. T. (Env.)
Senior Technologist
Phone: 604-363-1227
Zack.Kranjec@stantec.com

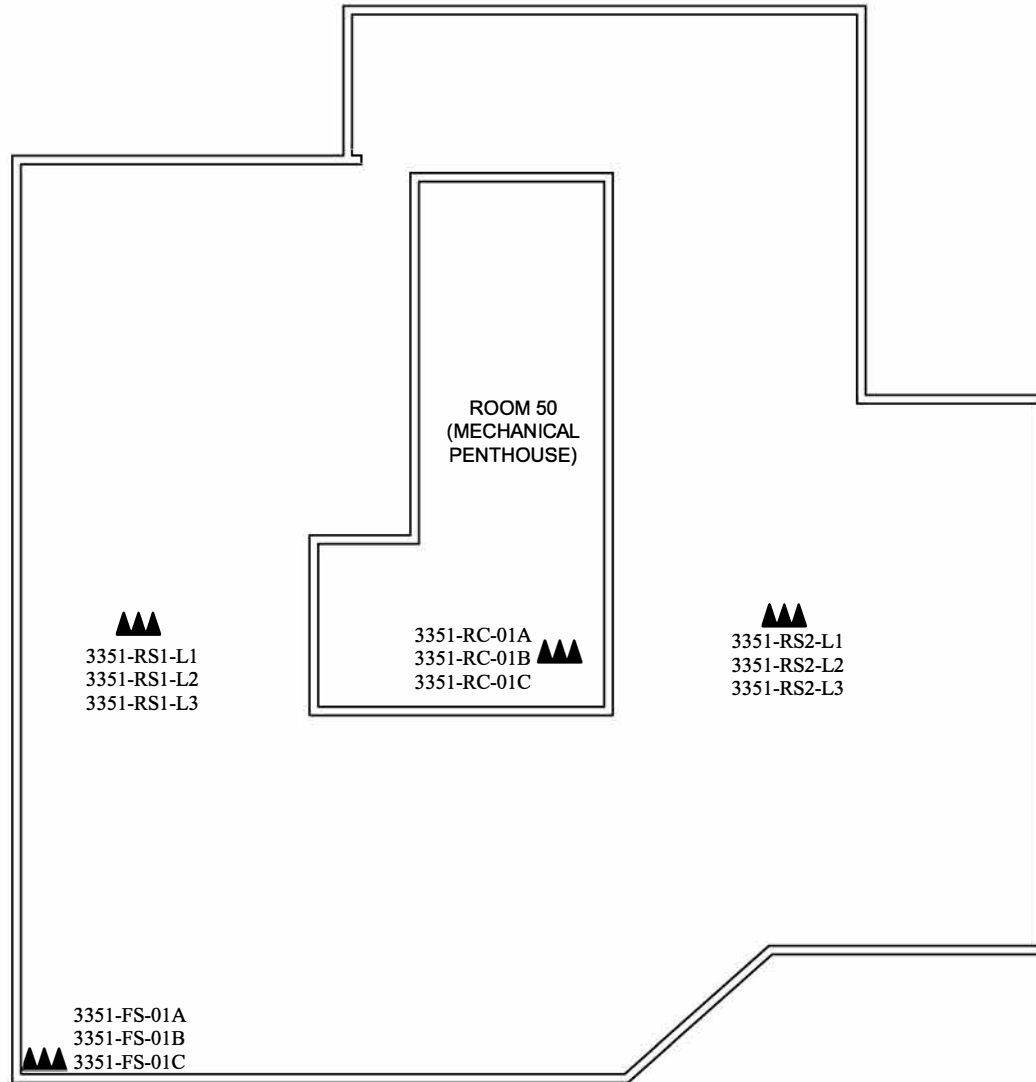


Keith Irwin Dipl. Tech.
Team Lead
Phone: 604-369-0055
Keith.Irwin@stantec.com



Sean Brigden B.Sc., P.B.Dipl., CRSP
Senior Associate
Phone: 250-655-6062
Sean.Brigden@stantec.com

Attachments: Floor Plan—1 page
Suspected ACM Bulk Sample Analytical Record (EMSL)—2 pages



▲▲▲
3351-RS1-L1
3351-RS1-L2
3351-RS1-L3

ROOM 50
(MECHANICAL
PENTHOUSE)
3351-RC-01A ▲▲▲
3351-RC-01B
3351-RC-01C

▲▲▲
3351-RS2-L1
3351-RS2-L2
3351-RS2-L3

▲▲▲
3351-FS-01A
3351-FS-01B
3351-FS-01C

ROOF

LEGEND

▲ ASBESTOS BULK SAMPLE

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

<p>FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS MATERIALS AND BULK SAMPLE LOCATIONS</p> <p>RCMP - E0551 - DETACHMENT - 3351 YELLOWHEAD HIGHWAY 16, SMITHERS, BC</p>	Project No.:	123221493	<p>Dwg. No.:</p> <p>1</p>	
	Scale:	N.T.S.		
	Date:	20/02/07		
	Dwn. By:	CD ^{SL2020020061} _{PT/CS}		
Client:	PUBLIC SERVICES AND PROCUREMENT CANADA	App'd By:	TW	



EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
 Phone/Fax: (604) 757-3158 / (604) 757-4731
<http://www.EMSL.com> / vancouverlab@EMSL.com

EMSL Canada Order 691902717
 Customer ID: 55JACQ30L
 Customer PO: 123221396.300
 Project ID:

Attn: Zack Kranjec Phone: (604) 412-3004
 Stantec Consulting Ltd. Fax:
 500 - 4730 Kingsway Collected:
 Burnaby, BC V5H 0C6 Received: 10/17/2019
 Analyzed: 10/24/2019

Proj: 123221396.300 / RCMP / E DIV HAZMAT / 3351 YELLOWHEAD HWY 16

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: 3351-RS1-L1 **Lab Sample ID:** 691902717-0007

Sample Description: West side of flat roof, layer 1/Roof core sample #1 on flat roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	Brown	0.0%	100%	None Detected	

Client Sample ID: 3351-RS1-L2 **Lab Sample ID:** 691902717-0008

Sample Description: West side of flat roof, layer 2/Roof core sample #1 on flat roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	Brown	0.0%	100%	None Detected	

Client Sample ID: 3351-RS1-L3 **Lab Sample ID:** 691902717-0009

Sample Description: West side of flat roof, layer 3/Roof core sample #1 on flat roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	Blue	0.0%	100%	None Detected	

Client Sample ID: 3351-RS2-L1 **Lab Sample ID:** 691902717-0010

Sample Description: East side of flat roof, layer 1/Roof core sample #2 on flat roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	Brown	0.0%	100%	None Detected	

Client Sample ID: 3351-RS2-L2 **Lab Sample ID:** 691902717-0011

Sample Description: East side of flat roof, layer 2/Roof core sample #2 on flat roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	Tan	0.0%	100%	None Detected	

Client Sample ID: 3351-RS2-L3 **Lab Sample ID:** 691902717-0012

Sample Description: East side of flat roof, layer 3/Roof core sample #2 on flat roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	Blue	0.0%	100%	None Detected	

Client Sample ID: 3351-FS-01A **Lab Sample ID:** 691902717-0013

Sample Description: On perimeter roof flashing/Brown caulking applied to flashing along perimeter of flat roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	Brown	0.0%	99.7%	0.31% Chrysotile	



EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
Phone/Fax: (604) 757-3158 / (604) 757-4731
<http://www.EMSL.com> / vancouverlab@EMSL.com

EMSL Canada Order 691902717
Customer ID: 55JACQ30L
Customer PO: 123221396.300
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: 3351-FS-01B **Lab Sample ID:** 691902717-0014

Sample Description: On perimeter roof flashing/Brown caulking applied to flashing along perimeter of flat roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	Brown	0.0%	100%	<0.25% Chrysotile	

Client Sample ID: 3351-FS-01C **Lab Sample ID:** 691902717-0015

Sample Description: On perimeter roof flashing/Brown caulking applied to flashing along perimeter of flat roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	Brown	0.0%	99.7%	0.31% Chrysotile	

Client Sample ID: 3351-RC-01A **Lab Sample ID:** 691902717-0016

Sample Description: On metal peak roof/White caulking applied to metal peak roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	White	0.0%	100%	None Detected	

Client Sample ID: 3351-RC-01B **Lab Sample ID:** 691902717-0017

Sample Description: On metal peak roof/White caulking applied to metal peak roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	White	0.0%	100%	None Detected	

