



Public Works and  
Government Services Canada

Requisition Number: EZ899-210837/A

MERX I.D. Number: \_\_\_\_\_

SPECIFICATIONS for:

**CBSA FUEL STORAGE TANKS  
HUNTINGDON, KINGSGATE,  
WANETA - BC  
Project No: R. 107701.002**

**Issued for Tender**

**APPROVED BY:**

Paul, Preetipal

Digitally signed by: Paul, Preetipal  
DN: CN = Paul, Preetipal C = CA O =  
GC OU = PWGSC-TPSGC  
Date: 2020.07.17 14:44:41 -0700'

Regional Manager, AES

\_\_\_\_\_ Date

Chris Patterson

Digitally signed by Chris Patterson  
Date: 2020.07.16 10:54:19 -07'00'

Construction Safety Coordinator

\_\_\_\_\_ Date

**TENDER:**

Mark, Kai

Digitally signed by: Mark, Kai  
DN: CN = Mark, Kai C = CA O = GC OU =  
PWGSC-TPSGC  
Date: 2020.07.28 14:45:00 -07'00'

Project Manager

\_\_\_\_\_ Date

**CONSULTANTS – SEAL & SIGNATURE**

**Discipline**

**Seal/Signature/Date**

Mechanical Consultant  
AME Group



Electrical Consultant  
O'M Engineering Electrical and Electronic Consulting Engineers



END OF SECTION 00 01 07

<b>SPECIFICATION DIVISION</b>		<b>SECTION</b>	<b>PAGES</b>
INDEX	00 00 10	Table of Contents	2
DIVISION 01 GENERAL REQUIREMENTS	00 01 07	Seal and Signature	1
	01 11 00	Summary of Work	3
	01 31 19	Project Meetings	3
	01 32 16.06	Construction Progress Schedule – Critical Path Method (CPM)	9
	01 33 00	Submittal Procedures	4
	01 35 33	Health and Safety	13
	01 41 00	Regulatory Requirements	2
	01 45 00	Quality Control	3
	01 51 00	Temporary Utilities	2
	01 52 00	Construction Facilities	3
	01 56 00	Temporary Barriers and Enclosures	2
	01 61 00	Common Product Requirements	4
	01 71 00	Examination and Preparation	2
	01 73 00	Execution Requirements	2
	01 74 11	Cleaning	2
	01 74 21	Construction Demolition Waste Management and Disposal	9
	01 77 00	Closeout Procedures	2
	01 78 00	Closeout Submittals	7
	01 79 00	Demonstration and Training	2
	01 91 13	General Commissioning (Cx) Requirements	8
	01 91 31	Commissioning (Cx) Plan	10
	01 91 33	Commissioning Forms	3
	01 91 41	Commissioning Training	3
	01 91 51	Building Management Manual (BMM)	4
DIVISION 02 EXISTING CONDITIONS	02 81 01.01	Hazardous Materials Use and Abatement - Huntingdon	6
	02 81 01.02	Hazardous Materials Use and Abatement - Waneta	7
	02 81 01.03	Hazardous Materials Use and Abatement - Kingsgate	6
DIVISION 03 CONCRETE	03 20 00	Concrete Reinforcement	3
	03 30 00	Cast-In-Place Concrete	7
DIVISION 05 METALS	05 12 00	Structural Steel	4
	05 31 00	Steel Deck	2
	05 50 00	Metal Fabrication	3
DIVISION 09 FINISHES	09 90 00	Painting	5
DIVISION 21	21 05 01	Common Work Results for Mechanical	25
DIVISION 23 HVAC	23 05 29	Hangers and Supports for Mechanical Piping and Equipment	5

**TABLE OF CONTENTS**

	23 05 48	Vibration and Seismic Control for Mechanical	11
	23 05 53	Identification for Mechanical Piping and Equipment	8
	23 07 13	Duct Insulation	19
	23 08 00	Commissioning of Mechanical Systems	5
	23 11 13	Facility Fuel Oil Piping	5
	23 13 00	Fuel Storage Tanks	9
DIVISION 26	26 05 00	Common Work Results for Electrical	8
ELECTRICAL	26 05 21	Wires and Cables (0 – 1000V)	3
	26 05 34	Outlet Boxes, Conduit Boxes & Fittings	5
	26 24 16.01	Panelboards Breaker Type	3
	26 27 26	Wiring Devices	4
	26 28 16.02	Moulded Case Circuit Breakers	2
	26 32 13	00000 – Power Generation Diesel	12
	26 50 00	Lighting	3
APPENDICES	Appendix A	Preliminary Hazard Assessment Form	4
	Appendix B	Pre-Renovation Hazardous Building Materials Assessment - Huntingdon	20
	Appendix C	Pre-Renovation Hazardous Building Materials Assessment - Kingsgate	12
	Appendix D	Pre-Renovation Hazardous Building Materials Assessment - Waneta	12
DRAWINGS	M001	Cover Page, Mechanical Symbols and Abbreviations	
	M100	Waneta Cover Page, Notes and Scope of Work	
	M200	Kingsgate Cover Page, Mechanical Symbols and Schedules	
	M201	Kingsgate Emergency Generator Room Demo & Reno Plans	
	M300	Huntingdon Cover Page, Mechanical Symbols and Schedules	
	M301	Huntingdon Emergency Generator Room Demo Plan	
	M302	Huntingdon Emergency Generator Room Reno Plan	
	M303	Mechanical Details	
	E001	Cover Page	
	E200	Kingsgate Border Crossing	
	E301	Huntingdon Border Crossing	

(See Drawings in Separate File)

**Part 1 General**

**1.1 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.

**1.2 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 Work of this Contract comprises renovation of fuel storage tanks at three facilities of Canadian Border Crossing Agency:
- Waneta Border Crossing Facility, BC
  - Kingsgate Border Crossing Facility, BC
  - Huntingdon Border Crossing Facility, BC
- .2 Prior to commencing with the renovation work, some hazmat abatement is required. Perform work in accordance with Health Canada and WorkSafeBC requirements.
- .3 At Waneta Border Crossing Facility, relocate the existing natural gas pipe elbows that are causing tripping hazard. Provide a kick protection.
- .4 At Kingsgate Border Crossing Facility, install a new radiator overflow storage tank and connect the existing relief line off the radiator. Install new service platform with a concrete pad for the existing fuel filling station.
- .5 At Huntingdon Border Crossing Facility, demolish the existing single walled fuel storage tank and the concrete spill containment wall. Install new double walled fuel storage tank with all piping and mechanical accessories. Install new fuel fill port with spill containment and lockable lid.
- .6 Refer to drawings and specifications for full architectural, electrical and mechanical scope of work.
- .7 Unless otherwise specified in Division 00 or 01, liability insurance requirements for the prime contractor are as follows:
- .1 The Contractor must comply with the insurance requirements specified herein. The Contractor must maintain the required insurance coverage for the duration of the Contract. Compliance with the insurance requirements does not release the Contractor from or reduce its liability under the Contract.
  - .2 The Contractor is responsible for deciding if additional insurance coverage is necessary to fulfill its obligation under the Contract and to ensure compliance with any applicable law. Any additional insurance coverage is at the Contractor's expense, and for its own benefit and protection.
  - .3 For Canadian-based Contractors, coverage must be placed with an Insurer licensed to carry out business in Canada, however, for Foreign-based Contractors, coverage must be placed with an Insurer with an A.M. Best Rating no less than "A-". The Contractor must, if requested by the Contracting Authority, forward to Canada a certified true copy of all applicable insurance policies.
- .8 Security escort is required to be present on site during site work. The commissionaire is to be hired by the contractor and the commissionaire is required to have Reliability Clearance from CBSA.

**1.3 CONTRACT METHOD**

- .1 Construct Work under single lump sum contract.
- .2 Relations and responsibilities between Contractor and subcontractors and subcontractors assigned by Departmental Representative are as defined in Conditions of Contract. Assigned Subcontractors must, in addition:
  - .1 Furnish to Contractor, bonds covering faithful performance of subcontracted work and payment of obligations thereunder.
  - .2 Purchase and maintain liability insurance to protect Contractor from claims for not less than limits of liability which Contractor is required to provide to Departmental Representative.

**1.4 WORK SEQUENCE**

- .1 Co-ordinate Progress Schedule.
- .2 Maintain fire access/control.

**1.5 CONTRACTOR USE OF PREMISES**

- .1 Unrestricted use of site until Substantial Performance.
- .2 Co-ordinate use of premises under direction of Departmental Representative.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.
- .6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

**1.6 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

- .1 Execute work with least possible interference or disturbance to building operations, and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.
- .2 Use only stairs existing in building for moving workers and material.
  - .1 Protect walls to approval of Departmental Representative prior to use.
  - .2 Accept liability for damage, safety and overloading of existing stairs.

**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 48 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 Provide alternative routes for personnel and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 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.
- .6 Provide temporary services to maintain critical building and tenant systems.
- .7 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .8 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .9 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .10 Record locations of maintained, re-routed and abandoned service lines.
- .11 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

**1.8 DOCUMENTS REQUIRED**

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

**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 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2 ADMINISTRATIVE**

- .1 Schedule and administer project meetings throughout the progress of the work at the call of Departmental Representative.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting four days in advance of meeting date to Departmental Representative.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Departmental Representative will record the meeting minutes, include significant proceedings and decisions, and identify actions by parties.
- .7 Departmental Representative will reproduce and distribute copies of minutes within five business days after meetings and transmit to meeting participants, and affected parties not in attendance.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

**1.3 PRECONSTRUCTION MEETING**

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Senior representatives of Departmental Representative, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
  - .1 Appointment of official representative of participants in the Work.
  - .2 Schedule of Work: in accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM).
  - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
  - .5 Delivery schedule of specified equipment.



- .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
- .8 Departmental Representative provided products.
- .9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .12 Monthly progress claims, administrative procedures, photographs, hold backs.
- .13 Appointment of inspection and testing agencies or firms.
- .14 Insurances, transcript of policies.

**1.4 PROGRESS MEETINGS**

- .1 During course of Work and two weeks prior to project completion, schedule progress meetings monthly.
- .2 Contractor, major Subcontractors involved in Work Departmental Representative are to be in attendance.
- .3 Notify parties minimum five days prior to meetings.
- .4 Departmental Representative will record minutes of meetings and circulate to attending parties and affected parties not in attendance within five business days after meeting.
- .5 Agenda to include the following:
  - .1 Review, approval of minutes of previous meeting.
  - .2 Review of Work progress since previous meeting.
  - .3 Field observations, problems, conflicts.
  - .4 Problems which impede construction schedule.
  - .5 Review of off-site fabrication delivery schedules.
  - .6 Corrective measures and procedures to regain projected schedule.
  - .7 Revision to construction schedule.
  - .8 Progress schedule, during succeeding work period.
  - .9 Review submittal schedules: expedite as required.
  - .10 Maintenance of quality standards.
  - .11 Review proposed changes for affect on construction schedule and on completion date.
  - .12 Other business.

**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            This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2            REFERENCES**

- .1            Definitions:
  - .1            Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
  - .2            Bar Chart (Gantt chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars.
  - .3            Baseline: original approved plan (for Project, work package, or activity), plus or minus approved scope changes.
  - .4            Cash Flow: projection of progress payment requests based on cash loaded construction schedule.
  - .5            Completion Milestones: they are firstly Interim Certificate and secondly Final Certificate.
  - .6            Constraint: applicable restriction or limitation, either internal or external to project, that will affect performance of Project. Factors that affect activities can be scheduled.
  - .7            Control: process of comparing actual performance with planned performance, analyzing variances, evaluating possible alternatives, and taking appropriate corrective action as needed.
  - .8            Critical Activity: any activity on a critical path.
    - .1            Most commonly determined by using critical path method.
  - .9            Critical Path: sequence of activities that determines duration of Project. Generally, it is the longest path through Project.
    - .1            Usually defined as those activities with float less than or equal to specified value, often zero.
  - .10           Critical Path Method (CPM): network analysis technique used to determine the amount of scheduling flexibility (amount of float) on various logical network paths in Project schedule network, and to determine the minimum total Project duration.
  - .11           Data Date: date through which project status and progress were last determined and reported for analyses, such as scheduling and performance measurements.
  - .12           Duration: total number of work periods (not including holidays or other non-working periods) required to complete activity or other Project element.
    - .1            Usually expressed as workdays or work weeks.
  - .13           Early Finish Date: in critical path method, earliest possible point in time on which uncompleted portions of activity (or Project) can finish, based on network logic and schedule constraints.

- .1 Early finish dates can change as Project progresses and changes are made to Project plan.
- .14 Early Start Date: in critical path method, earliest possible point in time on which uncompleted portions of activity (or Project) can start, based on network logic and schedule constraints.
  - .1 Early start dates can change as Project progresses and changes are made to Project Plan.
- .15 Finish Date: point in time associated with activity's completion.
  - .1 Usually qualified by one of following: actual, planned, estimated, scheduled, early, late, baseline, target, or current.
- .16 Float: amount of time that activity may be delayed from its early start without delaying Project finish date.
  - .1 This resource is available to both Departmental Representative and Contractor.
- .17 Impact Analysis: schedule analysis technique that adds a modeled delay to an accepted construction schedule to determined possible outcome of that delay on project completion.
- .18 Lag: modification of logical relationship that directs delay in successor activity.
- .19 Late Finish Date (LF): in critical path method, latest possible point in time that activity may be completed without delaying specified milestone (usually Project finish date).
- .20 Late Start Date (LS): in critical path method, latest possible point in time that activity may begin without delaying specified milestone (usually Project finish date).
- .21 Lead: modification of logical relationship that allows acceleration of successor task.
- .22 Logic Diagram: see Project network diagram.
- .23 Master Schedule: summary-level schedule that identifies major deliverable; work breakdowns structure and key milestones.
- .24 Milestone: significant point or event in Project, usually completion of major deliverable.
- .25 Monitoring: capture, analysis, and reporting of Project performance, usually as compared to plan.
- .26 Non-Critical Activities: activities which when delayed, do not affect specified Contract duration.
- .27 Project Control System: fully computerized system utilizing commercially available software packages.
- .28 Project Network Diagram: schematic display of logical relationships of Project activities.
  - .1 Always drawn from left to right to reflect Project chronology.
- .29 Project Plan: formal, approved document used to guide both Project execution and Project control.
  - .1 Primary uses of Project plan are to document planning assumptions and decisions, facilitate communication among stakeholders, and document approved scope, cost, and schedule baselines.
  - .2 Project plan may be summary or detailed.
- .30 Project Planning: development and maintenance of Project Plan.

- .31 Project Planning, Monitoring and Control System: overall system operated to enable monitoring of Project Work in relation to established milestones.
  - .32 Project Schedule: planned dates for performing activities and planned dates for meeting milestones.
  - .33 Quantified days duration: working days based on 5 day work week, discounting statutory holidays.
  - .34 Risk: uncertain event or condition that, if it occurs, has positive or negative effect on Project's objectives.
  - .35 Start Date: point in time associated with activity's start, usually qualified by one of following: actual, planned, estimated, scheduled, early, late, target, baseline, or current.
  - .36 Work Breakdown Structure (WBS): deliverable-oriented hierarchical decomposition of Work to be executed by contractor to accomplish project objectives and create required deliverables. It organizes and defines total scope of Project. Each descending level represents an increasingly detailed definition of Project Work. WBS is decomposed into Work packages.
- .2 Reference Standards:
- .1 Project Management Institute (PMI Standards)
    - .1 A Guide to the Project Management Body of Knowledge (PMBOK Guide) - Sixth Edition.
    - .2 Practice Standard for Scheduling - 2019.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Project Meeting:
  - .1 Meet with Departmental Representative within ten working days of Award of Contract date, to establish Work requirements and approach to project construction operations.
  - .2 Participate in regular project progress meetings with Departmental Representative specifically intended to discuss update of detailed schedule and contract changes.
- .2 Scheduling:
  - .1 Planning: ensure that planning process is iterative and results in generally top-down processing with more detail being developed as planning progresses, and decisions concerning options and alternatives are made.
  - .2 Ensure project schedule efficiencies through monitoring of Project in detail to ensure integrity of Critical Path, by comparing actual completions of individual activities with their scheduled completions, and review progress of activities that has started but are not yet completed.
  - .3 Monitor sufficiently often so that causes of delays can immediately be identified and removed.
- .3 Project monitoring and reporting:
  - .1 Keep team aware of changes to schedule, and possible consequences as project progresses.
  - .2 Use narrative reports to provide advice on seriousness of difficulties and measures to overcome them.

- .3 Begin narrative reporting with statement on general status of Project followed by summarization of delays, potential problems, corrective measures and Project status criticality.
- .4 Critical Path Method (CPM) Requirements:
  - .1 Ensure Master Plan and Detail Schedule are practical and remain within specified Contract duration.
  - .2 Revise Master Schedule and Detail Schedule deemed impractical by Departmental Representative and resubmit for approval.
  - .3 Change to Contract Duration:
    - .1 Acceptance of Master Schedule and Detail Schedule showing scheduled Contract duration shorter than specified Contract duration does not constitute change to Contract.
    - .2 Duration of Contract may only be changed through bilateral Agreement.
  - .4 Consider Master Schedule and Detail Schedule deemed practical by Departmental Representative, showing Work completed in less than specified Contract duration, to have float.
  - .5 First Milestone on Master Schedule and Detail Schedule will identify start Milestone with an "ES" constraint date equal to Award of Contract date.
  - .6 Calculate dates for completion milestones from Plan and Schedule using specified time periods for Contract.
  - .7 Interim Certificate with "LF" constraint equal to calculated date.
  - .8 Calculations on updates to be such that if early finish of Interim Certificate falls later than specified Contract duration then float calculation to reflect negative float.
  - .9 Delays to non-critical activities, those with float may not be basis for time extension.
  - .10 Do not use float suppression techniques such as software constraints, preferential sequencing, special lead/lag logic restraints, extended activity times imposed dates other than required by Contract.
  - .11 Allow for and show Master Plan and Detail Schedule adverse weather conditions normally anticipated.
    - .1 Specified Contract duration has been predicated assuming normal amount of adverse weather conditions.
  - .12 Provide necessary crews and manpower to meet schedule requirements for performing Work within specified Contract duration.
    - .1 Simultaneous use of multiple crews on multiple fronts on multiple critical paths may be required.
  - .13 Arrange participation on and off site of subcontractors and suppliers, as required by Departmental Representative, for purpose of network planning, scheduling, updating and progress monitoring.
    - .1 Approvals by Departmental Representative of original networks and revisions do not relieve Contractor from duties and responsibilities required by Contract.
  - .14 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative Project Control System for planning, scheduling, monitoring and reporting of project progress.
- .3 Submit Project Control System to Departmental Representative for approval.
  - .1 Failure to comply with each required submission, may result in progress payment being withheld.
- .4 Include costs for execution, preparation and reproduction of schedule submittals in bid documents.
- .5 Submit letter ensuring that schedule has been prepared in co-ordination with major sub-contractors.
- .6 Refer to article "PROGRESS MONITORING AND REPORTING" of this specification Section for frequency of Project control system submittals.
- .7 Submit impact analysis of schedule for changes that result in extension of contract duration.
  - .1 Include draft schedule update and report as outlined in article "PROGRESS MONITORING AND REPORTING".
- .8 Submit Project planning, monitoring and control system data as part of initial schedule submission and monthly status reporting and as required by Departmental Representative in following form.
  - .1 Flash drive files in original scheduling software containing schedule and cash flow information, labelled with data date, specific update, and person responsible for update.
  - .2 Master Schedule Bar Chart.
  - .3 Construction Detail schedule Bar Chart.
  - .4 Listing of project activities including milestones and logical connectors, networks (sub-networks) from Project start to end. Sort activities by activity identification number and accompany with descriptions. List early and late start and finish dates together with durations, codes and float.
  - .5 Criticality report listing activities and milestones with up to 5 days total float used as first sort for ready identification of critical paths through entire project. List early and late starts and finishes dates, together with durations, codes and float for critical activities.
  - .6 Progress report in early start sequence, listing for each trade, activities due to start, or finished within 2 months from monthly update date. List activity identification number, description and duration. Provide columns for entry of actual start and finish dates, duration remaining and remarks concerning action required.

#### **1.5 QUALITY ASSURANCE**

- .1 Use experienced personnel, fully qualified in planning and scheduling to provide services from start of construction to Final Certificate, including Commissioning.

## **1.6 WORK BREAKDOWN STRUCTURE (WBS)**

- .1 Prepare construction Work Breakdown Structure (WBS) within ten working days of Award of Contract date.
  - .1 Develop WBS through at least five levels: project, stage, element, sub-element and work package.

## **1.7 PROJECT MILESTONES**

- .1 Mandatory and recommended project milestones form targets for both Master Schedule and Detail Schedule of CPM construction network system.
  - .1 Recommended: interior finishing and fitting, mechanical and electrical work completed within 50 working days of Award of Contract date.
  - .2 Recommended: interim Certificate (substantial completion) within 55 working days of Award of Contract date.
  - .3 Mandatory: final Certificate completion within 60 working days of Award of Contract date.

## **1.8 MASTER SCHEDULE**

- .1 Structure and base CPM construction networks system on WBS coding in order to ensure consistency throughout Project.
- .2 Prepare comprehensive construction Master Schedule (CPM logic diagram) and dependent Cash Flow Projection within ten working days of finalizing Agreement to confirm validity or alternates of identified milestones.
  - .1 Master Schedule will be used as baseline.
    - .1 Revise baseline as conditions dictate and as required by Departmental Representative.
    - .2 Departmental Representative as Project progresses will review and return revised baseline within five work days.
- .3 Reconcile revisions to Master Schedule and Cash Flow Projections with previous baseline to provide continuous audit trail.
- .4 Initial and subsequent Master Schedule will include:
  - .1 Flash drive containing schedule and cash flow information, clearly labelled with data date, specific update, and person responsible for update.
  - .2 Bar chart identifying coding, activity durations, early/late and start/finish dates, total float, completion as percentile, current status and budget amounts.
  - .3 Network diagram showing coding, activity sequencing (logic), total float, early/late dates, current status and durations.
  - .4 Actual/projected monthly cash flow: expressed monthly and shown in both graphical and numerical form.

## **1.9 DETAIL SCHEDULE**

- .1 Provide detailed project schedule (CPM logic diagram) within ten working days of Award of Contract date showing activity sequencing, interdependencies and duration estimates. Include listed activities as follows:
  - .1 Shop drawings.



- .2 Samples.
- .3 Approvals.
- .4 Procurement.
- .5 Construction.
- .6 Installation.
- .7 Site works.
- .8 Testing.
- .9 Commissioning and acceptance.
- .2 Detail CPM schedule to cover in detail minimum period of three months beginning from Award of Contract date.
  - .1 Show remaining activities for CPM construction network system up to Final Certificate and develop complete detail as project progresses.
  - .2 Detail activities completely and comprehensively throughout duration of project.
- .3 Relate Detail Schedule activities to basic activities and milestones developed and approved in Master Schedule.
- .4 Clearly show sequence and interdependence of construction activities and indicate:
  - .1 Start and completion of all items of Work, their major components, and interim milestone completion dates.
  - .2 Activities for procurement, delivery, installation and completion of each major piece of equipment, materials and other supplies, including:
    - .1 Time for submittals, resubmittals and review.
    - .2 Time for fabrication and delivery of manufactured products for Work.
    - .3 Interdependence of procurement and construction activities.
  - .3 Include sufficient detail to assure adequate planning and execution of Work. Activities should generally range in duration from 3 to 15 workdays each.
- .5 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated and allow co-ordination and control of project activities. Show continuous flow from left to right.
- .6 Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being, whenever possible, continuous series of activities throughout length of Project to form "Critical Path". Increased number of critical activities is seen as indication of increased risk.
- .7 Insert Change Orders in appropriate and logical location of Detail Schedule. After analysis, clearly state and report to Departmental Representative for review effects created by insertion of new Change Order.

#### **1.10 REVIEW OF THE CONSTRUCTION DETAIL SCHEDULE**

- .1 Allow 5 work days for review by Departmental Representative of proposed construction Detail Schedule.
- .2 Upon receipt of reviewed Detail Schedule make necessary revisions and resubmit to Departmental Representative for review within 5 work days.
- .3 Promptly provide additional information to validate practicability of Detail Schedule as required by Departmental Representative.

- .4 Submittal of Detail Schedule indicates that it meets Contract requirements and will be executed generally in sequence.

#### **1.11 COMPLIANCE WITH DETAIL SCHEDULE**

- .1 Comply with reviewed Detail Schedule.
- .2 Proceed with significant changes and deviations from scheduled sequence of activities that cause delay, only after written receipt of approval by Departmental Representative.
- .3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.
  - .1 Corrective measures may include:
    - .1 Increase of personnel on site for effected activities or work package.
    - .2 Increase in materials and equipment.
    - .3 Overtime work and additional work shifts.
- .4 Submit to Departmental Representative, justification, project schedule data and supporting evidence for approval of extension to Contract completion date or interim milestone date when required. Include as part of supporting evidence:
  - .1 Written submission of proof of delay based on revised activity logic, duration and costs, showing time impact analysis illustrating influence of each change or delay relative to approved contract schedule.
  - .2 Prepared schedule indicating how change will be incorporated into the overall logic diagram. Demonstrate perceived impact based on date of occurrence of change and include status of construction at that time.
  - .3 Other supporting evidence requested by Departmental Representative.
  - .4 Do not assume approval of Contract extension prior to receipt of written approval from Departmental Representative.
- .5 In event of Contract extension, display in Detail Schedule that scheduled float time available for work involved has been used in full without jeopardizing earned float.
  - .1 Departmental Representative will determine and advise Contractor number of allowable days for extension of Contract based on project schedule updates for period in question, and other factual information.
  - .2 Construction delays affecting project schedule will not constitute justification for extension of contract completion date.

#### **1.12 PROGRESS MONITORING AND REPORTING**

- .1 On ongoing basis, Detail Schedule on job site must show "Progress to Date". Arrange participation on and off site of subcontractors and suppliers, as, and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Departmental Representative at least once monthly to establish progress on each current activity shown on applicable networks.
- .2 Update and reissue project Work Breakdown Structure and relevant coding structures as project develops and changes.
- .3 Perform Detail Schedule update monthly with status dated (Data Date) on last working day of month. Update to reflect activities completed to date, activities in progress, logic and duration changes.

- .4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.
- .5 Submit to Departmental Representative copies of updated Detail Schedule.
- .6 Requirements for monthly progress monitoring and reporting are basis for progress payment request.
- .7 Submit monthly written report based on Detail Schedule, showing Work to date performed, comparing Work progress to planned, and presenting current forecasts. Report must summarize progress, defining problem areas and anticipated delays with respect to Work schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate any potential delay. Include in report:
  - .1 Description of progress made.
  - .2 Pending items and status of: permits, shop drawings, change orders, possible time extensions.
  - .3 Status of Contract completion date and milestones.
  - .4 Current and anticipated problem areas, potential delays and corrective measures.
  - .5 Review of progress and status of Critical Path 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                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 21 05 01 Common Work Results for Mechanical

**1.2                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.

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada.
- .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 ten 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 transmittal letter, in duplicate, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .7 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.
- .8 After 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 product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .11 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.
- .12 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of project contract complete with project name.
- .13 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.
- .14 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .15 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 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.
- .20 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 to Departmental Representative's business address.

- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

**1.5 MOCK-UPS**

- .1 Erect mock-ups in accordance with 01 45 00 - Quality Control.

**1.6 PHOTOGRAPHIC DOCUMENTATION**

- .1 Submit electronic copy of colour digital photography in jpg format, standard resolution minimum monthly with progress statement or more frequently as directed by Departmental Representative.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints: 2 locations.
  - .1 Viewpoints and their location as determined by Departmental Representative.
- .4 Frequency of photographic documentation: weekly.
  - .1 Upon completion of: framing and services before concealment of Work.

**1.7 CERTIFICATES AND TRANSCRIPTS**

- .1 Immediately after award of Contract, 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)
  
- .8 Asbestos abatement: Refer to DST Consulting Engineers Inc. Hazardous Building Materials Assessment Reports (herein referred to as the Previous Environmental Reports):
  - .1 Pre-Renovation Hazardous Materials Assessment Emergency Generator Upgrade Project – Abbotsford Huntingdon Point of Entry, Abbotsford BC dated January 15, 2020: Appendix B
  - .2 Pre-Renovation Hazardous Materials Assessment Emergency Generator Upgrade Project – Kingsgate Point of Entry, 6923 Customs Road, Kingsgate, British Columbia, dated January 16, 2020.: Appendix C
  - .3 Pre-Renovation Hazardous Materials Assessment Emergency Generator Upgrade Project – Waneta Point of Entry, 10290 Highway 22A, Salmo, British Columbia, dated January 16, 2020 : Appendix D

## **1.2 RELATED SECTIONS**

- .1 Refer to the following current NMS sections as required:
  - .1 Section 01 01 50 - General Instructions

## **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 01 50.
- .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 01 50.
  - .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 AND HOT WORK**

- .1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.
- .2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.
- .3 Hot Work permits are a mandatory requirement for any hot work activities.

### **1.28 FIRE SAFETY REQUIREMENTS**

- .1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada. (as amended)
- .3 Portable gas and diesel fuel tanks are not permitted on most federal work sites. Approval from the Departmental Representative is required prior to any gas or diesel tank being brought onto the work site.

### **1.29 FIRE PROTECTION AND ALARM SYSTEM**

- .1 Fire protection and alarm systems shall not be:
  - .1 Obstructed.
  - .2 Shut off.
  - .3 Left inactive at the end of a working day or shift.
- .2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.
- .3 Be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.

### **1.30 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.

### **1.31 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.

### **1.32 MEETINGS**

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

### **1.33 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 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.

**1.2 REFERENCES AND CODES**

- .1 Perform design and Work in accordance with Codes Canada 2015, BC Building Code 2018, BC Plumbing Code 2018 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 Meet or exceed requirements of:
  - .1 Contract documents.
  - .2 Specified standards, codes and referenced documents.

**1.3 PERMITS & INSPECTIONS**

- .1 Contractor shall apply and obtain a building permit and include cost of associated fee within the tender price.
- .2 The Contractor shall obtain all permits and pay all fees relating to the Work to all authorities having jurisdiction unless otherwise directed by the Departmental Representative.

**1.4 HAZARDOUS MATERIAL DISCOVERY**

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative. Refer to 02 82 00.02 - Asbestos Abatement - Intermediate Precautions.
- .2 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Departmental Representative. Refer to Section 02 87 13.15 - Mould Remediation - Maximum Precautions.

**1.5 BUILDING SMOKING ENVIRONMENT**

- .1 Comply with smoking restrictions and municipal 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 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.

**1.2 INSPECTION**

- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction.

**1.3 INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Departmental Representative.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and reinspection.

**1.4 ACCESS TO WORK**

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

**1.5 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.

**1.6 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, amount of which will be determined by Departmental Representative.

**1.7 REPORTS**

- .1 Submit 4 copies of inspection and test reports to Departmental Representative.
- .2 Provide copies to subcontractor of work being inspected or tested or to manufacturer or fabricator of material being inspected or tested.

**1.8 TESTS AND MIX DESIGNS**

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

**1.9 MOCK-UPS**

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations as specified in specific Section.
- .3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups 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.
- .5 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.
- .6 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

**1.10 MILL TESTS**

- .1 Submit mill test certificates as required of specification Sections.



**1.11 EQUIPMENT AND SYSTEMS**

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

**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 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 21 05 01 Common Work Results for Mechanical.

**1.2 REFERENCES**

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water
  - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4 INSTALLATION AND REMOVAL**

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

**1.5 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 non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
  - .1 Facilitate progress of Work.
  - .2 Protect Work and products against dampness and cold.
  - .3 Prevent moisture condensation on surfaces.
  - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
  - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .5 Ventilating:
  - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
  - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
  - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.

- .4 Ventilate storage spaces containing hazardous or volatile materials.
- .5 Ventilate temporary sanitary facilities.
- .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Permanent heating system of building, not to be used when available. Be responsible for damage to heating system if use is permitted.
- .7 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform to 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.
- .8 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

**1.6 TEMPORARY COMMUNICATION FACILITIES**

- .1 Provide and pay for temporary telephone, data hook up, lines and equipment necessary for own use and use of Departmental Representative.

**1.7 FIRE PROTECTION**

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 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.

**1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
  - .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA-0121-17, Douglas Fir Plywood.
  - .3 CAN/CSA-S269.2-16, Access Scaffolding for Construction Purposes.
  - .4 CAN/CSA-Z321-96(R2006), Signs and Symbols for the Occupational Environment.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4 INSTALLATION AND REMOVAL**

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

**1.5 SCAFFOLDING**

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, platforms, and temporary stairs as needed.

**1.6 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 qualified operator.

**1.7 SITE STORAGE/LOADING**

- .1 Confine work and operations of employees by 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.

**1.8 CONSTRUCTION PARKING**

- .1 Parking will be permitted on site or adjacent street provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.
- .3 Clean runways and taxi areas where used by Contractor's equipment.

**1.9 SECURITY**

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

**1.10 OFFICES**

- .1 Provide office heated up to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

**1.11 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.

**1.12 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.

**1.13 PROTECTION AND MAINTENANCE OF TRAFFIC**

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs

- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Construct access road as necessary.
- .8 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .9 Dust control: adequate to ensure safe operation at all times.
- .10 Location, grade, width, and alignment of construction road: subject to approval by Departmental Representative.
- .11 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .12 Provide snow removal during period of Work.
- .13 Remove, upon completion of work, access road designated by Departmental Representative.

**1.14 CLEAN-UP**

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

**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 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
  - .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-O121-17, Douglas Fir Plywood.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

**1.3 INSTALLATION AND REMOVAL**

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

**1.4 GUARD RAILS AND BARRICADES**

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs, and where shown.
- .2 Provide as required by governing authorities and as indicated.

**1.5 WEATHER ENCLOSURES**

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors, exterior walls and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure.

**1.6 DUST TIGHT SCREENS**

- .1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.

**1.7 ACCESS TO SITE**

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

**1.8 PUBLIC TRAFFIC FLOW**

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

**1.9 FIRE ROUTES**

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

**1.10 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY**

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

**1.11 PROTECTION OF BUILDING FINISHES**

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Departmental Representative 3 locations and installation schedule days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

**1.12 WASTE MANAGEMENT AND DISPOSAL**

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

**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 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 21 05 01 Common Work Results for Mechanical.

**1.2 REFERENCES**

- .1 Within text of each specifications section, reference may be made to reference standards.
- .2 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

**1.3 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.

**1.4 STORAGE, HANDLING AND PROTECTION**

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

- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

#### **1.5 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.

#### **1.6 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, so that 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.

#### **1.7 QUALITY OF WORK**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

**1.8 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.

**1.9 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.

**1.10 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.

**1.11 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.

**1.12 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.

**1.13 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.

**1.14 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.

**1.15 EXISTING UTILITIES**

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

**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            This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2                REFERENCES**

- .1            Identification of existing survey control points and property limits.

**1.3                EXISTING SERVICES**

- .1            Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .2            Remove abandoned service lines within 2m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

**1.4                LOCATION OF EQUIPMENT AND FIXTURES**

- .1            Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2            Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3            Inform Departmental Representative of impending installation and obtain approval for actual location.
- .4            Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

**1.5                RECORDS**

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

**1.6                ACTION AND INFORMATIONAL SUBMITTALS**

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

**Part 2            Products**

**2.1                NOT USED**

- .1            Not Used.

**Part 3            Execution**

**3.1                NOT USED**

- .1            Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
  - .1 Structural integrity of elements of project.
  - .2 Integrity of weather-exposed or moisture-resistant elements.
  - .3 Efficiency, maintenance, or safety of operational elements.
  - .4 Visual qualities of sight-exposed elements.
- .3 Include in request:
  - .1 Identification of project.
  - .2 Location and description of affected Work.
  - .3 Statement on necessity for cutting or alteration.
  - .4 Description of proposed Work, and products to be used.
  - .5 Alternatives to cutting and patching.
  - .6 Date and time work will be executed.

**1.3 MATERIALS**

- .1 Required for original installation.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

**1.4 PREPARATION**

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work.

**1.5 EXECUTION**

- .1 Execute cutting, fitting, and patching to complete Work.
- .2 Fit several parts together, to integrate with other Work.
- .3 Uncover Work to install ill-timed Work.

- .4 Remove and replace defective and non-conforming Work.
- .5 Remove samples of installed Work for testing.
- .6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .7 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .8 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .10 Restore work with new products in accordance with requirements of Contract Documents.
- .11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

**1.6 WASTE MANAGEMENT AND DISPOSAL**

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

**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        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 23 01 31 Air Duct Cleaning – HVAC Systems.

**1.2            PROJECT CLEANLINESS**

- .1        Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by other Contractors (as applicable).
- .2        Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
- .3        Clear snow and ice from access to building, bank/pile snow in designated areas only.
- .4        Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5        Provide on-site dump containers for collection of waste materials and debris.
- .6        Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .7        Dispose of waste materials and debris off site at transfer station/disposal site.
- .8        Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .9        Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .10       Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .11       Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .12       Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

**1.3            FINAL CLEANING**

- .1        When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2        Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3        Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4        Remove waste products and debris other than that caused by other Contractors (as applicable).

- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, ceilings and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds affected by the Work.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems affected by the Work.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to building.

**1.4 WASTE MANAGEMENT AND DISPOSAL**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                WASTE MANAGEMENT GOALS**

- .1        Prior to start of Work conduct meeting with Departmental Representative to review and discuss PWGSC's Waste Management Plan and Goals.
- .2        PWGSC's Waste Management Goal 75 percent of total Project Waste to be diverted from landfill sites. Provide Departmental Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3        Accomplish maximum control of solid construction waste.
- .4        Preserve environment and prevent pollution and environment damage.

**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.

**1.3                DEFINITIONS**

- .1        Class III: non-hazardous waste - construction renovation and demolition waste.
- .2        Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.
- .3        Demolition Waste Audit (DWA): relates to actual waste generated from project.
- .4        Inert Fill: inert waste - exclusively asphalt and concrete.
- .5        Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .6        Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .7        Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .8        Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .9        Reuse: repeated use of product in same form but not necessarily for same purpose.  
Reuse includes:
  - .1        Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
  - .2        Returning reusable items including pallets or unused products to vendors.
- .10       Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .11       Separate Condition: refers to waste sorted into individual types.

- .12 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .13 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.
- .14 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .15 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

#### **1.4 DOCUMENTS**

- .1 Maintain at job site, one copy of following documents:
  - .1 Waste Audit.
  - .2 Waste Reduction Workplan.
  - .3 Material Source Separation Plan.
  - .4 Schedules A, B, C, D, and E completed for project.

#### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit following prior to project start-up:
  - .1 Submit 2 copies of completed Waste Audit (WA): Schedule A.
  - .2 Submit 2 copies of completed Waste Reduction Workplan (WRW): Schedule B.
  - .3 Submit 2 copies of completed Demolition Waste Audit (DWA): Schedule C.
  - .4 Submit 2 copies of Cost/Revenue Analysis Workplan (CRAW): Schedule D.
  - .5 Submit 2 copies of Materials Source Separation Program (MSSP) description.
- .3 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.
  - .1 Failure to submit could result in hold back of final payment.
  - .2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.
  - .3 For each material reused, sold or recycled from project, include amount in tonnes and the destination.
  - .4 For each material land filled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

#### **1.6 WASTE AUDIT (WA)**

- .1 Conduct WA prior to project start-up.
- .2 Prepare WA: Schedule A.
- .3 Record, on WA - Schedule A, extent to which materials or products used consist of recycled or reused materials or products.

**1.7 WASTE REDUCTION WORKPLAN (WRW)**

- .1 Prepare WRW prior to project start-up.
- .2 WRW should include but not limited to:
  - .1 Destination of materials listed.
  - .2 Deconstruction/disassembly techniques and sequencing.
  - .3 Schedule for deconstruction/disassembly.
  - .4 Location.
  - .5 Security.
  - .6 Protection.
  - .7 Clear labelling of storage areas.
  - .8 Details on materials handling and removal procedures.
  - .9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.
- .3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .4 Describe management of waste.
- .5 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.
- .6 Post WRW or summary where workers at site are able to review content.
- .7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

**1.8 DEMOLITION WASTE AUDIT (DWA)**

- .1 Prepare DWA prior to project start-up.
- .2 Complete DWA: Schedule C.
- .3 Provide inventory of quantities of materials to be salvaged for reuse, recycling, or disposal.

**1.9 COST/REVENUE ANALYSIS WORKPLAN (CRAW)**

- .1 Prepare CRAW: Schedule D.

**1.10 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)**

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Departmental Representative.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials.

- .5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .6 Locate separated materials in areas which minimize material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
  - .1 Transport to approved and authorized recycling facility.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.
  - .1 Ship materials to site operating under Certificate of Approval.
  - .2 Materials must be immediately separated into required categories for reuse or recycling.

**1.11 WASTE PROCESSING SITES**

- .1 Province of: British Columbia.
  - .1 Name: West Coast Landfill.
  - .2 Telephone: 250-726-2727.

**1.12 STORAGE, HANDLING AND PROTECTION**

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, materials for removal do not become Contractor's property.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Protect surface drainage, mechanical and electrical from damage and blockage.
- .5 Separate and store materials produced during dismantling of structures in designated areas.
- .6 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
  - .1 On-site source separation is recommended.
  - .2 Remove co-mingled materials to off-site processing facility for separation.
  - .3 Provide waybills for separated materials.

**1.13 DISPOSAL OF WASTES**

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, or paint thinner into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:
  - .1 Number and size of bins.
  - .2 Waste type of each bin.
  - .3 Total tonnage generated.
  - .4 Tonnage reused or recycled.

- .5 Reused or recycled waste destination.
  - .4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
  - .5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.
- 1.14 USE OF SITE AND FACILITIES**
- .1 Execute work with least possible interference or disturbance to normal use of premises.
  - .2 Maintain security measures established by existing facility.
- 1.15 SCHEDULING**
- .1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.
- Part 2 Products**
- 2.1 NOT USED**
- .1 Not Used.
- Part 3 Execution**
- 3.1 SELECTIVE DEMOLITION**
- .1 Reuse of Building Elements: this project has been designed to result in end of project rates for reuse of building elements as follows: do not demolish building elements beyond what is indicated on Drawings without approval by Departmental Representative's.
    - .1 Building Structure and Shell: extent as shown on plans.
    - .2 Interior Non-Shell Elements: extent as shown on plans.
- 3.2 APPLICATION**
- .1 Do Work in compliance with WRW.
  - .2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.
- 3.3 CLEANING**
- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
  - .2 Clean-up work area as work progresses.
  - .3 Source separate materials to be reused/recycled into specified sort areas.
- 3.4 DIVERSION OF MATERIALS**
- .1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by Departmental Representative, and consistent with applicable fire regulations.

- .1 Mark containers or stockpile areas.
- .2 Provide instruction on disposal practices.
- .2 On-site sale of salvaged, recovered, reusable, or recyclable materials is not permitted.
- .3 Demolition Waste:

Material Type	Recommended Diversion %	Actual Diversion %
Acoustic Tile	50	_____
Acoustical Insulation	100	_____
Carpet	100	_____
De-mountable Partitions	80	_____
Doors and Frames	100	_____
Electrical Equipment	80	_____
Furnishings	80	_____
Marble Base	100	_____
Mechanical Equipment	100	_____
Metals	100	_____
Rubble	100	_____
Wood (uncontaminated)	100	_____

- .4 Construction Waste:

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

**3.5 WASTE AUDIT (WA)**

- .1 Schedule A - Waste Audit (WA):

(1) Material Category	(2) Material Quantity Unit	(3) Estimated Waste %	(4) Total Quantity of Waste (unit)	(5) Generation Point	(6) % Recycled	(7) % Reused
Wood and Plastics Material Description						
Off-cuts						
Warped Pallet Forms						
Plastic Packaging						
Cardboard Packaging						
Other						
Doors and Windows Material Description						



Painted Frames						
Glass						
Wood						
Metal						
Other						

**3.6 WASTE REDUCTION WORKPLAN (WRW)**

.1 Schedule B:

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

**3.7 DEMOLITION WASTE AUDIT (DWA)**

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

(1) Material Description	(2) Quantity	(3) Unit	(4) Total	(5) Volume (cum)	(6) Weight (cum)	(7) Remarks and Assumptions
Wood						
Wood Stud						
Plywood						
Baseboard-						

Wood						
Door Trim - Wood						
Cabinet						
Doors and Windows						
Panel Regular						
Slab Regular						
Wood Laminate						
Byfold - Closet						
Glazing						

**3.8 COST/REVENUE ANALYSIS WORKPLAN (CRAW)**

.1 Schedule D - Cost/Revenue Analysis Workplan (CRAW):

(1) Material Description	(2) Total Quantity (unit)	(3) Volume (cum)	(4) Weight (cum)	(5) Disposal Cost/Credit \$(+/-)	(6) Category Sub-Total \$(+/-)
Wood					
Wood Stud					
Plywood					
Baseboard - Wood					
Door Trim - Wood					
Cabinet					\$
Doors and Windows					
Panel Regular					
Slab Regular					
Wood Laminate					
Byfold - Closet					
Glazing					\$
		(7) Cost (-) / Revenue (+)			\$

**3.9 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT**

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

Province	Address	General Inquires	Fax
British Columbia	Ministry of Environment Lands and Parks 810 Blanshard Street, 4 th Floor Victoria BC V8V 1X4	604-387-1161	604-356-6464

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

**END OF SECTION**

**Part 1 General**

**1.1 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 21 05 01 Common Work Results for Mechanical.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Acceptance of Work Procedures:
  - .1 Contractor's Inspection: Contractor: 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 Contractor's inspection and submit verification that corrections have been made.
    - .2 Request Departmental Representative inspection.
  - .2 Departmental Representative 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 Equipment and systems: tested, adjusted, and balanced and fully operational.
    - .4 Certificates required by Utility companies: submitted.
    - .5 Operation of systems: demonstrated to Departmental Representative.
    - .6 Commissioning of mechanical systems: completed in accordance with 01 91 13 - General Commissioning (Cx) Requirements and copies of final Commissioning Report submitted to Departmental Representative.
    - .7 Work: complete and ready for final inspection.
  - .4 Final Inspection:
    - .1 When completion tasks are done, request final inspection of Work by Departmental Representative, and Contractor.
    - .2 When Work incomplete according to Departmental Representative, complete outstanding items and request re-inspection.

**1.3 FINAL CLEANING**

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

- .2 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**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 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 21 05 01 Common Work Results for Mechanical.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-warranty Meeting:
  - .1 Convene meeting one week prior to contract completion with contractor's representative and Departmental Representative, in accordance with Section 01 31 19 - Project Meetings to:
    - .1 Verify Project requirements.
    - .2 Review warranty requirements and manufacturer's installation instructions.
  - .2 Departmental Representative to establish communication procedures for:
    - .1 Notifying construction warranty defects.
    - .2 Determine priorities for type of defects.
    - .3 Determine reasonable response time.
  - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
  - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in English.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

**1.4 FORMAT**

- .1 Organize data as 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.
  - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

- .5 Arrange content by systems under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
  - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg and PDF formats on flash drive.

### **1.5 CONTENTS - PROJECT RECORD DOCUMENTS**

- .1 Table of Contents for Each Volume: provide title of project;
  - .1 Date of submission; names.
  - .2 Addresses, and telephone numbers of Contractor with name of responsible parties.
  - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
  - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- .6 Training: refer to Section 01 79 00 - Demonstration and Training.

### **1.6 AS -BUILT DOCUMENTS AND SAMPLES**

- .1 Maintain at site for Departmental Representative one record copy of:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Change Orders and other modifications to Contract.
  - .5 Reviewed shop drawings, product data, and samples.
  - .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.
  - .1 Provide files, racks, and secure storage.

- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
  - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
  - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Departmental Representative.

