Public Works and
Government Services Canada

Requisition No. R.068835.001 - EZ899-171574-A

SPECIFICATIONS
for
Palace Grand Theater
Foundation/Mechanical/Electrical Renovation and General Upgrade
Dawson City, Yukon Territory
for
PWGSC / PARKS CANADA AGENCY

APPROVED BY:

Regional Manager, AES — Date: 2016-09-27

Construction Safety Coordinator — Date: 2016-09-21

TENDER:

August 31 2016

Real Property Services Branch, Professional and Technical Services, Pacific Region
Room 219 - 800 Burrard Street, Vancouver, B.C. V6Z 0B9

SPECIFICATION

Division 5- Metals

Division 06 – Wood, Plastics and Composites

Division 07 – Thermal and Moisture Protection

Division 8 – Openings

Division 9 – Finishes

Division 10 – Specialties

Division 20 – Mechanical General Requirements

Division 21 – Fire Suppression

Division 22 – Plumbing

Division 23 – Heating Ventilation and Air Conditioning

APPENDICIES

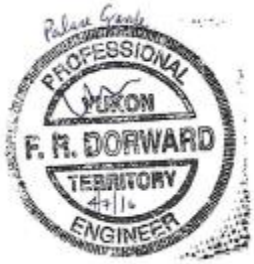
Drawing List (Bound Separately)

ARCHITECTURAL:

STRUCTURAL:

ELECTRICAL:

MECHANICAL:

DISCIPLINE	SEAL
PRIME CONSULTANT ARCHITECT **NUMBERTEN ARCHITECTURAL GROUP**	
MECHANICAL ENGINEER **STANTEC**	
ELECTRICAL ENGINEER **DORWARD ENGINEERING SERVICES LTD**	

STRUCTURAL ENGINEER **CWMM COSULTING ENGINEERS LTD**	
GEOTECHNICAL ENGINEER **AMEC FOSTER WHEELER**	
FIRE ENGINEER (CODE) **GHL CONSULTANTS LTD**	
CIVIL ENGINEER **STANTEC**	
FIRE PROTECTION ENGINEER (SPRINKLER) **STANTEC**	

END OF SECTION

.1 General

1.2 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract is to take place at Palace Grand Theater in Dawson City in Yukon Territory. The Palace Grand Theater is a heritage building.

1.3 DESCRIPTION OF WORK

.1 The work is comprised of interior and exterior improvements to the existing Palace Grand Theater. Applicable hazardous material abatement/disposal will be completed under this contract. Refer to Appendix A and B for Hazmat information.

The existing mechanical room will have all interior finishes removed from the walls and ceilings and be insulated with spray in place foam insulation to fill the cavities. The interior finishes and attachments will then be restored.

Existing asbestos containing exterior siding on the mechanical room, washrooms, vestibule and staircase portions of the building will be removed and replaced with a new reinforced cementitious panel siding system. A new sloped insulated roofing system will be installed over these areas. New windows will be installed in the vestibule and the washroom areas.

Roofing at the eaves of the existing building stair shafts, will be lifted and an eave protection membrane will be installed on the roof deck.

The entire existing Main and Mechanical room floors, will have material removed as required to install the spray foam insulation with the installation of fire taped gypsum wallboard attached to girts and or to the underside of the joists or floor structure. The crawl space floor material will be removed as necessary to perform structural, mechanical and electrical work and then an overall gravel layer will be added.

All work within the crawl space that is NOT associated specifically with removing or disturbing (digging, relocating, etc.) asbestos-contaminated soil MUST be conducted using personal protective equipment as well as entry, exit and decontamination procedures as stipulated in Section 02 82 00.01 – Asbestos Abatement – Minimum Precautions.
All work within the crawl space that WILL require removing or disturbing (digging, relocating, etc.) asbestos-contaminated soil MUST be conducted in accordance with the procedures as stipulated in Section 02 82 00.02 – Asbestos Abatement – Intermediate Precautions.

Interior renovations will be performed. Some of the items include installation of fire doors, installation of nosings and resilient mats in the stairwells and restoration of any interior finishes affected by the renovation work. Any interior work will be required to follow proper asbestos abatement procedures, where specified herein.

Mechanical/Electrical, scopes for the individual disciplines as listed below:

.1 Commissioning scope

.1 The successful bidder is responsible for obtaining the services of a Commissioning Agent to provide the following documents and services

.1 Prepare Cx Plan and Cx schedules

.2 Prepare Cx Forms.

.3 Witness test performed by the commissioning agents

.4 Prepare functional tests procedure.

.5 Witness the functional tests and repeat if necessary.

.6 Witness end user training.

.7 Provide letter of assurance on Mechanical and Electrical Commissioning

.8 Provide draft Electrical and Mechanical Commissioning report

.9 Confirm operation of seasonal deficiencies

Provide final Electrical and Mechanical Commissioning report

.2 Hazardous Materials Scope

.1 Hazardous Materials remediation for the exterior cladding and crawlspace soils will be completed under this contract. Portions of the project will also involve handling, modification, removal and /or disposal (abatement) of the following hazardous building materials:

.1 Asbestos-containing vermiculite - trace debris pinched between joists and overlying subfloor. Potential for release of this material during work in the crawlspace of the building must be addressed/mitigated.

.2 Asbestos-contaminated soil will require disturbance (digging, re-location, removal) to facilitate other work.

.3 Asbestos-containing joint compound on gypsum walls throughout.

.1 Localized patch and repair under asbestos abatement precautions.

.4 Localized patch and repair under asbestos abatement precautions.

.5 Asbestos-containing white woven flex duct connectors between the main furnace units and primary furnace ducting (one on each of the four furnaces) in the mechanical room will require removal and disposal.

.6 Asbestos-containing white fibrous liner/gaskets found on circular furnace hatches (one on each of the four furnaces) in the mechanical room will require removal and disposal

.7 Asbestos-containing white furnace gasket found between a furnace and a red burner box in the mechanical room will require removal and disposal.

.8 Lead-containing grey paint on furnace ducts, walls and ceiling (gypsum board and/or plywood) in the mechanical room will require appropriate action (e.g. exposure control plan for activities that will generate fine particulate; appropriate disposal) if disturbance and/or disposal of materials is planned.

.9 Potential PCB-containing light ballasts (1) will require assessment and appropriate disposal, if the fluorescent light fixture is taken out of service.

.10 Mercury-containing fluorescent light tubes (1 fixture) and thermostat (1) will required appropriate removal and disposal, if taken out of service.

.11 Ozone-depleting substances within the HVAC unit on the roof of the mechanical room (if present in the form of refrigerants) will require appropriate removal/recovery and/or disposal.

.12 Appropriate precautions to control silica exposure during work that will disturb concrete, ceramic tiles, cement, masonry block or other silica-containing items will be required.

.3 Structural Scope

.1 Provide crib foundations and floor beams as shown on drawings to existing west building wall and west stair wall;

.2 Replace existing split timber pile cap;

.3 Provide new concrete pad for mechanical units as shown on drawings;

.4 Strengthen north walls for new wall opening;

.5 Replace existing hanger bars;

.6 Strengthen existing ceiling joist end support;

.7 Other works as shown on the drawings.

.4 Architectural Scope

.1 Installation of new mineral fiber reinforced cementitious panels on portions of the building

.2 Installation of new modified bituminous roofing system on portions of the building.

.3 Installation of ice and water shield at eaves of existing roof.

.4 Removal of all interior finishes in the mechanical room, installing new spray foam insulation, and installing new GWB finishes.

.5 Removal of existing windows and replacement of new specified window system.

.6 Install from the building crawlspace, sprayed in place foam insulation and gypsum board to underside of entire main and mechanical floors.

.7 Install gravel, covering the crawlspace area of the main and mechanical building.

.8 Installation of fire rated doors as specified.

.9 Door hardware upgrades as indicated and specified.

.10 Interior GWB installation, removal and reinstatement.

.11 Installation of stair nosings and tactile warning mats in staircases.

.5 Mechanical Scope

.1 Demolish existing building mechanical systems as indicated including:

.1 Building sprinkler system;

.2 Select plumbing in crawlspace and on roof as indicated;

.3 All mechanical systems in mechanical/electrical room;

.4 Select ductwork as indicated.

.2 Provide new exterior air handling unit on concrete pad at North side of building.

.3 Install new HVAC ductwork and hydronic reheat coils as indicated. Connect to existing ductwork as indicated.

.4 Install a new smoke exhaust HVAC system as indicated.

.5 Clean all new and existing ductwork. Seal all existing ductwork. Balance ventilation system

.6 Install new water supply in crawlspace to mech/elec room.

.7 Install new sanitary systems in crawlspace as indicated.

.8 Install new sanitary vents with new washroom/corridor roof.

.9 Install new washroom and janitor room exhaust air goosenecks with new washroom/corridor roof.

.10 Install new low point sump in crawlspace and drain line to grade as indicated.

.11 Install a new dry sprinkler system complete with all appurtenances as indicated.

.12 Install new oil fired unit heater in mechanical room.

.13 Decommission existing FO storage tank.

.14 Provide new doubled walled ULc listed tank inside mech/elec room complete with exterior fill box.

.15 Install fuel oil system as indicated.

.16 Install new HVAC control system as indicated and as specified.

.17 For all mechanical; fire suppression, plumbing supply/drainage and HVAC work, allow for +/- 50mm deflection at any connection point for future jack leveling in the crawlspace and elsewhere affected by building movement either by gravity or by intentional building height adjustment.

.6 Electrical Scope:

.1 General

.1 For all wiring in the crawlspace; allow for +/- 50mm deflection at any connection point between the earth or crawlspace sidewalls and the building structure for future jack leveling in the crawlspace and elsewhere that may be affected by building movement either by gravity or by intentional building height adjustment.

.2 New wiring in historic public areas is to be installed in wiremold, or hidden inside careful removal of existing bulkheads. Conduit is acceptable for all new wiring in crawlspace, mechanical room, and non-public areas.

.3 Contractor to salvage generator control panel and transfer switch and turn over to owner.

.4 All other electrical equipment to be removed from site.

.5 Contractor to salvage emergency light battery packs and exit lights for reuse later.

.2 Lighting

.1 Supply and install new dimmable LED fixtures in staff and house lighting areas of the building.

.2 Supply and install new lamps in burnt out or inoperable light fixtures.

.3 Provide LED stair tread lighting for Stairway A, Stairway B, and Circle 206 as shown on drawings.

.4 Provide LED fixtures in the crawlspace.

.5 Existing house lighting dimmer panel to be reconnected once building has been reinsulated.

.3 Power

.1 Supply and install new receptacles in all locations.

.2 Supply and install new floor box receptacles on the Stage and Pinrail Gallery.

.3 Supply and install connections for new heating coils.

.4 Supply and install a minimum of eight (8) GFI receptacles in the crawlspace for complete and even coverage of the area.

.5 Replace any damaged or improperly secured conduits in the theatre and in the crawlspace.

.6 Install new heat trace for new and reuse sanitary line.

.7 Connect new 3000W DHWT under counter at Bar 102.

.8 New overhead service.

.9 Install new ground bus in mechanical/electrical room.

.10 Provide 2 new 84CCT panels in mechanical/electrical room.

.11 Install new dedicated outlet in mechanical/electrical room for glycol tank.

.12 Install new service entrance, MCC, and CDP and panels in mechanical/electrical room.

.13 Remove for re-insulation and replace as required all existing electrical equipment in mechanical/electrical room.

.14 Disconnect, correctly label, cap and make, safe all circuits in and leaving the mechanical room prior to reinsulating

.15 All existing circuits are to be reconnected into one of two new 84 CCT panels.

.16 Supply and install all electrical required for new mechanical systems including VFD for AHU-1.

.17 Repair disconnected conduits and provide additional strapping/support for crawlspace conduits.

.18 Replace damaged BX cable above access hatch to the attic space.

.19 All disconnected circuits are to be reconnected into new electrical equipment in the mechanical/electrical room, where shown on the plans.

.4 Telephone

.1 Install above ground tel service to existing Northwestel pole.

.5 Fire Alarm

.1 Supply and install new, fully supervised and addressable, Class A fire alarm system.

.2 Replace all existing fire alarm devices with new addressable devices.

.3 Install new fire alarm devices where shown on drawings.

.4 Supply and install new fire annunciator in mechanical/electrical room.

.5 Remove end of line resistors, and associated boxes and wiring, as new system will be Class A. Replace all EOL devices with blank cover plates to match existing finishes.

.6 Notification devices are to be replaced with new horn strobe combination.

.7 Install connections for new smoke evacuation system.

.8 Provide new UPS and VFD for two (2) 3HP smoke ventilation exhaust fan motors.

.9 Install new manual smoke detector deactivation system, for the smoke detectors in stage ceiling.

.10 Provide system monitoring demark connection.

.6 Emergency Lighting

.1 • Reconnect salvaged battery packs and Beghelli unit to existing emergency lighting wiring as found on site.

.7 Geotechnical Scope:

.1 Refer to Structural documentation for Geotechnical references.

1.4 CONTRACT DOCUMENTS

.1 The Contract documents, drawings and specifications are intended to complement each other, and to provide for and include everything necessary for the completion of the work.

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

1.5 DIVISION OF SPECIFICATIONS

.1 The specifications are subdivided in accordance with the current 6-digit National Master Specifications System.

.2 A division may consist of the work of more than 1 subcontractor. Responsibility for determining which subcontractor provides the labour, material, equipment and services required to complete the work rests solely with the Contractor.

.3 In the event of discrepancies or conflicts when interpreting the drawings and specifications, the specifications govern.

1.6 TIME OF COMPLETION

.1 Complete all work associated with the project and have the facility ready for use within (12) twelve months after Contract Award.

1.7 HOURS OF WORK

.1 The work may be scheduled at the contractor's discretion provided the contractor conforms to the local noise bylaw. This bylaw prohibits excessive noise between the hours of 11 pm and 7am. Any work outside of these hours required to achieve the deadline be approved with the City of Dawson and the Departmental Representative.

1.8 SITE MEETINGS

.1 General Contractor to arrange project meetings and to be responsible for arranging times, location, and recording and distributing meeting minutes.

1.9 COST BREAKDOWN

.1 Before submitting the first progress claim, submit a breakdown of the Contract lump sum prices in detail as directed by the Departmental Representative and aggregating Contract price. After approval by the Departmental Representative, cost breakdown will be used as a basis for progress draws.

1.10 CONTRACTORS USE OF PREMISES

.1 Contractor to have control of site until Substantial performance.

.2 Contractor to assume responsibility for assigned premises for performance of work

.1 This includes provisions for temporary heat and electrical services.

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

.4 Contractor to provide security of the work site and all Contractors and Subcontractors equipment and material. Secure Contractors work site at the end of the day.

.1 The contractor will be responsible for providing 24 hour fire watch and supervision of the existing building during any disconnection from utilities and fire suppression equipment

.2 This supervision will include the provision of appropriate fire suppression equipment and personnel required to operate the equipment.

.5 Contractor shall not obstruct access outside the Contractors work site. Maintain overhead clearances, keep roadways and walkways clear, and maintain routes for emergency response vehicles.

.6 Contractor to perform work in accordance with Contract documents. Ensure work is carried out in accordance with approved schedules.

1.11 EXISTING SERVICES

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

.2 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.

.3 Provide temporary services, to maintain critical building systems.

.4 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

.5 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

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

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

1.12 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 at least 48 hours prior to impending installation and obtain approval for actual location.

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

1.13 CUTTING AND PATCHING

.1 Propose any cutting of existing surfaces as required to accommodate new work that is not specified on the drawings to the Departmental Representative for review and approval. Cutting should be kept as minimum to minimize intervention to the building’s heritage aspects.

.2 Remove items so shown or specified.

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

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

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

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

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

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

1.14 SETING OUT OF WORK

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

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

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

1.15 ACCEPTANCE OF SUBTRADES

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

1.16 WORKS COORDINATION

.1 Coordinate work of sub-trades:

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

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

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

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

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

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

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

.6 Publish minutes of each meeting.

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

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

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

.4 Work cooperation:

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

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

.3 Ensure disputes between subcontractors are resolved.

.5 Departmental Representative is not responsible for, or accountable for extra costs incurred as a result of Contractor's failure to coordinate Work.

.6 Maintain efficient and continuous supervision.

1.17 APPROVAL OF SHOP DRAWINGS

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

.2 Allow sufficient time for the following:

.1 Review of product data.

.2 Approval of shop drawings.

.3 Review of re-submission.

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

1.18 TESTING AND INSPECTION

.2 Particular requirements for inspection and testing to be carried out by testing service or laboratory approved by the Departmental Representative are specified various Sections.

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

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

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

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

.4 Mill tests and certificates of compliance.

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

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

.5 The Departmental Representative may require, and pay for, additional inspection and testing services not included in paragraph 1.24.2.

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

.7 Contractor shall furnish labour and facilities to carry out specified testing and notify Departmental Representative in advance of planned testing.

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

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

.10 Provide Departmental Representative with 2 copies of testing laboratory reports as soon as they are available.

1.19 RELICS AND ANTIQUITIES

.1 Relics and antiquities and items of historical or scientific interest shall remain property of Department. Protect such articles and request directives from Departmental Representative.

.2 Give immediate notice to Departmental Representative if evidence of archeological finds are encountered during excavation/construction, and await Departmental Representative's written instructions before proceeding with work in this area.

1.20 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.

1.21 AS-BUILT DOCUMENTS

.1 The Departmental Representative will provide 2 sets of drawings and 2 sets of specifications for “as-built” purposes.

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

.3 Refer to Section 01 78 10 Closeout Procedures.

1.22 ADDITIONAL DRAWINGS

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

1.23 FAMILIARIZATION WITH SITE

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

1.24 SUBMISSION OF TENDER

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 56 00 Temporary Barriers and Enclosures.

.2 Section 01 52 00 Construction Facilities

1.2 ACCESS AND EGRESS

.1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

1.3 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.

.2 Maintain existing services to building and provide for personnel and vehicle access.

.1 When existing services are interrupted maintain temporary heating and power to facilitate the completion of the work.

.3 Where security is reduced by work provide temporary means to maintain security.

.4 Closures: protect work temporarily until permanent enclosures are completed.

1.4 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 of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

.3 Provide for pedestrian and vehicular traffic.

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

1.5 SPECIAL REQUIREMENTS

.1 Do not carry out noise generating between the hours of 11:00 pm and 7:00 am in accordance with local noise bylaws

.2 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

.3 Keep within limits of work and avenues of ingress and egress.

.4 Ingress and egress of Contractor vehicles at site, site office placement and material storage is limited to the parking area on the west side of the building.

1.6 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions. Smoking is not permitted.

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 SCHEDULES REQUIRED

.1 Construction Schedule

1.2 SCHEDULE FORMAT

.1 Prepare schedule in form of a horizontal bar chart. (Gantt)

.2 Provide a separate bar for each major operation

.3 Provide horizontal time scale identifying first Working Day of each week.

.4 Identification of listings

.5 By specific task

.6 Identify work by phase

1.3 SCHEDULE SUBMISSION.

.1 Submit initial format of schedules within seven working days after award of Contract, unless otherwise directed by the Departmental Representative.

.2 Submit schedules in electronic format, forward through e-mail - .pdf files.

.3 Departmental Representative will review schedule and return review copy within seven days after receipt.

.4 Resubmit finalized schedule within three days after return of review copy, Unless otherwise directed by the Departmental Representative

.5 Submit revised progress schedule with each application for payment.

.6 Distribute copies of revised schedule to:

.1 Subcontractors.

.2 Other concerned parties.

.7 Instruct recipients to report to Contractor within five working days, any problems anticipated by timetable shown in schedule.

1.4 SCHEDULING

.1 Show complete sequence of construction by activity, identifying Work of separate stages and final completion of the entire project within the time period required by the Contract documents. Indicate the following:

.1 Submission of Shop Drawings, product data, MSDS sheets and samples

.2 Indicate estimated percentage of completion for each item of Work at each submission.

.3 Include dates for commencement and completion of each phase of the construction.

.4 Indicate final completion date within the time period required by the contract documents.

1.5 PROGRESS REPORTS

.1 Maintain an accurate record of the Construction work. Submit progress report when requested by the Departmental Representative.

.2 Include in reports, the dates of commencement and percentage of work completed for different aspects of the work.

1.6 CHANGES IN THE SCHEDULE

.1 Whenever proposing a change in the construction schedule, submit proposed revised schedule to the Departmental Representative, together with such analyses thereof as are required to clearly indicate the purpose and anticipated results of such changes.

.2 If, in the opinion of the Departmental Representative, any proposed change in construction scheduled is inadequate to secure completion of the Work within the specified time, or is otherwise not in accordance with the specifications, or if the Work is not being adequately or properly prosecuted in any respect, the Departmental Representative reserves the right to require a revised schedule together with such analyses thereof as are required to indicate the anticipated results of such revision.

.3 Claims for additional compensation or extension of Contract Time on account of such requirements will not be considered.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

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

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

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

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

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

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

.7 Verify field measurements and affected adjacent Work are co-ordinated.

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

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

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

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

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

.3 Allow 5 days for Departmental Representative's review of each submission.

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

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

.6 Accompany submissions with electronic transmittal, containing:

.1 Date.

.2 Project title and number.

.3 Contractor's name and address.

.4 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 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.

.13 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative

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

.15 Delete information not applicable to project.

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

.17 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.

.18 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.

1.3 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.

1.4 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic copy of digital photography in jpg format, standard resolution as directed by Departmental Representative.

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

.3 Number of viewpoints: 4 locations.

.1 Viewpoints and their location as determined by Departmental Representative.

.4 Frequency of photographic documentation: weekly and as follows

.1 As directed by Departmental Representative.

1.5 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Yukon Workers' Compensation Health and Safety Board status.

.2 Submit transcription of insurance immediately after award of 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 REFERENCES

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

.2 National Building Code of Canada (NBC):
- .1 Part 8, Safety Measures at Construction and Demolition Sites.

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

.4 Fire Protection Engineering Services, HRSDC:
- .1 FCC No. 301, Standard for Construction Operations.
- .2 FCC No. 302, Standard for Welding and Cutting.

.5 American National Standards Institute (ANSI):
- .1 ANSI/ASSE A10.3-2006, American National Standard - Construction and Demolition Operations- Safety Requirements for Powder-Actuated Fastening Systems.

.6 Province of British Columbia:
- .1 Workers' Compensation Act Part 3-Occupational Health and Safety.
- .2 Occupational Health and Safety Regulation.

1.2 RELATED SECTIONS

.1 Refer to the following sections as required:

- .1 Section 02 41 16 - Demolition: health and safety requirements specific to demolition.

1.3 WORKERS COMPENSATION BOARD COVERAGE

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

.2 Maintain Workers' Compensation Board coverage during term of Contract, until

and including date that Certificate of Final Completion is issued.

1.4 COMPLIANCE WITH REGULATIONS

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

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

1.5 SUBMITTALS

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

.2 Work effected by submittal will not proceed until review is complete.

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

.4 Departmental Representative will review Contractor's site-specific project Health and Safety Plan and emergency procedures and provide comments to Contractor within 5 working days after receipt of plan. Revise plan as appropriate and re-submit to Departmental Representative.

.6 Submission of Health and Safety Plan and any revised version to Departmental Representative is for information and reference purposes only. It will not:
- .1 Be construed to imply approval by Departmental Representative.
- .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
- .3 Relieve Contractor of his legal obligations for provision of health and safety on project.

1.6 RESPONSIBILITY

.1 Assume responsibility as 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 HEATH AND SAFETY CO-ORDINATOR

1 Health and Safety Co-ordinator must:

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

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

.3 Be on site during execution of work.

1.8 GENERAL CONDITIONS

.1 Provide safety barricades and lights around work site as required to provide 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 work site.

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

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

1.9 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with:

.1 Thermal, acoustic and ductwork insulation.

.2 Energized electrical services.

.3 Asbestos

1.10 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 above authorities, the most stringent provision will apply. Should dispute arise in determining the most stringent requirement, the Departmental Representative will advise on course of action to be followed.

1.11 WORK PERMITS

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

1.12 FILING OF NOTICE

.1 Complete and submit Notice of Project as required by Provincial authorities.

.2 Provide copies of all notices to Departmental Representative.

1.13 HEATH AND SAFETY PLAN

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

.2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including but not limited to 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.
  - .9 Occupational Health and Safety meetings.
  - .10 Occupational Health and Safety communications and record keeping procedures.
- .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of work.

.3 List hazardous materials to be brought on site as required by work.
.4 Indicate engineering and administrative control measures to be implemented at 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 plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in plan.

.4 Submit to Departmental Representative as indicated in **1.5 Submittals**

1.14 EMERGENCY PROCEDURES

.1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:
.1 Designated personnel from own company.
.2 Regulatory agencies applicable to work and as per legislated regulations.
.3 Local emergency resources.
.4 Departmental Representative.

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

1.15 HAZARDOUS PRODUCTS

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

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

.1 Advise Departmental Representative beforehand of product(s) intended for use. Submit applicable MSDS and WHMIS documents as per Section 01 33 00 - Shop Drawings, Product Data and Samples.

.2 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when tenants have left building.

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

1.16 ELECTRICAL SAFETY REQUIREMENTS

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

.1 Before undertaking any work, coordinate 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.

1.17 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 Departmental Representative.

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

1.18 OVERLOADING

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

1.19 SCAFFOLDING

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

1.20 CONFINED SPACES

.1 Carry out work in confined spaces in compliance with Provincial regulations.

1.21 POWDER ACTUATED DEVICES

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

1.22 FIRE SAFETY AND HOT WORK

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

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

1.23 FIRE SAFETY REQUIREMENTS

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

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

1.24 FIRE PROTECTION AND ALARM SYSTEMS

.1 Where available, fire protection and alarm systems not to be:
- .1 Obstructed.
- .2 Shut off.
- .3 Left inactive at the end of a working day or shift.

.2 Where fire protection and alarm systems have been disconnected, provide 24 hour fire watch.

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

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

1.25 UNFORSEEN HAZARDS

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

1.26 POSTED DOCUMENTS

.1 Post legible versions of following documents on site:
- .1 Health and Safety Plan.
- .2 Sequence of work.
- .3 Emergency procedures.
- .4 Site drawing showing project layout, location(s) of first-aid station(s), evacuation route and marshalling station and emergency transportation provisions.
- .5 Notice of Project.
- .6 Floor plans or site plans.
- .7 Notice as to where a copy of Workers' Compensation Act and Regulations are available on work site for review by employees and workers.
- .8 Workplace Hazardous Materials Information System (WHMIS) documents.
- .9 Material Safety Data Sheets (MSDS).
- .10 List of names of Joint Health and Safety Committee members or Health and Safety Representative, as applicable.
  - .1 Name of "qualified co-ordinator" responsible for co-ordination of health and safety activities in accordance with Section 118 of Workers' Compensation Act.

.2 Post all Material Safety Data Sheets (MSDS) on site, in 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 to be protected from weather and be visible from street or exterior of principal construction site shelter provided for workers and equipment or as approved by Departmental Representative.

1.27 MEETINGS

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

1.28 CORRECTION OF NON COMPLIANCE

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

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

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

END OF SECTION

Part 1 General

1.1 FIRES

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

1.2 POLLUTION CONTROL

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

.2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.

.3 Prevent extraneous materials from contaminating air beyond application area.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.

.5 Place all waste, debris and lightweight materials in enclosed bins or under secure covers.

.6 Do not dispose of wastes or volatile materials into water courses, storm or sanitary sewers.

1.3 CONSTRUCTION EQUIPMENT

.1 All equipment to be in good working order, free of leaks that would contaminate the site.

.2 All equipment brought to site is to be clean and well maintained. Do not add fuel, oils or coolants to machinery on site. Provide properly placed drip pans under all fuel, oil and coolant filled machinery when machinery is left on site overnight and on weekends to contain leaks and drips.

1.4 SPILLS

.1 Report spills of hazardous materials immediately to the Departmental Representative.

1.5 SPILL KITS

.1 Provide and maintain fully stocked spill kits during execution of Work.

.2 Spill kits to contain mats to absorb spills, socks to prevent spread of spills, gloves, large labelled plastic disposal bags.

.3 Spill kits to be packed in sturdy bright yellow labelled nylon bags.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 Not used

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

.1 Perform Work in accordance with National Building Code of Canada (NBC) 2010 including amendments up to tender closing date and other indicated codes, Construction Standards and/or any other local Code or Bylaws.

.1 In case of conflict or discrepancy, more stringent requirements apply.

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

.3 Pay fees and obtain certificates and permits required

.4 Conform to the Canada Labour Code II, Canada Occupational Safety and Health regulations.

.5 FCC, Fire Commissioner of Canada.

.1 Standard No. 301, "Construction Operations" , June 1982.

.6 Yukon Workers Compensation Health and Safety Board.

.7 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

.8 Comply with conditions as stated in Standard Acquisition Clauses and Conditions (SACC) Manual.

1.2 PERMITS

.1 Building Permit

.1 Obtain and pay for Building Permit, Occupancy Permit, Certificates, Licenses and other permits through the Government of Yukon as required by regulatory municipal, territory or federal authorities to complete the work.

.2 Provide inspection authorities having jurisdiction with plans and information required for issue of acceptance certificates

.3 Furnish inspection certificates in evidence that the work installed conforms to the requirements of the authority having jurisdiction

1.3 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 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.

1.2 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, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents.

.4 In case of dispute, decisions as to standard or quality of work rests solely with the Departmental Representative

1.3 EQUIPMENT AND SYSTEMS

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

.2 Refer to individual specification sections for definitive requirements.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 INSTALLATION AND REMOVAL

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

.2 Remove from site all such work after use.

1.2 WATER SUPPLY

.1 Departmental Representative will provide continuous supply of potable water for construction use.

.2 Exercise conservation. Turn off water when not in use.

.3 Provide all equipment and temporary hoses to bring water supply to site, at no additional cost to the contract.

1.3 TEMPORARY POWER AND LIGHT

.1 Electrical power is available for construction purposes at no cost, with the exception of power used for heating purposes. Power to be provided only when building electrical service is in place.

.1 Contractor is responsible for providing temporary electrical services as required.

.2 Departmental Representative will determine delivery points and quantitative limits. Departmental Representative written permission is required before any connection is made. Connect to existing power supply in accordance with Canadian Electrical Code.

.3 Provide all equipment and temporary lines to bring these services to the work, at no additional cost to the contract.

.4 Exercise conservation whenever using temporary electrical power supply.

1.4 TEMPORARY HEATING AND VENTILATION

.1 Provide all temporary heating required during construction period, including attendance, maintenance and fuel.

.2 Construction heaters used inside building must be vented to outside or be flameless type. Solid fuel salamanders are not permitted.

.3 Provide temporary heat and ventilation in enclosed areas as required to:

.1 Facilitate progress of Work.

.2 Protect Work and products against dampness and cold.

.3 Prevent moisture condensation on surfaces.

.4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.

.5 Provide adequate ventilation to meet health regulations for safe working environment.

.4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.

.5 Ventilating:

.1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.

.2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.

.3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.

.4 Ventilate storage spaces containing hazardous or volatile materials.

.5 Ventilate temporary sanitary facilities.

.6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

.6 Permanent heating system of building is not to be used for construction heating.

.7 Maintain strict supervision of operation of temporary heating and ventilating equipment to:

.1 Conform with applicable codes and standards.

.2 Enforce safe practices.

.3 Prevent abuse of services.

.4 Prevent damage to finishes.

.5 Vent direct-fired combustion units to outside.

.8 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.5 FIRE PROTECTION

.1 A 24 hour fire watch will be provided by the General Contractor when any of the fire safety systems are out of commission.

.1 This supervision will include the provision of appropriate fire suppression equipment.

.2 Provide advance notification the local Fire Chief when any fire safety systems are to be taken out of commission.

.3 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.

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

Part 2 Products

2.1 NOT USED

Part 3 EXECUTION

.1 NOT USED

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Construction aids.

.2 Office and sheds.

.3 Parking.

.4 Project identification.

1.2 RELATED SECTIONS

.1 Section 01 51 00 - Temporary Facilities.

.2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 REFERENCES

.1 CAN/CSA-Z321- 96: Signs and Symbols for the Occupational Environment.

1.4 INSTALLATION AND REMOVAL

.1 Provide construction facilities in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.5 SCAFFOLDING

.1 Provide and maintain scaffolding and ladders as required.

1.6 HOISTING

.1 Provide, operate and maintain hoists required for moving of workers, materials and equipment.

.2 Hoists and cranes shall be operated by qualified operator.

1.7 SIGNS AND ADVERTISEMENTS

.1 No signs or advertising shall be allowed or displayed without the approval of the Consultant and Owner.

.2 This project will not be used to advertise or promote systems, construction or assembly methods, tools or equipment used and/or incorporated therein without written approval of the Consultant and Owner.

□

1.8 CONSTRUCTION PARKING

.1 Parking is available provided it does not disrupt performance of Work.

.2 Provide and maintain adequate access to project site.

1.9 OFFICES

.1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.

.2 Provide a clearly marked and fully stocked first-aid case in a readily available location.

.3 Subcontractors may provide their own offices as necessary. Direct location of these offices.

1.10 STORAGE, HANDLING AND PROTECTION

.1 Provide and maintain, in a 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 a manner to cause least interference with work activities.

.3 Handle and store products in a manner to prevent damage, deterioration and soiling and in accordance with manufacturer's recommendations when applicable.

.4 Store sensitive products in weather tight, climate controlled, enclosures in an environment favourable to Product.

.5 Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

.6 Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

.7 Store cementitious materials clear of earth or concrete floors, and away from walls.

.8 Remove and replace damaged products at own expense and to the satisfaction of the Consultant

1.11 SANITARY FACILITIES

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.2 Post notices and take such precautions as required by local health authorities.

.3 Keep sanitary facilities clean and fully stocked with the necessary supplies at all times.

□

END OF SECTION

□

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 74 21 Construction Waste Management and Disposal

1.2 REFERENCES

.1 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 HOARDING

.1 **Erect temporary** site enclosure using new 1.8m high snow fence wired to rolled steel "T" **bar fence posts spaces 2.4m maximum on centre. Maintain fence in good repair.**

.2 Provide one lockable truck gate and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys.

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

1.5 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells and open edges of floors and roofs.

.2 Provide as required by governing authorities.

1.6 WEATHER ENCLOSURES

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors 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

1.7 DUST TIGHT SCREENS

.1 Provide dust tight screens to localize dust generating activities, and for protection of workers, finished areas of Work and public.

.2 Provide Dust tight screens to protection of existing theater building and contents.

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

1.8 ACCESS TO SITE

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

1.9 PUBLIC TRAFFIC FLOW

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

1.10 FIRE ROUTES

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

1.11 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.

1.12 PROTECTION OF BUILDING FINISHES

.1 Provide protection for existing adjacent buildings, structures and utilities during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.

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

1.13 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 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.

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

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

1.3 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 Store sheet materials, and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.6 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.

.7 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative

.8 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.4 TRANSPORTATION

.1 Pay costs of transportation of products required in performance of Work.

1.5 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 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.

1.6 SETTING OUT OF WORK

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

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

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

1.7 ACCEPTANCE OF SUBSTRATES

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

1.8 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed

.2 Do not employ anyone unskilled in their required trade.

1.9 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.

1.10 CONCEALMENT

.1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

1.11 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.

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 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.

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 AND DISPOSAL

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

1.2 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris.

.2 Maintain public areas adjacent to the worksite in a tidy condition.

.3 Remove waste materials from site at daily and as directed by the Departmental Representative.

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

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

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

.7 Dispose of waste materials and debris.

.1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.

.2 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.

.3 Remove hazardous materials away from public areas as they are exposed.

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

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

1.3 DAILY CLEANING

.1 Conduct cleaning and disposal operations daily. Comply with local ordinances and anti-pollution laws.

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

.3 Vacuum clean and dust building interiors, behind grilles, louvers and screens.

.4 Maintain cleanliness of adjacent areas during the demolition phase.

1.4 FINAL CLEANING

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

.2 Remove waste products and debris other than that caused by others, 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.

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

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

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

.8 Remove dirt and other disfiguration from exterior surfaces.

.9 Clean and sweep roofs, gutters, areaways, and sunken wells.

.10 Sweep and wash clean paved areas.

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

.12 Clean roofs, downspouts, and drainage 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 SECTION INCLUDES

.1 Waste goals.

.2 Waste management plan.

.3 Third party responsibilities.

.4 Waste management plan implementation.

.5 Disposal of waste.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 DEFINITIONS

.1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.

.2 Construction and Demolition Waste: Solid wastes typically including but not limited to, building materials, packaging, trash, debris, and rubble resulting from construction, re-modelling, repair and demolition operations.

.3 Hazardous: Exhibiting the characteristics of hazardous substances including, but not limited to, ignitability, corrosiveness, toxicity or reactivity.

.4 Non-hazardous: Exhibiting none of the characteristics of hazardous substances, including, but not limited to, ignitability, corrosiveness, toxicity, or reactivity.

.5 Non-toxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

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

.7 Recycle: To remove a waste material from the Project site to another site for re-manufacture into a new product for reuse by others.

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

.9 Return: To give back reusable items or unused products to vendors for credit.

.10 Reuse: To reuse a construction waste material in some manner on the Project site.

.11 Salvage: To remove a waste material from the Project site to another site for resale or reuse by others.

.12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

.13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

.14 Toxic: Poisonous to humans either immediately or after a long period of exposure.

.15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

.16 Volatile Organic Compounds (VOC): Chemical compounds common in and emitted by many building products over time through outgassing:

.1 Solvents in paints and other coatings,

.2 Wood preservatives; strippers and household cleaners,

.3 Adhesives in particle board, fibreboard, and some plywood; and foam insulation,

.4 When released, VOC can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.

.17 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.4 SUBMITTAL

.1 Submit Waste Management Plan and other required submittals in accordance with Section 01 33 00.

.2 Prepare and submit to Departmental Representative prior to project start-up, a schedule of demolished materials and construction waste that will be diverted from the landfill. Schedule shall include an estimated quantity by weight of each material to be diverted from the landfill. The schedule shall include, but is not limited to the following:

.1 Cardboard / Paper.

.2 Clean dimensional wood.

.3 Beverage containers.

.4 Excavated material.

.5 Concrete.

.6 Masonry /Concrete Masonry Units (CMU).

.7 Asphalt.

.8 Metals from banding, steel stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.

.9 Gypsum board.

.10 Carpet and carpet pad.

.11 Paint.

.12 Plastic

1.5 WASTE MANAGEMENT GOALS

.1 Owner has established that this Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.

.2 Owner recognizes that waste in any project is inevitable, but indicates that as much of the waste materials as economically feasible shall be reused, salvaged, or recycled.

.3 Waste disposal in landfills shall be minimized.

1.6 THIRD PARTY RESPONSIBILITY

.1 Subcontractors shall cooperate fully with Contractor to implement the Waste Management Plan.

1.7 STORAGE, HANDLING AND PROTECTION

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

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

.3 Protect, stockpile, store and catalogue salvaged items.

.4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

.5 Protect structural components not removed for demolition from movement or damage.

.6 Protect surface drainage, storm sewers, sanitary sewers, and utility services from damage and blockage.

1.8 SCHEDULING

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 PREPARATION

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

3.2 USE OF SITE AND FACILITIES

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

3.3 WASTE MANAGEMENT IMPLEMENTATION

.1 Manager: Contractor to designate an on-site party responsible for instructing workers and overseeing and documenting results of the Waste Management Plan the Project.

.2 Instruction: Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.

.3 Separation facilities: Contractor shall lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.

.4 Hazardous wastes: Hazardous wastes shall be separated, stored, and disposed of according to local regulations.

3.4 DISPOSAL OF WASTE

.1 Burying of rubbish and waste materials is prohibited.

.2 Disposal of waste into waterways, storm, or sanitary sewers is prohibited.

3.5 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.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 78 00 - Closeout Submittals

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 Certificates required by Fire Commissioner: submitted.

.4 Operation of systems: demonstrated to Owner's personnel.

.5 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 .

.6 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.

.5 Final Payment:

.1 When Departmental Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.

.2 When Work deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.

1.3 FINAL CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

1.4 DOCUMENTS

.1 Collect reviewed submittals and assemble documents fully executed by subcontractors, suppliers, and manufacturers. Submit material prior to final Application for Payment.

.2 Submit as-built drawings in accordance with Section 01 11 00 – General Instructions.

.3 Provide warranties and bonds fully executed and notarized.

.4 Execute transition of Performance and Labour and Materials Payment Bond to warranty period requirements.

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

.6 Departmental Representative will issue a final change order reflecting approved adjustments to Contract Price not previously made.

.7 Prior to applying for a certificate of Substantial Performance, provide the following:

.1 Reconciliation of all Change Orders.

.2 Workers' Compensation Board letter as evidence that the Contractor and all Subcontractors are in good standing.

.3 Letters of Assurance where required as a condition of the work.

.4 Occupancy Permit from local authority.

.5 Certification by all testing, cleaning or inspection authorities or associations.

.6 List of items to be completed or corrected, including the time required to perform the Work as well as the proposed completion date

.8

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 77 10 - Closeout Procedures.

1.2 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.

.5 Pay cost of transportation.

1.3 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 format on CD.

1.4 CONTENTS - PROJECT RECORD DOCUMENTS

.1 Table of Contents for Each Volume:

.1 Provide title of project;

.2 Date of submission;

.3 Names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.

.4 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.

1.5 AS-BUILT DOCUMENTS AND SAMPLES

.1 Maintain at site for Departmental Representative one record copy of:

.1 Building Permit

.2 Contract Drawings.

.3 Specifications.

.4 Addenda.

.5 Change Orders and other modifications to Contract.

.6 Reviewed shop drawings, product data, and samples.

.7 Field test records.

.8 Inspection certificates.

.9 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.

1.6 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of black line 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.

.2 Mark changes directly onto the drawings with red ink. Indicate changes graphically, references to CCN, CO, or Site instructions alone will not be accepted.

.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 inspection certifications ,field test records as required by individual specifications sections.

.7 Provide digital photos, if requested, for site records.

1.7 MATERIALS AND FINISHES

.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.

.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.

1.8 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 on-site 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.

1.9 MAINTENANCE MATERIALS

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

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

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

.4 Receive and catalogue items.

.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.

1.10 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 [site] [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.

1.11 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

1.12 WARRANTIES AND BONDS

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

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

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

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

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

Part 1 General

1.1 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 Refer to the Related Sections below for specific commissioning requirements for Architectural, Mechanical and Electrical Systems.

1.2 RELATED SECTIONS

.1 Section 01 91 31 - Commissioning Plan

.2 Section 01 91 33 - Commissioning Forms

.3 Section 01 91 41 - Commissioning Training

.4 Section 23 08 00 - Commissioning of Mechanical Systems

.5 Section 26 08 00 - Commissioning of Electrical Systems

1.3 DEFINITIONS:

.1 Acronyms:

.1 Cx Authority - Personnel who directs commissioning

.2 Cx Agent – Personnel who executes commissioning

.3 Cx - Commissioning.

.4 EMCS - Energy Monitoring and Control Systems.

.5 O&M - Operation and Maintenance.

.6 PFC - Pre Functional Checklists

.7 PV - Performance Verification.

.8 TAB - Testing, Adjusting and Balancing.

.2 Cx - A required 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.

1.4 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 0&M manual.

.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 operate 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.

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1.5 COMMISSIONING OVERVIEW

.1 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.

.2 Cx Authority retained and paid for by owner

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

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

.5 Departmental Representative will issue Interim Acceptance Certificate when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by the Commissioning Authority.

.2 Equipment, components and systems have been commissioned.

.3 O&M training has been completed.

1.6 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 nonfunctional system, including related systems as deemed required by the Commissioning Authority.

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

1.7 PRE-CX REVIEW

.1 Before Construction:

.1 Review contract documents, confirm by writing to Commissioning Authority.

.1 Adequacy of provisions for Cx.

.2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:

.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

.1 Have completed Cx Plan up-to-date.

.2 Ensure installation of related components, equipment, sub-systems, systems is complete.

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

.5 Understand completely design criteria and intent and special features.

.6 Submit complete start-up documentation to Commissioning Authority.

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

.9 Complete TAB procedures on systems, submit TAB reports to Commissioning Authority for review and approval.

.10 Ensure "As-Built" system schematics are available.

.4 Inform Commissioning Authority in writing of discrepancies and deficiencies on finished works.

1.8 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to Commissioning Authority before start-up and obtain clarification.

.2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.9 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 Commissioning Authority for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.

.3 Submit proposed Cx procedures to Commissioning Authority where no specified and obtain written approval at least 8 weeks prior to start of Cx.

.4 Provide additional documentation relating to Cx process required by Commissioning Authority.

1.10 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Pre Functional checklist (PFC) / Performance Verification (PV) Forms for requirements and instructions for use.

.2 Commissioning Authority to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to Commissioning Authority.

1.11 COMMISSIONING SCHEDULE

.1 Convene Cx meetings following project meetings.

.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. Commissioning Authority to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

.1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.

.2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

.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 Commissioning Authority, who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.12 STARTING AND TESTING

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

1.13 WITNESSING OF STARTING AND TESTING

.1 Provide 14 days notice prior to commencement.

.2 Commissioning Authority to witness start-up and testing.

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

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1.14 MANUFACTURER'S INVOLVEMENT

.1 Factory testing: manufacturer to:

.1 Coordinate time and location of testing.

.2 Provide testing documentation for approval by Commissioning Authority.

.3 Arrange for Commissioning Authority to witness tests.

.4 Obtain written approval of test results and documentation from Commissioning Authority before delivery to site.

.2 Obtain manufacturers installation, start-up and operations instructions prior to start- up of components, equipment and systems and review with Commissioning Authority;

.1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.

.2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.3 Integrity of warranties:

.1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

.2 Verify with manufacturer that testing as specified will not void warranties.

.4 Qualifications of manufacturer's personnel:

.1 Experienced in design, installation and operation of equipment and systems.

.2 Ability to interpret test results accurately.

.3 To report results in clear, concise, logical manner.

1.15 PROCEDURES - GENERAL

.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 drawing 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 Commissioning Authority 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 the Commissioning

Authority. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

.1 Minor equipment/systems: implement corrective measures approved by Commissioning Authority.

.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Commissioning Authority.

.3 If evaluation report concludes that major damage has occurred, Commissioning Authority 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.

1.16 START-UP DOCUMENTATION

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

.2 Start-up documentation to include:

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

.2 Pre start-up inspection reports.

.3 Signed installation/start-up check lists.

.4 Start-up reports,

1.17 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

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

.2 With assistance of manufacturer develop written maintenance program and submit to Commissioning Authority 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.

1.18 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.

1.19 START OF COMMISSIONING

.1 Notify Commissioning Authority 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.

1.20 INSTRUMENTS / EQUIPMENT

.1 Submit the following to the Commissioning Authority for review and approval:

.1 Complete list of instruments proposed to be used.

.2 Listed data including, serial number, current calibration certificate,calibration date, calibration expiry date and calibration accuracy.

.2 Provide the following equipment as required:

.1 2-way radios.

.2 Ladders.

.3 Equipment as required to complete work.

1.21 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.

.4 EMCS trending to be available as supporting documentation for performance verification.

1.22 WITNESSING COMMISSIONING

.1 Commissioning Authority to witness activities and verify results. Sufficient notice shall be given for scheduling.

1.23 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 Commissioning Authority within 5 days of test and with Cx report.

1.24 COMMISSIONING CONSTRAINTS

.1 Since access into secure or sensitive areas will be very difficult after occupancy, it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

1.25 EXTRAPOLATION OF RESULTS

.1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part- load results to design conditions when approved by Commissioning Authority in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formula.

1.26 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 Commissioning Authority.

.3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.

.5 Perform additional commissioning until results are acceptable to Commissioning Authority.

1.27 REPEAT VERIFICATIONS

.1 Assume costs incurred by Commissioning Authority for third and subsequent verifications where:

.1 Verification of reported results fail to receive Commissioning Authority's recommended approval.

.2 Repetition of second verification again fails to receive recommended approval.

.3 Commissioning Authority deems Contractor's request for second verification was premature.

1.28 SUNDRY CHECKS AND ADJUSTMENTS

.1 Make adjustments and changes which become apparent as Cx proceeds.

.2 Perform static and operational checks as applicable and as required.

1.29 DEFICIENCIES, FAULTS, DEFECTS

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

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

1.30 COMPLETION OF COMMISSIONING

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

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

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

1.31 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.

1.32 TRAINING

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

1.33 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.34 OCCUPANCY

.1 Cooperate fully with the Commissioning Authority during stages of acceptance and occupancy of facility.

1.35 INSTALLED INSTRUMENTATION

.1 Use instruments installed under Contract for TAB and PV if:

.1 Accuracy complies with these specifications.

.2 Calibration certificates have been deposited with Commissioning Authority.

.2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.36 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special;s areas, to be within +/- 10 % of specified values.

.2 Instrument accuracy tolerances:

.1 To be of higher order or magnitude than the equipment being tested.

..3 Measurements tolerances during verification:

.1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.37 OWNER's PERFORMANCE TESTING

.1 Performance testing of equipment or system by Commissioning Authority will not relieve Contractor from compliance with specified start-up and testing procedures.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

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

1.2 REFERENCES

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

.1 Guideline 0 - The Commissioning Process

.2 Guideline 1.1 - HVAC & R Technical Requirements for the Cx Process

.3 Standard 202 - Commissioning Process for Buildings and Systems

.2 Public Works and Government Services Canada (PWGSC)

.1 PWGSC - Commissioning Guidelines CP.1 to 13.

.3 Underwriters' Laboratories of Canada (ULC)

.4 CSA Z320-11 Building Commissioning

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 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 Owner/Investor's 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 O&M - Operating & Maintenance

.3 EMCS - Energy Monitoring and Control Systems.

.4 MSDS - Material Safety Data Sheets.

.5 PV - Performance Verification.

.6 TAB - Testing, Adjusting and Balancing.

.7 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 correctrotation.

.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 CX PLAN

.1 Cx Plan to be 80% 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

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 4 weeks during construction phase. At each revision, indicate revision number and date.

.3 Submit each revised Cx Plan to Commissioning Authority 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 Project Manager is to maintain overall responsibility for managing the project and demonstrating to the client that the installed systems and overall facility meet the requirements of the TOR and the Technical Requirements.

.2 Project Manager will select Cx Team consisting of following members:

.1 PWGSC Cx Manager

.1 Undertakes a quality assurance role on behalf of the PWGSC project team;

.2 Fulfills the PWGSC Commissioning Quality Management System requirements;

.3 Provides technical advice on O&M matters;

.4 Reviews commissioning documentation from the Commissioning Authority at all stages of the project delivery and provides support to the Project Manager in matters relating to commissioning.

.2 Design Consultant:

.1 Develops the design solutions to meet client requirements and performance specification requirements (Design Criteria);

.2 The owner engages the services of an independent qualified Commissioning Authority. The appointment of a commissioning Authority does not permit the Design Consultant to abrogate traditional design responsibilities such as carrying out site supervision and ensuring that construction conforms to the design intent;

.3 Commissioning Authority (in-contract with the owner)

.1 Develops the initial commissioning plan, design intent, and system operating manual;

.2 Prepares commissioning specifications and other commissioning documentation including the Product Information (PI) and Performance Verification (PV) report forms;

.3 Develops the training plan;

.4 Monitors, witnesses, and certifies the performance of all commissioning activities as per the contract agreement;

.5 Responsible for design, construction, and warranty-related commitments for commissioning.

.4 Commissioning Agents (in-contract with or part of the contractor team)

.1 Carries out start-up and performance verification activities and performs acceptance tests and related procedures for all equipment, systems and integrated systems under the guidance of the Commissioning Authority.

.2 This individual also coordinates commissioning activities, conducts commissioning meetings, refines the commissioning plan, refines commissioning schedule, assembles maintenance manuals, and organizes training.

.5 Property Manager

.1 Represents lead role in Operation Phase and onwards

.2 Assigns operational personnel to witness systems and equipment testing and to participate in training.

.3 Day-to-day management and operation of the completed facility after it has been accepted from the project manager.

1.7 EXTENT OF CX

.1 Commission the building systems and associated equipment including site services buildings

.2 Fire Protection systems:

- .1 Portable fire extinguishers
- .2 Fire alarm control panel
- .3 Smoke detectors
- .4 Heat and flame detectors
- .5 Pull stations
- .6 Audiovisual devices

.3 Mechanical and Plumbing systems:

- .1 Federal Halocarbon Regulation compliance
- .2 Unit heaters
- .3 Domestic hot water, domestic cold water
- .4 Hydronic hot and cold water
- .5 Drainage
- .6 Fuel-oil piping
- .7 All HVAC
- .8 Air handling units and fans
- .9 Exhaust fans
- .10 Ductwork
- .11 Air flow measuring stations
- .12 Grilles and diffusers
- .13 Air filters
- .14 Air intakes
- .15 Glycol systems
- 16 Heating and cooling units
- .17 Chemical treatment and procedures
- .18 Variable frequency (speed) drives
- .19 Boilers

.20 Pumps

.21 Baseboard heaters

.22 DX cooling

.23 Refrigerant

.24 Mechanical vibration control

.25 Mechanical identification

.26 Smoke evacuation system.

.4 Building Control Systems

.1 EMCS

.2 Control panels. Duplicate of Control Panel wiring schematic inside each enclosure

.3 Boilers

.4 Dampers

.5 Valves

.6 Pumps

.5 Site Electrical Service

.1 Disconnects

.2 Power Distribution

.3 Cabling (Electrical and Telecommunication)

.4 Motor controls

.5 Lighting

.6 Interior lighting

.7 Outdoor lighting

.8 Smoke evacuation UPS and associated components.

1.8 DELIVERABLES RELATING TO O M PERSPECTIVES

.1 General requirements:

.1 Compile English documentation using SI units

.2 Documentation to be computer-compatible format ready for inputting for data management.

.2 Provide deliverables:

.1 Warranties..2 Project record documentation.

.3 Inventory of spare parts, special tools and maintenance materials.

.4 Maintenance Management System (MMS) identification system used.

.5 WHMIS information.

.6 MSDS data sheets.

.7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

1.9 DELIVERABLES RELATING TO THE CX PROCESS

.1 General:

.1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.

.2 Definitions:

.1 Cx as used in this section includes:

.1 Cx of components, equipment, systems, subsystems, and integrated systems.

.2 Factory inspections and performance verification tests.

.3 Deliverables: provide:

.1 Cx Specifications.

.2 Startup, pre-Cx activities and documentation for systems, and equipment.

.3 Completed installation checklists

.4 Completed Pre Functinal checklists

.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, and/ or Cx Authority:

.10 Tests performed by Owner/User.

.11 Training Plans.

.12 Cx Reports.

.13 Prescribed activities during warranty period.

.4 Departmental Representative to witness and certify tests and reports of results provided to Cx Authority.

.5 Commissioning Authority to participate.

1.10 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Items listed in this Cx Plan include the following:

.1 Pre-Start-Up inspections: by Commissioning Authority prior to permission to start up and rectification of deficiencies to Commissioning Authority's satisfaction.

.2 Commissioning Authority to use approved check lists.

.3 Commissioning Authority 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 Commissioning Authority and does not form part of Cx specifications.

.6 Commissioning Authority will monitor some of these inspections and tests.

.7 Include completed documentation in Cx report.

.2 Pre-Cx activities - MECHANICAL:

.1 Plumbing systems:

.1 "Bump" each item of equipment in its "stand-alone" mode.

.2 Complete pre-start-up checks and complete relevant documentation.

.3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

.2 HVAC equipment and systems:

.1 "Bump" each item of equipment in its "stand-alone" mode.

.2 At this time, 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 Commissioning Authority.

.5 Demonstrate performance of the smoke evacuation system, to be witnessed by Commissioning Authority and authority having jurisdiction.

.3 Control System

.1 Perform point-by-point testing in parallel with start-up.

.2 Carry out point-by-point verification.

.3 Demonstrate performance of systems, to be witnessed by Commissioning Authority 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 Cx Agent to perform pre- energization and post-energization tests.

.2 Lighting systems:

.1 Tests to include verification of lighting levels and coverage

1.11 START-UP

.1 Start up components, equipment and systems.

.2 Commissioning Authority to monitor start-up activities.

.1 Rectify start-up deficiencies to satisfaction of Commissioning Authority.

.3 Performance Verification (PV):

.1 Cx Agent to perform.

.1 Repeat when necessary until results are acceptable to Commissioning Authority.

.2 Use procedures modified generic procedures to suit project requirements.

.3 Commissioning Authority to witness and certify reported results using approved PFC and PV forms.

.4 Departmental Representative to approve completed PV reports and provide

to Commissioning Authority.

.5 Commissioning Authority verify up to 30% of reported results at random.

.6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

1.12 CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Perform Cx by specified Cx agency using procedures developed by Commissioning Authority and approved by Commissioning Authority.

.2 Commissioning Authority 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 Commissioning Authority.

.5 Commissioning Authority reserves right to verify a percentage of reported results at no cost to contract.

1.13 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

.1 Cx to be performed by specified Cx specialist, using procedures developed by Commissioning Authority and approved by Commissioning Authority.

.2 Tests to be witnessed by Commissioning Authority and documented on approved report forms.

.3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Commissioning Authority and submitted to Departmental Representative for review.

.4 Commissioning Authority reserves right to verify percentage of reported results.

.5 Integrated systems to include:

.1 HVAC and associated systems forming part of integrated HVAC systems:.

.2 Life safety systems, fire alarm systems.

1.14 INSTALLATION CHECK LISTS (ICL)

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

1.15 Pre Functional Checklists

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Pre Functional Checklists (PFC) / Performance Verification (PV) Forms.

1.16 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.

1.17 DELIVERABLES RELATING TO ADMINISTRATION OF CX

.1 General:

.1 Because of risk assessment, complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.18 CX SCHEDULES

.1 Prepare detailed Cx Schedule and submit to Commissioning Authority 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: 28days after contract award, and before construction starts.

.3 Cx agents' credentials: 60 days before start of Cx.

.4 Cx procedures: 3 months after award of contract.

.5 Cx Report format: 3 months after award of contract.

.6 Discussion of heating/cooling loads for Cx: 3 months before start-up.

.7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.

.8 Notification of intention to start TAB: 21 days before start of TAB.

.9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.

.10 Notification of intention to start Cx: 14 days before start of Cx.

.11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14days before start of integrated systemCx.

.12 Identification of deferred Cx.

.13 Implementation of training plans.

.14 Cx reports: immediately upon successful completion of Cx.

.2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Departmental Representative.

.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 Consultant, Contractor, Contractor's Cx agent, and Commissioning Authority will monitor progress of Cx against this schedule.

1.19 CX REPORTS

.1 Submit reports of tests, witnessed and certified by Departmental Representative to Commissioning Authority 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 Commissioning Authority.

1.20 ACTIVITIES DURING WARRANTY PERIOD

.1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:

.1 Fine tuning of HVAC systems.

.2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.

.3 Full-scale emergency evacuation exercises.

1.21 TESTS TO BE PERFORMED BY OWNER/USER

.1 None is anticipated on this project.

1.22 TRAINING PLANS

.1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.

1.23 FINAL SETTINGS

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

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

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 Commissioning Authority 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 Certified Equipment Manufacture technician shall sign start-up report and check lists upon completion, certifying stated checks and inspections have been performed; contractor to submit completed reports to the Commissioning Agent, Commissioning Authority, and design Consultant. Check lists will be required during Commissioning and will be included in Building Maintenance Manual (BMM) at completion of project. Following Equipment Reports are required:

.1 Major HVAC equipment;

.2 Major Plumbing equipment;

.3 Chemical Treatments;

.4 Building Management Systems;

.5 Motor Starters and Variable Frequency Drives units;

.6 Communication Systems "Wiring" (Voice, Data system tests and certifications)

.7 Insulation Resistance Testing of Electrical Feeders.

.8 As required by individual divisions 21 to 26 of specification sections.

.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 SAMPLES OF COMMISSIONING FORMS

.1 Commissioning Authority will provide forms to Contractor for incorporation into project-specific commissioning documents.

.2 Contractor to complete Commissioning forms to suit project requirements as per reviewed shop drawings and return to Cx Authority for review and final approval at least 12 weeks prior to final commissioning.

.3 Some samples of commissioning forms are included in this document to establish a general overview of the commissioning process.

1.4 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

.1 When additional forms are required, but are not available from Commissioning Authority develop appropriate verification forms with the Commissioning Authority for approval prior to use.

.1 Additional commissioning forms to be in same format as provided by the Commissioning Authority.

1.5 COMMISSIONING FORMS

.1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.

.2 Strategy for Use:

.1 Commissioning Authority provides Contractor project-specific Commissioning forms.

.2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.

.3 Confirm operation as per design criteria and intent.

.4 Identify variances between design and operation and reasons for variances.

.5 Verify operation in specified normal and emergency modes and under specified load conditions.

.6 Record analytical and substantiating data.

.7 Verify reported results.

.8 Form to bear signatures of recording technician and reviewed and signed

off by Commissioning Authority.

.9 Submit immediately after tests are performed.

.10 Reported results in true measured SI unit values.

.11 Provide Commissioning Authority with originals of completed forms.

.12 Maintain copy on site during start-up, testing and commissioning period.

.13 Forms to be both hard copy and electronic format with typed written results in Building Management Manual.

1.6 LANGUAGE

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 This Section specifies roles and responsibilities of Commissioning Training.

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 Contractor will provide:

.1 Descriptions of systems.

.2 Commissioning Authority, Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:

.1 Start-Up, operation, shut-down of equipment, components and systems.

.2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.

.3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.3 Contractor and equipment manufacturer to provide instruction on:

.1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

.1 Training to be detailed and duration to ensure:

.1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.

.2 Effective on-going inspection, measurements of system performance.

.3 Proper preventive maintenance, diagnosis and trouble-shooting.

.4 Ability to update documentation.

.5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training materials to include:

.1 "As-Built" Contract Documents.

.2 Operating and Maintenance Manual.

.3 Project Manager, PWGSC Cx Manager, Commissioning Authority, and Property Manager will review training materials.

.4 Training materials to be in a format that permits future training procedures to same degree of detail.

1.6 SCHEDULING

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be 3 hours in length.

.3 Training to be completed prior to acceptance of facility.

1.7 RESPONSIBILITIES

.1 Be responsible for:

.1 Implementation of training activities,

.2 Coordination among instructors,

.3 Quality of training, training materials,

.2 Commissioning Authority will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, witnessed by Commissioning Authority.

1.8 TRAINING CONTENT

.1 Training to include demonstrations by Instructors using the installed equipment and systems.

.2 Content includes:

.1 Review of system layout, equipment, components and controls.

.2 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.

.3 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.

.4 Maintenance and servicing.

.5 Trouble-shooting diagnosis.

.6 Step by step winterization and de-winterization procedure for the mechanical and electrical systems

.7 Review of O M documentation.

.3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Demolition of interior finishes in existing mechanical room.

.2 Removal of existing siding in portions of the work

1.2 RELATED SECTIONS

.1 Section 01 11 00 Summary of Work:

.2 Section 01 56 00 Temporary Barriers and Enclosures

.3 Section 01 74 19 Construction/Demolition Waste Management and Disposal

.4 Section 20 41 99 Demolition (Mechanical)

1.3 PROJECT RECORD DOCUMENTS

.1 Accurately record actual locations of capped utilities, and subsurface obstructions.

1.4 REGULATORY REQUIREMENTS

.1 Conform to applicable code for demolition of structures, safety of adjacent structures, and disposal.

.2 Obtain required permits from authorities.

.3 Notify affected utility companies before starting work and comply with their requirements.

.4 When discovering hazardous or contaminated materials, stop work and inform the Departmental Representative

1.5 PROJECT CONDITIONS

.1 Conduct demolition to minimize interference with adjacent and occupied building areas.

.2 Cease operations immediately if structure appears to be in danger and notify Departmental Representative. Do not resume operations until directed.

Part 2 Execution

2.1 PREPARATION

.1 Provide, erect, and maintain temporary barriers and security devices

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.2 Protect existing structures, which are not to be demolished.

.3 Erect and maintain weatherproof closures for exterior openings.

.4 Erect and maintain temporary partitions to prevent spread of dust, odours, and noise to adjacent properties.

.5 Notify affected utility companies before starting work and comply with their requirements.

.6 Mark location and termination of utilities.

.7 Provide appropriate temporary signage.

2.2 DEMOLITION REQUIREMENTS

.1 Conduct demolition to minimize interference with adjacent structures.

.2 Conduct operations with minimum interference to public.

.3 Sprinkle Work with water to minimize dust. Provide hoses and water connections for this purpose.

2.3 DEMOLITION

.1 Disconnect and cap designated utilities within demolition areas.

.2 Demolish in an orderly and careful manner

.3 Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.

.4 Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.

.5 Remove materials to be re-installed or retained in manner to prevent damage. Store and protect.

.6 Do not burn or bury materials on site. Leave site in clean condition.

.7 Remove temporary work.

END OF SECTION

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Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 35 30 - Health and Safety Requirements

.3 Section 01 35 43 - Environmental Procedures

.4 Section 01 74 11 - Cleaning

.5 Section 01 74 19 - Construction Waste Management and Disposal

.6 Section 02 82 00.01 - Asbestos Abatement - Minimum Precautions

.7 Section 02 82 00.02 - Asbestos Abatement - Intermediate Precautions

1.2 REFERENCES

.1 Reports

.1 "Hazardous Building Materials Assessments – Palace Grand Theatre, Dawson City, YT", prepared by Stantec Consulting Ltd., dated March 18, 2015.

.2 "Asbestos Abatement Closure Report – Floor Joist Cavity Vermiculite, Selected Exterior Cement Panels and Localized Areas of Mechanical Pipe Insulation – Palace Grand Theatre, Third and King Street, Dawson City, YT", prepared by Stantec Consulting Ltd., dated November 19, 2015.

.2 Definitions:

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

.2 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.

.3 Hazardous Waste: hazardous material no longer used for its original purpose and that is intended for recycling, treatment or disposal.

.3 Reference Standards:

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

.1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).

.2 Department of Justice Canada (Jus)

.1 Transportation of Dangerous Goods Act, 1992 (TDG Act) [1992], (c. 34).

.2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2001-286).

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

.1 Material Safety Data Sheets (MSDS).

.4 National Research Council Canada Institute for Research in Construction (NRC-IRC)

.1 National Fire Code of Canada-[2005].

.5 Government of the Yukon

.1 Occupational Health and Safety Act

.2 Yukon Occupational Health Regulations

.6 Yukon Environment

.1 Special Waste and Solid Waste Regulations document entitled Asbestos Disposal (2010).

.2 Contaminated Sites Regulations and the Yukon Government Special Waste Regulations

.7 The Federal Transportation of Dangerous Goods Regulation

.8 The Federal PCB Regulations (SOR/2008-273).

.9 The Federal Halocarbons Regulation, July 2003

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS in accordance with Sections 01 35 30 - Health and Safety Requirements and 01 35 43 - Environmental Procedures to Departmental Representative for each hazardous material required prior to bringing hazardous material on site.

.3 Submit hazardous materials management plan to Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

.4 Construction Waste Management:

.1 Submit project Demolition Waste Management Plan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating percentage of construction wastes were recycled or salvaged

.5 Low-Emitting Materials: submit listing of adhesives and sealants used in building, comply with VOC and chemical component limits or restrictions requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

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

.4 Storage and Handling Requirements:

.1 Co-ordinate storage of hazardous materials with Departmental Representative and abide by internal requirements for labelling and storage of materials and wastes.

.2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.

.3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.

.1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.

.2 Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the Departmental Representative.

.5 Transfer of flammable and combustible liquids is prohibited within buildings.

.6 Transfer flammable and combustible liquids away from open flames or heat-producing devices.

.7 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.

.8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.

.9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.

.10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:

.1 Store hazardous materials and wastes in closed and sealed containers.

.2 Label containers of hazardous materials and wastes in accordance with WHMIS.

.3 Store hazardous materials and wastes in containers compatible with that material or waste.

.4 Segregate incompatible materials and wastes.

.5 Ensure that different hazardous materials or hazardous wastes are stored in separate containers.

.6 Store hazardous materials and wastes in secure storage area with controlled access.

.7 Maintain clear egress from storage area.

.8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.

.9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.

.10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.

.11 When hazardous waste is generated on site:

.1 Co-ordinate transportation and disposal with Departmental Representative.

.2 Comply with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.

.3 Use licensed carrier authorized by provincial authorities to accept subject material.

.4 Before shipping material obtain written notice from intended hazardous waste treatment or disposal facility it will accept material and it is licensed to accept this material.

.5 Label containers with legible, visible safety marks as prescribed by federal and provincial regulations.

.6 Only trained personnel handle, offer for transport, or transport dangerous goods.

.7 Provide photocopy of shipping documents and waste manifests to Departmental Representative.

.8 Track receipt of completed manifest from consignee after shipping dangerous goods. Provide photocopy of completed manifest to Departmental Representative.

.9 Report discharge, emission, or escape of hazardous materials immediately to Departmental Representative and appropriate provincial authority. Take reasonable measures to control release.

.12 Ensure personnel have been trained in accordance with 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.

.5 Develop Demolition Waste Management Plan related to Work of this Section.

Part 2 Products

2.1 MATERIALS

.1 Description:

.1 Bring on site only quantities hazardous material required to perform Work.

.2 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

Part 3 Execution

3.1 HAZARDOUS MATERIALS ABATEMENT

.1 Scope of Abatement Activities (other than Asbestos – specified elsewhere) for the Palace Theatre Grand building.

.1 Abatement shall be conducted to remove and dispose of hazardous building materials as identified in the Stantec Report in accordance with applicable regulations, guidelines, standards and/or best practices for such work.