Client Sample ID: 3351-RC-01C **Lab Sample ID:** 691902717-0018

Sample Description: On metal peak roof/White caulking applied to metal peak roof area

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	10/24/2019	White	0.0%	100%	None Detected	

Analyst(s):

Dane Sorochuk PLM Grav. Reduction (12)

Reviewed and approved by:

Nicole Yeo, Laboratory Manager
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency or the U.S. Government

Samples analyzed by EMSL Canada Inc. Burnaby, BC

Report amended: 02/05/2020 16:54:23 Replaces amended report from: 02/05/2020 16:32:19 Reason Code: Client-Change to Appearance

APPENDIX B

Asbestos-Containing Materials Survey
Project E0551-
Smithers B.C.
Arcadis March 24 2019

ASBESTOS-CONTAINING MATERIALS SURVEY

RCMP BUILDINGS - E DIVISION

E0551, Detachment

Consultant Project # 102907.000

PSPC Project # R.101470.001

Public Services and Procurement Canada

Smithers, British Columbia

March 24, 2019





Shane Dooley, Dipl. Tech.
Field Technologist



Jerry Botti, AScT
Senior Project Manager

ASBESTOS- CONTAINING MATERIALS SURVEY

RCMP E Division

Prepared for:

Ashley Rabey

Environmental Specialist, Environmental
Services

Public Services and Procurement Canada

1230 Government Street, Suite 401

Victoria, BC, V8W 3X4

Prepared by:

Arcadis Canada Inc.

1080 Mainland Street

Suite 308

Vancouver, BC, V6B 2T4

Tel 604 706 4785

Our Ref.:102907.000

Date: March 24, 2019

VERSION CONTROL

Issue	Revision No	Date Issued	Page No	Description	Reviewed by
01	00	24 March 2019	All	Final Report	J. Botti

CONTENTS

Acronyms and Abbreviations.....	iii
Executive Summary.....	1
1 Introduction	3
1.1 Purpose.....	3
1.2 Scope of Work	3
2 Background Information.....	4
3 Regulations and Guidelines	4
3.1 Federal Regulations and Guidelines.....	4
3.2 Provincial Regulations	4
3.3 Provincial Guidelines	5
4 Survey Methodology	6
4.1 Asbestos-Containing Materials	6
4.2 Risk Assessment	6
5 Results	7
5.1 Confirmed Asbestos Materials.....	12
5.2 Presumed Asbestos Materials	12
6 Conclusions and Recommendations	13
7 References.....	14
8 Limitations	14

TABLES

Table 1. Building Description.....	3
Table 2. Bulk Material Sample Quantities	6
Table 3. Results of Bulk Sample Analysis.....	7
Table 4: Confirmed Asbestos-Containing Materials.....	12

APPENDICES

Appendix A: Site Photographs

Appendix B: Laboratory Certificates of Analysis – Asbestos

Appendix C: Floor Plans

Appendix D: Classification, Condition and Accessibility

ACRONYMS AND ABBREVIATIONS

ACM	Asbestos-Containing Materials
Arcadis	Arcadis Canada Inc.
CLC	Canada Labour Code
COHSR	Canada Occupational Health and Safety Regulations
HPP	Hazard Prevention Program
NIOSH	National Institute for Occupational Safety and Health
NJC	National Joint Council
OEL	Occupational Exposure Limit
OHS	Occupational Health and Safety
PLM	Polarized Light Microscopy
PSPC	Public Services and Procurement Canada
RCMP	Royal Canadian Mounted Police
TEM	Transmission Electron Microscopy
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

Arcadis Canada Inc. (Arcadis) was retained by Public Services and Procurement Canada (PSPC) on behalf of the Royal Canadian Mounted Police (RCMP) to conduct an asbestos-containing materials (ACM) survey of select facilities with RCMP E Division.

The objective of the assessment was to document the locations of ACM, evaluate their condition and develop corrective action plans as required for the purposes of long term management. The results of this assessment are not intended for construction, renovation, demolition or project tendering purposes.

Arcadis performed the assessment on January 18, 2019 This report includes results for the facility outlined in the table below.

Building Number (BU)	Building Name	Street Number	Street	Total Inside Gross m ²	Year Constructed
E0551	Detachment	3351	Yellowhead Highway 16, Smithers, BC	738.30	Unknown

Information on the methodologies used and details on the building listed above are presented in this report. The assessment was restricted to accessible locations of the buildings. Inaccessible areas, such as fixed ceiling spaces and behind fixed walls, were not investigated at the time of the ACM survey. Roofing or other material that may cause damage to the building envelope were not included. Concrete block walls were not investigated for vermiculite insulation. Crawlspace were inspected by Arcadis staff from the access hatch. No direct entry was made by Arcadis staff into crawlspace locations. Similarly, attic spaces were visually inspected by Arcadis staff using the existing access hatch. No direct entry was made by Arcadis staff into attic locations.

Summary of Findings

ACM are present as follows:

Material	Location(s)	Total Quantity	Condition (action)	Asbestos Type (%)
Tan vinyl sheet flooring	Room 7, 13, 17b, 20 and 21	20 m ²	Good (7)	Chrysotile 2%
Wrap with black mastic	Room 6b	1 Lin. m	Good (7)	Chrysotile 25%
Drywall joint compound	Room 50	50 m ²	Good (7)	Chrysotile 3%
Black vinyl stair tread	Room 21	6 m ²	Good (7)	Chrysotile 8%
Solid light grey w/grey square vinyl sheet flooring	Room 22	10 m ²	Good (7)	Chrysotile 45%

Recommendation

The following is a summary of significant recommendations; refer to the body of the report for detailed recommendations.

1. Ensure the Asbestos Management Plan (AMP) is available on-site.
2. Perform regular re-assessments of asbestos-containing materials, as described in the RCMP Asbestos Management Plan.
3. Perform a pre-construction intrusive assessment prior to renovation or demolition activities. The assessment should include sampling of materials excluded from this assessment.

Findings of this report are subject to our standard Limitations, as outlined in Section 8.

1 INTRODUCTION

1.1 Purpose

Arcadis Canada Inc. (Arcadis) was retained by Public Services and Procurement Canada (PSPC) on behalf of the Royal Canadian Mounted Police (RCMP) to conduct an asbestos-containing materials (ACM) assessments of select facilities with RCMP E Division.

The objective of the assessment was to document the locations of ACM, evaluate their condition and develop corrective action plans as required for the purposes of long term management. The results of this assessment are not intended for construction, renovation, demolition or project tendering purposes.

Fieldwork for the assessment was conducted on January 18, 2019 by Kenny Luong, Field Technologist of Sterling IAQ Consultants Ltd., and Nadia Rixen, Junior Field Technologist of Arcadis.

1.2 Scope of Work

The scope of work for the project, as referenced in the Request for Proposal dated October 25, 2018, identifies the requirement to conduct Asbestos Assessments within the RCMP E Division. The assessments were conducted in accordance with BC Reg 296/97, WorkSafeBC publication Safe Work Practices for Handling Asbestos, PSPC Asbestos Management Standard and ASTM E2356 Standard Practice for Comprehensive Buildings Asbestos Surveys (ASTM E2356 Standard). A general description of the building included in this assessment is provided in **Table 1** below:

Table 1. Building Description

Building Number (BU)	Building Name	Address	Total Inside Gross m ²	Year Constructed	Building Description
E0551	Detachment	3351 Yellowhead Highway 16, Smithers, BC	738.30	Unknown	Single story building with slab on grade foundation and attic. Torch-on roof. Concrete foundation. Exterior brick walls. Select drywall interior walls with gypsum board panels. Carpet, vinyl sheet flooring or concrete epoxy flooring. Heating was supplied by forced air furnace.

The assessment was restricted to accessible locations of the buildings. Inaccessible areas, such as fixed ceiling spaces and behind fixed walls, were not investigated at the time of the ACM survey. Roofing or other material that may cause damage to the building envelope were not included. Concrete block walls were not investigated for vermiculite insulation. Crawlspace were inspected by Arcadis staff from the access hatch. No direct entry was made by Arcadis staff into crawlspace locations. Similarly, attic spaces were visually inspected by Arcadis staff using the existing access hatch. No direct entry was made by Arcadis staff into attic locations.

2 BACKGROUND INFORMATION

Royal Canadian Mounted Police (RCMP) 'E' Division manages a large and diverse real property portfolio in British Columbia (BC), including several detachments, garages and employee residences across the entire province. In order to comply with federal requirements and the RCMP Asbestos Management Plans, an inventory of the location and condition of all ACMs is required for all buildings managed by RCMP. Arcadis conducted the ACM surveys for PSPC on behalf of the RCMP.