## **1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS**

- .1 Record information on set of black line opaque drawings, provided by Departmental Representative.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
  - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
  - .1 Measured depths of elements of foundation in relation to finish first floor datum.
  - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
  - .4 Field changes of dimension and detail.
  - .5 Changes made by change orders.
  - .6 Details not on original Contract Drawings.
  - .7 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
  - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
  - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, and field test records, required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

## **1.8 FINAL SURVEY**

- .1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

## **1.9 EQUIPMENT AND SYSTEMS**

- .1 For each item of equipment and each system include description of unit or system, and component parts.



- .1 Give function, normal operation characteristics and limiting conditions.
- .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
  - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
  - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control 01 91 13 - General Commissioning (Cx) Requirements.

**1.10 MATERIALS AND FINISHES**

- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
  - .1 Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional requirements: as specified in individual specifications sections.

**1.11 MAINTENANCE MATERIALS**

- .1 Spare Parts:
  - .1 Provide spare parts, in quantities specified in individual specification sections.

- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to Departmental Representative.
  - .2 Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
  - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to location as directed; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Departmental Representative.
    - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
  - .1 Provide special tools, in quantities specified in individual specification section.
  - .2 Provide items with tags identifying their associated function and equipment.
  - .3 Deliver to location as directed; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Departmental Representative.
    - .2 Include approved listings in Maintenance Manual.

**1.12 DELIVERY, STORAGE AND HANDLING**

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Departmental Representative.

**1.13 WARRANTIES AND BONDS**

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Departmental Representative approval.
- .3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

- .5 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
  - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
  - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.
  - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, by Departmental Representative.
- .9 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
  - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, motors, commissioned systems.
  - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
    - .1 Name of item.
    - .2 Model and serial numbers.
    - .3 Location where installed.
    - .4 Name and phone numbers of manufacturers or suppliers.
    - .5 Names, addresses and telephone numbers of sources of spare parts.
    - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
    - .7 Cross-reference to warranty certificates as applicable.
    - .8 Starting point and duration of warranty period.
    - .9 Summary of maintenance procedures required to continue warranty in force.
    - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
    - .11 Organization, names and phone numbers of persons to call for warranty service.
    - .12 Typical response time and repair time expected for various warranted equipment.

- .4 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.
- .5 Procedure and status of tagging of equipment covered by extended warranties.
- .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
  - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

**1.14 WARRANTY TAGS**

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
  - .1 Type of product/material.
  - .2 Model number.
  - .3 Serial number.
  - .4 Contract number.
  - .5 Warranty period.
  - .6 Inspector's signature.
  - .7 Construction Contractor.

**Part 2 Products**

**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 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 21 05 01 Common Work Results for Mechanical.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Demonstrate operation and maintenance of equipment and systems to Departmental Representative's personnel two weeks prior to date of final inspection.
- .2 Departmental Representative: provide list of personnel to receive instructions, and coordinate their attendance at agreed-upon times.
- .3 Preparation:
  - .1 Verify conditions for demonstration and instructions comply with requirements.
  - .2 Verify designated personnel are present.
  - .3 Ensure equipment has been inspected and put into operation in accordance with Section 23 11 13 Facility Fuel Oil Piping, Section 23 13 00 Fuel Storage Tanks, and Section 23 08 00 Commissioning of Mechanical Systems.
  - .4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and equipment and systems are fully operational.
- .4 Demonstration and Instructions:
  - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location.
  - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
  - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
  - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.
- .5 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system as follows:
  - .1 Ventilation System: one hour of instruction.
  - .2 Plumbing System: one half hour of instruction.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

**1.4 QUALITY ASSURANCE**

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
  - .1 Instruct Departmental Representative 's personnel.
  - .2 Provide written report that demonstration and instructions have been completed.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .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 01 91 33 – Commissioning Forms, 01 91 41 – Commissioning Training, 23 08 00, Commissioning of Mechanical Systems.
- .3 Acronyms:
  - .1 AFD - Alternate Forms of Delivery, service provider.
  - .2 BMM - Building Management Manual.
  - .3 Cx - Commissioning.
  - .4 EMCS - Energy Monitoring and Control Systems.
  - .5 O M - Operation and Maintenance.
  - .6 PI - Product Information.
  - .7 PV - Performance Verification.
  - .8 TAB - Testing, Adjusting and Balancing.

**1.2 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.

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

### **1.3 COMMISSIONING OVERVIEW**

- .1 Section 01 91 31 - Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility and 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.
- .6 Departmental Representative DCC Representative will issue Interim Acceptance Certificate when:
  - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
  - .2 Equipment, components and systems have been commissioned.
  - .3 O M training has been completed.

### **1.4 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, and 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.
  - .5 All Cx work is to be conducted as per CSA Z320-11 guidelines.

## **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 8 weeks prior to start of Cx.
  - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 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 (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Refer to Section 23 08 00 Commissioning of Mechanical Systems.
- .3 Departmental Representative to review and approve Cx documentation.
- .4 Provide completed and approved Cx documentation to Departmental Representative.

## **1.9 COMMISSIONING SCHEDULE**

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM).

- .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 Convene Cx meetings as needed following project meetings: Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM) and as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM). 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 in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Cx Agent, who will record and distribute minutes.
- .7 Ensure subcontractors are present at 60% 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 MANUFACTURER'S INVOLVEMENT**

- .1 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 before start-up.
- .2 Integrity of warranties:
  - .1 Use manufacturer's trained start-up personnel if required to maintain integrity of warranty.
  - .2 Verify with manufacturer that testing as specified will not void warranties.
- .3 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.

### **1.13 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 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.

### **1.14 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.

### **1.15 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.

#### **1.16 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.

#### **1.17 START OF COMMISSIONING**

- .1 Notify Departmental Representative at least 21 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

#### **1.18 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 Ladders.
  - .2 Equipment as required to complete work.

#### **1.19 COMMISSIONING PERFORMANCE VERIFICATION**

- .1 Carry out Cx:
  - .1 Under accepted simulated operating conditions, over entire operating range, in all modes.
  - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.

#### **1.20 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 so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Departmental Representative within 5 days of test and with Cx report.

**1.21 EXTRAPOLATION OF RESULTS**

- .1 Do not extrapolate. Contractor and commissioning agent shall allow for seasonal visits to site for verification of systems operation within the warranty period.

**1.22 EXTENT OF VERIFICATION**

- .1 Provide manpower and instrumentation to verify up to 30 % of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to Departmental Representative.

**1.23 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's approval.
  - .2 Repetition of second verification again fails to receive approval.
  - .3 Departmental Representative deems Contractor's request for second verification was premature.

**1.24 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.

**1.25 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.

**1.26 OCCUPANCY**

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

**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.
  - .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.

**1.2**

**REFERENCES**

- .1 American Water Works Association (AWWA)
- .2 Public Works and Government Services Canada (PWGSC)
  - .1 PWGSC - Commissioning Guidelines CP.4 -3rd edition-03.
- .3 Underwriters' Laboratories of Canada (ULC)

**1.3**

**GENERAL**

- .1 Provide a fully functional facility:
  - .1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
  - .2 Facility user and O M personnel have been fully trained in aspects of installed systems.
  - .3 Optimized life cycle costs.
  - .4 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this section means "Commissioning".
- .3 Use this Cx Plan as master planning document for Cx:
  - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
  - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
  - .3 Sets out deliverables relating to O M, process and administration of Cx.
  - .4 Describes process of verification of how built works meet design requirements.
  - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
  - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
    - .1 Overview of Cx.
    - .2 General description of elements that make up Cx Plan.
    - .3 Process and methodology for successful Cx.

- .4 Acronyms:
  - .1 Cx - Commissioning.
  - .2 BMM - Building Management Manual.
  - .3 EMCS - Energy Monitoring and Control Systems.
  - .4 MSDS - Material Safety Data Sheets.
  - .5 PI - Product Information.
  - .6 PV - Performance Verification.
  - .7 TAB - Testing, Adjusting and Balancing.
  - .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
  - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
  - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

#### **1.4 DEVELOPMENT OF 100% CX PLAN**

- .1 Cx Plan to be 95% completed before added into Project Specifications.
- .2 Cx Plan to be 100% completed within 8 weeks of award of contract to take into account:
  - .1 Approved shop drawings and product data.
  - .2 Approved changes to contract.
  - .3 Contractor's project schedule.
  - .4 Cx schedule.
  - .5 Contractor's, sub-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 1 month 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 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
  - .1 Review of Cx documentation from operational perspective.
  - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
  - .3 Protection of health, safety and comfort of occupants and O M personnel.
  - .4 Monitoring of Cx activities, training, development of Cx documentation.
  - .5 Work closely with members of Cx Team.
- .3 Departmental Representative is responsible for:
  - .1 Organizing Cx.
  - .2 Monitoring operations Cx activities.
  - .3 Witnessing, certifying accuracy of reported results.
  - .4 Witnessing and certifying TAB and other tests.
  - .5 Developing BMM.
  - .6 Ensuring implementation of final Cx Plan.
  - .7 Performing verification of performance of installed systems and equipment.
  - .8 Implementation of Training Plan.
- .4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
  - .1 Testing.
  - .2 TAB.
  - .3 Performance of Cx activities.
  - .4 Delivery of training and Cx documentation.
  - .5 Assigning one person as point of contact with Departmental Representative 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.
- .7 All Cx work is to be conducted as per CSA Z320-11 guidelines.

## **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.
  - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O M personnel, including:
    - .1 Modify ventilation rates to meet changes in off-gassing.
    - .2 Changes to heating or cooling loads beyond scope of EMCS.
    - .3 Changes to control strategies beyond level of training provided to O M personnel.
- .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 EXTENT OF CX**

- .1 Cx Structural and Architectural Systems:
  - .1 Architectural and structural:
    - .1 Service platform with concrete pad
- .2 Commission mechanical systems and associated equipment:
  - .1 Mechanical piping systems:
    - .1 Fuel supply and return piping.
    - .2 Condensate line
    - .3 Regular sanitary waste systems.
  - .2 Mechanical equipment:
    - .1 Condensate storage tank.
    - .2 Fuel storage tank
    - .3 Fuel fill-in station
  - .3 Seismic restraint and control measures.

- .1 Fuel storage tank
- .2 Service platform
- .4 Controls:
  - .1 For new fuel storage tank
- .3 Commission electrical systems and equipment:
  - .1 Low voltage below 750 V:
    - .1 New low voltage equipment.
    - .2 New low voltage distribution systems.

## **1.9 DELIVERABLES RELATING TO O M PERSPECTIVES**

- .1 General requirements:
  - .1 Compile English documentation.
  - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
  - .1 Warranties.
  - .2 Project record documentation.
  - .3 Inventory of spare parts, special tools and maintenance materials.
  - .4 Maintenance Management System (MMS) identification system used.
  - .5 WHMIS information.
  - .6 MSDS data sheets.
  - .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

## **1.10 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 of following witnessed by PWGSC Design Quality Review Team:
  - .1 Proper operation of fuel storage tank and accessories
- .10 Tests performed by Departmental Representative.
- .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 to Departmental Representative.
- .5 Departmental Representative to participate.

#### **1.11 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.
  - .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 - ARCHITECTURAL AND STRUCTURAL:
  - .1 Exterior walls: conduct thermographic surveys to ensure appropriate level of tightness after exterior envelope has been completed. Permanent HVAC systems are able to provide appropriate negative or positive pressure, a temperature of at 20 degrees C can be maintained between inside and outside and wind speed is less than 10 kph.
  - .2 Equipment:
    - .1 Service platform: As shown on architectural and mechanical drawings.
- .3 Pre-Cx activities - MECHANICAL:
  - .1 Mechanical piping systems:
    - .1 Drain the fuel supply and return lines
    - .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 Departmental Representative.
- .2 Mechanical equipment:
  - .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 Departmental Representative.
- .3 Controls:
  - .1 Perform testing in parallel with start-up.
  - .2 Carry out verification.
  - .3 Demonstrate performance of systems, to be witnessed by Departmental Representative prior to start of 30 day Final Acceptance Test period.
  - .4 Perform final Cx and operational tests during demonstration period and 30 day test period.
  - .5 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".
- .4 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: As shown on electrical drawings.
  - .3 Low voltage systems: these include:
    - .1 Low voltage lighting control systems.
  - .4 Security, surveillance and intrusion alarm systems (as applicable): to include verification Departmental Representative.

#### **1.12 START-UP**

- .1 Start up components, equipment and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:
  - .1 Fuel storage tank
- .3 Departmental Representative to monitor some of these start-up activities.
  - .1 Rectify start-up deficiencies to satisfaction of Departmental Representative.
- .4 Performance Verification (PV):
  - .1 Approved Cx Agent or Division 23 contractor to perform.
    - .1 Repeat when necessary until results are acceptable to Departmental Representative.
  - .2 Use procedures to suit project requirements.
  - .3 Departmental Representative to witness and certify reported results using approved PI and PV forms.

- .4 Departmental Representative to approve completed PV reports and provide to Contractor.
- .5 Departmental Representative reserves right to verify up to 30% of reported results at random.
- .6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

**1.13 CX ACTIVITIES AND RELATED DOCUMENTATION**

- .1 Perform Cx by specified Cx agency or Division 23 contractor using procedures developed by Departmental Representative and approved by Departmental Representative.
- .2 Departmental Representative to monitor Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .4 Departmental Representative to witness, certify reported results of, Cx activities and forward to Departmental Representative.
- .5 Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

**1.14 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION**

- .1 Cx to be performed by specified Cx specialist, using procedures developed by Cx specialist and approved by Departmental Representative.
- .2 Tests to be witnessed by Departmental Representative and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Contractor and submitted to Departmental Representative for review.
- .4 Departmental Representative reserves right to verify percentage of reported results.
- .5 Integrated systems to include:
  - .1 Fuel storage tanks and associated systems.
- .6 Identification:
  - .1 In later stages of Cx, before hand-over and acceptance Departmental Representative, Contractor, and Cx Manager to co-operate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, systems.

**1.15 INSTALLATION CHECK LISTS (ICL)**

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

**1.16 PRODUCT INFORMATION (PI) REPORT FORMS**

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

**1.17 PERFORMANCE VERIFICATION (PV) REPORT**

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

**1.18 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.

**1.19 CX SCHEDULES**

- .1 Prepare detailed critical path Cx Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule. Include:
  - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
    - .1 Design criteria, design intents.
    - .2 Pre-TAB review: 28 days after contract award, and before construction starts.
    - .3 Cx agents' credentials: 30 days before start of Cx.
    - .4 Cx procedures: 1 month after award of contract.
    - .5 Cx Report format: 1 month after contract award.
    - .6 Discussion of heating/cooling loads for Cx: 1 month before start-up.
    - .7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
    - .8 Notification of intention to start TAB: 21 days before start of TAB.
    - .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
    - .10 Notification of intention to start Cx: 14 days before start of Cx.
    - .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
    - .12 Identification of deferred Cx.
    - .13 Implementation of training plans.
    - .14 Cx reports: immediately upon successful completion of Cx.
  - .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over.
  - .3 6 months in Cx schedule for verification of performance in all seasons and wear conditions.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

**1.20 CX REPORTS**

- .1 Submit reports of tests, witnessed and certified by Departmental Representative 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 Departmental Representative.

**1.21 ACTIVITIES DURING WARRANTY PERIOD**

- .1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
  - .1 Contractor and commissioning agent shall allow for 10 months post construction visit to site for verification of systems operation within the warranty period.

**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.
- .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 All Cx work is to be conducted as per CSA Z320-11 guidelines.

**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 and will be included in Building Maintenance Manual (BMM) at completion of project.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

**1.3 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 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

**1.6 COMMISSIONING FORMS**

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
  - .1 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
  - .2 Confirm operation as per design criteria and intent.
  - .3 Identify variances between design and operation and reasons for variances.
  - .4 Verify operation in specified normal and emergency modes and under specified load conditions.
  - .5 Record analytical and substantiating data.
  - .6 Verify reported results.
  - .7 Form to bear signatures of recording technician and reviewed and signed off by Departmental Representative.
  - .8 Submit immediately after tests are performed.
  - .9 Reported results in true measured SI unit values.
  - .10 Provide Departmental Representative with originals of completed forms.
  - .11 Maintain copy on site during start-up, testing and commissioning period.
  - .12 Forms to be both hard copy and electronic format with typed written results in Building Management Manual in accordance with Section 01 91 51 - Building Management Manual (BMM).

**1.7 LANGUAGE**

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

**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 Commissioning Training.
- .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 All Cx work is to be conducted as per CSA Z320-11 guidelines.

**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 Departmental Representative will provide:
  - .1 Descriptions of systems.
  - .2 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor: 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 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 Multimedia presentations.
  - .2 Manufacturer's training videos.

**1.6 SCHEDULING**

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours, training sessions to be up to 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 will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative.

**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.

**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 is limited to portions of the Building Management Manual (BMM) provided to Departmental Representative by Contractor.
- .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 21 05 01 Common Work Results for Mechanical.
- .3 Acronyms:
  - .1 BMM - Building Management Manual.
  - .2 Cx - Commissioning.
  - .3 HVAC - Heating, Ventilation and Air Conditioning.
  - .4 PI - Product Information.
  - .5 PV - Performance Verification.
  - .6 TAB - Testing, Adjusting and Balancing.
  - .7 WHMIS - Workplace Hazardous Materials Information System.

**1.2 GENERAL REQUIREMENTS**

- .1 Standard letter size paper 216 mm x 279 mm.
- .2 Methodology used to facilitate updating.
- .3 Drawings, diagrams and schematics to be professionally developed.
- .4 Electronic copy of data to be in a format accepted and approved by Departmental Representative. Refer to Submittals under Section 21 05 01 Common Work Results for Mechanical for further information.

**1.3 APPROVALS**

- .1 Prior to commencement, co-ordinate requirements for preparation, submission and approval with Departmental Representative.

**1.4 GENERAL INFORMATION**

- .1 Provide Departmental Representative the following for insertion into appropriate Part and Section of BMM:
  - .1 Complete list of names, addresses, telephone and fax numbers of contractor, sub-contractors that participated in delivery of project - as indicated in Section 1.2 of BMM.
  - .2 Summary of architectural, structural, mechanical and electrical systems installed and commissioned - as indicated in Section 1.4 of BMM.
    - .1 Including sequence of operation as finalized after commissioning is complete as indicated in Section 2.0 of BMM.

- .3 Description of building operation under emergencies as indicated in Section 2.0 of BMM.
- .4 System, equipment and components Maintenance Management System (MMS) identification - Section 2.1 of BMM.
- .5 Information on operation and maintenance of architectural systems and equipment installed and commissioned - Section 2.0 of BMM.
- .6 Information on operation and maintenance of applicable life safety systems and equipment installed and commissioned - Section 2.0 of BMM.
- .7 Information on operation and maintenance of mechanical systems and equipment installed and commissioned - Section 2.0 of BMM.
- .8 Operating and maintenance manual - Section 3.2 of BMM.
- .9 Final commissioning plan as actually implemented.
- .10 Completed commissioning checklists.
- .11 Commissioning test procedures employed.
- .12 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by Departmental Representative.
- .13 Commissioning reports.

**1.5 CONTENTS OF OPERATING AND MAINTENANCE MANUAL**

- .1 For detailed requirements refer to Section 01 78 00 - Closeout Submittals.
- .2 Departmental Representative to review and approve format and organization within 12 weeks of award of contract.
- .3 Include original manufactures brochures and written information on products and equipment installed on this project.
- .4 Record and organize for easy access and retrieval of information contained in BMM.
- .5 Include completed PI report forms, data and information from other sources as required.
- .6 Inventory directory relating to information on installed systems, equipment and components.
- .7 Approved project shop-drawings, product and maintenance data.
- .8 Manufacturer's data and recommendations relating: manufacturing process, installation, commissioning, start-up, O M, shutdown and training materials.
- .9 Inventory and location of spare parts, special tools and maintenance materials.
- .10 Warranty information.
- .11 Inspection certificates with expiration dates, which require on-going re-certification inspections.
- .12 Maintenance program supporting information including:
  - .1 Recommended maintenance procedures and schedule.
  - .2 Information to removal and replacement of equipment including, required equipment, points of lift and means of entry and egress.



## **1.6 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES**

- .1 Provide Departmental Representative supporting documentation relating to installed equipment and system, including:
  - .1 General:
    - .1 Finalized commissioning plan.
    - .2 WHMIS information manual.
    - .3 Approved "as-built" drawings and specifications.
    - .4 Procedures used during commissioning.
    - .5 Cross-Reference to specification sections.
  - .2 Architectural and structural:
    - .1 Inspection certificates, construction permits.
    - .2 PV reports.
  - .3 Mechanical:
    - .1 Installation permits, inspection certificates.
    - .2 Piping pressure test certificates.
    - .3 Ducting leakage test reports.
    - .4 TAB and PV reports.
    - .5 Charts of valves.
    - .6 Copies of posted instructions.
  - .4 Electrical:
    - .1 Installation permits, inspection certificates.
    - .2 TAB and PV reports.
    - .3 Electrical work log book.
    - .4 Charts and schedules.
    - .5 Locations of cables and components.
    - .6 Copies of posted instructions.
- .2 Assist Departmental Representative with preparation of BMM.

## **1.7 LANGUAGE**

- .1 English Language.

## **1.8 IDENTIFICATION OF FACILITY**

- .1 When submitting information to Departmental Representative for incorporation into BMM, use following system for identification of documentation:
  - .1 Confirm with Departmental Representative prior to submission.

## **1.9 USE OF CURRENT TECHNOLOGY**

- .1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.
- .2 Obtain Departmental Representative's approval before starting Work.

**Part 2            Products**

**2.1                NOT USED**

.1                Not used.

**Part 3            Execution**

**3.1                NOT USED**

.1                Not used.

**END OF SECTION**

## General

### RELATED REQUIREMENTS

- Section 01 11 00 – Summary of Work
- Section 01 33 00 – Submittal Procedures
- Section 01 35 33 – Health and Safety Requirements
- Section 01 74 11 – Cleaning

### REFERENCES

#### Reports:

- .1 DST Consulting Engineers Inc. Hazardous Building Materials Assessment Report (herein referred to as the Previous Environmental Report):
  - .1 Pre-Renovation Hazardous Building Materials Assessment, Emergency Generator Upgrade Project – Abbotsford / Huntingdon Point of Entry, Abbotsford, BC, dated January 15, 2020.
  - .2 A copy of the Previous Report is attached in the Appendix of the Project Specifications.

#### Definitions:

- .2 Dangerous Goods: product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.
- .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.
- .5 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.

#### Reference Standards:

- .6 Canadian Environmental Protection Act, 1999 (CEPA 1999)
  - .1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).
- .7 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/2001-286).

- .8 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .9 National Research Council Canada Institute for Research in Construction (NRC-IRC)
  - .1 National Fire Code of Canada (2015).
- .10 WorkSafeBC
  - .1 British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97, including amendments to date of work).
- .11 British Columbia Hazardous Waste Regulation (BC Reg. 63/88).

### **ACTION AND INFORMATIONAL SUBMITTALS**

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

Product Data for hazardous materials to be used by the Contractor to complete the Work:

- .12 Submit manufacturer's instructions, printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .13 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements to Departmental Representative for each hazardous material required prior to bringing hazardous material on site.
- .14 Submit site specific risk assessment and exposure control plan to Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.
- .15 Construction/Demolition 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
- .16 Low-Emitting Materials: submit listing of adhesives and sealants used in building, comply with VOC and chemical component limits or restrictions requirements.

### **DELIVERY, STORAGE AND HANDLING**

Deliver, store and handle hazardous materials to be used by the Contractor to complete the Work in accordance with manufacturer's written instructions.

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.

Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

Storage and Handling Requirements:

- .17 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.

- .18 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.
- .19 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.
- .20 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.
- .21 Transfer of flammable and combustible liquids is prohibited within buildings.
- .22 Transfer flammable and combustible liquids away from open flames or heat-producing devices.
- .23 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.
- .24 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.
- .25 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.
- .26 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 Workplace Hazardous Materials Information System (WHMIS) requirements.
- .13 Report spills or accidents immediately to Departmental Representative. Submit a written spill report to Departmental Representative within 24 hours of incident.

## **Products**

### **MATERIALS**

#### Description:

- .27 Bring on site only quantities hazardous material required to perform Work.
- .28 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

## **Execution**

### **HAZARDOUS MATERIALS ABATEMENT**

#### Scope of Abatement Activities.

- .29 Abatement shall be conducted to handle, alter, remove and/or dispose of hazardous building materials as identified in the Previous Environmental 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.

- .30 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.
- .31 The listing below is a summary of the identified hazardous building material categories and associated removal and disposal regulations, guidelines and/or standards, based on the project scope of work.
  - .1 Silica
    - .1 When silica-containing materials are to be disturbed and/or removed (e.g., coring through concrete slabs, demolition of masonry, removal of ceramic tiles 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/m<sup>3</sup>). This would include, but not be limited to, the following:
      - .1 Providing workers with respiratory protection
      - .2 Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions
      - .3 Providing workers with facilities to properly wash prior to exiting the work area..

## **CLEANING**

Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning. Leave Work area clean at end of each day.

Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

Waste Management: separate waste materials for reuse and recycling.

- .32 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.
- .33 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.
- .34 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.
- .35 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.
- .36 Dispose of hazardous wastes in weekly in accordance with applicable federal and provincial regulations.
- .37 Minimize generation of hazardous waste to so all hazardous waste generated daily is packaged in accordance with applicable federal and provincial acts, regulations, and guidelines. Take necessary precautions to avoid mixing clean and contaminated wastes.

- .38 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 Lead-acid battery recycling.
  - .4 Hazardous wastes with economically recoverable precious metals.

**END OF SECTION**



## General

### RELATED REQUIREMENTS

- Section 01 11 00 – Summary of Work
- Section 01 33 00 – Submittal Procedures
- Section 01 35 33 – Health and Safety Requirements
- Section 01 74 11 – Cleaning

### REFERENCES

#### Reports:

- .1 DST Consulting Engineers Inc. Hazardous Building Materials Assessment Report (herein referred to as the Previous Environmental Reports):
  - .1 Pre-Renovation Hazardous Building Materials Assessment, Emergency Generator Upgrade Project – Waneta Point of Entry, 10290 Highway 22A, Salmo, British Columbia, dated January 16, 2020.
  - .2 A copy of the Previous Report is attached in the Appendix of the Project Specifications.

#### Definitions:

- .2 Dangerous Goods: product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.
- .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.
- .5 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.

#### Reference Standards:

- .6 Canadian Environmental Protection Act, 1999 (CEPA 1999)
  - .1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).
- .7 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/2001-286).

- .8 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .9 National Research Council Canada Institute for Research in Construction (NRC-IRC)
  - .1 National Fire Code of Canada (2015).
- .10 WorkSafeBC
  - .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 Lead" (latest edition).
- .11 British Columbia Hazardous Waste Regulation (BC Reg. 63/88).

### **ACTION AND INFORMATIONAL SUBMITTALS**

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

Product Data for hazardous materials to be used by the Contractor to complete the Work:

- .12 Submit manufacturer's instructions, printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .13 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements to Departmental Representative for each hazardous material required prior to bringing hazardous material on site.
- .14 Submit site specific risk assessment and exposure control plan to Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.
- .15 Construction/Demolition 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
- .16 Low-Emitting Materials: submit listing of adhesives and sealants used in building, comply with VOC and chemical component limits or restrictions requirements.

### **DELIVERY, STORAGE AND HANDLING**

Deliver, store and handle hazardous materials to be used by the Contractor to complete the Work in accordance with manufacturer's written instructions.

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.

Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

Storage and Handling Requirements:

- .17 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.
- .18 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.
- .19 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.
- .20 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.
- .21 Transfer of flammable and combustible liquids is prohibited within buildings.
- .22 Transfer flammable and combustible liquids away from open flames or heat-producing devices.
- .23 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.
- .24 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.
- .25 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.
- .26 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 Workplace Hazardous Materials Information System (WHMIS) requirements.
- .13 Report spills or accidents immediately to Departmental Representative. Submit a written spill report to Departmental Representative within 24 hours of incident.

## **Products**

### **MATERIALS**

Description:

- .27 Bring on site only quantities hazardous material required to perform Work.
- .28 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

## **Execution**

### **HAZARDOUS MATERIALS ABATEMENT**

Scope of Abatement Activities.

- .29 Abatement shall be conducted to handle, alter, remove and/or dispose of hazardous building materials as identified in the Previous Environmental 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.
- .30 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.
- .31 The listing below is a summary of the identified hazardous building material categories and associated removal and disposal regulations, guidelines and/or standards, based on the project scope of work.
  - .1 Lead and Lead-Containing Paints (LCPs)
    - .1 Refer to the Previous Environmental Report for identification and locations of lead-containing materials (including LCPs) that may require disturbance during the Work.
    - .2 Actions that will disturb lead-containing materials (including paints and materials coated with LCPs) are to be conducted in accordance with the requirements of the current version of the WorkSafe BC publication "Safe Work Practices for Handling Lead", latest edition, keeping airborne exposure to lead dust to less than the 8-hour Occupational Exposure Limit (OEL) for lead of 0.05 milligram per cubic metre (mg/m<sup>3</sup>).
    - .3 Although LCPs and items coated with LCPs will be disturbed and/or removed for disposal during the Work, 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.
      - .1 Refer to the provisions of the WorkSafe BC publication "Safe Work Practices for Handling Lead", latest edition, for removal of LCPs from surfaces before any welding and torch-cutting, should the Contractor plan to use such methods to complete the Work.
        - .1 Contractor will be responsible for verification testing of surfaces where LCPs have been removed. Confirmation of acceptable results is to be provided to the Departmental Representative for review before proceeding with any welding or torch-cutting on surfaces where LCPs were present.
    - .4 Waste transportation to be conducted in accordance with BC Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.
    - .5 Waste disposal to be conducted in accordance with BC Reg. 63/88.

- .2 Silica
  - .1 When silica-containing materials are to be disturbed and/or removed (e.g., coring through concrete slabs, demolition of masonry, removal of ceramic tiles 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/m<sup>3</sup>). This would include, but not be limited to, the following:
    - .1 Providing workers with respiratory protection
    - .2 Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions
    - .3 Providing workers with facilities to properly wash prior to exiting the work area..

## CLEANING

Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning. Leave Work area clean at end of each day.

Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

Waste Management: separate waste materials for reuse and recycling.

- .32 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.
- .33 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.
- .34 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.
- .35 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.
- .36 Dispose of hazardous wastes in weekly in accordance with applicable federal and provincial regulations.
- .37 Minimize generation of hazardous waste to so all hazardous waste generated daily is packaged in accordance with applicable federal and provincial acts, regulations, and guidelines. Take necessary precautions to avoid mixing clean and contaminated wastes.
- .38 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 Lead-acid battery recycling.
  - .4 Hazardous wastes with economically recoverable precious metals.

**END OF SECTION**

## General

### RELATED REQUIREMENTS

- Section 01 11 00 – Summary of Work
- Section 01 33 00 – Submittal Procedures
- Section 01 35 33 – Health and Safety Requirements
- Section 01 74 11 – Cleaning

### REFERENCES

#### Reports:

- .1 DST Consulting Engineers Inc. Hazardous Building Materials Assessment Report (herein referred to as the Previous Environmental Report):
  - .1 Pre-Renovation Hazardous Building Materials Assessment, Emergency Generator Upgrade Project – Kingsgate Point of Entry, 6923 Customs Road, Kingsgate, British Columbia, dated January 16, 2020.
  - .2 A copy of the Previous Report is attached in the Appendix of the Project Specifications.

#### Definitions:

- .2 Dangerous Goods: product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.
- .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.
- .5 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.

#### Reference Standards:

- .6 Canadian Environmental Protection Act, 1999 (CEPA 1999)
  - .1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).
- .7 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/2001-286).



- .8 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .9 National Research Council Canada Institute for Research in Construction (NRC-IRC)
  - .1 National Fire Code of Canada (2015).
- .10 WorkSafeBC
  - .1 British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97, including amendments to date of work).
- .11 British Columbia Hazardous Waste Regulation (BC Reg. 63/88).

### **ACTION AND INFORMATIONAL SUBMITTALS**

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

Product Data for hazardous materials to be used by the Contractor to complete the Work:

- .12 Submit manufacturer's instructions, printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .13 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements to Departmental Representative for each hazardous material required prior to bringing hazardous material on site.
- .14 Submit site specific risk assessment and exposure control plan to Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.
- .15 Construction/Demolition 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
- .16 Low-Emitting Materials: submit listing of adhesives and sealants used in building, comply with VOC and chemical component limits or restrictions requirements.

### **DELIVERY, STORAGE AND HANDLING**

Deliver, store and handle hazardous materials to be used by the Contractor to complete the Work in accordance with manufacturer's written instructions.

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.

Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

Storage and Handling Requirements:

- .17 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.

- .18 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.
- .19 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.
- .20 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.
- .21 Transfer of flammable and combustible liquids is prohibited within buildings.
- .22 Transfer flammable and combustible liquids away from open flames or heat-producing devices.
- .23 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.
- .24 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.
- .25 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.
- .26 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 Workplace Hazardous Materials Information System (WHMIS) requirements.
- .13 Report spills or accidents immediately to Departmental Representative. Submit a written spill report to Departmental Representative within 24 hours of incident.

## **Products**

### **MATERIALS**

#### Description:

- .27 Bring on site only quantities hazardous material required to perform Work.
- .28 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

## **Execution**

### **HAZARDOUS MATERIALS ABATEMENT**

#### Scope of Abatement Activities.

- .29 Abatement shall be conducted to handle, alter, remove and/or dispose of hazardous building materials as identified in the Previous Environmental 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.

- .30 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.
- .31 The listing below is a summary of the identified hazardous building material categories and associated removal and disposal regulations, guidelines and/or standards, based on the project scope of work.
  - .1 Silica
    - .1 When silica-containing materials are to be disturbed and/or removed (e.g., coring through concrete slabs, demolition of masonry, removal of ceramic tiles 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/m<sup>3</sup>). This would include, but not be limited to, the following:
      - .1 Providing workers with respiratory protection
      - .2 Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions
      - .3 Providing workers with facilities to properly wash prior to exiting the work area..

## **CLEANING**

Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning. Leave Work area clean at end of each day.

Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

Waste Management: separate waste materials for reuse and recycling.

- .32 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.
- .33 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.
- .34 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.
- .35 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.
- .36 Dispose of hazardous wastes in weekly in accordance with applicable federal and provincial regulations.
- .37 Minimize generation of hazardous waste to so all hazardous waste generated daily is packaged in accordance with applicable federal and provincial acts, regulations, and guidelines. Take necessary precautions to avoid mixing clean and contaminated wastes.

- .38 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 Lead-acid battery recycling.
  - .4 Hazardous wastes with economically recoverable precious metals.

**END OF SECTION**

**Part 1 GENERAL**

**1.1 DOCUMENTS**

- .1 This section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2 RELATED WORK**

- .1 Cast-in-Place Concrete: Section 03 30 00

**1.3 REFERENCES**

- .1 Do reinforcing work in accordance with CSA A23.1-09.
- .2 Do welding of reinforcement in accordance with CSA W186-M1990 (R2002), except where specified otherwise.

**1.4 SOURCE QUALITY**

- .1 Provide Consultant with certified copy of mill test reports of reinforcing steel, showing physical and chemical analysis, minimum 5 weeks prior to commencing reinforcing work.
- .2 Inform Consultant of proposed source of material to be supplied.
- .3 Testing of the reinforcement will be at the discretion of the Consultant. As a minimum, there will be one tensile and one bend test for each bar size used on the project.

**1.5 SUBSTITUTES**

- .1 Substitution of different size bars permitted only upon the written approval of the Consultant.

**Part 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Reinforcing steel: billet steel, Grade 400, deformed bars to CSA G30.18 unless indicated otherwise.
- .2 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.
- .3 Chairs, bolsters, bar supports, spacers: to CSA-A23.1 (non-metallic).
- .4 Mechanical splices: to develop the full capacity of the bar size being spliced, as manufactured by Dayton Superior (Bar Grip) or Lenton or alternate pre-approved by the Consultant subject to the approval of the Consultant.
- .5 Dowel Bars: to develop full capacity of the bar size being spliced, as manufactured by Dayton Superior or alternate pre-approved by the consultant.

- .6 Weldable rebar dowels as noted on the drawings. Field welding by others.

## **2.2 FABRICATION**

- .1 Fabricate reinforcing in accordance with CSA-A23.1 and ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures
- .2 Obtain Consultant's approval for locations of reinforcement splices other than shown on drawings. Stagger splices in adjacent bars.
- .3 Horizontal reinforcement to be made continuous around corners by use of corner bars of same size and strength as horizontal bars and as indicated on the drawings.
- .4 Bars noted as continuous to be spliced in accordance with structural drawings, staggered where possible.
- .5 Provide standard hook length for all bars noted "H1E", unless noted otherwise.
- .6 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and list.

## **Part 3 EXECUTION**

### **3.1 FIELD BENDING**

- .1 Do not field bend reinforcement except where indicated or authorized by Consultant.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars which develop cracks or splits.

### **3.2 PLACING**

- .1 Place reinforcing steel as indicated on drawings and in accordance with CSA-A23.1.
- .2 Metal reinforcement shall be protected by thickness of concrete indicated on drawings or as specified in CSA-A23.1.
- .3 Clean reinforcing steel of excess rust and previously deposited concrete prior to placing concrete.
- .4 Use non-metallic chairs and bolsters to support all reinforcement. Reinforcement shall be accurately placed and secured against displacement. Chairs in exposed concrete beam, slab band, and slab soffits shall be placed in a regular pattern. Randomly placed strips of "caterpillar" chairs shall be avoided.
- .5 Anchor bolts, dowels, and steel embedment's shall be set before concrete placement and shall not be inserted into placed concrete.
- .6 The Consultant shall be notified when the reinforcing steel is in place and in sufficient time to permit an inspection of same prior to concrete placement.
- .7 Cooperate with trades placing in-slab electrical services and radiant heating piping. Do not damage or displace items placed by other trades.

- .8 Drilled dowels to existing concrete shall be Hilti HY 200 to the standard embedment specified by Hilti or as shown on the drawings.
- .9 Reinforcement shall be spliced only in locations shown on the drawings or as approved in writing by the Consultant.
- .10 Where reinforcing bars are interrupted by formwork, provide threaded couplers that develop the full capacity of the bar being spliced or dowels with lap lengths specified on the drawings.

END OF SECTION



**Part 1 GENERAL**

**1.1 DOCUMENTS**

- .1 This section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2 RELATED WORK**

- .1 Concrete Reinforcement: Section 03 20 00
- .2 Concrete Finishes: Section 03 35 00

**1.3 REFERENCES**

- .1 Do work in accordance with CSA A23.1-09 and CSA A23.2-09 except where specified otherwise.

**1.4 CERTIFICATES**

- .1 Provide certification that plant, equipment and materials to be used in concrete comply with the requirements of CSA A23.
- .2 Provide certification that mix proportions selected will produce concrete of specified quality and yield, and that strength will comply with CSA A23.

**1.5 QUALITY CONTROL**

- .1 Submit proposed quality control procedures for Consultant's review.

**1.6 SAMPLES AND PROTOTYPES**

- .1 Material samples: submit the following samples of materials for approval to the Consultant. Approved samples shall be used as the acceptable standard for all materials used on the project.
- .2 Forming materials, including Class 1 Architectural Concrete finish materials.
- .3 Gaskets, sealing materials, and form jointing system (as applicable).
- .4 Ties, cones, and recessed precast concrete plugs, where specified.
- .5 Rustication strips, reveals, and reglet forming material.
- .6 Form release agent.
- .7 Expansion and isolation joints.

**Part 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Portland cement: Type GU or Type HS, as required to CSA-A3000-08 and CSA A3001-08.
- .2 Cementitious hydraulic slag: to CSA-A363.
- .3 Water: to CSA-A23.
- .4 Aggregates: to CSA-A23. Coarse aggregates to be normal density.
- .5 Air entraining admixture: to ASTM C260.
- .6 Chemical admixtures: to ASTM C494 and CSA S413-07. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Super-plasticizer: to CAN3-A266.5 "Guidelines for the use of Super-plasticizing Admixtures in Concrete".
- .8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents of pouring consistency, capable of developing a compressive strength of 50 MPa at 28 days.
- .9 Concrete curing and sealing compound: Where slabs are to receive resilient flooring or carpeting, use curing compounds compatible with flooring adhesive. Do not use where bond required for additional concrete or surface coating.

Acceptable products are as specified in Section 03 35 00.

- .10 Bonding agent: formulated for bonding new concrete to cured concrete.

Acceptable products are as specified in Section 03 35 00.

- .11 Waterstops: extruded PVC with factory welded corner and intersecting pieces.
- .12 Pre-moulded joint fillers, expansion and isolation joints: Bituminous impregnated fibre board: to ASTM D1751.
- .13 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots.
- .14 Underslab dampproof membrane: Polyethylene film 6mil to CGSB 51-GP-51M.
- .15 Control joints: All areas of slab-on-grade concrete require saw-cut joints. See structural and architectural drawings for layout pattern and depth of cut. Joint pattern to match architectural finish patterns. Depth of cut to be 30mm minimum unless noted otherwise. Cuts to be done within 24 hours of pour but after such time that cutting will not damage the slab edges at the cuts.
- .16 Waterproofing admixture: to elevator walls below grade as manufactured by Xypex or Kryton International Inc. or approved equal, in strict accordance with the manufacturers written instructions.
- .17 Waterstop slurry: to elevator walls below grade KIM Waterstop Slurry as manufactured by Kryton International Inc. or approved equal, in strict accordance with manufacturers

written instructions for Krystol Specification No. 3, Krystol Waterstop Concrete Joint Design.

- .18 Waterstop grout: to elevator walls below grade KIM Waterstop Grout as manufactured by Kryton International Inc. or approved equal, in strict accordance with manufacturers written instructions for Krystol Specification No. 3, Krystol Waterstop Concrete Joint Design.

## **2.2 CONCRETE MIXES**

- .1 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1, to give the properties shown on the structural drawings.
- .2 Mix designs are to be established in accordance to CSA-A23.1, Clause 4.3.5.1 or Clause 4.3.5.2.
- .3 Concrete mix designs to be submitted to the consultants for review prior to commencing work.

## **Part 3 EXECUTION**

### **3.1 GENERAL**

- .1 Do cast-in-place concrete work in accordance with CSA-A23.1.

### **3.2 WORKMANSHIP**

- .1 Obtain the Structural Consultant's approval before placing concrete. Provide 24 hours' notice, minimum, prior to placing concrete.
- .2 Pumping of concrete is permitted only after approval of equipment and mix design.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Consultant's approval of proposed method for protection of concrete during placing and curing. Provide minimum of 3 day moist curing for all slabs with an exposure class of N and 7 day moist cure for all other exposure classes.
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 Concrete shall not be deposited on concrete which has hardened sufficiently to cause the formation of seams or plains of weakness. If a section cannot be placed continuously, construction joints shall be located as permitted by the Consultant. All pour and construction joints shall be formed with a straight-edge fixed to formwork. Placing shall be carried out at such a rate that concrete which is being integrated with fresh concrete is still plastic.
- .7 Compact concrete with high-frequency vibrators applied directly to concrete by experienced personnel. Do not over-vibrate.
- .8 In locations where new concrete is dowelled to already completed work, drill holes in existing concrete. Attach steel dowels of deformed steel reinforcing bars with Hilti 'HY 200' epoxy adhesive to the depths shown on the drawings or specified by the

manufacturer. Intentionally roughen interface between existing and new concrete to 6mm amplitude.

- .9 Take every precaution to protect finished surfaces from stains and abrasions. Surfaces and edges likely to be damaged during the construction period, such as corners of columns, walls, and stair nosings, shall be especially protected with wood furring. All exposed concrete floor surfaces shall be protected from staining and damage by suitable means
- .10 Do not place load upon new suspended concrete until the concrete has reached the design 28-day strength, or has been suitably shored for the anticipated loads and/or as authorized by the structural consultant.

### **3.3 INSERTS**

- .1 Set sleeves, ties, pipe hangers, brace bay base hardware, embed plates, and other inserts and openings as indicated or specified elsewhere. NOTE: brace bay hardware to be set accurately, especially in alignment and plumbness to allow successful installation of brace bays members.
- .2 Sleeves and openings in slabs and walls greater than 300mm x 300mm not indicated on structural drawings must be approved by the Consultant.
- .3 NO sleeves, ducts, pipes or other openings shall pass through joists, beams, column capitals or columns, except where expressly detailed on structural drawings or approved by the Consultant.
- .4 Electrical conduit shall not be larger in outside diameter than one-third the thickness of the slab or wall in which they are embedded nor spaced closer than three diameters on centre.
- .5 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from the Consultant before placing of concrete.
- .6 Check locations and sizes of sleeves and openings shown on structural drawings with architectural, mechanical and electrical drawings.
- .7 Set special inserts for strength testing as indicated and as required by Non-Destructive Method of Testing Concrete.
- .8 Anchor bolts: Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
- .9 Dovetail Anchor Slots: Install continuous vertical anchor slot to forms where masonry abuts concrete wall or columns.

### **3.4 PLACING GROUT**

- .1 Grout underside of steel column and beam bearing plates with non-shrinking grout to manufacturer's instructions. Place grout to cover steel shims left in place.

### **3.6 PATCHING**

#### **.1 General:**

- .1 Areas to be repaired shall be determined by the Consultant and shall not exceed 0.2m<sup>2</sup> for each 100m<sup>2</sup> of surface area, and shall be widely dispersed. Repairs shall match the surrounding area. Patching of horizontal paving will not be accepted.
- .2 Before commencing any repair work, the Contractor shall confirm repair procedures with the Consultant and establish by trial mix the formula required. The Contractor shall demonstrate his repair techniques on a prototype sample panel.

#### **.2 The following are key steps to making a repair to architectural concrete:**

- .1 Prepare the area to be repaired. This should include achieving the desired finish in the surrounding area. Remove loose particles and chip out part of the sound concrete to avoid feather edge repairs.
- .2 Proportion the repair mix by weight according to the same proportions as used in the concrete mix but substituting a portion of white cement for grey cement. This should be based on tests to determine what is required to match the finished surface.
- .3 Apply a coat of bonding material to the root of the areas to be repaired, being careful to avoid dripping on any surface to be exposed.
- .4 Fill in the area to be repaired with mortar of the stiffest consistency that will permit placing. Consolidate in place and strike off so as to leave the repaired area slightly higher than the surrounding surface to permit initial shrinkage. The repair shall be left undisturbed for at least one hour before being textured.
- .5 The repaired area shall be cured by suitable means to minimize shrinkage and cracking and provide a durable finish.
- .6 Clean the repaired area to remove laitance and match the surrounding area.
- .7 Repair of cracks in concrete slabs and slabs-on-grade shall be the sole responsibility of the Contractor to satisfy the requirements of the floor finishes.

### **3.7 FINISHING**

#### **.1 Formed surface: The finishes to be provided for the various formed surfaces shall be:**

##### **.1 Unexposed Finish:**

1. This finish shall apply to formed surfaces which are not exposed to view and where roughness is not objectionable.

.2 The surface, in general, shall not require any treatment after form removal, other than repair of defective concrete, snap-tie holes, and the removal of ridges and surface irregularities.

##### **.2 Class 1 Architectural Concrete Finish:**

.1 This finish shall apply to formed exterior architectural concrete surfaces which are exposed to view, in accordance with Section 03 35 00 - Concrete Finishing.

##### **.3 Class 2 Smooth Form Finish:**

.1 This finish shall apply to formed exposed interior Class 2 concrete surfaces in accordance with Section 03 35 00 - Concrete Finishing.

.2 Unformed surface: The finish to be provided for the various unformed surfaces shall be:

.1 Plastic Concrete Surfaces:

.1 Working of the concrete surface shall take place while it is sufficiently plastic to achieve the desired shape, plane, and texture. Screeding shall be followed by one or more of the operations of darbying, floating, trowelling, and tooling of edges and joints, in that order, to provide the surface finish specified in the drawings or by the Consultant.