.2 The listing below is a summary of the identified hazardous building materials (other than asbestos) and associated removal and disposal regulations, guidelines and/or standards.

.1 Lead

Demolition to be conducted in accordance with the requirements of the current version of the WorkSafe BC publication "Lead-Containing Paint and Coatings: Preventing Exposure in the Construction Industry", keeping airborne exposure to lead dust to less than the Yukon Territory Occupational Health and Safety Act 8-hour Occupational Exposure Limit (OEL) for lead of 0.15 milligram per cubic metre (mg/m^3).

Waste transportation to be conducted in accordance the Federal Transportation of Dangerous Goods Regulation.

Waste disposal to be conducted in accordance with the following Yukon Government regulations:

1. Special Waste and Solid Waste Regulations document entitled Asbestos Disposal (2010).
2. Contaminated Sites Regulations and the Yukon Government Special Waste Regulations).

If the Contractor chooses to dispose of identified lead-containing materials or materials with identified lead-containing paints via landfill in BC or Alberta, the Contractor will be responsible for applicable leachate testing of waste materials to determine landfill options.

Lead-containing materials to be considered during demolition are summarized below:

1. Lead-containing paints:
    1. Per the Stantec Report: Grey paint on furnace ducts in the mechanical room
    2. Per the Stantec Report: Grey paint on mechanical room walls and ceiling
2. Lead is also expected to be present in lead-acid batteries used in emergency lighting, older electrical wiring materials and sheathing, solder used on domestic water lines, solder used in bell fittings for cast iron pipes, solder used in electrical equipment and vent and pipe flashings.

.2 Polychlorinated Biphenyls (PCBs)

For the fluorescent light fixtures within the Palace Grand Theatre:

1. Remove all fluorescent lamp fixtures. Assess all ballasts in comparison to the Environment Canada document entitled "Identification of Lamp Ballasts Containing PCBs, Report EPS 2/CC/2", dated August 1991 (or equivalent reference).
2. Sort PCB-containing lamp ballasts from non-PCB-containing lamp ballasts.

Waste transportation to be conducted in accordance the Federal Transportation of Dangerous Goods Regulation.

Waste disposal to be conducted in accordance with the following Yukon Government regulations:

1. Special Waste and Solid Waste Regulations document entitled Asbestos Disposal (2010).
2. Contaminated Sites Regulations and the Yukon Government Special Waste Regulations).

.3 Mercury

Remove all thermostats with mercury-containing switches, fluorescent light tubes and high intensity discharge lights (mercury vapour) and/or other mercury-containing items.

Waste transportation to be conducted in accordance with the Federal Transportation of Dangerous Goods Regulation.

Waste disposal to be conducted in accordance with the following Yukon Government regulations:

1. Special Waste and Solid Waste Regulations document entitled Asbestos Disposal (2010).
2. Contaminated Sites Regulations and the Yukon Government Special Waste Regulations).

With respect to thermostat switches, remove and dispose of the following:

1. Per the Stantec Report: in mechanical room (1 thermostat)

.4 Mould

Frost and ice was observed on drywall walls and around window frames in various locations throughout the building. When this melts, the resulting moisture can impact porous materials in the areas (e.g. paper facings of drywall), and can create conditions conducive to mould growth.

Measures are to be taken for routine review of surfaces throughout, and removal (drying) of condensation, melt or other moisture/water ingress.

.5 Ozone-Depleting Substances (ODSs)

ODSs within equipment to be drained and recaptured by licensed technicians in accordance with the Federal Halocarbons Regulations, complete with appropriate support documentation to be provided to the Departmental Representative.

Waste transportation to be conducted in accordance the Federal Transportation of Dangerous Goods Regulation.

Waste disposal to be conducted in accordance with the following Yukon Government regulations:

1. Special Waste and Solid Waste Regulations document entitled Asbestos Disposal (2010).
2. Contaminated Sites Regulations and the Yukon Government Special Waste Regulations).

Remove and dispose of the following ODS-containing / refrigerant-containing equipment:

1. One (1) HVAC unit located on the roof of the mechanical room – reportedly containing refrigerant R-22

.6 Silica

Silica may be present in ceramic tiles, concrete, cement, masonry blocks, and interior wall finishes which are present in various locations throughout.

When silica-containing materials are to be removed during demolition activities, ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated Yukon Territory Occupational Health and Safety Act. This would include, but not be limited to, the following:

1. Providing workers with respiratory protection
2. Wetting the surface of the materials to prevent dust emissions
3. Providing workers with facilities to properly wash prior to exiting the work area
4. Providing dust control to mitigate the potential for demolition dust to escape from the work area into public and/or adjacent areas

.7 Equipment with Radioactive Components

If smoke detectors with radioactive components are present, these items should be removed for disposal in accordance with applicable regulations.

3.2 CLEANING

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

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

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

.1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.

.2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.

.3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.

.4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.

.5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.

.6 Dispose of hazardous wastes in timely fashion in accordance with applicable federal and provincial regulations.

.7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.

.8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:

.1 Hazardous wastes recycled in manner constituting disposal.

.2 Hazardous waste burned for energy recovery.

.3 Lead-acid battery recycling.

.4 Hazardous wastes with economically recoverable precious metals.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Refer to the following reports attached in Appendix A and B for information pertaining to the asbestos-containing materials (ACMs) that have been identified in the Palace Grand Theatre and that may be impacted by the Work.

.1 "Hazardous Building Materials Assessments – Palace Grand Theatre, Dawson City, YT", prepared by Stantec Consulting Ltd., dated March 18, 2015.

.2 "Asbestos Abatement Closure Report – Floor Joist Cavity Vermiculite, Selected Exterior Cement Panels and Localized Areas of Mechanical Pipe Insulation – Palace Grand Theatre, Third and King Street, Dawson City, YT", prepared by Stantec Consulting Ltd., dated November 19, 2015.

.2 Unless otherwise determined through risk assessment conducted by a qualified person, comply with requirements of this Section when disturbance to the following materials is required to complete the Work:

.1 Asbestos-containing vermiculite, present as trace amounts of debris pinched between main floor joists and overlying subfloor.

.1 There is potential for release of this material during lifting and/or relocation of the building. Work procedures outlined in this section are to be used to clean-up or address debris, as it is released.

.2 At a minimum, workers conducting activities that may significantly vibrate the main floor joists should be provided with appropriate respiratory protection as outlined herein, for use until it is reasonably determined that work activities are not causing release of vermiculite debris.

.2 Asbestos-containing joint compound on gypsum walls throughout, when disturbing <1 square metre of material in a single location.

.1 May require localized abatement for installation of bracing associated with building support during relocation, or for installation of other services (fire sprinklers, electrical, etc.).

.2 May require localized patch and repair for damage incurred during building renovation.

.3 Asbestos-contaminated soil in discrete areas and volumes less than 1 cubic metre.

.1 Soil to be disposed of is to be considered asbestos waste and handled, transported and disposed of accordingly per the requirements of this Section.

.2 If disposal is not required, contaminated soil can remain within the crawlspace upon completion of the Work.

.3 Unless otherwise determined through risk assessment conducted by a qualified person, comply with the personal protective equipment, entry, egress and decontamination requirements of this Section when accessing and leaving the crawlspace to conduct any work.

1.2 SECTION INCLUDES

.1 Requirements and procedures for applicable procedures and personal protective equipment to be utilized during set-up of asbestos abatement work areas and for abatement of ACMs of the type described within.

1.3 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 35 30 - Health and Safety Requirements

.3 Section 01 74 19 - Construction Waste Management and Disposal

.4 Section 02 82 00.02 – Asbestos Abatement Intermediate Precautions

1.4 REFERENCES

.1 Government of Canada.

.1 Canada Labour Code - Part II

.2 Canada Occupational Health and Safety Regulations.

.2 Government of the Yukon

.1 Occupational Health and Safety Act

.2 Yukon Occupational Health Regulations

.3 Canadian General Standards Board (CGSB)

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

.4 Department of Justice Canada (Jus)

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

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

.1 Material Safety Data Sheets (MSDS).

.6 Transport Canada (TC)

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

.7 Underwriters' Laboratories of Canada (ULC)

.8 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention (CDC)/National Institute for Occupational Safety and Health (NIOSH)

.1 NIOSH 94-113-[August 1994], NIOSH Manual of Analytical Methods (NMAM), 4th Edition.

.9 U.S. Department of Labour - Occupational Safety and Health Administration - Toxic and Hazardous Substances

.1 29 CFR 1910.1001-[2001] Asbestos Regulations.

1.5 DEFINITIONS

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

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

.3 Asbestos-Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight (or vermiculite insulation materials with any asbestos) and are identified under Existing Conditions including fallen materials and settled dust.

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

.5 Authorized Visitors: Departmental Representative and representatives of regulatory agencies.

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

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

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

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

.7 Friable material: means material that:

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

.2 is crumbled, pulverized or powdered.

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

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

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

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

1.6 SUBMITTALS

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

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

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

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

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

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

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

1.7 QUALITY ASSURANCE

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

.2 Health and Safety:

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

.2 Safety Requirements: worker protection.

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

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

.2 Disposable-type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing shall consist of a head covering and full body covering that fits snugly at the ankles,

wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing to include suitable footwear, and to be repaired or replaced if torn.

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

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

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

.5 Ensure workers wash hands and face when leaving Asbestos Work Area. Facilities for washing are to be supplied by the Contractor.

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

1.8 WASTE MANAGEMENT AND DISPOSAL

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

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

.3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate and place in designated containers steel metal plastic waste in accordance with Waste Management Plan.

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

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

.7 Fold up metal banding, flatten and place in designated area for recycling.

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

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

1.9 EXISTING CONDITIONS

.1 Reports and information pertaining to ACMs to be handled, removed, or otherwise disturbed and disposed of during this project are bound into this specification in the appendices.

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

1.10 SCHEDULING

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

1.11 OWNER'S INSTRUCTIONS

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

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

.1 Fitting of equipment.
.2 Inspection and maintenance of equipment.
.3 Disinfecting of equipment.
.4 Limitations of equipment.

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

Part 2 Products

2.1 MATERIALS

.1 Drop Sheets:

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

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

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

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

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

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

Part 3 Execution

3.1 PROCEDURES

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

.2 Before beginning Work, isolate Asbestos Work Area using, minimum, preprinted cautionary asbestos warning signs in both official languages that are visible at access routes to Asbestos Work Area.

.1 Remove visible dust from surfaces in the work area where dust is likely to be disturbed during course of work.

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

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

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

.1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in Asbestos Work Area where dust and contamination cannot otherwise be safely contained. Drop sheets are not to be reused.

.4 Wet materials containing asbestos to be cut, ground, abraded, scraped, drilled, or otherwise disturbed unless wetting creates hazard or causes damage.

.1 Use garden reservoir type low - velocity fine - mist sprayer.

.2 Perform Work to reduce dust creation to lowest levels practicable.

.3 Work will be subject to visual inspection and air monitoring.

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

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

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

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

.6 Cleanup:

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

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

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

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

3.2 AIR MONITORING

.1 From beginning of Work until completion of cleaning operations, Departmental Representative to take air samples inside and outside of Asbestos Work Area enclosure[s] in accordance with Territorial Occupational Health and Safety Regulations and/or Federal Guidelines.

.1 Departmental Representative will be responsible for monitoring inside enclosures in accordance with applicable Territorial Occupational Health and Safety Regulations and/or Federal Guidelines.

.2 If air monitoring shows that areas outside Asbestos Work Area enclosure[s] are contaminated, enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area, at no additional cost to the Contract

.3 Ensure that respiratory safety factors are not exceeded.

.4 During the course of Work, Departmental Representative to measure fibre content of air outside Work areas by means of air samples analyzed by Phase Contrast Microscopy (PCM).

.1 Stop Work when PCM measurements exceed 0.05 f/cc and correct procedures.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Refer to the following reports attached in Appendix A and B for information pertaining to the asbestos-containing materials (ACMs) that have been identified in the Palace Grand Theatre and that may be impacted by the Work.

.1 "Hazardous Building Materials Assessments – Palace Grand Theatre, Dawson City, YT", prepared by Stantec Consulting Ltd., dated March 18, 2015.

.2 "Asbestos Abatement Closure Report – Floor Joist Cavity Vermiculite, Selected Exterior Cement Panels and Localized Areas of Mechanical Pipe Insulation – Palace Grand Theatre, Third and King Street, Dawson City, YT", prepared by Stantec Consulting Ltd., dated November 19, 2015.

.2 Unless otherwise determined through risk assessment conducted by a qualified person, comply with requirements of this Section when disturbance to the following materials is required to complete the Work

.1 Asbestos-containing joint compound on gypsum walls throughout, when disturbing >1 square metre of material in a single location.

.1 May require localized abatement for installation of bracing associated with building support during relocation, or for installation of other services (fire sprinklers, electrical, etc.).

.2 May require localized patch and repair for damage incurred during building relocation.

.2 Asbestos-containing white woven flex duct connectors between the main furnace units and primary furnace ducting (one on each of the four furnaces) in the mechanical room

.1 This material will require removal and disposal.

.3 Asbestos-containing white fibrous liner/gaskets found on circular furnace hatches (one on each of the four furnaces) in the mechanical room

.1 This material will require removal and disposal

.4 Asbestos-containing white furnace gasket found between a furnace and a red burner box in the mechanical room

.1 This material will require removal and disposal.

.5 Asbestos-contaminated soil in large areas and volumes greater than 1 cubic metre.

.1 Soil to be disposed of is to be considered asbestos waste and handled, transported and disposed of accordingly per the requirements of this Section.

.2 If disposal is not required, contaminated soil can remain within the crawlspace upon completion of the Work.

1.2 SECTION INCLUDES

.1 Requirements and procedures for applicable procedures and personal protective equipment to be utilized during set-up of asbestos abatement work areas and for abatement of ACMs of the type described within.

1.3 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 35 30 - Health and Safety Requirements

.3 Section 01 74 19 - Construction Waste Management and Disposal

.4 Section 02 82 00.01 – Asbestos Abatement Minimum Precautions

1.4 REFERENCES

.1 Government of Canada.

.1 Canada Labour Code - Part II

.2 Canada Occupational Health and Safety Regulations.

.2 Government of the Yukon

.1 Occupational Health and Safety Act

.2 Yukon Occupational Health Regulations

.3 Canadian General Standards Board (CGSB)

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

.4 Department of Justice Canada (Jus)

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

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

.1 Material Safety Data Sheets (MSDS).

.6 Transport Canada (TC)

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

.7 Underwriters' Laboratories of Canada (ULC)

.8 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention (CDC)/National Institute for Occupational Safety and Health (NIOSH)

.1 NIOSH 94-113-[August 1994], NIOSH Manual of Analytical Methods (NMAM), 4th Edition.

.9 U.S. Department of Labour - Occupational Safety and Health Administration - Toxic and Hazardous Substances

.1 29 CFR 1910.1001-[2001] Asbestos Regulations.

1.5 DEFINITIONS

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

.2 Asbestos-Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight (or vermiculite insulation materials with any asbestos) and are identified under Existing Conditions including fallen materials and settled dust.

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

.4 Authorized Visitors: Departmental Representative, and representatives of regulatory agencies.

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

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

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

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

.6 Friable Materials: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.

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

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

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

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

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

1.6 SUBMITTALS

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

.2 Submit proof satisfactory to Departmental Representative that suitable arrangements have been made to dispose of asbestos containing waste in accordance with requirements of authority having jurisdiction.

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

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

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

.6 Submit proof satisfactory to Departmental Representative that all asbestos workers have received appropriate training and education by a competent person in the hazards of asbestos

exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.

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

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

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

.1 Encapsulants;

.2 Amended water;

.3 Slow drying sealer.

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

1.7 QUALITY ASSURANCE

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

.2 Health and Safety:

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

.2 Safety Requirements: worker and visitor protection.

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

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

respirator unless he or she is physically able to perform the operation while using the respirator.

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

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

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

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

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

.7 Visitor Protection:

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

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

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

1.8 WASTE MANAGEMENT AND DISPOSAL

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

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

.3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers steel, metal, and/or plastic waste in accordance with Waste Management Plan.

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

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

.7 Fold up metal banding, flatten and place in designated area for recycling.

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

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

1.9 EXISTING CONDITIONS

.1 Reports and information pertaining to ACMS to be handled, removed, or otherwise disturbed and disposed of during this Project are bound into this specification in the appendices

.2 Notify Departmental Representative of additional suspected ACM discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

1.10 SCHEDULING

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

1.11 OWNER'S INSTRUCTIONS

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

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

.1 Fitting of equipment.
.2 Inspection and maintenance of equipment.
.3 Disinfecting of equipment.
.4 Limitations of equipment.

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

Part 2 Products

2.1 MATERIALS

.1 Drop and Enclosure Sheets:

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

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

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

.1 Inner container: 0.15 mm thick sealable polyethylene bag or where glove bag method is used, glove bag itself.

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

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

.4 Glove bag:

.1 Acceptable materials: safe-T-Strip products in configuration suitable for Work, or Alternative material approved by addendum during tendering period in accordance with Instructions to Tenderers.

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

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

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

.7 Encapsulant: penetrating type conforming to CAN/CGSB-1.205.

Part 3 Execution

3.1 SUPERVISION

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

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

3.2 PROCEDURES

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

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

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

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

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

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

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

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

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

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

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

.7 Cleanup:

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

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

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

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

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

3.3 AIR MONITORING

.1 From beginning of Work until completion of cleaning operations, Departmental Representative to take air samples inside and outside of Asbestos Work Area enclosure[s] in accordance with Territorial Occupational Health and Safety Regulations and/or Federal Guidelines.

.1 Departmental Representative will be responsible for monitoring inside enclosure in accordance with applicable Territorial Occupational Health and Safety Regulations and/or Federal Guidelines.

.2 If air monitoring shows that areas outside Asbestos Work Area enclosure[s] are contaminated, enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area, at no additional cost to the Contract

.3 Ensure that respiratory safety factors are not exceeded.

.4 During the course of Work, Departmental Representative to measure fibre content of air outside Work areas by means of air samples analyzed by Phase Contrast Microscopy (PCM).

.1 Stop Work when PCM measurements exceed 0.05 f/cc and correct procedures.

.5 Final air monitoring to be conducted as follows: After Asbestos Work Area has passed visual inspection and acceptable coat of lock-down agent has been applied to surfaces within enclosure, and appropriate setting period has passed, Departmental Representative will perform air monitoring within Asbestos Work Area.

.1 Final air monitoring results must show fibre levels of less than 0.01 f/cc.

.2 If air monitoring results show fibre levels in excess of 0.01 f/cc, re-clean work area and apply another acceptable coat of lock-down agent to surfaces.

.3 Repeat as necessary until fibre levels are less than 0.01 f/cc, at no cost to Contract.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

.1 Concrete Reinforcing — Section 03 20 00

.2 Cast-in-Place Concrete — Section 03 30 00

1.2 REFERENCES

.1 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction.

.2 CAN/CSA-O86-09, Engineering Design in Wood (Limit States Design).

.3 CSA O121-08, Douglas Fir Plywood.

.4 CSA O151-04, Canadian Softwood Plywood.

.5 CSA S269.1-1975, Falsework for Construction Purposes.

.6 CAN/CSA-S269.3-M92, Concrete Formwork.

1.3 SHOP DRAWINGS

.1 Prepare shop drawings for formwork and falsework in accordance with Section 01 33 00 – Submittal Procedures.

.2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings and comply with CAN/CSA-S269.3 for formwork drawings.

.3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.

.4 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.

.5 The contractor is responsible for the design of all formwork and shoring and for complying with all Workers' Compensation Board regulations pertaining to formwork construction, design and inspection. Formwork and shoring shall be designed by a qualified professional engineer registered or licensed in Yukon Territory.

2.0 PRODUCTS

2.1 MATERIALS

.1 Formwork materials:

.1 For concrete without special architectural features, use plywood and wood formwork materials to CSA-O121and CAN/CSA-O86,
.2 For concrete with special architectural features, use formwork materials to CAN/CSA-A23.1.

.2 Pan forms: removable as indicated.

.3 Form ties:
.1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
.2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.

.4 Form liner:
.1 Plywood: Douglas Fir to CSA O121 or Canadian Softwood Plywood to CSA O151 square edge.

.5 Form release agent: chemically active release agents containing compounds that react with free lime in concrete resulting in water insoluble soaps.

.6 Falsework materials: to CSA S269.1.

3.0 EXECUTION

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork / falsework and ensure dimensions agree with drawings.

.2 Obtain Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.

.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.4 Fabricate and erect falsework in accordance with CSA S269.1.

.5 Do not place shores and mud sills on frozen ground.

.6 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.7 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1.

.8 Align form joints and make watertight. Keep form joints to minimum.

.9 Use 20mm chamfer strips on external corners and/or 20mm fillets at interior corners of concrete members, joints, unless specified otherwise.

.10 Build in anchors, sleeves, and other inserts required to accommodate Work specific in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.11 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.

3.2 REMOVAL AND RESHORING

.1 Formwork removal and reshoring: Do not remove forms and shoring before the concrete has attained sufficient strength to ensure the safety of the structure and not before the following minimum and long term performance periods of time after placing concrete:

24 hours	footing sides

.2 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

.3 Re-use formwork and falsework subject to requirements of CAN/CSA-A23.1.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

1.	Concrete Forming and Accessories	Section 03 10 00
.2	Cast-in-Place Concrete	Section 03 30 00

1.2 REFERENCES

.1 ANSI/ACI 315-99, Details and Detailing of Concrete Reinforcement.

.2 ACI 315R-94, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.

.3 ASTM A775/A775M-04, Specification for Epoxy-Coated Reinforcing Steel Bars.

.4 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction.

.5 CAN3-A23.3-04, Design of Concrete Structures for Buildings.

.6 CSA G30.3-M1983(R1991), Cold Drawn Steel wire for Concrete Reinforcement.

.7 CSA G30.5-M1983(R1991), Welded Steel Wire Fabric for Concrete Reinforcement.

.8 CAN/CSA-G30.18-09, Billet-Steel Bars for Concrete Reinforcement.

.9 CSA G30.14-M1983(R1991), Deformed Steel Wire for Concrete Reinforcement.

.10 CSA G30.15-M1983(R1991), Welded Deformed Steel wire Fabric for Concrete Reinforcement.

.11 CAN/CSA-G40.21-04, Structural Quality Steels.

.12 CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles.

.13 CSA W186-M1990, Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.3 SOURCE QUALITY CONTROL

.1 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 1 week prior to commencing reinforcing work.

.2 Inform Departmental Representative of proposed source of material to be supplied.

1.4 SHOP DRAWINGS

.1 Produce shop drawings including placing of reinforcement.

.2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacing, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacing and locations of chairs, spacers and hangers. Prepare reinforcement drawings in accordance with ANSI/ACI 315 and ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.

.3 Detail lap lengths and bar development lengths to CAN3-A23.3, unless otherwise indicated.

1.5 SUBSTITUTES

.1 Substitute different size bars only if permitted in writing by Departmental Representative.

2.0 PRODUCTS

2.1 MATERIALS

.1 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.

.2 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA G30.18.

.3 Cold-drawn annealed steel wire ties: to CSA G30.3.

.4 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.

.5 Epoxy coating of non-prestressed reinforcement: to ASTM A775/A775M.

.6 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.

.7 Mechanical splices: subject to approval of Departmental Representative.

.8 Plain round bars: to CAN/CSA-G40.21.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1, ANSI/ACI 315, and ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures unless indicated otherwise. For epoxy coated bars, fabricate in accordance with ASTM D3963.

.2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists. For epoxy coated bars, method of bundling and transportation should be in accordance with ASTM A775/A775M and ASTM D3963.

3.0 EXECUTION

3.1 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars which develop cracks or splits.

3.2 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on placing drawings and in accordance with CAN/CSA-A23.1.

.2 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.

.3 Prior to placing concrete obtain Departmental Representative's approval of reinforcing material and placement.

.4 Ensure cover to reinforcement is maintained during concrete pour.

.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

.1	Concrete Forming and Accessories	Section 03 10 00
.2	Concrete Reinforcing	Section 03 20 00

1.2 REFERENCES

.1 ASTM C109-05, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50-mm Cube Specimens).

.2 ASTM C309-03, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.3 ASTM C332-99, Specification for Lightweight Aggregates for Insulating Concrete.

.4 ASTM C827-01a, Test Method for Early Volume Change of Cementitious Mixtures.

.5 ASTM C939-02, Test Method for Flow of Grout for Preplaced-Aggregate Concrete.

.6 ASTM D412-98a(2002), Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.

.7 ASTM D624-00e1, Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

.8 ASTM D1751-99, Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

.9 ASTM D1752-04, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

.10 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.

.11 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.12 CAN/CSA-A5-98, Portland Cement.

.13 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction.

.14 CAN/CSA-A23.2-09, Methods of Test for Concrete.

.15 CAN/CSA-A23.5-98, Supplementary Cementing Materials.

.16 ASTM C 260 – 01, Specifications for Air-Entraining Admixtures for Concrete.

.17 ASTM C 494M – 05a, Specifications for Chemical Admixtures for Concrete.

1.3 CERTIFICATES

.1 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.

.2 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.

1.4 QUALITY ASSURANCE

.1 Minimum 2 weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative's approval for following items:

.1 Falsework erection.
.2 Hot weather concrete.
.3 Cold weather concrete.
.4 Curing.
.5 Finishes.
.6 Formwork removal.
.7 Joints.

2.0 PRODUCTS

2.1 MATERIALS

.1 Portland cement: to CAN/CSA-A5.

.2 Supplementary cementing materials: to CAN/CSA-A23.5.

.3 Water: to CAN/CSA-A23.1.

.4 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density.

.5 Low density aggregate for insulating concrete: to CAN/CSA-A23.1 and ASTM C332 group II.

.6 Air entraining admixture: to ASTM C260.

.7 Chemical admixtures: to ASTM C494M. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.

.8 Non-shrink grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.

.1 Compressive strength: 50 MPa at 28 days.
.2 Consistency:

.1 Fluid: to ASTM C827. Time of efflux through flow cone (ASTM C939), under 30 s.
.2 Flowable: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portion) 125 to 145%.
.3 Plastic: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portions) 100 to 125%.
.4 Dry pack to manufacturer's requirements.

.9 Non premixed dry pack grout: composition of non metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 50 MPa at 28 days.

.10 Curing compound: to CAN/CSA-A23.1 and to ASTM C309, Type 1-chlorinated rubber.

.11 Ribbed waterstops: extruded PVC Arctic Grade of sizes indicated with welded corner and intersecting pieces:

.1 Tensile strength: to ASTM D412, method A, Die "C", minimum 11.4 MPa.
.2 Elongation: to ASTM D412, method A, Die "C", minimum 275%.
.3 Tear resistance: to ASTM D624, method A, Die "B", minimum 48 kN/m.

.12 Premoulded joint fillers:

.1 Bituminous impregnated fiber board: to ASTM D1751.
.2 Sponge rubber: to ASTM D1752, Type I, flexible grade.

.13 Weep hole tubes: plastic.

.14 Dampproofing: Emulsified asphalt, mineral colloid type, unfilled: to CAN/CGSB-37.2.

.15 Polyethylene film: 6 mil thickness to CAN/CGSB-51.34.

2.2 MIXES

.1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Alternative 1 to give the following properties:
.1 Cement: Type GU or GUb Portland cement
.2 Minimum compressive strength at 28 days, class of exposure and nominal size of coarse aggregate:

Member	minimum 28-days strength (Mpa)	maximum aggregate size (mm)	exposure class	air content Category
Exterior Equipment pads	35	25	C-1	1

.3 Slump at time and point of discharge: To CSA-A23.1 Clause 4.3.2.3. When superplasticizers are used, the slump may be increased by shall kept below the point where segregation will occur. The cost of superplasticizers shall be included in the cost of the concrete. Smaller aggregate size may be used where necessary to increase slump.

.4 Air content: To CSA-A23.1 Table 2 & 4 to suit appropriate exposure class.

.5 Chemical admixtures: following admixtures in accordance with to ASTM C494M. Admixtures shall contain no salts or acids.

.6 Concrete mix designs shall be submitted to a material consultant for approval and to Departmental representative for review prior to any concrete work.

3.0 EXECUTION

3.1 PREPARATION

.1 Obtain Departmental Representative's approval before placing concrete. Provide 72 h notice prior to placing of concrete.

.2 Pumping of concrete is permitted only after approval of equipment and mix.

.3 Ensure reinforcement and inserts are not disturbed during concrete placement.

.4 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing.

.5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.6 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.

.7 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 CONSTRUCTION

.1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1 and CAN/CSA-A23.2. Adhere strictly to CSA-A23.1 for proper preparation and protection for cold weather and hot weather concrete work.

.2 Provide reinforcement for Concrete topping as per drawings.

.3 Sleeves and inserts.

.1 No sleeves, ducts, pipes or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative.

.4 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100 mm not indicated, must be approved by Departmental Representative.

.5 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative before placing of concrete.

.6 Check locations and sizes of sleeves and openings shown on drawings.

.7 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.3 Anchor bolts.

.1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
.2 With approval of Departmental Representative, grout anchor bolts in holes drilled after concrete has set. Drilled holes to be to manufacturer's recommendations.
.3 Protect anchor bolt holes from water accumulations, snow and ice build-up.
.4 Set bolts and fill holes with epoxy grout.
.5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.

.4 Drainage holes and weep holes:

.1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forms and Accessories. If wood forms are used, remove them after concrete has set.
.2 Install weep hole tubes and drains as indicated.

.5 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.

.6 Finishing:

.1 Finish concrete in accordance with CAN/CSA-A23.1.
.2 Use procedures acceptable to Departmental Representative or those noted in CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.
.3 Use curing compounds compatible with applied finish on concrete surfaces. Applied finish on concrete: Provide written declaration that compounds used are compatible.

.7 Waterstops:

.1 Install waterstops to provide continuous water seal. Do not distort or pierce waterstop in such a way as 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 unless otherwise approved by Departmental Representative.

.8 Joint fillers:

.1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative. 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, construction and expansion joints as indicated. Install joint filler.

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

3.3 SITE TOLERANCE

.1 All horizontal surfaces shall meet the Class A Slab and Floor Finish classification (+/- 8mm) in accordance with Table 19 of CAN/CSA-A23.1 straight edge method.

.2 Tolerance closer than those specified in CSA-A23.1 may be required at certain locations for structural, architectural and construction requirements.

3.4 FIELD QUALITY CONTROL

.1 Inspection and testing of concrete and concrete materials will be carried out by a CSA certified Testing Laboratory designated by Departmental Representative in accordance with CAN/CSA-A23.1. Submit all concrete testing results to the Departmental representative.

.2 The costs of tests shall be borne by contractor as specified in Section 01 11 55 – General Instructions.

.3 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.4 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2.

.5 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

.1 Fire Stopping Section 07 84 00

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA)
- .1 CAN/CSA-S136-07, North American Specification for the design of Cold Formed Steel Structural Members.
- .2

.2 Canadian Sheet Steel Building Institute (CSSBI)
- .1 CSSBI 10M-08, Standard for Steel Roof Deck.

.3 American Society for Testing and Materials International, (ASTM)
- .1 ASTM A 653/A653M-11, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM A792/A 792M-05, Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .1 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 –Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

.1 steel sheet: to ASTMA653/A653M structural quality Grade 230, with Z275, coating, regular spangle surface, not chemically treated for paint finish, 0.91mm minimum base steel thickness.

.2 Closures: as indicated.

.3 Coverplates, deck flute closures and flashings: steel sheet with minimum base steel thickness of 0.91 mm. Metallic coating same as deck material.

.4 Primer: zinc rich, ready mix to MPI #200.

.5 Caulking: to Section 07 92 00 Joint Sealants.

.6 Fire stopping: to Section 07 84 00 Fire stopping.

2.2 TYPES OF DECKING

.1 Composite steel floor deck: 0.91 mm minimum base steel thickness, 38mm deep profile, non-cellular, upright embossed fluted profile, overlapping side laps.

3.0 EXECUTION

3.1 GENERAL

.1 Structural steel work: in accordance with CAN/CSA-S136 and CSSBI 10M.

.2 Unless noted on the drawings, Mechanical Fastener to be HiltiX-ENP2K or X-EDN 22 fasteners or approved equivalent spaced at 300mm maximum on center to structural members and edge angles and side laps with 1-#10 self drilling screws at maximum 300mm on center.

3.2 ERECTION

.1 Erect steel deck as indicated and in accordance with CSSBI 10M and in accordance with reviewed erection drawings.

.2 Butt ends: to 1.5 to 3 mm gap. Install steel cover plates over gaps wider than 3 mm.

.3 Lap ends: to 50 mm minimum.

.5 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.

.6 Prior to concrete placement, steel deck to be free of soil, debris, standing water, loose mil scale and other foreign matter.

.7 Unless noted otherwise, concrete topping shall be reinforced with WWM152x152xMW9.1/MW9.1. Locate 25mm from top of slab and spliced two cross wires plus 50mm.

Unless noted otherwise, provide 1.2mm closure angles around all openings which are not framed with angles.

3.4 CONNECTIONS

.1 Install connections in accordance with CSSB1-10M.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

.1	Cast-in-Place Concrete	Section 03 30 00
.2	Exterior Painting	Section 09 91 13
.3	Interior Painting	Section 09 91 23

1.2 REFERENCES

.1 ASTM A53/A53M-07, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A269-08, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

.3 ASTM A307-07b, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

.4 CAN/CGSB-1.40-97 Anticorrosive Structural Steel Alkyd Primer.

.5 CAN/CGSB-1.181-99, Ready-Mixed, Organic Zinc-Rich Coating.

.6 CAN/CSA-G40.21-13, Structural Quality Steels.

.7 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.8 CAN/CSA-S16-14, Design of Steel Structures.

.9 CSA W59-2013, Welded Steel Construction (Metal Arc Welding).

10. The Environmental Choice Program

.1 CCD-047a- 05 - Architectural Surface Coatings.

.2 CCD-048- 06 - Surface Coatings - Recycled Water-borne.

Please see attached for above listed documents]

1.3 SUBMITTALS

.1 **Product Data:**

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures

.2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's for finishes, coatings, primers and paints.

.2 **Shop Drawings:**

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

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.4 QUALITY ASSURANCE

.1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, Shipping, Handling and Unloading:

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

.2 Storage and Protection:

.1 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site.

.2 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

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

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

2.0 PRODUCTS

2.1 MATERIALS

.1 Structural Steel and Misc. Metal: to CAN/CSA-G40.20/G40.21, Grade as per drawings.

.2 Welding materials: to CSA W59.

.3 Welding electrodes: to CSA W48 Series.

.4 Bolts

connections to timber and anchor bolts: to ASTM A307;
connections between steel members: to ASTM A325.

.5 Grout: non-shrink, non-metallic, flowable, 24h, MPa 15, pull-out strength 7.9 MPa.

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof round headed screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m2 to CAN/CSA-G164.

.2 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper 0.010 mm thickness of nickel and 0.0025 mm thickness of chromium.

.3 Shop coat primer: to CAN/CGSB-1.40.

.4 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

2.4 ISOLATION COATING

.1 Isolate aluminum from following components, by means of bituminous paint:

.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
.2 Concrete, mortar and masonry.
.3 Wood.

2.5 SHOP PAINTING

.1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 Celsius degree.

.3 Clean surfaces to be field welded; do not paint.

3.0 EXECUTION

3.1 ERECTION

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Provide components for building by other sections in accordance with shop drawings and schedule.

.6 Make field connections with bolts to CAN/CSA-S16-14, or weld.

.7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 07 21 13 Board Insulation.

.2 Section 07 44 56 Mineral Fiber Cementitious Panels

.3 Section 07 46 16 Preformed Metal Siding

.4 Section 07 52 00 Modified Bituminous Sheet Roofing and Waterproofing

1.2 REFERENCES

.1 ASTM International

- .1 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 CSA International

- .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .2 CAN/CSA-G164-M92(R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA O121-08, Douglas Fir Plywood.
- .4 CSA O141-05(R2009), Softwood Lumber.
- .5 CSA O151-09, Canadian Softwood Plywood.
- .6 CAN/CSA-O325.0-07, Construction Sheathing.
- .7 CAN/CSA-S406-14, Specifications of Permanent Wood Foundations for Housing and Small Buildings

.3 National Lumber Grades Authority (NLGA)

- .1 Standard Grading Rules for Canadian Lumber 2010.

.4 American Wood-Preservers' Association (AWPA)

- .1 AWPA M2-01, Standard for Inspection of Treated Wood Products.
- .2 AWPA M4-06, Standard for the Care of Preservative-Treated Wood Products.

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

- .1 Material Safety Data Sheets (MSDS).

1.3 QUALITY ASSURANCE

.1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood identification: by grade mark in accordance with applicable CSA standards.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction /Demolition Waste Management and Disposal to the maximum extent economically possible.

.2 Do not burn scrap materials at the project site

1.5 HEALTH AND SAFETY REQUIREMENTS

.1 Submit Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 Submittal procedures

Part 2 Products

2.1 MATERIALS

.1 Lumber: unless specified otherwise, softwood, S4S, moisture content 15% or less in accordance with following standards:

.1 CAN/CSA-O86.1and CAN/CSA-O141

.2 NLGA Standard Grading Rules for Canadian Lumber.

.2 Furring, blocking, nailing strips, grounds, rough bucks, curbs, backing and sleepers:

.1 Board sizes: "Standard" or better grade.

.2 Dimension sizes: "Standard" light framing or better grade.

.3 Post and timbers sizes: "Standard" or better grade.

.3 Panel Materials:

.1 Douglas fir plywood (DFP): to CSA O121, standard construction.

.2 Canadian softwood plywood (CSP): to CSA O151, standard construction.

.4 Wood Preservative:

.1 Preservative: to CSA-O80 Series-08, odourless water-borne, for stained finish.

.2 Ensure wood preservative used is compatible with roofing and waterproofing membrane specified.

2.2 PANEL MATERIALS AND USES

.1 Wall Sheathing: Douglas Fir plywood, sheathing grade and 12.7mm thick.

2.3 ACCESSORIES

.1 All hot-dipped galvanized connection plates and fasteners shall conform to CSA G164 and related standards with minimum coating of 610 grams per square meters.

.2 Nails, spikes and staples: to CSA B111.

.3 Bolts and anchor bolts: to ASTM A307, complete with nuts and washers.

.4 All bolts and nuts must be fitted with cut steel washers.

.5 All steel plate and angles used in connection details: to CSA-G40.20/G40.21 300W.

.6 Bolts holes shall be 1mm larger than the bolt diameter. Bolts in wood shall not be less than 7 diameter from the end and 4 diameter from the edge unless otherwise detailed.

.7 Lag screws shall be predrilled with a bit size of 65% of the shank diameter for the threaded portion. Lead holes shall be the same length as the unthreaded portion and the same diameter as the shank. Screw all lags into place. Cut washers shall be provided under heads which bear on wood.

.8 No checks or splits allowed at areas to be bolted or lagged.

2.4 WOOD PRESERVATIVE TREATMENT AND HANDLING FOR TIMBER CRIBS

.1 All pressure treated members shall be treated with water-borne salts:
.1 Conform to CSA O80 Series and its current amendments for use categories of UC4.2.
.2 Refer to CSA O80.1 Table 10 for minimum retention for lumber and Table 20 for minimum retention for plywood.
.3 Contractor shall submit preservative type and % retention to the Departmental Representative for approval prior to use on the project.

.2 Treated material will be rejected if damaged in any manner during handling, including damage from strapping and slings.

.3 Do not make field cuts in treated material unless permitted by the Departmental Representative. When permitted, field treat cuts as soon as possible with preservative specified for the original timber treatment.

.4 Field drilled holes: when field treating is permitted, field treat to CSA O80, using 2 coats of approved wood preservative.

Part 3 Execution

3.1 DEMOLITION AND SALVAGE

.1 Remove existing skirting and flashings at perimeter of building, as indicated.

.2 Carefully remove lower sections of existing wood siding for reuse, Remove existing metal cladding as detailed. Existing asbestos cement board siding on the lower portion of the building perimeter will be removed by owner prior to start of work. Refer to drawings for specific areas and extent.

.3 Retain all of the wood siding for re application. Remove all fasteners. Take care not to split or damage the face of the salvaged siding. Remove fasteners through the non exposed face of the siding.

.4 Store the salvaged siding in a secure covered area until it is required for reapplication.

.5 Remove existing window in Vestibule 112

.6 Remove existing window infill wall in preparation for new glazed curtain wall installation.

.7 Open bulkhead to allow for fire sprinkler work.

3.2 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for rough carpentry installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied

3.3 PREPARATION

.1 Treat surfaces of materials with wood preservative before installation.

.2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and 1 minute soak on plywood.

.3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

.4 Treat material as follows :

.1 Wood sleepers supporting wood skirting, in direct contact with ground or fill.

.2 Exterior wooden stair risers, steps, ramps and boardwalk.

3.4 INSTALLATION- GENERAL

.1 Comply with requirements of NBC Part 9 and General Notes on Structural Drawings, whichever more stringent, supplemented by the following paragraphs.

.2 Install member true to line, levels and elevations.

.3 Align and plumb faces of furring and blocking.

.4 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.5 Install wood fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.

.6 Install sleepers and connections as indicated on Structural drawings.

.7 Use caution when working with treated materials. Use high quality respirator masks.

.8 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.9 Countersink bolts where necessary to provide clearance for other work.

3.5 INSTALLATION OF VENT WALL ASSEMBLY

.1 After installation of new structural foundation walls:

.1 Construct wood roof and vent wall.

.2 Apply SBS Membrane to surfaces as detailed.

.3 Install copper flashings, perforated metal insect screens, and necessary blocking.

.4 Re-install and add portions of copper downspouts in areas indicated.

.5 Install new metal siding, and cementitious siding materials in areas indicated.

.6 Re install salvaged wood siding in areas indicated.

3.6 WINDOW REMOVAL VESTIBULE 112

.1 Frame infill wall and install exterior finishes to match existing.

3.7 STAGE 105

.1 Frame new floor openings as required for mechanical work.

3.8 CORRIDOR 119

.1 Provide framing as required for installation of glass curtain wall.

3.9 CLEANING

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

.1	Cast-in-Place Concrete	Section 03 30 00
.2	Metal Fabrications	Section 05 50 00
.3	Rough Carpentry	Section 06 10 00
.4	Interior Painting	Section 09 91 23

1.2 WORK INCLUDED

.1 Fabrication of heavy timber structural framing consisting of crib foundation block, of constant profile.

1.3 QUALITY ASSURANCE

.1 Grading:

.1 NBC Part 4-Design, as applicable to Timber Construction

.2 Timber components and construction to CSA Standard 086.1 and according to N.L.G.A. Standard Grading Rules 2007 as applicable.

.3 Standards: CSA Standards S16.1 and 0.86.1 for Steel Connections.

1.4 SUBMITTALS

.1 Shop Drawings: submit drawings for all fabricated timber elements and connections of accordance with Section 01 33 00 - Submittal Procedures.

Indicate grades of timber, shop applied finishes and pre-staining requirements, shop and erection details including cuts, holes, fastenings and connection hardware.

.2 Review of shop drawings to be for size and arrangement of original and auxiliary members only. Such review will not relieve Contractor of responsibility for general and detail dimensions and fit or any errors or omissions.

.3 Drawings showing erection procedures and erection bracing to be prepared by fabricator. Erection procedures and details and size of temporary bracing are the responsibility of the Fabricator.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Store pre-fabricated components in Contractor's storage yard, piled off the ground, and stacked to provide maximum air circulation and ventilation until required at Construction Site.

.2 Protect with tarps from water, staining, soiling, dust and other construction activity until pick-up.

1.6 CONDITIONS

.1 Examine all conditions on which the successful work of this section depends.

.2 Refer to Structural and Architectural Drawings and Details and to Structural General Notes for specific framing and connecting requirements.

2.0 PRODUCTS

2.1 MATERIALS

.1 General: all materials shall be new and of the quality and grade specified. No seconds, off grades or materials not meeting tolerance specifications will be accepted in the finished construction.

.2 All heavy timber elements shall be properly kiln or air dried to a maximum of 19% moisture content prior to installation.

.3 All heavy timber to be dressed lumber to sizes indicated on drawings.

~~.4~~ All sizes are actual

.5 Steel connections: Supplied under Section 05 50 00 – Metal Fabrications.

3.0 EXECUTION

.1 Preservative Treatment: Comply with the requirements of CSA Standards O80 Series-08.

.2 Install members true to line, levels and elevation, brace and anchor until permanently secured by structure.

.3 Install lumber materials so that grade marks or other defacing marks in exposed areas are not visible or are removed by sanding.

.4 Splice and joint only at locations indicated on reviewed shop drawings.

.5 Apply sealer to all sides and ends of members and in bolt holes at connections exposed to the weather and where shown on the drawings.

.6 Fit all members closely and accurately to all other members and other assembles.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 06 10 00 Rough Carpentry

.2 Section 08 44 13 Glazed Curtain Walls

1.2 REFERENCES

.1 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)

.1 Architectural Woodwork Quality Standards, 1st edition, 2009.

.2 Section 12 - Historic Restoration Work

.2 CSA International

.1 CSA O121-08, Douglas Fir Plywood.

.2 CSA O141-05(R2009), Softwood Lumber.

1.3 QUALITY ASSURANCE

.1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board for any new lumber materials to be used.

1.4 DELIVERY, STORAGE AND HANDLING

.1 To Section 01 61 00 Common Product Requirements

Part 2 Products

2.1 MATERIALS

.1 Douglas fir plywood to CSA 0121-08, Sanded, good one side.

.2 Douglas fir bullnose

2.2 ACCESSORIES

.1 Nails: to CSA B111; galvanized to ASTM A123/A123M for interior areas.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of all wood materials previously installed, are acceptable for removal and reinstallation.

.1 Visually inspect substrate.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied

.4 Protect adjacent areas from damage during installation.

3.2 INSTALLATION

.1 Window sill and liners

.1 Install window sill and liners for curtain wall as detailed.

3.3 CLEANING

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by finish carpentry installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 06 10 11 Rough Carpentry

.2 07 28 00 Air and Vapour Barriers

.3 07 52 00 Modified Bituminous Roofing

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM C1289-05a,Standard specification for Faced Rigid Cellular Polyisocyanurate Thermal insulation board.

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurathane and Polyisocyanurate, Boards, Faced.

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

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit copy of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's insulation products and adhesives.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

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

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

Part 2 Products

2.1 INSULATION

.1 Rigid Cellular Polyisocyanurate core: glass fiber reinforced

.2 Surfaces:

.1 Facers: both sides, impermeable

.2 Shape flat and tapered as indicated

.3 Thickness; as indicated

2.2 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

2.3 WORKMANSHIP

.1 Install insulation after building substrate materials are dry.

.2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.3 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

.4 Offset both vertical and horizontal joints in multiple layer applications.

.5 Do not enclose insulation until it has been inspected and approved by Departmental Representative.

2.4 EXAMINATION

.1 Prior to commencement of work ensure:

.1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

2.5 ROOF INSULATION

.1 Refer to 07 52 00 Modified Bituminous Membrane roofing

2.6 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 06 10 00 Rough Carpentry

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.2 ASTM C665-12 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

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

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

Part 2 Products

2.1 INSULATION

.1 Pre formed mineral wool in batt form, unfaced, friction fit, to ASTM C665.

.1 Thermal resistance and sizes as indicated.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSULATION INSTALLATION

.1 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.2 Install insulation in continuous contact with interior side of wall sheathing.

.3 Cut flat on table, do not trim in place

.4 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.

.5 Fit insulation tight to windows and doors and other penetrations.

.6 Do not compress insulation to fit into spaces.

.7 Do not enclose insulation until it has been inspected and approved by Departmental Representative.

3.3 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

1.2 REFERENCES

.1 Canadian Urethane Foam Contractors' Association Inc. (CUFCA).

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

.1 Material Safety Data Sheets (MSDS).

.3 Underwriters' Laboratories of Canada (ULC).

.1 CAN/ULC-S101-07, Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.3 CAN/ULC-S705.1-01 (with August 2004 Amendment), Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Material Specification.

.4 CAN/ULC-S705.2-05, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.

1.3 SUBMITTALS

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

.2 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence and cleaning procedures.

.3 Submit WHMIS MSDS - Material Safety Data Sheets

.1 Indicate precautions for workers when handling and applying sprayed foam

.4 Submit product data sheets for system materials. Include product characteristics, performance criteria, physical size, finish and limitations.

.5 Quality assurance submittals:

.1 Submit certified test reports for insulation from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.2 Submit test reports in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.

1.4 QUALITY ASSURANCE

.1 Applicators to conform to CUFCA Quality Assurance Program.

.2 Qualifications:

.1 Installer: person specializing in sprayed insulation installations with documented experience and approved by foam manufacturer.

.2 Manufacturer: company with not less than 5 years experience producing type of foam material required for this project, with sufficient production capacity to produce and deliver required units without causing delay in work.

.3 Mock-up:

.1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.

.2 Construct mock-up of sprayed insulation not less than 10 m^2 in size in location directed by DCC Representative.

.3 Notify DCC Representative not less than 2 working days in advance for inspection of completed mock-up.

.4 Allow 2 working days for inspection of mock-up by DCC Representative before proceeding with sprayed insulation work.

.5 Approved mock-up may be part of finished work.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

1.6 SITE ENVIRONMENTAL REQUIREMENTS

.1 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

.2 Ventilate application areas as required, to maintain non-toxic, unpolluted, safe working conditions for applicators.

.3 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.

.4 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.

.5 Apply insulation only when surfaces and ambient temperatures are within foam manufacturer prescribed limits.

Part 2 Products

2.1 MATERIALS

.1 Insulation: spray polyurethane, closed cell, spray applied polyurethane foam, medium density, closed Cell SPF meeting the requirements of CAN / ULC-S705.1

.2 Primers: in accordance with foam manufacturer recommendations for existing surface conditions.

Part 3 Execution

3.1 MANUFACTURERS INSTRUCTIONS

.1 Comply with manufacturer written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and data sheets.

3.2 APPLICATION

.1 Apply insulation to clean surfaces in accordance with CAN/ULC-S705.2 and foam manufacturer printed instructions, whichever more stringent.

.2 Use primer where recommended by manufacturer.

.3 Apply insulation to thicknesses detailed/indicated.

.4 Accommodate installation of items to be tied into sprayed insulation.

.5 Trim excess and protruding insulation so as not to interfere with application of subsequent work.

3.3 CLEANING

.1 Remove insulation material spilled during installation and leave work area ready for application of cladding materials.

3.4 FIELD QUALITY CONTROL

.1 Section 01 45 00: Quality control, Field testing.

.2 Inspection will include verification of insulation thickness, density and pull testing.

.1 Site Tests

.1 The Licensed Installer shall conduct daily visual inspection, adhesion/cohesion testing and density measurements as outlined by the CAN/ULC S705.2-05 Installation standard. All foam installed must have a field density no less than 5% of the tested value of 37 kg m3 or 2.30 lb ft3 (>35 kg m3 or 2.18 lb ft3) as a minimum.

.2 The Licensed Installer shall complete the Daily Work Sheet and record all information required including the results of the testing. The Daily Work Sheet shall be kept on site for routine inspection.

- Copies of the Daily Work Record shall be forwarded to the owner and owner's representative.

- Copies of the Daily Work Record shall be sent to the Sprayed Insulation Manufacturer, Quality Assurance Program as required by the Sprayed Insulation Manufacturer to ensure compliance with all warranties and or guarantees.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Sheet air barriers.

1.2 RELATED SECTIONS

.1 Section 06 10 00 - Rough Carpentry.

.2 Section 07 52 00 – Modified Bituminous Sheet Roofing and Waterproofing

.3 Section 07 92 00 – Joint Sealant.

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM E 96-05 Standard Test Methods for Water Vapor Transmission of Materials.

1.4 SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Product Data: Provide data indicating material characteristics, performance criteria and limitations.

.3 Manufacturer's Installation Instructions: Indicate preparation and installation requirements, techniques.

1.5 QUALITY ASSURANCE

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

1.6 WHMIS

.1 Comply with WHMIS requirements when handing and using sealant materials.

1.7 INSPECTION TESTING

.1 Coordinate inspection of air barrier elements prior to air barrier system being covered up by other trades.

Part 2 Products

2.1 AIR BARRIER

.1 Air Barrier: spun bonded polyolefin or polypropylene

□

Part 3 Execution

3.1 EXAMINATION

.1 Verify condition of substrate and adjacent materials .

3.2 PREPARATION

.1 Remove loose or foreign matter which might puncture air barrier.

.2 Verify substrate surface is flat, free of honeycomb, fins, irregularities, materials or substances that may impede installation.

3.3 AIR BARRIER

.1 Apply air barrier over exterior surfaces of walls.

.2 Lap minimum of 200 mm and seal with tape.

.3 Fasten to framing or strapping at 600 mm on centre.

.4 Install air barrier to manufacturers recommendations. Seal top and bottom with recommended sealant to achieve a continuous structural membrane.

.5 Seal to window and door frames with self adhesive membrane. Seal to all penetrations in exterior walls.

END OF SECTION

□

Part 1 General

1.1 RELATED SECTIONS

.1 Section 06 10 11 Rough Carpentry.

.2 Section 07 52 00 Modified Bituminous Sheet Roofing and Waterproofing.

.3 Section 07 46 16 Preformed Metal Cladding.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM E96/E96M-[10], Standard Test Methods for Water Vapour Transmission of Materials.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 41-GP-6M-[83], Sheets, Thermosetting Polyester Plastics, Glass Fibre Reinforced.

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

.1 Material Safety Data Sheets (MSDS).

1.3 DESIGN REQUIREMENTS

.1 Design composite building panel wall to provide for thermal movement of component materials caused by ambient temperature range listed in NBC for building location without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.

.2 Include expansion joints to accommodate movement in wall system and between wall system and building structure, caused by structural movements, without permanent distortion, damage to infills, racking of joints, breakage of seals, or water penetration.

.3 Design panel system including, hat channels and connections to withstand wind loads and rain loads listed in NBC for building location without suffering permanent damage.

.4 Design panel system including, hat channels and connections for seismic conditions listed in NBC for building location.

.5 Provide for positive drainage of condensation occurring within wall construction and water entering at joints, to exterior face of wall in accordance with NRC "Rain Screen Principles".

1.4 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 cementitious materials and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit copy of WHMIS MSDS in accordance with Section 01 35 30 - Health and Safety Requirements. Indicate VOC's for cementitious materials.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Yukon Territory, Canada.

.1 Indicate dimensions, wall openings, head, jamb, sill and mullion detail, materials and finish, anchor details, compliance with design criteria and requirements of related work.

.4 Samples:

.1 Submit samples of panel materials indicating finishes and manufacturers full range of colours.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturers written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction /Demolition Waste Management and Disposal to the maximum extent economically possible.

Part 2 Products

2.1 MATERIALS

.1 Cementitious Board: thickness as indicated

2.2 COMPONENTS

.1 Panels:

.1 Description: proprietary manufactured asbestos-free composite product consisting of Portland cement, lime stone, bonding agent, high quality colour pigments, reinforcing fibres, water and air formed under pressure to produce panels intended for exterior wall use; insect resistant, fire resistant and non-combustible.

.2 Dimensions: 8 mm thick cut from 3040 mm x 1220 mm special order size sheets.

.3 Exposed face: cement composite panels with top finishing and core coloured through, protected with factory-applied removable protective film.

.4 Finish: factory applied and covered with dry strippable polyethylene film to protect surfaces from damage during fabrication, shipping and erection.

.5 Colours: As selected by Departmental Representative.

.2 Panel support:

.1 Galvanized hat track channel to ASTM A653/A653M-11- lengths to suit.

.2 Panel fasteners: approx. 15 mm o.d. saucer headed stainless steel alloy rivets provided by panel manufacturer, each fitted with EPDM weather-sealing washer, heads coloured to match adjacent panel colours.

.3 Ventilation screens

.1 Purpose made perforated aluminum flat/brake/u-shaped sections as detailed.

2.3 FABRICATION

.1 Cut panels to size/shape arrangements detailed/indicated and to produce following panel-to-panel joint when installed.

.1 Vertical joint width: as detailed mm.

.2 Cut panels using sharp shears, saws and tools recommended by panel manufacturer. Make cuts that will produce true even joints free of chips and splinters.

.3 Apply proprietary sealing compound to all cut edges, following manufacturers recommendations.

.4 Brake form metal flashings to profile required, in maximum lengths.

.5 Paint ungalvanized steel clips, supports and reinforcing steel with steel primer or isolation coating.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable in accordance with manufacturer's written instructions.

3.2 INSTALLATION

.1 Install horizontal/vertical tracks over previously installed SAM membrane as detailed.

.2 Install flashings as detailed.

.3 Install vertical/horizontal hat tracks, spaced to accept panels.

.1 Drill oversized holes through hat channel attachment flanges to accommodate thermal movement of hat channels.

.2 Provide stainless steel alloy washer under head of each attachment screw to prevent screw head from being pulled through over-sized hole.

.3 Provide stainless steel alloy or aluminum alloy or pvc plastic (thermal break) washers as required to shim hat channels that do not conform to planes required to bring panels within tolerances described in Installation Tolerances.

.4 Install screens at bottom of assembly

.5 Install panels to hat tracks, using manufacturers proprietary fasteners.

3.3 INSTALLATION TOLERANCES

.1 Maintain following installation tolerances:

.1 Maximum variation from plane or location shown on approved shop drawings: 10 mm/metre of length and up to 20 mm/100 metre maximum.

.2 Maximum offset from true alignment between 2 adjacent members abutting end to end, in line: 0.75 mm.

3.4 CLEANING

.1 Progress Cleaning

.1 Wash down exposed acrylic exterior surfaces using solution of mild domestic detergent in warm water, applied with soft clean wiping cloths.

.2 Wash down exposed aggregate exterior surfaces using fine water spray.

.3 Remove excess sealant with recommended solvent.

.4 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by mineral fibre reinforced panel installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 06 10 11 - Rough Carpentry.

.2 Section 07 52 00 - Modified Bituminous Sheet Roofing and Waterproofing.

1.2 REFERENCES

.1 ASTM A755/A755M-11 - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.

1.3 SYSTEM DESCRIPTION

.1 Assembly of components includes preformed and prefinished metal cladding system, and flashings, to match existing in colour and profiles; site assembled.

1.4 DESIGN REQUIREMENTS

.1 Components: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall.

.2 Maximum Allowable Deflection of Panel: 1/90 of span.

.3 Movement: Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; deflection of structural support framing.

.4 Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

.5 Products: Provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials.

.6 Vapour Retarder: Provide continuity of vapour retarder at building enclosure elements in conjunction with vapour retarders specified in Section 07 28 00.

1.5 SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Shop Drawings: Indicate dimensions, layout, joints, construction details, note methods of anchorage to match existing.

.3 Samples: Submit two samples of cladding, (1) 200 x 200 mm in size illustrating finish colour, sheen, profile and texture of new with (1) 200 x 200 mm in size illustrating finish colour, sheen, profile and texture of existing for comparison.

1.6 DELIVERY, STORAGE, AND PROTECTION

.1 Section 01 61 00: Transport, handle, store, and protect products.

.2 Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

.3 Store prefinished material off ground protected from weather, to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

.4 Prevent contact with materials which may cause discolouration or staining.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Construction /Demolition Waste Management and Disposal to the maximum extent economically possible.

Part 2 Products

2.1 EXTERIOR SHEET MATERIALS

.1 Precoated Galvanized Steel: ASTM A653/A653M, Z275 G90 zinc coating designation; shop pre-coated with silicone polyester coating. .

.1 Exposed Exterior Surfaces: Colour as selected from manufacturer's full range to match existing.

2.2 ACCESSORIES

.1 Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant; colour as selected.

.2 Sealants: Manufacturer's standard type suitable for use with installation of system; non-staining, non-skinning, non-shrinking and non-sagging; ultra-violet and ozone resistant; colour as selected..

.3 Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized; fastener cap same colour as exterior panel. Exposed fasteners same type and finish to existing panel system.

.4 Field Touch-up Paint: As recommended by panel manufacturer.

.5 Bituminous Paint: Asphalt base.

.6 Vapour retarder : refer to Section 07 28 00.

2.3 COMPONENTS.

.1 Exterior Sheet: Minimum 0.6 mm, 24 ga thick pre-coated steel, profile as indicated to match existing.

.2 Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitred to required angles. Mitred internal corners to be back braced with pre-coated sheet stock to maintain continuity of profile.

.3 Expansion Joints: Same material, thickness and finish as exterior sheets type, of profile to suit system.

.4 Miscellaneous Trim, Caps, Flashings and Closures: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

.5 Anchors: Galvanized steel.

2.4 FABRICATION

.1 Form sections true to shape, accurate in size, square, and free from distortion or defects.

.2 Form pieces in longest practicable lengths.

.3 Panel Profile: To match existing.

.4 Fabricate corners in one continuous piece with minimum 450 mm long pieces.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 61 00: Verify existing conditions before starting work.

.2 Verify that building framing members are ready to receive panel system.

3.2 INSTALLATION – VAPOUR RETARDER

.1 Install metal cladding over previously installed vapour retarder membrane as described in 07 28 00.

.2 Weather lap edges 150 mm and ends minimum 100 mm

.3 Stagger vertical joints of each layer.

3.3 INSTALLATION

.1 Install metal cladding system on walls to manufacturer's written instructions.

.2 Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.

.3 Fasten cladding ; aligned, level, and plumb.

.4 Locate joints over supports. Lap panel ends minimum 50 mm, 2 inches.

.5 Provide expansion joints where indicated.

.6 Use concealed/exposed fasteners to match existing unless otherwise approved by Consultant.

.7 Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.4 CLEANING

.1 Perform cleaning to Section 01 74 11

.2 Progress Cleaning

.1 Wash down exposed acrylic exterior surfaces using solution of mild domestic detergent in warm water, applied with soft clean wiping cloths.

.2 Wash down exposed aggregate exterior surfaces using fine water spray.

.3 Remove excess sealant with recommended solvent.

.4 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by mineral fibre reinforced panel installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International Inc.

.1 ASTM C1289-14, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

.2 ASTM D6162-0a(2008), Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.

.3 ASTM D6163-00(2008), Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.

.4 ASTM E96/E96M-05, Standard Test Methods for Water Vapour Transmission of Materials.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-37.5-M89, Cutback Asphalt Plastic Cement.

.3 Canadian Standards Association (CSA International)

.1 CSA B272-93(R2000), Prefabricated Self-Sealing Roof Vent Flashings.

.4 NBC, National Building Code of Canada (issue date listed in Section 01 41 00 - Regulatory Requirements).

.5 Roofing Contractors Association of British Columbia (RCABC).

.1 RGC, RCABC Guarantee Corporation.

.2 RGC Manual, RGC Roofing Practices Manual published by RCABC.

.6 Underwriters Laboratories' of Canada (ULC)

.1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.3 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 QUALITY ASSURANCE

.1 Do Work in accordance with latest standards published in RGC Manual.

.2 Follow respective membrane manufacturer installation requirements in order to provide required product guarantees wherever such requirements are more stringent that those published in RGC Manual.

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

1.3 WIND UPLIFT REQUIREMENTS

.1 Provide membrane roofing assemblies that will withstand wind uplift conditions listed in NBC for building location, unless more stringent values are identified on drawings.

1.4 SUBMITTALS

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

.2 Product Data:

.1 Provide copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide copies of WHMIS MSDS in accordance with Section 01 35 30 - Health and Safety Requirements and indicate VOC content for all products used in the work

.1 Indicate precautions for workers when handling roofing materials, sealants and mastics.

.3 Samples: submit samples of accessories proposed for use in Work upon Departmental Representatives request.

1.5 FIRE PROTECTION

.1 Provide and maintain approved ABC dry chemical-type fire extinguishers in ready and accessible condition with at least one extinguisher always within 6 metres of each torching operation.

.2 Provide "fire watch" for minimum of one hour after termination of torching operations to check for hot spots and signs of smouldering.

.3 Permit only experienced and trained personnel to operate torch equipment.

.4 Maintain fire watch for 1 hour after each day's roofing operations cease.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Storage and Handling Requirements:

.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.

.2 Provide and maintain dry, off-ground weatherproof storage.

.3 Store membrane rolls in heated enclosures prior to use where climatic conditions necessitate and as recommended by membrane manufacturer; bring only enough rolls for immediate use to work area.

.4 Remove only in quantities required for same day use.

.5 Place plywood runways over completed Work to enable movement of material and other traffic.

.6 Store sealants at +5 degrees C minimum.

.7 Lay out base and cap sheets and allow to flatten uncurl before attempting installation.

.8 Avoid prolonged exposure of light and heat sensitive materials to sunlight.

.9 Store combustible materials away from heat and open flame.

.10 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.11 Fold up metal banding, flatten and place in designated area for recycling.

1.7 WHMIS

.1 Comply with WHMIS requirements when handling primers and mastics

1.8 SITE CONDITIONS

.1 Do not perform work during inclement weather.

.2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

.3 Do not expose material vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

.4 Consult membrane manufacturer minimum ambient application temperature for cold weather applications and do not carry out roofing work when ambient temperature is less than 0 degrees C.

1.9 PROJECT REQUIREMENTS

.1 Protect surrounding surfaces from damage during roofing work. Where hoisting is necessary, hang tarpaulins to protect walls during delivery of materials from ground to roof level. Protect existing roofing from traffic damage by installing temporary mats or plywood.

.2 Where work must continue over new installed roofing, protect surfaces with plywood sheets. Arrange sheets to avoid tripping hazards. Weigh down sheets to prevent dislocation by wind uplift.

.3 Remove bituminous markings from finished surfaces. In areas where finished surfaces are soiled by bitumen or any other source of soiling caused by roofing work consult manufacturer of surfaces as to recommended cleaning methods and conform to their advice.

.4 Do not store materials on roof in concentrations which exceed roof design live load.

.5 Locate equipment and roofing materials to provide minimum interference and maximum useable space around job site.

1.10 WASTE MANAGEMENT

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

1.11 INSPECTION

.1 Inspections of roofing work to be performed by inspection agency for,

.1 Preparation of surfaces and

.2 Roofing membrane and membrane flashing installation.

.2 Pay all costs for inspection, unless noted otherwise.

.3 Notify inspection agency not less than 2 working days prior to commencement of work. If roofing work is stopped because of inclement weather or material shortage, notify inspection agency again prior to start- up of roofing work.

.4 Notify inspection agency not less than 2 working days prior to commencement of work. If roofing work is stopped because of inclement weather or material shortage, notify inspection agency again prior to start- up of roofing work.

.5 Inspection of roofing system will be performed to verify conformance with requirements specified in this Section following RCABC inspection procedures and any additional procedures recommended or required by membrane manufacturer. If defects are revealed, Departmental Representative may request that roofing be subject to further inspection and testing to ascertain full degree of defects. Pay additional costs incurred.

.6 Accompany inspection agency during inspections.

.7 Correct all defects and irregularities, at no cost to Contract.

1.12 WARRANTY

.1 For Work of this Section 07 52 00 - Modified Bituminous Membrane Roofing, 12 months warranty period is extended to:

.1 60 months for membrane roofing and membrane flashing installations remaining in place and maintaining leakproof assemblies.

.2 Warranty to be in form of RGC 5 Year Guarantee.

.3 120 months for membrane materials being free from manufacturing defects. Defective products to be corrected, replaced or maintained without cost to Canada as necessary to enable such products to perform as warranted.

.4 240 months for pre-manufactured vent pipe flashings/roof jacks to be free of leaks, condensation and defects in materials.

.2 Start warranties at date of Final Certificate of Completion.

1.13 CLOSEOUT SUBMITTALS

.1 Provide following in accordance with Section 01 78 00 - Closeout Submittals.

.1 "RCABC Roofing System Records" which includes RGC Guarantee, copies of inspection reports and Roof Maintenance Guide.

.2 Warranty certificates.

Part 2 Products

2.1 MATERIALS –FOUNDATION

.1 Vapour retarder primer: water-based or low VOC solvent-based asphalt emulsion recommended by vapour retarder manufacturer for securing vapour retarder to plywood sheathing. Must be compatible with pressure treated materials.

.2 Vapour retarder: minimum 2 mm thick self-adhering rubberized asphalt membrane manufactured and tested for air/vapour barrier use, with maximum 0.1 perms water vapour permeance rating, glass reinforced self-adhesive underside protected by silicone release sheet, sheet formulation suitable for ambient air temperature at time of installation.

.3 Vapour retarder must be suitable for application over pressure treated materials

2.2 MATERIALS-ROOFING

.1 Vapour retarder primer: water-based or low VOC solvent-based asphalt emulsion recommended by vapour retarder manufacturer for securing vapour retarder to plywood sheathing.

.2 Vapour retarder: minimum 2 mm thick self-adhering rubberized asphalt membrane manufactured and tested for air/vapour barrier use, with maximum 0.1 perms water vapour permeance rating, self-adhesive underside protected by silicone release sheet, sanded top surface, sheet formulation suitable for ambient air temperature at time of installation.

.3 Insulation board: polyisocyanurate to CAN/ULC-S704, factory finished both sides with impermeable facers to retard thermal drift of insulation material, glass fibre reinforced core, flat and tapered formats detailed/indicated for building roof slopes, square edges. Mechanically fastened to roof deck using fasteners approved by the manufacturer. Departmental Representative will use following ASTM C1289 Long Term Thermal Resistance (LTTR) values range for acceptance of insulation thicknesses required to provide total RSI values detailed/indicated on drawings.

.4 Overlayment board: minimum 4.8 mm thick mineral fortified asphaltic core board formed between 2 saturated glass fibre felt facers. Mechanically fastened to roof deck with approved fasteners.

.5 Flame barrier tape: glass fleece reinforced Styrene-Butadiene-Styrene (SBS) modified bitumen sheet, self-adhesive underside protected by silicone release sheet, sanded top surface.