No previous ACM survey of the facility was provided to Arcadis for review.

Please refer to the Site Photographs provided in **Appendix A** and the Floor Plans provided in **Appendix C** for additional reference.

3 REGULATIONS AND GUIDELINES

3.1 Federal Regulations and Guidelines

The Subject Properties are owned by the RCMP and are occupied by employees of the RCMP. Occupational Health and Safety (OHS) for federal employees is regulated by the Canada Labour Code (CLC) Part II. The *Canada Occupational Health and Safety Regulations (COHSR), Part X, Hazardous Substances* covers specific requirements related to the management and control of asbestos-containing materials (ACM). The COHSR, Part X, Hazardous Substances, states an employee shall be kept free from exposure to a concentration of airborne chrysotile asbestos in excess of 0.1 fibre/cm³ or f/cc. There are also specific requirements for hazard prevention detailed in the Hazard Prevention Program (HPP) in the CLC.

For the purposes of this report, the following federal requirements will be followed, unless provincial requirements are more stringent. Federal legislation and policy referenced in this report includes:

- Canada Labour Code, August 27, 2018;
- Canada Occupational Health and Safety Regulations Part X, Hazardous Substances; SOR/86-304, August 27, 2018;
- Public Services and Procurement Canada Asbestos Management Standard, June 2017;
- Asbestos Management Plan, Royal Canadian Mounted Police, Version 2018-01, February 2018; and
- Transport Canada, Transport of Dangerous Goods Regulations.

3.2 Provincial Regulations

The management and requirements for the potential disturbance of asbestos in buildings is also regulated at the provincial level under the *British Columbia Occupational Health and Safety Regulation, 296/97, and "Safe Work Practices for Handling Asbestos", WorkSafeBC, 2017 Edition.*

The legislation is referenced below:

3.2.1 Occupational Health and Safety Requirements

The BC Occupational Health and Safety Regulation, 296/97 (BC Reg 296/97), require specific actions when asbestos is a potential health hazard in a workplace. Section 6.1 of the regulation defines an asbestos-containing material as follows:

“asbestos-containing material” means the following:

(a) a manufactured article or other material, other than vermiculite insulation, that would be determined to contain at least 0.5% asbestos if tested in accordance with one of the following methods:

- (i) Asbestos, Chrysotile by XRD, Method 9000 (Issue 2, dated August 15, 1994) in the NIOSH Manual of Analytical Methods, published by the United States National Institute for Occupational Safety and Health, Centre for Disease Control;
- (ii) Asbestos (bulk) by Polarized Light Microscopy (PLM), Method 9002 (Issue 2, dated August 15, 1994) in the NIOSH Manual of Analytical Methods, published by the United States National Institute for Occupational Safety and Health, Centre for Disease Control;
- (iii) Test Method for the Determination of Asbestos in Bulk Building Materials (EPA/600/R-93/116, dated July 1993) published by the United States Environmental Protection Agency;

(b) vermiculite insulation that would be determined to contain any asbestos if tested in accordance with the Research Method for Sampling and Analysis of Fibrous Amphibole in Vermiculite Attic Insulation (EPA/600/R-04/004, dated January 2004) published by the United States Environmental Protection Agency;

The duties of employers, contractors, or owners include:

- identifying and labeling ACM that can potentially release asbestos fibres;
- keeping a current written record of all ACM present in the workplace;
- conducting regular surveillance and maintenance of asbestos materials to prevent fibre release;
- developing a written exposure control plan if workers may be exposed to harmful levels of asbestos;
- conducting work in a way that prevents the release of asbestos fibres as much as possible;
- notifying, informing, and training workers; and
- notifying Occupational Health and Safety (OHS) at least 48 hours before beginning an asbestos-abatement.

3.3 Provincial Guidelines

3.3.1 Asbestos Abatement Manual

The BC “Safe Work Practices for Handling Asbestos”, 2017 edition, provides guidelines for asbestos processes in building demolition and renovation.

4 SURVEY METHODOLOGY

4.1 Asbestos-Containing Materials

Readily accessible areas were inspected for the presence of materials which could contain asbestos. Bulk samples of materials suspected of potentially containing asbestos (i.e. drywall joint compound, vinyl flooring, ceiling tile, mastic, fire stop putty, pipe thread sealant and pipe elbow) were collected and submitted for analysis of asbestos content. Limited destructive sampling was required and Arcadis patched and/or otherwise repaired sample locations.

Bulk sampling protocols followed the ASTM E2356 Standard, which indicates requirements for the number of samples to collect for each homogeneous material. **Table 2**, shown below, provides an outline of the minimum number of samples to be collected from the ASTM E2356 Standard.

Table 2. Bulk Material Sample Quantities

Type of Material	Size of Area of Homogeneous Material	Minimum Number of Samples Collected
Any homogeneous material, including but not limited to fireproofing, drywall joint compound, ceiling tile stucco, acoustical and stipple finishes and visually similar floor tiles	Less than 90 m ² (<1,000 ft ²)	3
	90 m ² or more, but less than 450 m ² (1,000-5,000 ft ²)	5
	450 m ² or more (>5,000 ft ²)	7

Sample analysis was performed in accordance with the requirements of the PSPC Asbestos Management Standard dated June 5, 2017 and BC Reg 296/97. The PSPC Asbestos Management Standard states the following:

- *Analysis of bulk samples are to be performed, where possible, using the United States Environmental Protection Agency method EPA/600/R-93/116 for PLM. In some instances, analysis must be performed using Transmission Electron Microscopy (TEM) (an example of this would be analysis of vinyl floor tile).*

One sample of each set of three vinyl floor tiles and vinyl sheet flooring was analyzed by transmission electron microscopy (TEM) if the first two samples of a set were reported as no asbestos detected by PLM. Vermiculite attic insulation samples was analyzed by the Cincinnati Method EPA 600/R04/004 in accordance with WorkSafe BC requirements. All other samples were analyzed by PLM. A ‘stop positive’ protocol was requested for the laboratory for this program whereby one positive (more than 0.5%) sample from a homogeneous area can be considered evidence that all suspect material in that homogeneous area contains asbestos without analyzing the remaining samples.

Bulk samples of materials which could contain asbestos were collected and submitted to EMSL Canada Inc. (EMSL) for analysis of asbestos content.

4.2 Risk Assessment

The classification, condition, and accessibility were assessed for the materials which could contain asbestos. To determine these factors, Arcadis followed the methodology outlined in the PSPC Asbestos Management Standard (Standard) and the RCMP Asbestos Management Plan (AMP). The Standard and AMP provide definitions and criteria for the assessment of ACM. The classification, conditions, and accessibility information are provided in **Appendix D**. Section 5 – Results, presents classification, condition, and accessibility rankings for all ACM identified onsite.

5 RESULTS

A total of 74 samples were collected and sent via Chain of Custody to EMSL for PLM and/or TEM analysis. A total of six (6) of the samples were identified as asbestos-containing material and an additional 13 samples were not analysed using the stop positive approach. Laboratory certificates of analysis have been provided in **Appendix B**. Floor plans indicating sample locations are provided in **Appendix C**.

The results are summarized in **Table 3** below:

Table 3. Results of Bulk Sample Analysis

Sample Number	Sample Description	Sample Location	Asbestos Type %	Friable (Y/N)	Accessibility	Condition (action)
A1A	Drywall joint compound	Room 1 wall	None detected	NA	NA	NA
A1B	Drywall joint compound	Room 1 wall	None detected	NA	NA	NA
A1C	Drywall joint compound	Room 1 wall	None detected	NA	NA	NA
A1D	Drywall joint compound	Room 14 wall	None detected	NA	NA	NA
A1E	Drywall joint compound	Room 6 wall	None detected	NA	NA	NA
A1F	Drywall joint compound	Room 13 wall	None detected	NA	NA	NA
A1G	Drywall joint compound	Room 11 wall	None detected	NA	NA	NA
A1H	Drywall joint compound	Room 18 wall	None detected	NA	NA	NA
A1I	Drywall joint compound	Room 24 wall	None detected	NA	NA	NA
A1J	Drywall joint compound	Room 26 wall	None detected	NA	NA	NA
A1K	Drywall joint compound	Room 27 - wall	None detected	NA	NA	NA
A2A	Grey mosaic vinyl sheet flooring	Room 17B	None detected	NA	NA	NA
A2B	Grey mosaic vinyl sheet flooring	Room 2	None detected	NA	NA	NA
A2C	Grey mosaic vinyl sheet flooring	Room 8	None detected	NA	NA	NA