.2 Initial finishing shall be accomplished by screeding, darbying, or bull floating and shall be performed in accordance with the requirements of CSA-A23.1, Clause 7.5.

.3 Initial finishing operations shall be completed before any bleed or free water appears on the concrete surface. Overworking, which can bring excessive fines to the concrete surface, shall not be permitted.

.4 Final finishing shall be accomplished by mechanical floating, mechanical trowelling, creation of the specified surface finish, and tooling of edges and joints, in that order. Exposed edges and corners shall be as detailed. Surfaces at tooled edges shall be trowelled and sand-blasted to remove tool edge marks. Hand floating and trowelling shall only be permitted in small areas of restricted access. All final finishing procedures shall conform to the requirements of CSA-A23.1, Clause 7.5.4.

.5 Final finishing shall commence after bleed water has disappeared from the surface and when the concrete has stiffened sufficiently to prevent the working of excess water to the surface. No additional dry cement or water shall be used to facilitate finishing.

.6 The final finish to be provided shall be as specified on the drawings and in accordance with Section 03 35 00 Concrete Finishing for floor finishes.

### **3.8 WATERSTOPS**

.1 Install waterstops at all joints in all foundation walls surrounding below-grade occupied spaces to provide continuous water seal. Do not distort or pierce waterstop to hamper performance. Do not displace reinforcement when installing waterstops. Use equipment to manufacturer's requirements to field splice waterstops. Tie waterstops rigidly in place.

.2 Use only straight heat sealed butt joints in field. Use factory welded corners and intersections.

### **3.9 JOINT FILLERS**

.1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by the Consultant. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

.2 Locate and form isolation joints as indicated. Install joint filler.

.3 Use joint filler to separate slabs on grade from all vertical surfaces and extend joint filler from bottom of slab to within 12mm of finished slab surface unless indicated otherwise.

**3.10 CONTROL JOINTS**

- .1 Provide control joints in foundation walls in accordance with the details on the drawings at maximum 6.1m on centre. Align joints to suit architectural features.
- .2 Provide saw-cut joints in all slabs-on-grade and concrete paving in accordance with the details on the drawings and to suit Architectural finishes. Review locations with the Consultant.

**3.11 EXTERIOR SLABS-ON-GRADE AND PAVING**

- .1 Exterior slabs-on-grade used for pedestrian access only shall be a minimum 100mm thick reinforced with 10M at 350mm each way. Slabs-on-grade and paving for vehicle access shall be minimum 175mm thick reinforced with 15M at 300mm each way. Thicken edges to 300mm.
- .2 Provide minimum 100mm thick layer of 20mm minus clean crush gravel base under exterior slabs.
- .3 Provide control joints at 3000mm on centre each way unless noted otherwise.

**3.12 QUALITY CONTROL**

- .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by the Owner in accordance with CSA-A23.1. Non-destructive Methods for Testing Concrete shall be in accordance with CSA-A23.2.
- .2 Testing Laboratory will take additional test cylinders during cold weather concreting. Cure cylinders on job site under the same conditions as concrete which they represent.
- .3 If results of tests show concrete to be less than specified in quality or strength, the Consultant shall have the right to have the mix designs altered for the remainder of the work at no cost to the Owner. Further testing and remedial measures required by CSA-A23.1 shall be done, the costs of this work paid for by the Contractor.
- .4 Inspection or testing by Owner will not augment or replace Contractor quality control nor relieve them of their contractual responsibilities.

END OF SECTION

**Part 1 General**

**1.1 DOCUMENTS**

- .1 This section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2 RELATED WORK**

- .1 Steel Deck: Section 05 31 10
- .2 Painting: Section 09 90 00
- .3 Cast-in-Place concrete: Section 03 30 00

**1.3 REFERENCES**

- .1 ASTM A307-00, Specification for Carbon Steel Bolts and Studs, 60,000 psi tensile strength.
- .2 ASTM A325-02, Specification for High-Strength Bolts for Structural Steel Joints.
- .3 CISC/CPMA 1-73a or 2-75, Primer Structural Steel, Oil Alkyd Type.
- .4 CSA-G40.20-04, General Requirements for Rolled or Welded Structural Quality Steel.
- .5 CSA-G40.21-04, Structural Quality Steel.
- .6 CSA S16-09, Steel Structures for Buildings, (Limit States Design).
- .7 CSA W47.1-1983, Certification of Companies for Fusion Welding of Steel Structures.

**1.4 QUALITY CONTROL**

- .1 Prior to commencement of work, submit 2 certified copies of mill reports covering chemical and physical properties of steel used in this work.

**1.5 DESIGN OF DETAILS AND CONNECTIONS**

- .1 Design details and connections in accordance with requirements of CSA S16-09.
- .2 High strength bolt connections to conform to ASTM A325, Bearing Type. Bolts in bracing connections to be torqued.
- .3 For standard steel connections, select details from CISC Handbook of Steel Construction to ensure structural adequacy.
- .4 Connections for beams are to be designed for:
  - .1 A shear at each end of the beam equal to 50% of the total uniformly distributed factored loads for a laterally supported beam of the span shown, OR
  - .2 A shear at each end of the beam equal to 35% of the total uniformly distributed factored load for a laterally supported beam of the span shown acting simultaneously with the axial force shown on the brace bay drawings. The axial force for a W-section beam should be assumed to be tension or compression.
  - .3 Bracing connections to be designed for the Factored loads noted on structural drawings.



## **1.6 SHOP DRAWINGS**

- .1 Submit shop detail and erection drawings in accordance with Section 01 33 00 - Submittals.
- .2 Shop drawings of non-standard connections designed by the steel fabricator to be signed and sealed by a Professional Engineer registered in the Province of British Columbia. Provide Schedules S-B and S-C for consultants records.
- .3 On erection drawings, indicate member size, base plate elevation, anchor bolt size and location and other information necessary for assembly.
- .4 Submit description of methods, sequence of erection and type of equipment to be used in erecting structural steel, if requested.
- .5 Indicate welds by welding symbols defined in CSA W59.
- .6 Structural steel shop drawings are to be produced using 3D structural steel detailing software such as Xsteel or StruCAD.

## **Part 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Structural steel, angles, plates, welded wide flanges and channels: to CSA G40.21, Grade 345W.
- .2 Structural steel wide flanges: to CSA G40.21, Grade 345W except beams and columns in moment frames to ASTM A992/992M, Grade 345W.
- .3 Square and rectangular hollow structural sections: to CSA G40.21, Grade 350W, Class C.
- .4 Round hollow structural sections: to ASTM A500, Grade C (Fy = 317 MPa)
- .5 Anchor bolts: to ASTM A307, except Dywidag Threadbar to be Grade 500/550 to ASTM A706.
- .6 High strength bolts, nuts and washers: to ASTM A325.
- .7 Ordinary bolts, nuts and washers: to ASTM A307.
- .8 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.
- .9 Shop paint primer: to CISC/CPMA 1-73a.
- .10 Hot dip galvanizing: galvanize steel, where indicated, to CSA G164, minimum zinc coating of 600 g/m<sup>2</sup>.
- .11 Shear stud connectors: to CSA W59, Appendix H.

### **2.2 FABRICATION**

- .1 Fabricate structural steel, as indicated, in accordance with CSA S16-01 and in accordance with reviewed shop drawings.
- .2 Install shear studs in accordance with CSA W59.

- .3 Continuously seal HSS members with cap plates and by continuous welds. Grind smooth.
- .4 Reinforce openings to maintain required design strength.
- .5 Shop weld weldable rebar dowels to steel embed plates. Weldable rebar supplied by this section.
- .6 Unless noted otherwise, hot-dip galvanize all exterior exposed steel, except exterior steel that is exposed to view which shall receive an epoxy paint finish.
- .7 All exposed welds to be continuous, ground smooth, and formed to match profile of the adjacent steel members.
- .8 All exterior member welds to be continuous. Welds to fully seal joints between components.

### **2.3 SHOP PAINTING**

- .1 Clean, prepare surfaces and shop prime structural steel with grey colour in accordance with CAN/CSA S16-09 except where members to be encased in concrete, spray fire-proofed, or galvanized.
- .2 Structural steel to receive primer paint only to have SP-2 surface preparation.
- .3 All exposed structural steel to receive a finish coat shall have SP-6 surface preparation (commercial sandblast).

## **Part 3 EXECUTION**

### **3.1 GENERAL**

- .1 Do welding in accordance with CSA W59 and as noted on the drawings.
- .2 Fabrication and erection companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

### **3.2 CONNECTION TO WORK COMPLETED BY OTHER TRADES**

- .1 Verify dimensions of work completed by other trades before commencing fabrication and report any discrepancy and potential problem areas to Consultant and await instructions.

### **3.3 MARKING**

- .1 Mark materials in accordance with CSA G40.20. Do not use die stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.

### **3.4 ERECTION**

- .1 Erect structural steel as indicated in accordance with CSA S16-09 and in accordance with reviewed erection drawings.

- .2 Obtain written permission of Consultant prior to field cutting or altering of structural members not shown on shop drawings.
- .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection. Touch-up galvanizing with "Galvacon" or equivalent to manufacturer's recommendations.
- .4 Temporarily brace and shore structural steel as required for erection stability. Member sizes and design forces are for final erected conditions with steel decking attached and may not be adequate for the erection operation.

### **3.5 FIELD QUALITY CONTROL**

- .1 Inspection and testing of materials and workmanship will be carried out by an independent Testing Agency designated and paid for by the Owner and approved by the Consultant in accordance with CAN/CSA S16-01.
- .2 The testing and inspection program shall include, but not be limited to:
  - .1 Shop fabrication:
    - .1 Review of mill certificates, weld procedures, and welder qualifications.
    - .2 Review of workmanship on steel fabrication for conformance with project specifications.
    - .3 Visual examination of all welds
    - .4 Magnetic particle testing of approximately 5% of all welds.
    - .5 Complete ultra-sonic examination of all full-strength, full-penetration welds.
    - .6 Random check of structural steel member sizes.
  - .2 Field inspection:
    - .1 Review weld procedures and welder qualifications.
    - .2 Visual examination of all field welds including steel decking attachment to structural steel.
    - .3 Magnetic particle or other non-destructive testing of approximately 5% of field welds.
    - .4 Complete ultra-sonic examination of all full-strength, full-penetration field welds.
- .3 The above testing shall not be considered as a substitute for the fabricator's and erector's quality control programs.

**END OF SECTION**

**Part 1 General**

**1.1 DOCUMENTS**

- .1 This section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2 RELATED WORK**

- .1 Cast-in-place concrete: Section 03 30 00
- .2 Structural steel: Section 05 12 00
- .3 Painting: Section 09 90 00

**1.3 REFERENCES**

- .1 Do design, fabrication and erection in accordance with CSA S136-01.
- .2 Do steel decking work in accordance with Canadian Sheet Steel Building Institute Standards for Steel Roof Deck and Steel Floor Deck, except where specified otherwise.
- .3 Do welding in accordance with CSA W59 except where specified otherwise.
- .4 Fabricator certification: in accordance with CSA W47.1-03.

**1.4 DESIGN CRITERIA**

- .1 Steel decking shall safely carry dead and live and diaphragm loads as indicated.
- .2 Deflection under live load only shall not exceed 1/240th of span for roofs and 1/360th of span for floors, except that when gypsum board ceilings are hung directly from decking, live load deflection shall not exceed 1/360th of span.

**1.5 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 30 00.
- .2 Each drawing submitted shall clearly indicate decking layout, profile, dimensions, core thickness, side seam connections, connections to supports and spacing's, projections, openings, and reinforcement details and accessories.

**Part 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Sheet steel: to ASTM A653M Structural Quality Grade 230 and galvanized with Z275 zinc coating class for roof deck, and ZF75 zinc coating class for floor deck.

- .2 Flute closures: closed cell foam neoprene or purpose made, fire rated as required, profiled to deck corrugation, 25mm thick, over deck, under deck, and under roofing where indicated on drawings. Acoustic rated flute closures to be Q-stop from Fyre Sleeve Industries Ltd. or approved equal. Closures supplied to General Contractor for installation by others.
- .3 Metal flute closures: zinc coated steel to match decking profile and coating class.
- .4 Primer: zinc rich, ready mix to CGSB 1-GP-181M.
- .5 Self-tapping screws: #14 ga. (0.185 in.) plated.

## **2.2 TYPES OF DECKING**

- .1 Floor deck: single fluted element with minimum steel core thickness and nominal depth as noted on drawings, deformed ribs for composite action.

## **Part 3 EXECUTION**

### **3.1 ERECTION**

- .1 Erect metal decking as indicated to manufacturer's instructions.
- .2 Deck end laps shall be not less than 150mm and formed over supports. Floor deck to be butt jointed over supports.
- .3 Immediately after decking is permanently secured in place touch up galvanized surface with primer where burned by welding or damaged by screw installation.
- .4 Attach metal cell closures at locations shown to contain poured concrete or to conceal deck flute packing or insulation and at other locations where indicated on drawings.
- .5 Clean up and remove all debris of this trade from site.

### **3.2 OPENINGS AND AREAS OF CONCENTRATED LOADS**

- .1 Framing of deck openings 150 to 300mm shall be as recommended by the manufacturer except as otherwise indicated. No reinforcement required for openings cut in deck which are smaller than 150mm square.
- .2 For deck openings over 300mm square and for areas of concentrated load, reinforce in accordance with structural framing details and notes.

### **3.3 CONNECTIONS**

- .1 Fasten decking to supporting steel with mechanical fasteners, as indicated on the drawings.
- .2 Mechanically fasten side joints at maximum 300mm centres, and as noted on the drawings.
- .3 Mechanically fasten decking to seismic shear lugs and drag lines as noted on the drawings.

**END OF SECTION**

**Part 1 General**

**1.1 DOCUMENTS**

- .1 This Section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

**1.2 SECTION INCLUDES**

- .1 Supply and installation of metal fabrications.
- .2 All light iron and miscellaneous metal work not specified under another section but required for the work shall be provided under this section whether or not specifically referred to herein.
- .3 Raised, open grate access floors.
- .4 All mesh, fences, gates, doors.
- .5 Handrails at exterior stairs and ramps, with all shop drawings signed/sealed by a Professional Engineer registered in the Province of British Columbia.

**1.3 REFERENCE STANDARDS**

- .1 Do welding in accordance with CSA W59-1982 except where specified otherwise.

**1.4 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.
- .3 Submit engineered shop drawings. All shop drawings to be signed and sealed by a Professional Engineer licensed in BC. Design and Fabricate work in accordance with the BC Building Code. The said professional engineer to submit schedule B and C-B in accordance with BLBC current edition.

**Part 2 PRODUCTS**

**2.1 MATERIALS**

- .1 Steel sections and plates: to CAN 3 G40.21 M81, Grade 300W, and hollow structural sections, Grade 350W.
- .2 Steel pipe: to ASTM A53-82 minimum 35Ksi.
- .3 Welding materials to CSAW59 1982 by fabricators qualified to CSA W47.1 1983 Division 2.1 min.
- .4 Bolts and anchor bolts: to ASTM A307-82a.
- .5 Galvanizing: hot dipped galvanizing with zinc coating 610 g/m<sup>2</sup> to CSA G164-M1992.
- .6 Shop coat primer: to CGSB 1 GP 40M

- .7 Zinc primer: To CGSB 1 GP 48, CISC/CPMA 1-73A, CISC/CPMA 2-75.

## **2.2 ACCESS FLOOR**

- .1 Non-slip industrial steel bar grating floor providing a rectangular pattern open mesh complete with all required support angles/legs, attachments and access steps.
- .2 Engineer steel bar grating floor system for maximum 6.5 mm (1/4") deflection and provide shop drawings stamped/signed by a P.Eng. registered in the Province of British Columbia.
- .3 All components to be hot dipped galvanized.

## **2.3 RAILINGS & LANDINGS**

- .1 Exterior Stairs and Ramps:
  - .1 Fabricate from galvanized steel, free of distortion of section, with welded flush joints, ground smooth and filled as required.
  - .2 Cap and weld exposed ends of balusters.
  - .3 Weld balusters to stringers.
  - .4 All blends tight radius as detailed, complete with plate connections, brackets or for drilled in installation.
  - .5 Open ends fitted with bullet nose end clips.
  - .6 Galvanize all exterior components.

## **2.4 FABRICATION**

- .1 Build work square, true, straight, and accurate to required size with joints closely fitted and properly secured.
- .2 Fabricate items from steel unless otherwise noted.
- .3 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.
- .4 Where possible, fit, and shop assemble work, ready for erection.
- .5 Shop weld all connections possible with minimum 5 mm fillets unless noted otherwise.
- .6 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

## **2.5 FINISHES**

- .1 Shop painting:
  - .1 Apply one shop coat of primer to interior metal items, with the exception of stainless steel, aluminium or concrete encased items.
  - .2 Use primer unadulterated, as prepared by the manufacturer. Paint on dry surfaces, free from rust, scale, or grease. Do not paint when temperature is lower than 7° C.
  - .3 Clean surfaces to be field welded: do not paint.
  - .4 All exterior and interior exposed steel to be fully galvanized, including all connectors and other steel accessories.

**Part 3 EXECUTION**

**3.1 ERECTION**

- .1 Erect metal work square, plumb, straight, and true, accurately fitted, with tight joints, and intersections.
- .2 Provide suitable means of anchorage acceptable to the Consultant such as dowels, anchor clips, bar anchors, expansion bolts, and shields and toggles.
- .3 Make field connections with bolts to CSA S16 1969 and CSA S1653-current edition.
- .4 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .5 Touch up rivets, field welds, bolts, and burnt or scratched surfaces after completion of erection with primer.
- .6 Touch up galvanized surfaces with zinc primer where burned by field welding.
- .7 Isolate dissimilar metals.
- .8 Do welding work in accordance with CSA W59. On-site welding is strictly prohibited for all exterior steel work.

**END OF SECTION 05 50 00**



**Part 1 General**

**1.1 DOCUMENTS**

- .1 This Section of the specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

**1.2 SUMMARY**

- .1 Section Includes:
  - .1 All labour, materials, tools, scaffolds, and other equipment, services, and supervision required to cover the surfaces of the building or structure, the building services and accessories not otherwise protected or covered with paint, as shown and specified in the Contract Documents.
  - .2 Structural Steel and Miscellaneous Metal: painting where exposed to view.
  - .3 Galvanised Steel and Iron: washing (etch, if necessary).
  - .4 Drywall: ensure surfaces are in a ready condition prior to painting.
- .2 Section Does Not Include
  - .1 Surface preparation to receive painting and finishing under this section of work, except for specific pre-treatments described or specified in the Painting Specification Manual and the Contract Documents
- .3 Related Requirements:
  - .1 Section 03 30 00 Cast-in-Place Concrete
  - .2 Section 05 12 00 Structural Steel; shop priming
  - .3 Section 05 31 00 Steel Deck
  - .4 Section 05 50 00 Metal Fabrications; shop painting
  - .5 Design Condition: ensure the Paint Inspection Agency inspects surfaces requiring painting. Notify the Consultant and the Contractor in writing of any defects or problems, prior to starting work, and after the prime coat is applied and defects become visible in the substrate.

**1.3 QUALITY ASSURANCE**

- .1 Qualification of Manufacturer: the paint products of the paint manufacturer shall be as listed in the Association Manual, latest edition, under "Paint Product Recommendation" section.
- .2 Qualifications of Applicators: the Painting Contractor must have a minimum of five (5) years proven satisfactory experience in related work. Maintain a qualified crew of painters throughout the duration of the work to fully satisfy the requirements of this specification. Engage only qualified journeymen who have a provincial Tradesman Qualification Certificate of Proficiency (where applicable), and registered apprentices, in painting and decorating work

- .3 All materials, preparation and workmanship shall conform to the standards contained in the latest edition of the Master Painters Institute (MPI) Architectural Painting Specification Manual as issued by the local MPI Accredited Quality Assurance Association having jurisdiction

#### **1.4 SUBMITTALS**

- .1 Samples and Colours:
- .2 Paint colours as selected by the Consultant.

#### **1.5 PRODUCT STORAGE AND HANDLING**

- .1 Delivery of Materials: deliver paint materials to the site in sealed, original labelled containers, bearing the manufacturer's name, type of paint, brand name, colour designation, and instructions for mixing and/or reducing.
- .2 Storage of Materials: store paint materials at a minimum ambient temperature of 7°C in a well ventilated and heated single designated area provided by others.  
  
Fire Hazard and Safety: take necessary precautionary measures to prevent fire hazards and spontaneous combustion.
- .3 Toxic Materials: where toxic and explosive solvents and materials are used, take appropriate precautions and do not smoke in the area.

#### **1.6 1.7 ENVIRONMENTAL REQUIREMENTS: EXTERIOR**

- .1 Temperature: apply coatings only when the outdoor temperature is above 10° C.
- .2 Precipitation: Do not apply coatings during period of precipitation nor when precipitation is imminent
- .3 Wind: Do not apply coatings under high wind conditions resulting in windblown dust and debris.

#### **1.7 REFERENCE STANDARDS**

- .1 All workmanship and materials shall conform to the standards of the MPI Architectural Painting Specification Manual.
- .2 Where no specific Master Painters Institute code is provided for a paint finish, the contractor shall use the "premium grade" application suitable for that substrate.

#### **1.8 GUARANTEE**

- .1 Furnish either the local MPI Accredited Quality Assurance Association's two (2) year guarantee, or, alternatively, a 100% two (2) year Maintenance Bond — both in accordance with MPI Painting Manual requirements. The Maintenance Bond shall warrant that all painting work has been performed in accordance with MPI Painting Manual requirements.
- .2 All painting and decorating work shall be in accordance with MPI Painting Manual requirements and shall be inspected by the local MPI Accredited Quality Assurance Association's Paint Inspection Agency (inspector), whether using either the MPI Accredited Quality Assurance Association's guarantee, or the Maintenance Bond option. The cost for such inspections, and for either the local MPI Accredited Quality Assurance

Association's Guarantee, or the Maintenance Bond, shall be included in the Base Bid Price.

- .3 Painting and decorating Subcontractors choosing the Maintenance Bond option shall provide a maintenance bond consent from a reputable surety company licenced to do business in Canada. Cash or certified cheques are not acceptable in lieu of surety consent.

## **1.9 MAINTENANCE MATERIALS**

- .1 At project completion provide 1 gallon of each type and colour of paint from the same production run (batch mix) used in unopened cans, properly labelled and identified for Owner's later use in maintenance. Store where directed

## **Part 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Paint materials for each coating formula to be products of a single manufacturer.
- .2 Selection: Paint colours and other finishes will be selected by Consultant.
- .3 Except as otherwise specified, gloss levels for interior paint finishes shall be semi-gloss.
- .4 Prior to proceeding with finish coats, confirm with Consultant required gloss levels for all surfaces and light reflectance values of products intended to be used.

### **2.2 MIXING**

- .1 Use ready-mixed paints unless otherwise specified, except field mix any coating in paste or powder form, or to field-catalysed in accordance with the directions of its approved manufacturer. Fully grind pigments and maintain a soft paste consistency in the vehicle during storage which can be dispersed readily and uniformly by paddle to become a complete homogenous mixture.
- .2 Ensure paint has good flowing and brushing properties and is able to dry or cure free of sags, etc., to yield the finish specified.

## **Part 3 EXECUTION**

### **3.1 INSPECTION OF SURFACES**

- .1 Surface Examinations:
  - .1 Prior to commencement of work of this section, thoroughly examine surfaces scheduled to be painted.
  - .2 Report in writing to the Contractor and the Construction Manager any condition adversely affecting this work.
  - .3 Do not proceed with painting work until defects have been corrected and surfaces are acceptable to the Painting Inspector.
- .2 Surface Acceptance:

- .1 Commencement of work shall not be held to imply acceptance of surfaces except as qualified herein.
- .2 For surface preparation of drywall, structural steel, and miscellaneous metal surfaces, refer to the appropriate section's work and the MPDA Manual, latest edition.

### **3.2 PREPARATION OF SURFACES**

- .1 Refer to the Association Manual for surface preparations not included in the following:
  - .1 Mildew Removal: scrub with solution of T.S.P. and bleach, rinse with clear water, and allow surface to dry completely.
  - .2 Structural and Miscellaneous Steel (Factory Primed): Specify individual items to be painted. Ensure surfaces are in a proper condition to receive paint finish with grease, rust, scale, dirt, and dust removed. Where steel and iron have a heavy coating of scale, remove by wire brushing, sandblasting, etc., as necessary. Ensure steel surfaces are satisfactory before proceeding with paint finishing. Note: preparatory work shall be the responsibility of the steel supplier/erector.

### **3.3 APPLICATION**

- .1 General:
  - .1 Use method of paint application by the accepted trade method.
  - .2 Painting coats specified are intended to cover surfaces satisfactorily when applied in strict accordance with the manufacturer's recommendations.
  - .3 Apply each coat at the proper consistency.
  - .4 Ensure each coat of paint is slightly darker than preceding coat, unless otherwise approved.
  - .5 Sand lightly between coats to achieve an anchor for the required finish.
  - .6 Do not apply finishes on surfaces that are not sufficiently dry.
  - .7 Ensure each coat of finish is dry and hard before a following coat is applied unless the manufacturer's directions state otherwise, e.g., see polyurethane coatings.
  - .8 aTint filler to match wood when clear finishes are specified. Work filler well into the grain and before it has set wipe the excess from the surface.
  - .9 On exterior work, do not paint during temperatures under 7° C or immediately following rain, frost or dew. On interiors, do not paint during temperatures under 5° C or on surfaces where condensation has formed or is likely to form (unless specially formulated paints are used). The minimum temperatures allowed for latex paints shall be 7° C (interior work) and 10° C (exterior work) unless specifically approved by the Consultant.
  - .10 Prime on site any surfaces where no shop-applied primer.

### **3.4 EXTERIOR FINISHES**

- .1 Structural Steel and Metal Fabrications:
  - .1 Water Based light Industrial (over alkyd primer)
  - .2 one coat MPI #79 alkyd primer,
  - .3 two coats MPI #161 w. b. light industrial coating

- .4 for steel—high heat (pipes, flues, stacks, etc.):
- .5 one coat heat resistant enamel, MPI #21

**3.5 CLEANING AND PROTECTION**

- .1 Promptly as the work proceeds and on completion of the work, remove paint where spilled, splashed or spattered. During the progress of the work, keep the premises free from any unnecessary accumulation of tools, equipment, surplus materials, and debris. At the conclusion of the work, leave the premises neat and clean to the satisfaction of the Consultant.
- .2 Adequately protect surfaces from paint and damage; make good any damage caused by this section by failure to provide protection.
- .3 Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling completed or existing surfaces.
- .4 Rubbish: place cotton waste, cloths, and material which may constitute a fire hazard, in closed metal containers & remove from the site daily.

**END OF SECTION 09 90 00**

## **1. GENERAL**

### **1.1 Section Scope**

- .1 Materials and installation for hangers and supports for mechanical and plumbing piping, ducting and equipment.

### **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 21 05 01 – Common Work Results for Mechanical
- .3 Section 23 05 48 – Vibration and Seismic Control for Mechanical.

### **1.3 References**

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1 – Power Piping.
- .3 ASTM International
  - .1 ASTM A125 – Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod, 60,000 PSI Tensile Strength.
  - .3 ASTM A563 – Standard 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.
- .5 Underwriter's Laboratories of Canada (ULC)

### **1.4 Submittals**

- .1 Comply with Division 01 – Submittal Procedures and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and additionally the following:
  - .1 Submit shop drawings for:
    - .1 Bases, hangers and supports.
    - .2 Connections to equipment and structure.
    - .3 Structural assemblies.
  - .2 Certificates:
    - .1 Submit certificates from the manufacturer certifying that materials comply with specified performance characteristics and physical properties of the listed Related Standards.
  - .3 Manufacturers' Instructions:
    - .1 Provide manufacturer's installation instructions.

## **1.5 General Requirements**

- .1 Plumbing piping: to the more stringent requirements of the BC Plumbing Code and the National Plumbing Code of Canada.
- .2 Construct pipe hangers and supports to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .3 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
- .4 Ensure that supports do not transmit excessive quantities of heat to building structure.
- .5 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .6 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
- .7 Provide hangers and supports to secure equipment in place, prevent vibration, protect against damage from earthquake, maintain grade, provide for expansion and contraction and accommodate insulation.
- .8 Support from (top of) structural members. Where structural bearings do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members, as necessary.

## **2. PRODUCTS**

### **2.1 General**

- .1 Fabricate hangers and supports in accordance with ANSI B31.1 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- .3 Power actuated fasteners and "drop-in" anchors shall not be used for tension load applications such as pipe and duct hangers.

### **2.2 Riser Clamps**

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed, FM approved.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

### **2.3 PEX Pipe Support**

- .1 NPS 3 and under
  - .1 Non-combustible, self-gripping, galvanized-steel channel for crosslinked polyethylene (PEX-a) pipe. To provide continuous, uninterrupted support of PEX-a pipe.
  - .2 PEX-a pipe support shall be minimum 2700 long complete with stainless-steel strapping.

- .2 Use PEX-a Pipe Support in conjunction with un-insulated PEX-a pipe in ASTM E84 plenum applications.
- .3 The PEX-a pipe with pipe support can be insulated with typical CTS (copper tube size) pipe insulation.

#### **2.4 Insulation Protection Shields**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield, galvanized sheet carbon steel. Length designed for maximum 3 m span.
  - .2 Non-metallic support coupling, sized to suit standard and millimeter pipe O.D. UL listed, meeting 25/50 flame and smoke spread ratings. Supplied with hanger and/or strut mount as a complete support assembly.
- .2 Insulated hot piping:
  - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 300 mm and over.
  - .2 For piping to 60°C Non-metallic support coupling, sized to suit standard and millimeter pipe O.D. UL listed, meeting 25/50 flame and smoke spread ratings. Supplied with hanger and/or strut mount as a complete support assembly.

#### **2.5 Equipment Supports**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Division 5. Submit calculations with shop drawings.

#### **2.6 Equipment Anchor Bolts and Templates**

- .1 Provide templates to ensure accurate location of anchor bolts.

#### **2.7 Other Equipment Supports**

- .1 Fabricate equipment supports from structural grade steel meeting requirements of Division 5.
- .2 Submit structural calculations with shop drawings.

### **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 manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
  - .1 Install on piping systems as indicated.
- .3 Clamps on riser piping:



- .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
- .2 Bolt-tightening torques to industry standards.
- .3 Steel pipes: install below coupling or shear lugs welded to pipe.
- .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

### 3.3 Hanger Spacing

- .1 Within 300 mm of each elbow.

Maximum Pipe Size NPS	Maximum Spacing Steel m	Maximum Spacing Copper m	Minimum Rod Dia mm
up to 1/2	1.8	1.5	9
3/4, 1	2.4	1.8	9

- .2 Install PEX-a pipe support vertically or horizontally for plenum and non-plenum applications or support PEX pipe at 900 mm intervals with manufactured hanger fittings regardless of size. PEX installed with PEX-a pipe support shall follow the manufacturers pipe support recommendations for hanger spacing
- .3 For other plastic piping, provide supports at intervals recommended by manufacturer.

### 3.4 Hanger Installation

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Install hangers to provide minimum 13 mm space between finished covering and adjacent work.
- .5 Support vertical piping at every other floor.
- .6 Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- .7 Support riser piping independently of connected horizontal piping.
- .8 Install plastic inserts between steel studs and piping.
- .9 Provide insulation protection saddles on all insulated piping.

### 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**

## **1. GENERAL**

### **1.1 Section Scope**

- .1 The work in this section includes, but is not limited to the following:
  - .1 Vibration isolation for ductwork, and equipment.
  - .2 Equipment isolation bases.
  - .3 Seismic restraints for isolated equipment.
  - .4 Certification of seismic restraint designs and installation supervision.

### **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 21 05 01 – Common Work Results for Mechanical.
- .3 Section 23 33 00 - Duct Accessories.

### **1.3 References**

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Applicable Building Code: Refer to Section 21 05 01 – Common Work Results for Mechanical.
- .3 Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
  - .1 SMACNA – Seismic Restraint Manual Guidelines for Mechanical Systems.
- .4 American Society of Heating, Refrigeration, and Air Conditioning Engineers ASHRAE):
  - .1 ASHRAE HVAC Applications Handbook (Seismic Design Chapter 54).
- .5 Federal Emergency Management Agency (FEMA):
  - .1 FEMA – Installing Seismic Restraints for Mechanical Equipment.
- .6 Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).
  - .1 VISCMA – Installing Seismic Restraints for Mechanical Equipment.

### **1.4 Submittals**

- .1 Comply with Division 01 – Submittal Procedures and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and additionally the following:
  - .1 Consultant Assurance of Professional Design and Commitment for Field Review by Supporting Registered Professional Schedule S-B and Assurance of Professional Field Review and Compliance by Supporting Registered Professional Schedule S-C for seismic engineering.
  - .2 Shop drawings: submit drawings for vibration control stamped and signed by a Professional Engineer.
  - .3 Shop drawings: submit drawings for seismic control stamped and signed by a Professional Engineer registered or licensed in Province of British Columbia.

- .4 Provide separate shop drawings for each isolated system complete with performance and product data.

### **1.5 General Requirements**

- .1 All mechanical equipment, piping, and ductwork as noted on the equipment schedule or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
- .2 Provide seismic restraints for all required equipment, piping, and ductwork.
- .3 Responsibilities:
  - .1 The Contractor shall retain the services of a qualified professional seismic engineer (Seismic Engineer) registered in the Province of British Columbia. The Seismic Engineer shall design and review the installation of all seismic restraints as well as mechanical equipment and mechanical system supports. The restraints and supports shall be specifically designed to fasten to the structure indicated in the contract documents and installed in the field. The complete design for these systems shall comply with all applicable building code requirements.
  - .2 Seismic Engineer shall provide and submit to the Departmental Representative Assurance of Professional Design and Commitment for Field Review by Supporting Registered Professional Schedule S-B and Assurance of Professional Field Review and Compliance by Supporting Registered Professional Schedule S-C for seismic engineering.
  - .3 Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:
    - .1 Determine vibration isolation and seismic restraint sizes and locations.
    - .2 Provide vibration isolation and seismic restraints as scheduled or specified.
    - .3 Provide calculations and materials if required for restraint of non-isolated equipment.
    - .4 Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.
- .4 All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
- .5 It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.
- .6 All such systems must be installed in strict accordance with seismic codes, component manufacturer's, and building construction standards. Whenever a conflict occurs between the standards, the most stringent shall apply.
- .7 Seismic restraints shall be designed in accordance with seismic force levels as indicated in the Building Code for the specific region of the project.
- .8 All elastomeric components in isolation pads, mounts, and seismic snubbers shall be bridge bearing neoprene, meeting CSA Standard CAN3-S6 Section 11.10.
- .9 Provide an acceptable means of corrosion protection for all equipment, attachments, and accessories supplied under this section, suitable for the conditions in which this equipment, etc. will be installed.

- .10 Bolt all equipment to the structure. Do not bridge isolation elements.
- .11 Use ductile materials in all vibration isolation equipment.
- .12 Motor Drive Equipment:
  - .1 Provide vibration isolation on all motor driven fans regardless of power rating and all other motor driven equipment over 0.35 kW (as indicated on the motor nameplate), and on piping and ductwork specified herein.
  - .2 For fans less than 0.35 kW, provide isolation with neoprene grommets at the support points. Select isolators for a minimum static deflection of 3mm.
- .13 Isolators:
  - .1 Provide neoprene isolators for deflections 6mm and under.
  - .2 Provide either neoprene or steel spring isolators for deflections between 6mm and 12mm.
  - .3 Provide steel spring isolators for deflections of 12mm and over.
  - .4 Provide adjustable limit stops for spring isolation mounts on equipment with operating weights substantially different from the installed weights.
  - .5 All spring isolators shall be "open spring" unless otherwise stated. Seismically rated housed spring isolators may be used in lieu provided that they meet this project's requirements for seismic restraint.
  - .6 Isolators and bases which are factory supplied with equipment shall meet the requirements of this section. Where internal isolation is provided, the isolation requirements specified in the minimum static deflection table apply to all separate vibration sources in the unit. Where internal vibration isolation is not provided, the unit frame shall be rigid enough such that the isolators can be attached directly without additional stiffening.
  - .7 Space isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the center of gravity of the equipment. Include height of center of gravity on shop drawings. Otherwise, provide suitable horizontal restraint isolators.
  - .8 Select isolators in accordance with equipment weight distribution to allow for an average deflection meeting or exceeding the specified deflection requirements and so that no isolator has a deflection less than 80% of the static deflection specified. A minimum of 4 isolators are required for each piece of equipment, unless specified otherwise. Number and colour code each isolator to show location. Mark code number and colour on shop drawings, on each isolator and on each base to ensure proper placement. Clearly tag all springs to show undeflected height and static deflection.
  - .9 Refer to the minimum static deflection table contained in this Section.
- .14 Ducting:
  - .1 Install flexible duct connectors on all ductwork connected to isolated equipment.

.15 Piping Hangers:

- .1 Provide resilient hangers on all piping, etc., rigidly connected to vibration isolated equipment. Provide the hangers for a distance of 3.0m for a 1 NPS pipe and 13.5m for a 10 NPS pipe. Isolate other pipe sizes for a proportionate distance (both interpolation and extrapolation may be required). Select the three closest hangers to the vibration source for the lesser of 25mm static deflection or the static deflection of the isolated equipment. Select the remaining isolators for the lesser of 25mm static deflection or one-half the static deflection of the isolated equipment.
- .2 Where resilient hangers cannot be provided for piping rigidly connected to vibration isolated equipment (such as a rigid fire-stop falling within the required isolation distance), provide flexible connectors. One end of each flexible connector shall be installed directly to a flange of the isolated equipment (between the equipment and isolation valves) unless otherwise indicated on the drawings.

.16 Electrical Connections:

- .1 Coordinate with the Division 26 to ensure all electrical connections to vibration isolated equipment is made with flexible conduit or other flexible means and does not restrict the maximum anticipated movement.

## 1.6 Regulatory Requirements

- .1 Tested values must show that the seismic restraint hardware used in conjunction with the vibration isolation product is capable of withstanding the increased forces, as calculated for the specific project, using the formulae provided in the applicable building code.
- .2 Supply isolators and seismic restraints meeting the structural requirements of the building code, including Section 4.1.8.18 with respect to seismic snubbers, or provide equivalent requirements where integral seismic restraint is provided in isolators / bolting.
- .3 Include building code Section 6.2.1.6(2). Vibration isolator housings are considered a safety guard with respect to isolated equipment and any contained compressed springs. Include "Fail Safe" seismic restraint in all vibration isolation designed to hold mechanical equipment and springs in place.

## 2. PRODUCTS

### 2.1 General

- .1 Isolation, anchors, bolts, restraints, etc., are to be designed to withstand without failure or yielding, the dynamic G load as specified in Code for the seismic zone in which building is located. Design loads are ultimate limit state loads (1.5 times working load) acting through the centre of gravity of the anchored or restrained equipment. "Fail Safe" designs are acceptable.
- .2 Where impact forces may be significant, use ductile materials.
- .3 Seismic restraining devices factory supplied with equipment are to meet requirements of this Section.

### 2.2 Open Spring Mounts

- .1 Base mount free-standing assemblies, each complete with a stable colour coded steel spring welded in place, drilled mild steel mounting plate bonded to a ribbed rubber or neoprene acoustical pad, and an external 16 mm diameter level adjustment bolt.

### **2.3 Closed Spring Mounts**

- .1 Base mount free-standing enclosed assemblies, each complete with stable colour coded spring(s), 2 piece cast housing, non-binding rubber horizontal stabilizers, a ribbed rubber or neoprene acoustical pad bonded to base of the closed housing, and an external level adjustment bolt.

### **2.4 Totally Retained Spring Mounts**

- .1 Base mount free-standing enclosed and retained assemblies to limit both vertical and lateral movement of mounted equipment, each complete with stable colour coded spring(s), drilled welded steel housing and top plate, ribbed rubber or neoprene acoustical pad bonded to bottom of housing, vertical limit adjusting hardware, and a level adjustment bolt.

### **2.5 Type 1 - Neoprene Pad Isolators**

- .1 Neoprene or neoprene / steel / neoprene pad isolators.
- .2 Minimum static deflection 2.5 mm or greater.
- .3 Use hold down bolts selected for seismic loads. Isolate bolts from base of unit using neoprene washer/bushing.
- .4 Size bolt and washer/bushing for minimum lateral clearance.

### **2.6 Type 7N – Neoprene Hangers**

- .1 Double deflection neoprene hangers shall consist of a rigid steel frame containing a neoprene element with an upper embedded steel washer and an integral bottom flange, which will protrude, and friction fit into the lower circular opening of the hanger frame. The lower hole in the hanger box shall be of a large enough diameter to permit the threaded hanger rod to swing through a minimum 30° arc from side to side before contacting the neoprene flange. Nominal static deflection under load shall be 5mm. No hanger shall be loaded to less than 50% of this deflection nor exceed the manufacturers maximum recommended loading.

### **2.7 Type 7S – Spring Isolation Hangers**

- .1 Spring isolation hangers shall consist of a rigid steel frame containing a steel spring (see Type 3) and shall be seated in a steel washer reinforced neoprene cup. This cup shall have a neoprene bushing projecting through the steel box. Spring diameters and hanger box lower hole diameters shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the protruding neoprene bushing. Spring selection and submittal data similar to that for Type 3.

### **2.8 Type 7SN - Spring Hangers with Neoprene Elements**

- .1 Hangers shall consist of rigid steel frames containing minimum 32mm thick neoprene elements at the top and a steel spring seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box.
- .2 Provide a combination rubber and steel rebound washer as the seismic up stop for suspended piping, ductwork, and equipment. Rubber thickness shall be a minimum of 6mm.
- .3 To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring.

- .4 Spring diameters and hanger box lower hole diameters shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the protruding neoprene bushing.
- .5 Colour coded springs, rust resistant, painted box type hangers.

### **2.9 Type 8 - Neoprene Washer/Bushing**

- .1 A one piece molded bridge bearing neoprene washer/bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal to metal contact.
- .2 Use washer/bushing only on light-weight equipment.

### **2.10 Type 10 – Acoustical Split Wall Seals**

- .1 Split wall seals shall consist of two bolted pipe halves with a minimum 18 mm thick neoprene sponge bonded to the liner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping.
- .2 Concrete may be packed around the seal to make it integral with the floor, wall, or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum 25 mm past both sides of the wall.
- .3 Where temperatures exceed 113°C 10# density fiberglass may be used in lieu of the sponge.

### **2.11 Type 13 - Flexible Piping Connections**

- .1 Flexible piping connectors are to be supplied with seismic restraint materials.
- .2 Where flexible connections are not specified with piping in other Sections they are to be as specified herein.
- .3 Expansion joints shall be peroxide cured EPDM throughout with Kevlar® tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable.
- .4 Sizes 19mm through 50mm may have one sphere, bolted threaded flange assemblies, and cable retention.
- .5 Safety factors shall be a minimum of 3/1. All expansion joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment.
- .6 The piping gap shall be equal to the length of the expansion joint under pressure. Control rods passing through 13mm thick Neoprene washer bushings large enough to take the thrust at 0.7 kg/mm<sup>2</sup> of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the expansion joint rating without them.
- .7 Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration acceleration and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.
- .8 All expansion joints shall be installed on the equipment side of the shut off valves.

### **2.12 Type 14 - Flexible Duct Connectors**

- .1 Flexible duct connectors as specified in Section 23 33 00 Duct Accessories.
- .2 Provide 75 mm flexible duct connectors and a 40 mm metal to metal gap.



### 2.13 Anchor Bolts

- .1 Female wedge anchors are preferred in floor locations so isolators or equipment can be slid into place after the anchors are installed. Anchors shall be manufactured from full diameter wire, and shall have a safety shoulder to fully support the wedge ring under load. Female wedge anchors shall have an evaluation report number from the I.C.B.O Evaluation Service, Inc. verifying to its allowable loads.

### 2.14 Seismic Cable Restraints

- .1 Galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint.
- .2 Cables must be pre-stretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement.
- .3 Cables must not be allowed to bend across sharp edges.
- .4 Cable assemblies shall suit installation type:
  - .1 Ceiling and at the clevis bolt.
  - .2 Between the hanger rod nut and the clevis.
  - .3 Clamped to a beam.

## 3. EXECUTION

### 3.1 General

- .1 All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.
- .2 Brace in-line equipment independently of ducts and pipes.
- .3 Do not mix solid and cable bracing.
- .4 All runs to have a minimum of two transverse and one longitudinal brace. A run is defined as any change in direction except offsets.

### 3.2 Seismic Restraint Installation

- .1 The following Mechanical Components Restraint Guide is to be used as a general guide only to establish appropriate restraint methods, hardware, and attachments, however, due to differences in construction, size, weight, and configuration of different manufacturer's equipment and variety of ways and means that equipment and components can be installed, specific restraint methods are to be confirmed in the field. Seismic restraint materials and methods are to be reviewed and approved by Departmental Representative

### 3.3 Mechanical Component Restraint Guide

Item	Type Of Restraint	Minimum No. of Restraints	Notes
<b>AHU's and A/C Units Suspended</b>			
- Isolated	SCR	4	
- Non-Isolated	SCR	4	
<b>Fans – Suspended</b>			

Item	Type Of Restraint	Minimum No. of Restraints	Notes
- Isolated	SCR	4	
- Non-Isolated	SCR	4	
<b>Grilles, Registers, Diffusers</b>	SCR	4	Where not bolted to duct (i.e. in tee-bar ceilings)
<b>Piping</b>	SCR TSR	As required	As per Specification
<b>Ductwork</b>	SCR TSR	As required	As per Specification

LEGEND	
<b>SCR</b>	Slack cable restraint (bolted to structure)
<b>TSR</b>	Threaded support rod (bolted or clamped to structure)

### 3.4 Seismic Piping Restraints

- .1 Seismically restrain all new piping as follows:
  - .1 Piping located in all utility and mechanical equipment rooms that is 1 ¼ NPS and larger.
  - .2 All other piping 2 ½ NPS and larger.
- .2 Provide transverse piping restraints at 12m maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
- .3 Provide longitudinal restraints shall be at 24m maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
- .4 Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.

### 3.5 Seismic Ductwork Restraints

- .1 Seismically restrain all ductwork as follows:
  - .1 Restrain all ductwork and duct mounted equipment.
  - .2 Transverse restraints shall occur at 9m intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.
  - .3 Longitudinal restraints shall occur at 18m intervals with at least one restraint per duct run.
  - .4 The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
  - .5 A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
  - .6 Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.

### **3.6 Seismic Cable Restraints**

- .1 Cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.
- .2 Cable assemblies are installed taut on non-isolated systems.
- .3 Where cable restraints are installed on support rods with spring isolators, the spring isolation hangers must be specification type.

### **3.7 Vibration Isolator Installation - General**

- .1 Vibration isolation products as outlined in section 2 above are to be applied based on 2 basic project specific situations. The requirements for each of these is outlined below:
  - .1 Acoustical classification AA - Office Towers, Multi Storey Condominiums
  - .2 Acoustical classification A - Commercial
- .2 This project has an acoustical classification of AA. See Vibration Isolation Application Schedule for vibration isolation application requirements.
- .3 Unless otherwise specified, vibration isolation products are to be product of one manufacturer.
- .4 Ensure vibration isolation manufacturer coordinates material selections with equipment provided in order to ensure adherence to performance criteria. Allow for expansion and contraction when material is selected and installed.
- .5 Use the lowest RPM scheduled for two-speed equipment in determining isolator deflection.
- .6 Before bolting isolators to the structure, start equipment and balance the systems so that the isolators can be adjusted to the correct operating position before installing (seismically rated) anchors.
- .7 Isolate piping larger than 25 mm dia. directly connected to motorized and/or vibration isolated equipment with 25 mm static deflection spring hangers at spacing intervals in accordance with following:
  - .1 For pipe less than or equal to 100 mm dia. – first 3 points of support;
- .8 First point of isolated piping support is to have a static deflection of twice the deflection of the isolated equipment but maximum 50 mm.
- .9 Flexible pipe connectors (Type 13 isolator) shall be provided and installed per the Vibration Isolation Application Schedule.
- .10 Provide hot dipped galvanized housings and neoprene coated springs, or other acceptable weather protection, for all isolation equipment located outdoors or in areas of high moisture which may cause corrosion.
- .11 Provide a minimum clearance of 50mm to other structures, piping, equipment, etc., for all equipment mounted on vibration isolators.
- .12 Before bolting isolators to the structure, start equipment and balance the systems so that the isolators can be adjusted to the correct operating position before installing drilled inserts.
- .13 After installation and adjustment of isolators, verify deflection under load to ensure loading is within specified range.