.6 Roofing membrane sheets, membrane flashing sheets: containing not less than 15% Styrene-Butadiene-Styrene (SBS) elastomeric polymer, non-woven polyester plus glass grid reinforcement.

.1 Roofing membrane sheet 1 (base sheet): to ASTM D6162, minimum 2.5 mm sheet thickness, non-woven polyester plus glass grid reinforcement thermofusible polypropylene both surfaces.

.2 Base flashing sheet: to ASTM D6163, minimum 2.5 mm sheet thickness, glass grid reinforcement, self-adhesive underside protected by silicone release sheet, thermofusible polypropylene top surface.

.3 Roofing membrane sheet 2 (cap sheet), cap flashing sheet, roof edge warning strip: to ASTM D6162, minimum 4.0 mm sheet thickness, non-woven polyester plus glass grid reinforcement, thermofusible polypropylene underside, coloured granular top surface in colour selected by Departmental Representative.

.7 Walkways

.1 Walkways to consist of one additional ply of cap sheet membrane. Colour to be different from field membrane as selected by Departmental Representative.

.8 Fasteners

Insulation board, overlayment board fasteners: proprietary flat head countersunk self-drilling roof screws each with companion locking plastic plate or locking stamped sheet steel plate, screw threads designed for use on wood decks, corrosion-resistant coated, screw length to suit roof decks without projecting more than 25 mm beyond visible underside of deck surfaces, all in accordance with RGC requirements and roofing material manufacturer requirements whichever more stringent.

.1 Miscellaneous: #10 size, hot dip galvanized finish roofing nails with 13 mm dia. heads.

2.3 ACCESSORIES

.1 Vent pipe flashings/roof jacks: to CSA B272.

.1 Description: purpose-made spun aluminum proprietary units, sized to fit existing plumbing vent stacks, with integral mounting flange, c/w EPDM triple pressure seals to ensure permanent watertight installations to existing vent stacks.

.2 Material: 1.6 mm metal thickness spun aluminum, mill finish.

.3 Warranty: 20 year warranty against leaks, condensation and defects in materials.

.2 Roof drains: spun copper body complete with hinged aluminum dome for access, retention screw, clamping ring and sump receiver all surrounded by copper flange for sealing into roofing membrane.

.3 Roof drain connectors

.1 Description: proprietary purpose-made mechanical compression seals used to shorten roof drain tailpiece consisting of nylon flanges and stainless steel screws to compress EPDM rubber gasket seals to expand and make contact with inside walls of existing drainage piping, preventing vertical movement of roof drain tail piece and stopping water back-up damage.

.2 Sizes: to suit existing drainage piping.

.4 Overflow drains: purpose-made proprietary units consisting of not less than 50 mm dia. copper pipe factory soldered to sheet copper flange suitable for setting into membrane flashings, for emergency overflow drainage of roof water through building parapet beyond face of building.

.5 Plastic cement/mastic: to CAN/CGSB-37.5.

.6 Rock wool insulation: CAN/ULC-S702 Type 1, zero flame spread and smoke development in accordance with CAN/ULC-S102, non-faced, friction fit.

Part 3 Execution

3.1 PREPARATION

.1 Clean exposed plywood roof deck of debris.

3.2 MANUFACTURER INSTRUCTIONS

.1 Compliance: comply with manufacturer written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and data sheets.

3.3 WORKMANSHIP

.1 All materials must be dry (as manufactured) at time of application.

.2 Complete roofing on same day started.

.3 Perform moisture checks using an electronic moisture meter if work underway has become wet. Do not continue roofing until moisture content is reduced to acceptable levels.

.4 Ensure that inspections have been completed and defects corrected before starting each subsequent stage of roofing.

3.4 INSTALLATION OF FOUNDATION WALL MEMBRANE

.1 Apply self-adhesive waterproofing membrane in accordance with manufacturers directions.

.2 Install over primed surfaces where required by air barrier manufacturer to ensure 100% bonded installations.

.3 Make sealed side and end laps in accordance with manufacturer directions.

.4 Apply heavy pressure to installed membrane at top and bottom terminations to ensure positive adhesion at edges.

.5 After each sheet is applied, roll firmly and completely in place. Use an extension handled countertop roller or other similar type roller acceptable to manufacturer.

.6 Apply a trowelled bead of mastic or sealant to all air barrier terminations at end of each day's work.

.7 Repair defects as work progresses.

.8 Repair misaligned or inadequately lapped seams with a patch of membrane extending minimum 150 mm in every direction from deficiency.

.1 Fishmouths: slit, overlap flaps, patch with membrane. Trowel edges and patches with mastic or sealant.

.9 Reinforce construction joints and gaps wider than 2 mm with 150 mm wide strips of membrane prior to installation of field air barrier. Centre strips on joints and cracks.

.10 Back-up membrane with foam rod filler and compatible liquid membrane or compatible sealant at joints exceeding 13 mm width. Provide structural support for air barrier at joints exceeding 25 mm width.

.11 Reinforce inside and outside corners and junctions to other construction using strips of SBS membrane. Use minimum 300 mm wide strips, or of sufficient width to extend minimum 150 mm beyond either side of junctions and joints. Apply reinforcing strips prior to installation of field air barrier.

.12 Return membrane into wall openings and provide minimum 150 mm wide strip of air barrier for connection to full perimeter of each following wall penetration condition.

.1 Door frames.

.2 Window frames.

.3 Ventilation grilles, exhaust outlets.

.13 Protect exposed lap edges of membrane wall penetration connection strips while awaiting connection to other building components. Maintain peel-off component undisturbed on membrane lap edges to protect self-adhesive surface from contamination which would impair sealing of lap edges to other building components. Keep exposed lap edges safe from tears, abrasion and distortion caused by wind, workers and subsequent construction.

.14 Check all laps of each air barrier installation by running a trowel along seams to verify full adhesion prior to commencing next area of air barrier installation.

.15 Completed membrane installations to be:

.1 Structural: able to resist full wind loads in building.

.2 Continuous: sealed over entire building envelope.

.3 Impermeable: resistant to air, vapour and moisture transfer.

3.5 INSTALLATION OF ICE AND WATER DAM MEMBRANE

.1 Install under the edge of the existing roofing as detailed.

3.6 INSTALLATION OF NEW ROOFING SYSTEM

.1 Vapour retarder:

.1 Install over primed and prepared plywood sheathing using self- adhesive properties, with all laps sealed.

.2 Insulation board

.1 Install insulation board over vapour retarders to produce continuous thermal insulated roof plane.

.2 Use laminations of flat and tapered formats to produce roof slopes detailed/indicated.

.1 Offset 2nd layer from 1st layer by 1/2 board each direction to stagger board joints between layers where using 2-layer installation technique.

.2 Laminated boards must be in full contact with each other free of interlayer air passages.

.3 Use flat format where slopes not required.

.4 Trim insulation for tight fit to obstructions, projections and around roof perimeter.

.5 Fix board in place using screw-with-plates. Limit overall number of screws projecting to underside of visible decks by using minimal number of screws-with-plates to secure insulation board until covered by overlayment board.

.3 Overlayment board

.1 Install overlayment board over roof insulation.

.2 Fix overlayment board through insulation board in place using screws-with-plates to withstand wind conditions listed in NBC for building location.

.3 Overlayment board to present smooth continuous surface ready to accept roofing membrane.

.4 Flame barrier tape

.1 Apply to overlayment board joints in accordance with tape manufacturer recommendations to protect insulation under overlayment board during subsequent torching operations.

.5 Roof drain insulation

.1 Install to receive roof surface water.

.2 Connect to building drainage piping using roof drain connectors.

.6 Roof Membrane, membrane flashing

.1 Install 2-ply modified bituminous roof membrane and membrane flashings (strippings) over flame taped overlayment board to comply with RGC requirements and roofing membrane manufacturers recommendations

.2 Starting at low point of roof, perpendicular to slope, unroll sheets, align and re-roll from both ends.

.3 Each layer to be free of blisters, fishmouths and wrinkles.

.4 Offset joints in cap sheet not less than 300 mm from those in base sheet.

.5 Test laps for complete continuous sealing.

.6 For torch fixing to overlayment board:

.1 Torch apply roofing membrane sheet 1 (base sheet

.2 Torch apply membrane sheet 2 (cap sheet) over inspected membrane sheet 1 (base sheet).

.7 Membrane flashings

.1 Install base sheet using self-adhesive properties.

.2 Install cap sheet using torch method.

.3 Provide 75 mm minimum side lap and seal.

.4 Provide 75 mm minimum side lap and seal.

.5 Install membrane flashings without sags, blisters, fishmouths or wrinkles.

.6 Re-finish all lap joints, bitumen overflows and runs of cap sheets. Lap and seal membrane to all components penetrating roof.

.8 Roof edge warning and walkway strip

.1 Apply different colour 2nd layer of roofing membrane sheet 2 (cap sheet) on completed 2-ply assembly to delineate proximity of roof edge for maintenance personnel safety. Apply different colour 2nd layer to areas as indicated to delineate walkway areas. Colour to be selected by Departmental Representative.

.2 Remove selvage edge from roll goods before installing.

.3 Fix in place to resist foot traffic displacement and wind uplift without damaging integrity of 2-ply modified bituminous roof membrane assembly

3.7 ROOF SPECIALTIES AND ACCESSORIES

.1 Plumbing vent flashings:

.1 Install concurrent with roofing installation, to produce waterproof installations.

.2 Install plumb, to suit pipe vents.

.3 Install vent pipe replacement caps.

.2 Overflow drains

.1 Install concurrent with roofing installation, to produce waterproof installations.

.2 Slope to drain water off roof whenever roof drains become blocked.

.3 Seal to building faces with permanent flexible non-staining sealant in colours selected by Departmental Representative.

3.8 Cleaning

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.1 Progress cleaning: leave Work area clean at end of each day.

.2 Final cleaning: on completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, equipment and barriers.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 07 52 00 Modified Bituminous Sheet Roofing and Waterproofing.

.2 Section 08 44 13 Glazed Curtain Walls

.3 Section 07 44 56 Mineral Fiber Reinforced Cementitious Panels

.4 Section 07 46 00 Preformed Metal siding

1.2 REFERENCES

.1 ASTM International

.1 ASTM B370-11, Standard Specification for Copper Sheet and Strip for Building Construction.

.2 ASTM B209-07, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 ASTM A792/A792M-06a, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.2 Aluminum Association (AA)

.1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.

1.3 PERFORMANCE REQUIREMENTS

.1 Flashing system shall accommodate movement of components without buckling, failure of joint seals, undue stress on fasteners, or other detrimental effects when subjected to seasonal temperature changes and live loads.

1.4 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 copper and aluminum flashing materials and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:

.1 Submit duplicate 300 x 300 mm samples of copper and aluminum flashing materials

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations.

.2 Store and protect sheet metal roofing from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.6 WASTE MANAGEMENT

.1 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal

Part 2 Products

2.1 SHEET METAL MATERIALS

.1 Copper sheet: to ASTM B370, 060 temper designation for flashings and fascia.

.2 Aluminum sheet to ASTM B209-07

.1 Finish both sides of aluminum sheet in accordance with DAF 45.

.2 Clear anodic finish designation AA-M12C22A41 - Architectural Class I for 18 um (0.0007") of finish thickness.

.3 Aluminum- zinc alloy coated sheet steel to ASTM A792/A792M

2.2 ACCESSORIES

.1 Joint Sealant: One-part, copper and aluminum compatible elastomeric polyurethane, polysulfide, butyl or silicone rubber sealant as tested by sealant manufacturer for copper or aluminum substrates.

.2 Fasteners: stainless steel, concealed.

.3 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

2.3 FABRICATION OF FLASHINGS

.1 Shop fabricate work to the greatest extent possible.

.2 Manufacture various copper, aluminum and galvalume flashing profiles as indicated.

.3 Form individual pieces in 2400 mm maximum lengths. Make allowances for expansion at joints.

.4 Hem exposed edges on underside 12 mm or as detailed.

.5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.6 Form flat lock seams at panel connections.

.7 Miter exterior corners, provide flat seam connections.

2.4 FABRICATION OF PARAPET COVERS

.1 Fabricate in accordance with detail drawings to make watertight transitions onto new concrete panels below parapet flashings.

.2 Break shape to profiles detailed/indicated.

.3 Fabricate covers using not less than 0.68 mm thick pre-finished Aluminum-zinc alloy coated sheet steel, unless detailed/indicated otherwise. Use greater metal thickness at locations of wider span to prevent "oil-canning" and deformation of covers.

.4 Fabricate covers accurately with true crisp lines and quality metalwork joinery suitable for exposed installation.

.5 Hem exposed edges. Fold under minimum 10 mm.

.6 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sheet metal roofing installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Copper and Aluminum Flashings

.1 Install in accordance with detail drawings.

.2 Fit flashings together so that one end of each section is free to move in joint.

.3 Fit flashings secure in place. Make corners square, surfaces true and straight in all planes, and all lines accurate to profiles.

.2 Parapet covers:

.1 Install in accordance with detail drawings.

.2 Fix in place with cover screws

3.3 CLEANING

.1 Progress Cleaning

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by sheet metal roofing installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 Material Safety Data Sheets (MSDS).

.2 Underwriter's Laboratories of Canada (ULC)

.1 ULC-S115-1995, Fire Tests of Fire stop Systems.

1.2 DEFINITIONS

.1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.

.2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.

.3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

.4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.

.1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit product manufacturer's ULC result cut sheets for each fire stopping condition.

.3 Submit electronic copies of WHMIS MSDS - Material Safety Data Sheets (MSDS)

.1 Indicate precautions for workers using fire stopping products.

.3 Shop Drawings:

.1 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation.

.2 Construction details should accurately reflect actual job conditions.

.4 Samples:

.1 Submit samples showing actual fire stop material proposed for project on Departmental Representative's request.

.2 Submit manufacturer installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company specializing in fire stopping installations with 5 years documented experience.

.2 Overall Project quality control:

.1 Employ one applicator firm to install all firestopping throughout project, using personnel that meet installer qualifications stated above.

.2 Do not permit separate trades to firestop their own service penetrations.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

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

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.

.2 Storage and Protection:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

.3 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

.1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.

.1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended .

.2 Fire stop system rating: Refer to drawings for assembly ratings

.2 Service penetration assemblies: systems tested to CAN-ULC-S115.

.3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.

.4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.1 VOC limit: Maximum 250g/l

.6 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.7 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.8 Sealants for vertical joints: non-sagging.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.

.1 Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

.2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Tool or trowel exposed surfaces to neat finish.

.5 Remove excess compound promptly as work progresses and upon completion.

3.4 FIELD QUALITY CONTROL

.1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

.2 Installed firestopping will be examined to determine if assemblies have been installed in accordance with respective ULC listings.

.1 Allow for destructive testing of installed firestopping during examination including re-instatement of damaged firestopping during inspection, at no additional cost to Contract.

.2 Deviation from ULC listed systems will be considered grounds for rejection and will require replacement of firestopping to conform with respective ULC listings, at no additional cost to Contract.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 08 44 13 Glazed Aluminum Curtain Walls

.2 09 91 23 Interior Painting

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

- .1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
- .2 CAN/CGSB-19.13- M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
- .3 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
- .4 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.

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

- .1 Material Safety Data Sheets (MSDS).

.3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

- .1 SCAQMD Rule 1168-[A2005], Adhesives and Sealants Applications.

1.3 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 joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Manufacturer's product to describe:
  - .1 Caulking compound.
  - .2 Primers.
  - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Manufacturer's Instructions:

- .1 Submit instructions to include installation instructions for each product used.

1.4 DELIVERY, STORAGE AND HANDLING

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

.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 accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

1.5 WHMIS

.1 Submit copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

1.7 SITE CONDITIONS

.1 Environmental Conditions:

.1 Proceed with installation of joint sealants only when:

.1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.

.2 Joint substrates are dry.

.3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.2 Joint-Width Conditions:

.1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:

.1 Proceed with installation of joint sealants only after contaminants capable of affecting the sealant bond have been removed.

.4 Where sealants are qualified with primers use only these primers.

Part 2 Products

2.1 SEALANT MATERIALS

.1 VOC limit maximum 250 g/L for sealers used within the building envelope.

.2 Where sealants are qualified with primers, use only these primers

2.2 SEALANT MATERIAL DESIGNATIONS

.1 Polyurethanes: colours selected by Departmental Representative.

.1 Non-sag formulation: 1-part, to CAN/CGSB-19.13, Type 2, MCG-2-25, MCG-2-40.

.2 Acrylics one part: to CGSB 19-GP-5M.

.3 Acrylic latex: one part, non sag siliconized acrylic polymer to CAN/CGSB-19.17. Paintable when cured

.4 Preformed compressible and non-compressible back-up materials:

.1 Polyethylene, urethane, neoprene or vinyl foam:

.1 Extruded closed cell foam backer rod.

.2 Sized as required.

.2 Bond breaker tape:

.1 Polyethylene bond breaker tape which will not bond to sealant.

2.3 SEALANT SELECTION

.1 Penetrations in exterior walls to fill joints watertight including but not limited to exterior perimeters of door frames, window frames, curtain wall frames; exterior perimeters of wall vents; exterior perimeters of all other wall penetrations.

.1 Polyurethane, non-sag.

.2 Interior perimeters of door frames, window and curtain wall frames to make junctions filled, smooth and invisible suitable for subsequent "painting out" with interior wall finishes.

.1 Acrylic latex.

.3 Gypsum board control joints: to make joints suitable for subsequent "painting out" with interior wall finishes.

.1 Acrylic latex.

2.4 JOINT CLEANER

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.

.2 Primer: in accordance with sealant manufacturer's written recommendations.

Part 3 Execution

3.1 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.2 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.3 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.4 APPLICATION

.1 Sealant:

.1 Apply sealant in accordance with manufacturer's written instructions.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 Apply sealant in continuous beads.

.4 Apply sealant using gun with proper size nozzle.

.5 Use sufficient pressure to fill voids and joints solid.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing:

.1 Cure sealants in accordance with sealant manufacturer's instructions.

.2 Do not cover up sealants until proper curing has taken place.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Fire rated steel frames.

.2 Fire rated steel doors.

1.2 RELATED SECTIONS

.1 Section 08 71 00 - Door Hardware: Hardware and silencers.

.2 Section 09 91 23 Interior Painting.

1.3 REFERENCES

.1 ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM E152 - Methods of Fire Tests of Door Assemblies.

.3 CSDFMA (Canadian Steel Door and Frame Manufacturers Association).

.4 DHI - Door Hardware Institute: The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.

.5 NFPA 80 - Fire Doors and Windows.

.6 NFPA 252 - Fire Tests for Door Assemblies.

.7 SDI-100 - Standard Steel Doors and Frames.

.8 UL 10B - Fire Tests of Door Assemblies.

1.4 SUBMITTALS

.1 Section 01 33 00: Submission procedures.

.2 Product Data: Indicate frame configuration and finishes. Indicate door configurations, location of cut-outs for hardware reinforcement.

.3 Shop Drawings: Indicate frame elevations, reinforcement, anchor types and spacings, location of cut-outs for hardware, and finish. Indicate door elevations, internal reinforcement, closure method, and cut-outs for glazing, louvers, and finishes.

1.5 QUALITY ASSURANCE

.1 Conform to requirements of CSDFMA SDI-100.

1.6 REGULATORY REQUIREMENTS

.1 Fire Rated Frame Construction: Conform to UL 10B.

.2 Installed Door and Frame Assembly: Conform to NFPA 80 for fire rated class as scheduled.

1.7 PROJECT CONDITIONS

.1 Coordinate the work with frame opening construction, door, and hardware installation.

PART 2 PRODUCTS

2.1 FRAMES

.1 Frames: 0.058 inch thick material, base metal thickness with ZF75 Colourbond coating.

.2 Anchors: purpose made to rigidly secure frames, 3 per jamb.

.3 Primer: Zinc chromate type.

.4 Silencers: Resilient rubber set in steel fitted into drilled hole.

.5 Insulation: Fibreglass.

2.2 DOORS

.1 Fire Rated Doors: Minimum , 1.2 mm surface sheets and, top and bottom end channels, of ULC label requirements indicated on drawings.

.2 Reinforcement for hardware:

.1 Locks: minimum 1.52 mm steel.

.2 Butts: minimum 3.42 mmsteel.

.3 Flush Bolts: minimum 3.42 mm steel.

.4 Door Closures: minimum 1.9 mm steel.

2.3 FABRICATION FRAMES

.1 Fabricate frames as welded unit.

.2 Fabricate frames with hardware reinforcement plates welded in place.

.3 Reinforce frames wider than 1 200 mm with roll formed steel channels fitted tightly into frame head, flush with top.

.4 Prepare frames for silencers. Provide three single silencers for single doors and mullions of double doors on strike side. Provide two single silencers on frame head at double doors without mullions.

.5 Attach fire rated label to each fire rated door unit.

.6 Provide drywall returns on all frames.

.7 Attach channel spreaders at bottom of frames for shipping.

2.4 FABRICATION - DOORS

.1 Fabricate hollow metal doors and panels in accordance with requirements of "Canadian Manufacturing Standards for Steel Doors and Frames" produced by the Canadian Steel Door and Frame Manufacturer's Association and as indicated on Drawings. Fabricate doors with hardware reinforcement welded in place.

.2 Fabricate fire rated hollow metal doors in accordance with requirements of Underwriters Laboratories of Canada (ULC). Place ULC labels where visible when in installed position.

.3 Longitudinal seams: Mechanically interlocked, continuously welded, filled and sanded with no visible edge seams. Top and bottom of doors closed with end channels recessed and spot welded in place.

.4 Reinforce and prepare doors to receive hardware. Refer to Section 08 71 00 for hardware requirements.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify that opening sizes and tolerances are acceptable.

3.2 INSTALLATION

.1 Install frames in accordance with CSDFMA.

.2 Coordinate with wall construction for anchor placement.

.3 Coordinate installation of doors and frames with installation of hardware specified in Section 08 71 00

.4 After installation, touch up all scratched or damaged surface and prime.

3.3 ERECTION TOLERANCES

.1 Maximum Diagonal Distortion: 1.5 mm measured with straight edges, crossed corner to corner.

.2 Clearance on steel doors at head and jambs shall be: 3 mm maximum.

3.4 ADJUSTING

.1 Adjust door for smooth and balanced door movement.

3.5 CLEANING

.1 Do cleaning in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 06 20 00 Finish Carpentry

.2 Section 07 52 00 Modified Bituminous Sheet Roofing and Waterproofing.

.3 Section 07 92 00 Joint sealants

1.2 REFERENCES

.1 Aluminum Association (AA)

.1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.

.2 American Architectural Manufacturers Association (AAMA)

.1 AAMA CW-I-9, Aluminum Curtain Wall Design Guide Manual.

.2 AAMA CW-10 04, Care and Handling of Architectural Aluminum From Shop to Site.

.3 AAMA 501-05, Methods of Test for Exterior Walls.

.4 AAMA 609 & 610:2009, Cleaning And Maintenance Guide For Architecturally Finished Aluminum.

.3 ASTM International

.1 ASTM A36/A36M-08, Specification for Carbon Structural Steel.

.2 ASTM B209-07, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 ASTM B221-08, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.4 ASTM C864-05(2011), Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

.5 ASTM E283-04, Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.6 ASTM E330-02, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls, by Uniform Static Air Pressure Difference.

.7 ASTM E1105-00(2008), Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.

.4 CSA International

.1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA S136-07, North American Specification for the Design of Cold Formed Steel Structural Members.

.4 CAN/CSA-S157/S157.1-05, Strength Design in Aluminum/Commentary on CAN/CSA-S157, Strength Design in Aluminum.

.5 CSA W59.2-M1991(R2008), Welded Aluminum Construction.

1.3 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.

.2 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

.1 Indicate precautions for workers when handling and applying sealants.

.3 Shop Drawings: indicate the following information.

.1 Materials and profiles and provide full-size, scaled details of components for each type of frame.

.2 Interior trim and exterior junctions with adjacent construction.

.3 Junctions between combination units.

.4 Elevations of units.

.5 Core thicknesses of components.

.6 Exposed finishes, method of anchorage, number of anchors, supports, reinforcement and accessories.

.7 Locations of exposed caulking.

.8 Glazing provisions.

.9 Use qualified professional structural engineer registered in British Columbia for wind load and seismic designs.

.10 Submit shop drawings under seal of same professional engineer responsible for wind load and seismic designs.

.4 Samples:

.1 Submit the following if requested by the Departmental Representative.

.1 Frame and glazing accessory samples.

.5 Manufacturers Instructions:

.1 Submit manufacturers installation instructions.

1.4 QUALITY ASSURANCE

.1 Perform work in accordance with AAMA CW-I-9

.2 Manufacturer qualifications: company specializing in manufacturing products specified in this section, with not less than 5 years of documented experience. Provide such evidence upon Departmental Representative request.

.3 Installer qualifications: company specializing in performing work of this section and approved by manufacturer. Provide such evidence upon Departmental Representative request.

.4 Perform welding in accordance with CSA W59.2

1.5 DESIGN CRITERIA

.1 Design assemblies to meet following requirements:

.1 Withstand local positive and negative wind loads listed in NBC for location of building or identified on structural drawings, whichever more severe.

.2 Withstand seismic conditions for building location listed in NBC.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Handle work of this Section in accordance with AAMA CW-10.

1.7 WASTE MANGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

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

1.8 CLOSEOUT SUBMITTALS

.1 Make submissions in accordance with Section 01 78 10 - Closeout Submittals.

.2 Provide following for inclusion in Project operating and maintenance manuals:

.1 Certification under seal of same professional engineer responsible for sealing shop drawings that system has been installed in accordance with sealed shop drawings.

.3 Name, address and telephone number of installer.

Part 2 Products

2.1 SYSTEMS

.1 Description:

.1 System includes thermally broken tubular aluminum sections with self supporting framing, related flashings, anchorage and attachment devices.

.2 Assembled system to permit re-glazing of individual glass units from exterior without requiring removal of structural mullion sections.

.3 Horizontal joints to be sealed with pressure plates and finished with caps, to provide continuous appearance.

.2 Performance Requirements: Performance requirements: provide curtain wall framing to meet following requirements without suffering collapse, permanent deformation of components or breakage of glass.

.1 Withstand own weight plus weight of glass.

.2 Withstand local positive and negative wind loads listed in NBC for location of building or identified on structural drawings, whichever more severe.

.3 Withstand local snow loads listed in NBC for location of building or identified on structural drawings, whichever more severe.

.4 Accommodate thermal expansion and contraction through temperature ranges anticipated at building location.

.5 All components to be resistant to physical and chemical deterioration resulting from atmospheric conditions, contaminates and ultra-violet light exposure.

.6 Withstand seismic conditions listed in NBC for location of building or identified on structural drawings, whichever more severe.

.7 Meet or exceed following environmental performance:

.1 Air infiltration (ASTM E283 test): maximum 0.3L/s.m^2 @ 300 Pa static air pressure differential.

.2 Water (static) resistance (ASTM E331 test): no leakage at 479 Pa static air pressure differential as defined in AAMA 501.

.3 Water (dynamic) resistance (AAMA 501.1 test): no leakage at 479 Pa air pressure differential as defined in AAMA 501.

.4 Condensation resistance factor (AAMA 1503 test): not less than 68 for frame and 67 for glass.

.8 Limit structural deflection to L/175 of span for any framing member at design load, based on CAN3-S157.

.9 Drain water entering joints, condensation occurring in glazing channels or migrating moisture occurring within system, to exterior by weep drainage network.

.10 Provide continuous air barrier and vapour retarder through framing system, primarily in line with inside surface of glass and heel bead of glazing sealant.

2.2 MATERIALS

.1 Extruded aluminum: to ASTM B221.

.2 Sheet aluminum: to ASTM B209.

.3 Steel reinforcement: to CSA G40.20/G40.21 or ASTM A36/A 36M , shaped to suit mullion sections, hot dip galvanized to CAN/CSA-G164 with not less than 610 g/m^2 of zinc coating.

.4 Fasteners: stainless steel alloy

.5 Sealant types recommended by system fabricator/installer to suit applications, compatible with substrates and adequate to provide permanent seal at temperature ranges anticipated.

.6 Self-adhesive membrane (SAM): minimum 1.0 mm thick self-adhering composite sheet membrane comprised of 0.90 mm thick rubberized asphalt integrally bonded to 0.10 mm thick reinforced high density polyethylene film, with peel-off protective paper covering self-adhesive surface, with companion surface primer for attachment to substrates.

2.3 COMPONENTS

.1 Mullion profile:

.1 50 x73 mm nominal overall dimension for backtube.

.2 Thermally broken with interior tubular section insulated from exterior pressure plate by means of extruded silicone compatible elastomer that provides for silicone adhesion.

.3 Matching stops and pressure plate of sufficient size and strength to ensure adequate bite on glass.

.4 Caps: 13mm extruded caps to snap fit onto pressure plates, face width to match respective mullion face width.

.5 Drainage holes, deflector plates and internal flashings to accommodate internal weep drainage system.

.6 Internal mullion baffles to eliminate "stack effect" air movement within internal spaces.

.2 Reinforced mullions: same profiles as vertical glazing system fitted with internal reinforcement of shaped steel structural sections.

.3 Flashings: Not less than 1.0 mm thick aluminum secured with concealed fastening method.

.4 Pressure plate bolts: by system manufacturer, corrosion resistant, machine bolts.

.5 Glazing provision: flush, exterior glazed, dry gasket system keyed into mullion and pressure plate receivers, to accept sealed insulating glass units.

.6 Glazing gaskets:

.1 Interior: to ASTM C864, extruded from silicone compatible EPDM rubber to provide silicone adhesion to glass.

.2 Exterior: precision extruded EPDM rubber extrusion positioned at sightline with 100% solids highly adhesive and elastic cross linked butyl preformed sealant bonded below.

.7 Aluminum closures and flashings as required, and indicated on drawings. Anodized finish.

2.4 FINISHES

.1 Finish exposed surfaces of extruded aluminum and both sides of aluminum sheet in accordance with DAF 45.

.1 Clear anodic finish designation AA-M12C22A41 - Architectural Class I for 18 um (0.0007") of finish thickness.

.2 Protective film: clear plastic strippable film protective covering applied to aluminum finishes to protect surfaces from damage during fabrication, shipping and erection.

2.5 FABRICATION

.1 Fabricate items in accordance with reviewed shop drawings.

.2 Fabricate items to profiles and maximum face sizes detailed/indicated.

.3 Provide internal reinforcement as required.

.4 Fit joints tightly and secure mechanically. Make joints flush, hairline and weatherproof.

.5 Conceal fastenings.

.6 Maintain following tolerances.

.1 Square: maximum +/- 1.5 mm for units with diagonal measurement of 1800 mm or less, maximum +/- 3 mm for units with diagonal measurement exceeding 1800 mm.

.2 Offset from true plane between 2 adjacent members butting end to end, in line: maximum 1 mm.

.7 Isolate aluminum extrusions and aluminum sheet from direct contact with dissimilar metals, concrete and masonry.

.1 Shop apply full bodied coat of isolation coating.

.2 Isolation coating to be type that will not soften, run or drip under high heat conditions.

.3 Isolation coating must be dry and cured prior to delivery of items to site.

.8 Flashings:

.1 Fabricate using longest practical lengths for each location to minimize splice joints.

.2 Fabricate accurately on commercial metal forming equipment, with true crisp lines suitable for high visibility installations.

Part 3 Execution

3.1 MANUFACTURERS INSTRUCTIONS

.1 Compliance: comply with manufacturer written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions and data sheets.

3.2 INSTALLATION

.1 Install in accordance with reviewed shop drawings and to meet performance requirements.

.2 Set frames plumb, square, level at correct elevation in alignment with adjacent work.

.3 Anchor securely.

.4 Seal curtain wall system to adjacent construction using strips of SAM clamped into mullion glazing provision and extending onto adjacent construction. Seal to adjacent construction using SAM self-adhesive properties. Prime surfaces as require to ensure 100% adhesion.

3.3 SITE TOLERANCES

.1 Maximum variation from plumb: 1.5 mm/m non-cumulative or 12 mm/30 m, whichever is less.

.2 Maximum misalignment of two adjoining members abutting in plane: 0.8 mm.

.3 Maximum sealant space between curtain wall and adjacent construction: 13 mm.

3.4 CLEANING

.1 Remove protective film as work progresses. Do not permit loose protective film to blow around work site.

.2 Clean aluminum surfaces thoroughly upon installation to remove all stains and marks caused during installation. Do cleaning in accordance with AAMA 609 & 610.

.3 Proceed in accordance with Section 01 74 11 - Cleaning.

.1 Progress cleaning: leave Work area clean at end of each day.

.2 Final cleaning: on completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, equipment and barriers.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by glazed aluminum curtain wall installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 New hardware for new and existing hollow metal doors.

.2 Re use of existing hardware for new wood doors.

.3 Thresholds

.4 Weatherstripping, seals, and door gaskets.

1.2 RELATED SECTIONS

.1 Section 08 11 00 Metal Doors and Frames.

1.3 REFERENCES

.1 American National Standards Institute (ANSI).

- .1 ANSI/BHMA A156.1-2006, American National Standard for Butts and Hinges.
- .2 ANSI/BHMA A156.2-2003, Bored and Preassembled Locks and Latches.
- .3 ANSI/BHMA A156.3-2001, Exit Devices
- .4 ANSI/BHMA A156.4-2000, Door Controls - Closers.
- .5 ANSI/BHMA A156.5-2001, Auxiliary Locks.
- .6 ANSI/BHMA A156.13-2002, Mortise Locks and Latches Series 1000.
- .7 ANSI/BHMA A156.16-2002, Auxiliary Hardware.
- .8 ANSI/BHMA A156.18-2006, Materials and Finishes.

.2 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).

- .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): standard hardware location dimensions.

.3 NBC, National Building Code of Canada (issue date listed in Section 01 41 00 - Regulatory Requirements).

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00: Submission procedures.

.2 Samples:

- .1 Provide hardware samples requested by Departmental Representative.
- .2 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.

.3 Shop Drawings:

□

.1 Provide product data sheets to describe fully to Departmental Representative all products of this Section.

.2 Include descriptions of materials, composition, cautions, installation requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

.1 Submittals in accordance with Section 01 78 10: Submission procedures.

.2 Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

.3 Special tools:

.1 Provide 2 sets of wrenches for each type of door closer and lock set installed, for project maintenance use.

.2 At completion of installations and adjustments turn over to Departmental Representative all tools supplied by hardware manufacturers with hardware items installed for later use in hardware maintenance. Seal tools together with respective hardware data/installation sheets supplied with hardware in clear plastic bags.

1.6 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements, unless more stringent care is required by respective material manufacturer.

.2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

.3 Store door hardware in locked, clean and dry area.

.4 Include hardware templates and full installation/adjustment information.

.5 Supply hardware complete with all factory supplied mounting fasteners required for installation.

1.8 WASTE DISPOSAL AND MANAGEMENT

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

1.9 WARRANTY

.1 For Work of this Section 08 71 00 - Door Hardware, 12 months warranty period is extended to:

.1 60 months for door closers of this Section will be free from manufacturing defects.

□

.2 Manufacturing defects will be deemed to occur if any of following conditions are noted.

.1 Defects of material and factory workmanship.

.2 Fluids leaks.

.2 Defective products to be corrected, replaced or maintained without cost to Canada as necessary to enable such products to perform as warranted.

.3 Start warranties at date of Final Certificate of Completion.

Part 2 Products

2.1 MANUFACTURERS

.1 Hardware items to be of the best grade, free from defect and of first line quality production suitable for this level of project.

.2 Use one hardware manufacturer product only for each similar hardware item.

.3 Acceptable manufacturers:

.1 Hinges: McKinney, Stanley, Ives.

.2 Locks: Schlage, Sargent, Corbin.

.3 Closers: LCN, Sargent, Corbin.

.4 Weatherstripping: Pemko, KN Crowder, Hager

.5 Thresholds: Pemko, KN Crowder, Hager

2.2 HARDWARE - GENERAL

.1 General: refer to Hardware Schedule for further description and finishes of following items.

.2 Locks and latches:

.1 Bored and pre-assembled locks and latches: to ANSI/BHMA A156.2, series 2000 pre-assembled lock, grade 1, designed for functions scheduled.

.2 Mortise locks and latches: to ANSI/BHMA A156.13, series 1000 mortise lock, grade 1, designed for functions scheduled.

.3 Escutcheons: designs scheduled.

.4 Normal strikes: box type, lip projection not beyond jamb.

.5 Cylinders: keyed into keying system directed by Departmental Representative.

.6 Finishes: scheduled.

.3 Butts and hinges:

.1 Butts: to ANSI/BHMA A156.1, 5-knuckle, sizes x finishes scheduled, concealed bearing for scheduled doors, NRP for scheduled doors.

.4 Exit devices: to ANSI/BHMA A156.3 and as scheduled.

.5 Door closers and accessories:

□

.1 Door controls (closers): to ANSI/BHMA A156.4, designated by letter C, sizes as required by NBC and to provide following requirements.

.2 Maximum degree of opening required.

.3 Size to door.

.6 Thresholds: as scheduled, one length per door opening without joins or splices.

.7 Weatherstripping/sound seals: durable, non-absorbing material, resistant to deterioration caused by aging, types and materials scheduled, one length per door head and side application without joins or splices.

2.3 KEYING

.1 Doors receiving new lock sets to be keyed alike to existing lock sets.

.2 Obtain final keying from Departmental Representative before ordering.

.3 Prepare keying schedule in co-operation with Departmental Representative.

.4 Assist in taking building off construction key system.

.5 Key alike (KA) and key different (KD) locks directed by Departmental Representative.

.6 Use a bonded locksmith for all keying work. Stamp all keys "Do Not Copy".

2.4 FINISHES

.1 Finishes: Identified in Schedule.

Part 3 Execution

3.1 EXAMINATION

.1 Existing doors scheduled to receive new hardware:

.1 Examine existing doors scheduled to receive new latches, door closers or spring hinges. Review installation instructions for new hardware

.2 Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

.2 New doors to receive existing hardware

.1 Examine existing hardware prior to the fabrication of the new doors to ensure that the existing hardware is compatible with new door construction.

.2 Re use all existing fasteners.

.3 Notify the Departmental Representative of any discrepancies or deficiencies in the existing hardware sets.

3.2 INSTALLATION

.1 Machine or alter existing doors to accept new hardware

□

.2 Install hardware in accordance with manufacturer's instructions.

.3 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.

.4 Use templates provided by hardware item manufacturer.

.5 Use only manufacturer supplied fasteners. Failure to comply may void manufacturer warranties and applicable licensed labels. Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.

.6 Install existing hardware scheduled to be re-used onto new doors.

3.3 ADJUSTING

.1 Adjust hardware for smooth operation.

3.4 PROTECTION OF FINISHED WORK

.1 Do not permit adjacent work to damage hardware or finish.

3.5 CLEANING

.1 Proceed in accordance with section 01 74 11 Cleaning.

.2 Perform cleaning after installation to remove construction and accumulated environmental dirt.

.3 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer instructions.

3.6 SCHEDULES

.1 Refer to drawings.

END OF SECTION

□

Part 1 General

1.1 RELATED SECTIONS

.1 Section 08 44 13 Glazed Curtain Walls

1.2 REFERENCES

.1 ASTM International

.1 ASTM D2240-05, Standard Test Method for Rubber Property - Durometer Hardness.

.2 ASTM E330-02, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.

.2 CAN/CGSB-12.8-9, Insulating Glass Units.

.3 CAN/CGSB-12.10-M76, Glass, Light and Heat Reflecting.

.3 IGMAC, Insulating Glass Manufacturer's Association of Canada, Glazing Guidelines for Sealed Insulating Glass Units..

.4 NBC, National Building Code of Canada (issue date listed in Section 01 41 00 - Regulatory Requirements).

1.3 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 Glazing materials and sealants. Include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS - Material Safety Data Sheets.

.1 Indicate VOC for glazing materials during application and curing.

.3 Samples:

.1 Submit minimum 305 x 305 mm size samples of glass if requested by Departmental Representative.

.2 Manufacturers instructions

.1 Submit installation instructions

1.4 QUALITY ASSURANCE

.1 Installer qualifications: company specializing in performing work of this section and approved by manufacturer. Provide such evidence upon Departmental Representative request.

1.5 DESIGN CRITERIA

.1 Provide continuity of building enclosure vapour and air barrier using glass and glazing materials as follows:

.1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

.2 Size glass to withstand local positive and negative wind loads listed in NBC for location of building or identified on structural drawings, whichever more severe.

.3 Size glass to withstand seismic conditions for building location listed in NBC.

1.6 DELIVERY, STORAGE AND HANDLING

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

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

1.8 WHMIS

.1 Comply with WHMIS requirements regarding use, handling and storage of glazing materials.

1.9 WARRANTY

.1 For Work of this Section 08 80 50 - Glazing, 12 months warranty period is extended to:

.1 120 months for insulating glass units of this Section to be free from manufacturing defects.

.2 Manufacturing defects will be deemed to occur if any of following conditions are noted.

.1 Appearance of condensation between panes.

.2 Obstruction of vision within unit perimeter.

.3 Measurable deterioration (more than 10%) of specified thermal transmission or shading coefficient performance ratings.

.4 Chipping, cracking or breakage of glass panes occurring due to manufacturing defects or under specified service conditions.

.5 Migration of edge spacer.

.2 Defective products to be corrected, replaced or maintained without cost to Canada as necessary to enable such products to perform as warranted.

.3 Start warranties at date of Final Certificate of Completion.

Part 2 Products

2.1 MATERIALS

.1 Insulating Glass Units:

.1 Insulating glass units: to CAN/CGSB-12.8 and IGMAC requirements, double unit 25 mm overall thickness.

.1 Glass: to CAN/CGSB-12.1 and CAN/CGSB-12.10.

.2 Inter-cavity space thickness: 13 mm between inner and outer lights, with low conductivity spacers

.3 Glass coating: surface number 2, low "E" clear colour.

.4 Insulated glass unit assembly to provide following minimum performance requirements. Following is based on 6 mm thick Low E glass in 25 mm thick insulating unit with 13 mm thick Argon gas filled space. Interior glass to be safety tempered clear glass to CAN/CGSB-12.1

.1 Transmittance:

.1 Ultra-violet (UV) light: 19%

.2 Visible daylight: 70%

.3 Total solar energy: 33%

.2 Reflectance:

.1 Visible light: 11%

.2 Total solar energy: 30%

.3 U-values (Imperial):

.1 Winter night time: 0.29

.2 Summer day time: 0.28

.4 Shading coefficient factor: 0.44

.5 Solar heat gain coefficient: 0.38

.6 Light-to-solar gain (LSG): 1.84

2.2 ACCESSORIES

.1 Setting blocks: neoprene, EPDM or silicone, 80-90 durometer hardness to ASTM D2240, to suit each application.

.2 Spacer shims: neoprene, EDPM or silicone, 50-60 durometer hardness to ASTM D2240, Sized to suit each application

.3 Glazing tape: Glazing tapes: pre-formed macro-polyisobutylene tape with continuous integral neoprene shim (to prevent "pumping out" of tape under glass load conditions), paper release, black colour, width x thickness to suit installations.

.4 Glazing gaskets, wedges and splines: forming part of respective framing system.

.1 Refer to Section 08 44 13 - Glazed Aluminum Curtain Walls.

.5 Primers, sealers, cleaners: to glass manufacturer standards and compatible with framing system material/finish.

.6 Glazing sealant: purpose-made for glazing use, compatible with insulating glass units.

.7 Weather sealant: polyurethane, non-sag, 1-part formulation, colours selected by DCC Representative.

Part 3 Execution

3.1 MANUFACTURERS INSTRUCTIONS

.1 Compliance: comply with manufacturer written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions and data sheets.

3.2 GENERAL GLAZING REQUIREMENTS

.1 Clean sealing surfaces at perimeter of glass and sealing surfaces of rabbets before applying glazing tapes and sealant. Use solvent and cleaning agents recommended by manufacturer of sealing materials. Wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Install glazing tapes uniformly with accurately formed corners and bevels. Ensure that proper contact is made with glass and rabbet interfaces.

.4 Set glass on setting blocks, spaced as recommended by glass manufacturer. Place at least one block at quarter points from each corner.

.5 Centre glass in glazing rabbet to maintain required clearances at perimeter on all 4 sides.

.6 Use glazing sealant for heel beads to seal glazing vapour tight to frames.

.7 Make door glass installations rattle-free.

3.3 INSTALLATION

.1 Install glass and insulating glass units to metal doors and curtain wall assemblies:

- .1 Use glazing tape, on both sides. Butt tape tight at corners. Use full length pieces of glazing tape, from corner to corner.
- .2 Install removable stops without displacing glazing tape.
- .3 For interior exposure applications:
  - .1 Set glazing tape flush with glass sight line.
  - .2 Trim off glazing tape protruding above top of stops.
- .4 For exterior exposure applications:
  - .1 Set glazing tape approximately 2 mm below glass sight line to allow cap bead of sealant.
  - .2 Place cap bead of weather sealant to exterior side full perimeter of glass.
  - .3 Apply sealant to uniform and level line, flush with sight line.
  - .4 Tool sealant to a smooth concave appearance.

.2 Install insulating glass units into aluminum doors and frames in accordance with reviewed shop drawings and door/frame system manufacturer requirements.

.3 Install insulating glass units into aluminum curtain wall framing in accordance with reviewed shop drawings and framing system manufacturer requirements.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.1 Remove traces of primer, caulking.

.2 Remove glazing materials from finish surfaces.

.3 Remove labels.

.4 Clean glass [and mirrors] using approved non-abrasive cleaner in accordance with manufacturer's instructions.

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

3.5 PROTECTION

.1 After installation, mark each light with an "X" by using removable plastic tape or paste.

.2 Remove markings when directed by Departmental Representative

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 06 10 11 Rough Carpentry

.2 Section 09 91 23 Interior Painting

1.2 REFERENCES

.1 ASTM International

.1 ASTM C475-02(2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.2 ASTM C840-08, Standard Specification for Application and Finishing of Gypsum Board.

.3 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.4 ASTM C1396/C1396M-09a, Standard Specification for Gypsum Wallboard.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 gypsum board assemblies materials level off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.

.3 Protect from weather, elements and damage from construction operations.

.4 Handle gypsum boards to prevent damage to edges, ends or surfaces.

.5 Replace defective or damaged materials with new.

1.5 AMBIENT CONDITIONS

.1 Maintain temperature 10 degrees C minimum, 21 degrees C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.

.2 Apply board and joint treatment to dry, frost free surfaces.

.3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

Part 2 Products

2.1 MATERIALS

.1 Gypsum wallboard: to ASTM C1396/C1396M 16 mm thick, Type X, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.

.2 Metal furring runners, carrying channels, hangers, tie wires, inserts, anchors.

.3 Steel drill screws: to ASTM C1002.

.4 Joint compound: to ASTM C475, asbestos-free.

.5 Polyethylene film: to CAN/CGSB-51.34

.6 Sealant: compatible with vapour barrier materials.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies 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 APPLICATION

.1 Apply gypsum board after bucks, anchors, blocking, electrical and mechanical work have been approved.

.2 Apply single layer gypsum board to all exposed wood structure and stud framing using screw fasteners Maximum spacing of screws 300 mm on centre.

.1 Single-Layer Application:

.1 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

.3 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.

.4 Install gypsum board with face side out.

.5 Do not install damaged or damp boards.

.6 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.3 PREPARATION

.1 Reinstate interior insulation and vapour barrier in areas where it has been disturbed by construction.

.1 Seal seams in vapour barrier with acoustical sealant.

3.4 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure using contact adhesive for full length at 150 mm on centre.

.2 Locate control joints at changes in substrate construction at approximate 15 m spacing on ceilings.

.3 Install control joints straight and true.

.4 Splice corners and intersections together and secure to each member with 3 screws.

.5 Install access doors to electrical and mechanical fixtures specified in respective sections.

.1 Rigidly secure frames to furring or framing systems.

.6 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.7 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:

.1 Levels of finish:

.1 Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.

.8 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.9 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.10 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.11 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

.12 Mix joint compound slightly thinner than for joint taping.

.13 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.

.14 Allow skim coat to dry completely.

.15 Remove ridges by light sanding or wiping with damp cloth.

3.5 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

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

.2 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 74 19

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by gypsum board assemblies installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM F1859- 10 Standard Specification for Sheet Vinyl Floor Covering Without Backing.

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 flooring and adhesive and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit copies of WHMIS MSDS in accordance with Section 01 35 30 – Health and Safety Requirements

.3 Samples:

.1 Submit for review and acceptance one sample each of stair nosing and tactile stair landing mat

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect flooring accessories from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.4 SITE CONDITIONS

.1 Ensure high ventilation rate, with maximum outside air, during installation.

.1 Vent directly to outside.

.2 Do not let contaminated air recirculate through a district or whole building air distribution system.

Part 2 Products

2.1 STAIR NOSINGS AND TACTILE WARNING MATS

.1 Stair nosings

.1 Rubber stair nosings pre moulded to cover bullnose of existing stairs, extending 100 mm from the leading edge onto the tread of the stairs.

.2 Formed with tactile ribs on the top surface of the nosing.

.3 Maximum thickness of 3mm where rear of nosing meets stair tread.

.4 Color selected by Departmental Representative from standard color range.

.2 Tactile stair mats

.1 Tactile flooring mat to ASTM F1859, minimum 3 mm thick, safety ribbed pattern for use as well as stairway landing tactile warning mat,. Finished edges suitable for surface mounting.

.2 Colours selected by Departmental Representative from standard colour range.

.3 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on existing wooden substrate.

.1 Primer: in accordance with manufacturer's recommendations for surface conditions:

.1 VOC limit: 100]g/L maximum

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.

3.2 PREPARATION

.1 Prepare for installation in accordance with manufacturer's written recommendations.

3.3 APPLICATION: NOSINGS AND STAIR LANDING MATS

.1 Clean substrate and prime with one coat of adhesive.

.2 Apply adhesive to back of base.

.3 Set nosings and mats against floor surfaces tightly by using 3 kg hand roller.

.4 Install straight and level to variation of 1:1000.

.5 Use toeless type base where floor finish will be carpet, coved type elsewhere.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 Material Safety Data Sheets (MSDS).

.2 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - February 2004.

.3 National Fire Code of Canada.

1.2 QUALITY ASSURANCE

.1 Qualifications:

.1 Qualified journeypersons as defined by local jurisdiction to be engaged in painting work

.2 Apprentices: may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.

.3 Conform to latest MPI requirements for exterior painting work including preparation and priming.

.4 Materials: in accordance with MPI Painting Specification Manual "Approved Product" listing and from a single manufacturer for each system used.

.5 Retain purchase orders, invoices and documents to prove conformance with noted MPI requirements when requested by Departmental Representative.

.6 Standard of Acceptance:

.1 Walls: No defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Soffits: No defects visible from ground at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 30 – Health and Safety Requirements.

.3 Upon completion, submit records of products used. List products in relation to finish system and include the following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

.4 Manufacturer's Material Safety Data Sheets (MSDS).

.4 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit draw down paint samples according to Finish Schedule

.2 Finish schedule to be provided after contract award.

1.4 MAINTENANCE

.1 Extra Materials:

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Submit one, four litre can of each type and colour of stain or finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements, supplemented as follows:

.1 Deliver and store materials in original containers, sealed, with labels intact.

.2 Labels: to indicate:

.1 Manufacturer's name and address.

.2 Type of paint or coating.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Provide and maintain dry, temperature controlled, secure storage.

.5 Observe manufacturer's recommendations for storage and handling.

.6 Store materials and supplies away from heat generating devices.

.7 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.8 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

.2 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

.2 Paint, stain and wood preservative finishes and related materials (thinners, solvents, etc.) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.3 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.4 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.5 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground, the following procedures shall be strictly adhered to:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.6 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

.7 Close and seal tightly partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

1.6 AMBIENT CONDITIONS

.1 Heating, Ventilation and Lighting:

.1 Perform no painting work when maximum moisture content of substrate exceeds:

.1 15% for wood.

.2 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".

.3 Test concrete, masonry and plaster surfaces for alkalinity as required.

.2 Surface and Environmental Conditions:

.1 Do not apply sealers or paint in wet or inclement weather

Part 2 Products

2.1 MATERIALS

.1 Paint materials listed in latest edition of MPI Approved Products List (APL) are acceptable for use on this project.

.2 Paint materials for paint systems: to be products of single manufacturer.

2.2 COLOURS

.1 Exterior colour and paint types and gloss level rating to be supplied by the Departmental Representative after contract award

.2 Colors will also include touch up materials for existing exterior finishes.

2.3 EXTERIOR PAINTING SYSTEMS

.1 Exterior wall infill

.1 Fill and prime with primer compatible with owner specified paint

.2 Top coat with minimum 2 coats of owner specified paint.

.3 Paint entire wall face where wall infill occurs

2.4 MANUFACTURER'S INSTRUCTIONS

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

2.5 PREPARATION

.1 Perform preparation and operations for exterior painting in accordance with MPI Painting Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

.3 Clean and prepare exterior surfaces to be painted in accordance with MPI Painting Manual requirements. Refer to the MPI Manual in regard to specific requirements and as follows:

.1 Remove dust, dirt, and surface debris by wiping with dry, clean cloths.

.2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly. Allow sufficient drying time and test surfaces using electronic moisture meter before commencing work.

.5 Use water-based cleaners in place of organic solvents where surfaces will be repainted using water based paints.

.6 Many water-based paints cannot be removed with water once dried. Minimize use of kerosene or such organic solvents to clean up water-based paints.

.4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before priming and between applications of remaining coats. Touch-up, spot prime, and apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.5 Do not apply paint until prepared surfaces have been accepted by Departmental Representative.

.6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

2.6 PROTECTION

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Departmental Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect passing pedestrians, building occupants and general public in and about building.

2.7 APPLICATION

.1 Apply paint by brush or roller. Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:

.1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.

.2 Work paint into cracks, crevices and corners.

.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.

.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple.

.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Apply coats of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.5 Sand and dust between coats to remove visible defects.

.6 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as projecting ledges.

2.8 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 Material Safety Data Sheets (MSDS).

.2 Master Painters Institute (MPI)

.1 MPI Architectural Painting Specifications Manual, 2004.

.3 National Fire Code of Canada - 1995

1.2 SUBMITTALS

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

.2 Product Data:

.1 Submit product data and instructions for each paint and coating product to be used.

.2 Submit product data for the use and application of paint thinner.

.3 Submit copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application.

.3 Samples:

.1 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

.2 Manufacturer's Instructions:

.1 Submit manufacturer's installation application instructions.

.3 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

1.3 MAINTENANCE

.1 Extra Materials:

.1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00 - Closeout Submittals.

.2 Quantity: provide one one litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

.3 Delivery, storage and protection: comply with Departmental Representative requirements for delivery and storage of extra materials.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packing, Shipping, Handling and Unloading:

.1 Pack, ship, handle and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.

.2 Acceptance at Site:

.1 Identify products and materials with labels indicating:

.1 Manufacturer's name and address.

.2 Type of paint or coating.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Storage and Protection:

.1 Provide and maintain dry, temperature controlled, secure storage.

.2 Store materials and supplies away from heat generating devices.

.3 Store materials and equipment in well ventilated area.

.5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.

.7 Remove paint materials from storage only in quantities required for same day use.

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

1.5 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

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

.3 Unused coating materials must be disposed of at official hazardous material collections site as approved by Departmental Representative.

1.6 SITE CONDITIONS

.1 Surface and Environmental Conditions:

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.

.3 Apply paint when previous coat of paint is dry or adequately cured.

.2 Additional interior application requirements:

.1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

1.7 MATERIALS

.1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.

.2 Provide paint materials for paint systems from single manufacturer.

.3 Conform to latest MPI requirements for interior painting work including preparation and priming.

.4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.

1.8 COLOURS

.1 Interior colours paint and finish types will be provided by the contractor after contract award.

.2 Interior finishes are to match existing.

1.9 INTERIOR PAINTING SYSTEMS

.1 Galvanized metal doors and frames and Miscellaneous Metals,

.1 INT 5.3M - High performance architectural latex, gloss level and colour to be supplied by owner.

.2 Dressed lumber: including doors, door and window frames, casings, mouldings:

.1 INT 6.3E - Polyurethane varnish mat finish to match existing color and sheen.

.3 Plaster and gypsum board: gypsum wallboard, drywall, sheet rock type material.

.1 INT 9.2A - Latex –gloss level and colour to be supplied by owner (over primer).

Part 2 Execution

2.1 MANUFACTURER'S INSTRUCTIONS

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

2.2 GENERAL

.1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

2.3 EXAMINATION

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

2.4 PREPARATION

.1 Protection:

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative]

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect building occupants and general public in and about the building.

.2 Surface preparation: clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements

.3 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

.1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.

.2 Apply wood filler to nail holes and cracks.

.3 Tint filler to match stains for stained woodwork.

.4 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

.5 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Touch up of shop primers with primer as specified.

2.5 APPLICATION

.1 Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:

.1 Apply paint in uniform layer using brush and/or roller type suitable for application.

.2 Work paint into cracks, crevices and corners.

.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.

.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.

.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.

.4 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.5 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.6 Sand and dust between coats to remove visible defects.

.7 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

2.6 SITE TOLERANCES

.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

2.7 CLEANING

.1 Do cleaning in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Fire extinguishers.

.2 Cabinets.

.3 Accessories.

1.2 RELATED SECTIONS

.1 Section 09 91 23 – Interior Painting.

.2 Section 21 05 05 – Common Work Results for Fire Suppression.

1.3 REFERENCES

.1 NFPA 10-2007 - Portable Fire Extinguishers.

.2 CAN/ULC-S504-02 - Dry Chemical Fire Extinguishers.

.3 CAN/ULC-S508-02 - Rating and Fire Testing of Fire Extinguishers.

1.4 SUBMITTALS FOR REVIEW

.1 Section 01 33 00: Submission procedures.

.2 Product Data: Provide extinguisher operational features, colour and finish, anchorage details

.3 Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, wall bracket mounted measurements, location.

1.5 SUBMITTALS FOR INFORMATION

.1 Section 01 33 00: Submission procedures.

.2 Installation Data: Manufacturer's special installation requirements, including special criteria and wall opening coordination requirements.

.3 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

.1 Section 01 78 10: Submission procedures.

.2 Operation and Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.7 QUALITY ASSURANCE

.1 Products of This Section: Manufactured to ISO 9000 certification requirements.

.2 Provide units conforming with CAN/ULC-S508

1.8 REGULATORY REQUIREMENTS

.1 Conform to National Fire Code and NFPA 10 for requirements for extinguishers

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Extinguishers must be suitable for -50 degC due to only mechanical room being heated during winter.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable manufacturers

- .1 Kidde
- .2 Amerex
- .3 Ansul

2.2 EXTINGUISHERS

.1 Dry Chemical Type: CAN/ULC-S504, welded steel tank, with pressure gauge; Class A:B:C; size and classification as scheduled.

2.3 CABINETS

.1 Metal: Formed sheet steel, paintable satin coat ; 1.2 mm thick base metal.

.2 Configuration: Trimless Semi-recessed and Surface type as indicated, sized to accommodate fire extinguisher

.3 Door: 1.2mm thick, reinforced for flatness and rigidity; latch access.

.4 Door Glazing: Plastic, clear, 3-mm acrylic

.5 Cabinet Mounting Hardware: Appropriate to cabinet.

.6 Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.

.7 Pre-drill for anchors.

.8 Hinge doors for 180 degree opening with continuous piano hinge. Provide nylon roller type catch.

.9 Weld, fill, and grind components smooth.

.10 Finishing Cabinet Exterior Trim and Door: Primed for field paint finish.

2.4 ACCESSORIES

.1 Extinguisher Brackets: Formed steel, chromed finish.

.2 Graphic Identification: engraved, 100-mm x 100-mm, black on brushed brass, mounted bracket to attach to walls. Mount signs perpendicular to walls to enhance visibility in narrow corridors.

.3 Graphic:

Part 3 Execution

3.1 EXAMINATION

.1 Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

.1 Install to manufacturer's instructions.

.2 Install cabinets plumb and level in wall openings, 900- mm inches from finished floor to inside bottom of cabinet. Provide where indicated on drawings

.3 Secure rigidly in place.

.4 Place extinguishers and accessories in cabinets and on wall brackets as indicated.

.5 Position cabinet signage at 2050-mm to underside of sign

END OF SECTION

Part 1 General

1.1 INTENT

.1 Work in Division 20, 21, 22 and 23 will include all drawings and all sections of the specifications that form the Contract Documents, including all addenda, and including Division 01 and Division 00, whether defined in Division 20, 21, 22 and 23 or elsewhere, or whether defined in mechanical drawings or elsewhere.

.2 Provide complete, fully tested and operational mechanical systems to meet requirements described herein and in complete accord with applicable codes and ordinances. Include all costs to obtain all permits and to pay for all fees and charges, including inspection charges by the authorities that issue the permits; coordinate all related inspections. Permits, fees and inspections including sprinklers, fire protection, ventilation, boilers, building HVAC, plumbing, and fuel oil.

.3 Contract documents of the Specifications and Drawings, are generally diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.

.4 Review Contract Documents and notify the Departmental Representative of issues of conflict that require clarification prior to submitting tender. Failure by the Contractor to secure clarification does not relieve the Contractor to comply with the intent of the design and/or the Contract Document.

.5 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents. Provide adequate access space for maintenance and service, and clearances required by code and by the Authority.

.6 Install material and equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment as determined by the Departmental Representative.

.7 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the other parties. Uncrate equipment, assemble, move in place and install complete; start-up and test. Refer to Section 20 05 02 for supplied equipment by others and equipment furnished by other divisions.

1.2 RELATED REQUIREMENTS

.1	Procurement and Contracting Requirements	Division 00
.2	General Requirements	Division 01

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Bidding Requirements and General Conditions of Contract	Division 00 and Division 01
.2	Electric Motor Power Characteristics	Division 26
.3	Fire Detection and Alarm	Division 28

1.4 CODES, REGULATIONS, PERMITS, FEES AND INSPECTIONS

.1 Conform to the latest edition and supplements of the following for all materials and installations:

.1 National Building Code, as amended by local bylaws and Territorial Statutes.

.2 National Energy Code.

.3 National Fire Protection Association.

.4 National Fire Code.

.5 Codes, Standards, Bylaws, Statutes and Manufacturer's Association Specifications or instructions mentioned in Division 20, 21, 22 and 23 sections, refer to latest revisions thereof at time of calling of bids, unless specifically designated otherwise.

.6 In no instance shall the standard established by the drawings and specifications be reduced by code or otherwise.

.7 Where conflict or discrepancies between Codes, Standards, Bylaws, Statutes, Specifications, Drawings, etc., exist, the most stringent requirement to apply.

.8 Furnish all notices, obtain all necessary permits related to Division 20, 21, 22 and 23 work.

1.5 INSTALLATION REQUIREMENTS

.1 Install material and equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment as determined by the Departmental Representative. Field verify all dimensions, clearances, maintenance clearances, equipment handing requirements, invert elevations, and other similar measurements prior to any fabrication and installation. Notify the Departmental Representative of any discrepancies that require resolution.

.2 All materials and equipment installed in the crawlspace shall be kept accessible from all sides and be kept away from flanking beams to permit and future building height adjustments.

.3 Confirm invert elevations and locations of connection to utilities before any excavation work is started.

.4 Install piping and ductwork only in concealed spaces, unless otherwise approved.

.5 Remove and replace improperly installed mechanical work, or work that requires modifications due to coordination issues or conflicts.

.6 Review architectural drawings and confirm that plumbing fixtures defined on Architectural Drawings are consistent with plumbing fixtures defined on mechanical drawings. Mechanical work shall include supply and installation for all fixtures defined in the contract documents including architectural.

.7 Refer to Architectural Drawings and Structural Drawings for sections, details, dimensions and information such as fire separations, expansion joints, roof construction, wall construction, that has impact on the mechanical installation.

.8 Examine contract documents prepared by all disciplines and confirm that work can be installed as defined. No allowance will be made for changes unless the Departmental Representative has been notified in writing prior to tender close.

.9 Prepare dimensioned drawings showing sleeving, recesses, furring and openings to coordinate mechanical work with other trades.

.10 Prepare dimensioned drawings for congested areas such as shafts, corridors and spaces that require special attention to complete the installation.

.11 Make all piping connection to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by others. Install shut-off valves, vents, drains, unions, flanges, traps, fittings. Uncrate equipment, assemble, move in place and install complete; start-up and test. Refer to Section 20 05 02 for supplied equipment by others and equipment furnished by other divisions.

1.6 PROVISIONS FOR MAINTENANCE

.1 Install piping in racks with clearance in between pipes equal to the pipe diameter. Where piping is stacked, provide a minimum 300 mm clearance in between stacks.

.2 Install maintainable components such as valves, motors, traps, air vents, dampers, filters, coils in a manner to facilitate proper access for maintenance.

.3 Install major equipment components such as pumps, fans, boilers, chillers at levels indicated. Install piping connections with isolating valves located to allow component removal with minimal system drainage.

.4 Locate flanges/unions to allow equipment removal without interruption to piping work.

.5 Allow adequate space for removal of equipment and components from the mechanical room space.

.6 Install gauges and metering equipment in readily accessible and visual locations.

.7 Provide extensions to grease cups, lubrication fittings for bearings, etc. to outside of fan cabinets.

.8 Provide maintenance platforms, ladders, safety rails to Occupational Health and Safety Standards to accommodate equipment and components not easily accessed from the floor.

.9 Allow minimum clearance in front of electrical components, such as motor control centres, starters, VFDs, control panels in accordance with applicable codes.

1.7 WARRANTY

.1 Comply with warranty requirements defined in Division 01, General Requirements.

.2 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 of work. The Contractor shall repair and replace any work which fails or becomes defective during the term of the guarantee/warranty, providing the operating and maintenance instructions have been complied with. The period of guarantee specified shall not, in any way, supplant any other guarantees of a longer period provided by Manufacturers or as called for in the project documents.

1.8 REQUIREMENTS DURING WARRANTY

.1 Unless specified otherwise the Departmental Representative's personnel shall be responsible for all routine maintenance requirements as required in the manufacturer's instructions will be responsible for supplying filters, grease and belts.

1.9 MATERIALS

.1 Materials and equipment installed shall be new, full weight and of quality specified. Use same brand or manufacturer and model for each specific application.

.2 Each major component of equipment shall bear manufacturer's name, address, catalog and serial number in a conspicuous place.

.3 Replace materials or workmanship below specified quality and relocate work wrongly placed to satisfaction of the Departmental Representative and at no additional cost.

.4 Install materials and equipment in a quality manner providing good workmanship by competent tradesmen.

1.10 AVAILABILITY OF EQUIPMENT AND MATERIALS

.1 Make known in writing to the Departmental Representative ten (10) days prior to the issue of construction documents date any materials specified that are required to complete the work which are not locally supplied, or are not currently available or will not be available for use as called for herein. Failing to do so, it will be interpreted that the most expensive alternate has been included in the construction price.

1.11 ALTERNATE MATERIALS AND EQUIPMENT

.1 Comply with requirements in Division 01, General Requirements.

.2 This contract shall be based on the use of materials and equipment as specified or as contained within the acceptable equivalent manufacturers listed in each section.

.3 Requests for approval of equivalent materials or equipment shall be submitted in duplicate to the Departmental Representative, complete with all applicable technical data, including performance curves and physical details. Approval of requests shall only be given by addendum or on-site instruction and consistent with all requirements defined in Division 01, General Requirements.

.4 The Contractor shall indicate the degree of approval obtained from the Departmental Representative. In the event that the product has been approved as an "Alternate Only", this shall be stated in the quotation and the difference from the base bid price indicated.

.5 Approved equivalents and/or alternatives to specified products shall be equal in performance and materials to the specified product in every respect, operate as intended, meet the space, capacity, and noise requirements outlined.

.6 The Contractor shall be fully responsible for all costs for work or materials required by the trades or other contractors to accommodate use of other than specified materials or equipment including redesign costs.

1.12 METRIC CONVERSION

.1 All units in this division are expressed in SI units. Soft metric conversions are used throughout.

.2 Submit all shop drawings and maintenance manuals in SI units.

.3 On all submittals 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 only Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide adapters to ensure compatible connections to all metric sized fittings, equipment and piping.

.2 When CSA approved SI Metric pipes are available and are provided, the contractor shall provide adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

.3 Record accurately on "as-built" drawings the type of pipe (i.e., Metric or Imperial) installed.

EQUIVALENT NOMINAL DIAMETERS OF PIPES

mm	Inches	mm	Inches	mm	Inches
3	1/8	32	1-1/4	125	5
6	1/4	38	1-1/2	150	6
10	3/8	50	2	200	8
15	1/2	65	2-1/2	250	10
20	3/4	75	3	300	12
25	1	100	4	450	18

.5 Metric Duct Sizes

.1 The metric duct sizes are expressed as 25 mm = 1 inch.

1.13 DRAWINGS AND SPECIFICATIONS

.1 The responsibility and scope of each subtrade rests solely with the Contractor. Extras will not be considered based on the grounds of difference in interpretation of specifications as to which trade involved is to provide certain specifications or materials.

.2 Refer to architectural drawings for building dimensional data and construction details.

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

.4 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 a ruling from the Departmental Representative in writing or by Addendum, before submitting tender. If this is not done, it will be assumed that the most expensive alternate has been included.

.5 Where errors or discrepancies appear in catalogue numbers, provide the material in accordance with the system requirements and to the standard of the specifications.

.6 Prior to construction start, examine all contract documents, including all drawings and specifications for the project for all divisions, and work of other trades to ensure that work can be satisfactorily carried out without changes to building.