ASBESTOS CONTAINING MATERIALS SURVEY
 E Division – Building E0551, Smithers, British Columbia

Sample Number	Sample Description	Sample Location	Asbestos Type %	Friable (Y/N)	Accessibility	Condition (action)
A3A	White/grey/beige mosaic vinyl sheet flooring	Room 5	None detected	NA	NA	NA
A3B	White/grey/beige mosaic vinyl sheet flooring	Room 5	None detected	NA	NA	NA
A3C	White/grey/beige mosaic vinyl sheet flooring	Room 5	None detected	NA	NA	NA
A4A	4'x2' small fissure pattern ceiling tile	Room 1	None detected	NA	NA	NA
A4B	4'x2' small fissure pattern ceiling tile	Room 9	None detected	NA	NA	NA
A4C	4'x2' small fissure pattern ceiling tile	Room 3	None detected	NA	NA	NA
A5A	4'x2' small fissure pattern ceiling tile	Room 1	None detected	NA	NA	NA
A5B	4'x2' small fissure pattern ceiling tile	Room 16	None detected	NA	NA	NA
A5C	4'x2' small fissure pattern ceiling tile	Room 23	None detected	NA	NA	NA
A5D	4'x2' small fissure pattern ceiling tile	Room 8A	None detected	NA	NA	NA
A5E	4'x2' small fissure pattern ceiling tile	Room 12	None detected	NA	NA	NA
A6A	4'x2' small round fissure pattern ceiling tile	Room 1	None detected	NA	NA	NA
A6B	4'x2' small round fissure pattern ceiling tile	Room 4	None detected	NA	NA	NA
A6C	4'x2' small round fissure pattern ceiling tile	Room 4	None detected	NA	NA	NA
A7A	Tan vinyl sheet flooring*	Room 7	Chrysotile 2%	Y	A	Good (7)
A7B	Tan vinyl sheet flooring	Room 7	Stop Positive	Y	A	Good (7)

ASBESTOS CONTAINING MATERIALS SURVEY
 E Division – Building E0551, Smithers, British Columbia

Sample Number	Sample Description	Sample Location	Asbestos Type %	Friable (Y/N)	Accessibility	Condition (action)
A7C	Tan vinyl sheet flooring	Room 7	Stop Positive	Y	A	Good (7)
A7D	Tan vinyl sheet flooring	Room 13	Stop Positive	Y	A	Good (7)
A8A	Black mastic around pipe insulation**	Room 6b	Chrysotile 25% (mastic)	N	A	Good (7)
A8B	Black mastic around pipe insulation**	Room 6b	Stop Positive	N	A	Good (7)
A8C	Black mastic around pipe insulation**	Room 6b	Stop Positive	N	A	Good (7)
A9A	Black mastic around vapour barrier	Room 6b	None detected	NA	NA	NA
A9B	Black mastic around vapour barrier	Room 6b	None detected	NA	NA	NA
A9C	Black mastic around vapour barrier	Room 6b	None detected	NA	NA	NA
A10A	4'x2' pinhole pattern ceiling tile	Room 19	None detected	NA	NA	NA
A10B	4'x2' pinhole pattern ceiling tile	Room 19	None detected	NA	NA	NA
A10C	4'x2' pinhole pattern ceiling tile	Room 19	None detected	NA	NA	NA
A11A	1'x1' large fissure pattern ceiling tile	Room 12	None detected	NA	NA	NA
A11B	1'x1' large fissure pattern ceiling tile	Room 12	None detected	NA	NA	NA
A11C	1'x1' large fissure pattern ceiling tile	Room 12	None detected	NA	NA	NA
A12A	Brown mastic	Room 12 ceiling	None detected	NA	NA	NA
A12B	Brown mastic	Room 12 ceiling	None detected	NA	NA	NA

ASBESTOS CONTAINING MATERIALS SURVEY
 E Division – Building E0551, Smithers, British Columbia

Sample Number	Sample Description	Sample Location	Asbestos Type %	Friable (Y/N)	Accessibility	Condition (action)
A12C	Brown mastic	Room 12 ceiling	None detected	NA	NA	NA
A13A	Grey firestop putty	Room 25	Chrysotile 20%	N	A	N/A
A13B	Grey firestop putty	Room 25	Stop Positive	N	A	N/A
A13C	Grey firestop putty	Room 25	Stop Positive	N	A	N/A
A14A	Drywall joint compound	Second floor – Room 50 wall	Chrysotile 3%	N	A	Good (7)
A14B	Drywall joint compound	Second floor – Room 50 wall	Stop Positive	N	A	Good (7)
A14C	Drywall joint compound	Second floor – Room 50 wall	Stop Positive	N	A	Good (7)
A15A	Black vinyl stair tread	Room 21	Chrysotile 8%	N	A	Good (7)
A15B	Black vinyl stair tread	Room 21	Stop Positive	N	A	Good (7)
A15C	Black vinyl stair tread	Room 21	Stop Positive	N	A	Good (7)
A16A	Pipe thread sealant	Room 50	None detected	NA	NA	NA
A16B	Pipe thread sealant	Room 50	None detected	NA	NA	NA
A16C	Pipe thread sealant	Room 50	None detected	NA	NA	NA
A17A	Pipe elbow	Room 50	None detected	NA	NA	NA
A17B	Pipe elbow	Room 50	None detected	NA	NA	NA
A17C	Pipe elbow	Room 50	None detected	NA	NA	NA
A18A	Grey duct mastic	Room 50	None detected	NA	NA	NA
A18B	Grey duct mastic	Room 50	None detected	NA	NA	NA

ASBESTOS CONTAINING MATERIALS SURVEY
 E Division – Building E0551, Smithers, British Columbia

Sample Number	Sample Description	Sample Location	Asbestos Type %	Friable (Y/N)	Accessibility	Condition (action)
A18C	Grey duct mastic	Room 50	None detected	NA	NA	NA
A19A	Solid light grey w/grey square vinyl sheet flooring	Room 22	Chrysotile 45%	Y	A	Good (7)
A19B	Solid light grey w/grey square vinyl sheet flooring	Room 22	Stop Positive	Y	A	Good (7)
A19C	Solid light grey w/grey square vinyl sheet flooring	Room 22	Stop Positive	Y	A	Good (7)
A20A	White sink mastic	Room 29	None detected	NA	NA	NA
A20B	White sink mastic	Room 29	None detected	NA	NA	NA
A20C	White sink mastic	Room 29	None detected	NA	NA	NA
A21A	Drywall joint compound	Room 44 wall	None detected	NA	NA	NA
A21B	Drywall joint compound	Room 44 wall	None detected	NA	NA	NA
A21C	Drywall joint compound	Room 44 wall	None detected	NA	NA	NA

NOTE: * Mastic associated with sample – none detected for asbestos content.
 ** Wrap associated with material – none detected for asbestos content.

NA = Not Applicable

The following building materials were common in the building: however, these materials do not contain asbestos and were not sampled during the survey:

- Wood paneling, baseboard, concrete, ceramics, glass fiber insulation and similar man-made mineral fibers.

5.1 Confirmed Asbestos Materials

Asbestos-containing materials were confirmed present as follows:

Table 4: Confirmed Asbestos-Containing Materials

Material	Location(s)	Total Quantity	Condition (action)	Asbestos Type (%)
Tan vinyl sheet flooring	Room 7, 13, 17b, 20 and 21	20 m ²	Good (7)	Chrysotile 2%
Wrap with black mastic	Room 6b	1 Lin. m	Good (7)	Chrysotile 25%
Drywall joint compound	Room 50	50 m ²	Good (7)	Chrysotile 3%
Black vinyl stair tread	Room 21	6 m ²	Good (7)	Chrysotile 8%
Solid light grey w/grey square vinyl sheet flooring	Room 22	10 m ²	Good (7)	Chrysotile 45%

5.2 Presumed Asbestos Materials

A number of materials which might contain asbestos were not sampled during this assessment due to limitations in scope or were too destructive to sample effectively. Where present, these materials are presumed to contain asbestos until otherwise proven by sampling and analysis.

Materials observed on site and presumed to contain asbestos include:

- Roofing, felts and tar;
- Concrete floor levelling compound;
- Electrical components or wiring within control centers, breakers, motors or lights, insulation on wiring;
- Moulded plastic components (laboratory bench tops);
- Vermiculite in concrete block wall cavities;
- Adhesives;
- Caulking;
- Fibre reinforced paints and coatings;
- Paper products;
- Soffit and fascia boards;
- Fire resistant doors;

- Ceramic tile grout;
- Brick mortars; and
- Vibration dampers on HVAC equipment.