- .14 Where isolated piping connected to noise generating equipment is routed from the utility or mechanical room through plumbing chases or other openings, position isolated piping to avoid contact with the structure, framing, gypsum wallboard and other elements which may radiate noise. Submit proposed details to meet this requirement. On all AA projects, Type 10 acoustical seals shall be provided on piping entering or leaving utility and mechanical rooms.
- .15 Ensure that the installed seismic restraints do not adversely affect the proper functioning of any vibration isolation products required by this section.
- .16 For control wiring connections to vibration isolated equipment ensure flexible metallic conduit with 90° bend is used for conduit 25 mm dia. and smaller. Connections are to be long enough so that conduit will remain intact if equipment moves 300 mm laterally from its installed position, and flexible enough to transmit less vibration to structure than is transmitted through vibration isolation. Coordinate these requirements with mechanical trades involved. If electrical power connections are not made in a similar manner as part of the electrical work, report this fact to Departmental Representative.

### **3.8 Type 7S & 7SN - Spring Hangers**

- .1 Locate isolation hangers as near to the overhead support structure as possible.
- .2 Installation shall permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .3 All discharge ductwork runs for a distance of 15m from the connected equipment shall be isolated from the building structure by means of spring hangers. Spring deflection shall be a minimum of 19mm.

### **3.9 Type 8 - Neoprene Washer/Bushing**

- .1 Isolate variable frequency drive controller using neoprene washer/bushing isolators or soft grommets such that structure borne noise transmission to occupied space is less than airborne noise transmission.

### **3.10 Type 13 - Flexible Piping Connectors**

- .1 Supply flexible piping connectors for connections (including plumbing) to seismically restrained equipment. Hand connectors to appropriate piping trade at site for installation.

### **3.11 Type 14 - Flexible Duct Connectors**

- .1 Install flexible duct connectors so that duct cross-section is not reduced by the deflection of the flexible connector.

### **3.12 Minimum Static Deflection Schedule**

Equipment	Equipment Supported By:	
	Slab on Grade	Elevated Floor
<b>Fans, Blowers &amp; Packaged H &amp; V Units:</b>		
Under 0.5 HP	1mm	1mm
0.5 HP to 7.5 HP	25mm	25mm

NOTES:

- .1 Table indicates required static deflection of isolators for all fans regardless of power rating and for all other motor driven equipment over 0.37kW.
- .2 Advise Departmental Representative of equipment not contained in this table and obtain clarification as to the isolation performance requirements.
- .3 Steel spring isolators shall be used for all deflections 12mm and over.
- .4 Neoprene isolators shall be used for deflections 6mm and under.

**3.13 Vibration Isolation Application Schedule**

Equipment	AA	A
<b>Piping</b>		
Attached to Isolated Equipment	7SN - See 3.4.5	7SN - See 3.4.5
Through Mechanical Room Walls 1½"	10	-
Hot Water Risers - No Expansion Loops	11,12,13	-
<b>Fans Hung</b>		
>>1/2hp>>1200 rpm	7N & 14	8 & 14
<b>Fractional</b>	8 & 14	

Note:

- .1 Table indicates type of isolation required and any other sections of note.

**3.14 Field Quality Control**

- .1 Seismic Engineer:
  - .1 The Seismic Engineer shall perform all field services as required to fulfil the Building Code obligation for the provision of the Assurance of Professional Field Review and Compliance by Supporting Registered Professional Schedule S-C for seismic engineering.
  - .2 Submit concise field reports to the Departmental Representative within 3 days of each site review.
  - .3 Make adjustments and corrections in accordance with written report.
- .2 Manufacturer's Field Services:
  - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
  - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
    - .1 Twice during the installation, at 25 % and 60 % completion stages.
    - .2 Upon completion of installation.
  - .3 Submit a concise manufacturer's report to the Departmental Representative within 3 days of manufacturer representative's review.
  - .4 Make adjustments and corrections in accordance with written report.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Section Scope**

- .1 Materials and installation for the identification of all mechanical piping, ducting, equipment, and controls.

### **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 21 05 01 – Common Work Results for Mechanical.

### **1.3 References**

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Canadian Standards Association (CSA International):
  - .1 CAN/CSA B128.1 – Design and Installation of Non-potable Water Systems.
  - .2 CAN/CSA B128.2 – Maintenance and Field Testing of Non-potable Water Systems
  - .3 CAN/CSA Z305.1 – Non-flammable Medical Gas Piping.
  - .4 CAN/CSA Standard-Z7396.1-17 Medical Gas Pipeline Systems – Part 1
- .3 Canadian Gas Association (CGA):
  - .1 CSA/CGA B149.1 – Natural Gas and Propane Installation Code.
- .4 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-1.60 – Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3 – Identification of Piping Systems.
- .5 National Fire Protection Association (NFPA):
  - .1 NFPA 13 – Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 14 – Standard for the Installation of Standpipe and Hose Systems.

### **1.4 Submittals**

- .1 Comply with Division 01 – Submittal Procedures and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and additionally the following:
  - .1 Submit data on all materials.

### **1.5 General Requirements**

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 Identify each system and system component according to the nomenclature used on the drawings and specifications. Identification to be consistent throughout the project.
- .3 When identifying systems and components in existing buildings, the new items shall be numbered sequentially with existing systems. Where possible include the zone or building area serviced by each system.

- .4 Submit list of system and component labels to be Consultant for review prior to engraving

## **2. PRODUCTS**

### **2.1 Acceptable Manufacturers**

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers.

### **2.2 Piping Systems Governed by Codes**

- .1 Any piping that is governed by CSA/NFPA or any other applicable code as addressed in contract documents, is to comply with those applicable codes concerning identification.

### **2.3 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.

### **2.4 System Equipment Nameplates**

- .1 Each piece of equipment shall be identified with its equipment schedule identification, e.g. supply fan SF-1, cooling coil CC-1, pump P-1.
  - .1 Coordinate equipment with drawings and with owner's requirements
- .2 Colours:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .3 Construction:
  - .1 3 mm ( $\frac{1}{8}$ " ) thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .4 Sizes:
  - .1 Conform to following table:

Size No.	Size (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .5 Locations:
  - .1 Terminal cabinets, control panels: use size # 5.
  - .2 Equipment in Mechanical Rooms: use size # 9.

## **2.5 Piping Systems Identification**

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Medical Gas Pipeline Systems:
  - .1 All medical gas pipelines shall have a permanent label at intervals of 6.0 m [20 ft.], immediately before and after barriers, at each valve, and behind access doors and inlet and outlet points.
  - .2 Lettering colour, background colour, lettering height and gas or gas mixture symbol shall be in accordance with CAN/CSA Z7396.1 Medical Gas Pipeline Systems – Part 1.
- .3 Pictograms:
  - .1 Where required by Workplace Hazardous Materials Information System (WHMIS) regulations.
- .4 Letter Height:
  - .1 13 mm [1/2"] high - 1-1/4 NPS pipe & smaller.
  - .2 25 mm [1"] high - 1-1/2 NPS up to 2-1/2 NPS pipe.
  - .3 50 mm [2"] high - 3 NPS and larger pipe.
- .5 Arrows showing direction of flow:
  - .1 Outside diameter of pipe or insulation less than 75mm (3"): 100mm long x 50mm high (4" x 2").
  - .2 Outside diameter of pipe or insulation 75mm (3") and greater: 150mm long x 50mm high (6" x 2").
  - .3 Use double-headed arrows where flow is reversible.
- .6 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .7 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20mm (3/4") and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C (302°F) and intermittent temperature of 200°C (392°F).
- .8 Colours and Legends:
  - .1 Where not listed, obtain direction from the Consultant.



.2 Colours for legends, arrows: to following table:

Background Colour	Legend, Arrows
Yellow	BLACK
Green	WHITE
Red	WHITE
Blue	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background Colour Marking	Legend
Chilled Water Supply	Blue	CHILLED SUPPLY CHWS
Chilled Water Return	Blue	CHILLED RETURN, CHWR
Solar Water Supply	Yellow	SOLAR SUPPLY
Solar Water Return	Yellow	SOLAR RETURN
Heating Water	Yellow	HEATING SUPPLY, HWS
Heating Water	Yellow	HEATING RETURN, HWR
Make-Up Water	Yellow	MAKE-UP WTR
Domestic Hot Water Supply	Green	DOM. HW SUPPLY, DHW
Dom. HWS Recirculation	Green	DOM. HW CIRC, DHWR
Domestic Cold Water Supply	Green	DOM. CW SUPPLY, DCW
Storm Water	Green	STORM
Sanitary	Green	SAN
Compressed Air (Non-Medical)	Green	COMP. A.
Natural Gas	Refer to CGA code	
Gas Regulator Vents	Refer to CGA code	
Fire Protection Water	Red	FIRE PROT. WTR
Heat Pump Supply	Yellow	HT PUMP SUPPLY
Heat Pump Return	Yellow	HT PUMP RETURN
Radiant Floor Supply	Yellow	RAD FLR SUPPLY
Radiant Floor Return	Yellow	RAD FLR RETURN
Condensate Drain	Green	COND
Steam Condensate Supply	Orange	STM COND SUPPLY
Steam Condensate Return	Orange	STM COND RETURN

Contents	Background Colour Marking	Legend
Irrigation Water	Per CSA B128.1	
Non Potable Water	Per CSA B128.1	
Grey Water	Per CSA B128.1	

- .9 Labeling of Recycled Rainwater system (irrigation, crop irrigation systems) shall be as follows:
  - .1 Identification labels for crop irrigation shall include the term ``crop irrigation`` in addition to the following:
  - .2 The contractor shall install all piping and equipment associated with the rainwater collection storage filtration and recycled rainwater (non-potable) distribution system in accordance with:
    - .1 CAN/CSA Standard B128.1 Design and Installation of Non-potable Water Systems
    - .2 CAN/CSA Standard B128.2 Maintenance and Field Testing of Non-potable Water Systems.
  - .3 Fixtures, fittings, and appurtenances connected to the recycled rainwater system shall be marked in accordance with the CSA Standard.

## 2.6 Valves, Controllers Identification

- .1 Provide valve identification and secure with non-ferrous chain or "S" hooks suitable for the system temperature.
- .2 Identification tags shall be of brass, aluminum, metalphoto, lamicoïd or fiberglass, stamped or engraved with 12mm (½") high identifier markings.
- .3 Tag the following valves as a minimum:
  - .1 Valves on main piping circuits.
  - .2 Valves on major branch lines.
  - .3 Valves on minor branch lines in horizontal or vertical service spaces and mechanical rooms.
  - .4 Drain valves and hose bibbs on systems containing glycol.
  - .5 Control valves.
- .4 Do not tag the following valves:
  - .1 Valves on control valve stations.
  - .2 Valves on steam trap stations.
  - .3 Plumbing fixture stops or hose bibbs.
  - .4 System drain valves.
- .5 Provide a valve tag schedule. Include in the identification of each tagged item, valve type, service, function, normal position and location of tagged item.
- .6 Provide a flow diagram for each system, reference applicable charts and schedules.

## 2.7 Ductwork Systems Identification

- .1 50mm (1/2") high stencilled letters and directional arrows 150mm long x 50mm high (6" x 2").
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

## 2.8 Ductwork Access Identification

- .1 Secure 50 mm (2") high, self-adhesive stick on-letters, on duct access panels to identify their usage, according to the following:
  - .1 Cleaning and service access, colour black, tag "C.A"
  - .2 Controls including sensors, colour black, tag "C"
  - .3 Backdraft dampers, balance dampers and control dampers, colour black, tag "D"
  - .4 Fire dampers, colour red, tag "F.D."
  - .5 Smoke dampers and duct smoke detectors, colour red, tag "S.D."

## 2.9 Controls Components Identification

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section. Include: sensors, transmitters, BMS controlled valve and damper actuators, end-devices, distributed control panels (DCP)'s, application specific controllers (ASC)'s and field panels.
- .2 Inscriptions to include function and (where appropriate) fail safe position.
- .3 Warning notices shall be provided at all equipment controlled by the BMS and at all associated motor starters. The warning notices shall state that the equipment is under the control of the BMS and may start or stop at any time without warning. Provide warning notices at minimum at all MCC's, at local disconnect switches, at AHU plenum doors, and electrical motors.
- .4 Provide warning notices on all Distributed Control Panel doors indicating that hand held radio transmitters are not to be keyed within 3 meters of the DCP.
- .5 All BMS wire and cable shall be identification tagged. Wire/cable shall be identification tagged at every termination location. Wire/cable and tubing terminating at distributed control panels (DCP) and application specific controllers (ASC) shall be tagged with the DCP/ASC controller termination number. Wire/cable and tubing terminating at field devices shall be tagged with both the DCP/ASC number and the DCP/ASC termination number. At any splices or terminal strips between the field device and DCP/ASC, the wiring shall be tagged on both sides of the termination point the same as for a field device termination.
- .6 In accordance with CSA B44-07 [13] clause 2.7.9.2, provide signage indicating the allowable temperature and relative humidity range for the elevator machinery spaces, machine rooms, control spaces, and control rooms. Post in the machine room, control room, control space, or where specified by the elevator manufacturer, in the machinery space.

## 2.10 Ceiling Access Identification

- .1 Provide 6 mm (1/4") self adhesive coloured dots to the T-bar framing, adjacent to panel to be removed or to access doors in solid ceilings. Identify the location of equipment concealed above as follows:
  - .1 **Yellow** - Concealed equipment and cleaning access.
  - .2 **Black** - Control equipment, including control valves, dampers and sensors.

- .3 **Red** - Fire and smoke dampers, fire protection equipment and fire system drains.
- .4 **Green** – Heating water, chilled water, domestic cold water, domestic hot water isolation valves.

### **3. EXECUTION**

#### **3.1 General**

- .1 Provide identification only after painting has been completed.
- .2 Perform work in accordance with CAN/CGSB-24.3 Identification of Piping Systems except as specified otherwise.
- .3 Provide ULC and/or CSA registration plates as required by respective agency.

#### **3.2 Nameplates**

- .1 Location shall be in conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Provide standoffs for nameplates on hot and/or insulated surfaces.
- .3 Do not paint, insulate or cover nameplate data.

#### **3.3 Location of Identification on Piping and Ductwork Systems**

- .1 Provide on long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17m (55') 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 Provide adjacent to each change in direction.
- .3 Provide at least once in each small room through which piping or ductwork passes.
- .4 Provide on both sides of visual obstruction or where run is difficult to follow.
- .5 Provide on both sides of separations such as walls, floors, partitions.
- .6 Provide where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 Provide at beginning and end points of each run and at each piece of equipment in run.
- .8 Provide 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 shall be easily and accurately readable from usual operating areas and from access points. Position the identification approximately at right angles to the 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.

#### **3.4 Valves, Controllers Identification**

- .1 Provide identification on valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass located in the main mechanical room. Provide one copy in each operating and maintenance manual.

- .3 Number valves in each system consecutively.
  - .1 Identification coding is to start with a utility description followed by a maximum of three numerals:
  - .2 Domestic Water DW-1, DW-2, DW-3...
  - .3 Natural Gas G-1, G-2, G-3...
  - .4 Steam S-1, S-2, S-3...
  - .5 Heating Water HW-1, HW-2, HW-3...
  - .6 HVAC to be numbered H-1, H-2, H-3...
  - .7 Fire Protection to be numbered FP-1, FP-2, FP-3...

### **3.5 Identification Requirements Specific for Non-potable Water Systems**

- .1 Distribution piping for non-potable water systems shall be clearly identified in accordance with the following:
  - .1 Pipe for non-potable systems shall be:
    - .1 Marked with the legend WARNING: NON-POTABLE WATER – DO NOT DRINK.
    - .2 Purple in color, or marked with a continuous purple stripe.
  - .2 Markings on pipe for non-potable water systems shall be:
    - .1 Permanent, distinct, and easily recognizable.
    - .2 In legible letters and numerals at least 5mm (1/4") high, except where the size of the pipe makes 5mm (1/4") high letters and numbers impracticable.
    - .3 Of a color that contrasts with the color of the pipe.
    - .4 Repeated at intervals no greater than 1.5m (4.9').
  - .3 The presence of buried pipes shall be identified with a permanent warning tape installed at least 300mm (12") above the pipe, running lengthwise. In addition, a tracer wire shall be installed for non-metallic pipes.
  - .4 Outlet points shall be clearly and permanently marked with the legend WARNING: NON-POTABLE WATER – DO NOT DRINK or with a sign as depicted with the figure below. The sign shall be not less than 100mm x 100mm (4" x 4").

**END OF SECTION**

## **1. GENERAL**

### **1.1 Section Scope**

- .1 This Section specifies general conditions for Divisions 21, 22, 23 and 25 and is to be read, interpreted, and coordinated with all other sections.

### **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 Drawings and General Provisions of the Contract, including General and Supplementary Conditions, Division 00 and Division 01 Specification Sections apply to work specified in this section.
- .3 Section 25 05 00 – Common Works Results for Integrated Automation.

### **1.3 References**

- .1 The latest revisions of the following standards shall apply unless noted otherwise. Apply the greater requirement called for between the National and British Columbia codes.
- .2 National Codes:
  - .1 National Building Code of Canada 2015 (NBC).
  - .2 National Energy Code of Canada for Buildings 2015.
  - .3 National Fire Code of Canada 2015.
  - .4 National Plumbing Code of Canada 2015.
- .3 British Columbia Codes:
  - .1 British Columbia Building Code 2018 (BCBC).
  - .2 British Columbia Fire Code 2018.
  - .3 British Columbia Plumbing Code 2018.
  - .4 Technical Safety BC regulations and regulatory notices.
- .4 American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE):
  - .1 ASHRAE 62.1-01, Ventilation for Acceptable Indoor Air Quality.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .6 Electrical Equipment Manufacturers' Association Council (EEMAC):

### **1.4 Definitions**

- .1 "concealed" – means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.
- .2 "exposed" – means work normally visible, including work in equipment rooms, service tunnels, and similar spaces.
- .3 "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished.

**COMMON WORK RESULTS FOR MECHANICAL**

- .4 "provision" or "provide" (and tenses of "provide") – means supply and install complete.
- .5 "install" (and tenses of "install") – means secure in position, connect complete, test, adjust, verify and certify.
- .6 "supply" – means to procure, arrange for delivery to site, inspect, accept delivery and administer supply of products; distribute to areas; and include manufacturer's supply of any special materials, standard on site testing, initial start-up, programming, basic commissioning, warranties and manufacturers' assistance to Contractor.
- .7 "delete" or "remove" (and tenses of "delete" or "remove") – means to disconnect, make safe, and remove obsolete materials; patch and repair/finish surfaces to match adjoining similar construction; include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Departmental Representative.
- .8 "BAS" – means building automation system; "BMS" – means building management system; "FMS" – means facility management system; and "DDC" means direct digital controls; references to "BAS", "BMS", "FMS", and "DDC" generally mean same.
- .9 "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" – means government departments, agencies, standards, rules and regulations that apply to and govern work and to which work must adhere.
- .10 "OSHA" and "OHSA" – stands for Occupational Safety and Health Administration and Occupational Health and Safety Act, and wherever either one is used, they are to be read to mean local governing occupational health and safety regulations that apply to and govern work and to which work must adhere, regardless if Project falls within either authority's jurisdiction.
- .11 "Mechanical Divisions" – refers to Divisions 20, 21, 22, 23, 25 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Mechanical Contractor, unless otherwise noted.
- .12 "Electrical Divisions" – refers to Divisions 26, 27, 28 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Electrical Contractor, unless otherwise noted.
- .13 Wherever words "indicated", "shown", "noted", "listed", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean product referred to is "indicated", "shown", "listed", or "noted" on Contract Documents.
- .14 Wherever words "reviewed", "satisfactory", "as directed", "submit", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "to the satisfaction of", "submitted to", etc., Departmental Representative.

**1.5 General Scope**

- .1 The scope of Section 22 Plumbing, Section 23 HVAC, and Section 25 Control is for building services within the project structure and 1m from the building.
- .2 Provide complete, fully tested, and operational systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .3 Contract documents and drawings of this Division are diagrammatic and approximately, to scale unless detailed otherwise. They establish scope, material, and installation quality but are not detailed installation instructions.
- .4 Follow manufacturers' recommended installation instructions, details, and procedures for equipment, supplemented by requirements of the Contract Documents.

**COMMON WORK RESULTS FOR MECHANICAL**

- .5 Install equipment generally in locations and routes indicated. Run piping and ductwork close to building structure, parallel to building lines, maximize headroom and maintain minimum interference with other services and free space. Remove and replace improperly installed equipment to satisfaction of the Departmental Representative at no extra cost.
- .6 For work within existing facilities, confirm locations and elevations of existing piping and equipment prior to commencement of new work.
- .7 Install equipment to provide service access, maintain service clearances and for ease of maintenance.
- .8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Departmental Representative. Uncrate equipment, move in place and install complete; start up and test.
- .9 Install control dampers and other devices on piping and ductwork, furnished by Division 25.

**1.6 Coordination of Work**

- .1 Cooperate and coordinate with other trades on the project.
- .2 Make reference to electrical, mechanical, structural, and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.
- .3 Where dimensional details are required, work with the applicable architectural and structural drawings.
- .4 Full size and detailed drawings shall take precedence over scale measurements from drawings. Specifications shall take precedence over drawings.
- .5 Any areas indicated as space for future materials or equipment shall be left clear.

**1.7 Permits and Fees**

- .1 All work shall comply with provincial, municipal, bylaws and authorities having jurisdiction.
- .2 Obtain all permits and pay all fees applicable to the scope of work.
- .3 Contractor shall arrange for inspections of the work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.

**1.8 Tender Price Breakdown**

- .1 Submit a tender price breakdown within thirty (30) days of tender closing and before first progress claim, in a format agreed to with the Departmental Representative.
- .2 As a minimum, include the following in the tender price breakdown:
  - .1 Mechanical: Equipment, materials, labour
  - .2 Plumbing: Equipment, materials, labour
  - .3 Sheet Metal: Equipment, materials, labour
  - .4 Controls: Equipment, materials, labour

**1.9 Submittals**

- .1 Submittals shall be in accordance with Division 01 - Submittal Procedures, Division 01 – Closeout Procedures, Division 01 – Closeout Submittals and the following:



**COMMON WORK RESULTS FOR MECHANICAL**

- .2 No work may begin on any segment of this project until submittals have been successfully reviewed for conformity with the design intent.
- .3 Contractor shall provide and submit to the Departmental Representative Assurance of Professional Design and Commitment for Field Review by Supporting Registered Professional Schedule S-B and Assurance of Professional Field Review and Compliance by Supporting Registered Professional Schedule S-C for seismic engineering.
- .4 Requirements for Contractor Retained Engineers
  - .1 Professional engineers retained to perform consulting services with regard to Project work, i.e. seismic engineer or structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in Place of the Work.
  - .2 Retained engineer's professional liability insurance is to protect Contractor's consultants and their respective servants, agents, and employees against any loss or damage resulting from professional services rendered by aforementioned consultants and their respective servants, agents, and employees in regards to the Work of this Contract.
  - .3 Unless otherwise specified in Division 00 or 01, liability insurance requirements are as follows:
    - .1 Coverage is to be a minimum of \$1,000,000.00 CDN inclusive of any one occurrence;
    - .2 The Contractor must comply with the insurance requirements specified herein. The Contractor must maintain the required insurance coverage for the duration of the Contract. Compliance with the insurance requirements does not release the Contractor from or reduce its liability under the Contract.
    - .3 The Contractor is responsible for deciding if additional insurance coverage is necessary to fulfill its obligation under the Contract and to ensure compliance with any applicable law. Any additional insurance coverage is at the Contractor's expense, and for its own benefit and protection.
    - .4 The Contractor must forward to the Contracting Authority within ten (10) days after the date of award of the Contract, a Certificate of Insurance evidencing the insurance coverage and confirming that the insurance policy complying with the requirements is in force. For Canadian-based Contractors, coverage must be placed with an Insurer licensed to carry out business in Canada, however, for Foreign-based Contractors, coverage must be placed with an Insurer with an A.M. Best Rating no less than "A-". The Contractor must, if requested by the Contracting Authority, forward to Canada a certified true copy of all applicable insurance policies.
  - .4 Retained consultants are to ascertain that sub-consultants employed by them carry insurance in the form and limits specified above.
  - .5 Evidence of the required liability insurance in such form as may be required is to be issued to Departmental Representative and Municipal Authorities as required prior to commencement of aforementioned consultant's services.

**COMMON WORK RESULTS FOR MECHANICAL**

- .8 Submit shop drawings for all products identified in the relevant specification sections of Divisions 21, 22, 23 and 25. Provide drawings as electronic files (file format: .dwg, .dxf, pdf, or comparable). When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Submittals shall include a complete bill of materials of equipment to be used indicating quantity, manufacturer, model number, and other relevant technical data
- .9 Submit the following shop drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia.
  - .1 Fastening details for Seismic restraints.
  - .2 Mounting details for spring isolation of equipment.
- .10 Shop drawings and product data shall be 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 for compliance to applicable codes.
- .11 Shop drawings to indicate:
  - .1 Material Specification including CSA or ULC reference numbers.
  - .2 Installation details to suit the applications on this project.
  - .3 Operating and maintenance requirements.
- .12 Material Safety Data Sheets (MSDS):
  - .1 Submit Material Safety Data Sheets (MSDS) in accordance with Division 01 - Submittal Procedures for the following products. Indicate VOC emissions, prior to installation or use:
    - .1 Adhesives.
    - .2 Caulking compounds.
    - .3 Sealants.
    - .4 Insulating materials.
- .13 Closeout Submittals:
  - .1 Provide mechanical operation and maintenance data in compliance with Division 01 - Closeout Submittals and the following:
    - .1 The Contractor shall furnish and pay for three (3) complete sets of operating and maintenance manuals for the complete mechanical installation plus two (2) copies of the digital version of the manuals on USB type flash drive.
    - .2 Supply indexed copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Consolidate each copy of data in an identified hard cover three "D" ring binder. Each binder to include:

**COMMON WORK RESULTS FOR MECHANICAL**

- .1 Front cover: project name; wording – "Mechanical Systems Operating and Maintenance Manual"; and date;
- .2 Introduction sheet listing, Contractor, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses;
- .3 Equipment manufacturer's authorized contact person name, telephone number and company website;
- .4 Table of Contents sheet, and corresponding index tab sheets;
- .5 Copy of each "REVIEWED" or clean, updated "REVIEWED AS NOTED" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, company website address, and email address for local source of parts and service; when shop drawings are returned marked "Reviewed As Noted" with revisions marked on shop drawing copies, they are to be revised by equipment supplier to incorporate comments marked on "Reviewed" shop drawings and a clean updated copy is to be included in operating and maintenance manuals;
- .3 Operation and maintenance manual approved by, and final copies deposited with the Departmental Representative a minimum of 7-days before final inspection.
- .4 Operation data to include but not limited to:
  - .1 Pressure test reports, and certificates issued by governing authorities
  - .2 Control schematics for systems including environmental controls.
  - .3 Wiring and connection diagrams.
  - .4 A description of the systems and associated controls.
  - .5 Description of operation of systems at various loads together with reset schedules and seasonal variances.
  - .6 Operational instructions for systems and associated components.
  - .7 A description of actions to be taken in the event of equipment failure.
  - .8 Valves schedule and flow diagrams.
  - .9 Colour coding chart.
- .5 Maintenance data to include:
  - .1 Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task time.
  - .3 Recommended maintenance practices and precautions.
  - .4 Complete parts lists with numbers.
- .6 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets indicating point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results and final commissioning report.

**COMMON WORK RESULTS FOR MECHANICAL**

- .3 Special performance data as specified.
- .4 Testing, adjusting, and balancing.
- .7 Digital Version of Manuals
  - .1 The digital version of the manuals and the hard copy version shall be prepared by the same company.
  - .2 Utilize latest version of Adobe Acrobat, Portable Document Format (pdf).
  - .3 The digital manual shall be enhanced with the following features: Bookmarks, Internet Links, and Internal Documents Links and Optical Character Recognition (OCR).
  - .4 All shop drawings shall be scanned to a minimum 216mm x 279mm size. If the original page is 279mm x 432mm, the digital copy shall also be 279mm x 432mm.
  - .5 Provide a minimum 300 DPI for all scanned pages.
  - .6 All scanned material may be searched for text with minimum 60% Optical Character Recognition (OCR).
  - .7 Rotation of scanned page images/texts shall be displayed within +/- 20 degrees.
  - .8 Digital manual shall be organized in the same manner as the hard copy manual. Bookmark all major tabs and sub-sections and each set of shop drawings. Link the Table of Contents to the referenced section. Insert Internet Links to the Mechanical Equipment Manufacturers/Suppliers/Contractors official websites
- .8 Approvals:
  - .1 Submit 1 copy of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .9 Warranties
  - .1 Include copy of all equipment warranty and extended warranty certificates into the Operation and Maintenance Manual.
- .10 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need as it becomes apparent during demonstrations and instructions.
  - .2 Results of Departmental Representative's Orientation (demonstrations).
  - .3 List of spare parts turned over to Departmental Representative's forces.
- .2 Site records:
  - .1 Contractor shall maintain 1 set of white prints at contractors cost to mark changes as work progresses and as changes occur.

**COMMON WORK RESULTS FOR MECHANICAL**

- .2 Use different colour waterproof ink for each service. Do not use pencil or black ink.
- .3 Transfer information weekly to show work as actually installed.
- .4 Make available for reference purposes and inspection.
- .5 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to Departmental Representative for review. Make necessary revisions to drawings as per Departmental Representative's comments, to satisfaction of Departmental Representative.
- .3 Record drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for Mechanical, finalize production of record drawings.
  - .2 Use final reviewed "as-built" drawing set to provide CAD files of drawings thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by Departmental Representative as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Departmental Representative
  - .3 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
  - .4 Submit to Departmental Representative for approval and make corrections as directed.
  - .5 Perform testing, adjusting and balancing for HVAC using record drawings.
  - .6 Submit completed reproducible record drawings with Operating and Maintenance Manuals.
  - .7 Cost to transfer record information onto reproducible media & Auto-CAD are this contractor's responsibility. Departmental Representative will release drawings to contractor after signing a copyright form.
  - .8 Should the Contractor choose to utilise this Departmental Representative for transferring as built information, allow \$400 / sheet for all drawings in the construction set. This will cover costs for drafting time & printing costs.
  - .9 Submit copies of record drawings for inclusion in final testing and balancing report
  - .10 Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with AutoCAD software release version confirmed with Departmental Representative.

**1.10 Spare Parts Submittals**

- .1 Furnish spare parts in accordance with Division 01 - Closeout Submittals and as follows:
  - .1 One set of V-belts as applicable for each piece of machinery.

**COMMON WORK RESULTS FOR MECHANICAL**

- .2 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Additional spare parts shall also be included as outlined in their appropriate sections.
- .3 Provide one set of special tools if required to service equipment as recommended by manufacturers.

**1.11 Quality of Work**

- .1 All work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Departmental Representative.
- .2 Work, which does not conform to standards accepted by the Departmental Representative and the trade, may be rejected by the Departmental Representative. The Contractor shall redo rejected work to the accepted standard at no cost to the Departmental Representative.

**1.12 Metric Conversion**

- .1 All units in this division are expressed in SI units.
- .2 Submit all shop drawings and maintenance manuals in SI units.
- .3 On all submittals (shop drawings etc.), use the same SI units as stated in the specification.
- .4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:
  - .1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment, and piping.
  - .2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

<b>Equivalent Nominal Diameter Of Pipes</b>					
mm	inches (NPS)	mm	inches (NPS)	mm	inches (NPS)
3	1/8	40	1-1/2	200	8
6	1/4	50	2	250	10
10	3/8	65	2-1/2	300	12
15	1/2	75	3	375	15
20	3/4	100	4	450	18
25	1	125	5	500	20
30	1-1/4	150	6	600	24

- .5 Metric Duct Sizes:
  - .1 The Metric duct sizes are expressed as 25 mm = 1 inch.

**1.13 Drawings and Specifications**

- .1 Drawings and specifications are complementary to each other, and what is called for by one shall be binding as if called for by both.

- .2 Should any discrepancy appear between drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of the plans, and specifications, obtain written clarification from the Departmental Representative during the tender period. Without a written clarification, the better quality and/or greater quantity of work or materials shall be estimated, performed and furnished within the tendered price.
- .3 Examine all contract documents, including all drawings and specifications, and work of other trades to ensure that work is satisfactorily carried out without changes to building.

#### **1.14 Cutting, Patching and Coring**

- .1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Perform x-rays and obtain written approval from the Departmental Representative before cutting or burning structural members.
- .4 Provide openings and holes required in precast members for mechanical work. Cast holes 100 mm or larger in diameter. Field cut smaller than 100 mm.
- .5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.
- .6 Removal of any existing pipe, conduit, or ductwork within a slab core hole or slab opening through floors and roofs must be removed completely, including any associated sleeving, in a safe manner. Provisions are to be made during the removal process to protect any occupants and/or fabric of the space below. The Departmental Representative is to be advised of all existing mechanical service penetration locations, such that site visits and field reviews can be fully co-ordinated and undertaken before and after the opening is closed in and filled.
- .7 Filling of any existing slab core or opening is to be with an engineered design of concrete fill complete with doweling for adhesion and/or fire stopping system as appropriate.

#### **1.15 Excavation and Backfill**

- .1 Provide all excavating to facilitate installation of the mechanical work, including shoring, pumping, 150 mm compacted sand bedding under and first 300 mm of compacted sand over piping and ducting.
- .2 Refer to drawing details as applicable.

#### **1.16 Installation of Equipment**

- .1 Pipe all equipment drains to building drains except systems containing glycol.
- .2 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.
- .3 Maintain permanent access to equipment for maintenance.

#### **1.17 Connections to Existing Services**

- .1 Maintain liaison with the Departmental Representative and provide a mutually acceptable schedule to interrupt, reroute or connect to existing building services with the minimum of interruption of those services.

**COMMON WORK RESULTS FOR MECHANICAL**

- .2 Major services shall not be interrupted before all preparatory work is completed and all required materials are on site. Provide a minimum of 48 hours' notice for all service shutdowns. Allow for major service interruptions outside of normal operating hours of the facility.
- .3 Interruptions and shutdowns of existing services shall be by the building/plant maintenance staff. Advise building/plant maintenance staff of the duration of service interruption or shut down.

**1.18 Selective Demolition**

- .1 Reference Standards
  - .1 Unless otherwise specified, carry out demolition work in accordance to CSA S350-M1980 Code of Practice for Safety in Demolition of Structures.
- .2 Remove from site all equipment, ducting or piping which is no longer required because of work under this Contract.
- .3 Existing Conditions
  - .1 Visit and examine the site and note all characteristics and irregularities affecting the work of this Section.
- .4 Protection
  - .1 Prevent movement or settlement of adjacent work. Provide and place bracing or shoring and be responsible for safety of such work. Be liable for any such movement or settlement and any damage or injury caused.
  - .2 Cease operations and notify the Departmental Representative immediately for special protective and disposal instructions when any asbestos materials are uncovered during the work in this Section.
  - .3 Prevent debris from blocking surface drainage inlets and all types of drainage piping systems which remain in operation
- .5 Salvageable Materials
  - .1 Except as otherwise stated, salvageable materials from area of demolition shall become the property of the Departmental Representative at his discretion. All material not taken over by the Departmental Representative or removed from the building under this contract shall be removed from this site and disposed of as required by any applicable disposal regulations.
  - .2 Turnover to and deliver to the Departmental Representative's storage area all items which have been determined to have salvage value and has been removed due to the Work.

**1.19 Equipment and Materials**

- .1 Materials and equipment installed shall be new, CSA approved and of quality specified.
- .2 Each major component of equipment shall bear manufacturer's name, address, catalog and serial number in a conspicuous place.
- .3 Where two or more products of the same type are required, products shall be of the same manufacturer.



- .4 Notify the Departmental Representative in writing ten (10) days prior to the tender close, any materials or equipment specified which is not currently available or will not be available for use as called for herein. Failing this, the contract will assume that the most expensive alternate has been included in the tender price.
- .5 All equipment supplied to the project will meet efficiencies as defined in ASHRAE Standard 90.1 and NECB (current versions)

#### **1.20 Cleaning**

- .1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Departmental Representative. Before applying for a Certificate of Substantial Performance of the Work, remove rubbish and debris, and be responsible for repair of any damage caused as a result of work. Refer to Section 01 74 11 Cleaning.
- .2 Clean equipment and devices installed as part of this project

#### **1.21 Delivery, Storage and Handling**

- .1 Deliver, store and handle materials in accordance with Division 01 - Common Product Requirements, the manufacturer's written instructions and the following:
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials and equipment in accordance with the manufacturer's recommendations in a clean, dry, well-ventilated area.
  - .2 Store and protect equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping, equipment and duct systems.
- .5 Protect equipment and open-end duct with polyethylene covers and maintain equipment on crates until installation.
- .6 Operate, drain and flush out unsealed bearings and refill with fresh oil before final acceptance.
- .7 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.
- .8 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .9 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.
- .10 Develop a Construction Waste Management Plan or Waste Reduction Work plan as related to Work of this Section in accordance with Division 01 – Construction Demolition Waste Management and Disposal.
- .11 Packaging Waste Management

- .1 Remove for reuse and return pallets, crates, padding, packaging materials etc. as specified in the Construction Waste Management Plan or Waste Reduction Work plan in accordance with Division 01 - Construction Demolition Waste Management and Disposal.

### **1.22 Fire Stopping and Smoke Seals**

- .1 Provide fire stopping and smoke seals as required in accordance with Division 07 – Fire Stopping.

### **1.23 Access Doors**

- .1 General
  - .1 Provide access doors for maintenance or adjustment of all parts of the mechanical system. This shall apply but not be limited to valves, dampers, cleanouts and controls.
  - .2 Where equipment is concealed by a ceiling, the location of equipment shall be indicated by coloured markings. Refer to Section 23 05 53 Identification for Mechanical Piping and Equipment.
  - .3 Where equipment is concealed by a continuous structural or architectural surface, supply access doors of design to suit and match the surface in which they will be installed.
  - .4 Provide stainless steel doors in walls of washrooms, kitchen, utility rooms and laundry rooms.
  - .5 Provide Drywall type access doors in all drywall spaces requiring access to equipment.
  - .6 All fasteners on access panels shall be tamper proof, contractor shall provide three (3) sets of keys.
  - .7 Locate all access doors outside of secure areas where possible. Where not possible, review the locations of panels with the Departmental Representative prior to installation. All access panels within secure areas are to be of penal quality, lockable, vandal-proof and ligature resistant.
  - .8 Provide 300 mm x 300 mm minimum size for inspection and hand access.
  - .9 600 mm x 600 mm minimum size, larger if indicated on drawings, where entry is required and access is difficult.
  - .10 Size to suit masonry modules when located in a masonry wall.
  - .11 When located in a finished floor with tile, stonework, terrazzo, etc., a recessed bearing type access door is required. The door surface shall have a recess to take the particular surface material and pattern if this is available at the time the units are ordered.
  - .12 Security Access Doors:
    - .1 Access doors for security areas shall be 1.70 mm thick double skinned internally reinforced at 150 mm on centre, 4.76 mm thick, insulated in pressed sink wiped cold rolled steel metal frame (similar to door frame) complete with necessary preparation to receive security lock escutcheon and hinges.
- .2 Submittals:
  - .1 Submit shop drawings for all access doors anticipated on this project.

### **1.24 Single Point Electrical Connection**

- .1 If the equipment is indicated on the schedules or within the motor list (both included in the mechanical drawings) as a single point connection, the equipment shall be provided with all integral HOA type starters, internal wiring to all motors, starters, lighting, service outlets etc. such that a single electrical connection can be utilized to power all components within the unit. The unit shall also incorporate the required step-down transformers and wiring to connect all of these internal components including controls wiring. Coordinate with the controls subcontractor for the supply, installation, and wiring of control components.

### **1.25 Electrical Motors**

- .1 Supply mechanical equipment complete with electrical motors.
- .2 Quality Assurance
  - .1 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI. All motors to be UL listed and CSA labelled.
  - .2 All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch.
  - .3 The noise level of each motor shall comply with NEMA standards, less than 80 dBA at 1 meter.
  - .4 Minimum certified motor efficiency shall be as outlined in current version of ASHRAE 90.1 and NECB.
- .3 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.
- .4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection.
- .5 Motors less than 3/4-hp shall be 120 V, 60 Hz, 1 phase.
- .6 All motors shall be 1800 rpm unless otherwise noted.
- .7 Provide motors complete with equipment except where indicated.
- .8 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.
- .9 Provide motors designed with Class B insulation, Class F insulation for totally enclosed motors.
- .10 Motors exposed to outdoor temperature to be lubricated with lubricants suitable for operation at 6 deg. C. below the lowest temperature recorded by ASHRAE or the Climatic Information (Supplement to the National Building Code), for the location in which they are installed.
- .11 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.
- .12 Submittals
  - .1 Submit data of test method used and motor efficiencies with shop drawings.

### **1.26 Motor Starters and Accessories**

- .1 Motor starters must be capable of starting associated motors under the imposed loads. Confirm starter voltage matches motor prior to ordering.

- .2 Unless otherwise specified, starters for 1-phase motors are to be 115 volt; thermal overload protected manual starting switches with a neon pilot light, a surface or recessed enclosure to suit the application, and, where automatic operation is required, a separate H-O-A switch in an enclosure to match starter enclosure.
- .3 Starters for 2-speed double winding motors are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.
- .4 Starters for 2-speed single winding motors are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.
- .5 Unless otherwise specified, motor starter enclosures are to be in accordance with following NEMA ratings:
  - .1 Enclosures exposed to the elements – Type 3R, constructed of stainless steel;
  - .2 Enclosures inside the building in wet areas – Type 3R, constructed of stainless steel;
  - .3 Enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application;
  - .4 Enclosures except as noted above – Type 1;
  - .5 Enclosures located in finished areas – as above but recess type with brushed stainless steel faceplate.
- .6 Fuses are to be, unless otherwise scheduled or specified, English Electric Ltd. HRC fuses, Form I Class "J" for constant running equipment and Form II Class "C" for equipment that cycles on and off

#### **1.27 Miscellaneous Metals**

- .1 Provide all necessary miscellaneous to hang or support materials, equipment and provide access for work under this contract.
- .2 All miscellaneous metals shall be prime painted.
- .3 Miscellaneous metals shall include but not limited to:
  - .1 Hangers for equipment, piping and ductwork.
  - .2 Support for equipment.

#### **1.28 Scaffolding, Hoisting and Rigging**

- .1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval from Departmental Representative.
- .2 Immediately remove from site scaffolding, rigging and hoisting equipment when no longer required.
- .3 Do not place major scaffolding/hoisting equipment loads on any portion of structure without approval from Departmental Representative.

#### **1.29 Pipe Sleeves**

- .1 Pipe sleeves shall be provided for piping passing through walls and floors. Minimum schedule 40 steel pipes or factory fabricated, flanged, high-density polyethylene sleeves with reinforced nail bosses. Sleeves shall extend 25 mm on either side of the wall.

- .2 Schedule 40 steel pipes shall be used as floor pipe sleeves in wet areas with a 50 mm up-stand.
- .3 Review and coordinate sleeve diameters with fire stop installation details as applicable.
- .4 Pipe sleeves are not required where pipes pass through cored concrete walls or floors.

### **1.30 Water Proofing Materials**

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so when bolts are tightened the links expand to seal the opening watertight. Select seal assemblies to suit pipe size and sleeve size or wall opening size.

### **1.31 Escutcheons and Plates**

- .1 Provide escutcheons and plates on all piping and ductwork passing through finished walls, floors and ceilings.
- .2 Escutcheons shall be one piece, stainless or chrome plated steel.

### **1.32 Temporary Heat**

- .1 Do not use the permanent system for temporary heating purposes without written permission from the Departmental Representative.
- .2 If approved, permanent mechanical systems in building may be used for temporary heating during construction subject the following conditions:
  - .1 Each entire system is complete.
  - .2 Thoroughly clean and overhaul permanent equipment used during the construction period, replace worn or damaged worn or damaged parts before final inspection.
  - .3 Use of permanent systems for temporary heat shall not modify terms of warranty.
  - .4 Operate heating systems under conditions, which ensure no temporary or permanent damage. Operate with proper safety devices and controls installed and fully operational. Operate systems only with treated water as specified.
  - .5 Air systems shall not be used for temporary heating.
  - .6 When permanent systems are used for temporary heat, provide alarm indicating system failure. Connect alarm to independent alarm company system.
  - .7 Energy costs are to be paid by Contractor.
  - .8 During this period of construction, such systems/equipment to not become property of Departmental Representative or be Departmental Representative's responsibility for maintenance or service. Systems/equipment are to remain property of respective manufacturers/suppliers or Contractor, who are responsible for full maintenance and servicing of systems/equipment in order to maintain validity of warranties after turn over to Departmental Representative.
  - .9 Prior to application for a Certificate of Substantial Performance of the Work and turn over to Departmental Representative, such systems/equipment to be cleaned, restored to "new" condition, paint finishes "touched-up", filters cleaned or replaced, etc.

### **1.33 Progress Claim Breakdown**

- .1 Prior to submittal of first progress payment draw, submit a detailed breakdown of work cost to assist Departmental Representative in reviewing and approving progress payment claims.
- .2 Payment breakdown is subject to Departmental Representative's approval and review. Progress payments will not be processed until an approved breakdown is in place. Breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, system testing and verification, and project closeout submittals.
- .3 Indicate equipment, material and labour costs for site services (if applicable) and indicate work of each trade in same manner as indicated on progress draw.

### **1.34 Notice for Required Field Reviews**

- .1 Whenever there is a requirement for Departmental Representative to perform a field review prior to concealment of any work, to inspect/re-inspect work for deficiencies prior to Substantial Performance of the Work, for commissioning demonstrations, and any other such field review, give minimum 5 working days' notice in writing to Departmental Representative.
- .2 If Departmental Representative is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until Departmental Representative advises that it may be concealed.
- .4 When Departmental Representative is requested to perform a field review and work is not ready to be reviewed, reimburse Departmental Representative for time and travel expenses

### **1.35 Changes in the Work**

- .1 Whenever Departmental Representative proposes in writing to make a change or revision to design, arrangement, quantity or type of work from that required by Contract Documents, prepare and submit to Departmental Representative for review, a quotation being proposed cost for executing change or revision.
- .2 Quotation is to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.
- .3 Make requests for changes or revisions to work to Departmental Representative in writing and, if Departmental Representative agrees, will issue Notice of Change.
- .4 Do not execute any change or revision until written authorization for the change or revision has been obtained from Departmental Representative.