.7 The scope of work in this division shall include all work defined in the Contract Documents, including work which may exceed the minimum requirements of codes and standards that are referenced in the Contract Documents.

1.14 COORDINATION OF WORK

.1 Cooperate and coordinate with other trades on the project. Phase work in sequence with the General Contractor.

.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. Provide coordination drawings showing the work of all trades and contractors involved, in areas of potential conflict or congestion, as requested by Departmental Representative at no additional cost.

.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.

.5 Prepare and submit drawings showing sleeving, recesses, and formed work in concrete.

.6 Prepare and submit drawings for all shafts, duct openings, louvre openings and similar requirements.

.7 Coordinate with the Contractor and Electrical Trade all requirements for electrical services to mechanical components and equipment. Motor voltages will be defined in Division 26.

.8 Using shop drawing data, prepare a comprehensive list to define all specific electrical requirements needed by the Division 21, 22 and 23 work to complete the installation. Coordinate with Electrical Trade.

.9 Prepare and submit drawings to the Contractor and structural Departmental Representative defining mechanical system support loads and support details. Include definition of pipe and/or loads on structural elements and anchor arrangements.

1.15 CUTTING AND PATCHING

.1 Provide inserts, holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.

.2 Provide inserts or drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the Structural Departmental Representative before drilling, coring, cutting or burning structural members. Ensure post tensioned or pre-stressed strands are located accurately and avoid with an adequate margin of safety.

.4 Provide openings and holes required in precast concrete members for mechanical work. Cast holes larger than 100 mm in diameter. Field-cut holes smaller than 100 mm if location is approved.

.5 Patch and make good building where damaged from equipment installation, improperly located holes etc. Work to be performed by the trade or contractor responsible for that type of work.

1.16 CERTIFICATE OF SUBSTANTIAL PERFORMANCE

.1 Submit certification documents signed by a Professional Engineer registered in Yukon Territory confirming that automatic sprinkler installation and systems are installed and tested, consistent with the Contract Documents.

.2 In addition to the requirements of Division 00, Procurement and Contracting Requirements, and Division 01, General Requirements, and prior to application for a "Certificate of Substantial Performance" of the work, the contractor shall certify the following in writing to the Departmental Representative:

.1 The systems are installed and suitable for operation for the purpose intended.

.2 Heating ventilation and cooling systems are capable of operation with safety devices and alarm controls functional and automatic controls in operation and the Departmental Representative's personnel have had their initial training programs.

.3 All equipment within mechanical rooms is installed.

.4 All unit heaters, cabinet unit heaters, and fan coil units are installed and electrical connection made.

.5 All fans, pumps and equipment are installed and electrical connections made.

.6 All contractor system start-up and test sheets have been completed and submitted for review.

.7 All radiant panels, radiators and finned baseboard radiation complete with enclosures are installed.

.8 All fire stop flaps, fire dampers, and smoke dampers are installed and checked for operation; submit report.

.9 All ducted supply/return/exhaust grilles are installed.

.10 All supply air, return air, exhaust air, fresh air, and combustion air ductwork is installed and cleaned.

.11 All thermal and acoustic insulation is installed.

.12 All static pressure tests are complete.

.13 All access doors are suitably located, and equipment easily accessible including plumbing cleanouts.

.14 All fire protection including sprinklers, fire extinguishers, cabinets and brackets are installed and operational.

.15 All piping is installed, painted and clearly identified complete with flow arrows.

.16 Systems are chemically cleaned, flushed, and water treatment initiated.

.17 Temporary filters are installed and fan plenums cleaned.

.18 All equipment is checked for operation, alignment amperage draw and rotation.

.19 Air and water systems balance is completed and the reports have been submitted for review.

.20 All equipment is lubricated as per manufacturer's data.

.21 All plumbing fixtures are installed, solidly supported and in operation. Domestic water lines are flushed and disinfected.

.22 All valves are tagged, terminal air boxes are identified and numbered, and all equipment identified. Painting of equipment is completed and escutcheons are installed.

.23 All necessary tests and start-up procedures on equipment have been made, including those required by authorities.

.24 The building automation system seven (7) day acceptance test has been successfully completed.

.25 Automatic sprinkler systems have been tested and certification has been signed by sprinkler contractor's professional engineer and submitted.

.26 Documentation required by the following sections has been submitted:

.1	General Documentation	Section 20 05 05
.2	Systems Demonstration and Instruction	Section 20 05 06

.27 Following information has been submitted:

.1 Mechanical Contractor shall certify (by sign-off) that each deficiency listed in all inspection reports has been corrected, or defined as a seasonal deficiency with a cost allowance.

.2 Final draft of O&M Manuals.

.3 Final certificates from authorities having jurisdiction.

.4 System cleaning reports.

.5 Reports from manufacturer on noise and vibration control devices.

.6 Completed record drawings.

.7 Vendors equipment start-up reports in related sections and as required in Section 20 05 05, General Documentation.

.28 Training Seminars for all systems is complete.

.3 Identify any systems which cannot be installed and/or placed in operation for reasons beyond the normal control of the contractors and submit a statement of the value of the remaining work required to complete the project.

.4 Within ten (10) days of receipt of a written application for a "Certificate of Substantial Performance", the Departmental Representative shall visit the site to confirm that all requirements listed in Article 1.17.2 are complete. Mechanical Contractor shall attend this site review and provide a copy of the O&M Manual.

.5 If, after the Departmental Representative's site visit the application for a "Certificate of Substantial Performance" is not approved, the contractor shall reapply in accordance with the Departmental Representative's site visit report and pay for costs of re-inspection services.

1.17 CERTIFICATE OF TOTAL PERFORMANCE

.1 Comply with the requirements of Division 00, Procurement and Contracting Requirements, and Division 01, General Requirements.

.2 Prior to application for a statement of "Total Performance", the Contractor shall certify the following in writing to the Departmental Representative:

.1 All items noted in previous site visit reports including that performed for Substantial Performance have been completed.

.2 All controls have been calibrated and set.

.3 Warranty forms are mailed to manufacturer. (Provide copy of original warranty for equipment which has a warranty period of longer than one year).

.4 Temporary filters are removed and permanent filters are installed.

.5 Completed and accepted Operating and Maintenance (O&M) Manuals have been submitted to the Departmental Representative.

.6 Completed and accepted final air and water Balancing Reports have been included in the O&M Manuals.

.7 The Departmental Representative's personnel have received instructions in the operation and maintenance of the system.

.3 Within ten (10) days after receipt of a written application for a "Certificate of Total Performance", the Departmental Representative shall visit the site.

.4 The Departmental Representative shall provide one (1) visit for the purpose of reviewing the application for a "Certificate of Total Performance". Subsequent visit if required, shall be at the expense of the contractor.

1.18 SHOP DRAWINGS

.1 Submit shop drawings in electronic (PDF) format, complete with appropriate cover sheets, transmittals and stamps.

.2 Prior to submission to the Departmental Representative, the Contractor shall review all shop drawings. By this review, the Contractor certifies that he has determined and verified the following:

.1 Measurements are verified with field installation space requirements.

.2 "Handling" of equipment for access and maintenance is correct.

.3 Access for maintenance requirements is defined.

.4 Field connections for wiring, controls, piping and ductwork connections are defined.

.5 Electrical service connections and characteristics are defined.

.6 Work required by other trades is defined.

.7 Vendor's catalogue numbers are correct and consistent with the system performance criteria.

.8 Shop drawings meet all requirements of the contract documents.

.3 The Contractor's review of each shop drawing shall be indicated by stamp, date and signature of a responsible person.

.4 Identify materials and equipment by manufacturer, trade name, and model number. Include copies of applicable brochure or catalogue material. Do not assume applicable catalogues are available in the Departmental Representatives office. Maintenance and operating manuals are not suitable submittal material. Where equipment is identified by name or number on the drawings or specification, clearly mark each shop drawing with the identical name and/or number.

.5 Clearly mark each sheet of submittal material (using arrows, underlining, or circling) to show differences from what is specified, particularly sizes, types, model numbers, rating, capacities, and options actually being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pump seals, materials or painting.

.6 Include dimensional and technical data sufficient to check if equipment meets requirements. Include wiring, piping, service connection data and motor sizes.

.7 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Departmental Representative.

.8 The shop drawing review by the Departmental Representative will provide the following certification: "Review by Stantec is for the sole purpose of ascertaining general conformity with design. Contractor is responsible for dimensions, fabrication and construction methods, coordination of subtrades, detail design of components, and errors or omissions on shop drawings."

1.19 TEMPORARY HEAT

.1 Refer to Division 01.

.2 Prior to the use of the building systems for temporary heat the contractor shall provide a proposed temporary heat agreement for review.

.3 The agreement shall include payment schedule for utilities, spare parts listing and confirmation of warranty.

.4 Thoroughly clean and overhaul permanent equipment used during the construction period, replace worn or damaged parts before final inspection.

.5 Use of permanent systems for temporary heat shall not modify terms of warranty. Equipment Manufacturers shall certify that equipment is in "new" condition at start of warranty period.

.6 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.

.7 Air systems may not be used for temporary heating.

.8 Radiant panels may not be used for temporary heating.

.9 When permanent systems are used for temporary heat, provide alarm indicating system failure. Connect alarm to independent alarm company monitoring system.

.10 Where pumps are used for temporary heating, replace mechanical seals, regardless of condition, with new mechanical seals, prior to Total Performance.

.11 Avoid thermal shock to heating system during planning, construction and operation of temporary heating system.

1.20 EQUIPMENT PROTECTION AND CLEAN-UP

.1 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance.

.4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

1.21 TEMPORARY OR TRIAL USAGE

.1 Temporary or trial usage requested by the Departmental Representative of mechanical equipment supplied under contract shall not represent acceptance. Operate and maintain all equipment and systems during trial usage.

.2 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

.3 For all ventilation systems, the operation of the system shall be pre-tested by running the units in a 100% fresh air, 100% exhaust air mode once all distribution ductwork is installed. Inspect filters bi-monthly; change filters if pressure drop exceeds manufacturer's recommended operating limit.

.4 During the trial use test of the ventilation system the contractor shall arrange for a sound meter and test sound levels in locations selected by the Departmental Representative.

.5 The ventilation system trial use date shall be approved by the Departmental Representative.

1.22 COORDINATION WITH DIVISION 26 WORK

.1 Provide motors or mechanical equipment with voltage and phase characteristics as defined in Division 26.

.2 Comply with the requirements in Section 20 05 03, Electric Motors – Three Phase.

.3 Prior to ordering any motor driven mechanical equipment, meet with the electrical trade to confirm all electrical interface requirements with mechanical components.

.4 Division 20, 21, 22 and 23 (Mechanical) Trade shall:

.1 Submit a list of all motor specifications and electrical connections to mechanical equipment, outlets, components, panels and point source requirements. Maintain list up-to-date and make available for site review.

.2 Include motor list in O&M Manuals.

.3 Supply and install all low voltage (24 V) control devices, temperature control systems including direct digital central systems defined in Section 20 30 (Series) and 23 09 (Series), Controls.

.4 Supply and set in place all variable frequency drives that are defined in Section 20 05 04, including start-up and commission.

.5 Supply and install 110 V wiring interface with control devices on packaged equipment, such as liquid level controllers and multi-speed controllers.

.6 Supply and install all low and live voltage wiring associated with automatic control systems defined in Section 20 30 (Series) and 23 09 (Series), Controls.

.7 Provide CSA labeling on all mechanical equipment with electrical components.

.8 Provide all on-site interconnecting wiring for connecting loose electrical components supplied with mechanical equipment.

.5 Division 26 (Electrical) Trade will:

.1 Supply and install all electrical components which are required, but not part of Division 20, 21, 22 and 23 supplied packaged equipment.

.2 Provide wiring interface from distribution equipment to variable frequency drives (VFDs) and from VFDs to motors.

.3 Extend power wiring from electrical centers to packaged equipment that contains electrical components.

.6 Refer to Division 26.

Part 2 Products

NOT APPLICABLE

Part 3 Execution

NOT APPLICABLE

END OF SECTION

Part 1 General

1.1 SCOPE

.1 This specification covers 3-phase, integral horsepower, squirrel cage induction motors in integral NEMA frame sizes 143T-449T; ISO 9001 Certified.

.2 Provide motors that comply with this specification on all motor driven equipment defined in Division 20, 21, 22 and 23 sections for motors ¾ HP to 500 HP.

.3 Motors shall be suitable for horizontal, vertical or belt driven mounting.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Variable Frequency Drives	Section 20 05 04
.3	General Documentation	Section 20 05 05
.4	Pumps	Section 20 20 60
.5	In-Line HVAC Fans	Section 23 34 13
.6	Packaged Modular Outdoor Air Handling Units	Section 23 73 13
.7	Electrical	Division 26

1.3 STANDARDS

.1 All motors shall be in accordance with NEMA Standard MG-1, CSA C3900-1993, or the latest revision insofar as it is applicable. Motors also shall comply with the applicable portions of the Canadian Electric Code. Motors designed to IEC Standards are not acceptable.

.2 Motors driven by VFD equipment shall be “Inverter Duty” to match the drive manufacturer’s data. Refer to Section 20 05 04, Variable Frequency Drives.

.3 Motors, driven by VFD equipment, shall utilize dielectric grease on bearings and shall incorporate a motor shaft grounding system utilizing stainless steel brushes.

.4 Refer to Division 26 for VFDs.

1.4 SUBMITTALS

.1 Submit shop drawings indicating motor manufacturer, frame size, voltage, full load amps, insulation class, motor grade, and dimensions.

.2 Submit manufacturer’s recommended maintenance tasks for a one year period, based on application of the motor. Include maintenance schedules and lubrication products.

.3 Submit a copy of typical Warranty Certificate.

1.5 ELECTRICAL REQUIREMENTS

.1 Voltage and Frequency

Motors will be rated for operation on a 3-phase, 60 Hz power supply at 208 Volts. All motors shall be designed and manufactured to operate with ±10% voltage and ±5% frequency variations of the nameplate ratings. Combined voltage and frequency variation shall not exceed ±10%. Confirm voltages for ALL motors with Division 26.

.2 Operating Characteristics

.1 Torques

Motors shall meet or exceed the locked rotor (starting) and minimum breakdown torques specified in NEMA standard for Design B for the ratings specified.

.2 Currents

Locked rotor (starting) currents shall not exceed NEMA Design B maximum values for the specified rating. Motors shall be capable of a 20 second stall at six times full load current without injurious heating to the motor components.

.3 Efficiency

Motors shall be Premium Efficient design and have a minimum and nominal full load efficiency which will meet or exceed the values listed in NEMA MG1-12.55 Table 12-6B when tested in accordance with NEMA test standard MG1-12.54.1, IEEE Test Procedure 112, Method B using accuracy improvement by segregated loss determination including stray load loss measurements.

.4 Power Factor

The power factor of 3600 and 1800 rpm, 3 through 186.5 kW ratings at full load, at full voltage shall be a minimum of 85%. Six-pole ratings will be excluded from this requirement.

.3 Service Factor and Ambient

.1 Standard motors will be rated for a 1.15 service factor in a 40°C ambient.

.4 Insulation

.1 Standard motors shall have a full Class F non-hygroscopic insulation system.

.2 Standard motors shall be dipped and baked in polyester varnish to consolidate the winding.

.3 Motors on equipment serviced by Variable Frequency Drives (VFDs) shall utilize Inverter Grade Insulation which consists of a minimum Class F or better insulation materials with additional phase insulating material, extra end turn bracing, and Class H spike resistant wire, capable to withstand 2000 volt transients without premature motor failure and no cable limitations in motor application. Provide stainless steel brushes to ground the shaft.

.4 Refer to Section 20 05 04, Variable Frequency Drives.

1.6 MECHANICAL CONSTRUCTION

.1 Enclosures

.1 Construct Totally Enclosed Fan Cooled (TEFC) and Open Drip Proof (ODP) motors to NEMA T-frame, NEMA F1 Assembly.

.2 Provide Totally Enclosed Fan Cooled (TEFC) motors on fan equipment within air streams.

.3 Mount motor nameplate on enclosure with information described in NEMA standard MG1-20.60. Nameplates shall be of stainless steel and stamped per NEMA Standard MG1-10.40. Nameplate information shall include the nominal efficiency value per standard MG1-12.54.2 and nameplate information described in the most current NEMA Standard MG1-20.

.4 Horsepower/frame relationship shall conform to the latest NEMA standard for T-frame motors.

.5 Motors covered by this specification will be 143T-449T frame sizes.

.6 Conduit box shall be cast iron, diagonally split and rotatable in 90 degree increments.

.7 Four (4) hex head bolts shall be used to secure conduit box to frame.

.8 Four (4) hex head bolts shall be used for the conduit box cover.

.9 External hardware shall be zinc cadmium plated to resist corrosion.

.10 External full gloss epoxy enamel paint shall withstand industrial environments.

.2 Bearings

.1 All motors shall have anti-friction bearings, sized for L-10 life of at least 50,000 hours under minimum V belt heave sizes for maximum loading conditions (see NEMA Standard MG1-14.43) or 150,000 hours L-10 life for a direct connected load.

.2 Bearings shall be double-shielded, vacuum degassed steel ball bearings selected for electric motor service.

.3 Bearing housings shall be re-greasable with provisions for purging old grease.

.4 Bearings shall be lubricated with a premium dielectric, moisture resistant grease of a temperature range of -29°C to +149°C.

.5 Cast iron inner bearing caps.

.6 All fasteners and motor hardware shall be zinc cadmium plated.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 General Electric, US Motor, Baldor Century E Plus (VAV), Reliance XE, Westinghouse Optim HE, Marathon, Toshiba.

.2 All motors as listed are to be premium efficiency inverter grade.

2.2 TESTING

.1 Production Tests: Each motor shall receive a routine commercial test per NEMA MG-1.12. Prototype test reports shall be for each rating.

.2 Sound Level: The noise level of each motor shall comply with NEMA MG-1.12.49.

.3 Vibration Level: The vibration level of each motor shall not exceed those values listed in NEMA MG-1.12.05.

Part 3 Execution

3.1 COORDINATION

.1 Submit motor list to electrical trade for review and compatibility, including motor size, voltage, phase and VFD integration (where applicable).

.2 Refer to drawings, specifications and addenda that list motor driven equipment and supply integral motors suitable for drive interface.

.3 Refer to Division 26 and confirm voltage/phase requirements for motors.

3.2 VARIABLE FREQUENCY DRIVES

.1 Motors shall be designed for operation with Variable Frequency Drives. Refer to Division 26 for VFD requirements.

3.3 WARRANTY

.1 All motors shall be warranted three (3) years against defects in material and workmanship from date of final acceptance.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Variable frequency drive (VFD) are specified by and to be provided by Division 26.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Electric Motors – Three Phase	Section 20 05 03
.3	General Documentation	Section 20 05 05
.4	System Demonstration and Instruction	Section 20 05 06
.5	Equipment Testing and Start-up	Section 20 05 08
.6	Testing, Balancing and Adjusting	Section 20 22 00
.7	Controls	Section 20 30 Series
.8	HVAC Controls	Section 23 09 Series
.9	Plumbing	Division 22
.10	Heating, Ventilation and Air Conditioning	Division 23
.11	Electrical	Division 26

Part 2 Products

NOT USED

Part 3 Execution

NOT USED

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and transmit documentation for review to Departmental Representative at project milestones.

.2 Operating and Maintenance Manuals

.3 Record Drawings

.4 Vendor related equipment start-up reports.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Requirements	Division 01
.2	General Mechanical Provisions	Section 20 05 01
.3	Fire Suppression	Division 21
.4	Plumbing	Division 22
.5	Heating, Ventilation and Air Conditioning	Division 23

.2 Closeout Submittals

.1 General Requirements Division 01

1.3 QUALITY ASSURANCE

.1 Work specified in this section shall be performed by an Independent Agency specializing in this type of work.

Part 2 Products

2.1 OPERATING AND MAINTENANCE MANUALS

.1 Refer to Division 01, General Requirements.

.2 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and transmit documentation for review to Departmental Representative at project milestones.

2.2 BINDERS

.1 Provide four (4) electronic copies on flash drives of Operations and Maintenance Manuals, plus two (2) hard copies outlined as follows:

.1 Each set of manuals shall include as many binders as required to accommodate the project information.

.2 Binders shall be 216 mm x 280 mm, three (3) post, expanding spine type, with metal piano hinges and bound with heavy fabric.

.3 Maximum binder thickness when filled shall not exceed 100 mm, including a space allowance for 10% additional data.

.4 Binder colour shall be blue, Ontario buckram fabric, colour #OBV460.

.5 Project title and identification shall be silk screened on the front cover and spine. All lettering and borders shall be white.

.6 Binder spine identification to include Volume #, Set #, Title Description, Facility Name and Facility Location.

.7 Contractor to submit proof of cover layout for review prior to ordering binders.

2.3 TABS

.1 The divider tabs shall be laminated mylar plastic and coloured according to division and section.

.2 Plastic tabs with typewritten card inserts will not be accepted.

.3 Each tab to include tab number and title printed on the tab.

.4 The colouring for tabs for individual sections is as follows:

Green - Air Systems
Brown - Control Systems
Blue - Cooling Systems
Red - Fire Protection
Orange - Heating Systems
Yellow - Miscellaneous Systems
Purple - Plumbing Systems
Gray - not used, reserved for future use
White - not used, reserved for future use

2.4 MANUAL DIVISIONS

.1 Organize each manual into the following divisions.

.1 Operation Division
.2 Maintenance Division
.3 Contract Documentation Division

2.5 OPERATIONS DIVISION

.1 The operations division shall have all data organized into sections according to the system category with individual divider tabs as follows:

.1 AIR - Air Systems
.2 CTL - Control Systems
.3 CLG - Cooling Systems
.4 FPN - Fire Protection Systems
.5 HTG - Heating Systems
.6 MIS - Miscellaneous Systems
.7 PLG - Plumbing Systems

.2 Organize data for each system category (section) into individual sub-systems. Provide an index for each system category and a divider tab for each individual system.

.3 For each individual sub-system include the following:

.1 System Description - Provide details of system type, composition, areas served, location in the building, design criteria and function of major components. All equipment arranged

to operate together as one system shall be considered part of that system description. Design criteria shall, at minimum, include the following:

.1 Heating System
- .1 Outdoor design temperatures.
- .2 Indoor design temperature for each type of space; occupied and unoccupied.
- .3 Allowance for future expansion.

.2 Cooling System
- .1 Outdoor design dry bulb and wet bulb temperatures.
- .2 Indoor design temperature for each type of space; occupied and unoccupied.
- .3 Allowance for future expansion.
- .4 Special “dedicated” cooling systems, or plug load condensing systems

.3 Ventilation Systems
- .1 Minimum air change rate for each type of space.
- .2 Outdoor air supply rates per occupant for each type of activity.
- .3 Filtration levels for each ventilation system.
- .4 Unique systems, such as:
  - .1 Vestibule pressurization
  - .2 Mechanical room ventilation
  - .3 Smoke evacuation
- .5 Building relative pressure zones and relationships.

.4 Plumbing Systems
- .1 Water supply pressure.
- .2 Utility connections for water, storm sewer, sanitary sewer.
- .3 Special systems:
  - .1 Fuel oil
- .4 Domestic hot water systems:
  - .1 Kitchen
  - .2 Sinks/lavs
- .5 Backflow preventer requirements.

.5 Fire Protection Systems
- .1 Water density and hazard for each type of zone.
- .2 Utility water supply static and residual pressures.
- .3 Criteria for hydraulic design calculations.
- .4 Reference design standards.
- .5 Hydraulic calculations.
- .6 Occupancy type and densities.
- .7 Water supply: static and dynamic pressures used for design.
- .8 Referenced design standard.

.6 Controls
- .1 Provide per Section 20 30 01

.7 Occupied space conditions

.8 Outdoor ambient conditions

.9 Air circulation rate

.10 Exhaust air rate

.11 Minimum outside air

.12 Building pressurization

.13 Standby capabilities

.14 Calculated load and design capacity of domestic water supply mains.

.15 Calculated load and design capacity of drainage mains.

.2 System Schematics

.1 Provide individual system schematics for each system listed above.

.2 Include mechanical equipment and component identification using BCMS system mnemonic, as well as design designation.

.3 Use these specific naming conventions on all references through the O&M Manual.

.3 Operating Instructions - Provide, in "operator" layman language, the specific instructions for start-up, shutdown and seasonal change-over of each system component. Include exact type and specific location of each switch and device to be used in the system operation. Identify safety devices and interlocks that must be satisfied in order for the equipment to start. Also, list conditions to be fulfilled before attempting equipment start-up, i.e. valves position correct, glycol mixture concentration proper, piping filled with fluid, filters/strainers in place, etc.

.4 Equipment Identification - Provide data for each system component.

.5 Maintenance Division

.1 Organize data into the following sections with divider tabs:

.1 Maintenance Tasks And Schedules

.2 Spare Parts

.3 Suppliers And Contractors

.4 Tags And Directories

.2 Maintenance Tasks and Schedules - Organize data according to the system category, with further breakdown into individual systems as used in the operations division of the manual. Provide section index and divider tabs for each system category. Summarize maintenance tasks from manufacturers maintenance brochures, for each component of each system in the following format:

.1 Daily

.2 Weekly

.3 Monthly

.4 Semi-annually

.5 Annually

.6 When Required.

.3 Spare Part List - Organize data according to the system category, with further breakdown into individual systems as used in the operations division of the manual. Provide section index and divider tabs for each system category. Summarize from manufacturers maintenance brochures the recommended spare parts for each component of each system.

.4 Suppliers and Contractor List - Provide summary of Suppliers and Contractors for each components of each system. List name, address and telephone number of each.

.5 Tags and Directories - Provide a copy of the Mechanical Drawing, List, Valve Tag List, Piping Identification Schedule and all other directories as specified in the contract documents.

.6 Contract Documentation Division

.1 Organize all data required by the construction contract into sections, with divider tabs, as follows:

.1 Drawings List

.2 Shop Drawings and Product Data

.3 Certifications

.4 Warranties and Bonds

.5 Maintenance Brochures

.6 Reports

.2 Shop Drawings and Product Data - Provide <u>final</u> copies of all shop drawings and product data required by the contract documents. Include section index and divider tabs. Maximum of twenty-five (25) sheets or one (1) system shop drawing per tab.

.3 Certifications - Provide copies of Contractor Certifications for the performance of product and systems. Include copies of all pressure tests for piping and ductwork systems, equipment alignment certificates, local authority inspection reviews, backflow prevention certification, and fire protection certifications. Include section index and divider tabs with maximum of twenty-five sheets (25) or one report per tab.

.4 Warranties and Bonds - Include one copy each of the Contractor's warranty, manufacturers' warranties longer than one year, the bond, and any service contract provided by the contractor. Provide section index.

.5 Maintenance Brochures - Include copies of all manufacturers' printed maintenance brochures pertaining to each product, equipment or system. Provide section index and divider tabs. Maximum of twenty-five (25) sheets or one system brochure per tab.

.6 Reports - Include copies of all reports relating to the testing, adjusting and balancing of equipment and systems, water treatment reports and manufacturer's start-up reports, as required by the contract specification sections.

.7 Submissions and Approvals

<u>First Draft Submission</u>

.1 Contractor shall submit a draft copy of the operations and maintenance manuals for format review at the 50% construction completion stage.

.2 The draft submission is to be bound in 3 ring loose leaf type binders and shall include the following information:

.1 A table of contents for the complete manual.

.2 Index of each division of the manual.

.3 Index of each section of the operations and maintenance divisions.

.4 A sample operations division write-up for a typical system, including sample schematic.

.5 A sample maintenance division write-up for the same typical system.

.6 Sample proof of binder covers and spines.

.3 On completion of review of the first draft submission the Departmental Representative will return the copy of the manual with review comments for resubmission.

Provisional Edition

.1 The contractor shall submit two (2) copies of the provisional edition of the manual at the 75% construction completion stage.

.2 The provisional edition shall be complete in all respects, except for reports and certificates to be produced during the facility start-up phase. This manual shall have the same physical format, including divider tabs and indices, as the final edition of the manual. This provisional edition may be bound in standard three-ring loose leaf binders.

.3 One copy of the provisional edition shall be kept on site as an interim reference for all parties engaged in the facility start-up phase, and shall be used to familiarize and train the operating staff.

.4 The second copy shall be returned to the contractor with review comments.

.5 The contractor shall update contents of the site copy of the provisional edition manual as new information is generated during the facility start-up phase.

Final Edition

.1 Prior to final acceptance the contractor shall submit four (4) copies of the final edition of the manual.

.2 This final edition shall include all outstanding project information and conform to all requirements listed in this document.

2.6 RECORD DRAWINGS

.1 Refer to and comply with Section 20 05 01, General Mechanical Provisions.

.2 Refer to and comply with Division 01, General Requirements.

.3 The contractor shall keep, on site, available to the Departmental Representative at all times and particularly for each regularly scheduled site meeting, a complete set of prints, edge bound, that are to be updated daily showing any and all deviations and changes from the Contract Drawings. This set of drawings is to be used only for this purpose, and must not be used as the daily general reference set.

.4 Provide record drawings which identify location of smoke and fire dampers, major control lines, access doors, tagged valves, and actual room names or numbers. As well, deviations that are to be recorded shall include, in general, items that are significant or are hidden from view and items of major importance to future operations and maintenance, and to future alterations and additions including cleanouts and isolation valves.

Part 3 Execution

3.1 GENERAL

.1 Submit documents to the Departmental Representative for approval prior to transmitting to the Owner.

3.2 RECORD DRAWINGS

.1 Enter dimensions from building line to all buried services, including coordinates of manholes, catch basins, tanks, outside shut-off valves, and other similar elements.

.2 Service connections to water and sewer lines entering a building shall be recorded as to horizontal dimension from a convenient building element with suitable depth elevations relating to main floor level and sea level datum.

.3 At substantial completion, transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings, and change orders, to a set of disks to current AutoCad DWG versions and pdfs. Drafting quality layers, symbols, etc. shall be identical to original drawings. Prior to substantial performance, turn over a completed set of disks and a complete set of record drawings.

.4 Each "record" drawing shall bear the Contractor's identification, the date of record and the notation "We hereby certify that these drawings represent the "Work Record of Construction". The Contractor's signature and company seal shall be placed below that notation.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Demonstration of equipment and systems operations.

.2 Instruction and seminars for the Departmental Representative's personnel.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Requirements	Division 01
.2	General Mechanical Provisions	Section 20 05 01
.3	Equipment Testing and Start-Up	Section 20 05 08
.4	Controls	Section 20 30 Series
.5	HVAC Controls	Section 23 09 Series
.6	Fire Suppression	Division 21
.7	Plumbing	Division 22
.8	Heating, Ventilation and Air Conditioning	Division 23

1.3 QUALITY ASSURANCE

.1 Work specified shall be performed by the Contractor and his Subtrades and Suppliers.

Part 2 Products

NOT APPLICABLE

Part 3 Execution

3.1 GENERAL

.1 Arrange for presentation and demonstration of mechanical equipment and systems by appropriate specialists and shall ensure that required manufacturer's representatives are in attendance.

.2 Coordinate demonstration and instruction agenda and schedule with the Construction Manager and Departmental Representative.

.3 Coordinate demonstration and instruction agenda and schedule for work performed outside the contract with the Construction Manager and Departmental Representative.

.4 Provide personnel when necessary to ensure proper detailed training is provided for all mechanical systems.

3.2 DEMONSTRATIONS

.1 Demonstrate specific starting and stopping and general maintenance requirements for each major piece of equipment. Ensure all labeling and identification is completed.

.2 Demonstrate the following systems, in the form of instruction seminars and contractor-guided tour of the facility.

- .1 Air Systems
- .2 Fire Protection Systems
- .3 Plumbing Systems
- .4 Control Systems
- .5 Balancing

.3 Demonstrate the following pieces of equipment and systems to the Construction Manager and to the Authority Having Jurisdiction.

- .1 Fans/Air Handling Units
- .2 Condensing Units
- .3 Terminal Air Units
- .4 Domestic Water Heaters
- .5 Sprinkler Valve Assemblies
- .6 Fuel Storage and Transfer Systems

.4 Refer to sample mechanical system agenda schedules in Item 3.3 following for identifying the proposed sequence of demonstrations. Sequence of demonstration and duration of training seminars to suit project. Submit agenda for review by Departmental Representative one month prior to demonstration. Minimum of two (2) four (4) hour sessions, two (2) days apart.

.5 Answer all questions raised at demonstrations; if unable to satisfactorily answer questions immediately, provide written response within three (3) days.

.6 Provide sign off sheets for each session. Sign off sheets to have attendees, date, subject, presentation by and comments. Attach the sign off sheets to the agenda and submit a copy to the Departmental Representative following training seminars.

3.3 MECHANICAL SYSTEMS AGENDA (SAMPLE)

Mechanical Systems Agenda

Topic: Heating System

Day: .1 **Start Time**: 8:00 am
Meeting Place:_____

Approximate Duration: 7.5 hours

Agenda: .1 8:00 am - Classroom Presentation
.2 Contractor / Supplier: _____

Lunch Break: 12:00 to 1:00

Agenda: .1 1:00 pm - Site Walkthrough
.2 4:00 pm - Final Questions and Sign-off Log Sheet

Personnel to be in Attendance:

.1 Mechanical Contractor and Sub-Contractors (as required)
.2 Maintenance staff

Presentation Format:

Classroom:

Introduction

.1 Pass out handouts of system description
.2 Reference to equipment operation brochures as required.
.3 Detailed system overview by Mechanical Contractor, Sub-Contractors and Suppliers
.4 Review of system installations by the Mech. Contractors using record drawings

Site Tour:

.1 Mechanical Contractor to outline location of main piping runs, isolation valves, service access points.
.2 Review service procedures for heating boiler and circulation pumps.
.3 Terminal hot water heating units to be reviewed for service and operation.
Fuel Fired equipment to be reviewed as required to demonstrate servicing and operation.
.4 Provide written instructions on how to start and stop all equipment and demonstrate using instructions during tour.

Mechanical Systems Agenda

Topic: Plumbing System

Day: .1 **Start Time**: 8:00 am
Meeting Place:_____

Approximate Duration: 7.5 hours

Agenda: .1 8:00 am to 12:00 noon - Classroom Presentation
.2 Contractor / Supplier: _____

Lunch Break: 12:00 to 1:00

Agenda: .1 1:00 pm - Site Walkthrough
.2 4:00 pm - Final Questions and Sign-off Log Sheet

Personnel to be in Attendance:

.1 Mechanical Trade, Equipment Suppliers and Sub-Contractors (as required)
.2 Maintenance staff

Presentation Format:

Classroom:

Introduction

.1 Pass out handouts of system description
.2 Reference to equipment operation brochures as required.
.3 Detailed system overview by Mechanical Trade, Sub-Contractors and Suppliers
.4 Review of system installations by the Mechanical Trade using record drawings

Site Tour:

.1 Mechanical Trade to outline location of main piping runs, isolation valves, service access points.
.2 Review service procedures for heating systems, circulation pumps, pressure pumps and drainage.
.3 Plumbing fixtures to be reviewed for service and operation.
.4 Provide written instructions on how to start and stop all equipment and demonstrate using instructions during tour.

Mechanical Systems Agenda

Topic: Fire Suppression Systems

Day: .1 **Start Time**: 8:00 am
Meeting Place:_____

Approximate Duration: 4 hours

Agenda:
.1 8:00 am: Classroom Presentation
.2 9:15 am – 11:00 am: Site Walkthrough
.3 11:00 am – Noon: Final Questions and Sign-Off Log Sheet

Personnel to be in Attendance:

.1 Mechanical Contractor and fire suppression subtrade.
.2 Maintenance Staff

Presentation Format:

Classroom:

Introduction

.1 Distribute handouts of system description.
.2 Reference to equipment operation brochures as required.
.3 Detailed system overview by fire suppression subtrade.
.4 Review of system installations using record drawings.

Site Tour:

.1 Fire suppression subtrade to outline location of main piping runs, isolation valves, service access points.
.2 Fire pump operation and maintenance.
.3 Provide written instructions on how to start and stop all systems and demonstrate using instructions during tour.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Test domestic water piping.

.2 Test sanitary sewer piping.

.3 Test sewer vent piping.

.4 Test fuel oil piping.

.5 Test sprinkler system piping.

.6 Test low velocity ducts.

.7 Test refrigerant piping.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Requirements	Division 01
.2	General Mechanical Provisions	Section 20 05 01
.3	General Documentation	Section 20 05 05
.4	Pipe and Pipe Fittings	Section 20 20 10
.5	Testing, Balancing and Adjusting	Section 20 22 00
.6	Controls	Section 20 30 Series
.7	HVAC Controls	Section 23 09 Series
.8	Materials Testing – Plumbing Systems	Section 22 05 07
.9	Materials Testing for HVAC Systems	Section 23 05 07
.10	Fire Suppression	Division 21
.11	Plumbing	Division 22
.12	Heating, Ventilation and Air Conditioning	Division 23

1.3 QUALITY ASSURANCES

.1 Test equipment and material where required by specification or authority having jurisdiction to demonstrate its proper and safe operation.

.2 Test procedures in accordance with applicable portions of ASME, ASHRAE, SMACNA, N.F.P.A. and other recognized test codes.

.3 Perform tests on site to the satisfaction of the Departmental Representative.

.4 Piping, fixtures or equipment shall not be concealed or covered until installation is inspected and approved by the Departmental Representative. Provide written notice to the Departmental Representative at least seven (7) days in advance of tests or concealing of piping.

.5 Coordinate with Departmental Representative at start of the project, those tests that will require witnessing by the Departmental Representative.

.6 Submit sample test certificate forms for review two (2) weeks prior to any testing on site.

1.4 SUBMITTALS

.1 Obtain certificates of approval and acceptance, complying with rules and regulations from authorities having jurisdiction. Submit copies to be included in Operating and Maintenance Manuals.

.2 Perform tests as specified. Include test certificates in Operating and Maintenance Manuals.

.3 Provide copies of all submittals to Commissioning agent for use during commissioning.

1.5 LIABILITY

.1 Take charge of plant during tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration in this connection.

Part 2 Products

NOT APPLICABLE

Part 3 Execution

3.1 PRESSURE TESTS

.1 Provide equipment, materials and labour for tests and pay expenses. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy and date of calibration. Install permanent gauges and thermometers used for tests just prior to tests to avoid possible changes in calibration.

.2 Carry out tests for 8 hour period and maintain pressure with no appreciable pressure drop. Where leakage occurs, repair and re-test and pay necessary costs for re-witnessing.

.3 Drainage systems: Test by filling with water to produce water pressure to 30 kPa minimum and 62 kPa maximum.

.4 Water piping: Test to 1-1/2 times maximum working pressure or 1035 kPa, whichever is greater, water pressure measured at system low point.

.5 Fuel Oil Piping: Test as required by current edition of CSA B139, and authority having jurisdiction.

.6 Sprinkler System: Test as required by current edition of NFPA 13 and authorities having jurisdiction.

.7 Refrigerant Piping: Test with nitrogen to 2070 kPa on high pressure side and 1035 kPa on low side and refrigerant halide torch test.

.8 Ducts: Check for audible leaks at 500 Pa above associated fan external static pressure, or up to maximum duct construction pressure whichever is the lower test pressure.

.9 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubble test for air.

.10 During heating and cooling piping system tests, check linear expansion at elbows, U bends, expansion joints and offsets for proper clearance.

.11 When using water as test medium for system not using water, evacuate and dehydrate the piping and certify the lines are dry. Use agency specializing in this type of work.

.12 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubbler test for air or nitrogen test medium and halide torch for refrigerant medium.

.13 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by re-making joints in screwed fittings, cutting out and re-welding welded joints, re-making joints in copper lines. Do not caulk.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Performance testing of equipment.

.2 Manufacturer's startup of equipment.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Requirements	Division 01
.2	General Mechanical Provisions	Section 20 05 01
.3	General Documentation	Section 20 05 05
.4	Demonstration and Owner's Instruction for HVAC Systems	Section 23 05 06

1.3 QUALITY ASSURANCE

.1 Use factory trained representatives and submit manufacturer's check sheets for starting all systems and equipment.

.2 Testing and certification of each backflow prevention device shall be by an "Approved Cross Connection Installation Specialist". One copy of the certificate to be submitted to the Water Purveyor, and one copy is to be inserted in each O & M manual.

.3 Prior to starting, testing, balancing, adjusting, and cleaning processes, verify with Departmental Representative any tests required to be witnessed. Provide sufficient notice to Departmental Representative prior to commencement of procedures.

.4 Departmental Representative shall be allowed to witness any testing, adjusting, starting, balancing, and cleaning procedures.

.5 Assume all costs associated with starting and testing, including the supply of testing or cleaning medium.

.6 Prior to starting equipment or systems, secure and review manufacturer's installation, operation, and starting instructions. Read in conjunction with procedures defined herein.

.7 Use manufacturer's or supplier's starting personnel where required to ensure integrity of manufacturer's warranty.

.8 Compare installations to published manufacturer's data and record discrepancies. Items potentially detrimental to equipment performance shall be corrected prior to equipment starting.

.9 Some processes involved in starting procedures defined in this section may be duplications of authorities verification. To facilitate expedient completion of project, arrange for authorities to assist or witness these procedures.

.10 All starting, testing, and procedures shall be in accordance with applicable portions of ASME, ASHRAE, AABC, CSA, NFPA, SMACNA, ASTM, ASPE and as required and outlined in these specifications.

.11 Personnel involved in starting, testing, balancing and adjusting procedures shall be experienced in the design and operation of mechanical equipment and systems being checked and shall be able to interpret results of the readings and tests.

.12 Assume all liabilities associated with starting, testing and balancing procedures.

Part 2 Products

NOT APPLICABLE

Part 3 Execution

3.1 GENERAL

.1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested. Conduct tests as soon as conditions permit. Make changes, repairs, and adjustments required prior to operating tests.

.2 Meet with Division 26 contractors, suppliers, and other specialists as required to ensure all phases of work are properly coordinated prior to commencement of each particular testing procedure. Establish all necessary manpower requirements.

.3 Operate and test motors and speed switches for correct wiring and sequences and direction of rotation. Check and record overload heaters in motor starters.

.4 Confirm voltages and operating amperages at full load.

.5 Failure to follow instructions pertaining to correct starting procedures may result in re-evaluation of equipment by an Independent Testing Agency selected by the Departmental Representative at Contractor's expense. Should results reveal equipment has not been properly started, equipment may be rejected, removed from site, and replaced. Replacement equipment shall also be subject to full starting procedures, using same procedures specified on the originally installed equipment.

3.2 PROCEDURES

.1 Procedure shall be identified in the following five (5) distinct phases:

- .1 Pre-Starting: Visual inspection.
- .2 Starting: Actual starting procedure.
- .3 Post-Starting: Operational testing, adjusting or balancing, and equipment run-in phase.
- .4 Pre-Interim Acceptance of the Work: Final cleaning, re-testing, balancing and adjusting, and necessary maintenance.
- .5 Post-Interim Acceptance of the Work: Repeat tests and fine-tuning resulting from corrective action of deficiency clean-up.

.2 Check specified and shop drawing data against installed data.

.3 Check the installation is as defined by contract documents and as per manufacturer's recommendations including manufacturer's installation check sheets.

3.3 CONTRACTOR TESTING RESPONSIBILITIES

.1 The contractor shall be required to provide the following tests as part of his construction contract. For each test, a test form is to be filled out, witnessed, kept on site for the Departmental Representative to verify at any time during construction and then they are to be included in the final submission of the contractor O&M manuals.

.1 Air Systems

.1 Fans

.1 Check radiated and discharge sound power levels

.2 Determine rpm, air flow rates, static pressure and record on the fan curves

.3 Conduct fan performance test for total system volume on main air supply and exhaust units

.2 Mixing Chamber

.1 Measure temperature profile for stratification

.3 Motorized Dampers

.1 Verify that damper modulates through range of positions.

.2 Verify damper access

.4 Air Outlets

.1 Take sound readings at specified air flows at outlets

.5 Fire Dampers

.1 Test each damper to ensure proper blade movement and damper closure

.2 Verify damper accessibility for changing of the fusible links

.6 Ductwork

.1 Low pressure supply, return and exhaust ductwork is to be tested by sound and feel for leakage

.7 Heat and Re-Heat Coils

.1 Air pressure drop across the unit

.8 Packaged A/C Units

.1 Check unit is level

.2 Measure air flow and static pressure

.3 Entering dry bulb/wet bulb temp.

.4 Leaving dry bulb/wet bulb temp.

.5 Refrigerant SST temp.

.6 Acoustic measurements

.9 Unit Heater, Fan Coil Units

.1 Inlet/outlet air flows and temp.

.2 Fan speed setting

.3 Check acoustic performance

.2 Fire Protection System

.1 Sprinkler Systems

.1 Record incoming water pressure to building once a day for 10 days

.2 Test sprinkler system as per NFPA 13

.2 Fire Extinguishers

.1 Check that no pressure drop occurs over a 20 day period

.3 Plumbing Systems

.1 Domestic Water

.1 Piping to be tested to requirements of Section 20 05 07 Materials Testing
.2 Conduct pipe flushing and cleaning program with all fixtures in place
.3 Conduct a water analysis after shock treatment of piping system

.2 Drainage System
.1 Conduct a standing water test (30 kPa to 75 kPa) over eight (8) hour period

.3 Piping
.1 Rough in piping to be tested to 1½ times the working pressure or 1030 kPa with nitrogen for a 24 hour period
.2 Random sample of five (5) brazed joints to be removed for inspection
.3 All components to be tested with a 24 hour standing pressure test at 20% above the normal operating pressure

.4 Fuel Oil System
.1 Piping
.1 Test as per CSA B129
.2 Piping tested to 1½ times working pressure for a minimum of 10 hours
.3 Prior to initial use piping to be flushed and strainers cleaned

.2 Tanks
.1 Air test tanks at 35 kPa for 2 hours
.2 Verify operation of leak detection system
.3 Verify containment system
.4 Provide documentation on quantity and quality of initial fuel fill including details on additives

.5 Variable Speed Drives
.1 Startup test to requirements of Section 20 05 04 Variable Frequency Drives

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Provide meters and gauges and taps where shown on drawings and/or specified herein.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Valves and Strainers	Section 20 05 23
.4	Controls	Section 20 30 Series
.5	HVAC Controls	Section 23 09 Series
.6	Fire Suppression	Division 21
.7	Plumbing	Division 22
.8	Heating, Ventilation and Air Conditioning	Division 23

1.3 SUBMITTALS

.1 Submit shop drawings of proposed products to the Departmental Representative for review. Comply with Section 20 05 05, General Documentation.

.2 Submit data sheets on thermometers and pressure gauges indicating service, and temperature or pressure ranges, to the Departmental Representative for review.

.3 Submit list of all meters, including location, service, flow and corresponding reading for flow.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1	Thermometers	:	Marsh, Weksler, Trerice, Ashcroft, Wika.
.2	Pressure gauges	:	Marsh, Trerice, Ashcroft, Wika, Weksler.
.3	Static pressure gauges	:	Dwyer, Magnehelic
.4	Positive displacement meters	:	Neptune, Rockwell, Badger.

2.2 THERMOMETERS

.1 Dial Thermometers: 80 mm diameter dial in drawn steel case, bimetallic helix actuated, brass separable socket or flange and bushing, glass cover, adjustable pointer.

2.3 PRESSURE GAUGES

.1 100 mm diameter, drawn steel case, phosphor bronze bourdon tube, brass movement, extruded brass socket, 1% midscale accuracy, front calibration adjustment, black figures on white background. Pressure gauges shall be liquid filled with ½% accuracy in locations subject to vibration (on pumps, air handling units, and chillers), and 1% accuracy in all other locations.

.2 Provide, pulsating damper and ball valve for water service.

2.4 STATIC PRESSURE GAUGES

.1 Dial Gauge: 100 mm dial, diaphragm actuated, suitable for positive, negative, or differential pressure measurement. Accuracy within ±2% of full scale, complete with static pressure tips and mounting accessories.

2.5 POSITIVE DISPLACEMENT METERS

.1 Nutating disc measuring chamber, disc material to suit fluid encountered, odometer-type direct reading totalizer counter with 6 numerical wheels for cumulative readings.

Part 3 Execution

3.1 INSTALLATION

.1 Install positive displacement meters with isolating valves. Provide valved bypass for liquid service meters.

.2 Install flow meters in uninterrupted straight pipe, in accordance with manufacturers recommendations.

.3 Provide line size ball valve on all pressure gauges.

.4 Select gauges so that normal operating point is approximately mid-point of instrument range.

.5 On pipes 65 mm and smaller, place well in tee used in lieu of an elbow to accommodate well.

3.2 METERS AND GAUGES INSTALLATION SCHEDULE

.1 Positive Displacement Meter:

- .1 Domestic Cold Water
- .2 and where shown on drawings.

.2 Pressure Gauges:

- .1 Expansion Tanks
- .2 Pressure Tanks
- .3 Sprinkler piping - highest and lowest points of risers
- .4 Domestic Cold Water to Standpipe and/or Sprinkler
- .5 Leaving side of pressure reducing valves
- .6 and where shown on drawings.

.3 Thermometers:

- .1 Where shown on drawings.

.4 Static Pressure Gauges:

- .1 Across built-up filter banks
- .2 Across unitary filter sections
- .3 Across supply and return fans
- .4 and where shown on drawings.

.5 Static Pressure Taps:

- .1 Across all major dampers
- .2 Across heating and cooling coils

.3 On each side of balance valves

.4 and where shown on drawings.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Globe or angle valves.

.2 Check valves.

.3 Ball Valves

.4 Plug cocks.

.5 Eccentric plug valves.

.6 Butterfly valves.

.7 Drain valves.

.8 Hose bibbs.

.9 Strainers.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Pipe and Pipe Fittings	Section 20 20 10
.4	Fire Suppression	Division 21
.5	Plumbing	Division 22
.6	Heating, Ventilation and Air Conditioning	Division 23

1.3 MANUFACTURER

.1 Provide valves of the same type by the same manufacturer throughout.

.2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

.3 All valves shall meet the requirements of the Manufacturers Standardization Society, Standard Practice standards, latest edition. SP-67 Butterfly Valves, SP-70 Cast Iron Gate Valves, SP-71 Cast Iron Check Valves, SP-80 Bronze Gate, Globe, Angle and Check Valves and SP-82 for pressure testing.

.4 Ball valves to be ULC listed, SP. 110 Standard.

1.4 SHOP DRAWINGS

.1 Submit detailed shop drawings clearly indicating make, model, size, pressure rating, materials of construction and intended service.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1	Globe Valves	:	Jenkins, Crane, Toyo, Kitz.
.2	Angle Valves	:	Jenkins, Crane, Toyo, Kitz.
.3	Swing Check Valves	:	Jenkins, Crane, Toyo, Kitz, Mueller SPX, Moygro, Victaulic.
.4	Silent Check Valves	:	Val-Matic, APCO, Stream Flo, Duo-CheckII, Mueller SPX
.5	Ball Valves	:	Jenkins, Crane, Toyo, Kitz, MAS, Apollo.
.6	Plug Cocks	:	Newman-Milliken, DeZurik.
.7	Eccentric Plug and Ball-centric Valves	:	DeZurik, Homestead, Victaulic.
.8	Butterfly Valves	:	Keystone, DeZurik, Crane, Jenkins, ITT, Grinnell, Bray, Lunkenheimer, Toyo, Victaulic, Mueller SPX, Apollo, Kitz.
.9	Drain Valves	:	Dahl, Crane, Jenkins, Toyo, Kitz, Hammond.
.10	Hose Bibbs	:	Dahl, Crane, Jenkins, Toyo, Kitz, Hammond.
.11	Radiator Valves	:	Dahl, Crane, Jenkins, Toyo, Kitz.
.12	Strainers	:	Jenkins, Crane, Toyo, Kitz, Victaulic, Mueller SPX.

2.2 DOMESTIC COLD WATER SYSTEM

.1 Globe Valves up to 50 mm: Bronze body, screw over bonnet, threaded ends rating 1035 kPa steam, solder ends rating 2070 kPa water. Acceptable material: Jenkins Figure 106-BJ, Figure 106-BPJ, Crane #7TF, Toyo #221, Kitz #09, Kitz #10.

.2 Globe Valves 65 mm and Over: Cast iron body, flanged ends, O.S. and Y, renewable bronze seat ring, fully guided bronze disc. Rating 860 kPa steam. Acceptable material: Jenkins Figure 2342J, Crane #351, Toyo #400A, Kitz #76.

.3 Ball Valves up to 50 mm: 2 piece bronze body, full port, chrome plated, solid bronze ball, threaded or solder ends, TFE seat and packing. 4134 kPa non-shock WOG rating. Acceptable material: Jenkins Figure 901J, Toyo #5044A, Toyo #5049A, Kitz #58, Kitz #59.

.4 Butterfly Valves: Cast iron wafer full-lug body, Stainless steel shaft keyed to disk, bronze disc, replaceable EPDM seat, lever lock handle operator with multiple position lock plate for valve sizes to 100 mm, heavy duty gear handwheel operator with position indicator for valve sizes 150 mm and over. Minimum bi-directional rating 1000 kPa, 121°C. Full rating for end of line or isolation shut off service. Acceptable material: Victaulic #300, DeZurik Fig. 632 R.S., Bray Series 31 c/w trim 119, Kitz #6122 EL, Apollo #143CBE.

.5 Grooved-End Butterfly Valves: 65 mm - 150 mm, 2070 kPa, CTS grooved end for direct connection of copper tubing without flaring to IPS dimensions. Cast bronze body to CDA-836

(85-5-5-5). Bubble tight, dead-end or bi-directional service with memory stop for throttling, metering, or balancing service. Acceptable material: Victaulic Style 608

.6 Swing Check Valves up to 50 mm: Bronze body screw-in cap, renewable no. 125 composition disc, threaded ends 860 kPa steam. Acceptable material: Jenkins Figure 4475J, Toyo #236T.

.7 Swing Check Valves 65 mm and Over: Cast iron body, regrind-renew swing check, bolted cover, flanged or grooved ends, bronze disc and seat ring, rating 860 kPa steam. Acceptable material: Jenkins Figure 587J, Kitz #78, Toyo #435A, Kitz #78, Victaulic #716.

.8 Drain Valves:

.1 Drain Valves up to 50 mm: Forged brass body, brass cap, stem, and ball. Teflon stem seals and Teflon seat. Hose thread end. Working pressure 1725 kPa at 121°C. Acceptable material: Dahl 50.430, Jenkins Fig 901CJ, Toyo #5046, Kitz #68AC.

.2 Drain Valves 65 mm and Over: Bronze body, bronze ball, threaded ends, twin seal Teflon seats and Viton seals, "O" ring, lever handle, rating 2070 kPa at 121°C water. Acceptable material: Jenkins Figure 32BJ.

.9 Ball Valves:

Ball Valves 65 mm and larger: Class 125, flanged cast iron body, Teflon fused solid ball, blow out proof stainless steel stem, Teflon seats. Acceptable material: American Valve Model 400.

2.3 DOMESTIC HOT WATER SYSTEM

.1 Valves to be used in the hot water section of the system shall be exactly as specified in the cold water section with one exception, that all composition disc valves shall be fitted with discs suitable for hot water, rated for 2756 kPa at 94°C.

2.4 DOMESTIC HOT WATER RECIRCULATING SYSTEM

.1 Circuit Balancing Valves: Suitable for throttling. All metal parts non-ferrous, die cast non porous copper alloy. Flow measuring accuracy ±2%. Positive shut-off, drain connection with cap. Memory balancing feature. Fittings for connection of portable differential pressure meter. Acceptable material: Tour and Anderson, Bell & Gossett, Armstrong circuit setter.

2.5 FUEL OIL SYSTEM

.1 Ball Valves (Interior): Class 600 WOG, bronze body, full bore, forged brass ball, brass gland and PTFE Teflon seat, steel lever handle, screwed. Acceptable material: Kitz Figure 68/Toyo.

.2 Ball Valves (Exterior): Low temperature suitable for operating temperatures to -40ºC, Class 600 WOG, bronze body, full bore, forged brass ball, brass gland and PTFE Teflon seat, steel lever handle, screwed. Acceptable material: Kitz Figure 68A/Toyo.

.3 Check Valves up to 50 mm: Bronze body and disc, regrinding swing check, screw-in cap, threaded ends, rating 860 kPa steam. Acceptable material: Jenkins Figure 4092J, Toyo #236, Kitz #22.

2.6 FIRE PROTECTION SYSTEM

.1 To requirements of Section 21 13 16.

2.7 VALVE OPERATORS

.1 Provide suitable hand wheels for gate, globe or angle, radiation and drain valves, and inside hose bibbs.

.2 Provide valves larger than 100 mm located more than 2.1 m from floor in equipment rooms with chain operated sheaves. Extend chains to 1.5 m above floor and hook to clips to arrange to clear walking aisles.

2.8 STRAINERS

.1 Size 50 mm and under: Screwed brass or iron body, Y pattern with 0.75 mm stainless steel perforated screen. Acceptable material: R-W/Toyo 380 Kitz #15.

.2 Size 65 mm to 100 mm: Flanged iron body, Y pattern with 1 mm stainless steel perforated screen. Acceptable material: R-W/Toyo #381, Kitz #80

.3 Size 125 mm and larger: Flanged iron body, Y pattern with 3 mm stainless steel perforated screen.

.4 Screen free area shall be minimum three times area of inlet pipe.

Part 3 Execution

3.1 INSTALLATION

.1 Install valves with stem upright or horizontal, not inverted.

.2 Provide latch lock throttling handle on butterfly valves up to and including 150 mm; gear operators on valves 200 mm and larger.

.3 Install valves for shut-off and isolating service, to isolate all equipment, parts of systems, or vertical risers.

.4 Where butterfly valves are installed, provide threaded lug type valves on flanged systems. Grooved mechanical connections where approved.

.5 Install globe or circuit balancing valves for throttling service and control device or meter by-pass.

.6 Use circuit balancing valves in domestic hot water recirculating systems.

.7 Provide drain valves at main shut-off valves, low points of piping and apparatus and terminal units.

.8 Size drain lines and drain valves equal to size of apparatus drain connection.

.9 For pipe sizes 20 mm and over, minimum drain size to be 20 mm.

.10 Provide hose thread connection with cap and chain for 20 mm drain valves located in ceiling and public areas.

.11 Provide male NPT nipples with threaded pipe cap for drain sizes over 20 mm where not piped directly to floor drains.

.12 Provide valved drain and hose connection off the bottom of all strainers.

3.2 APPLICATION

.1 Provide valves as indicated on the drawings and as outlined in the following schedule:

.1 Globe and Angle Globe Valves

.1 Throttling service

.2 Control device

.3 Meter bypass

.2 Drain Valve
- .1 Near main shut-off valves
- .2 Low points in piping systems
- .3 Bases of vertical risers
- .4 At equipment

.3 Butterfly Valves
- .1 Interchangeable with ball and globe valves in hydronic and water systems only

.4 Ball Valves
- .1 Shut-off and isolation
- .2 Isolating service
- .3 Domestic water (hot and cold)
- .4 Drain valves

.5 Circuit Balancing Valves
- .1 Balancing service
- .2 On piping systems where shown on drawings
- .3 On domestic hot water recirculation systems
- .4 Control device
- .5 Throttling service

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Pipe hangers and supports.

.2 Duct hangers and supports.

.3 Flashing for mechanical equipment.

.4 Sleeving for mechanical equipment.

.5 Pipe anchors.

.6 Access Doors (in walls and ceilings).

.7 Pipe and duct penetrations through fire rated walls and floors.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Expansion Compensation	Section 20 20 40
.4	Fire Suppression	Division 21
.5	Plumbing	Division 22
.6	Heating, Ventilation and Air Conditioning	Division 23

1.3 REFERENCE STANDARDS

.1 Pipe supports shall meet the requirements of ANSI B31.1 Power Piping.

.2 Duct hangers shall conform to SMACNA Duct Manuals.

.3 Fire stopping to National Building Code requirements.

1.4 SUBMITTALS

.1 Comply with requirements of Section 20 05 05, General Documentation.

.2 Submit shop drawings of each factory fabricated component.

.3 Submit documentation for fire stopping materials and methods.

Part 2 Products

2.1 INSERTS

.1 Inserts shall be galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.

.2 Size inserts to suit threaded hanger rods.

.3 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

.4 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100 mm or ducts over 1500 mm wide.

.5 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.

2.2 PIPE HANGERS AND SUPPORTS

.1 Hangers, Pipe Sizes 15 mm to 40 mm: Adjustable wrought galvanized steel clevis.

.2 Hangers, Pipe Sizes 50 mm and Over: Adjustable wrought steel clevis, steel clevis.

.3 Hangers, Pipe Sizes 100 mm and Over: Steel roller.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods. Cast iron roll and stand for hot pipe sizes 150 mm and over.

.5 Wall Support, Pipe Sizes to 80 mm: Cast iron hook.

.6 Wall Support, Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support, Hot Pipe Sizes 125 mm and Over: Adjustable cast iron roll and stand, steel screws and concrete pier to steel support.

.9 Design hangers so they cannot become disengaged by movements of supported pipe.

.10 Provide copper plated hangers and supports for copper piping.

2.3 HANGER RODS

.1 Provide galvanized or cadmium plated rods, threaded both ends, threaded one end, or continuous threaded.

2.4 DUCT HANGERS AND SUPPORTS

.1 As a minimum, conform to Standards in SMACNA.

.2 All duct hangers in Lower Floor Service Rooms to be galvanized.

2.5 FLASHING

.1 Steel Flashing: 0.5 mm galvanized steel.

.2 Safes: 0.5 mm neoprene.

.3 Caps: Steel, 0.8 mm minimum, 1.6 mm at fire resistance structures.

2.6 SLEEVES

.1 Pipes through Floors: Form with steel pipe or PVC sleeves.

.2 Pipes through Beams, Walls, Fire Proofing, Footings, Potentially Wet Floor: Form with steel pipe.

.3 Ducts: Form with galvanized steel.

.4 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

2.7 ACCESS DOORS

.1 Steel frame access panel with stainless steel piano-type hinge, channel reinforced steel door panel, three "Symmons" fasteners per door. Door panel recessed to receive ceiling or wall material to give finished appearance showing only hinge and fasteners. Provide acoustic gasket

between door panel perimeter and steel frame. Rated access doors shall be UL-listed. Refer to Architectural plans for fire rated ceilings and walls.

.2 Acceptable Manufacturers and Products: Acudor; Miami Carey; Micor; Titus; Controlled Air; Mifab.

.3 Minimum 300 mm x 300 mm for inspection and hand access. Minimum 450 mm x 450 mm for personnel access.

2.8 FIRE STOPS

.1 Rated caulking for pipe penetration through fire rated floors and walls:

.1 Acceptable Manufacturers: Metacaulk; Spec Seal; Hilti; 3M; Flamesafe.

.2 Sealant shall be thioxtrepic, intumescent, non-slump, non-volatile.

.3 Firestop material shall provide a 2h rating and be in compliance with ASTM-E814, UL1479, ASTM-E119, UL723, ASTM-E84, UL263 and CAN4-5115.

.2 Rated fire stop for PVC plastic pipe:

.1 Acceptable Manufacturers: 3M; Spec Seal; Hilti; Flamesafe.

.2 Intumescent collars, suitable for use on PVC or CPVC pipes penetrating 1h or 2h rated wall or floor, tested to CAN4-S115, UL Listed.

.3 Fire Wrap for Ductwork

.1 To Section 23 07 13 Ductwork and Breeching Insulation.

Part 3 Execution

3.1 GENERAL REQUIREMENTS

.1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, provide for expansion and contraction.

.2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.

.3 Select hangers and supports for the service and in accordance with manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.

.4 Fasten hangers and supports to building structure or inserts in concrete construction.

.5 Provide and set sleeves or block-outs required for equipment, including openings required for placing equipment.

.6 Provide sleeves for all piping through rated assemblies. In non-rated assemblies, provide sleeves for all heating, cooling, steam, condensate, domestic hot, domestic cold, and domestic recirculation piping. Sleeves to be sized to allow insulation to pass through and to project through both sides of wall.

Provide sleeves for all piping through ceilings, floors and footings.

Provide sleeves for duct penetrations through walls, ceilings, floors and footings. Provide locations and dimensions for block-outs imbedded material if provided by others.

Core drill openings for pipes in new masonry or poured concrete construction where sleeves have been omitted.

.7 Do not weld piping, ductwork or equipment supports to building metal decking or building structural steel supports unless prior written approval has been obtained from the Structural Departmental Representative.

.8 Obtain approval prior to drilling for inserts and supports for piping system. Discuss and obtain approval for hanging systems and methods with the Structural Departmental Representative.

.9 Obtain approval prior to using percussion type fastenings.

.10 Use of ductwork, piping or equipment for hanger supports and use of perforated band iron, wire or chain as hangers is not permitted.

.11 Install rubber vibration isolators on piping supports within drywall partitions.

3.2 INSERTS

.1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practical.

.2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100 mm or ducts over 1500 mm wide.

.3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.

3.3 PIPE HANGERS AND SUPPORTS

.1 Support horizontal steel and copper piping as follows:

Nominal Pipe Size mm	Distance Between Supports mm		Hanger Rod Diameter mm
	Steel	Copper	
15 to 20	1800	1500	10
25 to 40	2100	1800	10
50 to 65	3000	2400	10
80 to 100	3600	3000	16
150 to 300	4200	4000	22
350 to 450	6000		25

.2 Install hangers to provide minimum 15 mm clear space between finished covering and adjacent work.

.3 Use oversize hangers to accommodate pipe insulation thickness. For pipes up to 50 mm use high density rigid pipe insulation at hanger location, with an insulation protection shield. For pipes 65 mm and over use insulation protection saddle.

.4 Place a hanger within 300 mm of each horizontal elbow.

.5 Use hangers which are vertically adjustable 40 mm minimum after piping is erected.

.6 Support cast iron horizontal drainage pipe near each hub and on each side of gasket and clamp joints, with 1500 mm maximum spacing between hangers.

.7 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.

.8 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.9 Where practical, support riser piping independently of connected horizontal piping.

.10 Support plastic piping in accordance with manufacturers recommendations.

3.4 DUCT HANGERS AND SUPPORTS

.1 Support duct work in accordance with SMACNA, and as a minimum as follows.

3.5 LOW PRESSURE DUCT HANGERS AND SUPPORTS

.1 Hanger Minimum Sizes:

Up to 750 mm wide:	25 mm x 1.6 mm at 3.0 m spacing;
775 mm to 1200 mm wide:	40 mm x 1.6 mm at 3.0 m spacing;
Over 1200 mm wide:	40 mm x 1.6 mm at 3.4 m spacing.

.2 Horizontal Duct on Wall Supports Minimum Sizes:

Up to 450 mm wide:	40 mm x 1.6 mm or 25 mm x 3 mm at 2.4 m spacing;
475 mm to 1000 mm wide:	40 mm x 40 mm x 3 mm at 1.2 m spacing.

.3 Vertical Duct on Wall Supports Minimum Sizes:

At 3.6 mm spacing;

Up to 600 mm wide:	40 mm x 1.6 mm;
625 mm to 900 mm wide:	25 mm x 25 mm x 3 mm;
925 mm to 1200 mm wide:	30 mm x 30 mm x 3 mm.

.4 Vertical Duct Floor Supports Minimum Sizes:

Riveted or screwed to duct;

Up to 1500 mm wide:	40 mm x 40 mm x 3 mm;
Over 1500 mm wide:	50 mm x 50 mm x 3 mm.

3.6 EQUIPMENT BASES AND SUPPORTS

.1 Provide reinforced concrete housekeeping bases poured directly on structural floor slab 100 mm thick minimum, unless otherwise indicated or where manufacturer requires greater thickness, extended 100 mm minimum beyond machinery bedplates for equipment. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment. For all refrigerant chillers, provide 150 mm thickness pads.

.2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

.3 Provide rigid anchors for ducts and pipes immediately after vibration isolation connections to equipment unless spring hangers are specified.

3.7 FLASHING

.1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors and roofs.

.2 Provide curbs for mechanical roof installations 450 mm minimum high. Flash and counterflash with galvanized steel, made waterproof.

.3 Provide continuous neoprene safes below air supply casings, built-up mop sinks, shower stalls and shower room floors located above finished rooms. Solder at joints, flash into floor drains and turn up 150 mm into walls or to top of curbs and caulk into joints.

3.8 SLEEVES

.1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeve.

.2 Extend sleeves through potentially wet floors 25 mm above finished floor level. Caulk sleeves full depth and provide floor plate.

.3 Piping and duct work passing through floor, ceiling or wall, close off space between duct and sleeve with non-combustible insulation. Caulk both sides.

.4 Piping passing through perimeter walls below grade and mechanical room floor, close off space between pipe and sleeve with synthetic rubber compound mechanical type seals.

.5 Sleeves provided through walls or floors where liquids could potentially pass from one side to the other, provide sleeves with a 25 mm 'flange' welded to the external face of the sleeve at the mid-point of the thickness of the structure to provide a water stop.

.6 Install chrome plated escutcheons where piping passes through finished surfaces.

3.9 ACCESS DOORS

.1 Provide access doors for maintenance or adjustment purposes for all mechanical system components including:

- .1 Valves
- .2 Volume and splitter dampers
- .3 Fire Dampers
- .4 Cleanouts and traps
- .5 Coils and terminal units
- .6 Expansion joints
- .7 Control components

.2 Mark removable ceiling tiles used for access with color coded pins. See Section 20 05 53, Identification for Mechanical Systems.

.3 Sizes to be 600 mm x 600 mm for body entry, 300 x 300 mm for hand entry.