6 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the ACM survey completed on January 18, 2019, Arcadis makes the following conclusions:

Asbestos-containing materials were identified as follows:

- Tan vinyl sheet flooring located in room 7, 13, 17b, 20 and 21.
- Black mastic on pipe wrap located in room 6b.
- Drywall joint compound located in room 50, second floor.
- Black vinyl stair tread in room 21.
- Solid light grey w/grey square vinyl sheet flooring in room 22.

ACMs were reported in good condition. Based on reference with the PSPC Standard and the RCMP AMP, all non-damaged ACM observed were considered to fall under a recommended Action Level 7 (routine surveillance).

Arcadis provides the following additional recommendations:

1. Ensure the Asbestos Management Plan (AMP) is available on-site.
2. Perform regular re-assessments of asbestos-containing materials, as described in the RCMP Asbestos Management Plan.
3. Perform a detailed intrusive assessment prior to building renovation or demolition operations. The assessment should include destructive testing (i.e. coring and/or removal of building finishes and components), and sampling of other hazardous materials (lead, mercury, PCBs, mould, etc.) and materials not tested in this study (e.g. roofing materials, caulking, mastics).
4. During renovations or demolition, if additional ACM, or suspected ACM are identified, these materials should be tested for asbestos. If the analytical results identify the substances as an ACM, they should be removed prior to any demolition or deconstruction work, in accordance with work practices and procedures specified in the PSPC Standard, the RCMP Asbestos Management Plan and BC Reg 296/97.

7 REFERENCES

Occupational Health and Safety Regulation, B.C. Reg. 296/97, WorkSafe BC.

Safe Work Practices for Handling Asbestos, WorkSafe BC, 2017 Edition.

Minister of Justice. 2018. Canada Labour Code. R.S.C., 1985, c. L-2. August 27, 2018. <http://laws-lois.justice.gc.ca/PDF/L-2.pdf>

Minister of Justice. 2018. Canada Occupational Health and Safety Regulations. SOR/86-304. August 27, 2018. <http://laws.justice.gc.ca/PDF/SOR-86-304.pdf>

Public Services and Procurement Canada. 2017. Asbestos Management Standard. June 5, 2017. <https://www.tpsgc-pwgsc.gc.ca/biens-property/ami-asb/nga-ams-eng.html>

Transport Canada. 2017. Consolidated Transport of Dangerous Goods Regulations including Amendment SOR/2017-253. https://www.tc.gc.ca/media/documents/tdg-eng/Consolidated_Marine_Provisions_English.pdf

ASTM E2356 Standard Practice for Comprehensive Buildings Asbestos Surveys

Royal Canadian Mounted Police, Asbestos Management Plan, Version 2018-01, February 2018

8 LIMITATIONS

This report, prepared for Public Services and Procurement Canada, on behalf of Royal Canadian Mounted Police, does not provide certification or warranty, expressed or implied, that the investigation conducted by Arcadis identified all hazardous materials associated with the subject building. The work undertaken by Arcadis was directed to provide information on the presence of asbestos materials in construction materials based on visual inspection of readily accessible areas of the subject building, and on the results of laboratory analysis of a limited number of bulk samples of material for asbestos. The material in this report reflects Arcadis' best judgment in light of the information available at the time of the investigation, which was performed on January 18, 2019. This report is not intended to be used as a scope of work or technical specification for remediation of hazardous materials. This report was prepared by Arcadis for Public Services and Procurement Canada, on behalf of Royal Canadian Mounted Police. Any use which any other party makes of the report, or reliance on, or decisions to be based on it, is the responsibility of such parties.

APPENDIX A

Site Photographs

APPENDIX B

Laboratory Certificates of Analysis – Asbestos

APPENDIX C

Floor Plans

APPENDIX D

Classification, Condition and Accessibility

1.1 Spray Applied Fireproofing, Insulation and Texture Finishes

To evaluate the condition of ACM spray applied as fireproofing, thermal insulation, or texture, decorative or acoustic finishes, the following criteria are applied:

GOOD

Surface of material shows no significant signs of damage, deterioration or delamination. Up to 1 percent visible damage to surface is allowed within range of **GOOD**. Evaluation of sprayed fire-proofing requires the surveyor to be familiar with the irregular surface texture typical of sprayed asbestos products. **GOOD** condition includes un-encapsulated or unpainted fireproofing or texture finishes, where no delamination or damage is observed, and encapsulated fireproofing or texture finishes where the encapsulation has been applied after the damage or fallout occurred.

POOR

Sprayed materials show signs of damage, delamination or deterioration. More than 1 percent damage to surface of ACM spray.

In observation areas where damage exists in isolated locations, both **GOOD** and **POOR** condition may be reported. The extent or percentage of each condition will be recorded on the survey or re-assessment form.

NOTE: FAIR condition is not utilized in the evaluation of the sprayed fireproofing, sprayed insulation, or texture coat finishes.

The evaluation of ACM spray applied as fireproofing, non-mechanical thermal insulation, or texture, decorative or acoustic finishes which are present above ceilings, may be limited by the number of observations made, and by building components such as ducts or full height walls that obstruct the above ceiling observations. Persons entering the ceiling are advised to be watchful for ACM **DEBRIS** prior to accessing or working above ceilings in areas of buildings with ACM regardless of the reported condition.

1.2 Mechanical Insulation

The evaluation of the condition of mechanical insulation (on boilers, breaching, ductwork, piping, tanks, equipment etc.) utilizes the following criteria:

GOOD

Insulation is completely covered in jacketing and exhibits no evidence of damage or deterioration. No insulation is exposed. Includes conditions where the jacketing has minor surface damage (i.e., scuffs or stains), but the jacketing is not penetrated.

FAIR

Minor penetrating damage to jacketed insulation (cuts, tears, nicks, deterioration or delamination) or undamaged insulation that has never been jacketed. Insulation is exposed but not showing surface disintegration. The extent of missing insulation ranges should be minor to none.

POOR

Original insulation jacket is missing, damaged, deteriorated or delaminated. Insulation is exposed and significant areas have been dislodged. Damage cannot be readily repaired.

The evaluation of mechanical insulation may be limited by the number of observations made and building components such as ducts or full height walls that obstruct observations. It is not possible to observe the full length of mechanical insulation from all angles.

1.3 Non-friable and Potentially Friable Materials

Non-friable materials generally have little potential to release airborne fibres, even when damaged by mechanical breakage. However, some non-friable materials, i.e., exterior asbestos cement products, may have deteriorated so that the binder no longer effectively contains the asbestos fibres. In such cases of significantly deteriorated non-friable material, the material should be treated as a friable product.

2. Evaluation of Accessibility

The accessibility of building materials known or suspected of being ACM is rated according to the following criteria:

ACCESS (A)

Areas of the building within reach (from floor level) of all building users. Includes areas such as gymnasiums, workshops, and storage areas where activities of the building users may result in disturbance of ACM not normally within reach from floor level.

ACCESS (B)

Frequently entered maintenance areas within reach of maintenance staff, without the need for a ladder. Includes: frequently entered pipe chases, tunnels and service areas or areas within reach from a fixed ladder or catwalk, e.g. tops of equipment, mezzanines.

ACCESS (C) EXPOSED

Areas of the building above 2.4 metres where use of a ladder is required to reach the ACM. Only refers to ACM that is exposed to view, from the floor or ladder, without the removal or opening of other building components such as ceiling tiles, or service access door or hatch. Does not include infrequently accessed service areas of the building.

ACCESS (C) CONCEALED

Areas of the building which require the removal of a building component, including lay-in ceilings and access panels into solid ceiling systems. Includes rarely entered crawl spaces, attic spaces, etc. Observations will be limited to the extent visible from the access points.

ACCESS (D)

Areas of the building behind inaccessible solid ceiling systems, walls or mechanical equipment, etc. where demolition of the ceiling, wall or equipment, etc. is required to reach the ACM. Evaluation of condition and extent of ACM is limited or impossible, depending on the surveyor's ability to visually examine materials in ACCESS D.

3. ACM DEBRIS

3.1 DEBRIS from Friable ACM

The presence of fallen ACM is noted separately from the presumed friable ACM source (sprayed fireproofing, thermal insulation, texture, decorative or acoustic finishes or mechanical insulation) and is referred to as **DEBRIS**.