### **1.36 Temporary or Trial Usage**

- .1 Temporary or trial usage by the Departmental Representative of mechanical equipment supplied under contract shall not represent acceptance.
- .2 Repair or replace permanent equipment used temporarily.
- .3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

### **1.37 Instruction to Departmental Representative**

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
- .2 Train Departmental Representative's designated personnel in aspects of operation and maintenance of equipment and systems as specified. Demonstrations and training are to be performed by qualified technicians employed by equipment/system manufacturer/supplier. Supply hard copies of training materials to each attendee.
- .3 Unless where specified otherwise in trade Sections, minimum requirements are for manufacturer/suppliers of each system and major equipment, to provide minimum two separate sessions each consisting of minimum 4 hours on site or in factory training (at Departmental Representative's choice), of Departmental Representative's designated personnel, on operation and maintenance procedures of system.
- .4 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Use Operating and Maintenance Manuals during training sessions. Training modules include but are not limited to:
  - .1 Operational Requirements and Criteria – equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations;
  - .2 Troubleshooting – diagnostic instructions, test and inspection procedures;
  - .3 Documentation – equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like;
  - .4 Maintenance – inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools;
  - .5 Repairs – diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.
- .5 Before instructing Departmental Representative's designated personnel, submit to Departmental Representative for review preliminary copy of training manual and proposed schedule of demonstration and training dates and times. Incorporate Departmental Representative's comments in final copy.
- .6 Obtain in writing from Departmental Representative a list of Departmental Representative's representatives to receive instructions. Submit to Departmental Representative prior to application for Certificate of Substantial Performance of the Work, complete list of systems for which instructions were given, stating for each system:
  - .1 Date instructions were given to Departmental Representative's staff;
  - .2 Duration of instruction;
  - .3 Names of persons instructed;
  - .4 Other parties present (manufacturer's representative, etc.).
- .7 Obtain signatures of Departmental Representative's staff to verify they properly understood system installation, operation and maintenance requirements, and have received operating and maintenance instruction manuals and "as-built" record drawings

**1.38 Guarantee / Warranty**

- .1 Furnish a written guarantee stating that all work executed in this contract will be free from defective workmanship and materials for a period of one (1) year from the date of Substantial Performance. The Contractor shall, at his own expense, repair and replace any work, which fails or becomes defective during the term of the guarantee/warranty, providing such work is not due to improper usage. The period of guarantee specified shall not in any way supplant any other guarantees of a longer period but shall be binding on work not otherwise covered.
- .2 Use of permanent systems for temporary heat shall not modify terms of the manufacturers' warranty or the guarantee.
- .3 If the equipment is used during construction, the warranty or guarantee period shall not be shortened or altered.

**1.39 Substantial and Total Performance**

- .1 Prior to requesting an inspection for Substantial Performance, provide a complete list of items, which are deficient.
- .2 A certificate of Substantial Performance will not be granted unless the following items are completed and available to the Departmental Representative:
  - .1 Final Plumbing Inspection Certificate from the Authority having Jurisdiction.
  - .2 Schedule S-C for seismic engineering.
  - .3 Commissioning checklists are completed and submitted as per Division 01.
  - .4 Vibration isolation supplier's inspection report
  - .5 Potable water piping's flushing and chlorination test certificate
  - .6 Major equipment – suppliers start-up test sheets and letters certifying start up. (packaged equipment)
  - .7 Draft Operating/Maintenance Manuals have been submitted for review.
  - .8 All mechanical systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation.
  - .9 Air system has been balanced with draft report submitted to the Departmental Representative.
  - .10 Mechanical identification is complete.
  - .11 Warranty forms have been mailed to the manufacturer. Provide copy of the original warranty for equipment, which has a warranty period longer than one year.
  - .12 Operating and Maintenance demonstrations have been provided to the Departmental Representative.
  - .13 Written inspection report by manufacturer's representative has been submitted for noise and vibration control devices and flexible connections.
  - .14 Record drawings have been submitted.
  - .15 Fan plenums have been cleaned, and temporary filters have been replaced with permanent filters.
  - .16 All previously identified deficiencies have been corrected and accepted.



**COMMON WORK RESULTS FOR MECHANICAL**

- .3 Prior to a Total Performance Inspection, provide declaration in writing that deficiencies noted at time of substantial performance inspection have been corrected and the following items completed prior to the total performance inspection:
  - .1 Submit final air balance report.
  - .2 Submit final operating and maintenance manuals.
  - .3 Complete final calibration.
- .4 The Departmental Representative shall provide one (1) visitation for the purpose of total performance inspection. Subsequent visitations if required shall be at the expense of the Contractor.
- .5 The Contractor shall provide qualified personnel in appropriate numbers to operate the facility until substantial performance is declared.

**1.40 Alternate Materials and Equipment**

- .1 The price submitted for this contract shall be based on the use of materials and equipment as specified.
- .2 Requests for alternate equivalent materials or equipment must be submitted to the Departmental Representative no later than seven (7) working days prior to the Mechanical trades' closing tender date. Submit all applicable technical data, including performance curves and physical details for review. Approval of requests shall only be given by addendum.
- .3 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, and meet the space, capacity, and noise requirements outlined.
- .4 The Contractor shall be fully responsible for any additional labour and materials required by any trades or other Contractors to accommodate the use of other than specified materials or equipment. The Contractor shall bear any and all costs for design/system modifications to accommodate the "alternate" equipment. Extras will not be approved to cover such work.

**2. PRODUCTS**

**2.1 Existing Services**

- .1 Disconnect and cap all mechanical services in accordance with requirements of the authority having jurisdiction.
- .2 Building Mechanical Services: Maintain activity of all building services during demolition/removal of existing services required of this contract.
- .3 Maintain all trap seals and cap open-end pipe to ensure no sewer gas enters the building during renovations or demolition work. Maintain all existing sewer piping in a wet condition daily.

**2.2 Demolition**

- .1 Completely demolish the items scheduled and remove all materials from the premises unless otherwise requested by the Departmental Representative.
- .2 Carry out demolition in a manner to cause as little inconvenience to the occupied building area as building area as possible. Co-ordinate this activity with the Departmental Representative.

- .3 Carry out demolition in an orderly and careful manner.
- .4 All coring, patching and removal of existing equipment, pipes, and ductwork, which may affect the operation of occupied areas of the building, shall be carried out outside of regular office hours or as scheduled with the Departmental Representative.

### **2.3 Asbestos**

- .1 The intent is for a Haz-Mat Contractor to remove all asbestos containing material prior to the proposed project work taking place. Notify the Departmental Representative if asbestos containing material is suspected to remain on site.
- .2 When new work is required to be connected to existing plumbing, piping, ductwork or equipment, which contains asbestos insulation or products the following, shall apply:
  - .1 Keep disruption to existing piping and equipment to a minimum
  - .2 Protect the site and all Contractors from the work
  - .3 Remove the asbestos at piping and equipment for new connections and carry out work in accordance with Work Safe BC requirements for asbestos removal.

### **2.4 Core Drilling**

- .1 Clearly identify all proposed piping penetrations through existing slabs, walls etc. and advise the General Contractor. Obtain x-rays of the locations to ensure penetration will avoid any existing post tension cables or reinforced steel. Advise the Departmental Representative of any conflicts as a result of the x-rays and obtain the Departmental Representative approval before any coring take place.

### **2.5 Fire Stopping and Smoke Seals**

- .1 Provide fire-stopping materials as applicable as per Division 07.

### **2.6 Access Doors**

- .1 Drywall Surface: Extruded aluminum frame with gypsum board inlay and structural corner elements. Hinge to be concealed 2-point hinge, non-corroding with screwdriver operated cam latch.
- .2 Masonry Surface: Universal design, steel door (1.6 mm) and steel frame (1.2 mm), door flush to frame, rounded safety corners, continuous concealed hinge, screwdriver operated cam latch, prime coat grey painted finish.
- .3 Tile Surface: Universal design, stainless steel door (1.6 mm) and stainless steel frame (1.2 mm), door flush to frame, rounded safety corners, continuous concealed hinge, screwdriver operated cam latch, #4 satin stainless steel finish.
- .4 Plaster Walls and Ceiling: steel door 2 mm and steel frame 2 mm, door flush to frame edge, expansion casing bead and 75 mm wide galvanized lath surround recessed 18 mm to receive plaster, continuous concealed hinge, screwdriver operated cam latch, prime coat grey painted finish.
- .5 Acoustic Plaster: Steel door (1.6 mm) and steel frame (2 mm), door recessed 12 mm lined with self-furring lath, 75 mm wide galvanized lath surround recessed 18 mm to receive plaster flush to frame edge, concealed pivoting rod type hinge, screwdriver operated cam latch, prime coat grey painted finish.

- .6 Acoustical Tile Ceilings: Steel door (1.6 mm) and steel frame (2 mm), door recessed 25 mm to receive acoustic tile, concealed pivoting rod type hinge, screwdriver operated cam latch, prime coat grey painted finish.
- .7 Ductwork: Ultra low leakage type, flat oval design, galvanized steel frame (0.7 mm), double skin galvanized steel door (0.7 mm) with 25mm insulation fully enclosed in panel, bulb type seal integrally fastened to door, lever cam locks. Provide stainless steel in lieu of galvanized steel in stainless steel ductwork.

## **2.7 Electrical Motors**

- .1 All Motors, 1 H.P. motors and larger, shall be energy efficient design and have a minimum and nominal full load efficiency, which will meet or exceed the values listed in accordance CAN/CSA C390-1. The minimum efficiency shall be guaranteed.
- .2 Belt Drives: Provide belt drives to the following requirements:
  - .1 Provide steel, cast iron or aluminum sheaves for motors less than 3/4 H.P.
  - .2 Provide steel or cast iron sheaves keyed to shafts, for motors 3/4 H.P. and larger.
  - .3 For motors less than 10 H.P. provide standard adjustable pitch drive sheaves having +/-10% range. Use mid-position of range for specified RPM.
  - .4 Match drive and driven sheaves.
  - .5 V-belts shall conform to the American Belt Manufacturers standards. Multiple belts shall be matched sets.
  - .6 Not less than a 2-belt configuration is required for each drive for motors 3/4 H.P. and larger.
  - .7 Minimum drive rating shall be 150% of nameplate rating of motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
  - .8 Motor slide rail adjustment baseplate with double draw bolt, shall allow for centre line adjustment.
  - .9 Tension belts to manufacturers recommendations before start up and after 100 hours of operation using calibrated belt tensioning gauge.
  - .10 Provide one spare set of belts for each piece of equipment with each belt separately identified for the equipment item to be served.
- .3 Shaft Couplings: Shaft couplings shall be of the pin or jaw neoprene insert type, gear type, or flexing steel insert type and shall allow coupling inserts to be easily removed without disassembly of the equipment.
- .4 Guards:
  - .1 Provide removable protective guards on all exposed V-belt drives and shaft couplings in accordance with Worker's Compensation Board requirements.
  - .2 Guards for drives shall have:
    - .1 1 mm expanded metal screen welded to 25 mm steel angle frame.
    - .2 1.5 mm thick galvanized sheet metal tops and bottoms.
    - .3 Removable sides for servicing.
    - .4 38 mm dia. holes on both shaft centres for insertion of tachometer.
    - .5 Sectionalize if necessary so one man can handle removal.

**COMMON WORK RESULTS FOR MECHANICAL**

- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Fabricate and install belt guards for V-belt drives to permit movement of motors for adjusting belt tension and for belt slap.
- .5 Provide removable "U" shaped guards for flexible couplings with 2.5 mm thick galvanized frame and 1.2 mm thick expanded mesh face.
- .6 Provide guards on all unprotected fan inlets and outlets. Guards to be provided by fan manufacturer.
- .7 Prime coat guards and finish paint to match equipment.
- .8 Secure guards to equipment allowing for ease of removal.

**3. EXECUTION**

**3.1 Painting Repairs and Restoration**

- .1 Do painting in accordance with Division 09 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.
- .4 Clean exposed bare metal surfaces supplied under Divisions 21, 22, 23 and 25. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .5 Paint all pipe hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer.

**3.2 System Cleaning**

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

**3.3 Field Quality Control**

- .1 Manufacturer's Field Services:
  - .1 Obtain written reports from manufacturers' verifying compliance of the work, in handling, installing, applying, protecting, cleaning and start-up of a product.
  - .2 Submit Manufacturer's Field Reports as described in PART 1 - Submittals.
  - .3 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

**3.4 Demonstration**

- .1 Departmental Representative may 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 the 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 Where specified elsewhere in Division 21, 22, 23 or 25 manufacturers to provide demonstrations and instructions.

- .4 Use operation and maintenance manual, record drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration requirements shall be as specified in the appropriate sections.
- .6 Contractor will record these demonstrations on digital video for future reference.

### **3.5 Fire Stopping and Smoke Seals**

- .1 Refer to Division 07.

### **3.6 Access Doors**

- .1 Installation:
  - .1 Provide all access doors required to access work installed by Divisions 21, 22, 23 and 25. Be responsible for coordinating locations, cutting opening and installing panels. Any secondary supports, blocking etc. will be by the ceiling or wall contractor.
  - .2 Access doors in mechanical equipment to be provided by this Division.
  - .3 Access panel requirements and locations shall be fully coordinated with all involved contractors prior to the installation of any mechanical systems or equipment.
- .2 Location:
  - .1 Ensure that equipment is within view and accessible for operating, inspecting, adjusting, servicing without using special tools.
- .3 Provide 3 sets of each type of access door key to the Departmental Representative at substantial completion. Obtain a signed receipt indicating date, quantity of keys and person receiving keys. Submit receipt to the Departmental Representative.

### **3.7 Electrical Motors**

- .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.
- .2 Installation:
  - .1 Unless otherwise noted starters and protection devices will be included under Division 26 - Electrical.
  - .2 Co-ordinate with Division 26 Contractor to ensure proper connection, correct thermal overload protection and correct motor controls.
  - .3 Where starters are included in this Division as an integral part of packaged equipment, they shall contain thermal overload protection in all ungrounded lines.
  - .4 Equipment, which has more than one voltage rating, shall be fed from a single power source through a disconnect switch.
  - .5 Fasten securely in place.
  - .6 Make removable for servicing, easily returned into, and positively in position.
- .3 Setting and Alignment:

**COMMON WORK RESULTS FOR MECHANICAL**

- .1 Employ a journeyman millwright to align all V-belt drives and/or shaft coupling drives. The millwright shall check that centrifugal fan wheels are properly centred on fan shafts.
- .2 Align shaft couplings, using a dial indicator, to within +/-0.051 mm after grouting is complete and the piping system is operational.
- .3 Align V-belt drives using a straight edge.
- .4 Submit a certificate from the millwright employed, certifying that all shaft couplings and V-belt drives have been aligned and centrifugal fan wheels centred prior to initial start-up and checked again after final system balance adjustment.

**3.8 Protection**

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

**END OF SECTION**

## **1. GENERAL**

### **1.1 Section Scope**

- .1 Internal and external thermal duct insulation, accessories, sealers, and finishes.

### **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 21 05 01 – Common Work Results for Mechanical.

### **1.3 References**

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Applicable Building Code – Refer to Section 21 05 01 – Common Work Results for Mechanical
- .3 Applicable energy code or standard – Refer to Section 21 05 01 – Common Work Results for Mechanical.
- .4 Thermal Insulation Association of Canada (TIAC) – National Insulation Standards.
- .5 British Columbia Insulation Contractors Association (BCICA) – Quality Standard for Mechanical Insulation Manual.
- .6 CAN/ULC S102-M88 – Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- .7 CGSB 51-GP-52MA – Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation
- .8 ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation
- .9 ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .10 ASTM C553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- .11 ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining.
- .12 ASTM C1290 – Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
- .13 Declare – Living Building Challenge (LBC), Red List

### **1.4 Submittals**

- .1 Comply with Division 01 – Submittal Procedures and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
  - .1 Certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Manufacturer's installation instructions.
  - .3 Manufacturer's declaration that products are either Declare – Living Building Challenge (LBC), Red List free, or LBC compliant.

## **1.5 General Requirements**

- .1 The Installation firm shall be a current member of one of the following:
  - .1 Thermal Insulation Association of Canada (TIAC).
  - .2 British Columbia Insulation Contractors Association (BCICA).
  - .3 Thermal Insulation Association of Alberta (TIAA).
- .2 Only Journeyman insulation applicators, with 3 years minimum successful experience in this size and type of project, shall perform the work.
- .3 Definitions:
  - .1 "CONCEALED" insulated mechanical services in trenches, chases, furred spaces, shafts and hung ceilings (services in tunnels are not considered to be concealed.)
  - .2 "EXPOSED" will mean not concealed.
  - .3 "K" value means Thermal Conductivity
  - .4 "UNCONDITIONED SPACE" referred to in the duct thickness tables are crawlspaces (vented or not vented), parkades, warehouse space, shipping and receiving areas and other areas noted on the drawings.
  - .5 "EXTERIOR SPACE" referred to in the duct thickness tables are all spaces outside the building insulation envelope, including attic spaces, unless noted otherwise.
  - .6 UL GREENGUARD: Provides independent third-party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Certification is based upon criteria used by Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA) and World Health Organization (WHO).
  - .7 ASJ: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper
  - .8 SSL: Self-Sealing Lap.
  - .9 FSK: Foil Scrim Kraft; jacketing.
  - .10 PSK: Poly Scrim Kraft; jacketing.
  - .11 PVC: PolyVinyl Chloride.
- .4 Unless otherwise specified, insulation system materials inside building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with ULC S102, Surface Burning Characteristics of Building Materials, and Assemblies.
- .5 Provide thermal insulation on all HVAC ductwork and as follows:
  - .1 Heating only duct and plenum – service temperature 20°C to 65°C (68°F to 149°F)
  - .2 Cooling only or combined cooling and heating duct and plenum - service temperature 5°C to 65°C (41°F to 149°F)
  - .3 Outside air duct and plenum - -40°C (-40°F) to ambient
  - .4 All exhaust air ductwork from outside wall or roof to damper but a minimum of 3 m (10 ft.) inside building.
  - .5 Combustion intake / relief air



- .6 Supply and return ductwork exposed in the space being served does not require insulation unless noted otherwise.
- .7 Where an internal duct liner is used in lieu of external insulation, the internal thickness shall match that of the "Rigid Exterior Duct Insulation" table.
- .8 Insulation may be omitted on heating only ductwork in return air plenums provided the ductwork serves that area.
- .6 Provide acoustic internal insulation on ductwork as follows:
  - .1 All ductwork indicated on drawings with cross hatching.
  - .2 All exposed supply and return ductwork in mechanical rooms from fan discharge to duct shaft or mechanical room perimeter wall.
  - .3 Where internal insulation is required, external insulation may be reduced or omitted by an equivalent thickness.
- .7 If the Contractor, during renovations, should discover asbestos (or material suspected to be asbestos) on piping, ductwork, etc., he shall immediately cease all work in that area and contact departmental representative.
- .8 Make good all existing insulation disturbed or removed to facilitate alterations and additions to existing piping.

## **2. PRODUCTS**

### **2.1 Acceptable Manufacturers**

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers

### **2.2 General**

- .1 Products shall not contain asbestos, lead, mercury, mercury compounds or Polybrominated diphenyl ethers (PBDE).
- .2 Mineral fibre specified includes glass wool and rock wool.
- .3 The RSI value shall not be reduced from the specified values when tested in accordance with ASTM C1290.
- .4 Insulation and jacketing materials shall not exceed 25 flame spread, 50 smoke developed rating when tested in accordance with CAN/ULC S102-M88.
- .5 Elastomeric insulation shall comply with NFPA 90A, 90B and ASTM C1534
- .6 Foam insulation products shall not use CFC or HCFC blowing agents in the manufacturing process and be formaldehyde free.
- .7 Glass mineral wool products shall have a recycled content of a minimum of 50 percent recycled glass content.
- .8 Low Emitting Materials: For all thermal and acoustical applications of glass mineral wool insulation, insulation shall be UL GREENGUARD Certified.
- .9 Products shall be either Declare LBC Red List free or LBC compliant.

### **2.3 Intermediate Temperature Range Insulation**

- .1 External rigid Insulation (TIAC C-1):
  - .1 Service temperature 5°C to 232°C (41°F to 450°F)

- .2 Glass mineral wool board for low and medium temperature applications.
- .3 Complying with ASTM C1071 and CGSB 51-GP-52MA
- .4 All service aluminum foil-scrim kraft (FSK) jacket with glass fibre reinforcement, factory applied.
- .5 Density 36kg/m<sup>3</sup> (2.25 PCF)
- .6 Minimum RSI 0.76/25mm (R 4.3/in)
- .2 External flexible duct wrap insulation (TIAC C-2):
  - .1 Service temperature 5°C to 121°C (41°F to 250°F)
  - .2 For service temperatures above 121°C refer to 2.4 High Temperature Insulation
  - .3 Glass mineral wool flexible blanket for low and medium temperature applications.
  - .4 Complying with CGSB 51-GP-52MA, ASTM C1071 and ASTM C553.
  - .5 All service aluminum foil-scrim kraft (FSK) jacket with glass fibre reinforcement, factory applied.
  - .6 Density 12kg/m<sup>3</sup> (0.75PCF),
  - .7 Minimum RSI 0.49/25mm (R 2.8/in) (installed)
- .3 Internal rigid duct liner:
  - .1 Rigid glass mineral wool board, for low and medium temperature acoustical applications.
  - .2 Complying with ASTM C1071 and CGSB 51-GP-52MA
  - .3 Airstream surface faced with a black mat bonded to the glass mineral wool substrate.
  - .4 Air velocity rating 25.4 m/s (5,000 ft/min)
  - .5 Density 48kg/m<sup>3</sup> (3 PCF),
  - .6 Minimum RSI 0.76/25mm (R 4.3/in)
  - .7 Sound absorption coefficients (type 'A' mounting):

Thickness		Frequency (Hz.)						
mm	inches	125	250	500	1000	2000	4000	NRC
25	1	0.13	0.24	0.56	0.83	0.92	0.98	0.65
40	1.5	0.19	0.41	0.89	1.02	1.03	1.04	0.85
50	2	0.33	0.67	1.07	1.07	1.03	1.06	0.95

- .4 Internal flexible duct liner:
  - .1 Flexible glass mineral wool blanket, for low and medium temperature acoustical applications.
  - .2 Complying with CGSB 51-GP-52MA, ASTM C1071 and ASTM C553.
  - .3 Airstream surface faced with non-woven fiberglass mat bonded to the glass mineral wool substrate.
  - .4 Air velocity rating 25.4 m/s (5,000 ft/min)
  - .5 Density 24kg/m<sup>3</sup> (1.5 PCF)

- .6 Minimum RSI 0.74/25mm (R 4.2/in)
- .7 Sound absorption coefficients (type 'A' mounting):

Thickness		Frequency (Hz.)						
mm	inches	125	250	500	1000	2000	4000	NRC
25	1	0.18	0.36	0.59	0.86	0.95	0.9	0.7
40	1.5	0.35	0.51	0.83	0.93	0.97	0.96	0.8
50	2	0.34	0.64	0.96	1.03	1	1.03	0.9

- .5 Internal fibre free elastomeric duct liner:
  - .1 Service temperature -40°C to 93°C (-40°F to 200°F)
  - .2 Flexible, closed-cell elastomeric insulation in sheet form, for low and medium temperature acoustical applications.
  - .3 Complying with ASTM C534, NFPA 90A and 90B.
  - .4 Insulation materials shall be manufactured without the use of CFC's, HFC's, HCFC's PBDE, or formaldehyde.
  - .5 Insulation materials shall be low VOCs, fibre free, dust free and resist mold and mildew, be ultra violet and weather resistant.
  - .6 Factory applied pressure sensitive adhesive or field applied adhesive.
  - .7 Air velocity rating 20.3 m/s (4,000 ft/min)
  - .8 Density 48kg/m<sup>3</sup> (3 PCF)
  - .9 Minimum RSI 0.74/25mm (R 4.2/in)
  - .10 Sound absorption coefficients (type 'A' mounting):

Thickness		Frequency (Hz.)						
mm	inches	125	250	500	1000	2000	4000	NRC
25	1	0.06	0.17	1.06	0.32	0.67	0.54	0.55
40	1.5	0.15	0.51	0.69	0.46	0.53	0.43	0.55
50	2	0.23	0.84	0.32	0.6	0.39	0.31	0.55

**2.4 High Temperature Range**

- .1 External flexible insulation (TIAC C-2):
  - .1 Service temperature 121°C to 538°C (250°F to 1000°F)
  - .2 Rock mineral wool or glass mineral wool flexible blanket for medium and high temperature applications.
  - .3 Complying with ASTM C553 and ASTM C1290.
  - .4 Density 25.6kg/m<sup>3</sup> (1.6PCF),
  - .5 Minimum RSI 0.76/25mm (R 4.3/in)
- .2 External flexible fire barrier insulation:

- .1 Service temperature to 538°C (1000°F)
- .2 Glass fiber or mineral fiber flexible batt and blanket, encapsulated in an aluminum foil fibreglass reinforced scrim covering.
- .3 Nominal 40mm (1.5") thick
- .4 Fire Resistance: For use in 1 hour fire resistant systems (single layer).
- .5 Fire Resistance: For use in 2 hour fire resistant systems (double layer)
- .6 Density 93.6 kg/m<sup>3</sup> (6PCF),
- .7 Minimum RSI 0.89 (R 6.4)
- .8 Complying with ASTM E 2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems

## **2.5 Fire Rated Duct Wrap**

- .1 Flexible, non-combustible, blanket type mineral fibre duct wrap completely encapsulated in reinforced foil, suitable for installation with zero clearance to combustibles (for grease ducts), and ULC tested and listed (ULC Designs FRD-17 & 23 for ventilation ducts, ULC Design FRD-19 for kitchen exhaust/grease duct) to facilitate a 2 hour fire resistance rating (76 mm [3"] thick) to kitchen grease exhaust duct in accordance with requirements of NFPA-96, and/or a 1 or 2 hour fire resistance rating (38 mm [1-½"] thick) to ventilation or pressurization ductwork in accordance with requirements of ISO 6944.

## **2.6 Fastenings, Adhesives and Coatings**

- .1 Insulation Fastenings:
  - .1 Min. 1.6 mm thick (16 ga) galvanized wire , 0.6 mm thick aluminium wire, 0.6 mm thick type 304 stainless steel wire or 1.6 mm thick copper wire.
  - .2 Mechanical fasteners, welded fasteners or adhesive fasteners to meet SMACNA HVAC Duct Construction Standard for mechanical fasteners.
- .2 Corner Beads: Galvanized steel or aluminum 38 mm x 38 mm x 0.37 mm thick.
- .3 Jacket Fastenings:
  - .1 Thermocanvas and All Service Jacket: Staples (flare type), compatible jacket finishing tape, contact adhesives recommended by the jacket manufacturer.
  - .2 Metal Jackets: Sheet metal screws, pop rivets.
- .4 Adhesives:
  - .1 Fabric adhesive to insulation covering, water based, ultra white, washable, anti-microbial.
  - .2 Internal elastomeric insulation adhesive shall be as per manufacturer's recommendations.
- .5 Coatings: Vapour barrier coating on reinforcing membrane.

## **2.7 Finish Jackets**

- .1 Thermocanvas Jacket: fire rated, 170g (6 oz) fire retardant canvas jacket for covering mechanical insulation indoors, 25/50 fire class, plain wave cotton, no dyes.

- .2 Aluminum Jacket: 51 mil (22 ga.) thick stucco or smooth aluminum jacketing with longitudinal slip joints and 50mm (2") end laps with factory applied protective liner on interior surface.
- .3 Bitumen Membrane: 55 mil composite membrane consisting of a multiply embossed UV-resistant aluminum foil/polymer laminate over a layer of rubberized asphalt specially formulated for use on insulated duct and piping applications.

### **3. EXECUTION**

#### **3.1 General**

- .1 Installation shall be to Thermal Insulation Association of Canada (TIAC): National Insulation Standards and the following:

#### **3.2 Rigid Insulation External Application**

- .1 Heating only Duct and Plenum – Service Temperature 20° to 65°C (CER/1)
  - .1 Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300 mm centers, each direction.
  - .2 Provide insulation without integral vapor retarder with horizontal surfaces overlapping vertical surfaces and edges tightly butted together. Secure insulation by impaling on mechanical fasteners.
  - .3 In areas of limited space wire fastenings, insulation adhesive, or other suitable methods of attachment may be substituted.
- .2 Cooling only or Combined Cooling and Heating Duct and Plenum - Service Temperature 5°C to 65°C (CER/2)
  - .1 Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300 mm centers, each direction.
  - .2 Install vapor retarder toward the ambient atmosphere with horizontal surfaces overlapping vertical surfaces tightly butted together. Secure insulation by impaling on mechanical fasteners.
  - .3 Where mechanical fasteners penetrate vapor retarder, and at all corners and joints, apply self adhesive vapor retarder tape or vapor retarder strips adhered with vapor retarder adhesive. Where raised seams are encountered, add a strip of insulation above seam termination on each side of the seam, secure to the seams an overlapping strip of insulating material of equal thickness to the one required to provide a continuous vapor retarder. Seal all joints and edges with self adhesive vapor retarder tape.
  - .4 In areas of limited space wire fastenings, insulation adhesive, or other suitable methods of attachment may be substituted.
- .3 Outside Air Duct and Plenum - -40°C to Ambient (CER/3)
  - .1 As per CER/2 application but firstly apply a layer of rigid insulation without vapor retarder before applying layer of rigid insulation with vapor retarder. All joints shall be staggered.

#### **3.3 Flexible Insulation External Application**

- .1 Heating only Duct and Plenum – Service Temperature 20°C to 65°C (CEF/1)

- .1 On rectangular ducts  $\geq$  600mm in width, apply mechanical fasteners to the bottom surface at approximately 300 mm centres.
- .2 Apply insulation without integral vapour retarder with 50 mm overlap at each joint. Secure insulation with wire fastening on approximately 300 mm centres, or by stapling laps.
- .2 Cooling only or Combined Cooling and Heating Duct and Plenum – Service Temperature 5°C to 65°C (CEF/2)
  - .1 On rectangular ducts  $\geq$  600 mm in width, apply to bottom surface mechanical fasteners at approximately 300 mm centers.
  - .2 Apply insulation with vapor retarder to the outside.
  - .3 Where mechanical fasteners or staples penetrate the vapor retarder and at all joints apply vapor retarder tape or vapor retarder strips adhered with vapor retarder adhesive.
  - .4 All joints shall be overlapped a minimum of 50 mm and stapled on approximately 100 mm centers.
  - .5 Secure insulation with wire fastening on approximately 300 mm centers.
- .3 Heating only Duct and Plenum Fire Barrier – ambient to 538°C (1000°F)
  - .1 As per manufacturers installation instructions

**3.4 Duct Insulation Minimum Thickness Table (Climatic Zone 5)**

<b>Rigid Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness in mm (in.)</b>				
Cooling Only Air Supply	25 (1")	25 (1")	25 (1")	125 (5")
Heating or H/C Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	125 (5")
Outdoor Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Combustion Air	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Return Air	25 (1")	0	25 (1")	125 (5")
Exhaust Air (1)(2)	25 (1")	0	25 (1")	25 (1")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	25 (1")	125 (5")
Mixed Air (3)	25 (1")	25 (1")	25 (1")	125 (5")
See note (6) for factory installed duct and plenums				

<b>Flexible Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness mm (in.)</b>				

<b>Flexible Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness mm (in.)</b>				
Cooling Only Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	188 (7-1/2")
Heating or H/C Air Supply	50 (2")	50 (2")	50 (2")	188 (7-1/2")
Outdoor Air Supply	50 (2")	50 (2")	50 (2")	0
Combustion Air	50 (2")	50 (2")	50 (2")	0
Return Air	38 (1-1/2")	0	38 (1-1/2")	188 (7-1/2")
Exhaust Air (1)(2)	38 (1-1/2")	0	38 (1-1/2")	38 (1-1/2")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	38 (1-1/2")	188 (7-1/2")
Mixed Air (3)	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	188 (7-1/2")
See note (6) for factory installed duct and plenums				

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 38mm (1-1/2") flexible duct insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Mixed Air includes tempered air downstream of heat recovery units

Note (4): Plenums located outside the building shall be insulated to the values listed in the exterior column.

Note (5): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications

Note (6): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the requirements of the relevant CSA Standard for that equipment and is insulated to RSI 0.58 (R3.3) or greater. Refer to NECB article 5.2.12.1 for relevant CSA Standards.

**3.5 Duct Insulation Minimum Thickness Table (Climatic Zone 6)**

<b>Rigid Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness in mm (in.)</b>				
Cooling Only Air Supply	25 (1")	25 (1")	25 (1")	150 (6")
Heating or H/C Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	150 (6")
Outdoor Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Combustion Air	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Return Air	25 (1")	0	25 (1")	150 (6")
Exhaust Air (1)(2)	25 (1")	0	25 (1")	25 (1")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0

Rigid Exterior Duct Insulation				
Duty	Plenum-Concealed (4)	Duct Location		
		Interior		Exterior
		Conditioned Space	Unconditioned Space	
Minimum Insulation Thickness in mm (in.)				
Tempered Air Supply or Makeup Air	0	0	25 (1")	150 (6")
Mixed Air (3)	25 (1")	25 (1")	25 (1")	150 (6")
See note (6) for factory installed duct and plenums				

Flexible Exterior Duct Insulation				
Duty	Plenum-Concealed (4)	Duct Location		
		Interior		Exterior
		Conditioned Space	Unconditioned Space	
Minimum Insulation Thickness mm (in.)				
Cooling Only Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	212 (8-1/2")
Heating or H/C Air Supply	50 (2")	50 (2")	50 (2")	212 (8-1/2")
Outdoor Air Supply	50 (2")	50 (2")	50 (2")	0
Combustion Air	50 (2")	50 (2")	50 (2")	0
Return Air	38 (1-1/2")	0	38 (1-1/2")	212 (8-1/2")
Exhaust Air (1)(2)	38 (1-1/2")	0	38 (1-1/2")	38 (1-1/2")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	38 (1-1/2")	212 (8-1/2")
Mixed Air (3)	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	212 (8-1/2")
See note (6) for factory installed duct and plenums				

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 38mm (1-1/2") flexible duct insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Mixed Air includes tempered air downstream of heat recovery units

Note (4): Plenums located outside the building shall be insulated to the values listed in the exterior column.

Note (5): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications

Note (6): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the requirements of the relevant CSA Standard for that equipment and is insulated to RSI 0.58 (R3.3) or greater. Refer to NECB article 5.2.12.1 for relevant CSA Standards.

**3.6 Duct Insulation Minimum Thickness Table (Climatic Zone 7)**

Rigid Exterior Duct Insulation		
Duty	Plenum-	Duct Location



	Concealed (4)	Interior		Exterior
		Conditioned Space	Unconditioned Space	
	Minimum Insulation Thickness in mm (in.)			
Cooling Only Air Supply	25 (1")	25 (1")	25 (1")	175 (7")
Heating or H/C Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	175 (7")
Outdoor Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Combustion Air	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Return Air	25 (1")	0	25 (1")	175 (7")
Exhaust Air (1)(2)	25 (1")	0	25 (1")	25 (1")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	25 (1")	175 (7")
Mixed Air (3)	25 (1")	25 (1")	25 (1")	175 (7")
See note (6) for factory installed duct and plenums				

Flexible Exterior Duct Insulation				
Duty	Plenum- Concealed (4)	Duct Location		Exterior
		Interior		
	Conditioned Space	Unconditioned Space		
Minimum Insulation Thickness mm (in.)				
Cooling Only Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	250 (10")
Heating or H/C Air Supply	50 (2")	50 (2")	50 (2")	250 (10")
Outdoor Air Supply	50 (2")	50 (2")	50 (2")	0
Combustion Air	50 (2")	50 (2")	50 (2")	0
Return Air	38 (1-1/2")	0	38 (1-1/2")	250 (10")
Exhaust Air (1)(2)	38 (1-1/2")	0	38 (1-1/2")	38 (1-1/2")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	38 (1-1/2")	250 (10")
Mixed Air (3)	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	250 (10")
See note (6) for factory installed duct and plenums				

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 38mm (1-1/2") flexible duct insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Mixed Air includes tempered air downstream of heat recovery units

Note (4): Plenums located outside the building shall be insulated to the values listed in the exterior column.

Note (5): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications

Note (6): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the requirements of the relevant CSA Standard for that equipment and is insulated to RSI 0.58 (R3.3) or greater. Refer to NECB article 5.2.12.1 for relevant CSA Standards.

**3.7 Duct Insulation Minimum Thickness Table (Climatic Zone 8)**

<b>Rigid Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness in mm (in.)</b>				
Cooling Only Air Supply	25 (1")	25 (1")	25 (1")	200 (8")
Heating or H/C Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	200 (8")
Outdoor Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Combustion Air	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	0
Return Air	25 (1")	0	25 (1")	200 (8")
Exhaust Air (1)(2)	25 (1")	0	25 (1")	25 (1")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	25 (1")	200 (8")
Mixed Air (3)	25 (1")	25 (1")	25 (1")	200 (8")
See note (6) for factory installed duct and plenums				

<b>Flexible Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness mm (in.)</b>				
Cooling Only Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	275 (11")
Heating or H/C Air Supply	50 (2")	50 (2")	50 (2")	275 (11")
Outdoor Air Supply	50 (2")	50 (2")	50 (2")	0
Combustion Air	50 (2")	50 (2")	50 (2")	0
Return Air	38 (1-1/2")	0	38 (1-1/2")	275 (11")
Exhaust Air (1)(2)	38 (1-1/2")	0	38 (1-1/2")	38 (1-1/2")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	38 (1-1/2")	275 (11")
Mixed Air (3)	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	275 (11")
See note (6) for factory installed duct and plenums				

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 38mm (1-1/2") flexible duct insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Mixed Air includes tempered air downstream of heat recovery units

Note (4): Plenums located outside the building shall be insulated to the values listed in the exterior column.

Note (5): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications

Note (6): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the requirements of the relevant CSA Standard for that equipment and is insulated to RSI 0.58 (R3.3) or greater. Refer to NECB article 5.2.12.1 for relevant CSA Standards.

**3.8 Duct Insulation Minimum Thickness Table (ASHRAE 90.1-2016 Zone 5)**

<b>Rigid Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness in mm (in.)</b>				
Cooling Only Air Supply	25 (1")	25 (1")	40 (1-1/2")	50 (2")
Heating or H/C Air Supply	25 (1")	25 (1")	40 (1-1/2")	75 (3")
Outdoor Air Supply	40 (1-1/2")	40 (1-1/2")	40 (1-1/2")	0
Combustion Air	40 (1-1/2")	40 (1-1/2")	40 (1-1/2")	0
Return Air	0	0	40 (1-1/2")	75 (3")
Exhaust Air (1)(2)	0	0	25 (1")	25 (1")
Grease Hood Exhaust (5)	N/A	40 (1-1/2")	40 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	40 (1-1/2")	75 (3")
Mixed Air (3)	25 (1")	25 (1")	40 (1-1/2")	75 (3")
See note (6) for factory installed duct and plenums				

<b>Flexible Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness in mm (in.)</b>				
Cooling Only Air Supply	25 (1")	25 (1")	56 (2-3/16")	75 (3")
Heating or H/C Air Supply	25 (1")	25 (1")	56 (2-3/16")	115 (4.5")
Outdoor Air Supply	50 (2")	50 (2")	56 (2-3/16")	0
Combustion Air	50 (2")	50 (2")	56 (2-3/16")	0
Return Air	0	0	56 (2-3/16")	115 (4.5")
Exhaust Air (1)(2)	0	0	40 (1-1/2")	40 (1-1/2")
Grease Hood Exhaust (5)	N/A	40 (1-1/2")	40 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	56 (2-3/16")	115 (4.5")
Mixed Air (3)	40 (1-1/2")	40 (1-1/2")	56 (2-3/16")	115 (4.5")
See note (6) for factory installed duct and plenums				

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 40mm (1-1/2") flexible duct insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Mixed Air includes tempered air downstream of heat recovery units

Note (4): Plenums located outside the building shall be insulated to the values listed in the exterior column.

Note (5): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications.

Note (6): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the requirements of the relevant CSA Standard for that equipment and is insulated to RSI 0.58 (R3.3) or greater. Refer to NECB article 5.2.12.1 for relevant CSA Standards.

**3.9 Duct Insulation Minimum Thickness Table (ASHRAE 90.1-2016 Zone 6)**

<b>Rigid Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness in mm (in.)</b>				
Cooling Only Air Supply	25 (1")	25 (1")	40 (1-1/2")	50 (2")
Heating or H/C Air Supply	25 (1")	25 (1")	40 (1-1/2")	75 (3")
Outdoor Air Supply	40 (1-1/2")	40 (1-1/2")	40 (1-1/2")	0
Combustion Air	40 (1-1/2")	40 (1-1/2")	40 (1-1/2")	0
Return Air	0	0	40 (1-1/2")	75 (3")
Exhaust Air (1)(2)	0	0	25 (1")	25 (1")
Grease Hood Exhaust (5)	N/A	40 (1-1/2")	40 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	40 (1-1/2")	75 (3")
Mixed Air (3)	25 (1")	25 (1")	40 (1-1/2")	75 (3")
See note (6) for factory installed duct and plenums				

<b>Flexible Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness in mm (in.)</b>				
Cooling Only Air Supply	25 (1")	25 (1")	56 (2-3/16")	75 (3")
Heating or H/C Air Supply	25 (1")	25 (1")	56 (2-3/16")	115 (4.5")
Outdoor Air Supply	50 (2")	50 (2")	56 (2-3/16")	0
Combustion Air	50 (2")	50 (2")	56 (2-3/16")	0
Return Air	0	0	56 (2-3/16")	115 (4.5")
Exhaust Air (1)(2)	0	0	40 (1-1/2")	40 (1-1/2")
Grease Hood Exhaust (5)	N/A	40 (1-1/2")	40 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	56 (2-3/16")	115 (4.5")
Mixed Air (3)	40 (1-1/2")	40 (1-1/2")	56 (2-3/16")	115 (4.5")
See note (6) for factory installed duct and plenums				

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 40mm (1-1/2") flexible duct insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Mixed Air includes tempered air downstream of heat recovery units

Note (4): Plenums located outside the building shall be insulated to the values listed in the exterior column.

Note (5): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications.

Note (6): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the requirements of the relevant CSA Standard for that equipment and is insulated to RSI 0.58 (R3.3) or greater. Refer to NECB article 5.2.12.1 for relevant CSA Standards.

**3.10 Duct Insulation Minimum Thickness Table (ASHRAE 90.1-2016 Zone 7)**

<b>Rigid Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness in mm (in.)</b>				
Cooling Only Air Supply	25 (1")	25 (1")	25 (1")	50 (2")
Heating or H/C Air Supply	25 (1")	25 (1")	40 (1-1/2")	75 (3")
Outdoor Air Supply	40 (1-1/2")	40 (1-1/2")	40 (1-1/2")	0
Combustion Air	40 (1-1/2")	40 (1-1/2")	40 (1-1/2")	0
Return Air	0	0	40 (1-1/2")	75 (3")
Exhaust Air (1)(2)	0	0	25 (1")	25 (1")
Grease Hood Exhaust (5)	N/A	40 (1-1/2")	40 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	40 (1-1/2")	75 (3")
Mixed Air (3)	25 (1")	25 (1")	40 (1-1/2")	75 (3")
See note (6) for factory installed duct and plenums				

<b>Flexible Exterior Duct Insulation</b>				
<b>Duty</b>	<b>Plenum-Concealed (4)</b>	<b>Duct Location</b>		
		<b>Interior</b>		<b>Exterior</b>
		Conditioned Space	Unconditioned Space	
<b>Minimum Insulation Thickness in mm (in.)</b>				
Cooling Only Air Supply	25 (1")	25 (1")	40 (1-1/2")	75 (3")
Heating or H/C Air Supply	25 (1")	25 (1")	56 (2-3/16")	115 (4.5")
Outdoor Air Supply	50 (2")	50 (2")	56 (2-3/16")	0
Combustion Air	50 (2")	50 (2")	56 (2-3/16")	0
Return Air	0	0	56 (2-3/16")	115 (4.5")
Exhaust Air (1)(2)	0	0	40 (1-1/2")	40 (1-1/2")

Flexible Exterior Duct Insulation				
Duty	Plenum-Concealed (4)	Duct Location		
		Interior		Exterior
		Conditioned Space	Unconditioned Space	
Minimum Insulation Thickness in mm (in.)				
Grease Hood Exhaust (5)	N/A	40 (1-1/2")	40 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	56 (2-3/16")	115 (4.5")
Mixed Air (3)	40 (1-1/2")	40 (1-1/2")	56 (2-3/16")	115 (4.5")
See note (6) for factory installed duct and plenums				

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 40mm (1-1/2") flexible duct insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Mixed Air includes tempered air downstream of heat recovery units

Note (4): Plenums located outside the building shall be insulated to the values listed in the exterior column.

Note (5): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications.

Note (6): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the requirements of the relevant CSA Standard for that equipment and is insulated to RSI 0.58 (R3.3) or greater. Refer to NECB article 5.2.12.1 for relevant CSA Standards

**3.11 Duct Insulation Minimum Thickness Table (ASHRAE 90.1-2016 Zone 8)**

Rigid Exterior Duct Insulation				
Duty	Plenum-Concealed (4)	Duct Location		
		Interior		Exterior
		Conditioned Space	Unconditioned Space	
Minimum Insulation Thickness in mm (in.)				
Cooling Only Air Supply	25 (1")	25 (1")	25 (1")	50 (2")
Heating or H/C Air Supply	25 (1")	25 (1")	40 (1-1/2")	75 (3")
Outdoor Air Supply	40 (1-1/2")	40 (1-1/2")	40 (1-1/2")	0
Combustion Air	40 (1-1/2")	40 (1-1/2")	40 (1-1/2")	0
Return Air	0	0	40 (1-1/2")	75 (3")
Exhaust Air (1)(2)	0	0	25 (1")	25 (1")
Grease Hood Exhaust (5)	N/A	40 (1-1/2")	40 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	40 (1-1/2")	75 (3")
Mixed Air (3)	25 (1")	25 (1")	40 (1-1/2")	75 (3")
See note (6) for factory installed duct and plenums				

<b>Flexible Exterior Duct Insulation</b>
--

Duty	Plenum- Concealed (4)	Duct Location		
		Interior		Exterior
		Conditioned Space	Unconditioned Space	
Minimum Insulation Thickness mm (in.)				
Cooling Only Air Supply	25 (1")	25 (1")	40 (1-1/2")	75 (3")
Heating or H/C Air Supply	25 (1")	25 (1")	56 (2-3/16")	115 (4.5")
Outdoor Air Supply	65 (2-1/2")	65 (2-1/2")	56 (2-3/16")	0
Combustion Air	65 (2-1/2")	65 (2-1/2")	56 (2-3/16")	0
Return Air	0	0	56 (2-3/16")	115 (4.5")
Exhaust Air (1)(2)	0	0	40 (1-1/2")	40 (1-1/2")
Grease Hood Exhaust (5)	N/A	40 (1-1/2")	40 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	56 (2-3/16")	115 (4.5")
Mixed Air (3)	40 (1-1/2")	40 (1-1/2")	56 (2-3/16")	115 (4.5")
See note (6) for factory installed duct and plenums				

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 40mm (1-1/2") flexible duct insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Mixed Air includes tempered air downstream of heat recovery units

Note (4): Plenums located outside the building shall be insulated to the values listed in the exterior column.

Note (5): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications

Note (6): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the requirements of the relevant CSA Standard for that equipment and is insulated to RSI 0.58 (R3.3) or greater. Refer to NECB article 5.2.12.1 for relevant CSA Standards.

### 3.12 Liner Internal Application

#### .1 General

- .1 Where an interior duct liner is used, external insulation shall not be applied unless noted otherwise.
- .2 Where an interior duct liner is used, the thickness shall be selected to match the thickness specified for external rigid insulation. Where no external insulation is required internal acoustic duct liner shall be a minimum 25mm (1").

#### .2 Rigid Duct Liner (CIR/1)

- .1 Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300 mm centers each direction.
- .2 Apply insulation with surfaces overlapping vertical surfaces and with edges tightly butted together.
- .3 Insulation shall be applied to the ductwork with a minimum 90% coverage of adhesive and mechanical fasteners.