.4 Provide UL-listed fire rated access doors installed in rated walls and ceilings.

3.10 FIRE RATED PENETRATIONS

.1 Install fire stop caulking on pipe penetrations through fire rated floors and walls. Refer to architectural documents for definition of rated construction components.

.2 Install fire stop device on all plastic pipe penetrations through rated walls and ceilings. Refer to Architectural documents for definition of rated construction components. Refer also to the National Building Code.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Supply labour and materials required to isolate motor driven mechanical equipment as indicated on the drawings and specified herein and guarantee the function of the materials and equipment supplied.

.2 Supply labour and materials required to isolate piping systems connected to motor driven equipment.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Expansion Compensation	Section 20 20 40
.4	Plumbing	Division 22
.5	Heating, Ventilation and Air Conditioning	Division 23

1.3 QUALIFICATIONS

.1 All vibration isolators and bases shall be supplied by an approved supplier with the exception of isolators which are factory installed and are standard equipment with the machinery.

.2 Provide shop and placement drawings for all vibration isolation elements for review, before materials are ordered. The drawings shall bear the stamp and signature of the responsible supplier's technical representative.

.3 The work shall be carried out in accordance with the specification and, where applicable, in accordance with the manufacturer's instructions and only by workmen experienced in this type of work.

1.4 SUBMITTALS

.1 Comply with the requirements of Section 20 05 05, General Documentation.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Vibron, IAC, Mason, Korfund, VAW Systems.

2.2 ISOLATORS

.1 Spring isolators located out of doors or in humid areas shall have Rustoleum Painted housing and neoprene coated springs, unless otherwise indicated on drawings.

.2 Isolation mounts for equipment with operating weights substantially different from the installed weights, such as chillers, or boilers, shall have adjustable limit stops.

2.3 OPEN SPRING ISOLATORS

.1 Springs shall be "Iso-Stiff" having equal stiffness in the horizontal and vertical planes with a working deflection between 0.3 and 0.6 of solid deflection.

.2 Spring mounts shall be complete with levelling devices, minimum 6 mm thick neoprene sound pads, and zinc chromate plated hardware.

.3 Sound pads shall be sized for a minimum deflection of 1.2 mm and shall meet the requirements for neoprene isolators.

2.4 CLOSED SPRING ISOLATORS

.1 Compression springs shall be used both for hangers and floor mount isolators.

.2 Springs shall be stable under operating conditions.

.3 Housings shall incorporate a minimum 6 mm thick sound pad sized for a minimum static deflection of 1.2 mm meeting the requirements for neoprene isolators.

.4 Floor mount units shall incorporate neoprene side stabilizers with a minimum 6 mm clearance.

2.5 NEOPRENE ISOLATORS

.1 All neoprene isolators shall be tested to ASTM specifications.

.2 Where a ribbed pad is used, the height of the ribs shall not exceed 0.7 times the width of the rib. A steel layer shall be used to distribute the load in a multi-layered unit.

.3 Neoprene pads or elements shall be selected at the manufacturer's optimum recommended loading and shall not be loaded beyond the limit specified in the neoprene manufacturer's literature.

2.6 SPRING HANGERS

.1 Hangers capable of a 10° misalignment shall be provided unless otherwise specified.

2.7 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: Alloy steel to ASTM A125, shot peened, magnetic particle inspected, with ±5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

.2 Load Adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel +20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.8 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical Movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical Movement Greater Than 50 mm: Use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

.4 Steel Alloy Springs: To ASTM A125, shot peened, magnetic particle inspected, with ±5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

Part 3 Execution

3.1 APPLICATION

.1 Provide vibration isolation for mechanical motor driven equipment throughout, unless specifically noted otherwise.

.2 Set steel bases for 25 mm clearance between housekeeping pad and base. Adjust equipment level.

.3 Deflections 12 mm and over shall use steel spring isolators.

.4 Deflections 5 mm and under shall use neoprene isolators.

.5 Horizontal limit springs shall be provided on fans operating in excess of 1.5 kPa static pressure, except vertical discharge fans, and on hanger supported, horizontally mounted axial fans where thrust due to static pressure exceeds 300 N.

.6 All equipment mounted on vibration isolators shall have a minimum clearance of 50 mm to other structures, piping, equipment, etc. All isolators shall be adjusted to make equipment level.

.7 Prior to making piping connections to equipment with operating weights substantially different from installed weights, the equipment shall be blocked up with temporary shims to the final heights. When full load is applied, the isolators shall be adjusted to take up the load just enough to allow shim removal.

.8 Adjustable, horizontal stabilizers on close spring isolators shall be adjusted so that the side stabilizers are clear under normal operating conditions.

.9 All piping connections to isolated equipment shall be supported resiliently for the following distances or to the nearest flexible pipe connector:

Pipe Size	Distance, m
15 - 40 mm	3.0
50 - 65 mm	4.5
75 - 100 mm	7.0
125 - 200 mm	9.0
225 - 275 mm	13.5
300 - 350 mm	15.0

The three closest hangers to the vibration source shall be selected for the lesser of a 25 mm static deflection or the static deflection of the isolated equipment. The remaining isolators shall be selected for the lesser of the 25 mm static deflection or 1/2 the static deflection of the isolated equipment.

.10 Spring hangers shall be installed without binding.

.11 Adjust isolators as required and ensure springs are not compressed.

.12 Provide neoprene side snubbers or retaining springs where side torque or thrust may develop.

.13 Where movement limiting restraints are provided, they shall be set in a position with minimum 6 mm air gap. Restraints, isolator equipment and attachment points shall be designed to withstand the impact of the isolated equipment subjected to an acceleration not exceeding 3 g without permanent distortion or damage.

.14 Wiring connections to isolated equipment shall be flexible.

3.2 INSPECTION

.1 A qualified representative of the isolator manufacturer shall inspect the isolated equipment after installation and submit a concise report stating any deficiencies in the installation. Comply with Section 20 05 08, Equipment Testing and Startup.

3.3 PERFORMANCE

.1 Install isolators of type and deflection as indicated on the Isolation Schedule or according to the following table, whichever provides the greater deflection.

The required static deflection of isolators for equipment exceeding 0.35 kW is indicated below. Spring isolators shall be "open spring". Closed spring isolators shall only be used where specified.

Machine Speed r/min	Slab on Ground Under 15 kW	Structural Slab Over 15 kW	Normal	Critical
Under 400	Special*	Special*	Special*	Special*
400 - 600	25 mm	50 mm	90 mm	Special*
600 - 800	12 mm	25 mm	50 mm	90 mm
800 - 1100	5 mm	12 mm	25 mm	50 mm
1100 - 1500	3 mm	4 mm	5 mm	12 mm

*"Special" indicates as directed by the acoustical Departmental Representative.

3.4 SCHEDULE

.1 Vertical In-Line Pumps: Neoprene/steel pad isolation between piping stands and housekeeping pad. See drawing details.

.2 Base Mounted AHU and FCU/HRU: Neoprene/steel pad isolation between unit base rail and housekeeping pad or curb.

.3 Base Mounted Condensing Units: Neoprene/steel pad between unit base rail and curb.

.4 Base Mounted HRV: Neoprene/steel pad isolation between unit base rail and housekeeping pad.

3.5 SPRING HANGERS

.1 Variable support spring hangers: Use for minimum first two hangers for piping systems with spring hanger isolation when connected to externally isolated equipment.

.2 Constant support spring hangers: Use for all other spring hangers for piping system with spring hanger isolation.

.3 Unless indicated otherwise, support piping connected to isolated equipment with spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS4: First 3 points of support. NPS5 to NPS8: First 4 points of support. NPS10 and Over: First 6 points of support.

.2 First Point of Support: Static deflection of twice deflection of isolated equipment, but not more than 50 mm.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors	Section 20 05 29
.4	Dry Pipe Sprinkler Systems	Section 21 13 16

1.2 REFERENCES

.1 Canadian Standards Association (CSA) S832-06, Seismic Risk Reduction of Operational and Functional Components of Buildings.

.2 SMACNA Seismic Restraint Manual - Guidelines for Mechanical Systems

.3 ASHRAE RP-812 Guide to Seismic Restraint

.4 National Building Code of Canada

.5 ANSI/NFPA 13, Installation of Sprinkler Systems

1.3 DEFINITIONS

.1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity. The Palace Grand Theatre Building is NOT a post disaster building.

.2 SRS: Acronym for Seismic Restraint System.

1.4 SYSTEM DESCRIPTION

.1 This section covers provision of SRS for all mechanical distribution systems and equipment, including but not necessarily limited to the following:

- .1 Refrigerant systems
- .2 DW and sanitary systems
- .3 All ventilation ducts
- .4 All vibration isolated EF and air handling units
- .5 All vibration isolated air system units
- .6 DHWH
- .7 Diffusers
- .8 Fire protection and sprinkler piping
- .9 Fuel oil storage tanks
- .10 All fuel piping systems
- .11 All suspended mechanical equipment

.2 Installation of SRS to be fully compatible with and to not affect performance of:

- .1 Noise and vibration controls specified elsewhere in this project specification.
- .2 Structural and mechanical, electrical design of project.

.3 The intent of the SRS systems is life safety and continued system operation. The seismic restraint systems shall be provided for the mechanical systems where life safety and immediate continued occupancy and functionality are of equal paramount importance. It shall be necessary that the building and all systems remain operative during and after an earthquake. During a seismic event, the SRS is to prevent systems and equipment from causing personal injury and from moving from normal position.

1.5 SUBMITTALS

.1 To the requirements of Section 01 33 00, Submittal Procedures and Section 20 05 05, General Documentation.

.2 Provide for all SRS elements including the following:

- .1 Refrigerant systems
- .2 DW and sanitary systems
- .3 All ventilation ducts
- .4 All vibration isolated EF and air handling units
- .5 All vibration isolated air system units
- .6 Packaged Air Handling Units
- .7 Oil-fired unit Heaters
- .8 DHWH
- .9 Diffusers
- .10 Fire protection and sprinkler piping
- .11 Fuel oil storage tanks
- .12 All fuel piping systems
- .13 All suspended mechanical equipment

.3 Shop drawings to be prepared by professional firm specializing in the design and supply of SRS systems.

.4 Submittals to include:

- .1 Full details of SRS systems for the following elements:
  - .1 Working drawings of any proposed alternates or deviations from the detailed and specified SRS.
  - .2 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
  - .3 Details of installation procedures and instructions.
  - .4 Design calculations including restraint sizing.

.5 All submittals to be sealed by a Professional Engineer specializing in design of SRS and registered in the Yukon Territory.

1.6 CLOSEOUT SUBMITTALS

.1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 20 05 05, General Documentation.

1.7 DESIGN OF RESTRAINT SYSTEMS

.1 Detailed design of piping, duct and other mechanical equipment is to be completed by a Professional Engineer specializing in design of SRS and registered in the Yukon Territory. Any details of restraint systems provided indicate the recommended system of SRS only with final

selection of system, detailed design and sizing of anchors and restraint elements to be provided by SRS design engineer. All piping and duct restraint systems to be designed to CSA S832-06 Seismic Risk Reduction of Operational and Functional Components of Buildings, SMACNA Seismic Restraint Manual-Guidelines for Mechanical Systems and ASHRAE RP-812 Guide to Seismic Restraint, whichever is more onerous.

1.8 SITE CERTIFICATION

.1 Site certification for all SRS systems to be provided at no additional cost. Provide for site certification of installation by a Professional Engineer specializing in design of SRS and registered in the Yukon Territoy and employed by the professional firm specializing in the design and supply of SRS systems for this project.

.2 Provide for any territorial schedules for the SRS by the SRS professional engineer. Submit as a requirement for Substantial Completion as defined in Section 20 05 01, General Mechanical Provisions.

Part 2 Products

2.1 SRS MANUFACTURER

.1 SRS to be from one manufacturer regularly engaged in production of same.

2.2 MECHANICAL ANCHORS

.1 Approved SRS type anchors. Minimum 13 mm dia.

.2 Acceptable material: Hilti

2.3 THREADED ANCHORS

.1 Minimum Type ASTM A 325. Minimum 13 mm dia.

2.4 CABLES

.1 Galvanized, size as required.

2.5 SLACK CABLE RESTRAINT SYSTEM (SCS)

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

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

.3 Hanger rods to withstand compressive loading and buckling.

Part 3 Execution

3.1 GENERAL

.1 SRS to provide gentle and steady cushioning action and avoid high impact loads and SRS to restrain seismic forces in all directions.

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

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

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

3.2 INSPECTION AND CERTIFICATION

.1 Do not cover any seismic restraint systems until reviewed by the Professional Engineer specializing in design of SRS and employed by the professional firm responsible for the design and supply of SRS systems and representative of Authority Having Jurisdiction, unless otherwise authorized.

.2 Seismic Engineer to provide written report to Departmental Representative with certificate of compliance a minimum 14 (fourteen) days prior to Substantial Completion.

3.3 COMMISSIONING DOCUMENTATION

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

3.4 STATIC EQUIPMENT

.1 Floor-Mounted Equipment (General)

.1 Anchor equipment to equipment supports at all times using SRS rated fasteners.

.2 Anchor equipment supports to structure or housekeeping pad thru manufactured supplied mounts using approved SRS anchors.

.3 Bolts size and locations as indicated or to manufactured recommendations.

.2 Vertical Tanks (General)

.1 Anchor to housekeeping pad where mounts provided. Where mounts not provided provide supplemental anchor points.

.2 Provide retaining structure above center of gravity for vertical tanks where required.

.3 Horizontal Exterior Tanks

.1 Pad and pile mounted. Anchor using approved anchors to pad or welded to piles.

.2 For pad and/or pile details see structural drawings.

.4 Suspended Equipment

.1 Motor driven equipment: Not acceptable. All non-vibration isolated equipment to be base supported.

.2 AHU silencers: As per duct systems.

.5 Diffusers

.1 As per SMACNA.

.6 HW Boilers

.1 Anchor to housekeeping pad where mounts provided. Where mounts not provided provide supplemental anchor points.

3.5 VIBRATION ISOLATED EQUIPMENT

.1 Floor Mounted Equipment, Systems (General)

.1 All isolators to be provided with integral snubbers/seismic restraints. Reference technical sections.

.2 All isolators to be secured to anchored concrete housekeeping pad or thru pad to building structure. Anchor size as per manufactured recommendations and as indicated with a

minimum 13dia. Oversize housekeeping pads as required to allow installation of SRS anchors to manufactured. requirements.

.2 Suspended Equipment, Systems:

.1 All isolators to be provided with integral snubbers/seismic restraints. Reference technical sections.

.2 All suspended equipment to be braced as follows:

.1 All inline centrifugal EF and centrifugal EF: Slack cable restraint system.

.2 Cabinet EF: SRS not required.

.3 UH: Slack cable restraint system.

.4 Other equipment: Slack cable restraint system unless otherwise approved by Contractor.

3.6 SLACK CABLE RESTRAINT SYSTEMS

.1 To requirements of SMACNA Seismic Restraint Manual and CSA S832-06 Seismic Risk Reduction of Operational and Functional Components of Buildings.

.2 Connect to suspended equipment so that axial projection of wire passes through center of gravity of equipment.

.3 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action

.4 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.

.1 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.

.5 Hanger rods to withstand compressive loading and buckling.

3.7 PIPING SYSTEMS

.1 All DW, DWV (CI and CU only) and fuel system piping systems to be supported to the requirements of SMACNA Seismic Restraint Manual and and CSA S832-06 Seismic Risk Reduction of Operational and Functional Components of Buildings.

.2 All Transverse and Longitudinal bracing to be installed utilizing cable attachments. Use of angle bracing will be acceptable only where approved by Engineer.

.3 Bracing details apply to all types of piping joints.

.4 Brace all piping and as specified with the following exceptions:

.1 Piping is not required to be braced when the piping hanger is less than 300 mm in length when measured from the top of the pipe to the bottom of the support where the hanger is attached and the pipe is supported by an individual hanger.

.2 All PVC and ABS DWV piping is not required to be braced.

.3 All piping 50 dia and smaller is not required to be braced unless otherwise noted.

.5 Brace all piping as follows and as noted on drawings whichever is greater:

.1 Brace all DW and Cast Iron/Copper DWV piping 63 dia and larger. Provide transverse bracing on maximum 12 m centers, longitudinal on 24 m centers.

.2 Brace all mechanical room, fan mezzanine, piping 32 dia and larger and all fuel oil piping. Provide transverse and longitudinal bracing as Sub 3.5.6.1 and 3.5.6.2.

.3 Alternate bracing is not acceptable where bracing systems have been designed to incorporate thermal expansion.

.4 Use of transverse bracing to provide longitudinal bracing is acceptable where indicated by SMACNA or approved by Contractor.

.5 Seismic bracing for trapeze hangers is acceptable at all locations except where the trapeze hanger may affect the operation of the thermal expansion systems.

.6 Bracing of branch piping to brace mains is not acceptable.

.7 All piping risers 63 dia and greater to be supported at all floor penetrations. Support at top of risers is not an acceptable alternate.

.6 Sprinkler Systems: To ANSI/NFPA 13, Installation of Sprinkler Systems.

3.8 DUCT SYSTEMS

.1 All ventilation duct systems to be supported to the requirements of SMACNA Seismic Restraint Manual and CSA S832-06 Seismic Risk Reduction of Operational and Functional Components of Buildings.

.2 All Transverse and Longitudinal bracing to be installed utilizing cable attachments. Use of angle bracing will be acceptable only where approved by Engineer.

.3 Bracing details apply to all types of duct joints when fabricated to SMACNA or an approved proprietary equivalent.

.4 Brace all ducts as specified with the following exceptions:

.1 Ducts are not required to be braced when piping hanger is less than 300 mm in length when measured from the top of the duct to the bottom of the support where the hanger is attached and where hangers are positively attached to the duct within 50 mm of the top of the duct with a minimum two #10 sheet metal screws and are supported individually.

.2 All ducts 700 dia and smaller and less than 0.56 m^2 is not required to be braced.

.3 All unbraced ducts to be installed a minimum 150 mm from all ceiling support wires.

.5 Brace all ducts as follows:

.1 Brace all ducts 700 mm dia or 0.56 m^2 and larger. Provide transverse and longitudinal bracing as per SMACNA Seismic Restraint Manual, Third Edition Chapter 6.

.2 Use of wall and floor penetrations to provide transverse and longitudinal bracing is acceptable. Block all duct penetrations where the bracing is required.

.3 Brace all suspended grilles and diffusers.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Identification for mechanical equipment, piping systems and related components.

1.2 RELATED REQUIREMENTS

.1	General Requirements	Division 01

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	Painting of Mechanical and Electrical Work	Division 09
.2	General Mechanical Provisions	Section 20 05 01
.3	Pipe and Pipe Fittings	Section 20 20 10
.4	Piping and Equipment Insulation	Section 20 20 30
.5	Fire Suppression	Division 21
.6	Plumbing	Division 22
.7	Heating, Ventilation and Air Conditioning	Division 23

1.4 QUALITY CONTROL

.1 Coordinate painting of piping and equipment with work of Division 09.

.2 Colour code mechanical equipment, piping and exposed ductwork. Refer to label identification schedules.

.3 Submit a schedule of pipe and equipment identification methods, materials and colours to the Departmental Representative for review.

1.5 REFERENCE STANDARDS

.1 ASME A13.1 – Scheme for the Identification of Piping Systems.

.2 CAN/CGSB-24.3 – Identification of Piping Systems.

.3 Federal Standard 595C Colours.

.4 WHMIS Pictograms – Workplace Hazardous Materials Information System – GHS (Globally Harmonized System of Classification and Labelling Chemicals) – Pictograms.

Part 2 Products

2.1 IDENTIFICATION LABELS

.1 Identification Labels for all mechanical piping and ductwork systems, to include:

.1 WHMIS Pictogram (as applicable), same colour as legend letters.

.2 A lettered legend on a coloured background, defining the contents in the pipe, its pressure and temperature and the information necessary to define the hazard.

.3 Arrows to define the direction of flow, same colour as legend letters.

.4 50 mm wide black tape at each end of the label, wrapped around the entire circumference of pipe/insulation to secure the Identification Labels.

.2 Identification Labels may be accomplished by paint, stenciling and/or factory fabricated labels. Labels shall cover full circumference of pipe or insulation.

2.2 HEIGHT OF LEGEND LETTERS AND NUMBERS

.1 Height of Legend Letters and Numbers:

Outside Diameter of Pipe or Covering (mm)	Height of Letters and Numbers (mm)	Length of Colour Field (mm)
19 to 32	13	200
38 to 51	19	200
64 to 150	32	300
200 to 250	64	600
Over 250	89	800

.2 Lettering and Direction of Flow Arrow:

.1 Lettering: Capital, Bold, Sans Serif, Century Gothic or Helvetica.

.2 For hazardous piping system: black letters and arrows.

.3 Fire protection, other piping systems and ductwork: white letters and arrows, unless otherwise specified.

2.3 VALVE TAGS, DIRECTORIES AND NAMEPLATES

.1 Valve Tags: 40 mm diameter with 20 mm lettering; brass, lamacoid or metal photo black numbers, secured to valve stem with key chain.

.2 Valve Directories: laminated sheets and electronic copy. Include the following information for each tagged valve:

.1 Valve identifier (valve number or logical point mnemonic).

.2 Location.

.3 Service.

.4 Make/model/size and CV for control valves.

.3 Engraved Plastic Nameplates: self-adhesive composite laminated plastic nameplates with one smooth white surface and core of black plastic designed to leave black lettering on a white background. Engraved lettering height as follows:

.1 All major equipment: 20 mm

.2 Air terminal boxes: 20 mm

.3 Magnetic contactors and VFDs: 20 mm

.4 All other: 8 mm

Part 3 Execution

3.1 GENERAL

.1 Identify piping systems and ductwork systems with Identification Labels. Refer to Article 3.2 Identification Schedules.

.2 Identify the location of the following items of equipment which are concealed above a ceiling with Avery "Data Dots". The colours shall conform to the following schedule:

HVAC equipment and duct cleaning access	yellow
HVAC valves and dampers	blue
Plumbing equipment and valves	green
Control dampers and sensors	black
Fire, smoke, and sprinkler equipment	Red

When T-bar ceilings are installed, adhere "Data Dots" on T-bar framing adjacent to panel to be removed.

3.2 IDENTIFICATION SCHEDULES

.1 Colour numbers for Identification Labels on piping systems, valves and equipment are defined in Federal Standard 595C Colours for colour code identification.

Black	:	17038
Yellow	:	13591
Green	:	14193
Orange	:	12473
Brown	:	10115
Red	:	11350
White	:	17860
Aluminum	:	16515
Blue	:	15180
Grey	:	16293
Light Blue	:	15450
Purple	:	17155

.2 Pipe Identification Label Schedule:

Service	Background	Lettering	WHMIS Symbol	Legend
Sprinkler	Red	White	N/A	WET SPRINKLER
Fire Water	Red	White	N/A	FIRE WATER
Domestic Cold Water	Light Blue	White	N/A	DOMESTIC COLD WATER
Domestic Hot Water	Light Blue	White	N/A	DOMESTIC HOT WATER
Domestic Hot Water Recirc.	Light Blue	White	N/A	DOMESTIC HOT WATER RECIRC
Drains	Aluminum	Green	N/A	DRAIN
Vent	Aluminum	Green	N/A	VENT
Fuel Oil	Brown	Black	Yes	FUEL OIL
Refrigerant R410a	Blue	White	Yes	R410a

.3 Ductwork:

Identify all ductwork with Identification Labels as follows, complete with directional arrows:

Service	Background Colour	Legend	Lettering
Return Air	Blue	RETURN AIR	White
Supply Air	Blue	SUPPLY AIR	White
Mixed Air	Blue	MIXED AIR	White
Combustion Air	Blue	COMBUSTION AIR	White
Relief Air	Blue	RELIEF AIR	White
General Exhaust Air	Blue	GENERAL EXHAUST AIR	White
WC Exhaust	Blue	WC EXHAUST AIR	White

.4 Identify duct access panels with Identification Labels, conforming to the following schedule:

	Background	Lettering
Cleaning and service access	yellow	Black
Controls, including heat sensors	black	White
Dampers (backdraft, balance and control)	blue	White
Fire dampers	red	White
Smoke dampers and detectors	red	White

.5 Equipment Bases/Housekeeping Pads:

.1 Grey, with 100 mm yellow and black angled bands around edges.

3.3 LOCATION OF LABELS

.1 Orient labels on piping systems in visual sight lines while standing at floor levels.

.2 Locate labels as follows:

.1 Upstream of valves.

.2 Adjacent to changes in direction.

.3 Branches.

.4 Where pipes pass through walls or floors.

.5 On straight pipe runs at 6 m intervals.

.6 For oil piping systems, at 6 m intervals on straight pipe runs.

.7 Where system is installed in pipe chases, ceiling spaces, shafts, or similar confined spaces, at entry and exit points and at access openings.

.8 At beginning and end points of each run and at each piece of equipment.

.3 Adhere labels to piping/insulation. Labels to cover entire pipe circumference. Secure both ends of labels with 50 mm wide black tape around the entire pipe circumference.

3.4 VISIBLE (EXPOSED) PIPING

.1 Paint all visible piping as directed by Architect. Refer to Division 09.

3.5 VISIBLE (EXPOSED) DUCTWORK

.1 Paint visible ductwork as directed by Architect. Refer to Division 09.

.2 Paint ductwork/flexible connectors that are visible behind grilles/diffusers, matt black. Refer to Division 09.

3.6 MECHANICAL CONTROL IDENTIFICATION

.1 Refer to Section 20 30 01, General Provisions for Controls.

3.7 RECORD PROVISIONS

.1 Mark valve numbers on Red Line system schematic drawings for transfer onto record drawings. Include copies in O&M Manuals.

3.8 VALVE TAGS

.1 Tag electric and digital controls, instruments and relays. Key to control schematics on which instruments are numbered in sequence.

.2 Tag all valves in mechanical rooms.

.3 Tag all control valves external to mechanical rooms. This includes control valves on radiant panels, perimeter radiation and air terminal boxes.

.4 Tag all circuit balancing and isolating valves external to mechanical rooms except valves at terminal heating and cooling equipment.

.5 Identify and tag thermostats relating to terminal unit and valve numbers.

3.9 VALVE DIRECTORIES

.1 Include laminated directories in operation and maintenance manuals. Also provide electronic copy in PDF, as well as spreadsheet user editable format.

3.10 NAMEPLATES

.1 Identify the following with engraved plastic nameplates:

- .1 All mechanical equipment.
- .2 Air terminal boxes, VFDs.
- .3 Thermostats.
- .4 Electric starting switches, electric disconnects, remote push buttons and control panels.

.2 All nameplates to be mechanically fastened, easily visible without need to use ladder or extraordinary body position. Affix additional nameplates if necessary.

.3 Provide for review a schedule and contents of each type of nameplate. Obtain written approval prior to engraving.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Expansion tanks.

.2 Fuel oil tanks.

.3 Accessories and connection to piping system.

.4 Saddles and structural supports.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Plumbing	Division 22
.4	Heating, Ventilation and Air Conditioning	Division 23

1.3 STANDARDS

.1 Construct pressure tanks to ASME Code for Unfired Pressure Vessels.

.2 Comply with Territorial Government Regulations.

.3 CAN/CSA-B139, Installation Code for Oil Burning Equipment

.4 ANSI/API 650, Tanks

.5 CGSB 1-GP-140M, Primer, Red Lead, Iron Oxide, Oil Alkyd Type

.6 ULC-S601, Steel, Aboveground Horizontal Tanks for Flammable and Combustible Liquids

.7 ANSI/API 650, Tanks

.8 ULC/ORD-C142.3

.9 ULC-S6300

.10 CAN/CGSB-41.22-93, Standard for Process Equipment: Reinforced - Polyester Chemical Resistant, Custom Contact Moulded.

1.4 SUBMITTALS

.1 Comply with the requirements of Section 20 05 05, General Documentation.

1.5 INSPECTIONS

.1 Obtain inspection certificates for pressure vessels from Territorial Authorities.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1	Expansion Tanks Diaphragm Type and DHW Pressure Tanks	:	Bell & Gossett, Armstrong, Amtrol
.2	Fuel Oil Tanks	:	Clemmer, Westeel

2.2 DHW DIAPHRAGM TYPE EXPANSION TANKS

.1 General: cylindrical steel pressurized diaphragm type expansion tank.

.2 Diaphragm: sealed butyl suitable for potable water.

.3 Working pressure: 1035 kPa.

.4 Air precharge: 276 kPa.

.5 Capacity: Refer to schedule on drawings.

.6 Dimensions: Refer to schedule on drawings.

.7 Acceptable material: Amtrol.

.8 Schedule: Refer to schedule on drawings.

2.3 INTERIOR MAIN FUEL OIL STORAGE TANK

.1 Capacity: Refer to schedule on drawings.

.2 Entire assembly including tank and secondary containment assembly to be ULC listed and constructed to ULC-S602 and tested to ULC/ORD-C142.3.

.3 Tank shall be vented to atmosphere and be equipped with primary and secondary emergency venting. Provide vent whistle on primary vent.

.4 Secondary containment shall be provided by complete secondary enveloping the main tank shell complete with visual means of interstitial monitoring.

.5 Factory applied paint shall be one coat red oxide primer applied to CGSB-1-GP-140M. Two final coats of polyurethane protective coating. Colour to be factory standard white.

.6 Sheet steel to ASTM A 635/A 635M-02 or equivalent. Heavy gauge shell and die-formed ends.

.7 Foot valve with dip tube.

.8 Tanks to be complete with factory fabricated ULC approved nameplate.

.9 Connection:

- .1 Vent 50 mm dia.
- .2 Fill 50 mm dia.
- .3 Emergency Vent: as required
- .4 Level Gauging: 50 mm dia
- .5 Suction: 50 mm dia
- .6 Spare: 50 mm dia

.10 Remote Fill Point:

- .1 Fill point shall be located in a locking leak proof spill box.
- .2 12 gauge epoxy coated steel or stainless steel construction.

.3 Weather tight cover, lockable hatch.

.4 Capacity: 65L minimum

.5 Approvals: CAN/ULC-S663 or ULC/ORD-C58.19

.11 Tank Tray Containment Pan

.1 Protects against fitting leaks.

.2 Polyethylene construction.

.3 Sized to match fuel tank.

.12 Acceptable Material: See schedule on drawings.

Part 3 Execution

3.1 INSTALLATION

.1 Provide 100 mm high housekeeping bases on floor mounted expansion and pressure tanks.

.2 Install on supports, spacing as noted on drawings as per manufactures recommendations.

3.2 INSTALLATION (FUEL OIL TANKS)

.1 Install tanks in accordance with CAN/CSA-B139 and manufacturer's directions.

.2 Position tanks using lifting lugs, handles and hooks, and where necessary use spreader bars. Do not use chains in contact with tank walls.

3.3 PERFORMANCE

.1 Provide tanks of dimensions and capacities indicated on the drawings and/or tank schedules.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Materials Testing	Section 20 05 07
.4	Valves and Strainers	Section 20 05 23
.5	Dry Pipe Fire Suppression Sprinkler Systems	Section 21 13 16
.6	Fire Suppression	Division 21
.7	Plumbing	Division 22
.8	Heating, Ventilating and Air Conditioning	Division 23

1.2 COORDINATION WITH WORK IN OTHER SECTIONS

.1 Coordinate piping installation routes and elevations with installation of sprinkler, sheet metal and electrical work.

1.3 QUALITY ASSURANCE

.1 Welding materials, fabrication standards and labour qualifications must conform to ANSI/ASME B31.1, ANSI B16.25, ASME Section IX, and the Territorial Board of Labour Regulations.

.2 Use welders fully qualified and licensed by Territorial Authorities.

.3 Oil Piping: CSA Standard B139, Installation Code for Oil Burning Equipment (latest edition), National Fire Code.

.4 Domestic Water, Drainage and Vent Piping: Federal, Territorial and Municipal codes.

.5 Refrigerant Piping: CSA B52.

.6 Non specified pipe joining and pipe fitting methods such as T-drill and Press Fit are not permitted in any piping system covered under Division 20.

.7 Retain services of grooved joint system supplier to:

.1 Prior to proceeding with work, review piping system and instruct the workmen installing the piping on the correct use of the jointing system. Review support, anchor, guide, requirements and provisions for expansion.

.2 The Contractor shall maintain a log of all personnel trained in installation of joint systems.

.3 The Contractor shall maintain an inspection and service log for all pipe cutting and forming tools for joint systems. Inspections of cutting and rolling dies shall be made weekly and conform to manufacturers specifications for groove dimensions.

.4 The Contractor shall maintain a construction log of grooved joint installations. Any joint assembled on site will be traceable to a date of installation, installation crew, grooving or forming tool and die and type of joint. This log will be available to the Departmental Representative upon request for review.

.5 A designated quality control manager will maintain all records and perform visual inspections of joints on an ongoing basis throughout the project. Written visual inspection reports shall be made for 2% of joints assembled on site.

.6 Any joint failure, rejection or reassembly due to miss-installation, product defect or any other reason will be reported to the Departmental Representative.

Part 2 Products

2.1 PIPE

Service		Material
.1	Domestic water, above ground (inside building)	Type 'L' hard copper ASTM B88M Schedule 40 304 S.S.
.2	Domestic water service below ground and in crawlspace	Polyethylene (HDPE), DR11 Pressure rating: 160psig at 73degF. To ASTM F714, ASTM D-1248, & CSA B137.1, AWWA C-906-90. The pipe shall be made from polyethylene resin compound qualified as Type III, Category 5, Class C, Grade P34 in ASTM D-1248 with the raw material containing a minimum of 2%, well dispersed, carbon black Factory insulated: Per requirements of Section 20 20 30 complete with heat trace channel. Heat Trace Conduit: Factory heat trace conduit installed on pipe prior to insulating. Coordinate number and position of heat trace conduits with heat trace supplier – Div 26 as-required. Provide additional heat trace conduit on first length of pipe emanating from the building for routing of temperature sensor (s), unless otherwise indicated. Acceptable material: Urecon pre-insulated pipe c/w heat trace channel
.3	Sanitary drainage within 10m of drain	Cast Iron, to conform with 3.4.8
.4	Sanitary drainage, and vent, inside building, above ground	'DWV' copper, ASTM B306 Cast iron, CSA B70 PVC - DWV certified fire resistant PVC. Approvals; CSA B181.2 listed for use in noncombustible construction, ULC listed to CAN 4-S102.2. Flame spread rating; less than 25, Smoke development rating; less than 50. Any penetration through a fire rated separation shall be protected with a device certified to CAN4-S115 and pressure tested to 50Pa. Notwithstanding other specification sections, this fire protection devise

Service		Material
		shall be supplied and installed by Division 20.
		Acceptable material: IPEX System XFR 15-50 PVC-DWV.
.5	Sanitary drainage and vent, outside building, below ground	To the requirements of .2, Domestic water service below ground
.6	Storm drainage, inside and outside building, above ground	Cast iron, CSA B70 DWV copper, ASTM B306
.7	Storm drainage, outside building below ground	To the requirements of .4, Domestic water service below ground
.8	Equipment drains and overflows	Schedule 40, galvanized steel, ASTM A120
		Type 'L' hard copper, ASTM B88M
.9	Fire protection	Refer to Section 21 13 16
.10	Refrigerant	ACR copper, ASTM B280
.11	Fuel Oil Supply Fill, Vent and Carrier Pipe	Steel: to ASTM A53/A53M, Schedule 40, continuous weld or electric resistance welded, screwed
		Copper: Type K, soft copper tubing, to ASMT B75M, in long lengths

2.2 FITTINGS & JOINTS

Service		Material	Joint
.1	Sanitary drainage and vent, inside building, above ground	Wrought or cast copper	50-50 solder
		Cast iron (hubless fitting)	Gasket & clamp
		PVC - DWV	Solvent weld
	Storm drainage, inside and outside building, above ground	Wrought or cast copper	50-50 solder
		Cast iron (hubless fitting)	Gasket & Clamp
.2	Domestic water, above ground	Wrought copper, bronze	95-5 solder, brazed or rigid grooved mechanical with angle pattern bolt pad for pipes over 50 mm
		Cast bronze	Screwed
		Stainless steel	Rigid grooved mechanical, welded

Service		Material	Joint
.3	Domestic water service, Sanitary drainage, Storm drainage, below ground,	HPDE In accordance with AWWA Specification C906 for HDPE pipe, latest revision thereof and ASTM D-2513/F1055.	Joining: Normal requirement is for thermal butt-fusion. Perform in accordance with manufacturer's recommended procedures. Electrofusion: Perform in accordance with manufacturer's recommended procedures. Provide proof of operator's up to date certification. Polyethylene to polyethylene joints: proprietary electro fusion. Use continuous run length from connection to existing piping to building, to ASTM D2657.
.4	Sanitary drainage within 10m of drain	Cast iron	Gasket & Clamp
.5	Equipment drains and overflows	Galvanized banded malleable iron	Threaded
		Wrought copper, bronze	50-50 Solder
		Cast brass	Screwed
.6	Fire protection	Refer to Section 21 13 16	
.7	Refrigerant	Wrought copper	Brazed, phos copper alloy
		Forged brass	Brazed, silver alloy

.8 Use factory fabricated butt welded fittings for welded steel pipes.

.9 Use long radius elbows for steel and cast iron water piping, including grooved mechanical fittings.

.10 Fuel Oil

.1 Steel:

.1 Malleable Iron: Screwed, banded, Class 150 to ASME B16.3.

.2 Steel: Butt-welding.

.3 Unions: 300 Class malleable iron, brass to iron, ground seat, screwed, to ASTM A 47M.

.4 Nipples: Schedule 40, to ASTM A 53/A 53M.

.2 Copper:

.1 Flared fittings.

2.3 UNIONS, FLANGES, AND COUPLINGS

.1 Size 50 mm and under: 1035 kPa malleable iron, bronze to iron ground joint unions for threaded ferrous piping, air tested for gas service, all bronze for copper piping.

.2 Sizes 65 mm and over: 1035 kPa forged steel welding neck flanges for ferrous piping, 1035 kPa bronze slip-on flanges for copper piping. Gaskets shall be 1.5 mm thick pre-formed ceramic fiber. Gaskets for gas service shall be synthetic rubber.

.3 Flange bolting: For systems up to 120°C, use carbon steel stud bolts, semi-finished, and heavy hex nuts, ASTM A307-GrB. For systems up to 215°C, use alloy steel bolts ASTM A193-GrB7, and semi-finished heavy hex nuts ASTM A194-Gr2H.

.4 Rigid grooved mechanical couplings shall have an angle bolt pattern design and shall provide system support and hanging requirements in accordance with ASME B31.1. Rigid couplings shall be used in all locations unless otherwise noted.

.1 Couplings: Victaulic Style 107 couplings to ASTM A-47

.1 Style 750 on reducing couplings

.2 Style 741 or 743 on all flanged component connections

.3 Style 77, 75 flexible couplings on connections to mechanical equipment

.4 Style 72 outlet couplings on pipe headers

.2 Fittings: Victaulic full flow malleable iron or ductile iron fittings with grooved or shouldered ends to ASTM A536 (Ductile Iron); ASTM A53 or A120 (Fabricated Steel).

.3 Gaskets: Pressure responsive type where pressure increases ability to seal; EPDM Grade E with green colour code identification to ASTM D-2000, suitable for -35°C to +110°C operating temperature range. Suitable for use with specified glycol medias for operating range and concentrations.

.4 Bolts and Nuts: Heat treated carbon steel to ASTM A183.

.5 Flanges: Victaulic Style 741 ANSI Class 125/150 ductile iron flanges to ASTM A183, suitable for opening, engaging grooves and securing in position with a tight fitting lock bolt.

.6 For domestic water, grooved mechanical coupling housings are cast with an angle pattern bolt pad for direct connection of copper tubing without flaring to IPS dimensions. Gaskets shall be molded of synthetic rubber in a FlushSeal configuration conforming to the copper tube size (CTS) outside diameter and coupling housing. Standard of acceptance Victaulic Style 606

.7 Submit shop drawings for grooved piping systems.

Part 3 Execution

3.1 PREPARATION

.1 Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.

.2 Protect all steel pipes when stored on site from external conditions and ensure protective coating remains intact. If in the opinion of the Departmental Representative, deterioration of the protective coating has instigated corrosion, all rust must be removed down to bare metal and prime coated with red oxide paint.

.3 Use roll grooving tools to groove pipe in accordance with manufacturer's specifications. Use copper rolls for copper pipe and stainless steel rolls for stainless steel pipe.

3.2 CONNECTION

.1 Screw joint steel piping up to and including 50 mm. Weld piping 65 mm and larger, including branch connections. Screw or weld 50 mm piping for liquid systems.

.2 Make screwed joints with full cut standard taper pipe threads with approved Teflon tape or non-toxic joint compound applied to male threads only, equal to Jet-Lube V-2 multi-purpose thread

sealant. For fuel oil piping use red paste jointing compound. Use of Teflon tape is not acceptable for fuel oil systems.

.3 Make joints for plain end pipe with gasket and clamp type mechanical fastener.

.4 Clamp cast iron water pipe at fittings with 20 mm rods and properly anchor and support.

.5 Use grooved mechanical couplings and mechanical fasteners where allowed, in accessible locations within mechanical rooms. All grooved components shall be of one manufacturer and conform to local code approval. A gauged torque wrench must be used if required by the manufacturer.

.6 Use galvanized couplings with galvanized pipe.

.7 Make connections to equipment, specialty components, and branch mains after isolation valves, with unions or flanges.

.8 Provide dielectric type connections wherever jointing dissimilar metals in open systems. Brass adapters and valves are acceptable.

.9 Use plastic isolation spacers for copper pipe installation in metal studs.

3.3 ROUTE AND GRADES

.1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furring to a minimum.

.2 Slope water piping 0.2% and provide hose bibb drains at low points.

.3 Equip low points with 20 mm drain valves and hose connections and caps.

.4 Provide air collection chambers with manual air vent at all high points of system. Collection chambers to be 25 mm dia or line size whichever is greater and 150 mm high minimum. Square tees may only be used to assist with complete venting and draining.

.5 Make reductions in water with eccentric reducing fittings installed to provide drainage and venting. Top flat for water.

.6 Grade horizontal drainage and vent piping 2% minimum, unless otherwise noted.

.7 Pipe the discharge from all relief valves, safety valves, vents, drains, equipment blowdowns, water columns, and overflows to the nearest building drain except for glycol systems. For glycol systems pipe to collection tank.

3.4 INSTALLATION

.1 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.

.2 Configure all piping which crosses a building expansion joint with an expansion loop at the building expansion joint.

.3 Provide clearance for proper installation of insulation and for access to valves, air vents, drains, unions and clearance to combustibles.

.4 Install piping material specified as inside the building to within 300 mm of building walls/floors.

.5 All oil piping above grade shall be primed, painted and labeled for its entire length, including ceiling spaces and outdoors.

.6 Fuel oil piping from oil storage tank to be above grade for full length and enter building above grade.

.7 Regardless of pipe and fitting materials specified in "Products" section of this specification section, All sanitary drainage piping within 10 m downstream of a relief valve or any device that may discharge fluid into the sanitary sewer above 60°C shall be cast iron.

.8 Pipe all drain pans on fan coil units, indoor pre-manufactured units, coils, and roof mounted pre-manufactured air handling units to closest suitable funnel floor drain.

.9 Drain pans for exterior pre-manufactured air handling units mounted on grade are to be piped to a common point and discharged to ground with elbow down. Do not provide p-trap for drains to ensure no freezing of piping during cold months.

3.5 PLASTIC PIPE INSTALLATION

.1 Comply with the requirements and limitations defined in the National Building Code and the Product Listings.

3.6 GROOVED PIPING SYSTEMS

.1 Use grooved mechanical piping systems only in Mechanical and Service Room spaces.

.2 Use roll grooving tools to groove pipe to manufacturer's specifications. Provide regular bi-daily checks to confirm depth of groove is within manufacturer's tolerances. Use copper rolls for copper pipe and stainless steel rolls for stainless steel pipe.

.3 Confirm pipe ends are clean and free from indentations, projections or roll marks from pipe end to groove to ensure proper gasket sealing.

.4 Confirm that gasket style and grade are suitable for the intended service.

.5 Lubricate gaskets with a thin coat of lubricant to manufacturers specifications; apply to gasket lips and exterior to ease installation and avoid pinching the gasket.

.6 Submit manufacturers quality control report.

3.7 WELDED PIPE BRANCH CONNECTIONS

.1 Make branch connections according to the following schedule:

HEADER	15	20	25	30	40	50	65	75	100	150	200	250	300
15 mm	T												
20 mm	T	T											
25 mm	T	T	T										
30 mm	T	T	T	T									
40 mm	T	T	T	T	T								
50 mm	S	S	S	T	T	T							
65 mm	S	S	S	S	T	T	T						
75 mm	S	S	S	S	S	T	T	T					
100 mm	S	S	S	S	S	T	T	T	T				
150 mm	S	S	S	S	S	W	T	T	T	T			
200 mm	S	S	S	S	S	W	W	W	T	T	T		
	15	**20**	**25**	**30**	**40**	**50**	**65**	**75**	**100**	**150**	**200**	**250**	**300**

Branch

T = Forged tee or reducing tee | S = Socolet | W = Weldolet

3.8 UNDERGROUND PIPING SYSTEMS

.1 Excavation

.1 To requirements of Section 31 23 10 - Excavating, Trenching, and Backfilling.

.2 Pipe work installation

.1 Install in accordance with Canadian Plumbing Code and ANSI/NFPA 13, and local authority having jurisdiction.

.2 Assemble piping using fittings manufactured to ANSI standards.

.3 Heat Trace Conduit:

.1 The position of the heat trace conduit relative the invert of the pipe is critical to heat trace function:

.1 Where single heat trace run is used, install conduit at bottom of pipe (below invert) unless otherwise indicated.

.2 Install per heat trace supplier's requirements: Coordinate with Division 22, 23, and 26 as-required.

.2 Coordination:

.1 Coordinate installation of heat trace, heat trace terminations and temperature sensors per the requirements of Division 26.

.3 Bedding

.1 Cut trenches and place bedding materials in uniform layers not exceeding 150mm compacted thickness to depth as indicated.

.2 Shape bed true to grade and to provide continuous, uniform bearing surface.

.3 Shape transverse depressions, as required, to suit joints.

.4 Compact each layer full width of bed to at least 98% of corrected maximum dry density.

.4 Surround

.1 During and on pipe laying surround and cover pipe.

.2 Provide for Departmental Representative to review work before covering pipe.

.3 Hand place surround material in uniform layers not exceeding 6" compacted thickness. Do not drop material within 5m of pipe.

.4 Place layers uniformly and simultaneously on each side of pipe.

.5 Compact each layer, hand tamped, from pipe invert to mid-height of pipe to at least 98% of corrected maximum dry density.

.6 Compact each layer, hand tamped, from mid-height of pipe to underside of backfill to at least 98% of corrected maximum dry density.

.7 Provide a minimum of 12" surround above top of pipe.

.5 Backfill

.1 To requirements of Section 31 23 10 - Excavating, Trenching, and Backfilling.

.2 Place backfill material above pipe surround in uniform layers not exceeding 300mm compacted thickness up to grades as indicated unless otherwisespecified.

3.9 FUEL OIL PIPING SYSTEMS

.1 Install piping as specified herein.

.2 Install oil piping system in accordance with CAN/CSA-B139 and CAN/CSA-B140.0.

.3 Slope piping in direction indicated.

.4 Assemble piping using fittings manufactured to ANSI standards. Provide threaded fittings except in locations as follows. For these locations provide welded fittings.

.1 Finished architectural interior spaces except mechanical and electrical service rooms.

.2 All concealed piping.

.5 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.6 Use eccentric reducers at pipe size change installed to provide positive drainage.

.7 Provide clearance for installation of insulation and access and maintenance of equipment, valves and fittings.

.8 Ream pipes, clean scale and dirt, inside and out.

.9 Use of copper piping is restricted to a maximum developed length of 900 mm from fuel oil supply and return branch piping to burners unless otherwise approved by Departmental Representative.

.10 Screwed fittings with red paste jointing compound.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Cold Systems: (refrigerant piping) from 2ºC to 18 ºC.

.2 Domestic Water Systems: (hot, cold, recirculation) ambient to 82ºC.

.3 Miscellaneous systems as scheduled.

.4 Equipment insulation.

.5 Adhesives, tie wires, tapes.

.6 Recovering.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Valves and Strainers	Section 20 05 23
.4	Pipe and Pipe Fittings	Section 20 20 10
.5	Plumbing	Division 22
.6	Heating, Ventilation and Air Conditioning	Division 23

1.3 REFERENCE DOCUMENTS

.1 American Society for Testing and Materials (ASTM)

.1	ASTM C335	Steady State Heat Transfer Properties of Pipe Insulation
.2	ASTM C411	Hot-Surface Performance of High Temperature Thermal Insulation
.3	ASTM C449	Mineral Fiber Hydraulic Setting Thermal Insulating and Finishing Cement
.4	ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
.5	ASTM C534	Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
.6	ASTM C547	Mineral Fiber Pipe Insulation
.7	ASTM C553	Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
.8	ASTM C612	Mineral Fiber Block and Board Thermal Insulation

.2 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1	ASHRAE Standard 90.1	Energy Standard for Buildings except Low Rise Residential Buildings

.3 Canadian General Standards Board (CGSB):

.1	CGSB 51-GP-52Ma	Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation
.2	CAN/CGSB-51.53	Poly (Vinyl Chloride) Jacketing Sheet for Insulated Pipes, Vessels and Round Ducts

.4 National Research Council of Canada

.1 Model National Energy Code of Canada for Buildings (MNECB).

.5 Thermal Insulation Association of Canada (TIAC)

.1 Mechanical Insulation Best Practices Guide.

.6 Underwriters Laboratories Canada (ULC)

.1	CAN/ULC-S102	Surface Burning Characteristics of Building Materials and Assemblies
.2	CAN/ULC-S701	Thermal Insulation, Polystyrene, Boards and Pipe

1.4 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.5 SUBMITTALS

.1 Product Data

.1 Submit manufacturer's product data in accordance with Section 01 33 00 – Submittal Procedures, and Section 20 05 01 – General Mechanical Provisions.

.1 When requested, submit product data and test reports indicating that insulation and recovery assemblies meet flame/smoke development ratings and performance requirements.

.2 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures, and Section 20 05 05 – General Documentation.

.1 For each application submit an insulation schedule to include the following information:

.1 Materials
.2 "k" value
.3 Thickness
.4 Density
.5 Finish
.6 Jacketing

.3 Submit information showing installed insulation and membrane products meet the requirements of the Model National Energy Code of Canada for Buildings (MNECB), 1997 and ASHRAE 90.1-2010.

1.6 DEFINITIONS

.1 For the purposes of this Section, the following definitions apply:

.1 Concealed: piping systems and equipment in trenches, shafts, furring, and suspended ceilings.

.2 Exposed: piping systems and equipment in mechanical rooms or otherwise not "concealed".

.3 "k" Value: thermal conductivity of insulating material per unit of thickness (W/m.°C).

1.7 FLAME/SMOKE DEVELOPMENT RATINGS

.1 Pipe insulations, recovery materials, tapes, vapor barrier facings and adhesives shall have maximum flame spread rating of 25 and maximum smoke developed rating of 50, when tested in accordance with CAN/ULC-S102.

.2 Insulating materials and accessories shall withstand service temperatures without smoldering, glowing, smoking or flaming when tested in accordance with ASTM C411.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store materials in original packaging with manufacturer's labels.

.2 Protect materials against damage from weather and construction activities.

.3 Separate waste materials for reuse and recycling in accordance with Division 01.

Part 2 Products

2.1 UNDERGROUND PIPING INSUALTION (WATER, SANITARY, AND STORM)

.1 Insulation:

.1 Density: 35 kg/m3 minimum ASTM D1622

.2 Closed cell content: 90% minimum ASTM D2856

.3 Water absorption: 4.0% by Volume ASTM D2842-69

.4 Thermal conductivity: 0.023W/m @ 22 degrees Celsius, ASTM C518

.5 Dimensional stability: 3% ASTM D2126-B, E

.6 Compressive strength: modified ASTM D1621 with 50 mil Jacket, approximately 411 to 549 kPa.

.2 Jacket:

.1 High-density polyethylene UV inhibited factory applied, for cold weather properties (to -45degF) by continuous extrusion or approved tape-wrap method

.2 Sealant: butyl rubber & resin

.3 Tensile strength" 3045psi minimum to ASTM D1000

.4 Thickness: 1.14mm minimum for extruded polyethylene or two (2) cross wraps, for a total minimum thickness of 1.27mm for tape-wrapped polyethylene application.

.3 Fabrication:

.1 Pipe shall be located at the center of the insulation material. An allowable tolerance on this specification is as follows:

.1 Total diameter of insulation pipe structure shall in no instance be less than the pipe diameter plus 4".

.2 The minimum thickness of insulation at any location of the pipe shall be 2".

.3 Provide extruded molding adhered to pipe to serve as conduit for heat tracing. Molding to be adhered to pipe before being insulated.

.4 Joints:

.1 With insulation half shells and heat shrink tape.

.5 Insulation kits for fittings:

.1 Insulation kits for fittings shall consist of rigid polyisocyanurate foam insulation with a fully bonded polymer protective coating on all exterior and interior surfaces, including ends. Kits to be supplied complete with silicone caulking for seams, stainless steel attachment straps and clips, and heat-shrink sleeves or butyl mastic tape to seal between pipe and insulation kit.

.2 Rigid polyisocyanurate foam insulation:

.1 Density (ASTM D1622) 1.7 to 2 lb/ft3.

.2 Compressive strength (ASTM D 1621) 19 to 23 psi.

.3 Closed cell content 90% maximum.

.4 Water absorption: (ASTM D2842) 4.0% by volume.

.5 K factor: (ASTM C 518) 0,027 W/m degC.

.6 Thickness, to match pipe insulation thickness.

.3 Polymer coating:

.1 Two component high density polyurethane coating, black in color.

.2 Density 73 lb/ft3.

.3 Durometer D scale 60.

.4 Tensile strength 1600psi.

.5 Tear strength 26.5 N/mm

.6 Thickness 0.075" outside surfaces, 0.02" inside surfaces.

2.2 HOT PIPE INSULATION

.1 Hot Pipe Insulation - Mineral Fibre (Water):

.1 Material: formed rigid mineral fibre insulation sleeving to ASTM C547.

.2 "k" Value: maximum 0.035 W/m°C at 24°C mean temperature.

.3 Service Temperature: up to 150°C.

.4 Jacket: factory applied general purpose jacket.

.2 Hot Pipe Insulation - Black Rubber (Refrigerant Systems):

.1 Material: flexible elastomeric unicellular preformed pipe covering to ASTM C534.

.2 "k" Value: 0.04 W/m. °C at 24°C mean temperature.

.3 Service Temperature: up to 100°C.

.4 Maximum Allowable Thickness: 25 mm.

2.3 HOT EQUIPMENT INSULATION

.1 Hot Equipment Insulation - Flat Surfaces:

.1 Material: rigid mineral fibre to ASTM C612.

.2 "k" Value: maximum 0.035 W/m.°C at 24°C mean temperature.

.3 Service Temperature: 20°C to 120°C.

.2 Hot Equipment Insulation - Curved Surfaces:

.1 Material: mineral fibre blanket to ASTM C553.

.2 "k" Value: maximum 0.035 W/m.°C at 24°C mean temperature.

.3 Service Temperature: 20°C to 120°C.

2.4 COLD PIPE INSULATION

.1 Cold Pipe Insulation (Water Systems)

.1 Material: formed mineral fibre rigid insulation sleeving to ASTM C547.

.2 "k" Value: maximum 0.035 W/m.°C at 24°C mean temperature.

.3 Service Temperature: -14°C to 100°C.

.4 Jacket: factory applied vapor barrier jacket to CGSB 51-GP-52Ma, Type 1, with longitudinal lap seal.

.2 Cold Pipe Insulation (Refrigerant Systems):

.1 Material: flexible elastomeric unicellular preformed pipe covering to ASTM C534.

.2 "k" Value: 0.04 W/m. °C at 24°C mean temperature.

.3 Service Temperature: -4°C to 100°C.

.4 Maximum Allowable Thickness: 25 mm.

2.5 COLD EQUIPMENT INSULATION

.1 Cold Equipment Insulation - Flat Surfaces:

.1 Materials: rigid mineral fibre to ASTM C612.

.2 "k" Value: maximum 0.035 W/m.°C at 24°C mean temperature.

.3 Service Temperature: -14°C to 100°C.

.4 Jacket: factory applied vapor barrier jacket to CGSB 51-GP-52Ma, Type 1.

.2 Cold Equipment Insulation - Curved Surfaces:

.1 Material: mineral fibre blanket to ASTM C553.

.2 "k" Value: maximum 0.035 W/m.°C at 24°C mean temperature.

.3 Service Temperature: -14°C to 100°C.

.4 Jacket: factory applied vapor barrier jacket to CGSB 51-GP-52Ma, Type 1.

2.6 ACCESSORIES

.1 For mineral fibre insulation materials:

.1 FSK Tape: vapor barrier tape consisting of laminated aluminum foil, glass fiber scrim and paper, with pressure sensitive self adhesive.

.2 ASJ Tape: vapor resistant tape consisting of all service jacket material with pressure sensitive self adhesive.

.3 Adhesive: quick setting adhesive for joints and lap sealing.

.2 Black Rubber Insulation Adhesive: manufacturers recommended contact cement.

.3 Thermal Insulating and Finishing Cement: to ASTM C449 mineral fibre hydraulic setting thermal insulating and finishing cement for use up to 650°C.

2.7 RECOVERY MATERIALS

.1 Canvas: ULC listed, 220 g/m^2 plain weave cotton fabric.

.2 Aluminum: to 0.5 mm thick smooth with longitudinal slip joints and 50 mm end laps, 0.4 mm thick die shaped fitting covers with factory attached protective liner on interior surface.

.3 PVC: to CAN/CGSB-51.53-95, 9 mm thick for interior use, off-white in color with one-piece premoulded fitting covers.

.4 Black Rubber Finish: insulation manufacturers recommended vinyl lacquer type coating.

2.8 INSULATED HANGER INSERTS

.1 10kg density molded fiberglass, fibers oriented parallel to the direction of pipe to high compressive strength, noncombustible; fully resistant to water, oils, gasoline or common solvents, or, corrosion, odors, insects and oxidation, operating range -84degC to 232degC.

.2 Length: 300mm.

.3 Acceptable material: Hamfab H Block.

Part 3 Execution

3.1 INSTALLATION, GENERAL

.1 Apply insulation after required piping system tests have been completed, witnessed and certified.

.2 Ensure piping surface is clean and dry before insulating.

.3 Install in accordance with TIAC National Standards.

.4 Install in accordance with manufacturers recommendations.

.5 Ensure insulation is continuous through walls and floor penetrations.

.6 Locate cover seams in least visible locations.

.7 Stagger butt joints where multi-layered insulation is used.

.8 On vertical piping with diameters 25 mm and larger, use insulation supports welded or bolted to pipe directly above lowest pipe fitting. Repeat supports on 4.5 m centers and at each valve and flange.

.9 Tightly fit insulation sections to pipe to make smooth and even surfaces. Cut insulation for proper fit where weld beads protrude. Bevel away from studs and nuts to allow their removal without damage to insulation. Trim closely and neatly around extending parts of pipe saddles, supports, hangers, clamp guides and seal with insulating/finishing cement.

3.2 HOT PIPE INSULATION APPLICATION

.1 Apply mineral fibre insulation when pipe surface temperatures are 50°C to 60°C.

.2 Apply mineral fibre insulation and recovery over full length of pipe without penetration of hangers, interruption at sleeves and fittings. Seal butt joints with 100 mm wide ASJ tape.

.3 Terminate mineral fibre insulation at each end of unions and flanges. Trowel finishing cement into bevel.

.4 Cover fittings and valves with equivalent thickness of finishing cement. Apply finishing cement over exposed fittings and valves before applying canvas recovering. Insulate with tightly placed flexible insulation and apply PVC fitting covers.

.5 Cut mineral fibre insulation layers straight on 10 m centers with 25 mm gap to allow for expansion between terminations. Pack void tightly with insulation and protect joints with aluminum sleeves.

.6 Seal black rubber insulation butt joints and seams with black rubber insulation adhesive.

.7 Recover interior exposed mineral fibre insulated piping with PVC.

.8 Recover mineral fibre insulated piping exposed to outdoors with waterproof aluminum jacket.

.9 Coat exposed black rubber insulation with two coats of black rubber finish material.

.10 Do not insulate the following piping system components:

.1 Heating piping in radiation cabinets.

.2 Unions, flanges, strainers, expansion joints, flexible piping connectors.

.3 Chrome plated or stainless steel piping.

.4 Valve bonnets on domestic water systems.

.5 Drains, plugs and caps.

.6 Exposed piping to steel radiators.

3.3 HOT EQUIPMENT INSULATION APPLICATION

.1 Use rigid fibreboard for flat surfaces and blanket for curved surfaces.

.2 Tightly butt edges and stagger joints. Weld mechanical fastener pins to equipment where necessary.

.3 Cover insulation with 25 mm galvanized hexagonal mesh and 12 mm coat of insulating cement. Finish with a final 12 mm coat of finishing cement and recover with canvas.

3.4 COLD PIPE INSULATION APPLICATION

.1 Insulate 2 m portion of plumbing vents measured from roof outlet back with 25 mm insulation. Do not insulate remaining vent piping.

.2 Insulate 2 m portion of fuel oil supply from wall penetration with 25 mm insulation.

.3 Apply vapor retardant mineral fibre insulation and recovery over full length of pipe without penetration of hangers, interruption at sleeves and fittings. Apply adhesive to ends of butt joints and seal joint seams with 100 mm wide strips of joint tape.

.4 Insulate complete system including valves, unions, flanges, strainers, drains, caps and fittings. Cover fittings and valves with equivalent thickness of finishing cement. Cover finishing cement with open mesh glass cloth and vapor retardant adhesive. Seal lap joints with 100% coverage of joint tape and seal the assembly with vapor retardant adhesive. Alternatively, insulate with tightly placed flexible insulation and apply reinforcing membrane embedded in vapor retardant coating and apply PVC fitting covers.

.5 Seal black rubber insulation butt joints and seams with black rubber insulation adhesive.

.6 Recover interior exposed mineral fibre insulated piping with PVC.

.7 Recover mineral fibre insulated piping exposed to outdoors with waterproof aluminum.

.8 Coat exposed black rubber insulation with two coats of black rubber finish material.

3.5 COLD EQUIPMENT INSULATION APPLICATION

.1 Tightly butt edges and stagger joints. Seal joints with 100 mm wide FSK tape.

.2 Cover insulation with 25 mm galvanized hexagonal mesh and 12 mm coat of finishing cement. Finish with a final 12 mm coat of finishing cement and recover with canvas.

3.6 VALVE, FLANGE AND STRAINER COVERS

.1 Flexible insulated accessible bag type covers may be used for hot and cold application to these devices in lieu of formed insulation methods specified. Insulating valves consistent with those specified for hot/cold piping and equipment.

3.7 INSULATION TYPE AND THICKNESS SCHEDULE

Insulation Type and Thickness Schedule		
Service Type and Nominal Pipe Diameter (mm)	**Insulation Type**	**Insulation Thickness (mm)**
Domestic Hot Water and Recirculation: 50 and smaller 65 and larger	 Hot Pipe Hot Pipe	 25 40
Refrigerant (5°C to 13°C): All Sizes	 Cold Pipe	 25
Domestic Cold water: 40 and smaller 50 and larger	 Cold Pipe Cold Pipe	 15 25
Plumbing Vents: All sizes	 Cold Pipe	 25
Domestic water in crawlspace: All sizes	 Cold Pipe	 80
Sanitary in crawlspace: All sizes	 Cold Pipe	 80
All underground piping: All sizes	Underground piping insulation	50 minimum
Roof Drains	Cold Equipment	25

Service Type and Nominal Pipe Diameter (mm)	Recovering Type
EXPOSED INDOORS	
All piping, all temperatures. 50mm and smaller.	PVC color coded , banded
All piping, all temperatures. 65mm to 100mm.	PVC color code banded
All piping, all temperatures. 150mm and larger.	PVC color code banded
OUTDOOR	
All piping, all temperatures. 50mm and smaller.	Aluminum
All piping, all temperatures. 64mm to 100mm.	Aluminum
All piping, all temperatures. 150mm and larger.	Aluminum
CONCEALED IN ENCLOSED SHAFTS	
All piping, all temperatures. 50mm and smaller.	Color coded, banded
All piping, all temperatures. 64mm to 100mm.	Color coded, banded
All piping, all temperatures. 150mm and larger.	Color coded, banded

Service Type and Nominal Pipe Diameter (mm)	Recovering Type
CONCEALED IN CEILING SPACES	
All piping, all temperatures except sanitary DWV and storm piping. 50mm and smaller.	Color coded, banded
All piping, all temperatures except sanitary DWV and storm piping.. 64mm to 100mm.	Color coded, banded
All piping, all temperatures except sanitary DWV and storm piping. 150mm and larger.	Color coded, banded

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Flexible pipe connections.

.2 Expansion joints and compensators.

.3 Pipe loops, offsets, and swing joints.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Pipe and Pipe Fittings	Section 20 20 10
.4	Plumbing	Division 22
.5	Heating, Ventilation and Air Conditioning	Division 23

1.3 REFERENCE STANDARD

.1 Conform to Standards of "Expansion Joint Manufacturers Association" and manufacturer's recommendations.

1.4 SHOP DRAWINGS

.1 Flexible pipe connector shop drawing data shall include maximum allowable temperature and pressure rating, overall face-to-face length, live length, hose wall thickness, hose convolutions per 300 mm and per assembly, fundamental frequency of assembly, braid structure and total number of wires in braid.

.2 Expansion joint shop drawings shall include maximum allowable temperature and pressure rating, and maximum expansion compensation.

1.5 INSPECTION

.1 Provide inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Flexible pipe connections : Mason, Flexonics, Minnesota Flexible Corporation.

.2 Expansion joints and compensators : Flexonics, Mason.

2.2 FLEXIBLE PIPE CONNECTORS

.1 Flexible Rubber Spools: Neoprene twin sphere connector of molded multiple plys of nylon tire cord fabric and neoprene, rated for 1035 kPa at 120°C. Union end connections for sizes 50 mm and under; floating galvanized ductile iron flanges for sizes over 50 mm.

.2 Spherical Rubber Spools: Neoprene single sphere elbow connector, construction and service rating same as 2.2.1 above.

.3 Braided Spools For Copper Piping: Stainless steel inner core and braid brazed to copper tube ends, suitable for 1035 kPa at 120°C.

.1 Flex Length: 300 mm general service.

.2 Flex Length: 450 mm fuel oil service.

.4 Braided Spools For Steel Piping: Stainless steel inner core and braid welded to steel pipe nipples, threaded for pipe up to 50 mm diameter, flanged for 65 mm diameter pipe and over. Suitable for service at 1035 kPa at 120°C.

2.3 EXPANSION JOINTS

.1 Copper piping: Laminated stainless steel bellows brazed to copper tube ends, internal guide, stainless steel external shroud. Suitable for 1035 kPa at 260°C.

.2 Steel piping up to 100 mm: Laminated stainless steel bellows welded to steel pipe nipples. Anti-torque device and threaded ends for sizes to 50 mm, flanged ends for sizes 65 mm and over. Internal guide and carbon steel shroud suitable for 1035 kPa at 260°C.

.3 Steel piping 100 mm and over: Guided externally pressurized laminated stainless steel bellows, flanged ends, internal guide tube and ring, external shroud and guide ring. Suitable for 1035 kPa at 260°C.

.4 Water service entry 100mm and over:

.1 Slip style, 250mm of axial movement, flanged ends.

.2 Body and packing ring to be ASTM A36 steel.

.3 Slip pipe to be ASTM A240 type 304 stainless steel, chemically passivated for maximum corrosion resistance.

.4 Rubber packing material to be made from NBR rubber compounded for water and sewer service in accordance with ASTMD2000.

.5 Flax packing to be provided for lubrication, alternated between rubber packing.

.6 Bolts and nuts to stainless steel.

.7 All cast steel parts to be fusion bonded epoxy coated.

.8 Joint to be factory assembled and to meet the requirements of AWWA C221.

2.4 PIPE GUIDES

.1 4 finger "spider" inside a guiding sleeve formed of two halves suitable for clamping onto pipe.

.2 Guided sleeve formed of two parts, suitable to be bolted to supporting structure.

.3 Guide length to be minimum 300 mm.

Part 3 Execution

3.1 APPLICATION

.1 Provide flexible pipe connectors on pipes connected to equipment supported by vibration isolation and where indicated on the drawing.

.2 Provide structural work and equipment required to control expansion and contraction of piping, loops, pipe offsets, and swing joints and provide expansion joints where indicated or required.

.3 Provide pipe guides as required to ensure correct pipe alignment for expansion joints. Minimum two guides on each side of expansion joints.

3.2 INSTALLATION

.1 Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.

.2 Rigidly anchor pipe to building structure at points shown, and where necessary provide pipe guides so that movement takes place along axis of pipe only.

.3 Install flexible connectors and expansion joints in accordance with manufacturer's instructions.

.4 Do not compress or expand connector during installation.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 All pumps except where integral with a manufactured piece of equipment.