3.2 DEBRIS from Damaged Non-Friable ACM

The presence of fallen ACM from damaged non-friable ACM is also reported separately from the non-friable ACM source. Only fallen non-friable ACM that has become friable is reported as **DEBRIS**.

The identification of the exact location or presence of **DEBRIS** on the top of ceiling tiles is limited by the number of observations made and the presence of building components such as ducts or full height walls

that obstruct observations. Workers are advised to be watchful for the presence of **DEBRIS** prior to accessing or working in proximity to mechanical insulation or above ceilings in areas of buildings with ACM regardless of the reported presence or absence of **DEBRIS**.

4. Action Matrix and Action Descriptions

The Asbestos Management Plan requires the following responses:

- Immediately clean-up **DEBRIS** that is likely to be disturbed.
- Remove, repair or enclose friable ACM in **POOR** or **FAIR** condition whose continued deterioration will result in **DEBRIS** that is likely to be disturbed.

The following factors shall be considered in making site-specific recommendations for compliance with the existing applicable regulations or codes and the practical implementation of the Asbestos Management Plan:

1. ACM in **POOR** condition is not routinely repairable. If an abatement action is necessary, removal is the recommended action (enclosure is a viable option in unusual circumstances, e.g. where removal is difficult or costly and the asbestos-containing material can be thoroughly enclosed).
2. Mechanical insulation in **FAIR** condition will be repaired or removed based on the following general recommendations, applied on a case-by-case basis:
 - ACM insulation found in **FAIR** condition in ACCESS (B) or ACCESS (C) EXPOSED areas is to be repaired.
 - ACM mechanical insulation found in **FAIR** condition in ACCESS (B) and ACCESS (C) EXPOSED areas, where future damage to the ACM is likely to occur, is to be removed.
3. ACM in **GOOD** condition present in ACCESS (A) can be managed by surveillance, as long as it is not disturbed by future renovation, maintenance or demolition. Proactive removal of the ACM in ACCESS (A) will be considered where damage is possible by on-going occupant activity (accidental or intentional).
4. Non-friable or manufactured products are considered in the action matrix as follows:
 - Non-friable and manufactured products reported in **POOR** condition, or friable **DEBRIS** resulting from the deterioration of non-friable ACM, are treated as friable materials and the appropriate action, and depending on accessibility is determined from the action matrix for friable ACM.
 - For non-friable or manufactured products reported in **GOOD** condition, Action 7 (surveillance) is recommended regardless of accessibility.
5. All asbestos-containing material from a particular area is to be removed where small quantities of asbestos are present and removal will negate the need for the use of an Asbestos Management Program in that area.

The action matrix provided below establishes the recommended asbestos control action. The ACTIONS themselves are described in full following the table.

4.1 Action Matrix Tables

FRIABLE ACM				
ACCESS	CONDITION			DEBRIS
	GOOD	FAIR	POOR	
(A)	ACTION 5/7 ¹	ACTION 5/6 ²	ACTION 3	ACTION 1
(B)	ACTION 7	ACTION 6/5 ³	ACTION 3	ACTION 1
(C) EXPOSED	ACTION 7	ACTION 6	ACTION 4	ACTION 2
(C) CONCEALED	ACTION 7	ACTION 7	ACTION 4	ACTION 2
(D)	ACTION 7	ACTION 7	ACTION 7	ACTION 7

¹ If material in **ACCESS (A)/GOOD** condition is not removed **ACTION 7** is required.

² If material in **ACCESS(A)/FAIR** condition is not removed **ACTION 6** is required.

³ Remove ACM in **ACCESS (B)/FAIR** condition if ACM is likely to be disturbed.

4.2 Action Descriptions

ACTION 1 - Immediate Clean-Up of DEBRIS that is Likely to Be Disturbed

Access that is likely to cause a disturbance of the ACM **DEBRIS** is to be restricted and **clean up ACM DEBRIS is to be done immediately**. Use correct asbestos procedures. This action is required for compliance with regulatory requirements and good practice. The assessor should immediately notify the Asset or Property and Facility Manager, or Regional/Area Asbestos Management Coordinator of this condition.

ACTION 2 - Intermediate risk precautions for Entry into Areas with ACM DEBRIS

At locations where ACM **DEBRIS** can be isolated in lieu of removal or cleaned up, use appropriate means to limit entry to the area. Restrict access to the area to persons using intermediate risk asbestos precautions. The precautions will be required until the ACM **DEBRIS** has been cleaned up, and the source of the **DEBRIS** has been stabilized or removed.

ACTION 3 - ACM Removal Required for Compliance

Remove ACM for compliance with regulatory requirements and good practice. Utilize asbestos procedures appropriate to the scope of the removal work.

ACTION 4 - Access into areas where asbestos-containing material is present and likely to be disturbed by access requires intermediate risk precautions.

Intermediate risk asbestos precautions are to be used when entry or access into an area is likely to disturb the ACM. **ACTION 4** must be used until the ACM is re-moved (Use **ACTION 1** or **2** if **DEBRIS** is present). Intermediate risk or high-risk precautions should be used for removal (depending on extent of removal).

ACTION 5 - Proactive ACM Removal

Removal of ACM in lieu of repair may be considered, even if it is in **GOOD** condition at locations, where ACM is easily accessible, limited in quantity, and removal would be cost-effective.

ACTION 6 - ACM Repair

Repair ACM found in **FAIR** condition, and not likely to be damaged again or disturbed by normal use of the area or room. Upon completion of the re-pair work treat ACM as material **in GOOD** condition and implement **ACTION 7**. If ACM is likely to be damaged or disturbed during normal use of the area or room, **ACTION 5** is to be implemented.

ACTION 7 - Routine Surveillance

Institute routine surveillance of the ACM. Trained workers or contractors must use appropriate asbestos precautions (low, intermediate or high) during disturbance of the remaining ACM.

Arcadis Canada Inc.

1080 Mainland Street

Suite 308

Vancouver, BC

Tel 604 706 4785

www.arcadis.com

APPENDIX C

Project Specific Pre-Renovation Hazardous Building
Materials Summary Report
Boiler Replacement Project E0551-
Smithers B.C.
Stantec January 21 2021

PROJECT-SPECIFIC PRE-RENOVATION HAZARDOUS BUILDING MATERIALS SUMMARY REPORT

Client:	PSPC on behalf of RCMP	PSPC Contract #	R.112373.001
Report Author:	Zack Kranjec	Stantec Project #:	123221743
		Date of Issue:	January 21, 2021
Location:	E0551—RCMP Detachment 3351 Yellowhead Highway 16, Smithers, BC		

Reference: Boiler Replacement Project - E0551 - RCMP Detachment, 3351 Yellowhead Highway 16, Smithers, BC

Stantec was retained by Public Services and Procurement Canada (PSPC) on behalf of the Royal Canadian Mounted Police (RCMP) to provide a project-specific summary of information regarding hazardous building materials within the RCMP Detachment located at 3351 Yellowhead Highway 16 in Smithers, BC (subject building), which was reportedly constructed in 1975.

Stantec understands that a boiler replacement project (the Project) is planned, which may impact various building materials, primarily within the Mechanical Penthouse. Stantec further understands that the only work planned to impact materials outside the mechanical room will be tasks associated with installing or modifying the venting through the roof and the potential enlargement of the air intake louvre.

PSPC commissioned this document review and summary report on behalf of the RCMP as a measure of diligence in maintaining compliance with the following, as they pertain to identifying hazardous building materials in support of renovation projects:

- Canada Labour Code, Part II Canada Occupational Health and Safety Regulations (COHSR)
- British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97)
- WorkSafeBC 2017 publication *Safe Work Practices for Handling Asbestos* (BC Asbestos Guide)
- PSPC June 5, 2017 Asbestos Management Standard (AMS) and Asbestos Management Directive (AMD)

The information provided herein is to be considered a summary of the information regarding hazardous building materials within the subject building as provided in the following reports (referred to collectively as the Previous Reports and individually as indicated below), specifically in relation to those building materials expected to be impacted by the Project:

- Arcadis Report No. 102907.000 entitled *Asbestos-Containing Materials Survey, RCMP Buildings—E Division, E0551, Detachment, Smithers, British Columbia*, dated March 24, 2019, prepared for Public Services and Procurement Canada (Arcadis Report)
- Stantec Report No. 123221493 entitled *Pre-Renovation Hazardous Building Materials Assessment Roof Replacement Project, E0551 – RCMP Detachment 3351 Yellowhead Highway 16, Smithers, BC*, dated February 13, 2020, prepared for Public Services and Procurement Canada (Stantec Roof Report)
- Stantec Report No. 123221396 entitled *Asbestos-Containing Materials Re-Assessment, E0551 – RCMP Detachment 3351 Yellowhead Highway 16, Smithers, BC*, dated March 17, 2020, prepared for Public Services and Procurement Canada (Stantec ACM Re-Assessment)

BACKGROUND, STANDARDS AND SCOPE

The following potential hazardous building materials were considered in preparing this summary report, in relation to those building materials expected to be impacted by the Project:

- Asbestos-containing materials (ACMs)
- Lead, including lead-containing paints (LCPs)

- Other hazardous building materials including electrical equipment containing polychlorinated biphenyls (PCBs); building materials impacted by mould; electrical items containing mercury; equipment that may contain ozone-depleting substances (ODS); and materials presumed to contain silica.