- .4 Where mechanical fasteners penetrate factory finish and at all joints, apply a heavy layer of seal coating.
- .5 On high velocity duct systems 20 m/s to 30 m/s (4000 fpm -6000 fpm) apply reinforcing membrane over the entire insulation joint surface.
- .6 Seal off leading edge of insulation to duct surface on low velocity ductwork with reinforced seal coating or metal nosing. On high velocity duct systems, (over 20 m/s (4000 fpm) use metal nosing.
- .3 Flexible Duct Liner (CIF/1)
  - .1 Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300 mm centers each direction.
  - .2 Apply insulation with edges tightly butted together.
  - .3 Insulation shall be applied to the ductwork with a minimum 90% coverage of adhesive and mechanical fasteners.
  - .4 Where mechanical fasteners penetrate factory finish and at all joints, apply a heavy layer of seal coating.
  - .5 On high velocity duct systems 20 m/s to 30 m/s (4000 fpm -6000 fpm) apply reinforcing membrane over the entire insulation joint surface.
  - .6 Seal off leading edge of insulation to duct surface on low velocity ductwork with reinforced seal coating or metal nosing. On high velocity duct systems, (over 20 m/s (4000 fpm) use metal nosing.
- .4 Elastomeric Duct Liner
  - .1 Install in accordance with TIAC National Standards and / or British Columbia Insulation Contractors Association (BCICA) Quality Standards Manual for Mechanical Insulation.
  - .2 Apply materials in accordance with manufacturer's instructions and as indicated.
  - .3 Work shall be performed at the temperatures recommended by the product manufacturer.
  - .4 The skin side (smooth side) shall be exposed to the airstream.
  - .5 Butt-edge seams using manufacturer's adhesive by compression fit method to allow for expansion/contraction. Leave a 1/2" wide uncoated border at the butt-edge seams on the duct surface and the insulation surface. Overlap the insulation 1/4" at the butt-edges and compress the edges into place. Apply adhesive.
  - .6 Allow minimum 48 hours for full adhesive cure before operating air system.
  - .7 Maintain uninterrupted continuity and integrity of insulation.

### **3.13 External Flexible Fire Barrier Insulation**

- .1 Install as per manufacturers installation instructions.

### **3.14 Finishes**

- .1 General
  - .1 Insulation on concealed ductwork shall be left with factory finish. No further finish is required.
  - .2 The following finishes apply to exposed ductwork and plenums only.



- .2 Canvas Jacket – Indoor (CRF/1) (CRD/1)
  - .1 Use over rigid insulation for rectangular ductwork and flexible insulation for round ductwork, all with an integral vapor retarder. Apply continuous metal corner bead to all corners. Adhere vapor retarder tape over all joints and breaks in vapor retarder, and at all corners.
  - .2 Secure canvas jacket over insulation using fire resistive lagging coating and adhesive, and finish with one (1) coat of fire resistive lagging coating adhesive.
- .3 Utility Finish – Indoor (CRF/2) (CRD/2)
  - .1 Use over rigid insulation for rectangular ductwork and flexible insulation for round ductwork, all with an integral vapor retarder. Apply continuous metal corner bead to all corners. Adhere vapor retarder tape over all joints and breaks in vapor retarder, and at all corners.
- .4 Aluminum Jacket – Outdoor (CRF/3) (CRD/3)
  - .1 Adhere vapour retarder tape over all joints and breaks in vapor retarder and at all corners on cold or dual temp ductwork.
  - .2 Apply over the insulation surface a stucco embossed aluminum jacket secured with pop rivets or stainless steel self tapping screws. All joints sealed or flashed to prevent water infiltration.
- .5 Bitumen Membrane – Outdoor (CRF/5) (CRD/4)
  - .1 Install a modified bitumen membrane on rectangular ductwork and an aluminized modified bitumen membrane on round ductwork.
  - .2 Install in accordance to manufacturer’s instructions.

**3.15 Duct Finishes Table**

- .1 Conform to the following:

Duty	Rectangular Duct		Round Duct	
	Type	TIAC Code	Type	TIAC Code
Indoor Concealed	None	None	None	None
Indoor Exposed in Mechanical Room & Elsewhere except Utility Areas	Canvas Jacket	CRF/1	Canvas Jacket	CRD/1
Indoor Exposed in Utility Areas, Parkade, Etc.	Utility Finish	CRF/2	Utility Finish	CRD/2
Outdoor Exposed to Precipitation	Aluminum Jacket	CRF/3	Aluminum Jacket	CRD/3
Outdoor Elsewhere	Bitumen Membrane	CRF/5	Bitumen Membrane	CRD/4

**END OF SECTION**

## **Part 1 General**

### **1.1 Section Scope**

- .1 Section includes commissioning process requirements for Fuel oil systems and equipment.
- .2 All Cx work is to be conducted as per CSA Z320-11 guidelines.

### **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.

### **1.3 References**

- .1 Commissioning Agency (CxA)
- .2 The latest revisions of the following standards shall apply unless noted otherwise.
  - .1 Applicable Building Code - Refer to Section 21 05 01.

### **1.4 Submittals**

- .1 Comply with Division 1 – Submission and Closeout Procedures,– Submittals and in addition the following:
  - .1 Pre-construction start up report for the current generator installation and start up.
  - .2 Commissioning Schedule
  - .3 Certificates of readiness (static verification)
  - .4 Certificates of completion of installation, prestart, and start-up activities (functional performance verification)
  - .5 Commissioning Report at Post Substantial Completion
  - .6 Retro-Commissioning report during the warranty period (at 10 months after occupancy)

### **1.5 Contractor's Responsibilities**

- .1 Perform commissioning tests
- .2 Attend construction phase controls coordination meeting.
- .3 Controls End-End point verification report.
- .4 Controls commissioning report.
- .5 Participate in orientations and inspections associated with Plumbing systems, assemblies, and equipment.
- .6 Correct all deficiencies identified during commissioning.
- .7 Provide information requested by the CxA for the final commissioning documentation.

- .8 Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- .9 Provide start up documentation for all equipment to CxA complete with a full record of all settings measured, confirmed, or altered/adjusted. Factory start-ups to be completed prior to CxA verifications.  

Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility. AHJ demonstrations should not replace Cx duties.
- .10 Include the cost of participating in the commissioning process as outlined in the specifications in the total contract price.
- .11 In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
- .12 Provide three sets of all keys, operators, special tools (software keys, security dongles, discs and unlock codes), etc required for the operation and maintenance of all equipment and systems. These shall be turned over to the Owner with a signed receipt.

## **1.6 CxA's Responsibilities**

- .1 Provide Project-specific construction checklists and commissioning process test procedures for actual fuel oil system and equipment, and components to be furnished and installed as part of the construction contract.
- .2 Prepare a Commissioning plan.
- .3 Organize and lead Cx meetings and activities during construction.
- .4 Prepare and provide coordinated Operating and Maintenance Manuals. Include description of systems, normal operating parameter. The CxA shall pull together documentation from the mechanical and controls contractors. Refer to 21 05 01 for additional O&M Manual requirements.
- .5 Facilitate owner training. Ensure the Owner is trained in all operating and routine maintenance aspects of the major building systems and specialty systems. Provide a minimum of 3 days, for at least 6 participants from the owner group. Provide all training documentation required including as-built drawings and complete O&M manuals. Owner training cannot begin until all systems have been fully commissioned and all deficiencies resolved.
- .6 Create a Maintenance program for the Major building systems that satisfies the manufacturer's warranty requirements and outlines recommended procedures to achieve the full service life of the equipment.
- .7 Provide Project-specific construction checklists and commissioning process test procedures for actual Plumbing systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

- .8 Carry out, verify and participate in commissioning testing. This includes witnessing the Fuel Tank Fill-up process to verify the systems are performing as intended. Note that AHJ demonstrations shall not replace CxA duties.
- .9 Verify testing, adjusting, and balancing of work are complete.
- .10 Provide copies of documentation to the Consultants.

### **1.7 Commissioning Documentation**

- .1 Commissioning Schedule
- .2 Certificates of readiness (static verification)
- .3 Certificates of completion of installation, prestart, and start-up activities (functional performance verification)
- .4 Commissioning Report at Post Substantial Completion
- .5 Retro-Commissioning report during the warranty period (at 10 months after occupancy)
- .6 Provide the following information to the CxA for the inclusion in the commissioning plan:
  - .1 Plan for delivery and review of submittals, systems manuals, and other documents and reports.
  - .2 Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
  - .3 Process and schedule for completing construction checklists for PLUMBING/PROCESS systems, assemblies, equipment, and components to be verified and tested.
  - .4 Certificate of completion certifying that installation, start-up checks, and start-up procedures have been completed.
  - .5 Test and inspection reports, and certificates.
  - .6 Documented verification of testing, adjusting, and balancing reports.
  - .7 All final set points and schedules to be listed in Cx report.

### **Part 2 Products (Not used)**

### **Part 3 Execution**

#### **3.1 Testing Preparation**

- .1 Certify that fuel oil system and equipment, have been installed, calibrated, and started and are operating according to the Contract Documents.
- .2 Construction documents review:
  - .1 Provide full set of Div 21, 22, 23, 25, 26 drawings and specifications for preliminary design review.

- .3 Certify that fuel oil systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- .4 Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- .5 Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- .6 Inspect and verify the position of each device and interlock identified on checklists.
- .7 Check safety cut-outs, alarms, and interlocks with life-safety systems during each mode of operation.
- .8 Testing instrumentation: Install measuring instruments and logging devices to record test data.

### **3.2 Testing and Balancing Verification**

- .1 Prior to performance of testing and balancing (TAB) work, provide copies of TAB procedures, reports, sample forms, checklists, and certificates to the CxA.
- .2 Notify the CxA at least 10 working days in advance of testing and balancing work, and provide access for the CxA to witness testing and balancing work.
- .3 Provide technicians, instrumentation, and tools to verify testing and balancing of fuel oil systems.
  - .1 The CxA will notify testing and balancing Contractor 10 working days in advance of the date of field certification. Notice will not include data points to be verified.
  - .2 The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
  - .3 Failure of an item includes, other than for sound measurements, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3dB shall result in rejection of final testing.
  - .4 Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

### **3.3 General Testing Requirements**

- .1 Scope of fuel oil system testing includes entire fuel oil system installation.
- .2 Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- .3 The CxA along with the Contractors, testing and balancing Contractor, and the Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for fuel oil systems, subsystems, and equipment.

- .4 Tests will be performed using design conditions whenever possible.
- .5 Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Calibrate testing instruments before simulating conditions. Provide equipment to simulate loads. Set simulated conditions and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- .6 Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical.
- .7 Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical.
- .8 If tests cannot be completed because of a deficiency outside the scope of the fuel oil system, document the deficiency and report it to the departmental representative. After deficiencies are resolved, reschedule tests.
- .9 If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### **3.4 Above Ground Storage Tanks**

- .1 CxA is to confirm:
  - .1 Fuel tank is built to meet CAN/ULC S602-07 requirements
  - .2 Factory pressure testing certificate
  - .3 Mounting, Support, and Seismic mounting for fuel tank.
  - .4 Confirm operation of leak detection system and connection to alarm systems.
  - .5 Confirm operation of high, low level switches.
  - .6 Tanks is to be 110% contained.

**END OF SECTION**

## **Part 1 GENERAL**

### **1.1 Summary**

- .1 Section Includes:
  - .1 Materials and installation for light fuel oil piping from oil tanks to boilers.
- .2 Related Sections:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 35 29 - Health and Safety Requirements.
  - .3 Section 01 45 00 - Quality Control.
  - .4 Section 01 74 19 - Waste Management and Disposal.
  - .5 Section 01 78 00 - Closeout Submittals.
  - .6 Section 02 61 33 - Hazardous Materials.

### **1.2 References**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME-B16.3- [16], Malleable-Iron Threaded Fittings.
  - .2 ASME-B16.9- [12], Factory-Made Wrought Steel Buttwelding Fittings.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A47/A47M- [14], Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M- [18], Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3 ASTM B61- [15], Standard Specification for Steam or Valve Bronze Castings.
  - .4 ASTM B75M- [11], Standard Specification for Seamless Copper Tube.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
  - .1 MSS-SP-80- [2013], Bronze Gate, Globe, Angle and Check Valves.

### **1.3 Submittals**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### **1.4 Quality Assurance**

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting [one] week prior to beginning work of this Section and on-site installations
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.

#### **1.5 Delivery, Storage and Handling**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
  - .4 Place materials defined as hazardous or toxic in designated containers.
  - .5 Handle and dispose of hazardous materials in accordance with Regional and Municipal, regulations.

### **Part 2 PRODUCTS**

#### **2.1 Fill Vent and Carrier Pipe**

- .1 Steel: to ASTM A53/A53M, Schedule 40, continuous weld or electric resistance welded, screwed.

#### **2.2 Steel Pipe Coating**

- .1 Bituminous paint: in accordance with manufacturer's recommendations.



### **2.3 Jointing Material**

- .1 Screwed fittings: Teflon tape.
- .2 Soldered fittings: 95/5.

### **2.4 Fittings**

- .1 Steel:
  - .1 Malleable iron: screwed, banded, Class 150 to ASME-B16.3.
  - .2 Welding: butt-welding to ASME-B16.9.
  - .3 Unions: malleable iron, brass to iron, ground seat, screwed, to ASTM A47/A47M.
  - .4 Nipples: Schedule 40, to ASTM A53/A53M.
- .2 Copper:
  - .1 Piping: soldered type.
  - .2 Connections to equipment: compression.

### **2.5 Ball Valves**

- .1 NPS 2 and under:
  - .1 Body and cap: cast high tensile bronze to ASTM B62.
  - .2 Pressure rating: 4140-kPa CWP.
  - .3 Connections: Screwed ends to ANSI B1.20.1 and with hexagonal shoulders [\_\_\_\_].
  - .4 Stem: tamperproof ball drive.
  - .5 Stem packing nut: external to body.
  - .6 Ball and seat: replaceable hard chrome solid ball and Teflon seats.
  - .7 Stem seal: TFE with external packing nut.
  - .8 Operator: removable lever handle.

### **2.6 Swing Check Valves**

- .1 Requirements common to check valves, unless specified otherwise:
  - .1 Standard specification: MSS SP 80.
  - .2 Connections: screwed with hexagonal shoulders.
- .2 NPS 2 and under bronze swing disc, Class 125:
  - .1 Body: Y pattern with integral seat at 45 degrees, screw in cap with hex head.
  - .2 Disc and seat: renewable rotating disc, two piece hinge disc construction; seat: regrindable.

### **2.7 Lubricated Plug Cocks**

- .1 NPS 2 and under, screwed:

- .1 To ASTM B61, Class 150, 1 MPa, bronze body.

### **Part 3 EXECUTION**

#### **3.1 Manufacturer's Instructions**

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

#### **3.2 Piping**

- .1 Install oil piping system in accordance with CSA-B139 and CSA-B140.0.
- .2 Slope piping down in direction of storage tank unless otherwise indicated.
- .3 Suction [and return] piping inside building:
  - .1 Steel, with screwed fittings.
  - .2 Install filter and gate valve at burners.
- .4 Fill, vent, suction outside building:
  - .1 Steel piping welded throughout except at tanks where use electrically isolating fittings.
  - .2 Grading: slope piping at [1] % minimum back to tanks.
- .5 Piping at tanks:
  - .1 Suction: terminate [150] mm from bottom of tank [with foot valve and strainer].
  - .2 Vent: extend into tank and terminate less than [25] mm from top. Terminate open end [3600] mm above grade with return bend and removable 10 mesh copper screen.
  - .3 Fill: terminate as indicated with liquid-tight and vapourproof cover locking cap, chain and padlock.
  - .4 Dipstick: extend tube to within [150] mm from bottom of tank. Terminate at grade with cap and chain and watertight cover.

#### **3.3 Valves**

- .1 Install valves with stems upright or horizontal unless approved otherwise by Consultant.
- .2 Install [gate] valves at branch take-offs, to isolate pieces of equipment and as indicated.
- .3 Install globe valves for balancing and in by-pass around control valves.
- .4 Install swing check valves as indicated.
- .5 Install plug cocks as indicated.

#### **3.4 Field Quality Control**

- .1 Site Tests/Inspection:

- .1 Test system in accordance with CSA-B139 and CSA-B140.0 and authorities having jurisdiction.
- .2 Isolate tanks from piping pressure tests.
- .3 Maintain test pressure during backfilling.
- .2 Manufacturer's Field Services:
  - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  - .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, at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 [Twice] during progress of Work at [25%] and [60%] complete.
    - .3 Upon completion of the Work, after cleaning is carried out.
  - .4 Obtain reports, within [3] days of review, and submit, immediately, to Consultant.
- .3 Performance Verification:
  - .1 Refer to Section 23 08 01 - Performance Verification Mechanical Piping System.

### **3.5 Cleaning**

- .1 In accordance with Section 23 25 00 – HVAC Water Treatment, supplemented as specified herein.
- .2 Flush after pressure test with [number 2] fuel oil for a minimum of [two] hours. Clean strainers and filters.
- .3 Dispose of fuel oil used for flushing out in accordance with requirements of authority having jurisdiction.
- .4 Check vents from regulators, control valves are terminated in approved location and are protected against blockage and damage.
- .5 Check entire installation is approved by authority having jurisdiction.
- .6 Perform cleaning operations in accordance with manufacturer's recommendations.
- .7 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## **Part 1 general**

### **1.1 Section Scope**

- .1 Materials and installation for aboveground oil storage tanks \.

### **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 01 77 00 - Closeout Procedures.
- .3 Section 23 11 13 - Facility Fuel Oil Piping.

### **1.3 References**

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
  - .1 Applicable Building Code and Fire Code - Refer to Section 21 05 01.
- .2 American National Standards Institute (ANSI).
  - .1 ANSI/NFPA-329-15, Recommended Practice for Handling Releases of Flammable and Combustible Liquids.
  - .2 ANSI/API 650-2013, Welded Steel Tanks for Oil Storage.
- .3 American Petroleum Institute (API).
  - .1 API RP 651-2014, Cathodic Protection of Aboveground Petroleum Storage Tanks.
- .4 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM C618-17a, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- .5 Canadian Council of Ministers of the Environment (CCME).
  - .1 CCME-PN1326, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.
- .6 Canadian Standards Association (CSA)/CSA International.
  - .1 CAN/CSA-B139-09, Installation Code for Oil Burning Equipment.
- .7 National Fire Protection Association (NFPA)
  - .1 NFPA 30-2018 – Flammable and Combustible Liquids Code
- .8 National Research Council/Institute for Research in Construction.
  - .1 NRCC 56192, National Fire Code of Canada (NFC) -2015, Part 4.
- .9 Underwriters' Laboratories of Canada (ULC).
  - .1 ULC-S601-2014, Standard for Shop Fabricated Steel Aboveground Tanks for Flammable and Combustible Liquids.

- .2 CAN/ULC-S602-14, Standard for Aboveground Steel Tanks for Fuel Oil and Lubricating Oil.
- .3 CAN/ULC-S655-15, Standard for Aboveground Protected Tank Assemblies for Flammable and Combustible Liquids.
- .4 CAN/ULC-S661-10, Standard for Overfill Protection Devices for Flammable and Combustible Liquid Storage Tanks.

#### **1.4 Quality Assurance**

- .1 Provide tank tie-down system, including concrete pads required, to prevent uplift of the tank.
- .2 Provide field review's by suppliers engineering certifying that installation conforms to manufacturers installation instructions.

#### **1.5 Submittals**

- .1 Comply with Division 01 – Submittal Procedures and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
  - .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .3 Indicate details of construction, appurtenances, installation, and leakage detection system.
  - .4 Shop drawings to detail and indicate following as applicable to project requirements. Submit manufacturer's product data to supplement shop drawings.
    - .1 Size, materials, and locations of lifting lugs.
    - .2 Tanks capacity.
    - .3 Size and location of fittings.
    - .4 Environmental compliance package accessories.
    - .5 Decals, type size, and location.
    - .6 Accessories: provide details and manufacturers product data.
    - .7 Finishes.
    - .8 Piping, valves, and fittings: type, materials, sizes, piping connection details, valve shut-off type, and location, cathodic protection system complete with stamp of corrosion expert indicating that design complies with standards, Federal, and Provincial regulations.
    - .9 Anchors: description, material, size, and locations.
    - .10 Size and location of site pads.
    - .11 Level gauging: type and locations, include:
      - .1 Reporting systems, types of reports and report frequency.
      - .2 Maximum number of tanks to be monitored.
      - .3 Number of probes required and sizes.

- .4 Provide details and manufacturer's product data.
- .12 Ancillary devices: provide details and manufacturer's product data.
- .13 Leak detection system, type, and locations, and alarm system.
- .14 Grounding and bonding: provide details of design, type, materials, and locations.
- .5 Provide maintenance data for tank appurtenances and leakage detection system for incorporation into manual specified in Section 01 77 00 –Closeout Procedures.

## **1.6 Delivery, Storage and Handling**

- .1 General: Comply with tank manufacturer's Installation and Operating Guidelines recommendations for delivery, storage, and tank handling.

## **Part 2 Products**

### **2.1 Acceptable Manufacturers**

- .1 Not in use.

### **2.2 Tanks: Conventional Steel Double Wall**

- .1 Product-Storage Requirements
  - .1 All such tanks must be mounted on a fire proof cradle which is so constructed to allow water to drain away from the tank and its supports. If the cradle is not an intrinsic part of the tank assembly (i.e., permanently attached), a rubber gasket must be placed between the cradle and the tank to prevent corrosion at the contact point.
  - .2 All primary tanks must be vented. Tanks are designed for operation at atmospheric pressure only, except for use with vapor recovery systems at a pressure or vacuum not to exceed 1 psig (7 kPa).
  - .3 Tanks shall be capable of storing liquids with specific gravity up to 1.1.
  - .4 Tank shall be capable of storing the following products:
    - .1 Diesel fuel oils for oil burning equipment at temperatures not to exceed 150°F.
    - .2 Oxygenated motor fuels at ambient temperatures with up to 20% (by volume) methyl tertiary butyl ether (MTBE), ethyl tertiary butyl ether (ETBE), di-isopropyl ether (DIPE), tertiary butyl alcohol (TBA), tertiary amyl methyl ether (TAME), or tertiary amyl ethyl ether (TAEE).
    - .3 Biodiesel-diesel blends with up to 100% biodiesel (B100 per ASTM) at ambient temperatures.
- .2 Materials
  - .1 As a minimum, the internal wall of a double wall tank shall be designed and built in conformance with one of the Standards provided in Section B.2.
  - .2 The outer wall shall cover a minimum of 300 degrees of the circumferential surface area of the primary tank, including 100% coverage of the primary tank heads.

- .3 The outer wall of a steel tank shall be of a minimum thickness of ten (10) gauge.
- .4 There shall be no penetration of any kind through the jacket to the tank, except for top entry manholes and fittings required for filling, gauging and venting of the tank and monitoring the interstitial space.
- .5 An interstitial leak detection system that is capable of detecting a perforation, or non-tightness in either wall of the tank, including the entry of water into the interstitial space shall be installed.
- .6 The interstitial space shall be tested, in accordance with the instructions of the tank manufacturer, or as a minimum, at least annually.
- .7 All double walled tanks shall be equipped with a manway where the product supply piping connects to the tank.
- .8 Dimensional Requirements (Refer to Schedule)
- .9 Monitoring Capabilities
  - .1 Double wall tanks shall have a monitoring space between the walls to allow for the free flow and containment of leaked product from the primary tank. The monitoring space shall provide equal communication in all directions.
  - .2 The following continuous monitoring conditions shall be compatible with the cavity between the inner and outer tanks:
    - .1 Vented to atmosphere
    - .2 Vacuum – 5 psig maximum
    - .3 Positive air pressure (5 psig maximum)
    - .4 External hydrostatic pressure – 7’ maximum groundwater head pressure over tank top
  - .3 The monitoring fitting for the monitoring space shall be a 4" NPT fitting.
  - .4 The monitoring system shall be capable of detecting a breach in the inner and outer tank under the following installed conditions:
    - .1 When the primary tank is empty.
    - .2 When the primary tank is partially or completely full and the ground water table is below tank bottom.
    - .3 When the primary tank is partially or completely full and the tank is partially or completely submerged in groundwater.
  - .5 The leak detection performance of the monitoring system shall be tested and verified by a qualified independent consultant to detect leaks in the primary or secondary tank walls as small as 0.10 gallons per hour within one-month.
  - .6 The hydrostatic monitoring system shall be capable of a precision tank test that is listed by the National Work Group on Leak Detection Evaluations (NWGLDE) and be listed as a continuous interstitial monitoring method (liquid filled) by NWGLDE.

- .7 If hydrostatically monitored, any solution used in the monitoring space shall be compatible with the tank and be of a contrasting color to the tank.
- .10 Accessories
  - .1 Fill Tubes - Fill tubes of appropriate design shall be supplied by contractor.
  - .2 Secondary Containment Collar
    - .1 UL label shall be affixed to collar.
    - .2 The collar shall be fiberglass reinforced plastic, 48" in diameter and shall be factory-installed in accordance with drawings.
    - .3 The collar shall include an internal adhesive channel.
    - .4 The collar shall be included in the 30-year tank warranty.
  - .3 Anchor Straps
    - .1 Straps shall be supplied by the tank manufacturer.
    - .2 Number and location of straps shall be as specified by manufacturer.
    - .3 Each strap shall be capable of withstanding a maximum load of 25,000 lbs
  - .4 Liquid Sensor Drawstring
    - .1 Galvanized steel drawstring shall be factory installed at the monitoring fitting to facilitate field insertion of sensor.
  - .5 Fittings Threaded NPT
    - .1 All threaded fittings shall be located on a manway cover or within 12" of the tank top center line. Fittings to be supplied with temporary thread protectors or threaded plugs.
    - .2 All standard fittings shall be 4" diameter NPT half couplings.
    - .3 Internal piping shall be terminated at least 4" from the tank bottom.
- .11 Level Gauging
  - .1 Tank gauging stick: to manufacturer's standard.
  - .2 Tank level gauging and indicator.
    - .1 Magnetic, remote reading device with 100 mm size dial.
    - .2 Gauge and gauge openings: protected against liquid overflow and possible liquid and vapour release.
    - .3 Fuel delivery report.
    - .4 Leak detection.
    - .5 Visual and audible alarm for:
      - .1 Overfill.
      - .2 Low product.
      - .3 High water.



- .4 Leaks.
- .6 Probe diagnostics.
- .7 Leak tests.
- .8 Probes and sensors: factory calibrated and pre-set, to suit diameter of tank.
- .9 Provide remote read-outs for both storage tank and day tank. Readout to be in fuel pump room.
- .3 Provide interface to BMS system to monitor fuel level, leak detection and all alarms.

### **2.3 Fuel Oil Tank Low Level Alarm**

- .1 Standard of Acceptance: Northwest Tech-Con Systems NTS 3400, supplied by McIntosh Supply; or GEMS LS-800, supplied by Delaval Turbine Canada Ltd., #14-5918 - 5th Street, S.E., Calgary or equivalent.
- .2 Low level alarm float switch mounted through top of tank.
- .3 Basic type 2 level switch.
- .4 Float - Buna "N" 26032.
- .5 Brass stem and mounting assembly.
- .6 Switch type to be SPST 100 watt (N.C.).
- .7 Note: Alarm contacts to close when fuel level is below 20% of total capacity.
- .8 Terminals for connection by the Controls Contractor to the BMS.

### **2.4 Anchorage**

- .1 See structural drawing for requirements.

### **2.5 Leakage Detection System**

- .1 To ANSI/NFPA-329.
- .2 Leak detector: cable system.
  - .1 Monitoring instrument.
    - .1 Temperature compensated solid state circuitry to continuously monitor leak detection circuits for open circuit or alarm condition. Alarm condition to be indicated by visual indicator light and operation of isolated relay to allow interface with other equipment.
    - .2 Supply voltage: 120 Vac.
    - .3 Module: complete with power-on lamp, alarm lamp, test switch, and reset switch.
  - .2 Leak detection cable: twisted pair of 20 AWG woven conductors insulated with hydrocarbon degradable dielectric with loose interlocking aluminum alloy armour.
  - .3 Control cable: twisted pair of 20 AWG woven conductors with 300 V insulation and PVC jacket.

- .4 Provide interface to BMS system to monitor alarm status.

## **2.6 Grounding and Bonding**

- .1 To Section 26 05 01 - Common Work Results - Electrical.

## **2.7 Overfill and Spill Containment**

- .1 Shop-fabricated storage tank overfill protection.
  - .1 Automatic valve closure on product supply line, or automatic pump shut-off to terminate petroleum product flow upon detection of high levels in the storage tank.
  - .2 Overfill protection device compatible with intended method of filling designed, built, and certified to CAN/ULC-S661 with positive shut-off action.
  - .3 Audible and visual alarm located where personnel care constantly on duty during transfer operation and can promptly stop or divert flow when detected levels are too high.
  - .4 Storage tanks with capacity of 4,000 L or less.
    - .1 Visual monitoring and gauging for frequent monitoring throughout transfer operation permitting personnel to promptly shut down flow, or communicate immediately with person controlling delivery for shut down.

## **2.8 Product Transfer**

- .1 Storage tanks with normal vent and separate emergency vent.
  - .1 Liquid- and vapour-tight connection on fill pipes for flammable products.
- .2 Coupling at end of storage tank suction tube for connection to transfer used oil.

## **2.9 Piping, Valves and Fittings**

- .1 In accordance with Section 23 11 13 - Facility Fuel Oil Piping.
- .2 Piping located below product level equipped with either manual or automatic shut-off at storage tank.
- .3 Provide means for collecting spills at connection point between storage tank system and delivery truck, rail car, or vessel.

## **Part 3 EXECUTION**

### **3.1 Tank Installation**

- .1 Install tanks in accordance with CAN/CSA-B139, BC Fire Code, manufacturer's recommendations and CCME PN 1326.
- .2 Position tanks using lifting lugs and hooks, and where necessary use spreader bars. Do not use chains in contact with tank walls.

- .3 Double wall tanks are shipped to the job site with a vacuum held on the annular space. If the vacuum level has dropped more than 2 in. Hg from the level recorded on the packing slip upon arrival of the tank(s) at the job-site, the tank must be pressure tested as per the manufacturers installation instructions, prior to commencement of installation and backfilling.
- .4 When the backfilling has been completed to the top of the tank, confirm and record the final vacuum reading on the gauge. Release the vacuum from the tank annular space and then conduct the Air Leakage Test (Primary Tank) in accordance with the manufacturer's installation instructions and as noted below.
- .5 Co-ordinate with other Divisions for the following:
  - .1 Excavation, backfilling, and bedding to be done under Division 31.
  - .2 Concrete work to be done under Division 3.
- .6 Refer to detail on drawings for installation details.
- .7 Install the tank with a minimum 1% grade down to fill end.
- .8 Install tanks using licensed trained certified installers.
- .9 Provide certification of installation to Consultant.

### **3.2 Piping Installation**

- .1 Refer to Section 23 11 13 and to supplementary instruction below.
- .2 Double wall flexible pipe shall be used for all buried fuel oil supply and return lines. Single wall flexible pipe shall be used for all buried fuel oil vent lines.
- .3 Steel or copper pipe shall be used for all non-buried piping.
- .4 Provide a horizontal swing check valve in the supply line(s) immediately above the tank.
- .5 Suction line(s) to terminate 50 mm [2"] above bottom of tank.
- .6 Return and fill lines to extend approximately 25 mm [1"] into tank.
- .7 The vent line shall not extend into the tank more than 25 mm [1"].
- .8 Install suction and return lines in a continuous run with no joints below grade. Ensure lines run straight and true, free from dips and kinks. Suction, return and fill lines shall be laid with a continuous slope down to tank.
- .9 Piping connected to an underground tank shall be arranged to permit the tank to settle without impairing the efficiency of the installation.

### **3.3 Field Quality Control**

- .1 Test tanks for leaks to requirements of and in presence of authority having jurisdiction.

### **3.4 Touch-Up**

- .1 Where coating is damaged, touch-up with original coating material.

### **3.5 Level Gauge System**

- .1 Provide leak and vapour proof caulking at connections.
- .2 Shield capillary and tubing connections in heavy duty 50 mm polyethylene pipe.
- .3 Calibrate system.

### **3.6 Leak Detection System**

- .1 Install in accordance with manufacturer's recommendations.

### **3.7 Installation and Testing**

- .1 Fiberglass underground tanks must be tested and installed according to the current installation instructions provided with the tank. Tanks are installed with pea gravel or crushed stone as specified in current installation instructions. [Containment Solutions'] tanks are intended for storing products listed in the warranty; any other products not listed in the warranty must be approved in advance by [Containment Solutions].
- .2 After backfilling - cap and seal all oil lines at their termination (suction, return, fill, levelometer, signal, vent). Pressure test the tank and all individual oil lines to 35 kPa [5 psig]. Ensure that no loss of pressure occurs over a period of four hours. Soap test all connections to ensure air tightness. This test shall be witnessed by the Consultant. Submit witnessed test report.

**END OF SECTION**

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1        This Section describes the Common Work Results applicable to electrical disciplines.

**1.2            DEFINITIONS**

- .1        Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

**1.3            GENERAL**

- .1        The general conditions and general requirements together with all amendments and supplements contained in the General Specifications shall form an integral part of the electrical specification and will be made part of this contract.
- .2        Reference to "Electrical Divisions" shall mean all Divisions 26, 27, 28, 33 and 48 in the Master Format or the Canadian Master Specifications.
- .3        The words "Provide" or "Furnish" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.
- .4        Review mechanical plans and specifications for the extent of electrical work required to make mechanical systems complete and include this work in the Tender/RFP sum.
- .5        Review existing record plans and site conditions for limitations of penetrations or inclusions of electrical equipment. In Tender/RFP sum, allow for avoiding critical areas with electrical equipment.
- .6        Comply with the requirements of the General Contract and coordinate the installation with all other trades on site.
- .7        Confirm on-site the exact location of equipment and fixtures.

**1.4            ELECTRICAL SCOPE OF WORK**

- .1        The electrical scope of work shall include the supply and installation of all the necessary materials and apparatus for complete operating systems as indicated on the plans or mentioned in this specification, with the exception of materials or apparatus specifically mentioned to be omitted or to be supplied by Departmental Representative.
- .2        Items obviously necessary or reasonably implied to complete the work shall be included as if shown on drawings and noted in the specifications.
- .3        All materials, tools, appliances, scaffolding, apparatus and labour necessary for the execution, erection and completion of the systems described herein shall be furnished. This includes providing temporary lighting and power for own work.
- .4        This contract shall include, but is not confined to, the following scope of work:
  - .1        **Huntingdon** – electrical isolation of existing generator during fuel pipe and tank replacement. Recommission existing diesel generator after new fuel tank and new fuel piping has been completed.
  - .2        **Kingsgate** – install new external lighting fixture at fuel filling location.

- .3 **Waneta** – no electrical work is required at this site.
- .5 Complete all electrical connections to equipment and accessories pertaining to this contract and leave all in operating condition to the Departmental Representative's satisfaction.
- .6 Remove all existing electrical equipment and material made redundant by this contract or in conflict with work to be carried out. Reroute, reinstall or replace existing electrical material that becomes necessary due to work carried out by this contract so a complete working electrical system will be retained in all areas affected by this installation.

## **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the new lighting fixture.
- .3 Shop drawings:
  - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .4 If changes are required, notify Departmental Representative of these changes before they are made.
- .4 Certificates:
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment 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.

## **1.6 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235.
- .2 Language operating requirements: provide identification labels for control items in English and French.
- .3 Use one label for each language.

### **2.2 MATERIALS AND EQUIPMENT**

- .1 Provide material and equipment in accordance with Section 01 61 00- Common Product Requirements.
- .2 Equipment and material to be CSA certified. Where CSA certified equipment and materials are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Lighting fixture and lighting control shall be as per standard of acceptance as indicated on the luminaire schedule.
- .4 Only metallic conduit to be used in this installation.

### **2.3 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and Departmental Representative.
- .2 Decal signs, minimum size 175 x 250 mm.

### **2.4 WIRING TERMINATIONS**

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

### **2.5 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with labels as follows:
  - .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
  - .3 Wording on to be approved by Departmental Representative prior to manufacture.
  - .4 Allow for minimum of twenty-five (25) letters per label.

- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.

**2.6 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, 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.
- .4 Use colour coded wires in communication cables, matched throughout system.

**2.7 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 10 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	

**2.8 FINISHES**

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

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.



- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

### **3.3 NAMEPLATES AND LABELS**

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

### **3.4 LOCATION OF OUTLETS**

- .1 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .3 Locate light switches on latch side of doors.
  - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

### **3.5 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1200 mm.
  - .2 Wall receptacles:
    - .1 General: 400 mm.
    - .2 Above top of counters or counter splash backs: 175 mm.
  - .3 Panelboards: as required by Code or as indicated.

### **3.6 CO-ORDINATION OF PROTECTIVE DEVICES**

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

### **3.7 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 - ACTION AND INFORMATIONAL 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 in accordance with Section 01 45 00- Quality Control.
    - .1 Power distribution system including phasing, voltage, grounding and load balancing.
    - .2 Circuits originating from branch distribution panels.
    - .3 Lighting and its control.
    - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
    - .5 Insulation resistance testing:
      - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
      - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
      - .3 Check resistance to ground before energizing.
  - .3 Notify Departmental representative 2 weeks prior to testing and carry out tests in presence of Departmental Representative if required.
  - .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
  - .5 Manufacturer's Field Services:
    - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
    - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.8 SYSTEM STARTUP**

- .1 Instruct Departmental Representative in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for a qualified diesel generator service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.
- .4 Ensure that the old low fuel alarm is disconnected from the old tank and that the new fuel level sensor is reconnected to the existing controller.
- .5 Notify Engineer 10 working days in advance of test date.

- .6 Provide fuel for testing and leave full tanks on acceptance.
- .7 Demonstrate:
  - .1 Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.
  - .2 Unit start and shut down on "Manual" control
  - .3 Unit start and transfer on "Test" control.
  - .4 Unit start on "Engine start" control.
  - .5 Operation of automatic alarms and shut down devices.
- .8 Perform 3 hours load testing of unit on full load to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling. Record following at 30 minute intervals during the entire test:
  - .1 Kilowatts
  - .2 Amperes
  - .3 Voltage
  - .4 Frequency
  - .5 Oil Pressure
  - .6 Coolant Temperature
  - .7 Room Temperature
  - .8 Noise level at 3m from unit
- .9 Record noise level measurements in dB at various locations around the unit and area surrounding the exhaust port.
- .10 At end of test run, check battery voltage to demonstrate battery charger has returned battery to full charged state.
- .11 After the demonstration, refill fuel tank.

### **3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.
- .3 Waste Management: separate waste materials for recycling/reuse in accordance with Section 01 74 19- 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      PRODUCT DATA**

- .1      Provide product data in accordance with Section [01 33 00- Submittal Procedures] .

**1.2      DELIVERY, STORAGE AND HANDLING**

- .1      Packaging Waste Management: remove for reuse and return of padding, pallets, packaging materials, crates, etc. in accordance with Section 01 74 21.

**Part 2      Products**

**2.1      BUILDING WIRES**

- .1      Conductors: stranded for [10] AWG and larger. Minimum size: [12] AWG.
- .2      Copper conductors: size as indicated, with 600V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.
- .3      Copper conductors: size as indicated, with thermoplastic insulation type T90 Nylon rated at 600 V.
- .4      Neutral supported cable: [1] [3] [2] phase insulated conductors of [Copper] [Aluminum] and one neutral conductor of [Copper] [Aluminum] steel reinforced, size as indicated. Type: [NS90] [NS75] Insulation: [Type NS-1 rated 300 V] [Type NSF-2 flame retardant rated 600 V] .

**2.2      TECK 90 CABLE**

- .1      Cable: in accordance with Section 26 05 00- Common Work Results for Electrical .
- .2      Conductors:
  - .1      Grounding conductor: copper.
  - .2      Circuit conductors: copper, size as indicated.
- .3      Insulation:
  - .1      Ethylene propylene rubber EP .
  - .2      Cross-linked polyethylene XLP .
  - .3      Rating:, 600 V.
- .4      Inner jacket: polyvinyl chloride material.
- .5      Armour: aluminum.
- .6      Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project .
- .7      Fastenings:

- .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for two or more cables at
- .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
  - .1 Approved for TECK cable.

### **2.3 ARMOURED CABLES**

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

### **2.4 CONTROL CABLES**

- .1 Type: LVT: [2] soft annealed copper conductors, sized as indicated:
  - .1 Insulation: thermoplastic.
  - .2 Sheath: thermoplastic jacket, and armour of closely wound aluminum wire.

### **2.5 NON-METALLIC SHEATHED CABLE**

- .1 Non-metallic sheathed copper cable type: NMD90 nylon, size as indicated.

## **Part 3 Execution**

### **3.1 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Perform tests before energizing electrical system.

### **3.2 GENERAL CABLE INSTALLATION**

- .1 Terminate cables in accordance with Canadian Electrical Code.
- .2 Cable Colour Coding: to Section 26 05 00- Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

### **3.3 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems as required by Canadian Electrical Code.

### **3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)**

- .1 Group cables wherever possible on channels.
- .2 Install cable concealed and securely supported by straps.

### **3.5 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible on channels.

### **3.6 INSTALLATION OF CONTROL CABLES**

- .1 Install control cables as required by Canadian Electrical Code.
- .2 Ground control cable shield.

### **3.7 INSTALLATION OF NON-METALLIC SHEATHED CABLE**

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section specifies the conduit, conduit fasteners, and conduit fittings.

**1.2                REFERENCE STANDARDS**

- .1            CSA Group (CSA)
  - .1            CAN/CSA C22.2 No. 18-98(R2003) , Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2            CSA C22.2 No. 45-M1981(R2003) , Rigid Metal Conduit.
  - .3            CSA C22.2 No. 56-04 , Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4            CSA C22.2 No. 83-M1985(R2003) , Electrical Metallic Tubing.
  - .5            CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.
  - .6            CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1            Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2            Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1            Submit cable manufacturing data.
- .3            Quality assurance submittals:
  - .1            Test reports: submit certified test reports.
  - .2            Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3            Instructions: submit manufacturer's installation instructions.

**1.4                WASTE MANAGEMENT AND DISPOSAL**

- .1            Separate waste materials for recycling in accordance with Section 01 74 19- Waste Management and Disposal.
- .2            Place materials defined as hazardous or toxic waste in designated containers.
- .3            Ensure emptied containers are sealed and stored safely for disposal away from children.



**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.
- .3 Identify cables for exclusively dc applications.
- .4 Reel and mark shielded cables rated 2,001 volts and above.

**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.
- .5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .6 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3

**2.3 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm NPS 2 and smaller.
  - .1 Two hole steel straps for conduits larger than NPS 2 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .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 Ensure factory "ells" where 90 degrees bends for NPS 1 25 mm and larger conduits.
- .3 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 100 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 Polypropylene .

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms in unfinished areas.
- .3 Use rigid hot dipped galvanized steel threaded conduit except where specified otherwise.
- .4 Use UPVC conduit underground and in corrosive areas.
- .5 Use electrical metallic tubing (EMT) except in cast concrete and above 2.4 m not subject to mechanical damage.
- .6 Use flexible metal conduit for connection to surface or recessed lighting fixtures, work in movable metal partitions and connection to recessed lighting fixtures without prewired outlet box, and connection to motors in dry areas.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .8 Use explosion proof flexible connection for connection to explosion proof motors.
- .9 Install conduit sealing fittings in hazardous areas.
  - .1 Fill with compound.
- .10 Minimum conduit size for lighting and power circuits: 19 mm NPS 3/4.
- .11 Install EMT conduit from computer room branch circuit panel to outlet boxes located in sub floor.
- .12 Install EMT conduit from computer room branch circuit panel to junction box in sub-floor immediately below panel.
  - .1 Run flexible conduit from junction box to outlet boxes for each computer 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 2- NPS 1 / 25 mm spare conduits up to ceiling space and 2 - NPS 1 / 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 surface 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.

### **3.3 SURFACE CONDUITS**

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

### **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 CONDUITS IN CAST-IN-PLACE CONCRETE**

- .1 Locate to suit reinforcing steel.
  - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
  - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.

- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

### **3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE**

- .1 Run conduits NPS 1 / 25 mm and larger below slab and encase in 75 mm concrete envelope.
  - .1 Provide 50 mm of sand over concrete envelope below floor slab.

### **3.7 CONDUITS UNDERGROUND**

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

### **3.8 CLEANING**

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

**END OF SECTION**

**Part 1 SPEC NOTE DESCRIPTION: Specifies panelboards with bus, mains and trim, and breakers including main breaker and lock-on devices.**

**Part 2 General**

**2.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No.29-[11] , Panelboards and Enclosed Panelboards.

**2.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section [01 33 00- Submittal Procedures] .
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings reviewed and stamped by contractor.
  - .2 Include on drawings:
    - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

**2.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section [01 78 00- Closeout Submittals] .
- .2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

**Part 3 Products**

**3.1 PANELBOARDS**

- .1 Panelboards: to [CSA C22.2 No.29] and product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipment.
  - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 250 V panelboards, 100amp bus.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Copper bus with neutral of same ampere rating of mains.
- .6 Mains: suitable for bolt-on breakers.
- .7 Trim with concealed front bolts and hinges.
- .8 Trim and door finish: as per colour schedule.
- .9 Isolated ground bus.
- .10 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

### **3.2 BREAKERS**

- .1 Breakers: to Section [26 28 16.02- Moulded Case Circuit Breakers] .
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

### **3.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section [26 05 00- Common Work Results for Electrical] .
- .2 Nameplate for each panelboard size 4 engraved [as indicated] .
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved [as indicated] .
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.
- .5 Circuits supplying Patient Care Areas must be entered in circuit directory with Bold Font.

## **Part 4 Execution**

### **4.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**4.2 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Mount panelboards to height specified in Section 26 05 00- Common Work Results for Electrical or as indicated.
- .3 Connect loads to circuits.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.

**4.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section [01 74 11- Cleaning] .

**4.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboards installation.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCE STANDARDS**

- .1    CSA Group (CSA)
  - .1    CSA C22.2 No.42-[10] , General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2    CAN/CSA C22.2 No.42.1-[00(R2009)] , Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3    CSA C22.2 No.55-[M1986(R2008)] , Special Use Switches.
  - .4    CSA C22.2 No.111-[10] , General-Use Snap Switches (Bi-national standard, with UL 20).

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section [01 33 00- Submittal Procedures] .
- .2    Product Data:
  - .1    Submit manufacturer's instructions, printed product literature and data sheets for [wiring devices] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3    Shop Drawings:
  - .1    Submit drawings for all wiring devices, reviewed and stamped by contractor.

**1.3                CLOSEOUT SUBMITTALS**

- .1    Submit in accordance with Section [01 78 00- Closeout Submittals] .
- .2    Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

**Part 2            Products**

**2.1                SWITCHES**

- .1    15A, 120 V, single pole switches to: 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 toggle.



- .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.

## **2.2 RECEPTACLES**

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, (or type 5-20R, 125V, 20A as required), U ground, to: CSA C22.2 No.42 with following features:
  - .1 white urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and rivetted grounding contacts.
  - .6 Tamper Resistant.
- .2 Provide GFCI type receptacles where indicated.
- .3 All existing receptacles shall be replaced with new tamper resistant type.
- .4 Other receptacles with ampacity and voltage as indicated.
- .5 Receptacles of one manufacturer throughout project.

## **2.3 COVER PLATES**

- .1 Cover plates for wiring devices to: [CSA C22.2 No.42.1] .
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Plastic, white cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .4 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .5 Weatherproof spring-loaded [cast aluminum] cover plates complete with gaskets for single receptacles or switches.

## **2.4 SOURCE QUALITY CONTROL**

- .1 Cover plates from one manufacturer throughout project.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### **3.2 INSTALLATION**

- .1 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 in accordance with Section 26 05 00- Common Work Results for Electrical .
- .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 for Electrical.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
  - .4 Install GFCI type receptacles as indicated.
  - .5 Replace all existing receptacles with tamper resistant type.
- .3 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.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section [01 74 11- Cleaning] .
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section [01 74 11- Cleaning] .
- .3 Waste Management: separate waste materials for [recycling] [reuse] in accordance with Section [01 74 19- Waste Management and Disposal] [01 35 21- LEED Requirements] .
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 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**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No. 5-[09] , Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section [01 33 00- Submittal Procedures] .
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include time-current characteristic curves for breakers with ampacity of 15A and over with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage] .