.2 Pumps controls where self-contained.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Electric Motors – Three Phase	Section 20 05 03
.4	Variable Frequency Drives	Section 20 05 04
.5	Valves and Strainers	Section 20 05 23
.6	Vibration Isolation	Section 20 05 48
.7	Expansion Compensation	Section 20 20 40
.8	Plumbing	Division 22
.9	Heating, Ventilation and Air Conditioning	Division 23
.10	Electrical	Division 26

1.3 SUBMITTALS

.1 Submit with shop drawings certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

1.4 QUALITY ASSURANCE

.1 Ensure pumps operate at specified system fluid operating temperatures and pressures without vapour binding and cavitation, are non-overloading in parallel or individual operation, operate within 25% of midpoint of published maximum efficiency curve. Motor capacity shall be adequately sized to prevent overloading throughout entire range of performance curve.

.2 Refer to Section 20 05 03 for Motor Requirements.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Sump : Meyers, Taco, Gundfos, Monarch

2.2 GENERAL

.1 Statically and dynamically balance rotating parts.

.2 Construction shall permit complete servicing without breaking piping or motor connections.

.3 Pumps shall operate at 1750 rpm unless specified otherwise.

.4 Pump connections shall be flanged.

.5 All pump flanges to be complete with pressure gauge tappings.

2.3 SUMP PUMP

.1 Type: Completely submersible centrifugal.

.2 Casing: Cast iron.

.3 Motor: Oil filled with vented power cord for pressure equalization.

.4 Controls: Field adjustable set diaphragm float switch.

.5 Schedule:

.1 Refer to schedule on drawings.

Part 3 Execution

3.1 INSTALLATION

.1 Complete work in accordance with CAN/CSA-B214.

.2 Decrease from suction line size with eccentric reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Support suction guide and discharge elbow from a floor stand with rubber and shear sandwich pad isolators or from above with hangers and spring isolators.

.3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

3.2 STARTUP

.1 Pre-Startup:

.1 Drain casing and bleed all air from volute and ensure pump full primed.

.2 Verify pump is level.

.3 Check nameplate is readily visible.

.2 Startup:

.1 Startup as recommended by manufacturer.

.2 Check rotation.

.3 Run in pump for minimum 0.5hrs continuous operation.

.4 Verify seal performance.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Balance, adjust, and test air and liquid systems and equipment and submit reports using identical units to those shown on contract documents.

.2 Obtain sound level readings and submit reports for the rooms listed within the building. Rooms where readings to be taken as specified.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Plumbing	Division 22
.4	Heating, Ventilation and Air Conditioning	Division 23

1.3 QUALITY ASSURANCE

.1 Work specified in this section shall be performed by an Independent Agency specializing in this type of work.

.2 Balancing (of both air and liquid systems) and sound level readings shall be performed by the same agency.

.3 Balancing procedures shall be in accordance with SMACNA and ASHRAE Standards.

1.4 APPROVED AGENCIES

.1 Aztec, Western Mechanical Services (1977) Ltd., Northern Climate Engineering.

1.5 SITE VISITS

.1 Prior to the TAB contractor executing his work, a site visit shall be made to correspond with a field review completed by the Departmental Representative. After the site visit, a written report shall be submitted to the Contractor and Departmental Representative. Site visit shall be completed at 70% completion of the air and liquid distribution work.

.2 The written report shall include a review of the installation and access to all valves, dampers, and equipment shall be made at the specified site visit and any additional dampers or valves required for proper balancing shall be forwarded in writing to be reviewed by the Departmental Representative.

.3 Allow for one visit to site to adjust systems for seasonal changes during warranty. Coordinate time of visits with the Departmental Representative and Contractor. Submit reports to Departmental Representative.

.4 Begin balancing after equipment start-up and testing and after systems have been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of balancing.

1.6 BALANCING AGENDA

.1 General: Submit balancing agenda to the Departmental Representative and commissioning contractor for review at least sixty (60) days prior to the start of balancing work. Start balancing work only after agenda has been approved. Include descriptive data, procedure data, and sample forms in agenda.

.2 Descriptive Data: General description of each system including associated equipment and different operation cycles, listing of flow and terminal measurements to be performed and selection points for proposed sound measurements.

.3 Procedure Data: Procedures for converting test measurements to establish compliance with requirements, specify type of instrument to be used, method of instrument application (by sketch) and correction factors.

.4 Sample Forms: Form showing application of procedures to typical systems.

.5 Prior to commencement of work on site, the balancing agent shall arrange with the Departmental Representative, a pre-determined test area on site. This is to determine the accuracy of test equipment and to review the balancing methods outlined in the written, pre-approved balancing procedures.

.6 At the completion of balancing the first major air system or pre-arranged milestone, the balancing agent shall notify the Project Manager to re-visit the site to evaluate work completed to this time. Provide the Project Manager with fourteen (14) days written notice, prior to request for site visit.

1.7 BALANCE REPORT

.1 Submit a draft outline for the balancing report (less field data) 60 days after award of contract. The report is to include all information available (i.e., fan curves and pump curves with design data plotted, distribution drawings, technical data [design and shop drawing], descriptive data, etc.). The Contractor will be able to invoice 5% of the contract value after the report is reviewed and accepted by the Departmental Representative.

.2 Provide a PDF database and four (4) copies of final reports to contractor for inserting in the building's Operating and Maintenance Manuals as described in Section 20 05 05 - Documentation.

.3 Include types, serial number, and dates of calibration of instruments in the reports.

1.8 SYSTEM DATA

.1 Air Handling Equipment

.1 Design Data:

.1 Total air flow rate;

.2 Fan total static pressure;

.3 System static pressure;

.4 Motor kW, r/min, amps, Volts, Phase;

.5 Outside air flow rate L/s;

.6 Fan r/min;

.7 Fan/kW;

.8 Inlet and outlet, dry and wet bulb temperatures.

.2 Installation Data:

.1 Manufacturer and model;

.2 Size;

.3 Arrangement discharge and class;

.4 Motor type, kW, r/min, voltage, phase, cycles, and load amperage;

.5 Location and local identification data.

.3 Recorded Data:

.1 Supply Air Fan

.1 Fan @ 100% Outside Air

.2 Air flow rate;

.3 Fan total static pressure;

.4 System static pressure;

.5 Fan @ Full Return/Min O/A

.6 Air flow rate;

.7 Fan total static pressure;

.8 System static pressure;

.2 Return and Exhaust Air Fan

.1 Fan @ 100% Exhaust Air

.2 Air flow rate;

.3 Fan total static pressure;

.4 System static pressure;

.5 Fan @ Full Return

.6 Air flow rate;

.7 Fan total static pressure;

.8 System static pressure;

.3 Fan r/min;

.4 For Axial Fans, note blade pitch angle

.5 Motor operating amperage;

.6 Inlet and outlet, dry and wet bulb temperatures.

.2 Duct Air Quantities - All mains supplying more than 10% of Volume, outside air and exhaust (maximum and minimum) major return air openings back to duct shafts.

.1 Duct sizes;

.1 Number of pressure readings;

.2 Sum of velocity measurements;

.3 Average velocity;

.4 Duct recorded air flow rate;

.5 Duct design air flow rate.

.3 Air Inlet and Outlets:

.1 Outlet identification location and designation;

.2 Manufacturers catalogue identification and type;

.3 Application factors (Refer to 3.1.3 for supporting information);

.4 Design and recorded velocities;

.5 Design and recorded air flow rates;

.6 Deflector vane or diffuser cone settings.

.4 Air Heating and Cooling Equipment

.1 Design Data:
- .1 Heat transfer rate;
- .2 Liquid and air flow rates;
- .3 Liquid pressure drop;
- .4 Air static pressure drop;
- .5 Entering and leaving liquid temperatures;
- .6 Entering and leaving air dry and wet bulb temperatures.

.2 Installation Data:
- .1 Manufacturer, model, type;
- .2 Entering and leaving fluid flow and temperatures;
- .3 Entering and leaving air flow and temperatures;
- .4 Fluid and air side pressure drops.

.3 Recorded Data:
- .1 Element type and identification (location and designation);
- .2 Entering and leaving air dry and wet bulb temperatures;
- .3 Entering and leaving water temperatures;
- .4 Liquid pressure drop;
- .5 Air static pressure drop;
- .6 Air and Liquid flow rates;
- .7 Adjusted temperature rise or drop.

.5 Condensing Unit

.1 Design Data:
- .1 Cooling capacity;
- .2 Refrigerant type;
- .3 Motor kW, voltage, phase, full load amps.

.2 Installation Data:
- .1 Manufacturer and model;
- .2 Motor type, kW, r/min, voltage, phase, and full load amperage;

.6 Sound Level Data

.1 Diagram or description of relationship of sound source and measuring instrument;

.2 Scale reading;

.3 Graph readings at each octave band frequency;

.4 Calculate room N.C. levels.

Part 2 Products

2.1 INSTRUMENTS

.1 Provide calibration histories for each instrument. Recalibration or use of other instruments may be requested when accuracy of readings is questionable.

Part 3 Execution

3.1 GENERAL PROCEDURE

.1 Permanently mark, by stick-on labels and/or fluorescent paint, settings on valves, splitters, dampers, and other adjustment devices.

.2 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.

.3 Where vane anemometer is used to measure supply, return or exhaust air grilles, AK factors shall be determined as follows:

.1 Determine and tabulate similar sized grilles being balanced for AK schedule.

.2 Traverse all ducts serving grilles (outlined in AK schedule) to verify AK factors.

.3 AK factor from schedule, must be approved by Departmental Representative during initial review with balancer on site. (Balancer shall include written procedure for determination of AK factors).

.4 No flow hoods are to be used for measurement of exhaust or return air grilles.

.4 Balancing shall be performed to the following accuracies:

.1	Air - terminal outlets	±10% (outlets less than 200 L/s)
.2	Air - terminal outlets	±5% (outlets greater than 200 L/s)
.3	Air - central equipment	±5%

.5 Balancing contractor shall advise mechanical contractor of required revised pulleys, sheaves and impeller shavings to allow proper balancing of systems (Refer to Section 23 05 92, Coordination with Balancing Agency).

.6 Where axial fans require blade pitch changes, this shall be the responsibility of the balancing contractor.

3.2 AIR SYSTEM PROCEDURE

.1 Perform balancing, adjusting, and testing with building doors and windows in their normal operation position.

.2 The following procedure shall be adopted for central systems:

.1 Ensure dampers or volume control devices are in fully open position.

.2 Balance central apparatus to ±5% air flow.

.3 Balance branches and mains in accordance with 3.1.4.

.4 Recheck central apparatus.

.5 Balance all terminal air outlets in accordance with 3.1.4.

.6 Re-balance central apparatus to ±5%.

.7 Recheck all air outlets.

.8 Perform acoustical measurements.

.3 When balancing air outlets:

.1 Rough balance furthest outlets and then balance sequentially back to source.

.2 Fine balance furthest outlet back to source.

.4 Take static pressure readings and air supply temperature readings at 10 points on each small system and 20 points on each major system.

.5 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. Take minimum of 16 for rectangular ducts, and 10 on each vertical and horizontal axis for round ducts, traverse readings. If readings are inconsistent across duct, try to obtain straight run of six (6) diameters widths upstream and re-do traverse.

.6 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters.

.7 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

.8 Where modulating dampers are provided, take measurements and balance at extreme conditions. (Balance variable volume systems at maximum air flow rate - full cooling, and at minimum air flow rate - full heating).

.9 Verify all terminal unit factory settings for maximum air flow (and minimum if applicable). Adjust terminal unit controller if required. Record adjusted units.

.10 The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. For multi-storey building test pressure conditions at ground, intermediate and upper levels. Front doors, exits, elevator shafts, should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.

3.3 FIRE DAMPER/FIRE STOP FLAP VERIFICATION

.1 Visually inspect all fire dampers and fire stop flaps:

- .1 Installation is straight.
- .2 Wall angles properly installed.
- .3 Duct has break away connection.
- .4 Fire stopping material where used is properly installed.
- .5 Adequate access.
- .6 Clearance between sleeve and wall.

.2 Inspect all fire damper blades and tracks prior to test firing. Sheet metal trade to clean all dirty dampers and tracks to satisfaction of balancer.

.3 Manually remove each fusible link to ensure damper blade drops properly, then reset damper. Mark dropped fire damper with black felt marker.

.4 Testing of 10% of the fusible links shall be performed with a suitable heat source capable of generating sufficient heat to detonate fusible link without burning or generating carbon deposits on the blades, frame or adjacent ductwork. Selection of links to be test dropped to be as directed by Departmental Representative. Retesting and resetting shall be witnessed by Departmental Representative.

.5 If fire damper does not close properly, sheet metal trade to repair installation and balancing agency to retest.

.6 Submit written confirmation that all fire damper tests are certified by Contractor and witnessed by the Commissioning Agent.

3.4 ACOUSTICAL MEASUREMENTS

.1 Provide full spectrum acoustical measurements for each major area as follows:

.1 Major equipment or service rooms.

.2 Outside air intakes or exhausts.

.2 Separate acoustic measurements shall be taken as follows:

.1	Rooms with single air outlet and not exceeding 10 m^2	=	1 central reading
.2	Rooms with multiple air outlets with an area less than 40 m^2	=	2 @ 1/3 point readings
.3	Rooms with multiple air outlets with an area exceeding 40 m^2	=	One reading in the center, and then readings at one-fifth and four-fifths points on each diagonal.

.3 Provide additional or repeat acoustical measurements as necessitated by final balancing of each space, system, or piece of equipment.

.4 Take measurements at maximum air volume conditions.

.5 Note room reflective conditions at time of readings. (i.e. furnishings, window coverings, rugs)

3.5 BALANCING AND ADJUSTING OF DOMESTIC WATER SYSTEMS

.1 Adjust PRV on main line to 570 kPa maximum.

.2 Balance domestic hot water recirculating system piping to ensure flow from all points in the system. Ensure all hot and cold supply shut off valves are fully open.

.3 Balance water service recirculating system piping.

3.6 BALANCING REPORT

.1 Submit draft copies of rough balancing reports prior to final acceptance of project.

.2 Include types, serial number and dates of calibration of instruments.

.3 Record test data on a database from the latest available revised set of mechanical drawings and submit three (3) copies upon completion of the balancing contract for inclusion in equipment and maintenance manuals.

.4 Submit with report, fan and pump curves with operating conditions plotted. Submit grille and diffuser shop drawings and diffusion factors. Submit report in an electronic database.

.5 Report shall be indexed as follows:

.1 Air

- .1 Summary
- .2 Procedure
- .3 Instrumentation
- .4 Drawings
- .5 Equipment Summary
- .6 Fan Sheets
- .7 Fan Curves
- .8 Fan Profile Data
- .9 Static Data
- .10 Air Monitoring Station Data
- .11 Traverse Data and Schedule
- .12 Terminal Unit Summary

.13 Outlet Data Summary and Schematics (per system)
.14 Building Schematic
.15 Building Pressurization Data
.16 Weather Conditions at Time of Test
.17 Diagnostic
.18 Millwright Reports

.2 Acoustics
.1 Summary
.2 Procedure
.3 Instrumentation
.4 Drawings
.5 Profile
.6 Scale Readings

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Provide all materials and services as documented within these specifications and as required to furnish a complete and fully operational control system to monitor and control the building systems referred to in this specification.

.2 The work includes the supply and installation of controllers, instrumentation, control devices, conduit, wiring, tubing and other devices as necessary to provide a complete system of automatic controls, compliant with these specifications.

.3 Supply, install and configure all software, programming and databases; set up equipment operating schedules; and perform system activation functions as identified within these specifications, to provide a complete and fully operational control system.

.4 Provide as identified within these specifications:

- .1 Submittals,
- .2 System Documentation,
- .3 Acceptance Testing, and
- .4 Instructions to Owners

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Systems Demonstration and Owner's Startup	Section 20 05 06
.4	Meters and Gauges	Section 20 05 19
.5	Identification for Mechanical Systems	Section 20 05 53
.6	Testing, Balancing and Adjusting	Section 20 22 00
.7	Controls	Section 23 09 Series

1.3 SUBMITTALS

.1 Shop drawings and technical data describing the proposed system.

.2 Sample calibration, point verification, system startup and verification check sheets and procedures for Departmental Representative approval.

.3 Draft O&M Manuals as specified in this section under system documentation.

.4 Prior to Acceptance Test:

- .1 Completed calibration, point verification, system startup and verification check sheets.
- .2 A signed declaration stating that all work has been completed or identifying any outstanding deficiencies and the anticipated completion date(s).
- .3 A complete set of manufacturers operations manuals for all software provided as part of this project.
- .4 An electronic copy of the final points list in Microsoft Excel or Access format complete with:

.1 Controller identification number
.2 Controller input/output point number
.3 Control point mnemonic and
.4 A complete concise English description of each point

.5 All "System Documentation" as specified in this section.

1.4 OWNER ORIENTATION

.1 Formal training sessions shall commence only after "as-built" drawings have been completed, reviewed and approved by the Departmental Representative and shall be in addition to Section 23 05 06, Demonstration and Owner's Instructions for HVAC Systems, requirements.

.2 All training sessions shall include training materials and shall follow a documented outline.

.3 A copy of the training materials, which shall include a detailed course outline shall be submitted to the Departmental Representative for approval three weeks prior to commencing any training sessions.

.4 Any training conducted without prior approval of the Departmental Representative shall repeated at the discretion of the Departmental Representative and/or will not count toward the contractors training obligations.

.5 The Contractor shall provide three weeks written notice to the Departmental Representative and building Owner prior to commencing formal training sessions.

.6 The Contractor shall provide three (3) complete sets and one (1) electronic copy on flash drive of training manuals to the Owner prior to commencing of the training session, plus one manual to the Departmental Representative.

.7 Provide for operator training according to the following schedule.

.1 A 1 day seminar/workshop the week before the 7-day acceptance test covering all aspects of system use as follows:

.1 operation of hardware components
.2 system software configuration
.3 user/system interaction
.4 calibration of sensors and system
.5 trouble shooting of system and components
.6 preventative maintenance

.2 Allow for an additional 1 day training seminars, in addition to the above seminars, within the first year of operation. These seminars are to be scheduled at owner selected dates and times.

1.5 WARRANTY

.1 Provide a one year warranty on all items provided under this contract including but not limited to all equipment, wiring and software. The warranty period shall commence on the date of final acceptance.

.2 Provide on site service including all labor, materials and software to maintain the complete control system in optimal functioning condition.

.3 The contractor shall supply and install at no cost all system software updates and upgrades occurring prior to the expiration of the warranty period.

.4 Maintain a service log on site of all control system maintenance activities during the warranty period.

1.6 SYSTEM DOCUMENTATION

Operating and Maintenance Manuals

.1 The Building Automation System Operation and Maintenance Manuals shall contain operational, product data, cleaning and maintenance information on all products and equipment supplied as part of this projects BAS. The final Manuals shall accompany the Project Record Drawings and shall be in place prior to substantial performance.

.2 Submit a Draft Manual for format review three (3) months after award of Contract and three (3) Manuals of Documentation for Interim submission at 75% construction. Draft Manuals are to be complete in all aspects less control programming. Interim submission is to include all control shop drawings, programming and system descriptions. Draft and Interim Manuals are to be submitted in 3 ring binders. Final Manuals to be in catalogue type binder with one (1) electronic copy on flash drive.

.3 Each manual shall be 215 mm x 280 mm capacity extension type Catalogue Binder bound in heavyweight fabricord, colour to be reviewed with the Departmental Representative prior to order and hot stamped in white lettering front and spine.

.4 The spine and front face of the binder shall be lettered with the following:

.1 Full identification title of the project

.2 Building Control System
Operation and Maintenance Manual

.3 Set X of Y

.4 Volume X of Y

.5 The manual shall be arranged according to the following format. Utilize colour coded laminated mylar plastic divider tabs with headings according to section.

.1 Table of Contents

.2 Introduction

.3 Control System Design

.4 Building System Descriptions

.5 Control Panel Layout

.6 Shop Drawings

.7 Equipment Schedules

.8 Certification and Testing

.9 Product Manuals

.10 Maintenance

.11 Software & Certificates

.6 On the first page of each binder, before the table of contents identify the following:

.1 Prime Consultant: name, address, telephone number.

.2 Contractor: name, address, telephone number.

.3 Subcontractors: name address, telephone number.

.7 Table of Contents

.1 Include in each binder a table of contents that provides an index in order of appearance of all sections and subsections within the manual.

.8 Introduction

.1 Provide a written explanation of the layout of the manual.

.2 List all other control system manuals submitted for this project including all software manuals and hardware manuals. Identify the quantities of each manual provided.

.9 Control System Design

.1 Design Intent

.1 Explain, in this section, the design intent and give a system overview which outlines the relationships between the hardware, operating system, control software and other control components.

.2 Provide a detailed description of all parts, components and software in the system.

.3 Describe the system architecture. Provide a system configuration schematic with the location, type and model of all control panels, work stations, remote access modems etceteras and identify the major equipment monitored and controlled by each panel.

.4 Identify all software products provided including third party software. This shall include but not be limited to all controller software. For each product, indicate the number of software licenses provided, the name of the respective vendor and any software protection devices required. Indicate the number of software protection devices provided.

.2 Operations

.1 Provide an overview of the building automation system operations. Include basic instruction on:

.1 system access

.2 alarms management (including, how and where alarms are annunciated, after-hours reporting of critical alarms, etc.)

.3 commonly used reports

.4 local and remote system access and

.5 basic trouble shooting directions.

.2 These instructions are to provide a basic understanding of the system operations and are to reference specific areas of the software manuals for further detailed instructions.

.10 Building System Descriptions

.1 System Design intent - Explain, in this section, the design intent and give a system overview which outlines the system components and the intended system function.

.2 Provide a schematic, control sequences, wiring diagram, device list and points list for each building system controlled by the system.

.3 Control sequences shall identify start-up and shut-down sequences, control loop set-points, reset schedules, system interlocks etceteras.

.4 As built record drawings in 11" X 17" format, folded to fit into the O&M binders may be used to provide part or all of the information required for this section.

.11 Control Panel Layout

.1 Provide as-built panel layout sheets and include locations of all panels.

.2 Include a panel points list that identifies each point name with concise English description and termination point. Identify panel spare points.

.3 Identify power source for each panel including emergency/normal, UPS, panel number and circuit number.

.12 Shop Drawings

.1 Insert in this section all approved shop drawings organized in the format specified in these specifications

.13 Equipment Schedules

.1 Provide an equipment schedule for all hardware provided including valves, dampers, actuators, controllers, transducers, input/output devices and other instrumentation.

.14 Certification and Testing

.1 Provide final copies of all completed calibration and verification check sheets including all airflow station calibration check sheets.

.15 Product Manuals

.1 Include in this manual or within product, user manuals and technical manuals, complete and detailed instruction on the use, setup and support of all control system software and hardware provided under this project.

.2 Provide detailed instructions on set-up and user operations including but not limited to system access, navigation, alarms, trending, historical trending, reporting and trouble shooting.

.3 Provide complete detailed instruction on database structure, set-up, initialization, expansion and editing.

.4 Provide complete detailed instruction to enable creation, modification and implementation of control sequences.

.16 Maintenance

.1 Provide a description in this section of maintenance procedures for all equipment and systems, as defined in this specification, including a schedule for recommended planned and preventative maintenance work items and intervals.

.2 Include a preventative maintenance program complete with suggested check list sheets.

.3 Provide a list of resources to call upon for maintenance and servicing of equipment which includes name, address and phone numbers for supplier and service contact for each piece of equipment.

.4 Include in this section a complete set of as-built drawings if not included elsewhere in this manual.

.5 Certification, guarantee, warranty.

.17 Software & Certificates

.1 Provide original copies of all software distribution media (flash drive in vinyl CD page holders designed for 3 ring binders). The originals are to be provided in “Set 1” of these O&M manuals and back-up copies are to be provided in “Set 2”.

.2 Provide software registration certificates, or other documents that verify authenticity of software.

1.7 RECORD DRAWINGS

.1 Before the certification of substantial performance will be issued the contractor must provide the Departmental Representative with record drawings as follows:

.1 One electronic copy of record drawings in current AutoCAD format.

.2 Seven (7) copies of as-built white prints in 280 mm x 432 mm capacity blue binders bound in heavy fabricated, hot stamped in white lettering front and spine. Each is to be identified As-Built Drawings and permanently numbered 1 to 7.

.3 The spine shall be lettered with the full identification title of the project and the front face shall be lettered with the following on the respective binders:

.1 Full identification title of the project.

.2 Prime Consultant and Sub-Consultant - full identification.

.3 Prime Contractor - full identification

.4 Mechanical Contractor - full identification

.4 Maintain an accurate record of all deviations and changes on a record drawing set of prints. Such record is to be maintained on a day-to-day basis.

.5 Maintain as-built data on the data gathering and automatic control equipment schedule and panel schedules.

Part 2 Products

NOT APPLICABLE

Part 3 Execution

NOT APPLICABLE

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 74 19 – Waste Management and Disposal

.2 Section 20 05 01 – General Mechanical

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA S350-M1980(R1998), Code of Practice for Safety in Demolition of Structures.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Where required by authorities having jurisdiction, submit for approval, drawings, diagrams, details and supporting data clearly showing sequence of demolition and removal work of building supporting structures and underpinning.

1.4 HAZARDOUS MATERIAL DISCOVERY

.1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately if material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative.

.2 PCB: Polychlorinated Biphenyl: stop work immediately if material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Departmental Representative.

.3 Mould: stop work immediately if material resembling mould is encountered during demolition work. Notify Departmental Representative.

1.5 SITE CONDITIONS

.1 Should material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.

.1 Do not proceed until written instructions have been received from Departmental Representative.

.2 Notify Departmental Representative before disrupting building access or services.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 PREPARATION

.1 Inspect building with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Notify and obtain approval of utility companies before starting demolition.

.4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

- .1 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.
- .2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

.5 Provide temporary dust screens, covers, railings, supports and other protection as required.

.6 Do Work in accordance with Section 01 35 30 - Health and Safety Requirements.

3.2 DEMOLITION

.1 Remove parts of existing building to permit new construction. Sort materials into appropriate piles for recycling.

.2 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.

3.3 DISPOSAL

.1 Dispose of removed materials, to appropriate recycling facilities where available in Yukon, otherwise in accordance with authority having jurisdiction.

3.4 REFRIGERANT REMOVAL AND DISPOSAL

.1 Remove and dispose R20 refrigerant in existing cooling system per applicable code requirements.

3.5 CLEANING

.1 Upon completion, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

.2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Territory of Yukon Canada.

.3 Shop drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.3 Detailed hydraulic calculations. stamped and signed by professional engineer registered or licensed in Yukon Territory, Canada

.4 On-site fire flow measurement verified, stamped and signed by professional engineer registered or licensed in Yukon Territory, Canada.

.4 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

.5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures : use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

.6 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

.2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative Consultant before final inspection.

.3 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.4 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

.6 Approvals:

.1 Submit 2 copies 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.

.7 Additional data:

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

.2 Data to include pro-forma log(s) to record daily, weekly and monthly operating performance as specified in the National Fire Code of Canada.

.8 Site records:

.1 Departmental Representative will provide 1 one set of reproducible mechanical drawings. Provide sets of white copy prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring .

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use red colour waterproof ink.

.4 Make available for reference purposes and inspection.

.9 As-Built drawings:

.1 Prior to start of verification of the fire sprinkler system, finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Departmental Representative for approval and make corrections as directed.

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

.10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control .

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

1.3 MAINTENANCE

.1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:

.1 One cabinet for spare sprinklers (capacity: twelve sprinklers).

.2 Twelve spare sprinkler heads, with a minimum of two for each type installed.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers, including a wrenches as required to remove all sprinkler types and in accordance with Section 01 78 00 - Closeout Submittals .

.3 Provide drawing mounted in 215-mm x 279-mm frame with glass cover, showing schematic layout of incoming water service, valves, appurtenances and mainline(s) to sprinkler zones.

.4 Provide drawing(s) mounted in 215-mm x 279-mm frame with glass cover, showing locations of all low point drains, fire extinguishers and fire extinguisher ratings.

.5 Attach framed drawings specified in paragraphs 1.4.3 and 1.4.4 on a wall adjacent to the fire alarm panel.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

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

Part 2 Products

NOT USED

Part 3 Execution

3.1 RESTORATION, REPAIRS AND PAINTING

.1 Install pipe within bulkheads, joist spaces and chases at locations where pipe is currently installed in bulk heads, joist spaces and chases.

.2 Exposed pipe may be installed only in areas where exposed pipe is currently installed.

.3 Reconstruct existing and construct new bulkheads and chases to match type and style of existing bulkheads and spaces.

.4 Provide wood spacers / escutcheons to match existing as required at sprinkler protrusions.

.5 Where access doors are required in wood bulkheads and chases to service valves and equipment, fabricate doors / removable panels to match.

.6 Do painting in accordance with Section 09 91 23 - Interior Painting .

.7 Prime and touch up marred finished paintwork to match original.

.8 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

.1 Clean interior and exterior of all systems.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS..

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.4 DEMONSTRATION

.1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate sections.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

.1 ANSI/NFPA13-2010 ,Standard for the Installation of Sprinkler Systems.

.2 ANSI/NFPA 25-2011 ,Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.

.2 National Building Code of Canada 2010

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

.1 Material Safety Data Sheets (MSDS).

.4 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC S543-M1984, Internal Lug Quick Connect Coupling for Fire Hose.

1.2 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures

.2 Shop Drawings:

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures and in accordance with ANSI/NFPA 13.

.1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Yukon Territory of Canada.

.3 Seismic Drawings:

.1 Submit seismic drawings in accordance with Section 01 33 00 - Submittal Procedures and in accordance with ANSI/NFPA 13.

.1 Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Yukon Territory of Canada.

.4 Samples:

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

.2 Submit samples of following:

.1 Each type of sprinkler head.

.2 Signs and valve tags.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

.6 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

.2 Provide detailed summary sheet, Contractor's Material and Test Certificate for piping, as well as other deliverables for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 13

1.3 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in dry sprinkler systems with documented experience approved by manufacturer.

.2 Health and Safety:

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

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Remove, retain, reuse and reinstallation:

.1 Carefully remove material for reuse and reinstallation to prevent damage. Store material to prevent damage.

.2 Reinstall materials for reuse once piping has been installed, tested and accepted.

.3 Waste Management and Disposal:

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

1.5 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals

.2 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

Part 2 Products

2.1 PIPE, FITTINGS AND VALVES

.1 Pipe:

.1 Ferrous, galvanized: schedule 10 and schedule 40 to ANSI/NFPA 13.

.2 Fittings and joints to ANSI/NFPA 13:

.1 Ferrous schedule 40: galvanized screwed,

.2 Ferrous, schedule 10: painted, cast ductile iron, gasketted, bolted gooved connector

.3 Ferrous, schedule 10: painted, cast ductile iron, gasketted saddle with U-bolt connector

.3 Backflow Prevention Valve:

.1 ULC listed for fire protection service.

.2 Type 304 stainless steel housing and sleeve, roll groove connections,

.3 Indicating butterfly isolation valves with integral tamper switches.

.4 Double, spring type swing check valves with elastomeric seat disks.

.5 Rated for 1200 kPa working pressure

.6 Pressure drop: not to exceed 40 kPa at 3,785 lpm

.7 Test ports

.4 Auxiliary valves:

.1 ULC listed for fire protection service.

.2 Up to NPS 2: bronze, screwed ends, gate.

.3 NPS 2 1/2 and over: or roll grooved ends, indicating butterfly valve.

.4 Swing check valves.

.5 Ball drip.

.6 Tamper devices wired back to fire alarm panel.

.5 Pipe hangers:

.1 ULC listed for fire protection services.

2.2 SEISMIC CONTROL MEASURES

.1 General:

.1 Following systems and/or equipment to remain operational during and after earthquakes.

.2 Provide hangers, braces, guides and restraints that are manufactured by a single manufacturer.

.3 Seismic control systems to work in every direction.

.4 Fasteners and attachment points to resist same maximum load as seismic restraint.

.5 Drilled or power driven anchors and fasteners not permitted.

.6 No equipment, equipment supports or mounts to fail before failure of structure.

.7 Supports of cast iron or threaded pipe not permitted.

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

.2 Static equipment:

.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.

.2 Suspended equipment:

.1 Use one or more of following methods:

.1 Install tight to structure.

.2 Cross brace in every direction.

.3 Brace back to structure.

.3 Seismic restraints:

.1 Cushioning action gentle and steady.

.2 Never reach metal-like stiffness.

.3 Piping systems:

.1 Fire protection systems: to NFPA 13.

.2 Piping systems: hangers longer than 300 mm; brace at each hanger.

.3 Compatible with requirements for anchoring and guiding of piping systems.

.4 Bracing methods:

.1 Approved by Engineer

.2 Structural angles or channels.

.5 Service and utilities entrance into building:

.1 Seismic separation assembly at water service entry and at seismic separation joints within the building

2.3 SPRINKLER HEADS

.1 General: to ANSI/NFPA 13 and ULC listed for fire services.

2.4 SPRINKLER HEAD TYPE A

.1 Upright bronze.

2.5 SPRINKLER HEAD TYPE B

.1 Recessed pendant chrome dry head type.

2.6 SPRINKLER HEAD TYPE C

.1 Sidewall, chrome glass bulb type.

2.7 SPRINKLER HEAD TYPE D

.1 Sidewall dry head chrome glass bulb .

2.8 SPRINKLER HEAD TYPE E

.1 Upright, bronze, open.

2.9 SPRINKLER HEAD ACCESSORIES

.1 Sprinkler guards.

2.10 AUXILIARY SUPERVISORY SWITCHES

.1 General: to ANSI/NFPA 13 and ULC listed for fire service.

.2 Valves:

.1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.

.3 Flow switch type:

.1 With normally open and normally closed contacts and supervisory capability.

.4 Pressure alarm switch:

.1 With normally open and normally closed contacts and supervisory capability.

2.11 FIRE DEPARTMENT CONNECTION

.1 To ANSI/NFPA 13 and ULC listed, siamese type, location as indicated. Thread specifications to be compatible with local fire department.

.2 Polished bronze exposed with identifying sign cast on plate. Threaded metal caps and chains.

.3 Check valve adjacent to connection to municipal water service

2.12 DRY PIPE VALVE

.1 ULC listed.

.2 Cast iron, flanged type, sized to suit water main.

.3 Components:

.1 Accelerator.

.2 Air maintenance device with low pressure alarm.

.3 Alarm pressure switch with supervisory capability.

.4 Pressure gauges.

.5 Drain valve.

.6 Test valve with associated piping.

.7 Shut off valve - butterfly with tamper-proof device wired back to fire alarm panel.

2.13 PRE-ACTION /DELUGE ALARM VALVE

.1 ULC listed.

.2 Cast iron, flanged type, sized to suit water main.

.3 Components:

.1 Accelerator.

.2 Air maintenance device with low pressure alarm

.3 Alarm pressure switch with supervisory capability.

.4 Test valve and associated piping

.5 Drain valve.

.6 Electrical tripping device to operate upon low-voltage signal from fire alarm control panel. Device to be fully compatible and approved for use with fire alarm control panel by manufacturer.

.7 Shut off valve butterfly with tamper-proof device wired back to fire alarm panel.

2.14 COMPRESSED AIR SUPPLY

.1 Automatic Air Compressor, electric drive, tank mounted, single stage compressor, , belt guard and controls.

.2 ULC listed, listed for use with fire protection systems.

.3 Capacity:

.1 To restore normal air pressure in system within 30 min

.2 To provide air pressure of 140 kPa in excess of calculated trip pressure of dry pipe valve and in accordance with instruction sheet furnished with dry pipe valve.

.3 Piping: galvanized ferrous, NPS 3/4 screwed joints and fittings, to ANSI/NFPA 13.

.4 Storage Tank: horizontal, steel, A.S.M.E. rated, 50 liter capacity, threaded couplings for air supply, air discharge, relief valve, control device.

.5 Ancillary Devices.

.1 Pressure switch for automatic operation, factory installed, wired and tested.

.2 Air maintenance device: complete with pressure regulator, check valve, isolation and bypass valves, General Air Products AMD-1 or equivalent

.3 Oil separator: zinc plated steel housing, spin-on replaceable separator element, 3 ppm separation with oil, Solberg or equivalent.

.4 Air Filter: General purpose modular air line filter both centrifugal pre-filter, 5-micron final filter.

.5 Automatic tank drain: General Air Products CDF2000 or equivalent

.6 Desiccant drier: silica based media, capacity for 113 std. cu. meter of compressed air dried to dew point of -43 C.

2.15 PRESSURE GAUGES

.1 ULC listed and to Section 23 05 19 - Meters Gauges

.2 Maximum limit of not less than twice normal working pressure at point where installed.

2.16 RELIEF VALVE

.1 ULC listed.

2.17 SIGNS

.1 Bilingual Signs for control drain and test valves: to ANSI/NFPA 13.

2.18 SPARE PARTS CABINET

.1 For storage of maintenance materials, spare sprinkler heads and special tools.

.2 Construct to sprinkler head manufacturers standard.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install, inspect and test to acceptance in accordance with ANSI/NFPA 13 and NFPA 25.

.2 Testing to be witnessed by Fire Commissioner of Canada and the authority having jurisdiction.

.3 Provide "Contractors Material Test Certificate" as per ANSI/NFPA 13 for insertion in O & M Manual.

.4 Valve identification: Identify drain valves and all auxiliary valves.

.5 Install fire department connections as indicated.

.6 Install spare parts cabinet as indicated.

.7 Pressure gauges:

.1 Location:

.1 On water side and air side of dry pipe valve.

.2 At air receiver.

.3 In each independent pipe from air supply to dry pipe valve.

.4 At exhausters and accelerators.

.2 Install to permit removal.

.3 Locate so as not subjected to freezing.

.8 Valve identification:

.1 Identify drain valve, by-pass valves and main shut-off valve and all auxiliary valves.

.2 Provide an isometric drawing showing all valves, system drains, (including room number where located). Install drawing complete with frame on a wall adjacent the sprinkler entry.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

.2 Verification requirements in accordance include:

.1 Provide written certification to Departmental Representative that system was installed, flushed and tested in accordance with appropriate codes, approved plans and calculations.

.2 Certificate to include:

.1 Contractors name.

.2 Contractors address.

.3 Contractors license number.

.4 List of approved materials and devices installed

.5 Description of system test conducted.

.6 Dates of flushing and testing.

.7 Certification that connections conform to acceptable standards.

.8 Certification that system is complete and in service.

.9 Approved signage has been provided and attached as appropriate.

.10 Hose connections of system and test connections match those of responding fire department.

.11 Copy of fire alarm verification certificate.

.12 Name, address and contact information of “Fire Alarm” monitoring agency.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Refer to and comply with the following sections:

.1 General Requirements Division 01

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Electric Motor Power Characteristics Division 26

.2 Services Connections Division 33

Part 2 Products

NOT APPLICABLE

Part 3 Execution

3.1 GENERAL

.1 Execute mechanical systems installation in accordance with the sections listed in Articles 1.1 and 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and transmit documentation for review to Departmental Representative at project milestones.

.2 Shop Drawings

.3 Operating and Maintenance Manuals

.4 Record Drawings

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Equipment Testing and Startup	Section 20 05 08

Part 2 Products

2.1 GENERAL

.1 Supply shop drawings, O&M Manuals and samples as defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Complete documentation and submittals in accordance with procedures defined in the sections listed in Articles 1.1 and 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Demonstration of plumbing equipment and systems operations.

.2 Instruction seminars for Departmental Representative 's personnel.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Systems Demonstration and Owner's Instruction	Section 20 05 06

Part 2 Products

NOT APPLICABLE

Part 3 Execution

3.1 GENERAL

.1 Instruct Departmental Representative(s) on mechanical systems operations and demonstrate equipment operation as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Test domestic water piping.

.2 Test sanitary sewer piping.

.3 Test sewer vent piping.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Materials Testing	Section 20 05 07

.2 Obtain certificates of approval and acceptance, complying with rules and regulations from authorities having jurisdiction. Submit electronic copies on flash drives and hard copies to be included in Operating and Maintenance Manuals.

.3 Submit electronic copies on flash drives and hard copies of test results in Operating and Maintenance Manuals.

Part 2 Products

2.1 GENERAL

.1 Supply materials necessary to carry out testing procedures defined in the sections listed in Article 1.1 and 1.2.

Part 3 Execution

3.1 GENERAL

.1 Test systems outlined in Article 1.1 as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Performance testing of equipment.

.2 Manufacturer's startup of equipment.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Systems Demonstration and Owner's Instruction	Section 20 05 06
.4	Equipment Testing and Startup	Section 20 05 08
.5	Controls	Section 20 30 Series
.6	HVAC Controls	Section 23 09 Series

Part 2 Products

2.1 GENERAL

.1 Supply all materials necessary to start-up and test mechanical systems as defined in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Start and test mechanical systems and equipment as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Provide meters and gauges and taps where shown on drawings and/or specified herein.

.2 Submit shop drawings of proposed products to the Departmental Representative for review.

.3 Submit data sheets on thermometers and pressure gauges indicating service, and temperature or pressure ranges, to the Departmental Representative for review.

.4 Submit list of all meters, including location, service, flow and corresponding reading for flow.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Meters and Gauges	Section 20 05 19

.2 Refer to drawings, forming part of the contract documents.

Part 2 Products

2.1 GENERAL

.1 Supply materials and equipment defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install meters and gauges as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Ball valves.

.2 Check valves.

.3 Butterfly valves.

.4 Drain valves.

.5 Hose bibbs.

.6 Strainers.

.7 Circuit balancing valves.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Valves and Strainers	Section 20 05 23

1.3 SHOP DRAWINGS

.1 Submit detailed shop drawings clearly indicating make, model, size, pressure rating, materials of construction and intended service.

Part 2 Products

2.1 GENERAL

.1 Supply valves and related components and materials as defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install valves and related components in piping systems and comply with the work defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Pipe hangers and supports.

.2 Flashing for mechanical equipment.

.3 Sleeving for mechanical equipment.

.4 Pipe anchors.

.5 Access doors (in walls and ceilings).

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors	Section 20 05 29

Part 2 Products

2.1 GENERAL

.1 Provide materials required for supporting pipe work and equipment as defined in the sections listed in Article 1.2.

.2 Provide materials required for flashing mechanical work, sleeving and sealing pipe penetrations as defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install pipe and equipment hangers and supports as defined in the sections listed in Article 1.2.

.2 Install flashing, sleeving, sealing and access doors as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Painting and Identification for plumbing systems.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Painting of Mechanical Work Division 09

.2 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	General Painting and Identification	Section 20 05 53
.4	Pipe and Pipe Fittings	Section 20 20 10

1.3 QUALITY CONTROL

.1 Coordinate colour coding of piping and equipment with work of Division 09.

Part 2 Products

2.1 GENERAL

.1 Provide materials for piping and equipment identification as defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install pipe and equipment identification as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Equipment insulation.

.2 Adhesives, tie wires, tapes.

.3 Recovering.

1.2 WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Piping and Equipment Insulation	Section 20 20 30
.4	Identification for Mechanical Systems	Section 20 05 53

Part 2 Products

2.1 GENERAL

.1 Provide materials and accessories as defined in the sections listed in Article 1.2.

2.2 EXECUTION

.1 General

.1 Insulate equipment as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Piping insulation.

.2 Adhesives, tie wires, tapes.

.3 Recovering.

1.2 WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Pipe and Pipe Fittings	Section 20 20 10
.4	Piping and Equipment Insulation	Section 20 20 30
.5	Identification for Mechanical Systems	Section 20 05 53

Part 2 Products

2.1 GENERAL

.1 Provide materials and accessories as defined in the sections listed in Article 1.2.

2.2 EXECUTION

.1 General

.1 Insulate equipment as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Domestic hot and cold water piping systems.

.2 Domestic hot water recirculating systems.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Pipe and Pipe Fittings	Section 20 20 10
.3	Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors	Section 20 05 29
.4	General Painting and Identification	Section 20 05 53
.5	Piping and Equipment Insulation	Section 20 20 30
.6	Expansion Compensation	Section 20 20 40
.7	Testing, Balancing and Adjusting	Section 20 22 00
.8	Domestic Water Piping Specialties	Section 22 11 19
.9	Domestic Water Piping System Cleaning and Disinfecting	Section 22 11 21

Part 2 Products

2.1 GENERAL

.1 Supply materials and accessories as defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install domestic water systems. Test, start and document as defined in the sections listed in Article 1.2.

.2 All domestic hot, cold and domestic recirculation water systems will be required to be flushed and disinfected. Add chlorine to water in system to 50 milligrams per litre and let stand for 24 hours. Check chlorine content after 24 hours and insure the content is not less than 20 milligrams per litre. If less than 20 milligrams per litre repeat process. Flush system until the chlorine content of water being drained is equal to the chlorine content of the make-up water. Utilize plumbing fixtures (i.e. lav, sinks, flushometers, etc.) for drainage. Submit water sample to approved testing lab and report test results.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Cleanouts.

.2 Water hammer arrestors.

.3 Water service connections.

.4 Backflow preventers.

.5 Vacuum breakers.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Pipe and Pipe Fittings	Section 20 20 10

1.3 GENERAL REQUIREMENTS

.1 Provide materials, equipment and labour to install plumbing as required by Territorial and Local Codes as specified herein.

.2 Provide water connections to equipment furnished in other sections of this specification and by the Departmental Representative. Refer to Section 22 05 02, Equipment Supplied by Others.

.3 Provide and include charges for connections to Municipal and Utility Company services, including costs to maintain temporary water supply pending acceptable water quality tests, where applicable.

.4 Provide an approved water meter and bypass installation conforming to Local Codes and Standards.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1	Water Hammer Arrestors:	Zurn, Watts, Ancon
.2	Backflow Preventers:	Febco, Watts, Zurn
.3	Vacuum Breakers:	Febco, Watts, Zurn

2.2 WATER HAMMER ARRESTORS

.1 Air chamber type:

.1 Provide air chambers same size as supply line or 20 mm minimum, and minimum 450 mm long.

.2 Stainless steel belows type:

.1 Brass piston, type 'K' copper casing.

.2 Pressure: test 3450 kPa, operating to 1725 kPa.

.3 Temperature: -54°C to 100°C.

.4 Seals: O-ring seals to NSF61.

.5 Size: according to manufacturer's recommendations and as indicated.

.6 Acceptable material: SMS PPP Inc, Series SC.

2.3 VACUUM BREAKER ASSEMBLIES

.1 Provide pressure type vacuum breaker assembly complete with shut-off valves before and after check valves and test cocks. Assembly shall consist of one (1) positive sealing check valve and one (1) atmospheric vent disk with stainless steel or bronze seats complete with shut-off valves before and after check valves and test cocks. Assembly shall meet AWWA requirements and CSA B64 standards. Watts No. 800.

.2 Provide hose connection type vacuum breaker assembly, consisting of a check valve disc assembly to be vandal proof and drainable. Watts No. 8A. For freezing conditions, Watts No. NF8.

2.4 PRESSURE REDUCING VALVES

.1 25 mm and Smaller:

.2 Bronze body, SS integral strainer, renewable SS seat, high temperature rated diaphragm suitable for hot or cold water. Rated at maximum inlet pressure of 2100 kPa, minimum reduced pressure 175 kPa, maximum temperature 90°C.

.3 30 mm and Larger:

.4 Pilot operated, cast iron body, modified globe design, threaded ends to 50 mm, flanged ends 65 mm and larger. Maximum inlet pressure 1225 kPa 2100 kPa. Maximum temperature 90°C. Bronze trim. Pilot control system: bronze with SS trim, hydraulically operated, diaphragm actuated.

.5 Size to suit flow capacities and service.

.6 Provide with gate valve and union on inlet and outlet, globe valve bypass, pressure gauge on inlet and outlet and pressure relief valve on reduced pressure side.

2.5 REDUCED PRESSURE BACKFLOW PREVENTER (WATER SERVICE)

.1 Reduced pressure principle backflow preventer, dual resilient seated spring loaded poppet type check valved, hydraulically dependent differential pressure relief valve, ,top entry design, replaceable EPDM discs, FDA epoxy coated ductile iron body and steel cover, SS springs and fasteners, bronze seats. Full port ball valve test cocks.

.2 Line size OS&Y isolation valves upstream and downstream of assembly.

.3 Maximum working pressure: 1205 kPa.

.4 Working temperature range: 0.5°C to 60°C.

.5 ULC, FM approved and to CSA B64.4

.6 Straight pattern.

.7 Acceptable material: Conbraco 40-200 Series, Watts.

2.6 BACKFLOW PREVENTERS(GENERAL DUTY)

.1 To CSA-B64 Series.

.2 Bronze body and covers, reduced pressure principal, dual mechanical stainless steel spring loaded poppet check valves, hydraulically dependent differential pressure relief valve, cast brass body, four test costs, dual full port ball shutoff valves.

.3 Approvals: CSA B64.4

.4 Max working pressure: 1205 kPa.

.5 Temperature range: 1°C to 82°C.

.6 Size: Line size.

.7 Acceptable Material: Conbraco Series 40-200 w/ ball valves, Watts.

.8 Application: general backflow prevention.

2.7 CONTINUOUS PRESSURE BACKFLOW PREVENTERS (GENERAL SERVICE)

.1 Continuous pressure, rough brass, CSA approved, 13diam.

.2 Acceptable Material: Conbraco 40-403 Series, Watts.

.3 Application: general backflow prevention where approved by the Departmental Representative.

2.8 AIR GAP DRAINS

.1 Cast bronze, epoxy coated, connects to RPBP valve body, threaded outlet.

.2 Acceptable material: Conbraco 40-200 AGD, Watts.

Part 3 Execution

3.1 INSTALLATION

.1 Install approved backflow preventer or vacuum breaker assemblies on water lines where contamination of domestic water may occur and where indicated. Generally necessary on boiler make-up lines, sprinkler mains, hose bibbs and flush valves and where required by the authority having jurisdiction.

.2 Install pressure reducing valves to limit maximum static pressure at plumbing fixtures to 550 kPa or to the rated maximum operating pressure of the devices downstream, whichever is lower.

.3 Reduced pressure backflow preventers shall be mounted in easily serviceable locations within 1500mm of floor. (ie. in mechanical room. Not in ceiling spaces.)

.4 Reduced pressure backflow preventers to be mounted in the horizontal position. Double checks can be in horizontal or vertical, depending on manufacturers installation instructions.

3.2 SERVICE CONNECTION

.1 Provide new water meter with bypass valves.

.2 Rising stem isolation valve c/w tamper-switch.

3.3 BACKFLOW PREVENTER ASSEMBLIES

.1 Install line size reduced pressure backflow preventer on each water service supply.

.2 Install line size reduced pressure backflow preventer assembly on water supply to: direct connected boiler make-up.

.3 Provide an air gap funnel floor drain under each reduced pressure backflow preventer. Pipe drain to sanitary sewer.

.4 Test and verify all backflow preventer assemblies in accordance with the requirements of authorities having jurisdiction. Provide certification sheets for insertion in O & M manuals.

3.4 VACUUM BREAKERS

.1 Install vacuum breaker on all hose bibbs.

.2 Install vacuum breaker on water supplies to dishwasher, flushometer valves, laundry machine, water heating/cooling coils, water closets, urinals, laundry sinks.

.3 Provide air gaps on all atmospheric drains such as drains from coils, blowdowns, tanks, equipment, riser drains, relief valve discharge.

3.5 WATER HAMMER ARRESTORS

.1 Fit supply to each fixture with air chamber.

.2 Provide stainless steel bellows type arrestor for each fixture group supply of greater than three fixtures.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Provide for flushing and disinfection of domestic water systems.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Pipe and Pipe Fittings	Section 20 20 10
.4	Domestic Water Piping	Section 22 11 16

Part 2 Products

2.1 GENERAL

.1 Provide materials required for flushing and disinfecting domestic water piping systems as defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Flush and disinfect domestic water piping systems. Submit documentation as outlined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Domestic drainage and vent piping systems.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors	Section 20 05 29
.3	Pipe and Pipe Fittings	Section 20 20 10
.4	Sanitary Waste Piping Specialties	Section 22 13 19

Part 2 Products

2.1 GENERAL

.1 Supply piping and accessories defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install domestic waste and vent piping, test and document as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Cleanouts.

.2 Floor drains.

.3 Sumps.

.4 Sanitary sewer service connections.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Pipe and Pipe Fittings	Section 20 20 10
.4	Sanitary Waste and Vent Piping	Section 22 13 16

1.3 GENERAL REQUIREMENTS

.1 Provide materials, equipment and labour to install plumbing as required by Territorial and Local Codes as specified herein.

.2 Provide drainage connections to equipment furnished in other sections of this specification and by the Departmental Representative. Refer to Section 22 05 02, Equipment Supplied by Others.

.3 Provide and include charges for connections to Municipal and Utility Company services.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1	Cleanouts:	Zurn, Ancon
.2	Floor Drains:	Zurn, Watts, Ancon

2.2 CLEANOUTS

.1 Provide caulked or threaded type extended to finished floor or wall surface. Ensure ample clearance at cleanout for rodding of drainage system.

2.3 FLOOR DRAIN – REGULAR (FD-1)

.1 Watts #FD-100-C-7-6-A5-1 Floor Drain - epoxy coated, cast iron body, reversible flashing clamp with primary and secondary weepholes, vandal proof, trap primer connection with plug, no hub outlet. Watts -A5-1 5" (127 mm) diameter, nickel bronze, adjustable round strainer.

2.4 FLOOR DRAIN – FUNNEL (FFD-1)

.1 Watts #FD-320-7-4-F4-50 Floor Drain - epoxy coated, cast iron body, body collar with weepholes and membrane clamp, trap primer connection with plug, anchor flange, no hub outlet. Watts -4-

F4-50 7-7/8" (200 mm) diameter, epoxy coated ductile iron, heel-proof, round grate, 4"Ø (102 mm) cast iron funnel.

2.5 EQUIPMENT DRAINS

.1 Provide a sloped connection from packaged equipment drain pans to nearest sanitary sewer trapped connection. Slope at minimum of 0.5% grade. Drain size to be 25 mm. Trap at unit is to be deep enough to ensure a 50 mm water seal at the maximum total pressure of the fan system.

2.6 VENT FLASHINGS

.1 CSA approved stainless steel flashing sleeve with integral deck flange, premoulded urethane insulation liner, EPDM Triple Pressure Grommet Seal and EPDM Base Seal.

.2 Acceptable Material: Thaler SJ-37. This is the only acceptable material.

2.7 TRAP GUARDS

.1 Material: Smooth, soft, flexible, elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at bottom.

.2 Operation: Allows wastewater to open and adequately discharge floor drain through its interior and closes and returns to original molded shape after wastewater discharge is complete.

.3 Compliance: NSK/ANSI 14, CSA B79.

.4 Acceptable material: ProSet Systems Trap Guard.

Part 3 Execution

3.1 INSTALLATION

.1 Lubricate cleanout plugs with mixture of graphite and linseed oil. Prior to building turnover, remove cleanout plugs, re-lubricate and re-install using only enough force to ensure permanent leakproof joint.

.2 Floor drains located in floating floors with no membrane provide lead flashing pan. 900 mm x 900 mm at 39 kg/m². Flash membrane or lead into flashing clamp on drain body.

.3 Drainage lines shall grade 2% per foot unless otherwise noted on drawings.

.4 Plumbing vents shall be located minimum 5 m from air intakes.

3.2 TRAP GUARDS

.1 Provide for all floor drains.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Storm drainage piping.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors	Section 20 05 29
.3	Pipe and Pipe Fittings	Section 20 20 10
.4	Piping and Equipment Insulation	Section 20 20 30

Part 2 Products

2.1 GENERAL

.1 Supply materials and accessories as defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install storm sewer system drainage piping and equipment as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Cleanouts.

.2 Roof drains.

.3 Storm sewer service connections.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Piping and Equipment Insulation	Section 20 20 30
.4	Facility Storm Drainage Piping	Section 22 14 13

1.3 GENERAL REQUIREMENTS

.1 Provide materials, equipment and labour to install plumbing as required by Territorial and Local Codes as specified herein.

.2 Provide and include charges for final building connections to Municipal and Utility Company services where required.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Cleanouts: Watts, Zrun, Ancon

.2 Roof Drains: Watts, Zurn, Ancon

2.2 CLEANOUTS AND CLEANOUT ACCESS COVERS

.1 Provide caulked or threaded type extended to finished floor or wall surface. Provide bolted coverplate cleanouts on vertical rainwater leaders only. Ensure ample clearance at cleanout for rodding of drainage system.

.2 Floor cleanout access covers in unfinished areas shall be round with nickel bronze scoriated frames and plates. Provide round access covers in finished areas with depressed centre section to accommodate floor finish. Wall cleanouts to have chrome plated caps.

2.3 ROOF DRAINS

.1 Flow Characteristics: Full open flow.

Part 3 Execution

3.1 INSTALLATION

.1 Lubricate cleanout plugs with mixture of graphite and linseed oil. Prior to building turnover, remove cleanout plugs, re-lubricate and re-install using only enough force to ensure permanent leakproof joint.

.2 Drainage lines shall grade 2% per foot unless otherwise noted on drawings.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Documentation	Section 20 05 05
.3	Equipment Testing and Startup	Section 20 05 08
.4	Systems Demonstration and Instruction	Section 20 05 06

1.2 REFERENCES

.1 ISO 9001 Quality Management System.

.2 NSF/ANSI Standard 61- Drinking Water System Components

.3 ASTM G123 - 00(2005) “Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution.

.4 ASME Boiler and Pressure vessel code, section IV, Part HLW.

1.3 QUALITY ASSURANCE

.1 Thermal efficiency and standby loss shall meet the requirements of ASHRAE 90.1.

.2 Listing: The entire water heater will be listed ETL listed to a recognized commercial test standard for water heaters.

.3 ASME Compliance: Water heater shall bear the ASME HLW stamp and be National Board listed

.4 Water heater manufacturer shall be certified with ISO 9001 Quality Management System.

1.4 WARRANTY

.1 Storage Tank: 10-year coverage for manufacturing or material defects, leaks, production of rusty water and/or chloride stress corrosion cracking. Tank warranty does not require inspection and maintenance of anode rods.

.2 All other heater parts: 1 year

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Electric Hot Water Heaters: AO Smith, Bradford White

2.2 ELECTRIC DHWH

.1 General: Light duty commercial electric, glass-lined storage tank with immersion type heating elements.

.2 Approvals: .ASME, NSF and UL approved. To CAN/CSA C22.2 No.110, CAN/CSA-C191 and CAN/CSA-C309.

.3 Tank: steel, glass lined with alkaline borosilicate fused to steel by firing at a temperature of 871degC.

.4 Rated pressure: 1034kPa.

.5 Cathodic protection: extruded magnesium anode

.6 Jacket: steel, backed enamel finish.

.7 Insulation: foam insulation to exceed requirements of latest edition of ASHRAE 90.1.

.8 Elements: heat duty medium watt density, incoloy sheathing and pre wired leads.

.9 Thermostat: immersion type, close differential with control range 35degC to 82degC.

.10 Control circuit: 120v, fused transformer.

.11 Contactors: heat duty UL rated, 100 000 cycle rated.

.12 Control cabinet: hinged, house 120v control circuit transformer, transformer fusing, magnetic contactor(s), thermostats, high limit thermostats, element fusing to NEC and elements with pre wired terminal leads.

.13 Acceptable material: See schedule on drawings.

2.3 TRIM AND INSTRUMENTATION

.1 Drain Valve: full port ball valve, minimum 19 dia as per Section 22 05 23, General Duty Valves and Strainers for Plumbing Systems.

.2 Thermometer; as per Section 20 05 19, Meters and Gauges.

.3 Pressure Gauge: as per Section 20 05 19, Meters and Gauges.

.4 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.

2.4 ANCHOR BOLTS AND TEMPLATES

.1 Supply for installation by other Divisions.

2.5 DOMESTIC HOT WATER TANK INSULATION AND JACKETS

.1 Insulated to ASHRAE 90.1-2010 requirements.

.2 Enameled steel panel finish.

Part 3 Execution

3.1 INSTALLATION

.1 Install in strict accordance with manufacturers recommendations.

.2 Pipe discharge from P&T relief valve to nearest floor drain.

.3 Prior to startup, certify the installation is consistent with manufacturers recommendations.

.4 Attend startup and assist the mechanical trade to adjust controls and put the system into operation. Refer to Section 20 05 08, Equipment Testing and Startup.

END OF SECTION

Part 1 General

1.1 INTENT

.1 Provide complete, fully tested and operational HVAC systems to meet requirements described herein and in complete accord with applicable codes and ordinances.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following section:

.1 General Mechanical Provisions Section 20 05 01

Part 2 Products

NOT APPLICABLE

Part 3 Execution

NOT APPLICABLE

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Motors integral with mechanical equipment.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Electric Motors	Section 20 05 03
.3	Variable Frequency Drives	Section 20 05 04

.2 Refer to Division 26 and confirm motor voltage and phase requirements.

Part 2 Products

2.1 GENERAL

.1 Factory install electric motors on motor driven mechanical equipment as defined in this section.

Part 3 Execution

3.1 GENERAL

.1 Start, test and put into operation all motor driven equipment as defined in this section.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Scope of work is to provide variable frequency drives complete with controls for HVAC equipment as identified in the motor schedule.

.2 Coordination with the contractor, delivery dates, equipment start up and technical support for the installing contractor.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Electric Motors – Three Phase	Section 20 05 03
.3	Variable Frequency Drives	Section 20 05 04
.4	Systems Demonstration and Instruction	Section 20 05 06
.5	Materials Testing	Section 20 05 07
.6	Equipment Testing and Startup	Section 20 05 08
.7	Controls	Section 20 30 Series
.8	HVAC Controls	Section 23 09 Series
.9	Electrical	Division 26

Part 2 Products

2.1 GENERAL

.1 Supply variable frequency drive equipment and accessories defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install, test, adjust and put variable frequency motor drives into operation as defined in the sections listed in Article 1.2.

.2 Provide documentation, test results, Departmental Representative's instructions and demonstrations, O&M Manuals as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Secure and assemble all necessary literature describing the operation and maintenance of all HVAC equipment provided. Complete and transmit documentation for review to Departmental Representative at project milestones.

.2 Operating and Maintenance Manuals.

.3 Record Drawings.

.4 Vendors certifications confirming their equipment is correctly installed prior to start-up and testing.

.5 Vendors start-up and test reports.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Equipment Testing and Startup	Section 20 05 08

Part 2 Products

2.1 GENERAL

.1 Provide materials defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Provide shop drawings, start-up and test results, O&M Manuals, and other documentation defined in the sections listed in Articles 1.1 and 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Demonstration of HVAC equipment and systems operations.

.2 Instruction seminars for Owner's personnel.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Systems Demonstration and Instruction	Section 20 05 06

Part 2 Products

NOT APPLICABLE

Part 3 Execution

3.1 GENERAL

.1 Deliver systems demonstration and instructions to the Departmental Representative as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Test low velocity ducts.

.2 Test refrigerant piping

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Materials Testing	Section 20 05 07

.2 Obtain certificates of approval and acceptance, complying with rules and regulations from authorities having jurisdiction. Submit copies to be included in Operating and Maintenance Manuals.

.3 Submit copies of test results in Operating and Maintenance Manuals.

Part 2 Products

2.1 GENERAL

.1 Provide all equipment and materials required to complete systems testing as defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Test all systems defined in Article 1.1. Provide documentation and test in accordance with procedures outlined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Performance testing of equipment.

.2 Manufacturer's startup of equipment.

.3 Submit copies of startup and test reports in Operating and Maintenance Manuals.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Systems Demonstration and Instruction	Section 20 05 06
.4	Equipment Testing and Startup	Section 20 05 08

1.3 RELATED REQUIREMENTS

.1 General Requirements Division 01

.2 Commissioning of Electrical Systems Division 26

Part 2 Products

2.1 GENERAL

.1 Provide materials and equipment required to complete work defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Complete HVAC systems start-up, testing, demonstrations, Departmental Representative's instructions and documentation defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Intake/exhaust louvres.

.2 Duct penetrations through building envelope.

.3 Pipe penetrations through building envelope.

.4 Flue penetrations through building envelope.

1.2 QUALIFICATIONS

.1 Installation work by competent qualified tradesman only.

Part 2 Products

2.1 MATERIALS

.1 Counterflashings - galvanized sheet steel of 0.8 mm minimum thickness.

Part 3 Execution

3.1 WORKMANSHIP

.1 Counterflashings for mechanical equipment shall lap the base flashings on the roof curbs.

.2 All joints in counterflashings shall be flattened and soldered double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around the top edge. Storm collars shall be used above all gum cups.

.3 Vertical flange section of storm collars shall be screwed to face curb.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Flexible pipe connections.

.2 Expansion joints and compensators.

.3 Pipe loops, offsets, and swing joints.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Pipe and Pipe Fittings	Section 20 20 10
.3	Expansion Compensation	Section 20 20 40
.4	Vibration Isolation	Section 20 05 48

Part 2 Products

2.1 GENERAL

.1 Supply equipment, materials and related accessories defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install piping systems with components and procedures as defined in the sections outlined in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Expansion tanks.

.2 Accessories and connection to piping system.

.3 Saddles and structural supports.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Tanks	Section 20 15 00

Part 2 Products

2.1 GENERAL

.1 Supply equipment, materials and accessories defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install tanks in systems as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Provide meters and gauges where shown on drawings and/or specified herein.

.2 Submit shop drawings of proposed products to the Departmental Representative for review.

.3 Submit data sheets on thermometers and pressure gauges indicating service, and temperature or pressure ranges, to the Departmental Representative for review.

.4 Submit list of all meters, including location, service, flow and corresponding reading for flow.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Meters and Gauges	Section 20 05 19

Part 2 Products

2.1 GENERAL

.1 Supply materials and equipment defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install meters, gauges and taps as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Globe or angle valves.

.2 Check valves.

.3 Ball valves.

.4 Butterfly valves.

.5 Drain valves.

.6 Strainers.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Valves and Strainers	Section 20 05 23
.4	Pipe and Pipe Fittings	Section 20 20 10

Part 2 Products

2.1 GENERAL

.1 Supply valves and related components and materials as defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install valves and related components in piping systems and comply with the work defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Pipe hangers and supports.

.2 Duct hangers and supports.

.3 Sleeving for mechanical equipment.

.4 Pipe anchors.

.5 Access doors (in walls and ceilings).

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors	Section 20 05 29

Part 2 Products

2.1 GENERAL

.1 Provide materials required for supporting piping, ductwork and equipment installations as defined in the sections listed in Article 1.2.

.2 Provide materials required for sealing pipe and duct penetrations as listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install pipe, duct and equipment hangers and supports as defined in the sections listed in Article 1.2.

.2 Install sleeving, sealing and access doors as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Supply all labour, materials, and equipment required and necessary to isolate and restrain the equipment as indicated on the drawings and specified herein and guarantee the function of the materials and equipment supplied.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Equipment Testing and Startup	Section 20 05 08
.4	Vibration Isolation	Section 20 05 48
.5	Expansion Compensation	Section 20 20 40
.6	Air Duct Accessories	Section 23 33 13

Part 2 Products

2.1 GENERAL

.1 Supply equipment, materials and accessories defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install vibration isolation on systems and equipment defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Painting and identification for heating, ventilation, air conditioning and refrigeration systems.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Equipment Testing and Startup	Section 20 05 08
.4	Vibration Isolation	Section 20 05 48
.5	General Painting and Identification	Section 20 05 53

Part 2 Products

2.1 GENERAL

.1 Provide all materials and accessories required to complete HVAC systems painting and identification work defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Paint and identify HVAC systems as defined in sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Prepare the facility for balancing.

1.2 RELATED REQUIREMENTS

.1	Starting and Adjusting	Division 01
.2	Commissioning	Division 01

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	Starting and Adjusting Equipment Prior to Balancing	Division 01
.2	General Mechanical Provisions	Section 20 05 01
.3	Documentation for HVAC Systems	Section 23 05 05

Part 2 Products

NOT APPLICABLE

Part 3 Execution

3.1 INSTALLATION

.1 Bring the work to an operating state and ready for balancing, including:

- .1 Clean equipment and ductwork.
- .2 Install air terminal devices.
- .3 Provide temporary filters in air handling equipment and carry out a rough air balance to ensure all equipment performs required function.
- .4 Replace filters with specified filters prior to final balancing.
- .5 Verify lubrication of equipment.
- .6 Install permanent instrumentation.
- .7 Complete the "start-up" of equipment.
- .8 Check rotation and alignment of rotating equipment and tension of belted drives.
- .9 Set control points of automatic apparatus, check-out sequence of operation.
- .10 Make available control diagrams and sequence of operation.
- .11 Clean work, remove temporary tags, stickers, and coverings.
- .12 Make available one (1) copy of Maintenance Manuals especially for use in balancing.
- .13 Provide Balancing Agency a complete set of mechanical drawings and specifications.

.2 Cooperate with the Balancing Agency as follows:

- .1 Make corrections as required by Balancing Agency.

.2 Allow Balancing Agency free access to site during construction phase. Inform Balancing Agency of any major changes made to systems during construction and provide a complete set of record drawings for their use.

.3 Provide and install any additional balancing valves, dampers, and other materials requested by the balancing agency and/or necessary to properly adjust or correct the systems to design flows.

.4 Provide and install revised pulleys and sheaves for rotating equipment and shave pump impellers, as required to properly balance the systems to design flows. Obtain requirements from balancing agency (Refer to Section 23 05 93, Testing, Adjusting and Balancing for HVAC Systems).

.5 Operate automatic control system and verify set points during Balancing.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Balance, adjust, and test air and liquid systems and equipment and submit reports using identical units to those shown on contract documents.

.2 Obtain sound level readings and submit reports for no less than 5% of the rooms within the building. Rooms where readings to be taken to be selected by the Departmental Representative.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Testing, Balancing and Adjusting	Section 20 22 00

Part 2 Products

2.1 GENERAL

.1 Provide all equipment and materials required to complete testing, adjusting and balancing as defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Carry out testing, balancing and adjusting procedures and submit documentation as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Duct thermal insulation.