Applicable standards for each hazardous building material considered in the preparation of this summary report are summarized below.



- Asbestos
 - The presence of asbestos in federal workplaces and pertaining to federally regulated workers is governed by the COHSR. According to the COHSR, ACM means:
 - o Any article that is manufactured and contains 1% or more asbestos (by weight) at the time of manufacture, or any material that contains 1% or more asbestos when tested in accordance with accepted methods.
 - The presence of asbestos in the workplace in British Columbia pertaining to provincially regulated workers is governed by BC Reg. 296/97. According to the current version of BC Reg. 296/97, ACM means:
 - o Any material containing at least 0.5% asbestos, or vermiculite insulation with any asbestos
 - As both federally regulated workers and provincially regulated workers (e.g., contractors) are expected to carry out work activities within the subject building, and as the provincial regulations have a more stringent definition of ACM, and generally include the requirements noted in the COHSR, the information in this summary report has been prepared to meet the requirements of BC Reg. 296/97.
- Lead
 - Under the COHSR and BC Reg. 296/97, a regulatory limit has been established for occupational exposure to airborne lead that may be present in a workplace. The occupational exposure limit (OEL) for airborne lead dust or fumes per both regulatory instruments should not exceed the time-weighted average value of 0.05 milligram per cubic metre of air (mg/m³). The OEL represents the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse health effects.
 - WorkSafeBC has published the following document, which is intended to provide guidelines for managing lead exposures within applicable limits during renovation or demolition work, and which would meet the requirements of both the COHSR and BC Reg. 296/97:
 - o WorkSafeBC 2017 publication entitled Safe Work Practices for Handling Lead (BC Lead Guide)
 - Lead in paint:
 - o In Canada, the Surface Coating Materials Regulations (SOR/2005-109) under the federal Hazardous Products Act provides a concentration of lead that must not be exceeded in surface coatings that are presently sold in this country (90 parts per million, or “ppm”). However, it is important to note that this regulation does not comment on the potential occupational exposure if the material is disturbed.
 - o With respect to potential lead exposures associated with disturbance to surfaces coated with lead-containing products:
 - The 2011 WorkSafeBC manual titled Lead-Containing Paint and Coatings: Preventing Exposure in the Construction Industry, indicates the following:
 - Improper removal of lead paint containing 600 mg/kg (equivalent to “parts per million” or “ppm”) lead results in airborne lead concentrations that exceed half of the exposure limit
 - o Potential for exposure exceeding half of the occupational exposure limit would be the trigger for implementation of an exposure control plan
 - Lead concentrations as low as 90 mg/kg may present a risk to pregnant women and children
 - o Any risk assessment should include for the presence of high risk individuals within the workplace
 - The BC Lead Guide indicates the following:
 - Unlike for asbestos-containing material, WorkSafeBC does not numerically define what would be considered a lead-containing paint or coating. All suspected paints or coatings should be tested for lead because, depending on the nature of the work, even a small amount could pose a risk to workers. In order to determine which controls and personal protective equipment would be required for a particular job, a qualified person must consider this information as part of the risk assessment.





- When reviewing the above, “high risk” individuals are not expected to be present in the workplace associated with this building/structure/site during building material alteration activities (i.e., renovation or demolition) that would create significant disturbance to paint with such individuals present. As such, paints containing 600 ppm lead or more will be considered “lead-containing” for the purpose of this report, such that appropriate risk assessments can be completed for demolition planning. However, information regarding the lead content of all paints tested is provided herein, for reference and risk assessment should the consideration of high risk individuals be necessary, based on the requirements of a particular situation.
- In addition, the following information is provided in the BC Lead Guide:
 - Welding or torch cutting of paints or coatings on metal can create very high concentrations of airborne lead fumes. Torch cutting structural steel, coated with paint containing as little as 130 mg/kg (equivalent to ppm) lead, can release airborne levels of lead as high as 0.8 mg/m³ (16 times the exposure limit).
 - Given this information and that the analytical detection limit for lead paint analysis is approximately 80–90 ppm (not significantly different than 130 ppm, which, per above, may release airborne lead levels 16 times the exposure limit), any paint coating on a metal surface to be welded, burned or torch-cut must be removed prior to that action being undertaken, unless a project-specific or task-specific risk assessment and safe work practices are developed by a qualified person
- Other hazardous building materials:
 - Various other hazardous building materials may be present that would have special management requirements, and/or requirements for appropriate handling and/or disposal if they were to be impacted by renovation activities. In our review of the Previous Reports, information regarding the following was also considered, as it pertains to building materials expected to be impacted by the Project:
 - o PCBs in electrical equipment.
 - o Mould contamination on building materials that have been impacted by unintended moisture.
 - o Mercury in electrical equipment such as thermostats and fluorescent light tubes.
 - o ODSs in refrigeration or air conditioning equipment
 - o Silica in building products such as wallboard, concrete, ceiling tiles and other materials.


SUMMARY OF DOCUMENT REVIEW

The table below summarizes the findings of the Previous Reports, with information regarding hazardous building materials and whether (or not) they are anticipated to be impacted by the Project, based on our understanding of the work tasks included in the Project.

Hazardous Building Material	Considerations for the Project	Photo
Asbestos	The following ACM that was identified in the Arcadis Report IS anticipated to be impacted by the Project: <ul style="list-style-type: none"> • Drywall joint compound on walls and ceiling (3% Chrysotile) throughout the Mechanical Penthouse 	

Hazardous Building Material	Considerations for the Project	Photo
Asbestos	<p>Vermiculite insulation, a potential ACM, MAY be present in masonry block wall cavities. As per the Stantec ACM Re-Assessment, initial observations did not indicate presence of this material (none observed in breaches, holes or cracks present in masonry walls), however absence cannot be confirmed without destructive testing.</p> <p>Masonry walls of the Mechanical Penthouse will be impacted by the Project.</p>	
Asbestos	<p>The following ACMs that have been identified within the subject building are NOT anticipated to be impacted by the Project:</p> <ul style="list-style-type: none"> • Vinyl sheet flooring (tan – 2% chrysotile; grey – 45% chrysotile) present in various rooms, both exposed and under carpet • Black mastic on foil-wrapped fibreglass insulation on mechanical pipes (25% Chrysotile – not observed in the Mechanical Penthouse) • Black vinyl stair tread (8% Chrysotile) • Grey firestop putty (20% Chrysotile) 	<p>No photos</p>
Asbestos	<p>Other building materials that will be impacted by the project for which previous assessment and/or testing information indicates non-ACM are summarized below:</p> <ul style="list-style-type: none"> • Mechanical insulation. No asbestos detected in samples collected on the main floor; no suspect materials observed in the Mechanical Penthouse. • Roofing materials. Sampling conducted per Stantec Roof Report - no asbestos detected. • White caulking applied to metal roofing joints. Sampling conducted per Stantec Roof Report - no asbestos detected • Brown caulking applied to flashing on the flat roof area. Sampling conducted per Stantec Roof Report - no asbestos detected. 	