**Part 2 Products**

**2.1 BREAKERS GENERAL**

- .1 Circuit breakers, Moulded-case circuit breakers, fused circuit breakers, ground-fault circuit-interrupters: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Plug-in moulded case circuit breakers: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .4 Common-trip breakers: with single handle for multi-pole applications.
- .5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
- .6 Provide arc fault circuit interrupter (AFCI) breakers where indicated on panel schedules and as required by code.

**2.2 THERMAL MAGNETIC BREAKERS (DESIGN A)**

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

**2.3 MAGNETIC BREAKERS (DESIGN B)**

- .1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION**

- .1 Install circuit breakers as indicated.
- .2 Provide arc fault breakers feeding outlets in bedrooms and living rooms, and as required by code.
- .3 Replace existing breakers feeding outlets in bedrooms and living rooms with arc fault type breakers, to meet code requirements.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.
- .3 Waste Management: separate waste materials for recycling/reuse in accordance with Section 01 74 19- 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            SECTION INCLUDES**

- .1    Provide an optional price for the diesel generator
- .2    Diesel engine driven generator set, 200kW, 3 phase, 120/208V.

**1.2            REFERENCES**

- .1    American National Standards Institute (ANSI)/American Petroleum Institute (API)
  - .1    ANSI/API 650-[1988(A2000)], Welded Steel Tanks for Oil Storage Tenth Edition; Addendum 1.
- .2    American National Standards Institute (ANSI)/National Electrical Manufacturers' Association (NEMA)
  - .1    ANSI/NEMA MG1-[2006], Motors and Generators.
- .3    Canadian General Standards Board (CGSB)
  - .1    CAN/CGSB-3.6-[2000], Regular Sulphur Diesel Fuel.
- .4    International Organization for Standardization (ISO)
  - .1    ISO 3046-1-[2002], Reciprocating Internal Combustion Engines - Performance - Part 1: Declarations Of Power, Fuel And Lubricating Oil Consumptions, And Test Methods.
- .5    National Electrical Manufacturers Association (NEMA)
- .6    Environmental Protection Agency (EPA):
  - .1    EPA 40 CFR 89, emission Standards for Non-Road Source Diesel Engines – Stationary Engines – Tier 2
- .7    Underwriters' Laboratories of Canada (ULC)
  - .1    ULC-S601-[00], Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids.
  - .2    CAN/ULC-S603-[92], Standard for Steel Underground Tanks for Flammable and Combustible Liquids.

**1.3            SYSTEM DESCRIPTION**

- .1    Generating system consists of:
  - .1    Diesel engine.
  - .2    Alternator.
  - .3    Alternator control panel.
  - .4    Battery charger and battery.
  - .5    Block Heater
  - .6    Automatic engine enclosure ventilation system.
  - .7    Fuel supply system.
  - .8    Exhaust system.
  - .9    Steel mounting base.
  - .10    Sub-base fuel tank

- .11 Exterior Enclosure
- .2 System designed to operate as an unattended standby unit.

#### 1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 26 05 00 Common Work Results - Electrical.
- .2 Include:
  - .1 Engine: make and model, with performance curves.
  - .2 Alternator: make and model.
  - .3 Voltage regulator: make, model and type.
  - .4 Manual bypass switch: make and model.
  - .5 Battery: make, type and capacity.
  - .6 Battery charger: make, type and model.
  - .7 Alternator control panel: make and type of meters and controls.
  - .8 Governor type and model.
  - .9 Automatic engine enclosure ventilation system.
  - .10 Cooling air requirements in m<sup>3</sup>/s.
  - .11 British standard or DIN rating of engine.
  - .12 Flow diagrams for:
    - .1 Diesel fuel.
    - .2 Cooling air.
  - .13 Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, sub-hose fuel tank and total weight.
  - .14 Continuous full load output of set at 0.8PF lagging.
  - .15 Enclosure construction details including
    - .1 Material
    - .2 Insulation
    - .3 Door openings
    - .4 Locking mechanism
    - .5 Dimensions
  - .16 Description of set operation including:
    - .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.
    - .2 Manual starting.
    - .3 Automatic shut down and alarm on:
      - .1 Overcranking.
      - .2 Overspeed.
      - .3 High engine temp.
      - .4 Low lube oil pressure.

- .5 Short circuit.
- .6 Alternator overvoltage.
- .7 Lube oil high temperature.
- .8 Over temperature on alternator.
- .4 Manual remote emergency stop.

### **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for diesel generator for incorporation into manual specified in Section 26 05 00 – Common Work Results - Electrical.
- .2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier and:
  - .1 Operation and maintenance instructions for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.
  - .2 Technical data:
    - .1 Illustrated parts lists with parts catalogue numbers.
    - .2 Schematic diagram of electrical controls.
    - .3 Flow diagrams for:
      - .1 Fuel system.
      - .2 Lubricating oil.
      - .3 Cooling system.
    - .4 Certified copy of factory test results.
    - .5 Maintenance and overhaul instructions and schedules.
    - .6 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

### **1.6 WARRANTY**

- .1 For Work of this Section 12 month warranty period prescribed in Section 26 05 00 – Common Work Results. Regular maintenance to be included for first 12 months. – Electrical is extended to 60 months or 1500 operating hours, whichever occurs first.

### **1.7 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with the manufacturer's recommendations.
- .2 Include, at a minimum:
  - .1 2 fuel filter replacement elements.
  - .2 2 lube oil filter replacement elements.
  - .3 2 air cleaner filter elements.
  - .4 2 sets of fuses for control panel.
  - .5 Special tools for unit servicing.



**Part 2**

**Products**

**2.1**

**DIESEL ENGINE**

- .1 Diesel engine: to ISO 3046-1.
  - .1 Engine: standard product of current manufacture, from company regularly engaged in production of such equipment.
  - .2 Naturally aspirated, synchronous speed 1800 r/min.
  - .3 Capacity:
    - .1 200kW standby power at 208V
    - .2 Rated continuous power in kW at rated speed, after adjustment for system losses in auxiliary equipment necessary for engine operation; to be calculated as follows: Rated continuous output = Generator kW divided by Generator efficiency at full load.
      - .1 Under following site conditions (near Hope, BC):
        - .1 Altitude: 42 m.
        - .2 Ambient temperature: 9.8 degrees C.
  - .4 Cooling System:
    - .1 Liquid cooled: heavy duty industrial radiator mounted in generating set base with engine driven pusher type fan to direct air through radiator from engine side with ethylene glycol anti-freeze non-sludging above minus 30 degrees C.
    - .2 To maintain manufacturer's recommended engine temperature range at 10% continuous overload in outside ambient temperature of -20 degrees C to 40 degrees C.
    - .3 Block heater: thermostatically controlled lube oil or liquid coolant heater connected to line side of automatic transfer switch to allow engine to start in room ambient minus 10 degrees C.
      - .1 Switch and fuse in heater circuit, mounted in engine-alternator control cubicle and fed from line side of automatic transfer switch.
  - .5 Fuel:
    - .1 Type A fuel oil: to CAN/CGSB-3.6.
  - .6 Fuel system: solid injection, mechanical fuel transfer pump with hand primer, fuel filters and air cleaner, fuel rack solenoid energized when engine running.
  - .7 Governor:
    - .1 Mechanical hydraulic with:
      - .1 Steady state speed band of plus or minus 0.5%.
      - .2 Speed regulation no load to full load 5% maximum.
      - .3 Electronic load sharing type, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.
  - .8 Lubrication system:
    - .1 Pressure lubricated by engine driven pump.

- .2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.
- .3 Lube oil cooler.
- .4 Engine sump drain valve.
- .5 Oil level dip-stick.
- .9 Starting system:
  - .1 Positive shift, gear engaging starter 12 or 24V dc.
  - .2 Cranking limiter to provide 3 cranking periods of 10s duration, each separated by 5 s rest.
  - .3 Lead acid, 12 or 24V storage battery with sufficient capacity to crank engine for 1min at 0 degrees C without using more than 25% of ampere hour capacity.
  - .4 Battery charger: constant voltage, solid state, two stage from trickle charge at standby to boost charge after use. Regulation: plus or minus 1% output for plus or minus 10% input variation. Automatic boost for 6h every 30 days. Equipped with dc voltmeter, dc ammeter and on-off switch. Minimum charger capacity: 7 A.
- .10 Vibration isolated engine instrument panel with:
  - .1 Lube oil pressure gauge.
  - .2 Lube oil temperature gauge.
  - .3 Lube oil level gauge.
  - .4 Coolant temperature gauge.
  - .5 Coolant level gauge.
  - .6 Running time meter: non-tamper type.
- .11 Guards to protect personnel from hot and moving parts. Locate guards so that normal daily maintenance inspections can be undertaken without their removal.
- .12 Drip tray.

## 2.2 ALTERNATOR

- .1 Alternator: to ANSI/NEMA MG1.
- .2 Rating: 208 V, 3 phase 4 wire, 60Hz, at 0.8PF.
- .3 Output at 40 degrees C ambient:
  - .1 100% full load continuously.
  - .2 110% full load for 1h.
  - .3 150% full load for 1 min.
- .4 Revolving field, brushless, single bearing.
- .5 Drip proof.
- .6 Amortisseur windings.
- .7 Synchronous type.
- .8 Dynamically balanced rotor permanently aligned to engine by flexible disc coupling.
- .9 Exciter: rotating brushless.
- .10 NEMA class H insulation on windings.

- .11 Voltage regulator: thyristor controlled rectifiers with phase controlled sensing circuit:
  - .1 Stability: +/-1% maximum voltage variation at any constant load from no load to full load.
  - .2 Regulation: 1.5% maximum voltage deviation between no-load steady state and full-load steady state.
  - .3 Transient: 4% maximum voltage dip on one-step application of 0.8PF full load.
  - .4 Transient: 25% maximum voltage rise on one-step removal of 0.8PF full load.
  - .5 Transient: 2.5 s maximum voltage recovery time with application or removal of 0.8PF full load.
- .12 Alternator: capable of sustaining 300% rated current for period not less than 10s permitting selective tripping of down line protective devices when short circuit occurs.

### 2.3 CONTROL PANEL

- .1 Weatherproof totally enclosed, mounting base isolated from diesel generator.
- .2 Instruments:
  - .1 Digital indicating type 2% accuracy, rectangular face, flush panel mounting:
    - .1 Voltmeter: ac, scale 0 to 750 V.
    - .2 Ammeter: ac, scale 0 to 2200 A.
    - .3 Wattmeter scale 0 to 2200 kW.
    - .4 Frequency meter: scale 55 to 65Hz.
    - .5 kW.h meter.
  - .2 Voltmeter selector switch, rotary, panel mounting, round notched handle, four position, labelled "Off-Phase A-Phase B-Phase C".
  - .3 Ammeter selector switch, rotary, maintained contacts, panel mounting, designed to prevent opening of current circuits, round notched handle, four position labelled "OFF- Phase A-Phase B-Phase C".
  - .4 Instrument Transformers
    - .1 Potential-dry type for indoor use:
      - .1 Ratio: 600 to 120.
      - .2 Rating: 208 V, 60Hz, BIL 25 kV.
    - .2 Current-dry type for indoor use:
      - .1 Ratio: 600 to 5.
      - .2 Rating: 208 V, 60Hz, BIL 25 kV.
      - .3 Positive action automatic short-circuiting device in secondary terminals.
- .3 Controls:
  - .1 Engine start button.
  - .2 Selector switch: Off-Auto-Manual - Test full load test no load.
  - .3 Engine emergency stop button and provision for remote emergency stop button.
    - .1 Alternator output breaker:

- .1 Circuit breaker: bolt-on, moulded case, temperature compensated for 40 degrees C ambient, dual thermal-magnetic trip.
- .2 Voltage control rheostat: mounted on inside of control panel.
- .3 Operating lights, panel mounted:
  - .1 "Normal power" pilot light.
  - .2 "Emergency power" pilot light.
  - .3 Green pilot lights for breaker on and red pilot lights for breaker off.
- .4 Solid state indicator lights for alarm with 1set manually reset NO/NC contacts wired to terminal block for remote annunciation on:
  - .1 Low fuel level.
  - .2 Low battery voltage.
  - .3 Low coolant temperature.
  - .4 Low DC voltage.
  - .5 High DC voltage.
  - .6 Ground fault.
  - .7 Fuel leak.
- .5 Provision for remote monitoring.
- .6 The alarms and conditions for shut down indicated in items .4 and .5 shall be available on digital display panel on the control panel.
- .7 The control system shall include time delay start and time delay stop functions. The time delay start shall be adjustable 0-300 seconds, factory set at 3 seconds. The time delay stop shall be adjustable 0-600 seconds, factory set at the manufacturer's recommended setting.
- .8 The control system shall include sender failure monitoring logic for speed sensing, oil pressure and engine temperature and be capable of discriminating between failed sender or wiring components and an actual failure conditions.
- .9 The control system shall include an idle mode control which allows the engine to run in the idle mode in the Manual position only. In this mode, the alternator excitation system shall be disabled.
- .10 The control system to have data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set as well as the total time of operation at various loads as a percent of the standby rating of the generator set.
- .11 Three sets of NO/NC relays to be provided, one for common alarm one for the running condition one for low fuel condition.
- .12 The controls shall include a load shed control, to operate a set of dry contacts when the generator is overload.
- .13 Provide Modbus and other interface required in order to connect the generator control panel to the BMS in the Building. The BMS

must be able to read all the monitoring and operation signals from genset. This contractor is responsible for all the conduit and wires to the BMS panel and coordinate with Division 15 for final connection.

## 2.4 ENCLOSURE

- .1 The generator set shall be provided with an outdoor weatherproof waterproof enclosure, complete with hospital grade silencer and sound attenuation of 65dBA at 7m from the entrance.
- .2 The package shall comply with the requirements of the Canadian Electrical Code for all wiring materials and component spacing.
- .3 The total assembly of generator set and enclosure shall be designed to be lifted into place using spreader bars.
- .4 Housing shall provide suitable airflow for generator set operation at rated load in an ambient temperature of -30 degrees C up to 40 degrees C.
- .5 The housing shall have hinged access doors as required to maintain easy access for all operating and service functions.
- .6 All doors shall be lockable, and include retainers to hold the door open during service.
- .7 Enclosure roof shall be cambered to prevent rainwater accumulation.
- .8 Openings shall be screened to limit access of rodents into the enclosure.
- .9 All electrical power and control interconnections shall be made within the perimeter of the enclosure.

## 2.5 STEEL MOUNTING BASE

- .1 Complete generating set mounted on concrete pad and steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.
- .2 Assembly fitted with vibration isolators.
  - .1 Spring type isolators with adjustable side snubbers and adjustable for levelling.
- .3 Sound insulation pads for installation between isolators and concrete base.
- .4 Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation of service work.
- .5 Enclosure shall be constructed of minimum 12 gauge steel for framework and 14 gauge steel for panels. All hardware and hinges shall be stainless steel. Acoustic protection and insulation shall be provided to attenuate sound by 65dBA, 7m from the enclosure
- .6 A factory-mounted hospital-grade exhaust silencer shall be installed inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.
- .7 The enclosure shall include the following maintenance provisions:
  - .1 Flexible coolant and lubricating oil drain lines, that extend to the exterior of the enclosure, with internal drain valves.
  - .2 External radiator fill provision.

- .8 The fueling tank and generator enclosure manufactured and assembled by the same manufacturer and must be available for inspection before delivery to the site.

## 2.6 EXHAUST SYSTEM

- .1 Heavy duty hospital grade exhaust silencer with condensate drain, plug and flanged couplings.
- .2 Heavy duty flexible exhaust pipe with flanged couplings as required.
- .3 Fittings and accessories as required.
- .4 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.

## 2.7 FUEL SYSTEM

- .1 Fuel storage tanks: to ANSI/API 650, ULC labelled.
  - .1 Above ground tank: to ULC-S601.
  - .2 Day tank integral to generator and capable of supplying generator for 24 hours minimum.
    - .1 The tank to be dual wall sub-base constructed with corrosion resistant steel.
    - .2 The tank shall be completed with drain tap and dip stick (mark in letters and inches) for manually checking the fuel level.
    - .3 The tank shall be completed with a locking (padlock) fuel fill cap and spiral type mechanical fuel gauge next to the fuel cap.
    - .4 The tank also complete with a float type leak detector between the inner and outer wall for detecting any inner wall rupture.
    - .5 The integrated sub base fuel tank to be on painted steel structural steel support base frame complete with flexible supply and return hoses with connection fittings, fuel filter, vent line connection fittings and 110% containment capacity and accessories specified.
    - .6 Submit the size of tank based on calculated recommendation from manufacturer to consultant for approval.
    - .7 The fuel tank and all accessories to be waterproof.
  - .3 Factory installed leak detection of day tank and leak alarm kit.
  - .4 Float switch with high fuel level indicator to reduce the probability of overfilling tank during refueling
  - .5 Low level alarm kit.

## 2.8 COOLING AIR SYSTEM

- .1 Provide engine ventilation in accordance with high sound attenuation factory enclosure. Provide provisions to modulate air temperature as needed to provide proper engine operation in all temperatures between -30C and +40C

## **2.9 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Control panel:
  - .1 Size 4 nameplates for controls including alternator breakers and program selector switch.
  - .2 Size 2 nameplates for meters, alarms, indicating lights and minor controls.

## **2.10 FABRICATION**

- .1 Shop assemble generating unit including:
  - .1 Base.
  - .2 Engine and radiator.
  - .3 Alternator.
  - .4 Control panel.
  - .5 Battery and charger.

## **2.11 FINISHES**

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Alternator control cubicle: paint inside, exterior to match engine and alternator.
- .3 Exhaust and inlet air hoods – factory standard
- .4 Other ducts and racks grey.
- .5 Supply 0.25L of touch-up enamel (appropriate colour)
- .6 Exterior housing - Black.

## **2.12 SOURCE QUALITY CONTROL**

- .1 Factory test generator set including engine, alternator, control panels and accessories. Provide consultant with test reports prior to shipping.
- .2 Test procedure:
  - .1 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:
    - .1 Date.
    - .2 Generator set serial no.
    - .3 Engine, make, model, serial no.
    - .4 Alternator, make, model, serial no.
    - .5 Voltage regulator, make and model.
    - .6 Rating of generator set, kW, kV.A, V, A, r/min, Hz.
  - .2 Mark check sheet and record data on forms in duplicate as test proceeds.
- .3 Tests:
  - .1 With 100% rated load, operate set for 1 h, taking readings at 5 min intervals, and record following:
    - .1 Time of reading.

- .2 Running time.
- .3 Ambient temp in degrees C.
- .4 Lube oil pressure in kPa.
- .5 Lube oil temp in degrees C.
- .6 Engine coolant temp in degrees C.
- .7 Exhaust stack temp in degrees C.
- .8 Alternator voltage: phase 1, 2, 3.
- .9 Alternator current: phase 1, 2, 3.
- .10 Power in kW.
- .11 Frequency in Hz.
- .12 Power Factor.
- .13 Battery charger current in A.
- .14 Battery voltage.
- .15 Alternator cooling air outlet temp.
- .2 After completion of run, demonstrate following shut down devices and alarms:
  - .1 Overcranking.
  - .2 Overspeed.
  - .3 High engine temp.
  - .4 Low lube oil pressure.
  - .5 Short circuit.
  - .6 Alternator overvoltage.
  - .7 Low battery voltage, or no battery charge.
  - .8 Manual remote emergency stop.
  - .9 High alternator temperature.
- .3 Next install continuous strip chart recorders to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:
  - .1 No load to full load to no load.
  - .2 No load to 70% load to no load.
  - .3 No load to 20% load to no load.
  - .4 20% load to 40% load to no load.
  - .5 40% load to 60% load to no load.
  - .6 60% load to 80% load to no load.
- .4 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Locate generating unit and install as indicated.
- .2 Install fuel supply system as indicated.



- .3 Complete wiring and interconnections as indicated.
- .4 Start generating set, provide load bank and fuel and test to ensure correct performance of components.
- .5 Provide power for charger from an emergency power panel.
- .6 Provide connection and monitoring to Fire Alarm Panel and annunciator.
- .7 Provide connection and monitoring to BMS.

### **3.2 FIELD QUALITY CONTROL**

- .1 Notify Engineer 10 working days in advance of test date.
- .2 Provide fuel for testing and leave full tanks on acceptance.
- .3 Demonstrate:
  - .1 Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.
  - .2 Unit start and shut down on "Manual" control
  - .3 Unit start and transfer on "Test" control.
  - .4 Unit start on "Engine start" control.
  - .5 Operation of automatic alarms and shut down devices.
- .4 Perform 6 hours load testing of unit on full load to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling. Record following at 30 minute intervals during the entire test:
  - .1 Kilowatts
  - .2 Amperes
  - .3 Voltage
  - .4 Frequency
  - .5 Oil Pressure
  - .6 Coolant Temperature
  - .7 Room Temperature
  - .8 Noise level at 3m from unit
- .5 Record noise level measurements in dB at various locations around the unit and area surrounding the exhaust port.
- .6 At end of test run, check battery voltage to demonstrate battery charger has returned battery to full charged state.
- .7 After the demonstration, refill fuel tank.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 This section specifies the materials and installation for luminaires for the entire project including exterior lighting fixtures.
- .2 Refer to the Luminaire Schedule on the electrical drawings.

**1.2 REFERENCE STANDARDS**

- .1 CAN/CSA C22.1-09, Canadian Electrical Code, Part I.
- .2 CAN/CSA C22.2 No.9.0, General Requirements for Luminaires.
- .3 Underwriters' Laboratories of Canada (ULC)

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Consultant.
  - .3 Photometric data to include: IES data files.
- .3 Samples:
  - .1 Provide samples as indicated prior to any orders being placed.
- .4 Quality assurance submittals: provide following in accordance with Section 01 45 00- Quality Control.
  - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures.

**1.4 QUALITY ASSURANCE**

- .1 Provide mock-ups in accordance with Section 01 45 00- Quality Control.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

- .3 Divert unused metal materials from landfill to metal recycling facility.
- .4 Disposal and recycling of fluorescent lamps as per local regulations.
- .5 Disposal of old PCB filled ballasts.

**Part 2 Products**

**2.1 LAMPS**

- .1 Only LED lamps will be used as per luminaire schedule on the drawings.
- .2 Compatible LED drivers will be provided with all fixtures.

**2.2 FINISHES**

- .1 Light fixture finish and construction to meet ULC listing and CSA certification related to intended installation.

**2.3 OPTICAL CONTROL DEVICES**

- .1 As indicated in luminaire schedule.

**2.4 LUMINAIRES**

- .1 As indicated in luminaire schedule.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

**3.2 WIRING**

- .1 Connect luminaires to lighting circuits:
  - .1 Install flexible or rigid conduit for luminaires as indicated.

**3.3 LUMINAIRE SUPPORTS**

- .1 For suspended ceiling installations support luminaires independently of ceiling.

**3.4 LUMINAIRE ALIGNMENT**

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

**3.5 CLEANING**

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

**END OF SECTION**

## APPENDIX A

---



**PRELIMINARY HAZARD ASSESSMENT FORM**

**APPENDIX "A"**

<b>Project Number:</b>	Project Number: R.107701.001
<b>Location:</b>	CBSA Fuel Storage Tanks at Huntingdon, Kingsgate, and Waneta Points of Entry
<b>Date:</b>	December 19, 2019
<b>Name of Departmental Representative:</b>	Kai Mark Public Service and Procurement Canada (PSPC)
<b>Name of Client:</b>	Canada Border Service Agency (CBSA)
<b>Name of Client Project Co-ordinator</b>	Kai Mark (PSPC) PH: ( 604) - 365 - 0089

Site Specific Orientation Provided at Project Location  Yes

Notice of Project Required  Yes

**NOTE:**  
PWGSC REQUIRES A Notice of Project FOR ALL CONSTRUCTION WORK RELATED ACTIVITIES

**NOTE:**  
OHS law is made up of many municipal, provincial, and federal acts, regulations, bylaws and codes. There are also many other pieces of legislation in British Columbia that impose OHS obligations.

**Important Notice:** This hazard assessment has been prepared by PSPC for its own project planning process, and to inform the service provider of actual and potential hazards that may be encountered in performance of the work. PSPC does not warrant the completeness or adequacy of this hazard assessment for the project and the paramount responsibility for project hazard assessment rests with the service provider.

TYPES OF HAZARDS TO CONSIDER	Potential Risk for:				COMMENTS
	PWGSC, OGD's, or tenants		General Public or other contractors		
Examples: Chemical, Biological, Natural, Physical, and Ergonomic  Listed below are common construction related hazards. Your project may include pre-existing hazards that are not listed. Contact the Regional Construction Safety Coordinator for assistance should this issue arise.	Yes	No	Yes	No	Note: When thinking about this pre-construction hazard assessment, remember a <b>hazard</b> is anything that may cause harm, such as chemicals, electricity, working from heights, etc; the <b>risk</b> is the chance, high or low, that somebody could be harmed by these and other hazards, together with an indication of how serious the harm could be.

Typical Construction Hazards					
Concealed/Buried Services (electrical, gas, water, sewer etc)	yes				
Slip Hazards or Unsound Footing	yes				
Working at Heights		no			Fall protection regulation in a federal facility is 2.4m.



Working Over or Around Water		no			
Heavy overhead lifting operations, mobile cranes etc.		no			
Marine and/or Vehicular Traffic (site vehicles, public vehicles, etc.)	yes				
Fire and Explosion Hazards		no			
High Noise Levels	yes				Drilling into concrete and cutting conduit
Excavations	yes				To be determined by contractor
Blasting		no			
Construction Equipment	yes				Mobile Lift
Pedestrian Traffic (site personnel, tenants, visitors, public)	yes				Federal employees, visitors, and incarcerated individuals will be on site.
Multiple Employer Worksite	yes				Federal employees and general public will be on site.

<b>Electrical Hazards</b>					<b>Comments</b>
Contact With Overhead Wires		no			
Live Electrical Systems or Equipment	yes				All electrical work must be coordinated with the site Electrical authority.
<b>Other:</b>					
<b>Physical Hazards</b>					
Equipment Slippage Due To Slopes/Ground Conditions	yes				
Earthquake	yes				
Tsunami		no			
Avalanche	yes	no			
Forest Fires		no			
Fire and Explosion Hazards	yes				A Hot Work Permit is required
Working in Isolation		no			
Working Alone		no			
Violence in the Workplace	yes				
High Noise Levels	yes				Drilling and cutting conduit
Inclement weather	yes				Travelling to and from the site
High Pressure Systems		no			
<b>Other:</b>					
<b>Hazardous Work Environments</b>					
Confined Spaces / Restricted Spaces PSPC employees do not enter confined space.	TBD				
Suspended / Mobile Work Platforms		no			
<b>Other:</b>					
<b>Biological Hazards</b>					
Mould Proliferations		no			
Accumulation of Bird or Bat Guano		no			
Bacteria / Legionella in Cooling Towers / Process Water		no			
Rodent / Insect Infestation		no			
Poisonous Plants		no			



Sharp or Potentially Infectious Objects in Wastes	yes				
Wildlife	yes				
<b>Chemical Hazards</b>					
Asbestos Materials on Site	n/a				
Designated Substance Present		no			
Chemicals Used in work		no			
Lead in paint	n/a				
Mercury in Thermostats or Switches	n/a				
Application of Chemicals or Pesticides		no			
PCB Liquids in Electrical Equipment		no			
Radioactive Materials in Equipment		no			
<b>Other: SILICA</b>	yes				Exposure Control Plan will be required
<b>Contaminated Sites Hazards</b>					
Hazardous Waste		no			
Hydrocarbons		no			
Metals		no			
Other:					

Security Hazards					Comments
Risk of Assault	yes				The work is being performed within a federal corrections facility
<b>Other:</b>					
<b>Other Hazards</b>					

Other Compliance and Permit Requirements <sup>1</sup>	YES	NO	Notes / Comments <sup>2</sup>
Is a Building Permit required?			
Is an Electrical permit required?			
Is a Plumbing Permit required?			
Is a Sewage Permit required?			
Is a Dumping Permit required?			
Is a Hot Work Permit required?			
Is a Permit to Work required?			Mandatory for ALL AFD managed work sites.
Is a Confined Space Entry Permit required?			Mandatory
Is a Confined Space Entry Log required			Mandatory for all Confined Spaces
Discharge Approval for treated water required			

**Notes:**

- (1) Does not relieve Service Provider from complying with all applicable federal, provincial, and municipal laws and regulations.
- (2) TBD means To Be Determined by Service Provider.





**Service Provider Acknowledgement: We confirm receipt and review of this Pre-Project Hazard Assessment and acknowledge our responsibility for conducting our own assessment of project hazards, and taking all necessary protective measures (which may exceed those cited herein) for performance of the work.**

<b>Service Provider Name</b>			
<b>Signatory for Service Provider</b>		<b>Date Signed</b>	
<b>RETURN EXECUTED DOCUMENT TO PSPC DEPARTMENTAL REPRESENTATIVE PRIOR TO ANY WORK COMMENCING</b>			

## APPENDIX B

---



**DST Consulting Engineers Inc.**  
Unit B - 4125 McConnell Drive  
Burnaby BC, V5A 3J7  
Canada

---

Public Services and Procurement Canada  
#401 – 1230 Government Street  
Victoria, BC  
V8W 3X4

January 15, 2020

Attention: Ms. Sherry Steele  
Environmental Specialist

**Subject: Pre-Renovation Hazardous Building Materials Assessment  
Emergency Generator Upgrade Project – Abbotsford / Huntingdon Point of  
Entry, Abbotsford, BC**

DST File No.: GV-VC-040154

---

## **1.0 INTRODUCTION**

DST Consulting Engineers Inc. (DST) was retained by Public Services and Procurement Canada (PSPC) to complete a pre-renovation, hazardous building materials assessment limited to the Emergency Generator Room (herein referred to as the Project Area) at the Abbotsford / Huntingdon Point of Entry, in Abbotsford, BC (herein referred to as the Subject Building).

## **2.0 SCOPE OF WORK**

The assessment was limited to include asbestos-containing materials (ACMs), lead-based coatings (LBCs), polychlorinated biphenyls (PCB), ozone-depleting substances (ODS), elemental mercury, silica, rodent droppings and suspect visible mould, located within the Project Area in preparation for Emergency Generator upgrades planned for the Subject Building.

## **3.0 REGULATIONS AND GUIDELINES**

### **3.1 Provincial Regulations**

In British Columbia, the management of hazardous building materials in the work place is regulated by WorkSafeBC under the Workers' Compensation Act (effective April 15, 1998), as amended by the Workers' Compensation (Occupational Health and Safety) Amendment Act (including amendments to the date of this report). Specific requirements of the Occupational

Health and Safety Amendment Act are prescribed in the British Columbia Occupational Health and Safety (BC OH&S) Regulation.

### **3.1.1 Hazardous Materials & Demolition/Renovations**

Section 20.112 of the BC OH&S Regulation details the requirements that employers and owners are responsible for before beginning work on the demolition, renovation or salvage of machinery, equipment, buildings, or structures. The employer or owner must:

- Inspect the site to identify any asbestos, lead and/or other potentially hazardous materials that may be handled, disturbed, or removed;
- Have the inspection results available at the worksite; and,
- Ensure that the hazardous materials are safely contained or removed.

### **3.1.2 Asbestos-Containing Materials (ACMs)**

ACMs in the workplace are regulated under Part 6 (sections 6.1 to 6.32) of the BC OH&S Regulation.

#### ***Applicable WorkSafeBC Guideline - Safe Handling of Asbestos, a Manual of Standard Practices***

This manual outlines basic information on asbestos and asbestos products, health hazards requirements for worker protection, safe work procedures and principles that should be followed in selecting the most suitable technique for the safe abatement of ACM. This document provides a guide to current practices that are to be followed in the Province of British Columbia.

### **3.1.3 Lead**

Lead in the workplace is regulated under Part 6 (sections 6.59 to 6.69) of the BC OH&S Regulation.

#### ***Applicable WorkSafeBC Guideline – Lead-Containing Paints and Coatings – Preventing Exposure in the Construction Industry***

This manual provides a guide to current practices that are to be followed in the Province of British Columbia, providing basic information on lead and lead products, health hazards and requirements for worker protection, safe work procedures and principles that should be followed in selecting the most suitable technique for the safe abatement of lead.

The *Hazardous Products Act (HPA)*, *Surface Coating Materials Regulation (SOR/2005-109)* provides regulatory requirements for the sale and labeling of surface coatings.

The Surface Coating Materials Regulation reduced the threshold for lead in paint from 5,000 mg/kg to 600 mg/kg, and in 2010, to 90 mg/kg. However, Provincial regulations do not require lead controls for surface coatings containing <600 mg/kg, as such, DST identifies a lead-based coating as a coating containing >600 mg/kg or >0.05 mg/cm<sup>2</sup>.

### **3.1.4 Hazardous Waste**

In British Columbia, environmental matters pertaining to waste generally fall under the jurisdiction of the British Columbia Ministry of Environment (MoE), pursuant to the Environmental Management Act. The key waste regulation under the Environmental Management Act relating to hazardous building materials is the Hazardous Waste Regulation (HWR), as amended from time to time. The HWR provides the requirements for the proper handling, storage, transportation, treatment, recycling and disposal of hazardous wastes in the province. The regulation also outlines the materials and criteria to be used to characterize waste as hazardous.

## **3.2 Federal Regulations**

### **3.2.1 Canada Labour Code**

In federal jurisdictions, hazardous building materials are regulated under the *Canada Labour Code, Part II, Part X, Hazardous Substances*.

### **3.2.2 Asbestos-Containing Materials (ACMs)**

ACMs are regulated under the Canada Occupational Health and Safety Regulations, (SOR/86-304). An asbestos-containing material is defined as a manufactured product that contains >0.5 % asbestos fibres by weight, at the time of manufacture, or vermiculite insulation that contains any asbestos fibres.

Vermiculite insulation is commonly found in the hollow cores of cinderblock walls, masonry brick, used as attic / floor cavity insulation, as well as an additive in wall / ceiling plaster compounds. As per WorkSafeBC requirements, vermiculite that contain any asbestos fibres, regardless of concentration, must be considered asbestos-containing. The recommended sample volume for vermiculite insulation is ~ one (1) Litre and analysis can be completed following US EPA analytical method EPC/600/R-93/116, or by Transmission Electron Microscopy (TEM) analysis.

In addition, PSPC has developed the Asbestos Management Standard, effective June 5, 2017, that provide specific requirements for the management and abatement of ACMs.

### **3.2.3 Lead-Based Coatings (LBCs)**

The *Hazardous Products Act (HPA)*, *Surface Coating Materials Regulation (SOR/2005-109)* provides regulatory requirements for the sale and labeling of surface coatings. The Surface Coating Materials Regulation reduced the threshold for lead in paint from 5,000 mg/kg to 600 mg/kg, and in 2010, to 90 mg/kg.

### **3.2.4 Halocarbon and Ozone Depleting Substances (ODS)**

Halocarbon and Ozone Depleting substances are regulated under the Canadian Environmental Protection Act (CEPA), "*Federal Halocarbon Regulations, 2003, (SOR/2003-289)*".

### **3.2.5 Polychlorinated Biphenyl's (PCBs)**

PCBs are regulated under the Canadian Environmental Protection Act, specifically under the "*PCB Regulations*" (SOR/2008-273), including amendments up to the date of this report.

### **3.2.6 Transportation of Dangerous Goods Act**

The Transportation of Dangerous Goods Act provides detailed requirements for the transportation of hazardous materials.

## **4.0 METHODOLOGY**

The assessment was completed on December 18, 2019, by Philip Pow, B.Sc., Field Technologist of DST. DST referenced a report prepared by DST Consulting Engineers Inc., entitled "*Hazardous Building Materials Assessment, Huntingdon Border Crossing, 2 Sumas Way, Abbotsford, BC*", dated June 19, 2013 (herein referred to as the Previous Report).

Suspect hazardous building materials were visually identified, based on the surveyor's knowledge of the historic composition of building products. Visual identification of materials suspected to contain asbestos or lead (in coatings) was supported by the analysis of representative samples.

Bulk asbestos samples were analyzed using Polarised Light Microscopy (PLM) using National Institute for Occupational Safety and Health (NIOSH) Analytical Method 9002 – Asbestos (Bulk) by PLM. Suspect ACM samples were analyzed for asbestos content at EMSL Canada Inc. (EMSL).

Suspect LBC samples were tested for content at Bureau Veritas Canada Inc., by inductively coupled plasma-atomic emission spectrometry (ICP-AES), following EPA 6010c R3 m.

## 5.0 FINDINGS

The following sections outline the findings of the hazardous building materials assessment.

### 5.1 Condition of Material Samples

The condition of the sampled materials were classified in the following format:

**GOOD** Surface of materials show no significant signs of damage, deterioration or delaminating. No repairs required.

**FAIR** Surface of materials show some significant signs of damage, deterioration or delaminating. Repairs required as soon as possible.

**POOR** Surface materials show significant signs of damage, delaminating or deterioration. Repairs required immediately and will require removal and/or significant alterations.

### 5.2 Asbestos-Containing Materials (ACMs)

Through the assessment twelve (12) samples of suspect ACMs were collected and analyzed for asbestos content. The sample locations, descriptions and analytical results are summarized in **Table 1** below.

Certificates of analysis are presented in **Appendix I**. A Site plan, illustrating sample point locations is presented in **Appendix II**.

Table 1 - Asbestos Results – Emergency Generator Room Abbotsford / Huntingdon Point of Entry, Abbotsford, BC							
Sample Number	Sample Location	Material Type	Analytical Result (% Mass by Mass)	Friability	Accessibility	Current Condition	Current Risk of Exposure
A-1	Generator Room – South Wall	Drywall Joint Compound	None Detected	N/A	N/A	N/A	N/A
A-2	Generator Room – South Wall	Drywall Joint Compound	None Detected	N/A	N/A	N/A	N/A

<b>Table 1 - Asbestos Results – Emergency Generator Room Abbotsford / Huntingdon Point of Entry, Abbotsford, BC</b>							
<b>Sample Number</b>	<b>Sample Location</b>	<b>Material Type</b>	<b>Analytical Result (% Mass by Mass)</b>	<b>Friability</b>	<b>Accessibility</b>	<b>Current Condition</b>	<b>Current Risk of Exposure</b>
A-3	Generator Room – South Wall	Drywall Joint Compound	None Detected	N/A	N/A	N/A	N/A
A-4	Generator Room – AST Containment	Green Membrane Liner	None Detected	N/A	N/A	N/A	N/A
A-5	Generator Room – South Wall	Drywall Joint Compound (Patching Mud)	None Detected	N/A	N/A	N/A	N/A
A-6	Generator Room – South Wall	Drywall Joint Compound (Patching Mud)	None Detected	N/A	N/A	N/A	N/A
A-7	Generator Room – South Wall	Drywall Joint Compound (Patching Mud)	None Detected	N/A	N/A	N/A	N/A
A-8	Generator Room – Exterior (South Wall)	Brown Silicone Caulking	None Detected	N/A	N/A	N/A	N/A
A-9	Generator Room – Exterior – South Wall (Penetration)	Fibrous Membrane	None Detected	N/A	N/A	N/A	N/A
A-10	Generator Room Generator Unit – East End	Grey Mastic	None Detected	N/A	N/A	N/A	N/A
A-11	Generator Room Generator Unit – East End	Grey Mastic	None Detected	N/A	N/A	N/A	N/A
A-12	Generator Room Generator Unit – East End	Grey Mastic	None Detected	N/A	N/A	N/A	N/A

Based on the above-summarized analytical results and the Previous Report, ACMs were not identified within the Project Area.

### 5.3 Lead-Based Coatings (LBCs)

Suspect LBC samples that were determined to contain a concentration of lead equal to or 600 (ppm) were classified as LBCs, i.e., paints with hazardous levels of lead.



Through the assessment one (1) sample of suspect LBC was collected and analyzed for lead content. The sample locations, descriptions and analytical results are summarized in **Table 2**, below.

Certificates of analysis are presented in **Appendix I**. A Site plan, illustrating sample point locations is presented in **Appendix II**.

<b>Table 2 - Lead Results – Emergency Generator Room Abbotsford / Huntingdon Point of Entry, Abbotsford, BC</b>									
<b>Sample Number</b>	<b>Area or Room</b>	<b>Material Type</b>	<b>Location</b>	<b>Substrate</b>	<b>Analytical Result (PPM)</b>	<b>Lead-Based Coating (Yes/No)</b>	<b>Current Condition</b>	<b>Accessibility</b>	<b>Current Risk of Exposure</b>
L-1	Generator Room	Off-White Paint	South Wall	Drywall	<4	No	N/A	N/A	N/A

Based on the findings of our assessment, the off-white colored paint applied to the walls in the Project Area was found to contain lead below the laboratory limit of detection and as such, is not considered to be a lead-based paint.

#### **5.4 Halocarbon and Ozone Depleting Substances (ODSs)**

Equipment suspected to contain halocarbon and ozone-depleting substances were not identified within the Project Area.

#### **5.5 Elemental Mercury**

Fluorescent light fixtures (fluorescent lamp tubes) were observed throughout the Project Area are known to contain mercury vapor.

#### **5.6 Polychlorinated Biphenyls (PCBs)**

Fluorescent light ballasts, suspected to be PCB-containing, were not identified throughout the Project Area.

## **5.7 Mould Amplification**

Suspected mould amplification was not identified within the Project Area.

## **5.8 Crystalline Silica**

Sources of crystalline silica and rock dust were identified in the masonry slabs and walls of the Project Area.

## **5.9 Rodent Droppings**

No rodent droppings were observed during the site assessment within the Project Area.

## **6.0 RECOMMENDATIONS**

### **6.1 Elemental Mercury**

When taken out of service, mercury-containing equipment should be managed in accordance with the requirements of the British Columbia Ministry of Environment and should be transported in accordance with the requirements of the Federal Transportation of Dangerous Goods Act.

### **6.2 Crystalline Silica**

Through the course of mechanical renovation activities, the masonry slabs and walls should be wetted (saturated) with water, prior to, during and upon completion of renovation activities in an effort to minimize the potential for crystalline silica or rock dust release.

## **7.0 REPORT LIMITATIONS**

This report is intended for client use only. Any use of this document by a third party, or any reliance on or decisions made based on the findings described in this report, are the sole responsibility of such third parties, and DST Consulting Engineers Inc. accepts no responsibility for damages, suffered by any third party as a result of decisions made or actions conducted based on this report. No other warranties are implied or expressed.

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the client. The sampling program included asbestos bulk sampling and paint chip sampling in select representative areas for laboratory analysis. Note, however, that no scope of work, no matter how exhaustive, can guarantee to

identify all contaminants. This report therefore cannot warranty that all building conditions are represented by those identified at specific locations.

Recommendations, when included, are made in good faith and are based on several successful experiences.

Note also that standards, guidelines and practices related to environmental investigations may change with time. Those which were applied at the time of this investigation may be obsolete or unacceptable at a later date.

Any comments given in this report on potential remediation problems and possible methods are intended only for the guidance of the designer. The scope of work may not be sufficient to determine all of the factors that may affect construction, clean-up methods and/or costs. Contractors bidding on this project or undertaking clean-ups should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the conditions may affect their work.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the client.

## 8.0 CLOSURE

We hope the information presented in this document meets your current requirements. If you have any questions, or require additional information please contact us at your convenience.

Yours truly,

### **DST Consulting Engineers Inc.**

Report Prepared By:



Philip Pow, B.Sc.  
*Field Technologist*

Report Reviewed By:



Christian Injates, CEC, CEM  
*Associate, Regional Manager*

**APPENDIX I**  
**CERTIFICATES OF ANALYSIS**



# EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1

Tel/Fax: (604) 757-3158 / (604) 757-4731

<http://www.EMSL.com> / [vancouverlab@EMSL.com](mailto:vancouverlab@EMSL.com)

EMSL Canada Order: 691903421

Customer ID: 55DSTV42

Customer PO:

Project ID:

**Attention:** Christian Injates  
DST Consulting Engineers  
4125 McConnell Drive  
Unit B  
Vancouver, BC V5A 3J7

**Phone:** (604) 436-4588

**Fax:**

**Received Date:** 12/20/2019 5:11 PM

**Analysis Date:** 12/27/2019

**Collected Date:**

**Project:** GV-VC-040154 / CBSA - ABBOTSFORD/HUNTINGDON CROSSING

## Test Report: Polarized Light Microscopy (PLM) Performed by Modified NIOSH Method 9002, Issue 2

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
A-1 691903421-0001	GENERATOR ROOM WALL - DRYWALL JOINT COMPOUND	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
A-2 691903421-0002	GENERATOR ROOM WALL - DRYWALL JOINT COMPOUND	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
A-3 691903421-0003	GENERATOR ROOM WALL - DRYWALL JOINT COMPOUND	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
A-4 691903421-0004	GENERATOR ROOM - CONTAINMENT - GREEN MEMBRANE LINER	Green Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
A-5 691903421-0005	GENERATOR ROOM WALL - DRYWALL PATCHING MUD	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
A-6 691903421-0006	GENERATOR ROOM WALL - DRYWALL PATCHING MUD	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
A-7 691903421-0007	GENERATOR ROOM WALL - DRYWALL PATCHING MUD	Beige Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
A-8 691903421-0008	GENERATOR ROOM - EXTERIOR - BROWN SILICONE/CAULKIN G	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
A-9 691903421-0009	GENERATOR ROOM - EXTERIOR PENETRATION HOLE - FIBROUS BUILDING MEMBRANE	Gray Non-Fibrous Homogeneous	10% Synthetic	90% Non-fibrous (Other)	None Detected
A-10 691903421-0010	GENERATOR ROOM - GENERATOR - GREY MASTIC	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
A-11 691903421-0011	GENERATOR ROOM - GENERATOR - GREY MASTIC	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
A-12 691903421-0012	GENERATOR ROOM - GENERATOR - GREY MASTIC	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial report from: 12/27/2019 19:23:15



# EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1

Tel/Fax: (604) 757-3158 / (604) 757-4731

<http://www.EMSL.com> / [vancouverlab@EMSL.com](mailto:vancouverlab@EMSL.com)

**EMSL Canada Order:** 691903421

**Customer ID:** 55DSTV42

**Customer PO:**

**Project ID:**

Analyst(s) \_\_\_\_\_

*Dane Sorochuk (12)*

\_\_\_\_\_  
Nicole Yeo, Laboratory Manager  
or Other Approved Signatory

Disclaimers: EMSL maintains liability limited to the 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 data reported that relies on information provided by the client, sample collection activities, or analytical method limitations. The results relate only to the materials received, and the data supplied by the customer. Interpretation and use of test results are the responsibility of the client. All samples received in acceptable condition, unless otherwise noted. This report format is a modification to report discreet asbestos concentrations instead of ranges. Non-friable organically bound materials present a problem matrix, and therefore, EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available upon request.

Samples analyzed by EMSL Canada Inc. Burnaby, BC

Initial report from: 12/27/2019 19:23:15



Your Project #: GV-VC-040154  
 Site Location: ABBOTSFORD/HUNTINGDON CROSSING  
 Your C.O.C. #: 08476460

**Attention: Philip Pow**

DST CONSULTING ENGINEERS  
 Unit B - 4125 McConnell Drive  
 Burnaby, BC  
 CANADA V5A 3J7

**Report Date: 2019/12/27**  
 Report #: R2828869  
 Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BV LABS JOB #: B9A9633**

**Received: 2019/12/23, 11:54**

Sample Matrix: Solid  
 # Samples Received: 1

Analyses	Date		Laboratory Method	Analytical Method
	Quantity	Date Extracted		
Elements by ICP-AES (acid extr. solid)	1	2019/12/27	2019/12/27 BBY7SOP-00018	EPA 6010d m

**Remarks:**

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

**Encryption Key**

Please direct all questions regarding this Certificate of Analysis to your Project Manager.  
 Lindsay Sunderman, Key Account Specialist  
 Email: lindsay.sunderman@bvlabs.com  
 Phone# (403)735-2237 Ext:2237

=====  
 This report has been generated and distributed using a secure automated process.