.2 Duct acoustic insulation.

.3 Breeching insulation.

.4 Adhesives, tie wires, tapes.

.5 Recovery.

.6 Duct acoustic lagging.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following section:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Piping and Equipment Insulation	Section 20 20 30

1.3 REFERENCE DOCUMENTS

.1 American Society for Testing and Materials (ASTM):

.1	ASTM B209M	Specification for Aluminum and Aluminum Alloy Sheet and Plate
.2	ASTM C335	Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation
.3	ASTM C411	Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation
.4	ASTM C423	Standard Test Method for Sound Absorption and Sound Absorption Coefficients by Reverberation Room Method
.5	ASTM C449	Standard for Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
.6	ASTM C553	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
.7	ASTM C921	Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
.8	ASTM C1071	Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
.9	ASTM G21	Standard of Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

.2 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

.1	ASHRAE 90.1	Energy Standard for Buildings Except Low-Rise Residential Buildings

.3 Canadian General Standards Board (CGSB):

.1	CAN/CGSB-51.2	Thermal Insulation, Calcium Silicate for Piping, Machinery and Boilers

.2	CAN/CGSB-51.9	Mineral Fiber Thermal Insulation for Piping and Round Ducting
.3	CAN/CGSB-51.10	Mineral Fibre Board Thermal Insulation
.4	CAN/CGSB-51.11	Mineral Fibre Thermal Insulation Blanket
.5	CAN/CGSB-51.12	Thermal Insulating and Finishing Cement
.6	CGSB 51-GP-52Ma	Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation

.4 Model National Energy Building Code of Canada for Buildings

.5 National Fire Protection Association (NFPA):

.1	NFPA 255	Standard Method of Test of Surface Burning Characteristics of Building Materials

.6 Underwriters Laboratories of Canada (ULC):

.1	CAN/ULC S102	Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.4 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.5 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's product data in accordance with Section 20 05 05 – General Documentation.

.1 Submit product data and test reports when requested to substantiate that insulation and recovery assemblies meet flame/smoke development ratings and performance requirements for the assembly and thickness used.

.2 Submit information showing installed insulation and membrane products meet the requirements of ASHRAE 90.1.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 20 05 05 – General Documentation.

.1 Submit an insulation schedule, for each application include the following information:

.1 Materials
.2 "k" value
.3 Thickness
.4 Density
.5 Finish
.6 Jacketing

1.6 DEFINITIONS

.1 For the purposes of this section, the following definitions apply:

.1 Concealed: ductwork and equipment in shafts, furring, suspended ceilings and attics.

.2 Exposed: ductwork and equipment in mechanical rooms or otherwise not "concealed".

.3 "k" Value: thermal conductivity of insulating material per unit of thickness (W/m.°C) to ASTM C553.

1.7 FLAME/SMOKE DEVELOPMENT RATINGS

.1 Duct insulation, recovery materials, vapour barrier facings, tapes and adhesives shall have maximum flame spread rating of 25 and maximum smoke developed less than or equal to 50, when tested in accordance with CAN/ULC S102.

.2 Insulating materials and accessories shall withstand service temperatures without smoldering, glowing, smoking or flaming when tested in accordance with ASTM C411.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Separate waste materials for reuse and recycling in accordance with Division 01.

Part 2 Products

2.1 HOT DUCT INSULATION

.1 Hot Duct Insulation - Round and Oval:

.1 Material: flexible mineral fibre blanket insulation to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.

.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature.

.3 Service Temperature: 20°C to 65°C.

.2 Hot Duct Insulation - Rectangular

.1 Material: rigid mineral fibre insulation to ASTM C612 with factory applied vapour retarder jacket to CGSB 51-GP-51Ma.

.2 "k" Value: maximum 0.035 W/m.°C at 24°C mean temperature.

.3 Service Temperature: 20°C to 65°C.

.3 Hot Duct Insulation - Round & Rectangular (Exposed to Outdoors):

.1 Material: semi-rigid mineral fibre in roll form.

.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature

.3 Service Temperature: -40°C to 65°C.

.4 Jacket: factory applied reinforced aluminum for vapour barrier to CGSB 51-GP-52Ma.

2.2 COLD DUCT INSULATION

.1 Cold Duct Insulation - Round and Oval:

.1 Material: flexible mineral fibre blanket insulation to CAN/CGSB-51.11.

.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature.

.3 Service Temperature: -40°C to 65°C.

.4 Jacket: factory applied reinforced aluminum foil vapour barrier to CGSB 51-GP-52Ma.

.2 Cold Duct Insulation - Round & Rectangular (Exposed to Outdoors):

.1 Material: semi-rigid mineral fibre in roll form.

.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature

.3 Service Temperature: -40°C to 65°C.

.4 Jacket: factory applied reinforced aluminum for vapour barrier to CGSB 51-GP-52Ma.

.3 Cold Duct Insulation - Rectangular:

.1 Material: rigid mineral fibre insulation to CAN/CGSB-51.10.

.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature.

.3 Service Temperature: 20°C to 65°C.

.4 Jacket: factory applied reinforced aluminum foil vapour barrier to CGSB 51-GP-52Ma.

2.3 DUCT LINER

.1 General:

.1 To requirements of CAN/CGSB-51.11 and CAN 4-S102.

.2 Fibrous glass duct liner of inorganic glass fibers bonded by thermosetting resin.

.3 Mat faced.

.4 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with ASTM E84-01, UL 723 and ANSI/NFPA 255.

.2 Density: 24 kg/m№ minimum.

.3 Thermal resistance: minimum 0.74 W/m.ºC for 25 mm thickness when tested in accordance with ASTM C177, at 24ºC mean temperature.

.4 Operating temperature: to 121ºC.

.5 Vapor absorption: less than 3% by weight to ASTM C1104/C1104M.

.6 Microbial growth: mat finish treated with EPA registered anti-microbial agent.

.7 Sound absorption: at 24 kg/m^3 and 25 mm thickness to ASTM C423 absorption coefficients as follows:

Hz	125	250	500	1000	2000	4000	NRC
	.18	.36	.59	.86	.95	.90	.70

.8 Acceptable Material: Knauf Liner E-M.

2.4 EXTERNAL DUCT ACOUSTIC LAGGING

.1 Vinyl reinforced aluminum facing, nominal 25mm thick quilted fiberglass decoupler, scrim backing.

.2 Composite weight: 1.0 lb/ft^2

.3 Thickness: 25 mm.

.4 Flame spread: 10 to ASTM E84

.5 Smoke spread: 40 to ASTM E84

.6 Service temperature: -40ºC to 104ºC.

.7 STC Rating: 27

.8 Performance: in accordance with ASTM E90-90.

Hz	125	250	500	1000	2000	4000
Transmission Loss (db)	15	19	21	28	33	37

.9 Acceptable Material: Wilrep Ltd. Barymat FRC.

2.5 BREECHING INSULATION

.1 Material: Semi-rigid mineral fibre with glass mat.

.2 "k" Value: Maximum 0.038 W/m°C at 24°C mean temperature.

.3 Service Temperature: 65°C to 450°C.

2.6 SOLID & PERFORATED METAL LINING

.1 22 gauge perforated with 3 mm hole staggered galvanized sheet metal liner.

2.7 ACCESSORIES

.1 FSK Tape: vapour barrier tape consisting of laminated aluminum foil, glass fiber scrim and paper, with pressure sensitive self adhesive.

.2 ASJ Tape: vapour resistant tape consisting of all service jacket material with pressure sensitive self adhesive.

.3 Contact Adhesive: quick setting, adhesive to adhere flexible or rigid mineral fibre insulation to ducts.

.4 Lap Seal Adhesive: quick setting adhesive for joints and lap sealing of vapour barriers.

.5 Canvas Adhesive: dilute, washable, fire retardant lagging adhesive for cementing canvas jacket to duct insulation.

.6 Pins: welding pins 4 mm diameter shaft with 35 mm diameter head for installation through the insulation. Length to suit thickness of insulation with 32 mm square nylon retaining clips.

.7 Finishing Cement: to CAN/CGSB-51.12, Type 1 - mineral fibre hydraulic setting thermal insulating and finishing cement for use up to 650°C.

2.8 RECOVERY MATERIALS

.1 Canvas: ULC listed, 220 g/m^2 plain weave cotton fabric treated with fire retardant lagging adhesive to ASTM C921.

.2 Aluminum Jacket: ASTM B209, 0.5 mm thick stucco embossed corrugated with aluminum alloy butt straps and vapour barrier secured with mechanical fastener.

Part 3 Execution

3.1 INSTALLATION, GENERAL

.1 Ductwork dimensions shown on drawings are clear inside free area measurement regardless of insulation placement or thickness. Fabricate ducts accordingly.

.2 Apply insulation after required duct system tests have been completed and inspected by the Departmental Representative.

.3 Ensure duct surfaces are clean and dry before installing insulation.

.4 Install insulation over entire surface of duct, for full length of duct run including portions of duct passing penetrations through walls and floors unless otherwise noted.

.5 Install insulation in a manner to insure hangers and standing duct seams do not penetrate insulation.

.6 Locate finished seams in least visible location.

.7 Do not insulate ductwork with external thermal insulation where acoustic duct insulation has been specified.

.8 Do not insulate ductwork located within conditioned occupied spaces.

.9 Install insulation at ambient temperatures within acceptable temperature ratings for tapes, sealants and adhesives.

3.2 HOT DUCT INSULATION APPLICATION

.1 Adhere insulation to round and oval ductwork with contact adhesive applied in 150 mm wide strips on 400 mm centres. Band on outside with wire until adhesive has set.

.2 Butt insulation and seal joints with lap seal adhesive; cover joint ASJ tape.

.3 Secure rigid insulation on rectangular ducts with 50% area coverage using contact adhesive, impale on pins located 400 mm on centre, secure in place with retaining clips.

.4 Butt rigid insulation on rectangular ducts and seal joints with lap seal adhesive; cover joints with 100 mm strips of open mesh cloth imbedded between two coats of lap seal adhesive.

3.3 COLD DUCT INSULATION APPLICATION

.1 Adhere mineral fibre insulation to round and oval ductwork with adhesive applied in 150 mm wide strips on 400 mm centres. Band on outside until mastic sets then remove bands.

.2 Butt mineral fibre insulation and seal joints with lap seal adhesive; cover joint with FSK tape.

.3 Secure rigid insulation on rectangular ducts with 50% area coverage of adhesive and impale on pins located 400 mm on centre and secure in place with the retaining clips.

.4 Butt rigid insulation on rectangular ducts and seal joints with lap seal adhesive; cover joints with 100 mm strips of open mesh cloth imbedded between two coats of lap seal adhesive.

3.4 ACOUSTIC DUCT INSULATION APPLICATION

.1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.

.2 Install in accordance with manufacturer's recommendations, and as follows:

.1 Fasten to interior sheet metal surface with 100% coverage of adhesive.

.2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres. Utilize aluminum pins for all acoustic duct insulation within aluminum ductwork (AHU-1.1 Supply air and Return air Plenums).

.3 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:

.1 Bed tape in sealer.

.2 Apply two coats of sealer over tape.

.4 Replace damaged areas of liner at discretion of the Departmental Representative.

.5 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

.6 Provide internal perforated metal liner on all acoustically lined round ducts.

.7 Provide acoustic lining where indicated and to the following schedule, whichever is greater:

.1 S/A mains: from AS unit or fan discharge a minimum 5m.

.2 R/A mains: a minimum 3 m upstream of AS unit or fan inlet.

.3 E/A mains: a minimum 3 m up and downstream of all EF.

.4 Transfer Air Ducts: for full length of duct.

3.5 BREECHING INSULATION APPLICATION

.1 Face breeching with 9.5 mm rib lath turn out to provide 12 mm space between insulation and hot surface and 12.5 mm mesh expanded lath on the outside.

.2 Butt insulation firmly together and secure with 1.6 mm galvanized wire.

.3 Lace metal mesh together. Coat with 12 mm thick finishing cement. Finish with a final 12 mm coat of finishing cement with 25% by weight of Portland cement. Trowel to a smooth hard finish.

3.6 EXPOSED DUCTS

.1 Finish exposed and insulated ducts with canvas jacket suitable for paint finish.

.2 Do not insulate exposed supply air ducts located in finish architectural spaces.

3.7 INSULATION TYPE AND THICKNESS SCHEDULE

Service Type	Insulation Type	Insulation Thickness (mm)
Exhaust and relief ducts up to BDD or CD	Hot duct	100
Relief ducts and plenums	Hot duct	25
Supply ducts and plenums	Hot duct	25
Combustion air	Cold duct	50
Outside air	Cold duct	100
Mixing plenums	Cold duct	50
Supply air plenums	Cold duct	25
Low pressure supply ducts	Cold duct	25
Ventilation equipment	Cold duct	50
High and Medium pressure supply ducts	Acoustic	50
Low pressure supply and return	Acoustic	25 (50 where noted)
Low pressure exhaust	Acoustic	25
Plenums	Acoustic	50
Boilers & Fuel-fired Appliances	Breeching	50

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Piping insulation.

.2 Adhesives, tie wires, tapes.

.3 Recovering.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Piping and Equipment Insulation	Section 20 20 30
.4	Identification for Mechanical Systems	Section 20 05 53

Part 2 Products

2.1 GENERAL

.1 Supply pipe and equipment insulation materials as defined in the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Insulate pipe and equipment as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 RELATED SECTIONS

.1 Section 01 91 13 - General Commissioning

.2 Section 01 91 31 - Commissioning Plan

.3 Section 01 91 33 - Commissioning Forms

.4 Section 01 91 41 - Commissioning Training

.5 Section 26 08 00 - Commissioning of Electrical Systems

1.3 QUALITY ASSURANCE

.1 The commissioning shall be executed in accordance with the intent of Section 01 91 13 General Commissioning and referenced sections.

1.4 GENERAL

.1 Be responsible for the performance and commissioning of all equipment supplied under the Sections of Divisions 21, 22, 23, 25. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.

.2 In consultation with the General Contractor, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems.

.3 Fully cooperate with the Commissioning Authority.

.4 Refer to related sections for additional requirements.

1.5 COMMISSIONING AND DEMONSTRATION

.1 The commissioning agent can be part of the contracting team or an independent third party. If the commissioning agent is part of the contracting team, this individual can only participate in the construction of the facility as a Commissioning Agent.

.2 The mechanical contractor will collaborate with commissioning agent to coordinate the commissioning process specified under this division and

those items of other Divisions which interact with work of this Division as outlined herein, including the complete life safety system.

.2 The cooperation of all trades is essential for an efficient and planned process. A team comprising the following is recommended:

.1 Commissioning Authority

.2 General Contractor

.3 Mechanical Contractor's Supervisor

.4 Mechanical Consultant

.5 Building Owner's Representative

.6 Mechanical Trades: especially Controls Contractor & TAB Agency.

.7 Electrical Trades

.3 Prepare a commissioning statement for each of the four [4] phases that the process is perceived to be worked through. In sequence, the phases are expected to be:

.1 PHASE 1 - System readiness.

.2 PHASE 2 - System start-up, testing, balancing etc..

.3 PHASE 3 - Verification of system performance.

.4 PHASE 4 - Demonstration & instruction.

.4 Each phase is applicable to each major and/or separate system making up the work in Divisions 21, 22, 23, 25 plus Divisions 26, 27, 28 interfaces as applicable.

.5 Regular meetings shall be held during the commissioning process. Minutes of the meetings shall be issued to all contractors involved, the Consultant and the Owners representative.

.6 Plan the work to be specific in respect of personnel, schedule, review and laboratory tests.

.1 Personnel: Assign direct overall charge of commissioning to a person (the commissioning coordinator) fully qualified through practical experience and a comprehensive knowledge of the interactive nature of building systems and their controls to understand the complete system and be available to carry the project through to total completion. This person shall be responsible for Commissioning, Demonstration to the Consultant and Owner and Certifications of Substantial and Total Performance.

.2 Schedule: Submit a schedule, as part of the construction schedules, for the commissioning phase of the work. This schedule shall show:

.1 Equipment start-up schedule.

.2 Submission dates for the various documents required prior to substantial performance.

.3 Timing of the various phases of the commissioning, testing, balancing and demonstration process.

.3 Review: Within three [3] months of commencing with the project work, the person having direct overall charge of commissioning shall review design intent and intended commissioning procedures with the Consultant. Six [6] months prior to the date of scheduled substantial performance, submit a detailed plan that addresses the entire approach to the commissioning process. The plan should be prepared specifically for the project at hand. The plan should include the following components:

.1 Name and qualifications of the commissioning coordinator.

.2 Itemized check lists for the readiness, start-up and operational verification of all equipment and systems.

.3 Outline of proposed method of notification and correction of interim operational deficiencies.

.4 Outline of proposed demonstration and operator training program.

.4 Troubleshooting: Where problems become apparent during the commissioning process, work at the identification and resolution of these problems. The basic functions in trouble shooting are:

.1 What - Identification and definition of the problem.

.2 Why - Determination and evaluation of the causes.

.3 When - Determine the time available to resolve the problem.

.4 Involve the Departmental Representative in the review of the problem and proposed resolution.

.5 Co-ordinate remedial action with the appropriate parties.

.6 Evaluate the effectiveness of the remedial action.

.5 Laboratory Tests: If the field tests indicate that equipment supplied to the project does not meet specifications, laboratory certification of the potentially deficient equipment may be requested by the Commissioning Authority. In the event that equipment does not meet specifications, be responsible for the costs of:

.1 The above laboratory tests, and

.2 All subsequent testing and correction required.

.6 The work included in each of the four phases shall be generally as follows:

.1 PHASE 1 System readiness

.1 Before starting any of the separate systems, provide a certificate stating that the specific system is ready for start-up and the following conditions have been met.

.1 All safety controls installed and fully operational (dry run test).

.2 Qualified personnel available to operate the plant.

.3 Permanent electrical connections made to all equipment.

.2 System readiness shall include, but not necessarily be limited to the following:

.1 Checking system physical completion, including all instrumentation.

.2 Flushing, chemical cleaning (as required), charging, fluid treating (as required).

.3 Equipment lubrication and prestart checks.

.4 Rotational checks.

.5 Air system cleaning complete.

.6 All D.X. systems checked for pressure and leakage.

.7 Filter systems installed and sealed in place.

.8 Adjusting vibration isolation and seismic restraints.

.9 Alignment of drives (direct and belt).

.10 Control function checks, including all alarms.

.11 Self diagnostic packaged control items checked.

.12 All deficiencies to be recorded, reviewed by the commissioning team and, subsequently, corrected before proceeding to PHASE 2.

.2 PHASE 2 System startup, testing, balancing

.1 System commissioning shall include, but not necessarily be limited to:

.1 Activation of all equipment and systems.

.2 Testing and adjustment of all equipment and systems.

.3 All deficiencies are to be recorded, reviewed by the commissioning team and, subsequently, corrected. The process at the point of the deficiency, shall be repeated before proceeding to PHASE 3.

.2 Phase 2 is concluded when the installation is in full working order and acceptable for use. The work will include the following:.

.1 Balancing of the air systems as specified in this section.

.2 Balancing of the liquid systems as specified in this section.

.3 Set up air diffusers, registers and grilles for optimum distribution/comfort.

.4 Set up and test all implosion/explosion doors.

.5 Set up all automatic control valves/dampers and automatic temperature control devices.

.6 Set up constant volume and variable volume fans.

.7 Adjust mixing boxes and air valves as necessary.

.8 Plug all air pressure and flow measuring holes.

.9 Adjust vibration isolators and earthquake restraints as necessary.

.10 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non- rated) and sound separations.

.11 Verification of water tightness of all roof and exterior wall penetrations.

.12 Verification that all coil drain pans operate.

.13 Testing and debugging of B.M.S. (Building Management System).

.14 Set up and test all alarm protective devices.

.15 Calibration and adjustment of the smoke venting and pressurization systems.

.16 Power failure test with emergency generator start-up.

.3 Fine Tuning

.1 Setting up automatic controls for accurate response and precise sequencing.

.2 Correction of problems revealed by Balance Agency and change of fan speed and pitch as necessary.

.4 Testing

.1 A detailed check by a person having direct overall charge of commissioning. This check to include all items and functions to be later demonstrated to the Commissioning Authority, Consultant and Owner's representatives.

.3 PHASE 3 Verification of System Performance

.1 Verification of system performance by the Consultant will not commence until PHASE 2 has been totally completed. Submit test procedure completion test certificates at the time of requesting the commencement of the verification procedure. The verification process will include the demonstration of the following:

.1 The ease of access that has been provided throughout for servicing coils, motors, drives, fusible fire damper links, control and smoke dampers and damper operators.

.2 Location of and opening and closing of all access panels.

.3 Operation of all automatic control dampers and automatic temperature control devices.

.4 Proper response of all mixing boxes and variable volume air valves to thermostats and volume adjustment controls.

.5 Operation of all smoke dampers and all smoke pressurization and removal provisions.

.6 Operability of randomly selected fire dampers.

.7 Noise level from typical mixing boxes and variable volume air valves under extreme operating conditions.

.8 Operation of all equipment and systems, under each mode of operation including:

.1 B.M.S. control features.

.2 D.X. condensing and evaporating systems.

.3 Packaged air-conditioners.

.4 Heat exchangers/immersion heaters.

.5 Pumps.

.6 Cabinet unit heaters.

.7 Unit heaters.

.8 Fans.

.9 Coils.

.10 Humidifiers

.11 Boilers and associated gas/oil fuel systems.

.12 Chiller(s) and cooling tower(s).

.13 All heat recovery systems.

.14 Tanks - domestic hot water,and expansion.

.15 Deaerator

.16 Condensate return units.

.17 Smoke evacuation system.

.2 At the completion of Phase 3, the Contractor shall submit the following to the Consultant:

.1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.

.2 A commissioning report which should include completed copies of all Phase 2 documentation outlined in the commissioning plan plus copies of start-up reports from specialty contractors and vendors and any other relevant information for inclusion in the operating & maintenance manuals.

.3 Yukon Boiler Inspection Dept. approval of boiler, pressure vessels and pressure piping installations.

.4 Fire Commissioner's approval of oil fuel installations.

.5 Record drawings as specified, update to include changes resulting from commissioning.

.6 A statement confirming completion of B.M.S. acceptance test.

.4 PHASE 4 Demonstration and Acceptance

.1 Demonstration and acceptance shall not commence until the commissioning process PHASE 3 has been successfully completed.

.2 The Demonstration process is a planned process requiring a preplan approval before commencement and a signed statement of satisfaction from the Owner upon completion.

.3 For Demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to Division 25 (Integrated Automation).

.4 Systems operation in the fire mode (pressurization and smoke removal) shall be demonstrated to the Authorities having jurisdiction. Obtain a written statement/certificate of approval.

.5 Post Substantial Performance Visits

.1 Provide follow-up visits to the site at one month and six month after substantial performance for a minimum period of two days, to ensure that the systems are operating correctly and that they are being operated and maintained properly.

.2 Submit a report to the Commissioning Authority, Consultant and Owner which documents any problems that have arisen and correction action required.

End Of Section

Part 1 General

1.1 SCOPE

.1 Provide all materials and service defined in the Contract Documents that are required to furnish a complete and fully operational control system to monitor and control the building HVAC systems.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Systems Demonstration and Owner's Instruction	Section 20 05 06
.4	General Painting and Identification	Section 20 05 53
.5	General Provisions for Controls	Section 20 30 01
.6	Electric and Electronic Control Systems for HVAC	Section 23 09 33

Part 2 Products

2.1 GENERAL

.1 Supply all materials, equipment and accessories that meet the requirements of the sections listed in Article 1.2.

Part 3 Execution

3.1 GENERAL

.1 Install, test, adjust and document the HVAC controls work as defined in the sections listed in Article 1.2.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 .CSA C22.2-94. 0-M91, Canadian Electrical Code, Part II, General Requirements.

.2 .CAN/CSA-Z234.1-89, Canadian Metric Practice Guide.

.2 .2 American National Standards Institute (ANSI)

.1 .ANSI/ISAS5.5-1985, Graphic Symbols for Process Displays.

.2 ANSI/IEEE260-1978, Letter Symbols for SI and Certain Other Units of Measurements.

1.2 SCOPE

.1 The system is to be installed as a complete package by the contractor. The contractor shall furnish all materials, including all controls, wiring, extra starters or relays, and piping. The contractor shall be responsible for the detailed engineering, installation, supervision and labour services, calibration, and commissioning necessary for a complete and fully operational system as specified hereafter. Adjustment and calibration shall be provided as a prerequisite.

1.3 SHOP DRAWING REVIEW

.1 Submit preliminary shop drawings for review in accordance with Section 01 33 00 – Submittal Procedures.

.2 Include:

.1 Specification sheets for each item. To include manufacturer's descriptive literature, specification, drawings, diagrams, performance and characteristic curves, catalog cuts, manufacturer's name, trade name, catalog or model number, nameplate data, size, layout, dimensions, capacity, all other data to establish compliance.

.2 Controller locations.

.3 Auxiliary control cabinet locations.

.4 Single line diagrams showing cable routing, conduit sizes, spare capacity between control centre, field controllers and systems being controlled.

.5 Complete schedule listing including following information: designation, service, manufacturer, model, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque.

.6 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.

.7 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

.8 Control schematics with narrative control description logic describing automatic and manual procedure required to achieve proper operation of project.

.9 Wiring diagrams.

.10 Piping diagrams and hook-ups.

.11 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.

.12 Listing of all time schedules.

1.4 STANDARDS OF COMPLIANCE

.1 All equipment and material to be from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate

1.5 GENERAL DESCRIPTION

.1 The electric and electronic control system to be based on standalone electric and electronic controls including:

- .1 All wiring, conduit, panels, and accessories for a complete operational system.
- .2 All electrical work associated with the building control system including:
  - .1 All wiring in accordance with all local and national codes.
  - .2 Provide all line voltage wiring in accordance with the Division 26 specifications, NEC and local building code.
  - .3 Provide extension of 120 volt, 20 amp circuits and circuit breakers from Emergency power panels for all control equipment power. Provide and install local supply for all control system panels and equipment.
  - .4 All low voltage electrical control wiring throughout in accordance with the Electrical specifications, local building code and the NEC.
  - .5 Provide all miscellaneous field device mounting and interconnecting wiring for all mechanical systems.
  - .6 All systems requiring interlock wiring shall be hardwired interlocked and shall not rely on the controls to operate. Interlock wiring shall be run in separate conduits from EMCS associated wiring.
- .3 All wells for water monitoring devices, flow switches and alarms, as required.
- .4 All field control devices.
- .5 Complete operating and maintenance manuals and field training of operators and maintenance personnel.
- .6 Acceptance tests, technical support during startup and full documentation.
- .7 Wiring interface co-ordination of equipment supplied by Electrical and Mechanical Divisions.
- .8 Miscellaneous work as specified in these sections and as indicated.

1.6 METRIC REFERENCES

.1 Conform to CAN/CSA-Z234.1-00.

.2 Provide all required adapters between Metric and Imperial components.

1.7 QUALITY ASSURANCE

.1 The control system shall be designed and installed, commissioned and serviced by factory trained personnel. The Contractor shall have an in place a support facility with technical staff, spare parts inventory and necessary test and diagnostic equipment. The Contractor shall provide on-site whenever controls work is being completed, personnel responsible for the design, installation and start-up of the Control system. The Contractor shall be regularly engaged in the installation and maintenance of building control systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the installation and maintenance of building control systems similar in size and complexity to this project.

.2 The Contractor shall maintain a service organization consisting of factory trained service personnel.

.3 Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

Part 2 Products

2.1 GENERAL

.1 Provide all wiring, conduit, relays, starters, electronics, etc., not indicated or specified but required for a complete and functional automatic control system.

.2 Location of controllers and panels not as per drawing locations to be approved by Departmental Representative prior to installation.

.3 All scales to be in SI units.

.4 Operating range to suit application range.

.5 Control equipment shall be the product of one manufacturer unless otherwise specified or approved.

.6 All controllers mounted outside of the mechanical room are to be suitable for operation at temperatures down to -50degC. Where possible, mount all controllers in mechanical room and provide wiring to individual devices through the crawlspace.

.7 Acceptable materials: Belimo, Honeywell, Johnsons, Tekmar

2.2 THERMOWELLS

.1 Provide stainless steel wells for all applications.

2.3 LOW VOLTAGE THERMOSTATIC CONTROLLER (TIMECLOCK)

.1 CSA approved, low voltage, 7 day programmable heat/cool thermostat with occupied/unoccupied timeclock, day/night time setback, backlight display, 3 heat, 1 cool, auto changeover, spare for ventilation to run on same timeclock.

2.4 TEMPERATURE SENSORS AND TRANSMITTERS

.1 All sensors should match the requirements of the equipment that they connect to.

.2 Sensing element: hermetically sealed. Stem and tip construction: copper or type 304 stainless steel. Time constant response: less than 3 seconds to temperature change of 10C.

.3 General purpose duct type: suitable for insertion into ducts at any angle, insertion length as required to reach centre of duct.

.4 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in EEMAC 12 enclosure.

.5 Water sensors: with a separable copper, MONEL or stainless-steel well.

.6 Transmitter ranges: Select narrowest range to suit application.

2.5 THERMOSTAT (LOW VOLTAGE-HEATING AND COOLING)

.1 Low voltage wall mounted electric heat-cool thermostat with:

.1 Temperature setting range: 5 degrees C to 30 degrees C.

.2 Thermometer range: 5 degrees C to 30 degrees C.

.3 Markings in 5 degree increments.

.4 Differential temperature fixed at 2 degrees C.

.5 LCD display

2.6 THERMOSTAT (LINE VOLTAGE-HEATING AND COOLING)

.1 Line voltage, wall-mounted thermostat, for cooling with:

.1 Full load rating: 16 A at 120 V.

.2 Temperature setting range: 5 degrees C to 30 degrees C.

.3 Thermometer range: 5 degrees C to 30 degrees C.

.4 Markings in 10 degree increments.

.5 Differential temperature fixed at 1.1 degrees C.

2.7 THERMOSTAT (LINE VOLTAGE, HEATING)

.1 Line voltage integral electric heating thermostat with:

.1 Full load rating: 22 A at 120 V.

.2 Temperature setting range: 5 degrees C to 30 degrees C.

.3 Single pole.

.4 Thermometer range: 5 degrees C to 30 degrees C.

.5 Scale markings: off-5-10-15-20-25 degrees C.

2.8 LOW LIMIT TEMPERATURE ALARM

.1 Low limit temperature alarm with:

.1 Rating: 6.5 A at 240 V.

.2 Sensing bulb and 1.5 m long capillary tube.

.3 Switching action: manual.

.4 Temperature setting range: 0 degrees C to 15 degrees C.

2.9 DUCT MOUNTED LOW TEMPERATURE CONTROLLER

.1 SPDT, manual reset, 24V low limit with set point range to 0degC.

2.10 DUCT CO2 SENSOR

.1 General: microprocessor based space CO2 detector designed to requirements of ASHRAE 62 latest edition. Minimum 15 year sensor element life.

.2 Element: non dispersive infrared detector, lithium tantalate, dual element.

.3 Range: 0-2000ppm.

.4 Accuracy: 2%

.5 Operating temp: 0-50degC.

.6 Operating humidity: 0-95%

.7 Repeatability: 20ppm

.8 Drift: 2%

.9 Display: LCD in PPM

.10 Output: 0-10VDC or 4-20mA selectable.

.11 Certification: ISO 9002 certified.

2.11 CURRENT SENSOR

.1 Analog current sensor, loop powered, fully isolated ISA type 2, Class U with a 4 to 20 ma or 2 to 10 volt DC output, sensor through-hole to accommodate up to #2/0 THHN insulated wire suitable for sensing up to 200 amperes, and provided with over-range protection.

.2 Current sensor to be sized to suit equipment load.

.3 Performance:

.1 Accuracy of plus or minus 0.5 percent of full scale

.2 Linearity and repeatability of plus or minus 0.1 percent of full scale

.3 Response time of no less than 300 milliseconds to 99 percent of full scale

2.12 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

.1 Requirements:

.1 Internal materials: suitable for continuous contact with compressed air, water, etc., as applicable.

.2 Adjustable setpoint and differential.

.3 Switch: snap action type, rated at 120V, 15 amps AC.

.4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.

.5 Accuracy: within 2% repetitive switching.

.6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source

2.13 DIFFERENTIAL PRESSURE (PA) TRANSMITTERS

.1 Requirements:

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, glycol, as applicable.

.2 Output signal: 4-20 mA into 500 ohm maximum load.

.3 Output variations: less than 0.2% full scale for supply voltage variations of plus or minus 10%.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5% of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed plus or minus 1.5% full scale/ 50C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

2.14 ELECTRONIC CONTROL DAMPER ACTUATORS

.1 Direct mount proportional type as indicated

.2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated

.3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater

.4 Power requirements: 5 VA maximum at 24 V AC

.5 Operating range: 0 - 10 V DC or 4 - 20 mA DC

.6 Damper actuator to drive damper from full open to full closed in less than 90 seconds

.7 End switches for interlocking with devices where indicated on drawings.

.8 Provide weather proof enclosures on damper actuators located outdoors.

2.15 STANDALONE ELECTRONIC CONTROLLER

.1 General: standalone programmable electronic temperature controller capable of on/off and or modulating control based on temperature as indicated on drawings complete with integral LCD screen.

.2 Operating range: 0 - 10 V DC or 4 - 20 mA DC.

.3 Controller to be installed in mechanical room at location indicated OR is to be suitable for operation at -50 degC.

.4 Re-heat coil controller

.1 Minimum two (2) inputs for room thermostats.

.2 One (1) input for duct temperature sensor.

.3 A call for heat from thermostat to activate controller.

.4 Controller to modulate valve to meet supply air temperature setpoint (adjustable)

.5 Mechanical Room cooling controller:

.1 One (1) digital output to cycle fan on/off.

.2 One (1) digital output to drive control damper open/closed.

2.16 TRANSFORMERS

.1 Provide CSA approved transformers of required kVa and voltage.

2.17 SELECTOR SWITCHES

.1 General: CSA approved, standard hand knob, non illuminated, gasketted, heavy duty.

.2 Size: 1"

.3 Type: 2 or 3 position as indicated.

.4 Contacts and Throws: as required.

.5 Voltage: as required.

.6 Acceptable material: Square D, Allen Bradley.

2.18 PUSHBUTTON SWITCHES

.1 General: CSA approved, spring return, gasketted, full guard, heavy duty.

.2 Size: 1"

.3 Contacts and Throws: as required.

.4 Voltage: as required.

.5 Acceptable material: Square D, Allen Bradley.

2.19 PILOT LIGHTS

.1 General: CSA approved, neon or LED, gasketted, spring return push to test, heavy duty.

.2 Size: 1"

.3 Colour: as indicated.

.4 Voltage: as required.

.5 Acceptable material: Square D, Allen Bradley.

2.20 WIRING

.1 To requirements of CSA C22.2-94.0, Canadian Electrical Code and Division 26

2.21 CONDUIT

.1 To requirements of CSA C22.2-94.0, Canadian Electrical Code and Division 26

2.22 TERMINATIONS, BOXES

.1 To requirements of CSA C22.2-94.0, Canadian Electrical Code and Division 26

2.23 SPECIAL SUPPORTS

.1 Structural grade steel, primed and painted after fabrication and prior to installation.

Part 3 Execution

3.1 GENERAL

.1 Provide all wiring, conduit, relays, starters, electronics, etc., not indicated or specified but required for a complete and functional automatic control system.

.2 Location of controllers and panels not indicated or not as per drawing locations to be approved by Departmental Representative prior to installation.

.3 All scales to be in SI units.

.4 Operating range to suit application range.

3.2 INSTALLATION

.1 Install all systems and hardware in accordance with the requirements of this specification, good controls practice and the requirements of Division 26.

.2 Install all equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.3 Follow building lines.

.4 Run all systems exposed and do not pass thru or touch un-heated ducts or enclosures.

.5 Locate thermostat sensors 1500 mm above floor as indicated. When conflict occurs follow Departmental Representative's instructions. On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.

.6 Outdoor air temperature sensors to be install in NEMA12 enclosures protected from solar radiation and wind effects by stainless steel shields and located in area unaffected by direct sunlight.

.7 All wiring to be as per the requirements of Division 26.

.8 Wiring of line voltage mechanical equipment as per Division 26.

3.3 ELECTRICAL GENERAL

.1 Complete installation in accordance with requirements of:

.1 Division 26, this specification.

.2 Electrical safety Code of Province/Territory having jurisdiction.

.3 ANSI/NFPA 70-1996SB.

.4 ANSI C2-1997.

.2 Fully enclose or properly guard electrical wiring, terminal blocks, all high voltage above 70 V contacts and mark to prevent accidental injury.

.3 Conform to all manufacturer's recommendations for storage, handling and installation.

.4 Check all factory connections and joints. Tighten where necessary to ensure continuity.

.5 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.

.6 Shield and mark all live parts "LIVE 120 VOLTS" or other appropriate voltage.

.7 Holes through exterior wall and roofs: flash and make weatherproof.

.8 All digital controllers to be connected to dedicated surge and transient protected power supply. Reference Division 26.

3.4 SPECIAL SUPPORTS

.1 Provide all special steelwork as required for installation of work at no additional cost.

3.5 START-UP

.1 Provide representative to assist in Building Start Up as specified in Section 23 05 01. Representative is to be on site when Start Up testing is performed and witnessed.

.2 Adjust equipment to suit balancing of systems.

3.6 INITIAL START-UP AND PRE-TESTING REPORT

.1 One week prior to system Testing contractor is to start up all control systems and provide written report detailing results of initial start up. Report is to detail any outstanding deficiencies, operating difficulties and how these items affect the present building operations.

3.7 TESTING GENERAL

.1 Testing to include:

.1 Acceptance testing and verification of all systems.

.2 Perform work under direction of, and in presence of, Departmental Representative where indicated.

.3 Provide all test equipment necessary, including two-way radios.

.4 Inform, and obtain approval from the Departmental Representative in writing at least 14 days prior to tests. Indicate:

.1 Testing procedures, anticipated results.

.2 Names of testing personnel.

.5 Co-ordinate with all other trades.

.6 Correct deficiencies, re-test in presence of the Departmental Representative until satisfactory performance is obtained.

.7 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

3.8 ACCEPTANCE TESTS

.1 Upon completion of installation perform operational test of entire system under direction of the Departmental Representative.

.2 Provide:

.1 At least one technical personnel capable of adjusting field hardware and devices.

.3 Purpose: to demonstrate that control system functions in accordance with all contract requirements.

.4 Test to last at least 2 consecutive 24 hour days.

.5 Tests to include:

.1 Demonstration of correct operation of all controlled devices.

.2 Demonstration of operation of all sequences and alarms as per design control logic.

.3 Testing and calibration all devices.

.4 Testing and calibration of each controller using calibrated instruments.

.6 System is accepted if:

.1 Control system and devices operate as per intent of specifications and drawings to the satisfaction of the Departmental Representative.

.7 Correct all defects when they occur and before resuming test.

3.9 CONTROL LOGIC – AIR HANDLING UNIT AHU-1

.1 General description:

.1 A constant volume air handling unit installed exterior to the building along the rear stage wall provides ventilation air for both heating and cooling as well as minimum outdoor air.

.2 The unit consists of a return fan, economizer section with return/exhaust/outdoor air dampers, filter section, cooling coil, supply fan, and heating coil. The unit also contains an integral air cooled chiller to serve the cooling coil.

.3 Supply air from the unit is delivered to the building where it is split into four separate supply air zones. Each zone has its own re-heat coil.

.4 Return air to the unit is drawn from several locations in the attic space via a common return air duct with branches.

.2 AHU-1 Schedule:

.1 Time Schedule: Schedule to be fully adjustable at the timeclock located in the mechanical room. AHU-1 operates based on a 365 day time-based schedule, split into summer and winter modes. Initial time based setpoint (confirm with Departmental Representative):

.1 Summer mode:

.1 AHU-1 ON (occupied): Mon-Sun @ 1200hrs,

.2 AHU-1 STANDBY (unoccupied): Mon-Sun @ 1400hrs

.3 Allow for one additional daily on/off period, coordinate with Departmental Representative.

.2 Winter mode:

.1 AHU-1 OFF.

.3 AHU-1 Sequence:

.1 AHU-1 OFF/Fail:

.1 Supply and return fans off.

.2 EA and OA dampers to full closed, RA damper to full open.

.3 HC (heating coil) and CC (cooling coil) to be off.

.4 On failure of supply or return fan indicate alarm and unit to fail.

.5 On failure of secondary pumps, indicate alarm.

.2 AHU-1 ON:

.1 On startup the supply and return fans to start, the OA and EA dampers to remain closed, the RA damper to remain 100% open.

.2 After 30 second time delay and proof of fan operation, dampers to modulate to the minimum outdoor air position.

.3 Alarms: Start/Stop Fail, Low SAT, Hi Filter DP

.3 AHU-1 STANDY

.1 Standby mode to allow for AHU-1 to provide heating for building when not occupied.

.2 AHU to start in standby mode if any of building thermostats call for heat.

.3 On start up in standby mode, supply and return fans to start, RA damper to remain 100% open and the OA and EA dampers to remain closed.

.4 AHU to operate until zone thermostats are satisfied.

.4 Minimum outdoor air:

.1 OA damper minimum position: 1050 L/s, approximately 23%.

.5 AHU-1 CO2 Control:

.1 Duct mounted RA CO2 sensor to modulate OA, EA, and RA dampers to satisfy CO2 setpoint.

.2 Initial setpoint: 1200 ppm.

.6 AHU Heating and Cooling Coils:

.1 AHU-1 SAT (supply air temperature) controller to control heating coil stages on/off to maintain the reset SAT.

.2 AHU-1 SAT controller to modulate the cooling coil control valve and the integral chiller to maintain the reset SAT.

.3 Initial reset supply air temperature based on outdoor air temperature as follows:

OAT	Initial SAT
-10 degC	19degC
0 degC	18degC
15 degC	17degC

.4 All reset ratios and set points to be adjustable at the integral AHU controller.

.5 When OAT < 10 degC AND RAT < 16 degC, provide +3 degC modifier on the rest SAT until RAT ≥ 18 degC.

.6 Freeze protection is provided by a two stage alarm system. First stage is if the supply air temperature is 5degC less than the reset air set point for greater than 5 minutes: alarm. The second stage is if the supply air temp is 5degC less than the reset air set point for more than 15 minutes OR greater than 5degC less than the reset air set point for more than 5 minutes: alarm and the unit to fail.

.7 Free Cooling

.1 When RAT > OAT AND HC and CC coil valves are closed, free cooling economizer OA damper to modulate with EA damper to maintain the reset supply air temperature.

.2 To ensure simultaneous heating/cooling does not occur, free cooling OA and EA dampers to be enabled only when the HC heating coil valves are closed.

.8 Mechanical Cooling

.1 When RAT < OAT and all heating coil valves are closed (AHU HC and RHC), free cooling economizer to be disabled and mechanical cooling to be enabled.

.2 Minimum outdoor air in mechanical cooling mode to be the maximum of the minimum outdoor air setpoint or the CO2 setpoint derived outdoor air.

3.10 CONTROL LOGIC – ZONE RE-HEAT COILS

.1 RHC SAT controller to modulate electric RHC to maintain zone temperature setpoint.

.2 Locate zone thermostats per plans.

.3 Controllers for supply air re-heat coils to be located in the mechanical room for ease of access and adjustment by building O&M persons. Provide lamacoids for each controller reading “Zone X S/A RHC Controller”.

.4 RHC and or controller to be disabled if AHU-1 operating in free cooling or mechanical cooling mode.

.5 Initial zone temperature setpoints = 20 deg C.

3.11 CONTROL LOGIC – FANS

.1 Mechanical room cooling exhaust fan CF-1:

.1 Reverse acting thermostat and standalone electronic controller to energize supply fan in cooling mode to meet setpoint requirements.

.2 Controller to start fan and open O/A damper if temperature above setpoint.

.1 Minimum fan run time of 5 minutes.

.2 Room low temperature alarm to lock out fan at space temperature of 10 degC.

.3 Initial space temperature setpoint = 24 degC.

.2 Smoke evacuation exhaust fans EF-1 and EF-2:

.1 Smoke evacuations exhaust fans to be activated by building fire alarm system when smoke detected.

.2 Fans to cycle modulate per differential pressure sensor between stage and exterior to prevent excessive negative pressure.

.3 Initial pressure setpoint = -46.0 Pa (exact setpoint to be determined on site).

.1 Pressure setpoint to be adjusted such that no single door requires more than 90N of force to open.

.4 Fans to be disabled by switch adjacent to fire alarm panel. Switch to be in lockable cabinet to prevent tampering. Provide lamacoid reading "Smoke evacuation fan on/off switch – Fire fighting use only".

.3 Existing washroom exhaust fans:

.1 Washroom exhaust fans are to be controlled on by motion detectors. Provide 15 minute delay off.

3.12 CONTROL LOGIC – MECHANICAL ROOM HEATING

.1 Initial space temperature setpoint = 18 deg C.

.2 Unit Heater:

.1 Line voltage thermostat to cycle unit heater on/off.

.2 Unit heater burner and fan to operate on integral controls.

3.13 CONTROL LOGIC – DOMESTIC WATER

.1 Domestic Hot water

.1 Domestic hot water heater packaged temperature controller to cycle electric heating elements to satisfy setpoint. Initial setpoint = 40 deg C.

3.14 LOW BUILDING TEMPERATURE ALARM

.1 In event of low building temperature as sensed by temperature sensor and 15 minute time delay, alarm to building security system (by Div 26).

.1 Initial setpoint = 10 deg C

.2 Low temperature sensors located in Mechanical Room.

3.15 CRAWLSPACE SUMP PUMP

.1 Weeping tile sump pump to operate on integral level switch.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Fuel oil storage tanks.

.2 Fuel oil piping and fittings.

.3 Fuel oil piping supports.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Electric Motors	Section 20 05 03
.3	General Documentation	Section 20 05 05
.4	Systems Demonstration and Instruction	Section 20 05 06
.5	Materials Testing	Section 20 05 07
.6	Equipment Testing and Startup	Section 20 05 08
.7	Meters and Gauges	Section 20 05 19
.8	Valves and Strainers	Section 20 05 23
.9	Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors	Section 20 05 29
.10	Identification for Mechanical Systems	Section 20 05 53
.11	Tanks	Section 20 15 00
.12	Pipe and Pipe Fittings	Section 20 20 10
.13	Pumps	Section 20 20 60
.14	Controls	Section 20 30 Series
.15	HVAC Controls	Section 23 09 Series

1.3 QUALITY ASSURANCE

.1 Tanks to be suitable for No. 2 diesel fuel and to carry ULC labels.

.2 Pumps, valves, piping and fittings to be suitable for No. 2 diesel fuel. Piping system to be ULC approved.

.3 Pump controls to carry ULC and CSA labels.

.4 Installation shall meet all governing codes including the current edition of CSA Standard B139, NFPA and API Standards, National Fire Code and requirements set out by local Authority Having Jurisdiction.

Part 2 Products

2.1 TANKS

.1 Refer to Section 20 15 00, Tanks.

2.2 ABOVE GROUND PIPING AND FITTINGS

.1 Refer to Section 20 20 10, Pipe and Pipe Fittings.

.2 Provide all necessary isolation valves, check valves, unions, and strainers as required for complete installation.

2.3 REMOTE FUEL INDICATOR

.1 Provide remote fuel level indicator for outside storage tank. Locate indicator in mechanical/electrical room adjacent exterior door closest to tank.

.2 The fuel indicator shall be hydraulically powered float type. Use Clemer Model 6755 for tanks up to 10,000 litre capacity..

2.4 VENT CAPS

.1 Aluminum body and cap, slip on with brass set screw, 40 mesh brass screen.

.2 Flow Rate: 3300 L/s at 14 kPa pressure drop.

.3 Compliance: NFPA 30.

.4 Acceptable Material: OPW 23.

2.5 FUSIBLE LINK VALVE

.1 Brass Body: ULC listed.

.2 Acceptable Material: Firomatic.

2.6 DRIP TRAY

.1 Welded steel min 12 ga liquid tight with minimum 25 mm high sides.

.2 Min dimensions: 300 x 300.

2.7 ANTI SYPHON VALVE

.1 Compatible with suction or pressurized systems.

.2 Integral thermal expansion relief.

.3 Ductile iron body.

.4 Stainless steel cap and spring.

.5 Stainless steel plunger with Viton disc.

.6 Size: to suit total burner flows and tank/burner height difference.

2.8 REMOTE FILL SPILL CONTAINMENT

.1 12 Gauge Epoxy Power-Coated Steel or Stainless Steel Construction

.2 Weather tight cover, lockable hatch;

.3 Capacity: 65L minimum;

.4 Approvals: CAN/ULC-S663 or ULC/ORD-C58.19

Part 3 Execution

3.1 INSTALLATION

.1 Install vent with 180° turn down and insect screen. Slope vent pipe towards the tank.

.2 Securely cap all pipes and plug all tank openings which are temporarily not connected during construction. Clean all dirt and foreign matter in pipe prior to final hookup. Flush all piping with diesel fuel.

.3 Provide all necessary isolation valves, check valves, unions, and strainers to properly complete the system. Test complete system in the presence of the Departmental Representative to ensure the system operates satisfactorily.

.4 Provide plugged tees at low points of oil system to allow drainage of system of condensate and sludge.

.5 Use flexible hose to allow for relative movement due to expansion or heaving. Minimum flex length 450 mm.

3.2 TESTING

.1 Test system in accordance with 20 05 07, Materials Testing, CAN/CSA-B139 and CAN/CSA-B140.0 and authorities having jurisdiction supplemented as specified herein.

.2 Isolate tanks from piping during tests.

.3 Flush after pressure test with number 2 fuel oil for a minimum of one hours. Clean strainers and filters.

.4 Dispose of fuel oil used for flushing out in accordance with requirements of authority having jurisdiction.

.5 Check vents from regulators, control valves are terminated in approved location and are protected against blockage and damage.

.6 Check entire installation is approved by authority having jurisdiction.

.7 Test pressure shall be not less than 1-1/2 times the maximum working pressure and not less than 340 kPa at the highest point of the system. Test shall be maintained for at least 10 hours. Underground tank to be air tested Refer to the current edition of CSA Standard B-139, and the National Fire Code. Air test tanks at maximum 35 kPa for a minimum of 2 hours.

3.3 DRIP TRAYS

.1 Provide for the following locations:

.1 All fuel oil filters.

.2 All fuel oil burners.

3.4 OIL FILTERS

.1 Install as indicated.

.2 At time of acceptance, replace filter cartridge with new.

.3 Provide drip pans.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Ductwork and plenums. Fire rated duct system.

.2 Fasteners.

.3 Sealants.

.4 Connection / integration of ductwork to equipment, louvres, plenums, dampers, flexible ducts, terminal boxes, air outlets and other similar accessories.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Materials Testing	Section 20 05 07
.4	Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors	Section 20 05 29
.5	Testing, Balancing and Adjusting	Section 20 22 00
.6	Duct Insulation	Section 23 07 13
.7	Ductwork Cleaning	Section 23 31 14
.8	Air Duct Accessories	Section 23 33 13
.9	Air Outlets and Inlets	Section 23 37 13
.10	Breeching and Chimneys	Section 23 51 10

1.3 DEFINITIONS

.1 Low Pressure: Static pressure in duct less than 500 Pa and velocities less than 10 m/s.

.2 Duct sizes shown on plans are inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes inside ducts.

1.4 REFERENCE DOCUMENTS

.1 American Society for Testing and Materials (ASTM):

.1	ASTM A653/A653M-09	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

.2 National Fire Protection Association (NFPA):

.1	NFPA 90A	Standard for the Installation of Air Conditioning and Ventilation Systems
.2	NFPA 90B	Standard for the Installation of Warm Air Heating and Air Conditioning Systems

.3 Model National Energy Building Code of Canada for Buildings, 1997

.4 Sheet Metal and Air Conditioning National Contractors Association (SMACNA):

.1 SMACNA IAQ Guideline for Occupied Building Under Construction

.5 South Coast Air Quality Management District, California State (SCAQMD):

.1 SCAQMD Rule 1168, Adhesive and Sealant Applications

1.5 QUALITY ASSURANCE

.1 Ductwork shall meet the requirements of NFPA No. 90A - Air Conditioning and Ventilating Systems.

.2 Fabricate in accordance with the most stringent requirement of SMACNA duct manuals and ASHRAE handbooks as a minimum, unless more stringent requirements are not identified in the contract documents. Straight tap fittings and dovetail joints are not permitted.

1.6 SUBMITTALS

.1 Submit shop drawings and samples of duct fittings for approval, including particulars such as gauge sizes, welds and configurations prior to start of work.

.2 Comply with the requirements of Division 01 and Section 20 05 05, General Documentation.

1.7 ALTERNATIVES

.1 Obtain written permission from the Departmental Representative prior to making variations in duct configuration or sizes. Size alternatives using ASHRAE table for circular equivalents of rectangular ducts.

Part 2 Products

2.1 MATERIALS (GENERAL DUCTS)

.1 Ducts: Galvanized steel lock forming quality, having galvanized coating of 380 g/m^2 to ASTM A653M-G90 designation for both sides.

.2 Fasteners: Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts. All rivets, bolts and screws for aluminum duct systems to be aluminum.

.3 Sealant: Water resistant, fire resistive, compatible with mating materials meeting Rule 1178, Adhesive and Sealant Applications, South Coast Air Quality Management District, California State (SCAQMD).

2.2 LOW PRESSURE DUCT THICKNESSES (MINIMUM)

.1 Rectangular Ducts

Maximum Width	mm
Up to 300 mm	0.6
330 mm to 760 mm	0.8
790 mm to 1370 mm	0.8
1400 mm to 2130 mm	1.0
2160 mm and Over	1.2

.2 Round Ducts

Duct Diameter	mm
Up to 330 mm	0.6
350 mm to 550 mm	0.8
580 mm to 1270 mm	0.8

1300 mm to 1520 mm	1.2

.3 Underground Ducts

Duct Diameter	Spiral Lock Seam mm	Longitudinal Seam mm
Up to 380 mm	0.8	0.8
400 to 510 mm	0.8	1.0
530 to 890 mm	1.0	1.2
Over 910 mm	1.2	1.6

2.3 PLENUM GAUGES

.1 Fabricate fan plenums and plenums downstream of fan in accordance with duct gauges.

.2 Fabricate plenums upstream of fan between apparatus of 1.6 mm.

.3 Fabricate plenums upstream of filters of 1.2 mm

2.4 FABRICATION

.1 Complete metal ducts with themselves with no single partition between ducts. Where width of duct exceeds 450 mm cross break for rigidity. Open corners are not acceptable.

.2 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

.3 Construct tees, bends, and elbows with radius of not less than one (1) times width of duct on centreline. Where not possible and where rectangular elbows used, provide approved type air foil turning vanes. Where acoustical lining is provided, provide turning vanes of perforated metal type with fibreglass inside.

.4 Increase duct sizes gradually, not exceeding 15 degree divergence wherever possible. Maximum divergence upstream of equipment to be 30 degree and 45 degree convergence downstream.

.5 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.

.6 Provide easements where low pressure ductwork conflicts with piping and structure where easements exceed 10% duct area, split into two ducts maintaining original duct area.

.7 Provide necessary baffling in mixed air plenums to ensure good mixed air temperature with variations of not more than ± 15°C under all operating conditions.

.8 Fabricate plenums and casings to configurations shown on drawings. Construct plenums of galvanized panels joined standing seams on outside of casing riveted or bolted on approximately 300 mm centers. Reinforce with suitable angles and provide diagonal bracing as required. Tightly fit at apparatus and caulk with sealant.

.9 Provide 75 mm reinforced concrete curb for plenum walls and floor mounted casings. At floor, rivet panels on 200 mm centers to angles. Where floors are acoustically insulated, provide liner at 1.2 mm galvanized expanded metal mesh, turned up 300 mm at sides with sheet metal shields.

.10 Reinforce door frames with angle iron tied to horizontal and vertical plenum supporting angles. Install hinged access doors where shown, specified or where required for access to equipment for cleaning and inspection.

.11 Fabricate acoustic plenums of galvanized steel. Provide 1.6 mm back facing and 0.8 mm perforated front facing with 3 mm diameter holes on 4 mm centers. Construct panels 75 mm thick

packed with 72 kg/m^3 minimum fibrous glass media, on inverted channels of 1.6 mm [on 75 mm reinforced concrete curb].

.12 Fabricate seams and joints in outdoor air ducts liquid tight with continuous external welds.

.13 Weld all stainless steel ducts and ensure smooth finish on inside of duct. Do not grind, polish, buff or otherwise abrade stainless steel ductwork

Part 3 Execution

3.1 DUCT SEALING

.1 All supply, return and exhaust duct joints, longitudinal as well as transverse, shall be sealed using,

.1 Low Pressure Ductwork:

.1 Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.5 mm use heavy mastic type sealant.

.2 Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.

.3 Other Joints: Heavy mastic type sealant.

.2 Duct tapes as sealing method are not permitted.

.3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.

.4 Prior to sealing all ductwork, demonstrate sealing of a section of each type of duct and obtain approval from the Departmental Representative.

.5 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application.

3.2 INSTALLATION

.1 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.

.2 Coordinate the location of duct access doors. Refer to Section 20 05 29, Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors.

.3 Install intake/exhaust louvres, duct accessories, grilles, dampers, air outlets, terminal boxes and other similar components of the duct distribution system. Refer to Article 1.2, Related Work Specified in Other Sections.

.4 Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal cap with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

.5 Interrupt duct linings at fire, balancing, backdraft and smoke dampers so as not to interfere with operation of devices. Provide sheet metal edge protection over linings on both side of damper device.

.6 Shield ductwork from dust and construction material during construction. Clean any ductwork found to be dirty at no extra cost to the Contract.

.7 Protect carbon steel ductwork exposed to weather by painting or coating with suitable weather resistant material.

.8 Install ducts associated with fans subject to forced vibration with flexible connections immediately adjacent to equipment. Refer to Section 23 33 13, Duct Accessories.

.9 Do not use flexible duct to change direction.

.10 Connect diffusers or troffer boots to low pressure ducts with 300 mm maximum stretched length of flexible duct. Hold in place with caulking compound and strap or clamp.

.11 Prove that ductwork is substantially air tight before covering or concealing.

.12 Clean duct systems and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning.

.13 Clean systems with power vacuum machines. Refer to Section 23 31 14, Ductwork Cleaning.

.14 All segmented type elbows shall be spot welded. No adjustable type elbows are allowed.

.15 All ducts crossing walkways shall be offset to run as close as possible to underside of structure above.

.16 Where ducts cross a walkway at low elevation, step overs shall be provided by the sheet metal contractor, constructed of lightweight checker plate and angle frames.

.17 Rigidly construct metal ducts with joints mechanically airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk all duct joints and connections with sealant as ducts are being installed. Seal seams on fresh air and exhaust ducts watertight with mastic or high velocity duct sealant.

.18 Lap metal ducts in direction of air flow. Hammer down all edges and slips to leave smooth duct interiors.

.19 Fabricate ductwork from field measurements and not from plans and shop drawings exclusively. Failure to do so will not constitute an extra to the Contract.

.20 Set plenum doors 150 mm above floor. Arrange door swings so that fan static holds door in closed position.

.21 For fire rated duct systems, install in accordance with manufacturers recommendations, confirm with manufacturers duct hanging methods and systems. Firestop all locations where the fire rated duct passes through a fire separation using a Listed Firestop system. Refer to Section 20 05 29, Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors.

3.3 DUCT PRESSURE SCHEDULE

.1 Low Pressure:

.1 All ducts unless otherwise noted.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Clean supply / exhaust / return ductwork systems and plenums.

.2 Clean all terminal boxes and reheat coils.

.3 Clean air handling unit and all interior components, including fans, silencers, heating / cooling coils, humidifiers, and motors.

.4 Supply and install access doors where required to facilitate ductwork cleaning.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Metal Ducts	Section 23 31 13
.4	Air Duct Accessories	Section 23 33 13
.5	Air Coils	Section 23 82 16

1.3 QUALITY ASSURANCE

.1 The HVAC system cleaning sub-trade shall be a certified member of the National Air Duct Cleaners Association (NADCA) or equivalent.

.2 The Departmental Representative may hire an independent agency to review duct cleaning procedures prior to starting work and perform spot checks to confirm that duct system cleaning has been effectively executed.

.3 Submit a letter certifying that all systems have been completely cleaned and are ready for inspection.

.4 Acceptable contractors: Air Care Yukon.

1.4 SUBMITTALS

.1 Submit certification of NADCA membership.

.2 Submit list of five (5) recent projects of similar magnitude.

.3 Submit the name of the superintendent-in-charge of the work and list his project experience.

.4 Submit an outline of the work scope for each ductwork system, lighting procedures, equipment, materials and schedule, prior to starting work.

.5 Submit a certificate of completion for each ductwork system that cleaning has been completed as defined in the specifications.

1.5 DEFINITIONS

.1 Level 1 Clean: No visible particulates or deposition after vacuum techniques have been completed.

.2 Level 2 Clean: "White glove" clean, ductwork to be wiped clean with de-ionized water. Wipe down interior of ductwork in room downstream of supply air terminals, including all low velocity ductwork.

.3 Air System: Includes central equipment; supply, return, exhaust fans, coils, dampers, turning vanes, grilles, diffusers, and low pressure ductwork (supply, return and exhaust) that is associated with an air handling system.

Part 2 Products

2.1 MATERIALS

.1 Access Doors: Minimum 450 mm x 350 mm door, hinge and frame type, positive latching/locking mechanism. Refer to Section 23 33 13, Air Duct Accessories.

.2 Cleaning Equipment: 5.0 kPa suction capacity and 12,000 L/s minimum capacity.

.3 Temporary Filters: 3 ply filter element with 35% ASHRAE 52-76 dust spot efficiency of 2.64 m/s face velocity to protect equipment during cleaning operation.

.4 Cleaning Agent:

.1 Safeguard

.2 Microban

Part 3 Execution

3.1 GENERAL

.1 Perform HVAC system cleaning in accordance with the current published standards of NADCA.

3.2 PREPARATION

.1 Isolate items to be cleaned so as not to contaminate unprotected work.

.2 Equip vacuum equipment with filters.

3.3 INSTALLING ACCESS DOORS

.1 Locate access doors and install as follows:

.1 At 12.0 m intervals in vertical ducts.

.2 Horizontal ducts at intervals of 6 m.

.3 At the base of all duct risers.

.4 Both sides of turning vanes in all ducts.

.5 At each fire damper location.

.6 At each side of all coils except where an access is provided.

.7 At all locations of internally duct mounted equipment or devices including balancing dampers, automatic dampers, damper motors, duct mounted smoke detectors and heat detectors, and controls, except where access is provided.

.8 Where required to facilitate duct cleaning.

3.4 DUCT SYSTEM CLEANING

.1 Commence Level 1 Standard cleaning after completion of duct system installation and before air handling system are started.

.2 Following completion of Level 1 cleaning procedures, clean the following duct systems to Level 2 standard:

.1 As directed by Departmental Representative.

.3 Install filters as follows:

.1 Behind all grilles and diffusers.

.2 In front of all duct coils.

.3 At inlet of all terminal high velocity units to protect pitot openings.

.4 When the duct systems are completed and before any fan systems are operated, clean all ductwork, plenums, coils and air handling equipment by compressed air and mechanical equipment or compressed air and high power suction equipment.

.5 Do not use mechanical brushes on acoustic lined ductwork.

.6 Remove all filters within five days after vacuum procedures is completed. Ensure the number of filters removed is equal to the number of filters installed.

.7 Seal all ductwork outlets and plenum openings with polyethylene sheet cover after ductwork has been cleaned.

3.5 QUALITY ASSURANCE AND VERIFICATION

.1 The HVAC system will be visually inspected to confirm no visual contaminants are present. If visible contaminants are evident, those portions of the system shall be re-cleaned and re-inspected.

.2 A NADCA vacuum test analysis and particulate count will be performed by a qualified third party.

.3 Submit a report to the Departmental Representative confirming that the HVAC system and its components have been successfully cleaned and verified by visual inspection, and that any parts of the HVAC system damaged by this work have been identified and corrective measures have been undertaken.

.4 Repeat duct cleaning procedures on all sections found not satisfactory by independent test agency hired by the Departmental Representative.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Access doors (duct access and plenum access).

.2 Fire dampers.

.3 Combination fire/smoke dampers.

.4 Balancing dampers.

.5 Flexible connections to equipment.

.6 Backdraft dampers.

.7 Turning vanes.

.8 Sealants.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Metal Ducts	Section 23 31 13
.4	Ductwork Cleaning	Section 23 31 14
.5	Air Outlets and Inlets	Section 23 37 13

1.3 QUALITY ASSURANCE

.1 Fire dampers shall be ULC listed and constructed in accordance with CAN/ULC Standard S 112, Standard Method of Fire Test of Fire Damper Assemblies.

.2 Fusible links on fire dampers shall be constructed to ULC Standard S 505, Standard for Fusible Links for Fire Protection Service.

.3 Demonstrate re-setting of fire dampers to authorities having jurisdiction and Departmental Representative.

.4 Access doors shall be ULC labelled.

.5 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems. Fabricate in accordance with SMACNA Duct Manuals.

.6 Flexible air duct shall comply with NFPA 90A and UL181 Standard for Factory-Made Air Ducts and Air Connectors.

.7 At job completion, demonstrate that all fire dampers operate freely and without binding, and that ratings of fire dampers meet or exceed the rating of the fire wall.

1.4 SUBMITTALS

.1 Submit shop drawings of factory fabricated assemblies.

.2 Submit samples of shop fabricated assemblies as requested by the Departmental Representative.

.3 Comply with requirements of Section 20 05 05, Documentation.

Part 2 Products

.1 Acceptable Manufacturers

.1	Access Doors:	Acudor, Hilcor, Controlled Air, Nailor, Air-O-Metal, Titus, Ductmate.
.2	Fire Dampers:	Controlled Air, Ruskin, Ductmate, Nailor.
.3	Smoke Dampers:	Controlled Air, Nailor, Hart, Ruskin
.4	Combination Fire/Smoke Dampers:	Controlled Air
.5	Backdraft Dampers:	Tamco, Ruskin.
.6	Sealants:	Ductmate.

2.2 DUCT ACCESS DOORS

.1 Fabricate rigid and close-fitting doors of galvanized steel or aluminum to suite mounting duct with sealing gaskets and suitable quick fastening locking devices. Duct access panels with screws are not acceptable. Install minimum 25 mm thick insulation with suitable sheet metal cover frame for insulated ductwork.

.2 Fabricated with two butt hinges and two sash locks for sizes up to 450 mm, two hinges and two compression latches with outside and inside handles for sizes up to 600 mm x 1200 mm and an additional hinge for larger sizes.

2.3 PLENUM ACCESS DOORS

.1 600 mm x 1200 mm in air plenums to accommodate total body access to mechanical components.

.2 Access doors to be fabricated of same material as plenum.

2.4 FIRE DAMPERS

.1 Fabricate of galvanized steel or prime coated black steel unless otherwise noted, weighted for static application (i.e., non-ducted) and spring operated for dynamic application (i.e., ducted), to close and lock in closed position when released by fusible link.

.2 Fire dampers shall be curtain type static weighted for non-ducted systems and dynamic spring operated for ducted systems with damper blades retained out of air stream in a recess so free area of connecting ductwork is not reduced.

.3 Fusible links shall be set for 71°C.

.4 Refer to architectural drawings for ratings of fire walls and provide fire dampers with compatible ratings.

2.5 COMBINATION FIRE/SMOKE DAMPERS

.1 Combination Fire/Smoke dampers, rated as a unit by ULC, shall be provided c/w actuators by the Mechanical Contractor. Mechanical Contractor shall install in locations noted.

.2 Fire/smoke dampers shall be wired by the controls contractor.

.3 Coordinate correct size of smoke/fire damper with Control Contractor.

.4 Fabricate combination fire and smoke dampers of multiple blades readily adjustable in open position. Dampers shall be ULC rated.

.5 Fire and smoke damper free area opening shall not be less than internal duct size indicated on plans. If a multiple of blade sizes does not equal opening size, oversize damper and increase and decrease ductwork accordingly.

2.6 SPLITTER DAMPERS

.1 Fabricate splitter dampers of double thickness sheet metal to streamline shape, properly stiffened to avoid vibration.

.2 Fabricate galvanized steel or aluminum to match duct type, minimum 1.6 mm, and provide with adjustable rod and locking screw.

.3 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

2.7 BALANCING DAMPERS

.1 Fabricate of galvanized steel or aluminum to match duct material, minimum 1.6 mm. Full blade-length shafts of hollow square construction with blades rigidly fastened along entire blade length.

.2 Lockable quadrant type operating mechanism with end bearings on accessible rectangular ducts up to 400 mm deep and on accessible round ducts.

.3 Wide pitch screw operating mechanism with crank operator and end bearings on accessible rectangular ducts 425 mm and over in depth and on all inaccessible rectangular and round ducts.

.4 On rectangular ducts up to 275 mm deep construct of single blade (butterfly) type.

.5 On rectangular ducts 300 mm to 400 mm deep construct of two opposed blades mechanically interlocked with pivots at quarter points.

.6 On rectangular ducts over 425 mm deep construct of multiple opposed blades, mechanically interlocked with blades no greater than 200 mm deep and pivots equally spaced.

.7 On round ducts construct of single blade (butterfly) type. On 500 Pa class and on all dampers over 300 mm diameter fabricate with full blade-length shaft.

.8 Provide over-ride limiting stops on all operating mechanisms.

.9 Identify the air flow direction and blade rotation and open and close positions on operating mechanism.