Hazardous Building Material	Considerations for the Project	Photo
Lead	<p>The Previous Reports have not included testing of the lead content of paints. Paint applications on interior and exterior materials to be impacted by the Project should be presumed to have a lead content greater than 600 ppm.</p>	
Lead (in other materials)	<p>Lead may be present in the following materials within the Mechanical Penthouse that MAY be impacted by the Project:</p> <ul style="list-style-type: none"> • lead-acid batteries used in emergency lighting • older electrical wiring materials and sheathing • solder used on domestic water lines • solder used in bell fittings for cast iron pipes and in electrical equipment • vent and pipe flashings (lead roof vents are present throughout the roof area) 	 
PCBs	<p>Equipment and/or items expected to contain PCBs were not identified pertaining to materials expected to be impacted by the Project. Fluorescent fixtures with low voltage light tubes are present – ballasts within such fixtures are not suspected to contain PCBs.</p>	<p>No photos</p>
Mercury	<p>Mercury vapour is present in the following materials that may be impacted by the Project:</p> <ul style="list-style-type: none"> • Light tubes in four fluorescent light fixtures in the Mechanical Penthouse. 	
ODSs	<p>ODS-containing equipment has not been identified. HVAC equipment located on the roof was reported to be charged with non-ODS refrigerants.</p>	<p>No photos</p>

Hazardous Building Material	Considerations for the Project	Photo
Mould	Mould and/or animal waste contamination has not been identified in relation to building materials anticipated to be impacted by the Project.	No photos
Silica	<p>Silica is expected to be present in the following materials that will be impacted by the Project:</p> <ul style="list-style-type: none"> • gypsum board • masonry block and associated block mortar • asphalt sheeting (roofing material) • concrete 	

CONCLUSIONS AND RECOMMENDATIONS

In summary, the following hazardous building materials will require consideration during the Project:

- ACMs/Potential ACMs
 - Asbestos-containing drywall joint compound on the walls and ceilings in the Mechanical Penthouse
 - Potential asbestos-containing vermiculite, which may be present within masonry block walls in the Mechanical Penthouse
- Lead
 - Paint applications on building materials to be impacted by the Project are presumed to have a lead content greater than 600 ppm.
 - Lead may be present in lead-acid batteries used in emergency lighting, older electrical wiring materials and sheathing, solder used on domestic water lines, solder used in bell fittings for cast iron pipes and in electrical equipment
 - Lead roof vents are present throughout the roof area
- Mercury vapour is present in fluorescent light tubes within four fixtures in the Mechanical Penthouse
- Silica is present in gypsum board, concrete, masonry block and associated block mortar in the Mechanical Penthouse, and in asphalt sheeting (roofing material) throughout the roof area.

Based on the above, the following recommendations are provided as they pertain to the Project:

- Asbestos
 - ACMs that may be impacted during the renovations activities should be removed by appropriately trained personnel (e.g., asbestos abatement contractor personnel), in accordance with the requirements of the COHSR and BC Reg. 296/97, and prior to the initiation of project work that will disturb them.

- Where masonry block walls require impacts during by the Project, intrusive assessments for vermiculite must be undertaken prior to work that would create openings. If vermiculite insulation is present, this material should be treated as an ACM until assessment and testing conducted by a qualified person confirms otherwise.
- Suspected ACMs deemed visually similar to the ACMs identified in this report should be considered asbestos-containing and handled as such, until assessment and testing conducted by a qualified person confirms otherwise.
 - o The contractor completing work of the Project should review the site prior to initiating work, to determine whether materials deemed visually similar to the ACMs identified in this report are present and will require impacts. Given the tasks expected to be completed, and the materials anticipated to be impacted, particular consideration should be given to confirming that the following ACMs, which are confirmed to be present in other areas of the subject building, are not present in areas and pertaining to materials to be impacted by the Project:
 - Pipe wrap with black mastic
 - Grey firestop putty
- Should a material suspected to contain asbestos fibres become uncovered during renovation activities, all work in the areas that may disturb the material should be stopped. Assessment and testing should be conducted by a qualified person to determine asbestos content. Confirmed ACMs should be handled in accordance with the requirements of the COHSR, BC Reg. 296/97 and the BC Asbestos Guide.
 - o Given the nature of the areas to be impacted by the Project and the limitations of the Previous Reports, the contractor's preliminary site review should include investigation for forms of mechanical insulation in difficult to reach areas, that appear to be different from those assessed or tested in Previous Reports.
- Ensure asbestos containing waste is handled, stored, transported and disposed of in accordance with the requirements of the Federal Transportation of Dangerous Goods Regulation and the British Columbia Hazardous Waste Regulation (BC Reg. 63/88).
- Lead
 - Paints on building materials to be impacted by the project must be considered lead-containing unless assessment and testing conducted by a qualified person confirms otherwise.
 - When paints or other lead-containing equipment/materials within the subject building are to be disturbed and/or removed, including in instances where paint chip debris is removed and/or paint debris is created (e.g. preparing surfaces for re-painting), ensure compliance with the following:
 - o Exposure protection requirements of the COHSR and BC Reg. 296/97, including the provisions of the BC Lead Guide.
 - o Transportation and disposal requirements of BC Reg. 63/88.
 - o Transportation requirements of the Federal Transportation of Dangerous Goods Regulation.
 - Corrective action or remedial work on paint applications containing any concentration of lead should be undertaken in a manner so as to avoid generating fine particulate matter or dust (i.e., avoid sanding). Airborne lead dust or fumes should not exceed the COHSR and BC Reg. 296/97 eight-hour occupational exposure limit (OEL) of 0.05 mg/m³ during the removal of paints and products containing any concentration of lead.
 - Ultimately, the Contractor is responsible to review the work tasks required and the ways in which materials (including those coated with paints that may contain lead in varying concentrations) will be impacted, as well as the individuals that will be present in the immediate vicinity of the work (i.e., potential for high-risk individuals) in order to determine the appropriate personal protective equipment (PPE—including respirators and protective clothing), containment and/or decontamination measures and work procedures that should be followed to protect workers from lead exposure.
 - Using an arc welder or oxyacetylene torch on steel that is coated with lead-containing paint can create hazardous lead fumes and is prohibited by section 12.115 of BC Reg. 296/97. Any paint coating on a metal surface to be welded, burned or torch-cut must be removed prior to that action being undertaken, unless a project-specific or tasks-specific risk assessment and safe work practices are developed by a qualified person.

- Mercury
 - Complete removal of mercury-containing items is required prior to renovation activities that may disturb such items. When mercury-containing items (e.g., fluorescent light tubes) are removed, ensure all mercury waste is handled, stored transported and disposed of in accordance with the requirements the following:
 - o transportation and disposal requirements of the British Columbia Hazardous Waste Regulation (BC Reg. 63/88)
 - o transportation requirements of the Federal Transportation of Dangerous Goods Regulation
 - Precautions should be taken if workers may potentially be exposed to mercury or mercury vapours to ensure that workers exposure levels do not exceed the occupational exposure limit of 0.025 mg/m³ as per BC Reg. 296/97. This can be achieved by providing respiratory and skin protection applicable to the hazard and task to be completed
- Silica
 - When silica-containing materials are to be disturbed during the renovation activities, ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated by the COHSR and BC Reg. 296/97 (cristobalite and quartz—each 0.025 mg/m³). This would include, but not be limited to, the following:
 - o Providing workers with respiratory protection
 - o Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions
 - o Providing workers with facilities to properly wash prior to exiting the work area
- Other hazardous building materials
 - Other hazardous building materials as indicated herein were not identified. As such, no additional recommendations have been developed.

LIMITATIONS

This report has been prepared for general information purposes to support the Project. This report does not necessarily constitute an assessment that would be sufficient to support other renovation projects or building demolition, which would typically require destructive removal of building finishes to observed concealed conditions. Prior to any other renovation or demolition work within the subject building, this report should be reviewed by an appropriately qualified professional (with education and experience associated with the management of hazardous building materials) to determine what, if any, additional assessment is necessary.

In preparation of this report, Stantec used professional judgment based on experience. The work was conducted in accordance with generally accepted professional standards. Stantec relied on information in the Previous Reports and limited information that was gathered during the previous assessment work completed by Stantec. The conclusions presented in this report are subject to the same limitations outlined in the Previous Reports.

This report has been prepared for the exclusive use of PSCP on behalf of the RCMP, for the purpose of assessing general conditions in the subject building, only as they pertain to the Project. Any use that a third party makes of this report, or reliance on, or decisions to be made on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

CLOSING

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this document, we request that we be notified immediately to reassess the information provided herein.

We trust that the document meets your current requirements. Should you have any questions or concerns regarding the above, please do not hesitate to contact the undersigned.

Regards,

Stantec Consulting Ltd.

Field report prepared by:



Zack Kranjec, Dipl. T (Env.)

Senior Technologist

Phone: (604) 363-1227

zack.kranjec@stantec.com




Keith Irwin, Dipl. Tech.

Team Lead

Phone: (604) 369-0055

keith.irwin@stantec.com



Sean Brigden, B.Sc., P.B.Dipl., CRSP

Senior Associate

Phone: (250) 655-6062

sean.brigden@stantec.com