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



**BUREAU**  
**VERITAS**

BV Labs Job #: B9A9633  
Report Date: 2019/12/27

DST CONSULTING ENGINEERS  
Client Project #: GV-VC-040154  
Site Location: ABBOTSFORD/HUNTINGDON CROSSING

### LEAD IN PAINT CHIPS (SOLID)

<b>BV Labs ID</b>		XE1376		
<b>Sampling Date</b>		2019/12/18		
<b>COC Number</b>		08476460		
	<b>UNITS</b>	<b>L-1 GENERATOR RM-WALL</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Total Metals by ICP</b>				
Total Lead (Pb)	mg/kg	<4.0	4.0	9721314
RDL = Reportable Detection Limit				





**BUREAU  
VERITAS**

BV Labs Job #: B9A9633

Report Date: 2019/12/27

DST CONSULTING ENGINEERS

Client Project #: GV-VC-040154

Site Location: ABBOTSFORD/HUNTINGDON CROSSING

## GENERAL COMMENTS

### LEAD IN PAINT CHIPS (SOLID) Comments

Sample XE1376 [L-1 GENERATOR RM-WALL] Elements by ICP-AES (acid extr. solid): Detection limits raised due to insufficient sample volume.

**Results relate only to the items tested.**



BUREAU  
VERITAS

BV Labs Job #: B9A9633  
Report Date: 2019/12/27

### QUALITY ASSURANCE REPORT

DST CONSULTING ENGINEERS  
Client Project #: GV-VC-040154  
Site Location: ABBOTSFORD/HUNTINGDON CROSSING

QC Batch	Parameter	Date	Spiked Blank		Method Blank		RPD		QC Standard	
			% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9721314	Total Lead (Pb)	2019/12/27	100	75 - 125	<2.0	mg/kg	2.1	40	106	70 - 130

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.



BUREAU  
VERITAS

BV Labs Job #: B9A9633

Report Date: 2019/12/27

DST CONSULTING ENGINEERS

Client Project #: GV-VC-040154

Site Location: ABBOTSFORD/HUNTINGDON CROSSING

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

A handwritten signature in black ink, appearing to read "Andy Lu", written over a horizontal line.

Andy Lu, Ph.D., P.Chem., Scientific Specialist

---

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

08476460  
**est for Laboratory  
 ertical Services**



B9A9633\_COC

**merica, Inc.**

**IMPORTANT:** Date results required: \_\_\_\_\_  
 Rush charges authorized? Yes  No   
 Fax or  E-mail results   
 E-mail Address: \_\_\_\_\_

Page: \_\_\_\_\_  
 For Lab Use Only  
 Lab Project #: \_\_\_\_\_

Client Project Number: GV-VC-090159 Send invoice to: \_\_\_\_\_ P.O. No. \_\_\_\_\_  
 Name \_\_\_\_\_ Name \_\_\_\_\_  
 Company DST CONSULTING ENGINEERS INC. Company DST CONSULTING ENGINEERS INC.  
 Mailing Address Unit B - 4125 McConnell Drive Address Unit B - 4125 McConnell Drive  
 City, State, Zip Burnaby BC, V5A 3J7 City, State, Zip Burnaby BC, V5A 3J7  
 Telephone No. \_\_\_\_\_ Fax No. \_\_\_\_\_

Special instructions and/or specific regulatory requirements:  
 (method, limit of detection, etc.)

Site: Abbotsford/Huntingdon Crossing

**Asbestos/Soil samples only: Which state are these from?** \_\_\_\_\_

Water samples are:  
 Drinking water \_\_\_\_\_ Groundwater \_\_\_\_\_  
 Wastewater \_\_\_\_\_

Client Sample Identification	Date Sampled	Time Sampled	Matrix/Media	Air Volume (Liters)	# of Jars	ANALYSIS REQUESTED (List each analyte on the lines below, multiple analytes per line)
<u>L-1 Generator Pm-Wall</u>	<u>Dec 18</u>		<u>Bulk</u>			<u>Lead in paint</u>

Collected by: Philip Pw Date/Time Dec 20/16 Collector's Signature: [Signature] Date/Time Dec 20/16  
 Relinquished by: \_\_\_\_\_ Date/Time \_\_\_\_\_ Received by: [Signature] Date/Time 2019/12/23 11:54  
 Relinquished by: \_\_\_\_\_ Date/Time \_\_\_\_\_ Received by: \_\_\_\_\_ Date/Time \_\_\_\_\_  
 Method of Shipment: \_\_\_\_\_ Sample Condition on Receipt: NIF  
 Authorized by: \_\_\_\_\_ Acceptable  Other: \_\_\_\_\_  
 (Signature MUST accompany request) (Explain)

**Ship to:**

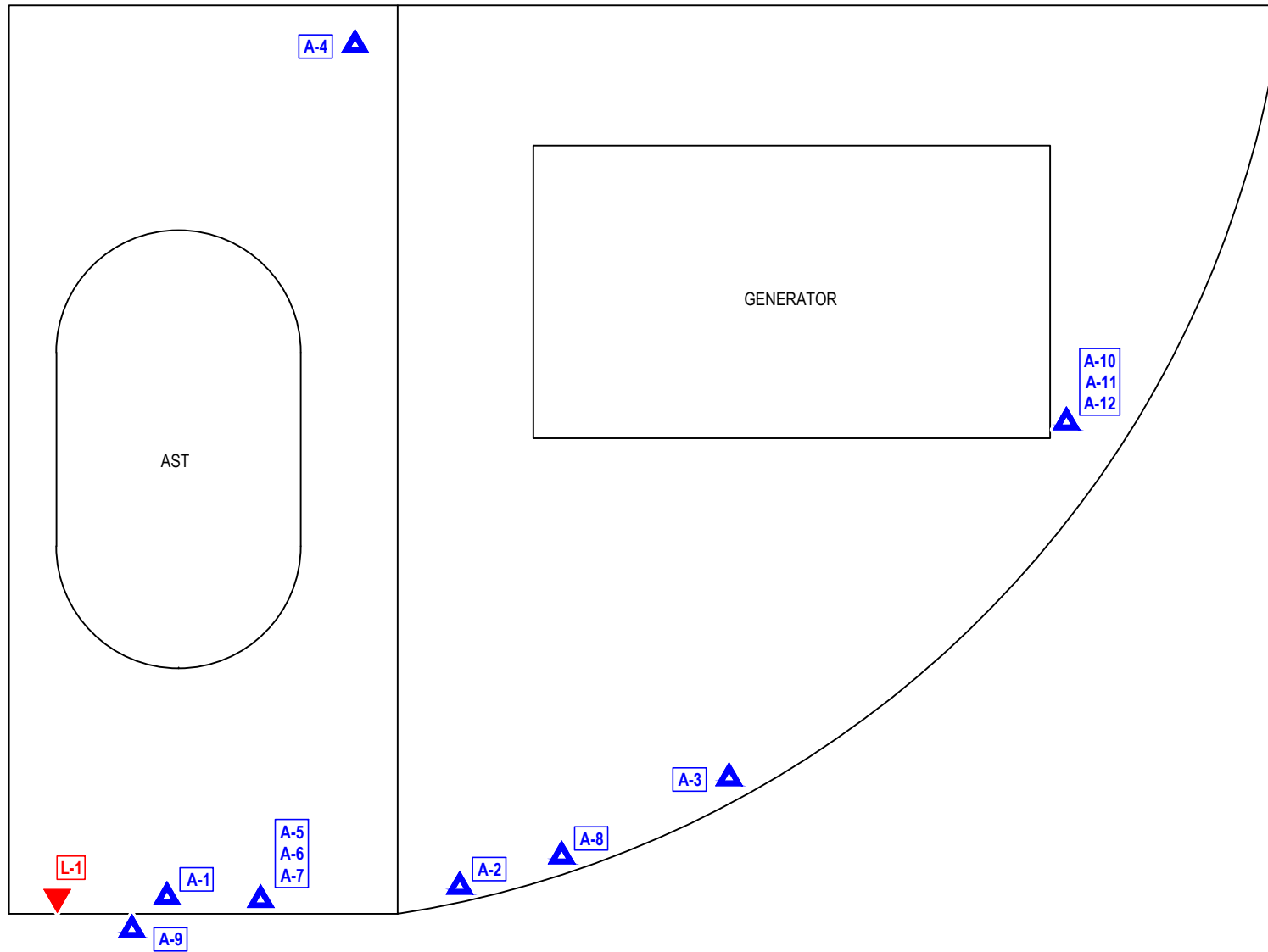
<b>Detroit Lab</b> 22345 Roethel Drive Novi, MI 48375 248.344.2652 800.806.5887 Fax: 248.344.2655	<b>Atlanta Lab</b> 3380 Chastain Meadows Pkwy., Ste 300 Kennesaw, GA 30144 770.499.7701 800.806.5887 Fax: 770.499.7511	<b>Chicago Lab</b> 95 Oakwood Road Lake Zurich, IL 60047 888.576.7522 847.726.3320 Fax: 847.726.3323
--	---	---

**Canadian Clients**  
 1415 Janette Ave  
 Windsor, ON N8X 1Z1  
 \*Unless otherwise agreed to in writing, work submitted on this Chain of Custody is subject to Bureau Veritas' standard Terms & Conditions. Signing of this Chain of Custody document is acknowledgment & acceptance of our terms available at <http://www.bvlabs.com/terms-and-conditions>

289

**APPENDIX II**  
**SITE PLANS**

Drawing: 1 Floor Plan.dwg Folder: L:\TSCAD\Projects\GV\VC-040154 - Abbotsford\2020 Sampling Location\DWGs Wednesday, January 15, 2020 @ 12:28 by Joven Mendoza



**Note**

1. This drawing shall be read in conjunction with the associated technical report.
2. Do not scale drawing.
3. Base plan provided by client.

**Legend**

- ▲ Approximate asbestos sample location
- ▼ Approximate lead sample location

Revision	Date	Issue	Approval
A	01/15/2020	Preliminary	

Client  
**Public Service Procurement Canada**

Site  
**Abbotsford-Huntington Port of Entry**

Report Title  
**Hazardous Material Assessment  
Emergency Generator Room**

Drawing Title  
**Floor Plan**

Designed By	C.I.	Scale	As shown
Drawn By	J.M.	Date	January 2020
Approved By	C.R.	Project No.	GV-VC-040154
Figure No.	<b>1</b>		<b>DRAFT</b>

## APPENDIX C

---



**DST Consulting Engineers Inc.**  
Unit B - 4125 McConnell Drive  
Burnaby BC, V5A 3J7  
Canada

---

Public Services and Procurement Canada  
#401 – 1230 Government Street  
Victoria, BC  
V8W 3X4

January 16, 2020

Attention: Ms. Sherry Steele  
Environmental Specialist

**Subject: Pre-Renovation Hazardous Building Materials Assessment  
Emergency Generator Upgrade Project Kingsgate Point of Entry  
6923 Customs Road, Kingsgate, British Columbia**

DST File No.: GV-VC-040154

---

## **1.0 INTRODUCTION**

DST Consulting Engineers Inc. (DST) was retained by Public Services and Procurement Canada (PSPC) to complete a hazardous building materials assessment limited to the potential disturbance of building materials pertaining to the proposed emergency generator upgrade at the Kingsgate Point of Entry, 6923 Customs Road, Kingsgate, British Columbia (herein referred to as the Project Area).

## **2.0 SCOPE OF WORK**

The assessment was completed to establish an inventory of select hazardous materials. The assessment was limited to include asbestos-containing materials (ACMs), lead-based coatings (LBCs), polychlorinated biphenyls (PCB), ozone-depleting substances (ODS), elemental mercury, silica, rodent droppings and suspect visible mould, located within the Project Area in preparation for a emergency generator upgrades.



### **3.0 REGULATIONS AND GUIDELINES**

#### **3.1 Provincial Regulations**

In British Columbia, the management of hazardous building materials in the work place is regulated by WorkSafeBC under the Workers' Compensation Act (effective April 15, 1998), as amended by the Workers' Compensation (Occupational Health and Safety) Amendment Act (including amendments to the date of this report). Specific requirements of the Occupational Health and Safety Amendment Act are prescribed in the British Columbia Occupational Health and Safety (BC OH&S) Regulation.

##### **3.1.1 Hazardous Materials & Demolition/Renovations**

Section 20.112 of the BC OH&S Regulation details the requirements that employers and owners are responsible for before beginning work on the demolition, renovation or salvage of machinery, equipment, buildings, or structures. The employer or owner must:

- Inspect the site to identify any asbestos, lead and/or other potentially hazardous materials that may be handled, disturbed, or removed;
- Have the inspection results available at the worksite; and,
- Ensure that the hazardous materials are safely contained or removed.

##### **3.1.2 Asbestos-Containing Materials (ACMs)**

ACMs in the workplace are regulated under Part 6 (sections 6.1 to 6.32) of the BC OH&S Regulation.

##### ***Applicable WorkSafeBC Guideline - Safe Handling of Asbestos, a Manual of Standard Practices***

This manual outlines basic information on asbestos and asbestos products, health hazards requirements for worker protection, safe work procedures and principles that should be followed in selecting the most suitable technique for the safe abatement of ACM. This document provides a guide to current practices that are to be followed in the Province of British Columbia.

##### **3.1.3 Lead**

Lead in the workplace is regulated under Part 6 (sections 6.59 to 6.69) of the BC OH&S Regulation.

### ***Applicable WorkSafeBC Guideline – Lead-Containing Paints and Coatings – Preventing Exposure in the Construction Industry***

This manual provides a guide to current practices that are to be followed in the Province of British Columbia, providing basic information on lead and lead products, health hazards and requirements for worker protection, safe work procedures and principles that should be followed in selecting the most suitable technique for the safe abatement of lead.

The *Hazardous Products Act (HPA)*, *Surface Coating Materials Regulation (SOR/2005-109)* provides regulatory requirements for the sale and labeling of surface coatings.

The Surface Coating Materials Regulation reduced the threshold for lead in paint from 5,000 mg/kg to 600 mg/kg, and in 2010, to 90 mg/kg.

#### **3.1.4 Hazardous Waste**

In British Columbia, environmental matters pertaining to waste generally fall under the jurisdiction of the British Columbia Ministry of Environment (MoE), pursuant to the Environmental Management Act. The key waste regulation under the Environmental Management Act relating to hazardous building materials is the Hazardous Waste Regulation (HWR), as amended from time to time. The HWR provides the requirements for the proper handling, storage, transportation, treatment, recycling and disposal of hazardous wastes in the province. The regulation also outlines the materials and criteria to be used to characterize waste as hazardous.

### **3.2 Federal Regulations**

#### **3.2.1 Canada Labour Code**

In federal jurisdictions, hazardous building materials are regulated under the *Canada Labour Code, Part II, Part X, Hazardous Substances*.

#### **3.2.2 Asbestos-Containing Materials (ACMs)**

ACMs are regulated under the Canada Occupational Health and Safety Regulations, (SOR/86-304). An asbestos-containing material is defined as a manufactured product that contains >0.5 % asbestos fibres by weight, at the time of manufacture, or vermiculite insulation that contains any asbestos fibres.

Vermiculite insulation is commonly found in the hollow cores of cinderblock walls, masonry brick, used as attic / floor cavity insulation, as well as an additive in wall / ceiling plaster compounds. As per WorkSafeBC requirements, vermiculite that contain any asbestos fibres, regardless of

concentration, must be considered asbestos-containing. The recommended sample volume for vermiculite insulation is ~ one (1) Litre and analysis can be completed following US EPA analytical method EPC/600/R-93/116, or by Transmission Electron Microscopy (TEM) analysis.

In addition, PSPC has developed the Asbestos Management Standard, effective June 5, 2017, that provide specific requirements for the management and abatement of ACMs.

### **3.2.3 Lead-Based Coatings (LBCs)**

The *Hazardous Products Act (HPA)*, *Surface Coating Materials Regulation (SOR/2005-109)* provides regulatory requirements for the sale and labeling of surface coatings. The Surface Coating Materials Regulation reduced the threshold for lead in paint from 5,000 mg/kg to 600 mg/kg, and in 2010, to 90 mg/kg.

### **3.2.4 Halocarbon and Ozone Depleting Substances (ODS)**

Halocarbon and Ozone Depleting substances are regulated under the Canadian Environmental Protection Act (CEPA), "*Federal Halocarbon Regulations, 2003, (SOR/2003-289)*".

### **3.2.5 Polychlorinated Biphenyl's (PCBs)**

PCBs are regulated under the Canadian Environmental Protection Act, specifically under the "*PCB Regulations*" (SOR/2008-273), including amendments up to the date of this report.

### **3.2.6 Transportation of Dangerous Goods Act**

The Transportation of Dangerous Goods Act provides detailed requirements for the transportation of hazardous materials.

## **4.0 METHODOLOGY**

The assessment was completed on November 18th, 2019, by Kevin Smith, Senior Project Manager of DST. DST referenced a report prepared by DST Consulting Engineers Inc., entitled "*Canada Border Services Agency, Kingsgate, BC, Hazardous Material Assessment*", dated February 8, 2019 (herein referred to as the Previous Report).

Suspect hazardous building materials were visually identified, based on the surveyor's knowledge of the historic composition of building products. Visual identification of materials suspected to contain asbestos or lead (in coatings) was supported by the analysis of representative samples. Bulk asbestos samples were analyzed using Polarised Light Microscopy (PLM) using National Institute for Occupational Safety and Health (NIOSH) Analytical Method 9002 – Asbestos (Bulk)

by PLM. Suspect ACM samples were analyzed for asbestos content at EMSL Canada Inc. (EMSL).

Suspect LBC samples were tested for content at EMSL Canada Inc., by Flame Atomic Absorption, (FLAA) (SW 846 3050B/7000B).

## **5.0 FINDINGS**

The following sections outline the findings of the hazardous building materials assessment.

### **5.1 Condition of Material Samples**

The condition of the sampled materials were classified in the following format:

**GOOD** Surface of materials show no significant signs of damage, deterioration or delaminating. No repairs required.

**FAIR** Surface of materials show some significant signs of damage, deterioration or delaminating. Repairs required as soon as possible.

**POOR** Surface materials show significant signs of damage, delaminating or deterioration. Repairs required immediately and will require removal and/or significant alterations.

### **5.2 Asbestos-Containing Materials (ACMs)**

Through the assessment, no materials suspected to contain asbestos were identified as having to be disturbed to complete the emergency generator upgrades.

### **5.3 Lead-Based Coatings (LBCs)**

Through the assessment, one (1) sample of suspect LBCs was collected and analyzed for lead content. The sample location, description and analytical result is summarized in **Table 1**, below.

Certificates of analysis are presented in **Appendix I**. A Site plan, illustrating sample point locations is presented in **Appendix II**.

<b>Table 1 - Lead Results – Emergency Generator Room Kingsgate Point of Entry, Kingsgate, BC</b>									
<b>Sample Number</b>	<b>Area or Room</b>	<b>Material Type</b>	<b>Location</b>	<b>Substrate</b>	<b>Analytical Result PPM</b>	<b>Lead-Based Coating (Yes/No)</b>	<b>Current Condition</b>	<b>Accessibility</b>	<b>Current Risk of Exposure</b>
L-1	Generator Room	Light Grey Paint	Wall and Conduit	Drywall and Steel Conduit	<80	No	N/A	N/A	N/A

Note: **Bold print** indicates a coating containing potentially hazardous levels of lead.

Based on the findings of our assessment, light grey paint applied to the walls and electrical conduit in the Project Area were found to contain lead below the laboratory limit of detection and as such, is not considered to be a lead-based paint.

#### **5.4 Halocarbon and Ozone Depleting Substances (ODSs)**

Equipment suspected to contain halocarbon and ozone-depleting substances were not identified within the Project Area.

#### **5.5 Elemental Mercury**

No Sources of Elemental Mercury were observed within the Project Area.

#### **5.6 Polychlorinated Biphenyls (PCBs)**

No Sources of PCBs were identified within the Project Area

#### **5.7 Mould Amplification**

Suspected mould amplification was not identified within the Project Area.

#### **5.8 Crystalline Silica**

Sources of crystalline silica were identified in the masonry walls of the Project Area.

#### **5.9 Rodent Droppings**

No rodent droppings were observed during the site assessment within the Project Area.

## **6.0 RECOMMENDATIONS**

### **6.1 Crystalline Silica**

Through the course of mechanical renovation activities, the masonry walls should be wetted (saturated) with water, prior to, during and upon completion of mechanical renovation activities in an effort to minimize the potential for crystalline silica or rock dust release.

## **7.0 REPORT LIMITATIONS**

This report is intended for client use only. Any use of this document by a third party, or any reliance on or decisions made based on the findings described in this report, are the sole responsibility of such third parties, and DST Consulting Engineers Inc. accepts no responsibility for damages, suffered by any third party as a result of decisions made or actions conducted based on this report. No other warranties are implied or expressed.

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the client. The sampling program included asbestos bulk sampling and paint chip sampling in select representative areas for laboratory analysis. Note, however, that no scope of work, no matter how exhaustive, can guarantee to identify all contaminants. This report therefore cannot warranty that all building conditions are represented by those identified at specific locations.

Recommendations, when included, are made in good faith and are based on several successful experiences.

Note also that standards, guidelines and practices related to environmental investigations may change with time. Those which were applied at the time of this investigation may be obsolete or unacceptable at a later date.

Any comments given in this report on potential remediation problems and possible methods are intended only for the guidance of the designer. The scope of work may not be sufficient to determine all of the factors that may affect construction, clean-up methods and/or costs. Contractors bidding on this project or undertaking clean-ups should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the conditions may affect their work.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the client.

## 8.0 CLOSURE

We hope the information presented in this document meets your current requirements. If you have any questions, or require additional information please contact us at your convenience.

Yours truly,

### **DST Consulting Engineers Inc.**

Report Prepared By:



for,

Kevin Smith

*Associate, Senior Project Manager*

Report Reviewed By:



Christian Injates, CEC, CEM

*Associate, Regional Manager*

**APPENDIX I**  
**CERTIFICATES OF ANALYSIS**





**EMSL Canada Inc.**

2333 18th Avenue NE, Unit 48, Calgary, AB T2E 8T6  
Phone/Fax: (403) 879-1149 / (403) 879-1152  
<http://www.EMSL.com> [CalgaryLab@EMSL.com](mailto:CalgaryLab@EMSL.com)

EMSL Canada Or 652000257  
CustomerID: 55DSTC42  
CustomerPO:  
ProjectID:

Attn: **Kevin Smith**  
**DST Consulting Engineers Inc.**  
**#102 - 1629 Baker Street**  
**Cranbrook, BC V1C 1B4**

Phone: (250) 421-9434  
Fax:  
Received: 01/14/20 11:29 AM  
Collected: 1/13/2020

Project: **GV-VC-037767 / 6917 HWY 95, KINGSGATE, BC, V0B 1V1**

**Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)\***

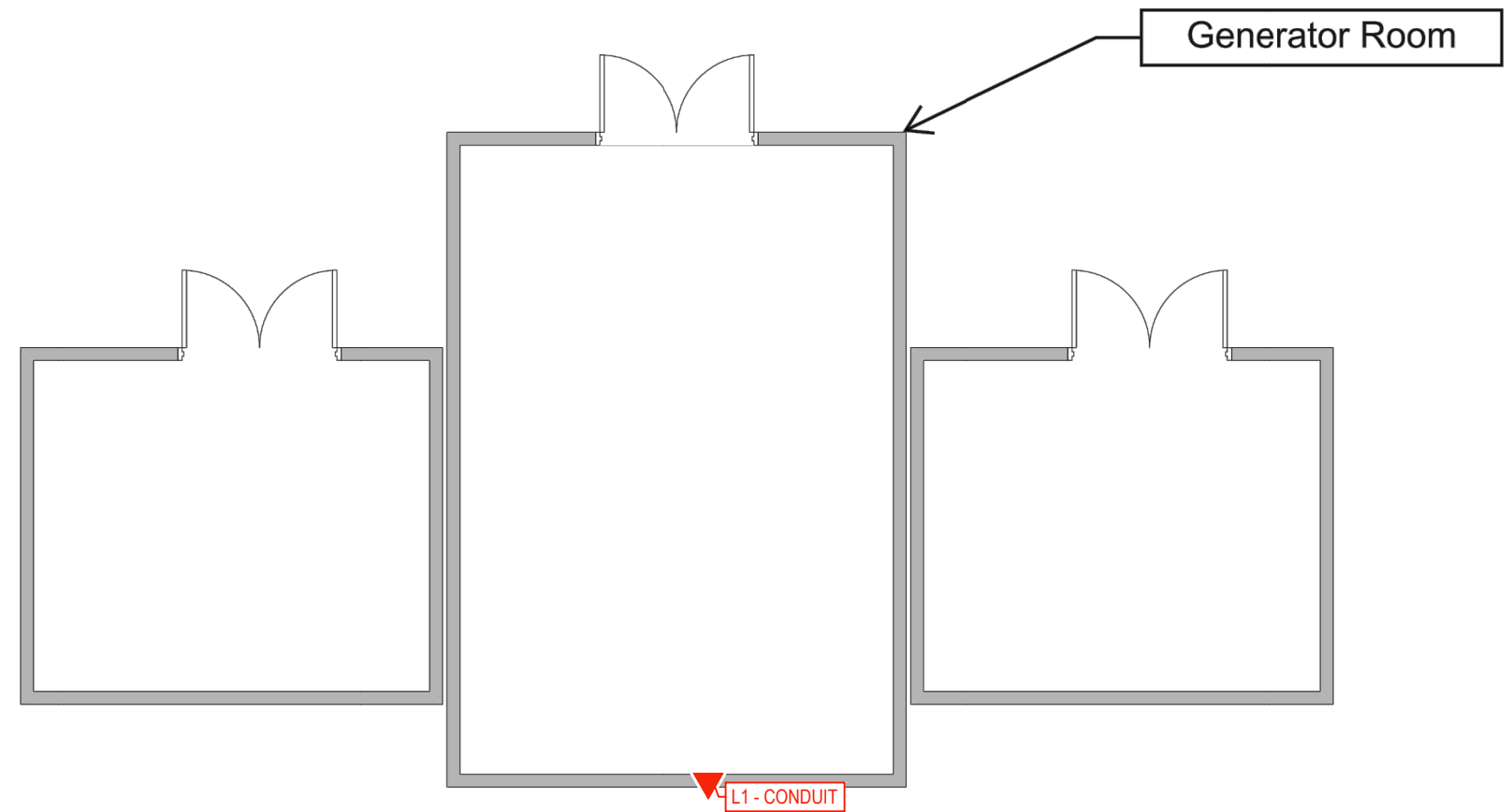
<i>Client Sample Description</i>	<i>Lab ID</i>	<i>Collected</i>	<i>Analyzed</i>	<i>Weight</i>	<i>Lead Concentration</i>
LCB-1	652000257-0001	1/13/2020	1/14/2020	0.2632 g	<80 ppm
Site: GENERATOR BUILDING - WEST WALL Desc: ELECTRICAL CONDUIT - LIGHT GREY					

Jefferson Salvador, Laboratory Manager  
or other approved signatory

\*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. 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. Samples received in good condition unless otherwise noted. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.  
Samples analyzed by EMSL Canada Inc. Calgary, AB CALA Accreditation #A3942

Initial report from 01/14/2020 14:09:28


**APPENDIX II**  
**SITE PLANS**



**Note**

1. This drawing shall be read in conjunction with the associated technical report.
2. Do not scale drawing.
3. Base plan provided by client.

**Legend**

 Approximate lead sample location

Revision	Date	Issue	Approval
A	01/15/2020	Preliminary	

Client  
**Public Services and Procurement Canada**

Site  
**Kingsgate Port of Entry**

Report Title  
**Hazardous Material Assessment  
Emergency Generator Room**

Drawing Title  
**Sample Location Plan**

Designed By <b>K.S.</b>	Scale <b>NTS</b>
----------------------------	---------------------

Drawn By <b>K.M.</b>	Date <b>January 2020</b>
-------------------------	-----------------------------

Approved By	Project No. <b>GV-VC-040154</b>
-------------	------------------------------------

Figure No. **2**



## APPENDIX D

---



**DST Consulting Engineers Inc.**  
Unit B - 4125 McConnell Drive  
Burnaby BC, V5A 3J7  
Canada

---

Public Services and Procurement Canada  
#401 – 1230 Government Street  
Victoria, BC  
V8W 3X4

January 16, 2020

Attention: Ms. Sherry Steele  
Environmental Specialist

**Subject: Pre-Renovation Hazardous Building Materials Assessment  
Emergency Generator Upgrade Project Waneta Point of Entry  
10290 Highway 22A, Salmo, British Columbia**

DST File No.: GV-VC-040154

---

## **1.0 INTRODUCTION**

DST Consulting Engineers Inc. (DST) was retained by Public Services and Procurement Canada (PSPC) to complete a hazardous building materials assessment limited to the potential disturbance of building materials pertaining to the proposed generator upgrade at the Waneta Point of Entry, 10290 Highway 22A, Salmo, British Columbia (herein referred to as the Project Area).

## **2.0 SCOPE OF WORK**

The assessment was completed to establish an inventory of select hazardous materials. The assessment was limited to include asbestos-containing materials (ACMs), lead-based coatings (LBCs), polychlorinated biphenyls (PCB), ozone-depleting substances (ODS), elemental mercury, silica, rodent droppings and suspect visible mould, located within the Project Area in preparation for emergency generator upgrades.

At the time of DST's assessment, DST noted that the existing emergency generator had been removed and replaced. This assessment was limited to exterior surfaces (curbs and bollards) that may be impacted through limited excavation of a suspected underground storage tank located within the Project Area.

### **3.0 REGULATIONS AND GUIDELINES**

#### **3.1 Provincial Regulations**

In British Columbia, the management of hazardous building materials in the work place is regulated by WorkSafeBC under the Workers' Compensation Act (effective April 15, 1998), as amended by the Workers' Compensation (Occupational Health and Safety) Amendment Act (including amendments to the date of this report). Specific requirements of the Occupational Health and Safety Amendment Act are prescribed in the British Columbia Occupational Health and Safety (BC OH&S) Regulation.

##### **3.1.1 Hazardous Materials & Demolition/Renovations**

Section 20.112 of the BC OH&S Regulation details the requirements that employers and owners are responsible for before beginning work on the demolition, renovation or salvage of machinery, equipment, buildings, or structures. The employer or owner must:

- Inspect the site to identify any asbestos, lead and/or other potentially hazardous materials that may be handled, disturbed, or removed;
- Have the inspection results available at the worksite; and,
- Ensure that the hazardous materials are safely contained or removed.

##### **3.1.2 Asbestos-Containing Materials (ACMs)**

ACMs in the workplace are regulated under Part 6 (sections 6.1 to 6.32) of the BC OH&S Regulation.

##### ***Applicable WorkSafeBC Guideline - Safe Handling of Asbestos, a Manual of Standard Practices***

This manual outlines basic information on asbestos and asbestos products, health hazards requirements for worker protection, safe work procedures and principles that should be followed in selecting the most suitable technique for the safe abatement of ACM. This document provides a guide to current practices that are to be followed in the Province of British Columbia.

##### **3.1.3 Lead**

Lead in the workplace is regulated under Part 6 (sections 6.59 to 6.69) of the BC OH&S Regulation.

### ***Applicable WorkSafeBC Guideline – Lead-Containing Paints and Coatings – Preventing Exposure in the Construction Industry***

This manual provides a guide to current practices that are to be followed in the Province of British Columbia, providing basic information on lead and lead products, health hazards and requirements for worker protection, safe work procedures and principles that should be followed in selecting the most suitable technique for the safe abatement of lead.

The *Hazardous Products Act (HPA)*, *Surface Coating Materials Regulation (SOR/2005-109)* provides regulatory requirements for the sale and labeling of surface coatings.

The Surface Coating Materials Regulation reduced the threshold for lead in paint from 5,000 mg/kg to 600 mg/kg, and in 2010, to 90 mg/kg.

#### **3.1.4 Hazardous Waste**

In British Columbia, environmental matters pertaining to waste generally fall under the jurisdiction of the British Columbia Ministry of Environment (MoE), pursuant to the Environmental Management Act. The key waste regulation under the Environmental Management Act relating to hazardous building materials is the Hazardous Waste Regulation (HWR), as amended from time to time. The HWR provides the requirements for the proper handling, storage, transportation, treatment, recycling and disposal of hazardous wastes in the province. The regulation also outlines the materials and criteria to be used to characterize waste as hazardous.

### **3.2 Federal Regulations**

#### **3.2.1 Canada Labour Code**

In federal jurisdictions, hazardous building materials are regulated under the *Canada Labour Code, Part II, Part X, Hazardous Substances*.

#### **3.2.2 Asbestos-Containing Materials (ACMs)**

ACMs are regulated under the Canada Occupational Health and Safety Regulations, (SOR/86-304). An asbestos-containing material is defined as a manufactured product that contains >0.5 % asbestos fibres by weight, at the time of manufacture, or vermiculite insulation that contains any asbestos fibres.

Vermiculite insulation is commonly found in the hollow cores of cinderblock walls, masonry brick, used as attic / floor cavity insulation, as well as an additive in wall / ceiling plaster compounds. As per WorkSafeBC requirements, vermiculite that contain any asbestos fibres, regardless of

concentration, must be considered asbestos-containing. The recommended sample volume for vermiculite insulation is ~ one (1) Litre and analysis can be completed following US EPA analytical method EPC/600/R-93/116, or by Transmission Electron Microscopy (TEM) analysis.

In addition, PSPC has developed the Asbestos Management Standard, effective June 5, 2017, that provide specific requirements for the management and abatement of ACMs.

### **3.2.3 Lead-Based Coatings (LBCs)**

The *Hazardous Products Act (HPA)*, *Surface Coating Materials Regulation (SOR/2005-109)* provides regulatory requirements for the sale and labeling of surface coatings. The Surface Coating Materials Regulation reduced the threshold for lead in paint from 5,000 mg/kg to 600 mg/kg, and in 2010, to 90 mg/kg.

### **3.2.4 Halocarbon and Ozone Depleting Substances (ODS)**

Halocarbon and Ozone Depleting substances are regulated under the Canadian Environmental Protection Act (CEPA), "*Federal Halocarbon Regulations, 2003, (SOR/2003-289)*".

### **3.2.5 Polychlorinated Biphenyl's (PCBs)**

PCBs are regulated under the Canadian Environmental Protection Act, specifically under the "*PCB Regulations*" (SOR/2008-273), including amendments up to the date of this report.

### **3.2.6 Transportation of Dangerous Goods Act**

The Transportation of Dangerous Goods Act provides detailed requirements for the transportation of hazardous materials.

## **4.0 METHODOLOGY**

The assessment was completed on November 18th, 2019, by Kevin Smith, Senior Project Manager of DST. DST referenced a report prepared by Arcadis Canada Inc., entitled "*Hazardous Building Materials Assessment for Waneta Border Crossing*", dated March 9, 2017 (herein referred to as the Previous Report).

Suspect hazardous building materials were visually identified, based on the surveyor's knowledge of the historic composition of building products. Visual identification of materials suspected to contain asbestos or lead (in coatings) was supported by the analysis of representative samples. Bulk asbestos samples were analyzed using Polarised Light Microscopy (PLM) using National Institute for Occupational Safety and Health (NIOSH) Analytical Method 9002 – Asbestos (Bulk)



by PLM. Suspect ACM samples were analyzed for asbestos content at EMSL Canada Inc. (EMSL).

Suspect LBC samples were tested for content at EMSL Canada Inc., by Flame Atomic Absorption, (FLAA) (SW 846 3050B/7000B).

## **5.0 FINDINGS**

The following sections outline the findings of the hazardous building materials assessment.

### **5.1 Condition of Material Samples**

The condition of the sampled materials were classified in the following format:

**GOOD** Surface of materials show no significant signs of damage, deterioration or delaminating. No repairs required.

**FAIR** Surface of materials show some significant signs of damage, deterioration or delaminating. Repairs required as soon as possible.

**POOR** Surface materials show significant signs of damage, delaminating or deterioration. Repairs required immediately and will require removal and/or significant alterations.

### **5.2 Asbestos-Containing Materials (ACMs)**

Through the assessment, no materials suspected to contain asbestos were identified as having to be disturbed to complete the generator upgrades.

### **5.3 Lead-Based Coatings (LBCs)**

Through the assessment two (2) samples of suspect LBCs were collected and analyzed for lead content. The sample locations, descriptions and analytical results are summarized in **Table 1**, below.

Certificates of analysis are presented in **Appendix I**. A Site plan, illustrating sample point locations is presented in **Appendix II**.

<b>Table 1 - Lead Results – Emergency Generator Area Waneta Point of Entry, Salmo, BC</b>									
<b>Sample Number</b>	<b>Area or Room</b>	<b>Material Type</b>	<b>Location</b>	<b>Substrate</b>	<b>Analytical Result PPM</b>	<b>Lead-Based Coating (Yes/No)</b>	<b>Current Condition</b>	<b>Accessibility</b>	<b>Current Risk of Exposure</b>
L-1	Safety Ballard	Safety Yellow Paint	Adjacent to Former Generator Pad	Steel	<80	No	N/A	N/A	N/A
<b>L-2</b>	<b>Sidewalk</b>	<b>Safety Yellow Paint</b>	<b>Adjacent to Former Generator Pad</b>	<b>Concrete</b>	<b>25,000</b>	<b>Yes</b>	<b>Fair</b>	<b>High</b>	<b>Mod</b>

Note: **Bold print** indicates a coating containing potentially hazardous levels of lead.

Based on the findings of our assessment, the Yellow colored paint applied to the sidewalk was found to contain potentially hazardous levels of lead.

#### **5.4 Halocarbon and Ozone Depleting Substances (ODSs)**

Equipment suspected to contain halocarbon and ozone-depleting substances were not identified within the Project Area.

#### **5.5 Elemental Mercury**

No Sources of Elemental Mercury were observed within the Project Area.

#### **5.6 Polychlorinated Biphenyls (PCBs)**

No Sources of PCBs were identified within the Project Area

#### **5.7 Mould Amplification**

Suspected mould amplification was not identified within the Project Area.

#### **5.8 Crystalline Silica**

Sources of crystalline silica were identified in the masonry slabs of the Project Areas.

## **5.9 Rodent Droppings**

No rodent droppings were observed during the site assessment within the Project Area.

## **6.0 RECOMMENDATIONS**

### **6.1 Lead-Based Coatings (LBCs)**

Control the preparation of painted surfaces in accordance with the requirements of WorkSafeBC, specifically but not limited to include those requirements prescribed in Parts 5.48-5.59 – Controlling Exposure and Parts 6.59-6.69 – Lead of the BC OH&S Regulation. Working in proximity to identified LBCs presents a low risk of exposure. As such, DST would recommend Low Risk safe work procedures for demolition activities that will be conducted in close proximity to identified LBCs.

DST recommends reference to WorkSafeBC publication “*Safe Work Practices for Handling Lead*”, latest edition. This manual provides a guide to current practices that are to be followed in the Province of British Columbia, providing basic information on lead and lead products, health hazards and requirements for worker protection, safe work procedures and principles that should be followed in selecting the most suitable technique for the safe abatement of LBCs.

Lead-containing wastes should be disposed of in accordance with the British Columbia Ministry of Environment and should be transported in accordance with the requirements of the Federal Transportation of Dangerous Goods Act.

### **6.2 Crystalline Silica**

Through the course of mechanical renovation activities, the masonry slabs should be wetted (saturated) with water, prior to, during and upon completion of mechanical renovation activities in an effort to minimize the potential for crystalline silica or rock dust release.

## **7.0 REPORT LIMITATIONS**

This report is intended for client use only. Any use of this document by a third party, or any reliance on or decisions made based on the findings described in this report, are the sole responsibility of such third parties, and DST Consulting Engineers Inc. accepts no responsibility for damages, suffered by any third party as a result of decisions made or actions conducted based on this report. No other warranties are implied or expressed.

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the client. The sampling program included

asbestos bulk sampling and paint chip sampling in select representative areas for laboratory analysis. Note, however, that no scope of work, no matter how exhaustive, can guarantee to identify all contaminants. This report therefore cannot warranty that all building conditions are represented by those identified at specific locations.

Recommendations, when included, are made in good faith and are based on several successful experiences.

Note also that standards, guidelines and practices related to environmental investigations may change with time. Those which were applied at the time of this investigation may be obsolete or unacceptable at a later date.

Any comments given in this report on potential remediation problems and possible methods are intended only for the guidance of the designer. The scope of work may not be sufficient to determine all of the factors that may affect construction, clean-up methods and/or costs. Contractors bidding on this project or undertaking clean-ups should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the conditions may affect their work.

Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the client.

## 8.0 CLOSURE

We hope the information presented in this document meets your current requirements. If you have any questions, or require additional information please contact us at your convenience.

Yours truly,

### **DST Consulting Engineers Inc.**

Report Prepared By:



for,

Kevin Smith  
*Associate, Senior Project Manager*

Report Reviewed By:



Christian Injates, CEC, CEM  
*Associate, Regional Manager*

**APPENDIX I**  
**CERTIFICATES OF ANALYSIS**



**EMSL Canada Inc.**

2333 18th Avenue NE, Unit 48, Calgary, AB T2E 8T6  
Phone/Fax: (403) 879-1149 / (403) 879-1152  
<http://www.EMSL.com> [CalgaryLab@EMSL.com](mailto:CalgaryLab@EMSL.com)

EMSL Canada Or 651909187  
CustomerID: 55DSTC42  
CustomerPO:  
ProjectID:

Attn: **Kevin Smith**  
**DST Consulting Engineers Inc.**  
**#102 - 1629 Baker Street**  
**Cranbrook, BC V1C 1B4**

Phone: (250) 421-9434  
Fax:  
Received: 11/21/19 11:30 AM  
Collected: 11/18/2019

Project: **GV-VC-040154 / WANETA BORDER CROSSING, BRITISH COLUMBIA, CANADA**

**Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)\***

<i>Client Sample Description</i>	<i>Lab ID</i>	<i>Collected</i>	<i>Analyzed</i>	<i>Weight</i>	<i>Lead Concentration</i>
040154-L1	651909187-0001	11/18/2019	11/22/2019	0.2551 g	<80 ppm
Site: NEAR OLD GEN PAD BALLARD ADJACENT TO OLD GEN PAD Desc: PAINT - LIGHT YELLOW					
040154-L2	651909187-0002	11/18/2019	11/22/2019	0.2604 g	25000 ppm
Site: NEAR OLD GEN PAD - SIDEWALK ADJACENT TO OLD GEN PAD Desc: PAINT - MEDIUM YELLOW					

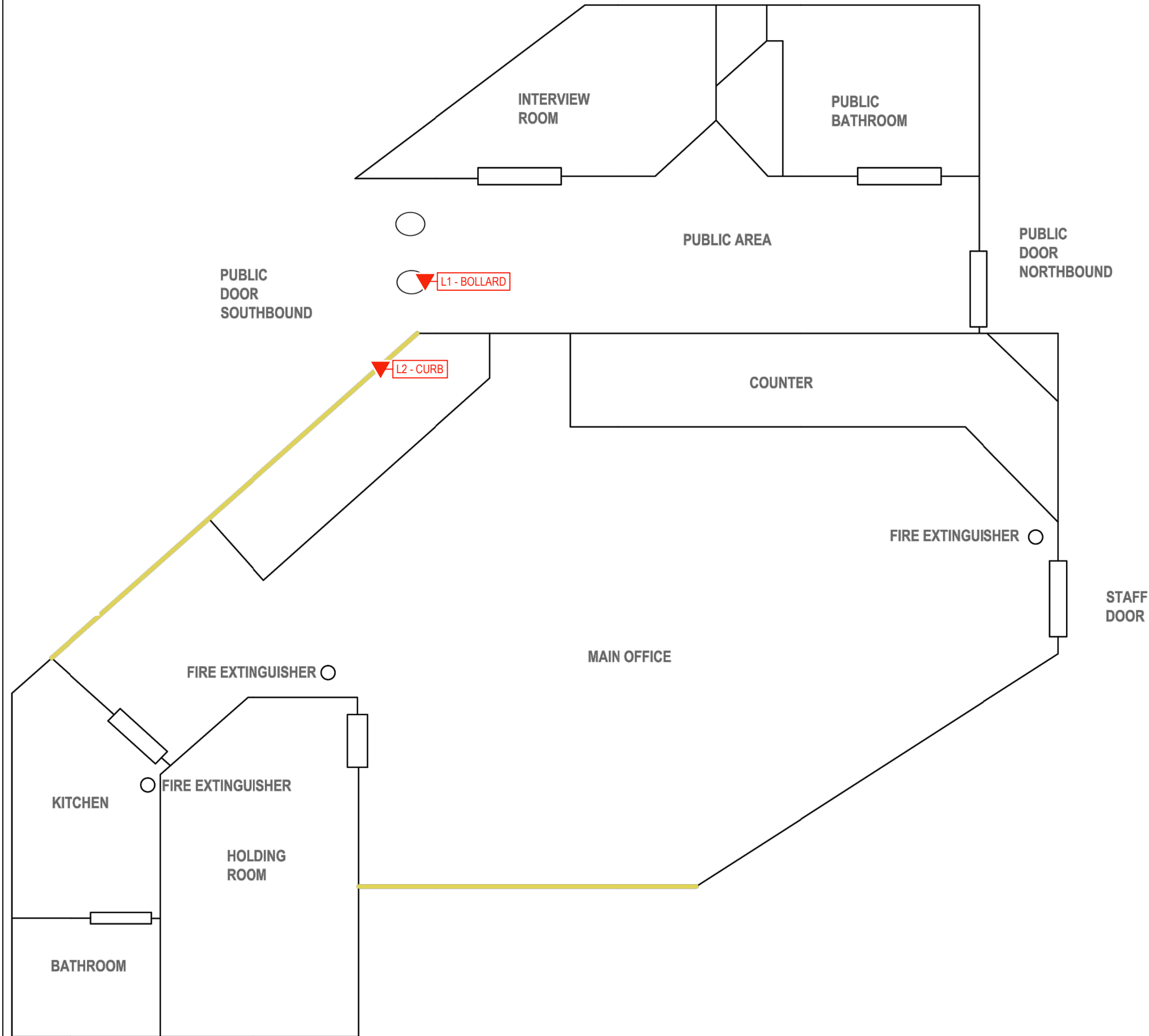
Jefferson Salvador, Laboratory Manager  
or other approved signatory

\*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. 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. Samples received in good condition unless otherwise noted. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.  
Samples analyzed by EMSL Canada Inc. Calgary, AB CALA Accreditation #A3942

Initial report from 11/22/2019 15:48:52

**APPENDIX II**  
**SITE PLANS**

Drawing: 1 waneta.dwg Folder: L:\TSCAD\Projects\GV\VC-040154 Waneta and Kingsgate 2020 Hazmat Assessment\DWGs Thursday, January 16, 2020 @ 09:43 by Kris Morin



**Note**

1. This drawing shall be read in conjunction with the associated technical report.
2. Do not scale drawing.
3. Base plan provided by client.

**Legend**

▼ Approximate lead sample location

Revision	Date	Issue	Approval
A	01/15/2020	Preliminary	

Client  
**Public Services and Procurement Canada**

Site  
**Waneta Port of Entry**

Report Title  
**Hazardous Material Assessment  
Emergency Generator Room**

Drawing Title  
**Sample Location Plan**

Designed By <b>K.S.</b>	Scale <b>NTS</b>
----------------------------	---------------------

Drawn By <b>K.M.</b>	Date <b>January 2020</b>
-------------------------	-----------------------------

Approved By	Project No. <b>GV-VC-040154</b>
-------------	------------------------------------

Figure No.  
**1**