.10 On round ductwork, install operating mechanism on a steel mounted base firmly secured to the ductwork.

.11 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

2.8 FLEXIBLE CONNECTIONS TO EQUIPMENT

.1 Fabricate of ULC approved neoprene coated flameproof glass fabric approximately 150 mm wide tightly crimped into metal edging strip and attached to ducting and equipment by screws or bolts at 150 mm intervals. Flexible connection airtight at 500 Pa.

2.9 BACKDRAFT DAMPERS

.1 Construct of minimum 1.3 mm galvanized steel channel frame.

.2 Construct of minimum 0.6 mm aluminum blades, complete with stiffeners along trailing edge. Fabricate single blade dampers for duct sizes to 240 mm, multi-blade dampers for ducts greater than 240 mm.

.3 Provide full blade-length shafts complete with brass or nylon bearings.

.4 Provide neoprene anti-clatter blade strips on pivot side of blades.

.5 Construct blade connecting linkage of minimum 2.0 mm aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.

.6 Maximum blade length of 750 mm.

.7 Backdraft damper suitable for 10 m/s face velocity.

2.10 TURNING VANES

.1 Full radius arc; single blade vanes fabricated or same material as duct.

.2 Acoustic vanes constructed in airfoil pattern with fibrous glass padding, 0.8 mm perforated lining.

2.11 FLEXIBLE DUCT CONNECTIONS TO AIR OUTLETS

.1 Perforated aluminum flexible metal core with 20%-25% opening area. Enclosed with 25 mm thick glass fibre insulating wood with minimum density of ¾ lb and compressed to 25% minimum. Triple lock aluminum flexible ducting.

.2 Operating Temperature Range: 40°C to 200°C.

.3 Operating Pressure: Maximum 3 kPa static.

.4 Products: Flexmaster.

2.12 SEALANTS

.1 Comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.

.2 Sealants to contain zero VOC,

2.13 ALUMINUM INSULATED / THERMALLY BROKEN DAMPERS

.1 Frame: Extruded 6063T5 aluminum, 2.03 mm thick, 101.6 mm deep, insulated with Styrofoam on three sides for duct mounting and four sides for flanged mounting.

.2 Blades: Extruded 6063T5 aluminum, internally insulated with expanded polyurethane foam, thermally broken, minimum insulation value 0.4 RSI.

.3 Blade and Frame Seals: Extruded silicone secured in integral slot with aluminum extrusions.

.4 Bearings: Celcon inner bearing, 11 mm aluminum hexagon blade pin, polycarbonate outer bearing.

.5 Linkage: Frame side, aluminum and corrosion resistant zinc plated steel with slip-proof cup-point trunion screws. Blade linkage hardware to be installed out of air-stream.

.6 Jack Shaft Assemblies: To be provided for multiple damper installations.

.7 Operating Temperature Range: -40ºC to 100 ºC.

.8 Leakage: 25 L/s/m^2 at 1 kPa differential static pressure at -40 ºC.

.9 Pressure Drop: Full open 1200 x 1200 damper not to exceed 0.007 kPa at 5.08 m/s.

.10 Certification: AMCA 511.

.11 Schedule:

.1 Refer to schedule on drawings.

.12 Mounting: Flanged to duct.

.13 Acceptable Material: TAMCO Series 9000 SC Thermally Insulated Damper.

2.14 ALUMINUM AIRFOIL DAMPERS

.1 Frame: Extruded 6063T5 aluminum, 2.03 mm thick, 101.6 mm deep.

.2 Blades: Extruded 6063T5 aluminum.

.3 Blade and Frame Seals:

.1 Blade: Extruded EPDM.

.2 Frame: Extruded TPE.

.3 All gaskets in integral slot with aluminum extrusions.

.4 Bearings: Celcon inner bearing, 11 mm aluminum hexagon blade pin, polycarbonate outer bearing.

.5 Linkage: Frame side, aluminum and corrosion resistant zinc plated steel with slip-proof cup-point trunion screws. Blade linkage hardware to be installed out of air-stream.

.6 Jack Shaft Assemblies: To be provided for multiple damper installations.

.7 Operating Temperature Range: -40ºC to 100 ºC.

.8 Leakage: 52 L/s/m^2 at 1 kPa differential static pressure at -40 ºC.

.9 Pressure Drop: Full open 1200 x 1200 damper not to exceed 0.004 kPa at 5.08 m/s.

.10 Certification: AMCA 511.

.11 Schedule:

.1 Return Air: Opposed blade.

.2 Isolation: Opposed blade.

.12 Mounting: Flanged to duct.

.13 Acceptable Material: TAMCO Series 1000 Airfoil Control Damper.

Part 3 Execution

3.1 APPLICATION

.1 Duct Access Doors

.1 Provide access door minimum 450 mm x 350 mm or 50 mm smaller than duct dimension for cleaning and inspection at positions indicated by drawings and as follows:

.1 At 6.0 m intervals on all horizontal ducts.

.2 At 12.0 m intervals in all vertical duct systems.

.3 At the base of all duct risers.

.4 Both sides of turning vanes in all ducts.

.5 At each fire damper location.

.6 At each side of all heating or cooling coils.

.7 At all locations of internally duct mounted devices including automatic dampers, damper motors, duct mounted smoke detectors and heat detectors, and control sensors and devices.

3.2 PLENUM ACCESS DOORS

.1 Install plenum access doors where required to service mixing dampers, coils, filters, humidifiers and fans. Install 150 mm above floor. Arrange door swing so that fan static holds door in closed position.

3.3 FLEX CONNECTORS TO EQUIPMENT

.1 Allow 50 mm movement for flexible connectors on low pressure fans and equipment subject to forced vibration; 100 mm for equipment subject to large differential movement.

.2 Install with just sufficient slack to prevent vibration transmission.

.3 Provide fire retardant flexible connectors on kitchen exhaust systems.

3.4 TURNING VANES

.1 Install full radius turning vanes in duct elbows where center line radius is less than 1.25 times width of duct.

.2 Install acoustic turning vanes in acoustic lined ductwork where centerline radius is less than 1.25 times width of duct.

3.5 FIRE DAMPERS

.1 Provide fire dampers where duct penetrates fire rated membranes. Install to NFPA 90A and SMACNA Standard “Fire Damper Guide for Air Handling Systems”. Refer to drawings.

.2 Recess curtain type fire damper so that free area of connecting ductwork is not reduced.

.3 Provide curtain type fire dampers in duct systems with pressure greater than 250 Pa.

.4 Provide multi-blade, offset butterfly or recessed curtain blade fire dampers on duct systems with pressure less than 250 Pa.

3.6 COMBINATION FIRE/SMOKE DAMPERS

.1 Provide motorized combination fire/smoke dampers where duct penetrates an area of refuge fire rating zones separation zone. See plans for details and additional locations.

.2 Install to SMACNA Standard.

3.7 BALANCING DAMPERS

.1 Install balancing dampers at all branch ducts on low pressure supply, return and exhaust air distribution ductwork and where indicated on drawings.

.2 Provide single blade dampers for duct sizes to 240 mm x 760 mm. Provide multi-blade opposed blade dampers with maximum blade size at 150 mm x 1800 mm.

3.8 BACKDRAFT DAMPERS

.1 Provide gravity backdraft dampers on all exhaust air outlets to outdoor and exhaust fans where motorized dampers are not indicated, and where shown on drawings.

3.9 FLEXIBLE DUCT CONNECTIONS TO AIR OUTLETS

.1 Install maximum 300 mm length of flexible duct between ceiling diffuser and sheet metal duct.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Centrifugal Inline Fans.

.2 Cabinet Fans.

.3 Fan Accessories.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Electric Motors – Three Phase	Section 20 05 03
.3	Variable Frequency Drives	Section 20 05 04
.4	General Documentation	Section 20 05 05
.5	Equipment Testing and Startup	Section 20 05 08
.6	Vibration Isolation	Section 20 05 48
.7	Testing, Balancing and Adjusting	Section 20 22 00
.8	Air Duct Accessories	Section 23 33 13

1.3 QUALITY ASSURANCE

.1 Conform to AMCA Bulletins regarding construction and testing. Fans shall bear AMCA certified rating seal for performance and sound ratings.

.2 Fans shall bear CSA label.

1.4 SUBMITTALS

.1 Submit with shop drawings acoustical data and fan curves showing fan performance with fan and system operating point plotted on curves.

.2 Comply with the requirements of Section 20 05 05, General Documentation including shop drawing submissions and Operating and Maintenance documentation.

1.5 JOB CONDITIONS

.1 Do not operate fans for any purpose, temporary or permanent until ductwork is clean, filters are in place, bearings are lubricated and installation has been reviewed by the vendor.

1.6 ALTERNATES

.1 Equivalent fan selections shall not increase motor kilowatts, increase rpm, increase noise level, increase tip speed or increase inlet air velocity from that of the specified fan.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 In-Line Fans: Greenheck, Penn, Chicago, Carnes, Cook

2.2 GENERAL

.1 Provide motors to comply with Section 20 05 03, Electric Motors – Three Phase.

.2 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.

.3 For belt-driven fans, provide balanced variable sheaves on constant volume applications for motors 11.2 kW and under and fixed sheave for 15 kW and over.

.4 Fans are to be capable of accommodating static pressure variations of +10% with no objectionable operating characteristics.

.5 Supply replacement pulleys and sheaves for fans as required to properly balance the systems to design flows at actual job site static pressure conditions. Obtain requirements from balancing agency. (Refer to Section 20 22 00, Testing, Balancing and Adjusting.)

.6 Provide belt guards with tachometer holes.

2.3 IN-LINE CENTRIFUGAL FANS

.1 Characteristics and construction: centrifugal fan wheels, with axial flow construction

.2 Casing: heavy gauge galvanized steel, square design, duct mounting collars, removable access panels.

.1 25 mm thick acoustic lining where noted. See schedule.

.2 Aluminum fabrication where noted. See schedule.

.3 Fan: centrifugal backward inclined, aluminum, wheel cone, statically and dynamically balanced.

.4 Motors:

.1 General: heavy duty ball bearing type, belt driven, motor outside of air stream.

.2 Variable Speed: to requirements of 20 05 03, Electric Motors - Three Phase.

.3 Efficiency: to requirements of 20 05 03, Electric Motors - Three Phase.

.5 Bearings: permanently lubricated and sealed pillow block bearing.

.6 Drives: belt driven or direct drive as indicated. Belt driven drives to be rated to 150% of driven horsepower, adjustable sheaves.

.7 Fans to bear AMCA ratings seal for sound and air performance.

.8 Vibration Isolation: manufacturer supplied open spring type with sound deadening pads.

.9 Insulation: insulated housing where indicated, 25mm thickness.

.10 Acceptable Material: Greenheck BSQ and SQ, Twin City Fans

.11 Schedule:

.1 See schedule on drawings

2.4 AXIAL FLOW FANS (TUBE-AXIAL OR VANE-AXIAL)

.1 Casings: aerodynamically designed with integral punched flanges, rolled steel with continuous welded seem, bolted access plates.

.2 Motor Supports: constructed of structural steel suitable to support weight of motor and propeller. Motor supports within the fan housing are to be welded to the fan casing.

.3 Fan Impeller:

.1 Cast aluminum airfoil blades and cast aluminum hub. Blades to be adjustable within hub to allow for performance changes.

.2 Propeller to be statically and dynamically balanced.

.3 Propeller and fan inlet shall be carefully matched and have precise running tolerances for maximum performance and operating efficiency.

.4 Supports:

.1 Ceiling suspended units: support brackets welded to side of casing. Extend grease lubrication facilities to outside of casing.

.5 Bearings: ball or roller with extension tubes to outside of casing.

.6 Motors:

.1 Motors shall be 3600 RPM, 1800RPM, or 1200RPM, totally-enclosed fan cooled (TEFC)

.2 Standard NEMA T-frame design.

.3 Motors for emergency smoke ventilation shall use insulation class F or H as noted below:

.1 572 degF (300 degC) for a minimum of 1 hour of operation requires class H insulation

.4 Direct drive:

.1 Diameter of wheel hub: at least equal to that of motor frame.

.2 Adjustable blades for varying range of volume and pressure. Provide permanent pitch angle indication vernier scale on hub. Provide adjustment set at factory before shipment. Provide adjustment stops to avoid overloading motor.

.5 Belt drive:

.1 Drive adjustable blades by externally mounted motors through V-belt drive. Provide internal belt fairing, external belt guards and adjustable motor mounts.

.2 Adjust blades for varying range of volume and pressure. Hubs to facilitate indexing of blade angle. Provide manual adjustment stops to avoid overloading motor.

Part 3 Execution

3.1 INSTALLATION

.1 Where inlet or outlet is exposed, provide safety screen.

.2 Provide belt guards on belt driven fans complete with tachometer access.

.3 Supply and install sheaves as necessary for final air balancing.

.4 Provide 100 mm high housekeeping base for floor mounted units.

.5 Install inlet and discharge configuration in strict accordance with manufacturers recommendations.

.6 Install flexible connectors on fan inlet and discharge. (Refer to Section 23 33 13, Air Duct Accessories.)

.7 Provide vibration isolation on fan supports. (Refer to Section 20 05 48, Vibration Isolation.)

3.2 PRIMING

.1 Prime coat fan wheels and housing factory inside and outside. Prime coating on aluminum parts is not required.

3.3 PERFORMANCE

.1 Base fan performance on sea level conditions.

.2 Refer to fan schedules on drawings.

3.4 STARTUP AND TESTING

.1 Prior to startup, vendor shall certify that the fan installation is consistent with manufacturers recommendations.

.2 Start, test and balance fans to comply with:

.1	Systems Demonstration and Owner's Instruction	Section 20 05 08
.2	Testing, Balancing and Adjusting	Section 20 22 00

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Diffusers.

.2 Grilles and Registers.

.3 Outside Louvers (intake and exhaust).

.4 Door Grilles.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Testing, Balancing and Adjusting	Section 20 22 00
.4	Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors	Section 20 05 29
.5	Air Duct Accessories	Section 23 33 13

1.3 QUALITY ASSURANCE

.1 Air flow tests and sound level measurement shall be made in accordance with applicable ADC equipment test codes, ASHRAE Standards and AMCA Standards.

.2 Unit rating shall be approved by ADC and AMCA.

.3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.

.4 Outside louvers shall be tested to AMCA 500 Test Procedure and shall bear AMCA seal for free area and water penetration.

1.4 JOB CONDITIONS

.1 Review requirements of outlets as to size, finish and type of mounting prior to submitting shop drawings and schedules of outlets.

.2 Positions indicated are approximate only. Confirm locations of outlets and make necessary adjustments in position to conform with Architectural features, mounting requirements, symmetry and lighting arrangement.

1.5 SUBMITTALS

.1 Submit shop drawings with complete catalogue information, materials of construction, dimensions and accessories. Comply with Section 20 05 05, General Documentation.

.2 Submit colour selection charts of finishes, for approval prior to fabrication.

.3 Comply with requirements of Section 20 05 05, General Documentation..

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1	Diffusers:	Price, Titus, Nailor, Krueger, Metalaire
.2	Grilles and Registers:	Price, Titus, Nailor, Seiho, Krueger, Metalaire
.3	Outside Louvre:	Price, Aerolite, Westvent, Ruskin.
.4	Door Grilles:	Price, Titus, Nailor, Metalaire

2.2 GENERAL

.1 Base air outlet application on total space noise level of NC 25 maximum.

.2 Provide supply outlets with sponge rubber seal around the edge.

.3 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.

.4 Provide plaster frame for diffusers located in plaster surfaces.

.5 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.

.6 Refer to Air Outlet Schedule for specifications of air outlets.

2.3 DOOR GRILLES

.1 Fabricate of V-shaped louvers of 1.0 mm steel, 25 mm deep on 15 mm centers.

.2 Provide 1.0 mm steel frame with auxiliary frame to give finished appearance on both sides of door.

.3 Factory finish in prime coating.

2.4 OUTSIDE LOUVERS

.1 Louvers 150 mm deep with blades on 40° slope with double drainable blade and drainable heavy channel frame, birdscreen with 15 mm square mesh. Equivalent to Ruskin ELF6811DD (150 mm) or E.H. Price DE635.

.2 Fabricate of 2.0 mm extruded aluminum blades and frame. Where openings exceed 1800 mm in height, jamb frames shall be 2.0 mm. Provide welded assembly.

.3 Finish:

.1 Smoke Exhaust: Anodized Dark Bronze, Architectural Class I (0.7mils minimum), Aluminium Association Specification AA-M10C21A44 / AA-M45C22A44. Provide sample of finish and confirm color acceptable with Departmental Representative prior to ordering.

.2 Others: Clear anodized finish, minimum thickness 0.4 mils.

Part 3 Execution

3.1 INSTALLATION

.1 Make airtight connection between diffusers and ductwork.

.2 Provide balancing damper on duct take-off to each diffuser at main branch take-off, even when volume dampers are specified as part of grille assembly.

.3 Sizes indicated are nominal. Provide correct standard product nearest to nominal to deliver the capacity listed without increasing noise levels or pressure drop.

.4 Arrange to paint ductwork visible behind air outlets matte black. Refer to Section 20 05 53, Identification for Mechanical Systems.

.5 Confirm air outlet/inlet and louvre dimensions, mounting, finish and colours with ceiling and wall construction prior to submitting shop drawings.

.6 Adjust supply outlets to deliver air patterns defined on drawings or as directed by the Departmental Representative.

.7 Provide smudge resistant frames on diffusers located on textured ceilings.

.8 Provide factory finish on each air inlet/outlet, louvre and intake hood as scheduled.

3.2 GRILLES AND DIFFUSERS SCHEDULE

.1 Refer to schedule on drawings.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Panel filters.

.2 Frames.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Air Duct Accessories	Section 23 33 13
.4	Packaged Modular Indoor Air Handling Units	Section 23 73 13

1.3 QUALITY ASSURANCE

.1 Filters shall be product of and supplied by one manufacturer.

.2 Filter media shall be UL listed.

.3 Filter components assembled to form filter banks shall be products of same manufacturer.

.4 Filters shall comply with ASHRAE Standard 52.2 – Method of Testing General Ventilation, Air Cleaning Devices for Removal Efficiency by Particulate Size.

.5 Filters containing asbestos, urea formaldehyde or fibreglass shall not be acceptable.

1.4 ALTERNATIVES

.1 Size, media face area, material, test efficiency, initial and final air resistance of alternative manufacturers shall be as specified.

1.5 SUBMITTALS

.1 Comply with requirements of Section 20 05 05, General Documentation.

Part 2 Products

2.1 APPROVED EQUALS

Panel Filters: Camfil Farr – 30/30, AAF – Perfect Pleat HCM8, Flanders – Pre-Pleat 40

2.2 FRAMES

.1 Fabricate filter frames and supporting structures of galvanized steel or extruded aluminum with necessary gasketing between frames and walls. Provide holding frames 1.6 mm, "T" section construction, locking clips and provision for front mounted filters.

.2 Provide standard size frames to provide interchangeability of filter media of other manufacturers.

2.3 PANEL FILTERS

.1 Mount filler media in a high wet strength beverage-board frame, suitable of withstanding 500 kPa pressure without blow-out, suitable for maintaining in galvanized steel frames described in Article 2.2.

.2 The filter shall be UL Class 2.

.3 The filter shall have a minimum MERV8 rating in compliance with ASHRAE 52.2, 50 mm deep pleated filter.

Part 3 Execution

3.1 INSTALLATION

.1 Construct and install filters to prevent passage of unfiltered air. Provide felt, rubber or neoprene gaskets.

.2 Do not operate fan system connected to filter banks until filters (temporary or permanent) are in place. Provide new filters at take-over by the Owner. Replace filters used during construction.

.3 Construct filter frames with provision for removal and access.

3.2 SCHEDULE

Tag	Flow (L/s)	Size	MERV Rating
CF-1	75	1 @ 300x200	8

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Pleated filters.

.2 High efficiency box filters.

.3 Filter frames.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Air Duct Accessories	Section 23 33 13
.4	Packaged Modular Outdoor Air Handling Units	Section 23 73 13

1.3 QUALITY ASSURANCE

.1 Filters shall be product of and supplied by one manufacturer.

.2 Filter media shall be UL listed, Class I or Class II.

.3 Filter components assembled to form filter banks shall be products of same manufacturer.

.4 Filters shall comply with ASHRAE Standard 52.2 – Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particulate Size.

.5 Filters containing asbestos, urea formaldehyde or fibreglass shall not be acceptable.

1.4 ALTERNATIVES

.1 Size, media face area, material, test efficiency, initial and final air resistance of alternative manufacturers shall be as specified.

1.5 SUBMITTALS

.1 Comply with requirements of Section 20 05 05, General Documentation.

Part 2 Products

2.1 APPROVED EQUALS

High Efficiency Box Filters: Camfil Farr – Aeropac, AAF – VariCel, Flanders – Precision Cell

2.2 FRAMES

.1 Fabricate filter frames and supporting structures of galvanized steel or extruded aluminum with necessary gasketing between frames and walls. Provide holding frames 1.6 mm, "T" section construction, locking clips and provision for front mounted filters.

.2 Provide standard size frames to provide interchangeability of filter media of other manufacturers.

2.3 HIGH EFFICIENCY FINAL FILTERS

.1 General: high performance, pleat in pleat, totally rigid and disposable type, V bank.

.2 Media: high density microfine glass fibres formed into uniformly spaced pleats separated by glass filament separators and formed into minipleat pack design.

.3 Configuration: assembled into V-bank configuration with appropriate number of packs to obtain desired pressure drop.

.4 Bonding: media packs bonded on inside periphery of enclosing frame with fire retardant phosphorous free sealant.

.5 Enclosing frame: modular, injection molded plastic channels, molded modular supports on entering and exiting side to promote uniform airflow and structural support, transport handle.

.6 Header: nominal 25 mm integral to enclosing frame.

.7 End caps: rigid, injection molded, bonded to top and bottom of enclosing structure.

.8 Gasket: for header to header sealing.

.9 Air flow: bi-directional.

.10 Performance: average efficiency 90 - 95% on the ASHRAE Test Standard (52-76) and an average dust spot resistance of not less than 99% on that standard and a minimum efficiency reporting value to ANSI/ASHRAE 52.2 of MERV 14.

.11 Initial air resistance: 100Pa at airflow of 2.5m/s.

.12 Listing: UL 900 - Class 2.

.13 Manufacturer approvals: ISO 9001.

.14 Access: Service upstream. Side access when service upstream is unavailable.

.15 Maximum acceptable velocity: 2.5m/s.

.16 Acceptable material: Farr Durafil 2V.

Part 3 Execution

3.1 INSTALLATION

.1 Construct and install filters to prevent passage of unfiltered air. Provide felt, rubber or neoprene gaskets.

.2 Do not operate fan system connected to filter banks until filters (temporary or permanent) are in place. Provide new filters at take-over by the Owner. Replace filters used during construction.

.3 Provide filter banks in arrangement shown with removal and access indicated.

3.2 PERFORMANCE

.1 Refer to air system unit schedule and details on drawings.

END OF SECTION

Part 1 General

1.1 Scope

.1 Site fabricated breeching.

.2 Manufactured chimneys for forced draft and neutral draft fuel oil fired equipment.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Supports, Anchors, Seals, Pipe and Duct Penetration, and Access Doors	Section 20 05 29
.4	Piping and Equipment Insulation	Section 20 20 30
.5	Metal Ducts	Section 23 31 13
.6	Counterflashing for Mechanical Equipment	Section 23 05 10
.7	Terminal Heat Transfer – Unit Heater	Section 23 82 39

1.3 QUALITY ASSURANCE

.1 Vents and Chimneys: Labelled by Underwriters' Laboratory of Canada.

.2 The successful bidder for the self-supporting stack shall provide to the general contractor, all relevant moments and loads that result from wind, earthquake and vortex shedding so that the contractor can design and install the suitable concrete base and building tie backs as required.

1.4 DEFINITIONS

.1 Vent: enclosed passageway for conveying flue gases from the appliances to outdoors.

.2 Breeching: portion of vent from the appliance to the chimney.

.3 Chimney: primary vertical portion of vent.

.4 Draft: flow of air or combustion products or both, through an appliance and its venting system.

.5 Mechanical Draft: draft produced by a mechanical device such as a fan, blower, or aspirator which may supplement natural draft.

.6 Forced Draft: a mechanical draft produced by a device upstream of the combustion zone of an appliance.

.7 Induced Draft: a mechanical draft produced by a device downstream from the combustion zone of an appliance.

.8 Natural Draft: a draft other than mechanical draft.

1.5 QUALITY ASSURANCE

.1 Vents and accessories forming part of the venting system shall be ULC labelled.

1.6 SUBMITTALS

.1 To the requirements of Section 01 33 00 - Submittal Procedures and Section 20 05 05, General Documentation.

.2 Comply with requirements of Section 20 05 05, General Documentation and in accordance with Section 01 33 00 - Submittal Procedures.

.3 Clearly indicate following:

.1 Methods of expansion.

.2 Details of thimbles.

.3 Base and intermediate supports.

.4 Guy details.

.5 Exit cone.

.6 Flange details.

Part 2 Products

2.1 ALL FUELS PRESSURE CHIMNEY

.1 General: sectional, gas tight, expansion compensating without the requirement of bellows, factory built, ULC labeled, liquid/gas fuel rated to 760 degrees C for pressure and force draft appliances.

.2 Seal: primary gas seal graphite gasket factor installed to inner liner.

.3 Insulation:

.1 HW Boilers: 50 mm thickness high temperature mineral wool insulation.

.4 Liner: type 304 stainless steel.

.5 Shell: type 304 stainless steel.

.6 Couplings: mated couplings with collar.

.7 Fittings for each chimney:

.1 Base lateral tee with cap and drain.

.2 Exit cone.

.3 Roof flashing, collar and roof brace.

.4 Radiation shields at each floor penetration.

.5 Base and intermediate supports as required.

.8 Acceptable Material: Security Chimney CIX

2.2 BREECHING TYPE 2:

.1 For forced, induced, or natural draft with dilution, liquid or solid fuel fired appliances, use one of the following:

.1 Mild steel, all welded construction with thicknesses as follows:

Vent Diameter	Min. Thickness
300 mm and smaller	1.3 mm
325 mm to 600 mm	1.6 mm

.2 Breeching constructed of same vent components as chimney.

2.3 ACCESSORIES

.1 Cleanouts: bolted, gasketted type, full size of breeching area.

.2 Barometric Damper: double acting sized to 70% of full size of breeching area.

.3 Appurtenances: exit core, thimbles, support brackets and guys, flashing and counterflashings, and other materials required to complete the assembly.

Part 3 Execution

3.1 VENT INSTALLATION

.1 Install vents, complete with accessories and appurtenances, in accordance with CAN/CSA B139, National Building Code of Canada, manufacturer's instructions and as follows:

.1 Type A: to CAN4-S604.

.2 Do not penetrate flue gas chamber of vent with screws or mechanical fasteners.

.3 Install breeching with positive slope upward from appliance.

.4 Suspend breeching using trapeze hangers at 1500 mm centers.

.5 Install cleanout at base of chimney.

.6 Install drain tee cap (TD) at base of chimney and exhaust air risers.

.7 Provide breeching damper as indicated on drawings.

.8 Support chimney at bottom, roof and intermediate levels.

.9 Install thimbles where penetrating roof, floor and ceiling.

.10 Install outlet cone (EC) on chimney outlet.

.11 Install counterflashing where chimneys pass through roof.

.12 Provide for expansion and contraction of chimney and breeching.

.13 Foil tape all joints in flue piping serving forced draft infrared heaters.

.14 Provide Type A chimney for full length of vertical chimney and breeching header to breeching connectors from appliances.

3.2 BREECHING CONNECTORS

.1 Flange connections at boiler discharge and chimney connections. Breeching connectors from appliance connections to common breeching header.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Electric duct heaters

.2 Coil installation.

.3 Coil accessories.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Equipment Testing and Startup	Section 20 05 08
.4	Meters and Gauges	Section 20 05 19
.5	Testing, Balancing and Adjusting	Section 20 22 00
.6	Controls	Section 20 30 Series
.7	HVAC Controls	Section 23 09 Series
.8	Metal Ducts	Section 23 31 13
.9	Ductwork Cleaning	Section 23 31 14
.10	Packaged Modular Outdoor Air Handling Units	Section 23 73 13

1.3 QUALITY ASSURANCE

.1 Coils shall be the product of manufacturer regularly engaged in production of coils who issues complete catalogue data on such products.

.2 Coil capacities, pressure drops, and selection procedures shall be certified in accordance with ARI Standard 410 for Forced Circulation Air Cooling and Air Heating Coils and bear ARI seal.

1.4 REFERENCE STANDARDS

.1 Canadian Standards Association CSA C22.2 No.46-[M1998(R2001)], Electric Air-Heaters.

.2 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).

.3 AMCA Standards

.4 ARI 410 – Forced Circulation Air Cooling and Air Heating Coils

.5 ANSI/ASHRAE/ESNA Standard 90.1 – Energy Standard for Buildings Except Low Rise and Residential Buildings.

.6 ASTM Standards

1.5 SUBMITTALS

.1 Comply with the requirements of Division 01 and Section 20 05 05, General Documentation.

.2 Shop drawings shall include dimensions, materials of construction and performance data to match specifications.

.3 Submit product data and include:

.1 Element support details.
.2 Heater: total kW rating, voltage, phase.
.3 Number of stages.
.4 Rating of stage: rating, voltage, phase.
.5 Heater element watt/density and maximum sheath temperature.
.6 Maximum discharge temperature.
.7 Physical size.
.8 Unit support.
.9 Performance limitations. Clearance from combustible materials.
.10 Internal components wiring diagrams.
.11 Minimum operating airflow.
.12 Pressure drop operating airflow.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Approved manufacturer shall be Thermolec, with pre-approved alternates as listed. Manufacturers not pre-approved, must obtain pre-approval in writing from Departmental Representative. Alternates must comply with all performance and features as called for in this specification. Job awarded on basis of specified equipment. Alternate will be evaluated and considered after job is awarded.

.2 Manufacturer must clearly define any exceptions made to Plans and Specifications. Any deviations in layout or arrangement shall be submitted to Departmental Representative prior to bid date. Acceptance of deviation(s) from specifications shall be in the form of written approval from the Departmental Representative. Mechanical Contractor is responsible for expenses that occur due to exceptions made.

.3 Approved Manufacturers

.1 Thermolec Open Coil Duct Heaters

.4 Approved Alternatives

.1 Price Open Coil Elements (Model C)
.2 Greenheck IDHB series

2.2 AIR DUCT HEATERS

.1 Duct heaters: flange type.

.2 Elements: Helical coils of nickel chrome alloy resistance wire, suitable for long term non-operation at -50 degC.

.3 Element supports: ceramic bushing, non-rotating, held in frame by lock to keep floating and stress-free.

.4 Enclosure: corrosion resistant galvanized steel.

.5 Maximum temperature at discharge: 40 degC.

.6 Controls:

.1 Controls to be mounted in factory prepared remote control panel(s). Panel to be mounted in mechanical/electrical room.

.2 Controls required to be mounted at coil are to be suitable for -50 degC while non-operational.

.3 Use terminal blocks for power and control wiring to thermostat and air proving switch

.4 Controls mounted in a CSA Type enclosure(s) and to include:

.1 High limit cut-outs

.2 Magnetic contactors as required

.3 Air flow sensor

.4 Factory mounted modulating (SCR) controller

.5 Disconnect switch at heater

.5 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.

.6 Temperature sensors and staging:

.1 Heaters are to receive a 0-10 VDC or 4-20mA signal from the remote space temperature sensor.

.2 Heaters to maintain space temperature set-point as indicated in Section 23 09 93 – Electric and Electronic Control Systems for HVAC and on drawings.

.7 Acceptable material:

.1 See schedule on mechanical drawings.

Part 3 Execution

3.1 INSTALLATION

.1 Make power and control connections to CSA C22.2 No.46 and manufacturers recommendations.

.2 Ensure air flow equal across coil face.

3.2 PERFORMANCE

.1 Refer to schedule on drawings.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Modular designed and built Air Handling Units (AHU) to meet the specific physical and performance criteria defined in this section, related sections and in the contract documents, suitable for outdoor mounting.

.2 Overall dimensions and configuration are defined in the Contract Documents.

1.2 RELATED WORK IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Requirements	Section 20 05 01
.2	Electric Motors – Three Phase	Section 20 05 03
.3	Variable Frequency Drives	Section 20 05 04
.4	Equipment Testing and Startup	Section 20 05 08
.5	Vibration Isolation	Section 20 05 48
.6	Seismic Restraint Systems	Section 20 05 49
.7	Testing, Balancing and Adjusting	Section 20 22 00
.8	Ductwork Cleaning	Section 23 31 14
.9	Panel Air Filters	Section 23 41 13
.10	Air Coils	Section 23 82 16
.11	Duct Heaters	Section 23 55 01
.12	Electrical	Division 26

1.3 QUALITY ASSURANCE

.1 It is the intent of this specification that the manufacturer provide Air Handling Units designed and manufactured specifically to the requirements of this project. Overall dimensions, and configuration are to be as shown on the plans and as described in the specifications. Take responsibility for the engineering and operational integrity of the air processing unit.

.2 Air Handling Units are to be built by a recognized manufacturer of Air Handling Units who maintains a parts and service agency within Yukon Territory.

.3 Electrical installation shall comply with the requirements of Division 26, and the Canadian Electrical Code.

.4 Air flow rates, external static pressures, water flow rates, coil face velocities, filter face velocities, water and air side pressure drops shall be the same or better than specified, for equivalent selections.

.5 Fans shall be AMCA certified.

.6 Coils shall be ARI certified.

.7 Provide all motors with thermal overload protection. Comply with the requirements of Section 20 05 03, Electric Motors – Three Phase.

.8 Construction shall comply with Territorial Codes and shall have CSA approval.

.9 Execute startup of unit by manufacturer's personnel. Submit a complete manufacturer's check list of field startup tests must be submitted with operations and maintenance instructions and shall be signed by startup technician and mechanical trade, field supervisor as certified satisfactory for operation.

.10 All components, paints, and lining shall have a flame spread rating of not over 25 with no evidence of continued progressive combustion and a smoke developed rating no higher than 50 as tested according to AN/ULC – S102.2 Standard Method of Test for Surface Burning Characteristics of Building Materials and assemblies.

.11 Supply replacement pulleys and sheaves for fans as required to properly balance the systems to design flows at actual job site static pressure conditions. Obtain requirements from balancing agency. (Refer to Section 23 05 93, Testing, Adjusting and Balancing for HVAC Systems.)

.12 Sealing of all unit casing penetrations made on site such as for piping, conduit, hanger rods, etc. shall be the responsibility of the mechanical contractor to the satisfaction of the Air Handling unit manufacturer. Sealing method and components shall be suitable to withstand 1.5 times the working pressure of the unit.

.13 Use the following as selection criteria and supply as specified:

.1 air flow rate

.2 external static pressure

.14 The following are to be equaled or improved:

.1 coil face velocities equaled or lowered

.2 filter face velocities equaled or lowered

.3 sound power levels equaled or lowered

.4 outlet velocities equaled or lowered

.5 internal static pressure equaled or lowered

.6 fan motor power equaled

1.4 REFERENCE STANDARDS

.1 AMCA Standards

.2 ARI 410 – Forced Circulation Air Cooling and Air Heating Coils

.3 ARI 610 – Central System Humidifiers

.4 AHRI 1060 – Heat Wheel Performance Certification

.5 CSA – labeled

.6 NFPA 90A – Flame Spread and Smoke Ratings

.7 SMACNA – HVAC Duct Construction Standards – Metal and Flexible

.8 ANSI/ASHRAE/ESNA Standard 90.1 – Energy Standard for Buildings Except Low Rise and Residential Buildings.

.9 ASTM Standards

.10 NFPA Standards

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, protect and handle products to the site as defined in Section 01 61 00 – Common Product Requirements.

.2 Prior to shipment, comply with the following procedures to ensure equipment delivered to site is clean and protected.

.1 Thoroughly clean interior and exterior of the unit and/or modules.

.2 Vacuum interior of unit to remove all dust, metal shavings and such debris.

.3 Wipe down all surfaces with isopropyl alcohol, removing excess caulking.

.4 Submit electronic photographic record of packaging process, confirming the condition of equipment before and after packaging.

.3 Ship product in factory fabricated protective containers with factory installed shipping skids and lugs.

.4 Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

.5 Store components in a clean, dry space until site construction is ready for installation. Protect from weather and construction work. Handle with care to protect from damage to components, enclosure and finish.

1.6 SUBMITTALS

.1 Comply with the requirements of Division 01 and Section 20 05 05, General Documentation.

.2 Submit shop drawing including the following information. Shop drawings submitted without this information shall be rejected.

.1 Submit unit construction drawings for each modular section.

.2 Unit Dimensions: Indicated outside dimensional drawing including service clearances.

.3 Indicate material and gauge of all construction components.

.4 Show point loads, and recommended method of unit installation.

.5 Submit fan performance curves as well as performance tables.

.6 Make, model, selection criteria, and pressure drop for air blenders.

.7 Coil selection criteria indicating air side and refrigerator side capacities, inlet and outlet conditions, velocities, pressure drops and fouling factors. Submit a drawing showing headers, circuiting arrangement, connection sizes, and materials of construction. Refer to Section 23 82 16, Air Coils.

.8 Indicate air filter media, MERV rating, velocity, pressure drop charts and capacities. Indicate mounting method and arrangement.

.9 Energy recovery systems.

.10 Table indicating pressure drops through each unit.

.11 Damper shop drawings.

.12 Detailed composite wiring diagrams showing factory installed wiring, including wiring of the control components.

.13 Submit sound power levels generated by the air handling unit at the inlet and outlet of the unit and outside the fan section. List for individual octave bands from 125 HZ to 8000 HZ in dB referenced to A rating.

.14 Variable speed drives.

.15 All electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations.

.16 All performance data, including capacities and airside and waterside pressure drops, for components.

.17 A filter schedule must be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, unit size, corresponding filter section location within the AHU, filter arrangement (e.g. angled/flat), filter depth, filter type (e.g. pleated media), MERV rating, and filter quantity and size.

.18 An electrical MCA – MOP schedule shall be provided for each electrical circuit to which field-power must be supplied. Schedule to detail unit tag, circuit description,

voltage/phase/hertz, Minimum Circuit Ampacity (MCA), and calculated Maximum Overcurrent Protection (MOP).

.19 The AHU manufacturer shall provide appropriate sets of submittals as referenced in the General Conditions and shall submit to the departmental representative electronic copies of the IOM.

.20 The AHU manufacturer shall list any exceptions to the specification.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Approved manufacturer shall be Trane, with pre-approved alternates as listed. Manufacturers not pre-approved, must obtain pre-approval in writing from Departmental Representative. Alternates must comply with all performance and features as called for in this specification. Job awarded on basis of specified equipment. Alternate will be evaluated and considered after job is awarded.

.2 Manufacturer must clearly define any exceptions made to Plans and Specifications. Any deviations in layout or arrangement shall be submitted to Departmental Representative prior to bid date. Acceptance of deviation(s) from specifications shall be in the form of written approval from the Departmental Representative. Mechanical Contractor is responsible for expenses that occur due to exceptions made.

.3 Approved Manufacturers

.1 Trane Performance Climate Changer

.4 Approved Alternatives

.1 Haakon

.2 Venmar CES

.3 Engineered Air

.4 Silent-Aire

.5 Daikin McQuay

2.2 GENERAL

.1 Unit layout and configuration as per drawing 1/M601 and as scheduled.

.2 Unit manufacturer to provide a 150 mm welded base and steel cross members for structural rigidity and supports the full perimeter of the air handling unit. AHU panels must overhang the primary unit base such that no ledge exists for water to pool. The entire AHU perimeter shall be sealed for additional water management protection. A drain pan under the entire unit or sections shall not be an acceptable alternative to prevent water from entering the building space.

.3 Unit base shall be designed to allow the unit to rest on a slab on grade.

2.3 UNIT CASING

.1 Walls and Ceilings

.1 Interlocking double wall panel construction with at least two breaks at each interlocking joint. Wall and ceiling joints to be broken inward. All panel joints to be gasketed with closed cell, EDPM soft rubber gaskets. Casing depth to match the specified insulation thickness. Inside surfaces shall be clean and flush, free of exposed flanges.

.2 Outdoor unit roofs shall incorporate a standing seam on the exterior to ensure a rigid roof construction and prevent water infiltration. Roof assembly shall overhang all walls by

40mm minimum to prevent sheeting from roof to side panels. Rain gutters shall also be provided over all doors to direct rain away from the door assembly.

.3 Outdoor roofs shall be sloped, not less than 1mm per meter, for water drainage. Where outdoor units are shipped in multiple sections, provide standing-seam joiners at each split with adhesive, hardware, and cover strips for field joining by the installing contactor.

.4 Stiffeners of angle steel shall be supplied as required to maintain casing deflection criteria of 1/200 at 1.5 times the working pressure. If panels cannot meet this deflection, add addition internal reinforcing.

.5 Casing performance – Casing air leakage shall not exceed leak class 6 (CL = 6) per ASHRAE 111 at specified casing pressure, where maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65.

.6 Air leakage shall be determined at 1.00 times maximum casing static pressure up to 1995 Pa Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit as a percentage of supply air, and as an ASHRAE 111 Leakage Class.

.7 Unit casing (wall/floor/pressure bulkhead roof panels and doors) shall be able to withstand up to 1.5 times design static pressure up to 1995 Pa in all positive pressure sections and 1995 Pa in all negative pressure sections, whichever is less, and shall not exceed 0.1 mm per 25 mm of panel span (L/240).

.8 Unit casing panels shall be 50 mm double-wall construction, with solid galvanized exterior and solid stainless steel interior, to facilitate cleaning of unit interior.

.9 Minimum 1.6 mm G90 galvanized steel exterior panels with air dried enamel finish. Color to be selected by Departmental Representative prior to ordering.

.10 Minimum 1.0 mm solid G90 galvanized steel inner panels unless otherwise noted.

.2 Base and Floor

.1 Floor panels shall be double-wall construction and designed to support a 300-lb load during maintenance activities and shall deflect no more than 0.0042" per inch of panel span.

.2 Tread plate shall be applied to the unit floor to improve the walking surface in unit sections where floor is fully accessible.

.3 Insulation

.1 Insulate all exterior walls and roof with 50 mm foam injected insulation RSI 2.28 or approved alternate.

.4 Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.

.5 Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

.6 Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.

.7 Weather Hoods

.1 Outside and exhaust air weather hoods shall be fabricated from the same material as the unit exterior. Hoods shall extend past the perimeter of the unit casing opening to ensure the hood does not obstruct the airflow path. Hoods shall be painted with the same paint requirements identified for the external casing herein.

.2 All hoods shall be sized for 100 percent of nominal damper capacities and furnished with bird screens or similar protection to prevent nesting and entry into AHU inlet or exhaust paths.

.3 Inlet hoods for each outside damper shall be provided with a high performance sine-wave moisture eliminator to prevent entrainment of water into the unit from outside air. Wire mesh screens shall not be acceptable as a moisture eliminator. Exhaust hoods shall be provided on exhaust air openings.

2.4 ACCESS DOORS

.1 Access doors shall be 50 mm double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.

.2 All doors shall be provided with a thermal break construction of door panel and door frame.

.3 Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

.4 Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.

.5 Handle hardware shall be designed to prevent unintended closure.

.6 Access doors shall be hinged and removable without the use of specialized tools to allow.

.7 Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions.

.8 Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.

.9 All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by the unit height.

.10 Multiple door handles shall be provided for each latching point of the door necessary to maintain the specified air leakage integrity of the unit.

2.5 PRIMARY DRAIN PANS

.1 All heat recovery sections shall be provided with an insulated, double-wall, stainless steel drain pan.

.2 The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements. See section 2.07, paragraph F through H for specifications on intermediate drain pans between cooling coils.

.3 The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

.4 All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit floor shall not be accepted.

.5 Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 65 mm beyond the base to ensure adequate room for field piping of condensate traps.

.6 The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.

.7 Coil support members inside the drain pan shall be of the same material as the drain pan and coil casing.

.8 If drain pans are required for heating coils, access sections, or mixing sections they will be indicated in the plans.

2.6 AIR MIXER/BLENDER SECTIONS

.1 Air mixers (blenders) shall be provided and located as indicated on the schedule and drawings. Mixers shall incorporate fixed blades, with no moving parts. Mixer panels shall be sized and installed in the unit with adequate distances upstream and downstream, based on the manufacturer's cataloged performance, to ensure a minimum mixing effectiveness of 70% at 25% outside air, one mixer diameter downstream of the mixer. The pressure drop rating for static air mixers installed with the unit shall include the pressure loss due to the mixer design and the mixer-to-plenum area ratio.

2.7 FANS

.1 Fan sections shall have a minimum of one access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components.

.2 Provide fans of type and class as specified on the schedule. Fan shafts shall be solid steel, coated with a rust-inhibiting coating, and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans controlled by variable frequency drives shall be statically and dynamically tested for vibration and alignment at speeds between 25% and 100% of design RPM. If fans are not factory-tested for vibration and alignment, the contractor shall be responsible for cost and labor associated with field balancing and certified vibration performance. Fan wheels shall be keyed to fan shafts to prevent slipping.

.3 Belt-driven fans shall be provided with grease lubricated, self-aligning, anti-friction bearings selected for L-50 200,000-hour average life per ANSI/AFBMA Standard 9. Lubrication lines for both bearings shall be extended to the drive side of the AHU and rigidly attached to support bracket with zerk fittings. Lubrication lines shall be a clear, high-pressure, polymer to aid in visual inspection. If extended lubrication lines are not provided, manufacturer shall provide permanently lubricated bearing with engineering calculations for proof of bearing life.

.4 All fans, including direct-drive plenum fans, shall be mounted on spring isolation bases. Internally-mounted motor shall be on the same isolation base. Fan and motor shall be internally isolated with spring isolators. Unit sizes up to nominal 4,000 cfm shall have 1-inch springs. Unit sizes larger than nominal 4,000 cfm shall have 2-inch spring isolators. A flexible connection (e.g. canvas duct) shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.

.5 Fan sections containing multiple fans shall be provided as indicated on the schedule and drawings. Each fan shall operate in parallel to each other fan in the array. The fans shall be SWSI plenum type with high efficient AF blades. Fans shall be direct-driven. Fan wheels shall be aluminum. The Hp characteristic of the fans shall be non-overloading.

.6 Fan sections containing multiple fans shall be controlled using a common control signal, such as the duct static control signal, to modulate the fan speed.

.7 Fan airflow measurement systems shall be provided for all supply, return and exhaust fan diagrams to measure fan airflow directly or to measure differential pressure that can be used to calculate airflow. The accuracy of the devices shall be no worse than +/- 5 percent when operating within stable fan operating conditions. Devices shall not affect the submitted fan performance and acoustical levels. Devices that obstruct the fan inlet or outlet shall not be acceptable. Devices shall be connected to transducers with a 2-10 VDC output. Signal shall be proportional to air velocity. See drawing control diagrams for required locations.

.8 Belts shall be enclosed as required by OSHA standard 29 CFR 1910 to protect worker from accidental contact with the belts and sheaves.

2.8 MOTORS

.1 To requirements of Section 20 05 03, Electric Motors – Three Phase.

.2 All motors and drives shall be factory-installed and run tested. All motors shall be installed on a slide base to permit adjustment of belt tension. Slide base shall be designed to accept all motor sizes offered by the air-handler manufacturer for that fan size to allow a motor change in the future, should airflow requirements change. Fan sections without factory-installed motors shall have motors field installed by the contractor. The contractor shall be responsible for all costs associated with installation of motor and drive, alignment of sheaves and belts, run testing of the motor, and balancing of the assembly.

.3 Motors shall meet or exceed all NEMA Standards Publication MG 1 – 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be ULC Listed.

.4 Fan Motors shall be heavy duty, NEMA Premium efficient TEFC, operable at 208/60/3, exceeding the EPAct efficiency requirements.

.5 Belt-driven fan sections with single fans shall use 4-pole (1800 rpm) motors, NEMA Design B, with Class B insulation to operate continuously at 104°F (40°C) ambient without tripping of overloads.

.6 Direct-driven fan sections shall use 2-pole (3600 rpm), 4-pole (1800 rpm), or 6-pole (1200 rpm) motors, NEMA Design B, with Class B insulation to operate continuously at 104°F (40°C) ambient without tripping of overloads. Multiple fan selections utilizing 8-pole (900 rpm) motors are unacceptable due to motor inefficiency, cost, and replacement lead times.

.7 Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.

.8 V-Belt Drive shall be fixed pitch rated at 1.5 times the motor nameplate. Drives 20 hp and larger or any drives on units equipped with VFDs shall be fixed pitch.

.9 All fans with fixed-pitch drives and motors 15 hp and larger shall be equipped with multiple belt drives.

.10 Manufacturer shall provide for each fan a nameplate with the following information to assist air balance contractor in start-up and service personnel in maintenance:

- .1 Fan and motor sheave part number
- .2 Fan and motor bushing part number
- .3 Number of belts and belt part numbers
- .4 Fan design RPM and motor HP
- .5 Belt tension and deflection
- .6 Center distance between shafts

.11 Factory mount motors and wire to an external disconnect switch. Disconnect switch by air handling unit manufacturer. Run wiring in EMT liquid-tight conduit/raceways.

.12 Motors to be suitable for use with VFD where scheduled.

2.9 VIBRATION ISOLATION

.1 Each fan and motor are to mounted on an all welded, structural steel, prime coated, internal isolation base, completed with open spring isolators with an internal isolation efficiency of at least 99% from the building structure. Isolators shall be free standing with sound deadening pads and

levelling bolts. Spring diameter to compressed operating height ratio shall be 1 to 1. Spring deflection shall be 50 mm. The outlet of the fan shall be separated from the unit casing by means of a factory installed flexible fabric connection.

.2 Manufacturer to provide independent data for internal isolation bases. If 99% efficiency cannot be met, cost of inertia bases shall be the responsibility of supplier.

2.10 COILS

.1 Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.

.2 Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.

.3 Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.

.4 Construct coil casings of galvanized steel steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.

.5 All coils to be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

.6 When two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil. The intermediate drain pan shall be designed being of sufficient size to collect all condensation produced from the coil and sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate drain pan shall be constructed of the same material as the sections primary drain pan.

.7 The intermediate drain pan shall begin at the leading face of the water-producing device and be of sufficient length extending downstream to prevent condensate from passing through the air stream of the lower coil.

.8 Intermediate drain pan shall include downspouts to direct condensate to the primary drain pan. The intermediate drain pan outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

.9 Electric Heating Coils

.1 Per the requirements of section 23 55 01 – Duct Heaters except coil to be supplied and/or manufactured by AHU supplier and to be factory installed in the unit.

.2 Coil element(s) must be suitable for non-operation at -50 degC.

.10 Refrigerant Cooling Coils

.1 Refrigerant suction and liquid connections shall be clearly labeled on unit exterior.

.2 Coils shall be proof-tested to 413 kPa and leak-tested to 2756 kPa air pressure under water. After testing, insides of tubes shall be air dried, charged with dry nitrogen or dry air (-28°C dew point), and sealed to prevent contamination.

.3 Refrigerant suction and liquid headers shall be constructed of copper tubing. Suction and liquid connections shall penetrate unit casing to allow for sweat connections to refrigerant lines. Suction and liquid headers to be constructed for two-circuit interwoven arrangement for independent connection to stand-alone redundant condensing units.

.4 Tubes shall be 13 mm dia, minimum 0.4 mm thick copper. Fins shall be aluminum.

.5 Coils shall have equalizing type vertical distributors sized in conjunction with capacities of coils.

.6 Cooling coils to be constructed for two independent interwoven coil circuits. Each coil circuit to be sized for 50% of total required capacity noted in DX Cooling Coil schedule.

2.11 PREFILTER MODULE

.1 Filters Containing urea formaldehyde or fiberglass are not acceptable.

.2 50 mm, Pleated summer and winter prefilter, average efficiency MERV 8 on ASHRAE Test Standard 52.2, Addendum B, Appendix J.

.3 Frame only for winter prefilter, same as summer filter frame.

.4 Galvanized mounting racks to suit specified filter type.

.5 Limit filter velocity based on face area to less than 2.5 m/s.

.6 Provide One Dwyer 2000 magnehelic filter gauge for each bank of filters, including for each position of prefilter. Flush mount gauge on the exterior of the unit.

2.12 FINAL FILTER

.1 General: High performance, pleat-in-pleat, totally rigid and disposable type, V-bank.

.2 Media: High density microfine glass fibres formed into uniformly spaced pleats separated by glass filament separators and formed into minipleat pack design.

.3 Configuration: Assembled into V-bank configuration with appropriate number of packs to obtain desired pressure drop.

.4 Bonding: Media packs bonded on inside periphery of enclosing frame with fire retardant phosphorous free sealant.

.5 Enclosing Frame: Modular, injection molded plastic channels, molded modular supports on entering and exiting side to promote uniform airflow and structural support, transport handle.

.6 Header: Nominal 25 mm integral to enclosing frame.

.7 End Caps: Rigid, injection molded, bonded to top and bottom of enclosing structure.

.8 Gasket: For header to header sealing.

.9 Air Flow: Bi-directional.

.10 Performance: Average efficiency 90 – 95% on the ASHRAE Test Standard (52-76) and an average dust spot resistance of not less than 99% on that standard and a minimum efficiency reporting value to ANSI/ASHRAE 52.2 of MERV14.

.11 Initial Air Resistance: 100 Pa at airflow of 2.5 m/s.

.12 Listing: UL 900 Class 2.

.13 Manufacturer Approvals: ISO 9001:2000.

.14 Access: Service upstream. Side access when service upstream is unavailable.

.15 Maximum Acceptable Velocity: 2.5 m/s.

.16 Acceptable Material: Farr Durafil 2V.

.17 Provide a drain pan in all coil modules.

2.13 ALUMINUM INSULTED/THERMALLY BROKEN DAMPERS

.1 Frame: extruded 6063T5 aluminum, 2.03mm thick, 101.6mm deep, insulated with Styrofoam on three sides for duct mounting and four sides for flanged mounting.

.2 Blades: extruded 6063T5 aluminum, internally insulated with expanded polyurethane foam, thermally broken, minimum insulation value 0.4RSI.

.3 Blade and Frame Seals: extruded silicone secured in integral slot with aluminum extrusions.

.4 Bearings: celcon inner bearing, 11mm aluminum hexagon blade pin, polycarbonate outer bearing.

.5 Linkage: frame side, aluminum and corrosion resistant zinc plated steel with slip proof cup-point trunion screws. Blade linkage hardware to be installed out of air-stream.

.6 Jack Shaft Assemblies: to be provided for multiple damper installations.

.7 Operating Temperature Range: -40°C to 100°C.

.8 Leakage: 25 L/s/m2 at 1 kPa differential static pressure at -40°C.

.9 Pressure Drop: full open 1200 x 1200 damper not to exceed .007 kPa at 5.08 m/s.

.10 Certification: AMCA 511.

.11 Schedule: All E/A and O/A dampers

.12 Acceptable Material: TAMCO Series 9000 SC Thermally Insulated Damper.

.13 Acceptable alternate manufactures: Ruskin, Nailor

2.14 ALUMINUM AIRFOIL DAMPERS

.1 Frame: extruded 6063T5 aluminum, 2.03 mm thick, 101.6 mm deep.

.2 Blades: extruded 6063T5 aluminum.

.3 Blade and Frame Seals:

.1 Blade: extruded EPDM.

.2 Frame: extruded TPE.

.3 All gaskets in integral slot with aluminum extrusions.

.4 Bearings: Celcon inner bearing, 11mm aluminum hexagon blade pin, polycarbonate outer bearing.

.5 Linkage: Frame side, aluminum and corrosion resistant zinc plated steel with slip proof cup-point trunion screws. Blade linkage hardware to be installed out of air-stream.

.6 Jack Shaft Assemblies: to be provided for multiple damper installations.

.7 Operating Temperature Range: -40°C to 100°C.

.8 Leakage: 52 L/s/m2 at 1 kPa differential static pressure at -40°C.

.9 Pressure Drop: full open 1200 x 1200 damper not to exceed .004 kPa at 5.08 m/s.

.10 Certification: AMCA 511.

.11 Schedule: All return air dampers.

.12 Acceptable Material: TAMCO Series 1000 Airfoil Control Damper

.13 Acceptable alternate manufactures: Ruskin, Nailor

2.15 AIRFLOW MONITORING STATION

.1 Provide where air flow measurement station and integral damper indicated on controls diagrams or as scheduled.

.2 Airflow measuring stations shall be provided and located in the outside and/or return air paths as indicated on the schedule and plans to measure airflow. Airflow measuring stations shall be tested per AMCA Standard 611 and licensed to bear the AMCA Ratings Seal for airflow measurement performance. Refer to Item 2.9.

.3 The airflow measurement station shall measure up to 100 percent of the total outside air and/or return air. The airflow measurement station shall be capable of measuring down to 1.52 m/s. The airflow measuring device shall adjust for temperature variations. Output shall be provided from the station as a 2-10 VDC signal. Signal shall be proportional to air velocity. The accuracy of the measuring station shall be no greater than ±5 percent. Airflow measuring stations shall be mounted on the AHU interior.

2.16 DISCHARGE PLENUM SECTIONS

.1 Plenums shall be provided as indicated in the schedule and plans to efficiently turn air and provide acoustical attenuation. Discharge plenum opening types and sizes shall be scaled to meet pressure drop requirements scheduled and align with duct takeoffs.

.2 Discharge plenum panels shall include an acoustical liner where indicated in the schedule and plans to meet acoustical requirements. All discharge liners shall be fabricated from stainless steel perforated material to prevent corrosion and designed to completely encapsulate fiberglass insulation. The perforation spacing and hole size shall be such as to prevent insulation breakaway, flake off, or delamination when tested at 9000 fpm, in accordance with UL 181 or ASTM C1071. Insulation material must be resistant to fungi in accordance with ASTM C1338.

2.17 VARIABLE FREQUENCY DRIVES (VFDS)

.1 Variable frequency drives shall be provided, mounted and wired by the AHU manufacturer as indicated on the schedule. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. The VFDs shall be UL listed. The listing shall allow mounting in plenum or other air handling compartments.

.2 Variable frequency drives to the requirements of Division 26 and as supplement herein.

.3 Separate electronic variable frequency drives shall be provided for the supply, return and exhaust air fans. Independent drives, one per fan, shall be provided. Each drive shall be factory installed in a designated access section, downstream of the filters in a manner that the drive[s] are directly cooled by the filtered, mixed air stream. The completed unit assembly shall be listed by a recognized safety agency, such as ETL. Drives are to be accessible through a hinged door assembly complete with a single handle latch mechanism. Mounting arrangements that expose drives to high temperature, unfiltered ambient air are not acceptable.

.4 The unit manufacturer shall install all power and control wiring. A manual bypass contactor arrangement shall be provided. The bypass arrangement will allow fan operation at full design CFM, even if the drive has been removed for service.

.5 The drive output shall be controlled by the factory installed main unit control system and drive status and operating speed shall be monitored and displayed at the main unit control panel. The supply and return/exhaust fan drive outputs shall be independently controlled in order to provide the control needed to maintain building pressure control. Supply and return/exhaust air fan drives that are slaved off a common control output are not acceptable.

.6 All drives shall be factory run tested prior to unit shipment.

.7 All drives to come complete with BACnet interface.

2.18 MIXING SECTION

.1 Provide dampers to modulate the volume of outdoor, return or exhaust air.

.2 Comply with ASHRAE 90.1 standard defining the maximum leakage rates.

.3 Provide a drain plan in the mixing section module.

2.19 MARINE LIGHTS AND ELECTRICAL WORK

.1 Install a factory mounted, weather resistant (enclosed and gasketed) LED fixture in each module to provide instant-on white light, minimum 50,000 h life.

.2 Wire lights to a switch on each module. Switch to include a GFCI receptacle. All wiring in steel conduit, comply with Division 26 standards and CEC and CSA.

2.20 CONVENIENCE RECEPTACLES

.1 A 15-amp, 115V GFCI convenience outlet shall be provided by the AHU manufacturer. The outlet shall be separate from the load side of the equipment. Installing contractor shall be responsible for providing 115V supply to the factory-mounted GFCI outlet circuit per CEC.

2.21 FACTORY-INSTALLED MOTOR WIRE TERMINATION, VFD, AND COMBINATION STARTER / DISCONNECT ENCLOSURES

.1 VFDs shall be factory mounted on the drive side of the fan section. VFD may be mounted on the interior of the unit, accessible from the unit exterior through an access door, or on the casing exterior in a NEMA Type 1 enclosure for indoor units. If not mounted on the fan section due to NEC disconnect height limitations or serviceability constraints in the mechanical equipment room, VFD may be mounted in another location other than the fan.

.2 Any welds shall be properly finished with no rough edges. Enclosures shall house circuit breaker disconnects, bypass circuitry, Drive-OFF-Bypass switches, manual speed controls, and control transformers. VFDs and starter/disconnects shall have an external disconnect located on the outside of the access door.

2.22 FACTORY WIRING OF LIGHTS, VFDS, AND COMBINATION STARTERS/DISCONNECTS

.1 VFDs shall be wired per NEC, UL, NFPA 90A, and Division 26 requirements.

.2 All power wiring for voltages greater than 24V and traveling through multiple unit sections shall be contained in an enclosed, metal, power-wiring raceway or EMT. Sections less than 6’ in length may be contained in FMC.

2.23 FACTORY COMMISSIONING OF VFDS AND COMBINATION STARTER/DISCONNECTS

.1 After mounting and wiring of VFDs, on the AHUs, trained factory personnel shall ensure proper operation of each VFD, through a thorough factory test. Testing shall include a Hypot test of unit wiring to ensure that no weaknesses exist in wiring or motor. Each VFD shall be energized and the fan run to ensure the VFD will operate throughout the usable range of the drive and that the fan rotation is correct. Each VFD with bypass shall also be tested in the bypass position to ensure the bypass is operational.

Part 3 Execution

3.1 ASSEMBLY

.1 Modules are to be constructed factory assembled and tested. Dismantle for shipping if required. Clearly label all parts for assembly.

.2 Pipe units to permit coil removal.

.3 Seal piping or conduit passing through the unit casings to prevent air or water leakage, and isolate to prevent vibration transfer.

.4 Install units on specified roof curbs or surface.

3.2 AHU-1 – PACKAGED MODULAR AIR HANDLING UNIT SCHEDULE

.1 Fan Schedule:

.1 Refer to Packaged Outdoor Air Handling Unit Schedule on drawings.

.2 Mixing Section

.1 Insulated outdoor air damper / air foil return damper / insulated exhaust air damper.

.3 Heating Coil Schedule:

.1 Refer to Packaged Outdoor Air Handling Unit Schedule on drawings.

.4 Packaged DX Cooling Coil and Condenser

.1 Refer to Packaged Outdoor Air Handling Unit Schedule on drawings.

.2 Unit to be complete with a condenser section. Use of a separation condenser for cooling coil is not acceptable.

.5 Component Schedule:

.1 Return / exhaust fan
.2 Economizer section
.3 Filters
.4 Cooling coil
.5 Heating coil
.6 Supply fan

.6 Sound Power Level Schedule:

.1 Unit Ref:

Position	Frequency							
	63	125	250	500	1000	2000	4000	8000
Discharge	90	88	83	81	81	77	74	70
Return/ Exhaust	73	72	71	68	65	60	57	52

3.3 STARTUP

.1 Purpose: to confirm that the AS units function in accordance with all contract requirements prior to commencing on site commissioning activities.

.2 Startup to be completed by manufacturer's representative to the requirements of Section 20 05 08 – Equipment Testing and Startup, and in cooperation with the Controls acceptance testing startup specified in Section 20 30 01 – General Provision for Controls.

.3 Startup and operate systems for at least seven (7) consecutive twenty-four (24) hour days. Coordinate startup to ensure all air systems started up and operated in an integrated manner for same consecutive 7 day period and through the Controls startup specified in Section 20 30 01 – General Provisions for Controls.

.4 Correct all defects when they occur.

.5 Confirm in writing to Departmental Representative successful completion of startup. Provide list of any outstanding deficiencies.

.1 Bear signature of technician and supervisor (where applicable).

.6 Startup to include:

.1 Lubricate all bearings as recommended by manufacturer.

.2 Vacuum all AHU clean prior to operating fans.

.3 Ensure filters are installed. Do not operate systems without filters installed.

.4 Ensure all fire dampers are open.

.5 Ensure all coils are operational and correct capacities are being achieved during operation.

.6 Startup and operation of all controls including operation of all sequences, reports, special control algorithms, diagnostics, software.

.1 System to operate at AEL of at least 99 % for operating period.

.2 In event of failure to attain specified AEL during startup period, extend startup period on day-to-day basis until specified AEL is attained.

3.4 CONSTRUCTION USE OF AIR HANDLING UNITS

.1 Construction use of air handling units for ventilation, heating, de-humidification, humidification, dust control or any other use is strictly prohibited.

.2 Startup of the AHU can only occur after all ducts installed and cleaned and building and systems are completed to the pre-requisite requirements for commencing Testing Adjusting and Balancing as specified in Section 23 05 93.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Refrigerant coils.

.2 Coil installation.

.3 Coil piping and accessories.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	General Documentation	Section 20 05 05
.3	Equipment Testing and Startup	Section 20 05 08
.4	Meters and Gauges	Section 20 05 19
.5	Valves and Strainers	Section 20 05 23
.6	Pipe and Pipe Fittings	Section 20 20 10
.7	Piping and Equipment Insulation	Section 20 20 30
.8	Testing, Balancing and Adjusting	Section 20 22 00
.9	Controls	Section 20 30 Series
.10	HVAC Controls	Section 23 09 Series
.11	Hydronic System Specialties – Glycol	Section 23 21 31
.12	Metal Ducts	Section 23 31 13
.13	Ductwork Cleaning	Section 23 31 14
.14	Packaged Modular Outdoor Air Handling Units	Section 23 73 13

1.3 QUALITY ASSURANCE

.1 Coils shall be the product of manufacturer regularly engaged in production of coils who issues complete catalogue data on such products.

.2 Coil capacities, pressure drops, and selection procedures shall be certified in accordance with ARI Standard 410 for Forced Circulation Air Cooling and Air Heating Coils and bear ARI seal.

1.4 SUBMITTALS

.1 Shop drawings shall include dimensions, materials of construction and performance data to match specifications.

.2 Submit coil selection sheets or computer calculations with shop drawings.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Trane, McQuay, Heat Craft.

2.2 GENERAL

.1 Provide extended surface type coils with tubes of copper or brass, and plate or helical type fins of copper or aluminum.

.2 Space fins 14 per 25 mm maximum. Helical fins may be crimped.

.3 Mount coil section in galvanized steel casing designed for bolting to other sections of ductwork.

Part 3 Execution

3.1 INSTALLATION

.1 Support coil sections on steel channel or double angle frames and secure to casings. Arrange supports for cooling coils so they do not pierce or short circuit drip pans. Level serpentine coils and install drainable tube coils with pitch within casing. Arrange galvanized steel casings for bolting to other section, ductwork or unit casings. Provide airtight seal between coils and duct or unit cabinets.

.2 Make necessary connections to coils, including valves, air vents, unions and connections from drip pans. Provide gate valve on supply line and eccentric plug valve on return line to each water coil.

.3 Locate water supply at bottom of supply header and return water connection at top to provide self-venting and reverse return arrangement. Provide manual air vents at high points complete with stop valve. Ensure water coils are drainable and provide drain connection at low points.

.4 Protect coils so fins and flanges are not damaged. Replace loose and damaged fins. Comb out bent fins unless required to be replaced.

3.2 PERFORMANCE

.1 Refer to schedule on drawings.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Oil-Fired Unit Heaters

.2 Related accessories and specialties

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 05 01
.2	Electric Motors	Section 20 05 03
.3	General Documentation	Section 20 05 05
.4	Systems Demonstration and Instruction	Section 20 05 06
.5	Materials Testing	Section 20 05 07
.6	Equipment Testing and Startup	Section 20 05 08
.7	Meters and Gauges	Section 20 05 19
.8	Valves and Strainers	Section 20 05 23
.9	Supports, Anchors, Seals, Pipe and Duct Penetrations, and Access Doors	Section 20 05 29
.10	Identification for Mechanical Systems	Section 20 05 53
.11	Pipe and Pipe Fittings	Section 20 20 10
.12	Controls	Section 20 30 Series
.13	HVAC Controls	Section 23 09 Series
.14	Facility Fuel Oil System	Section 23 11 14

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-B140.2.1-M90, Oil Burners, Atomizing Type.

.2 CSA B140.2.2-1971), Pressure Atomizing Oil Burner Nozzles.

.3 CAN/CSA B140.4, Oil-Fired Warm Air Furnaces.

.4 CSA B140.14-M1979, Automatic Flue-Pipe Dampers for Use with Oil Fired Appliances

.5 CAN/CSA-B139, Installation Code for Oil Burning Equipment.

1.4 QUALITY ASSURANCE

.1 Terminal heat transfer units shall be product of manufacturer regularly engaged in production of such units who issues complete catalogue date on such products.

1.5 SUBMITTALS

.1 Shop drawings shall include dimensions, materials of construction and performance data to match specifications.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Sterling, Modine, Reznor

2.2 OIL-FIRED UNIT HEATER

.1 General:

.1 Provide CSA approved, packaged factory assembled unit consisting of cabinet, fan, induced fan, fan motor, intake/exhaust assembly, heat exchanger, combustion chamber, burner, controls, air filter, condensate drain.

.2 Certification of components and construction of factory assembled oil-fired unit: to CAN/CSA B140.4.

.2 Capacity:

.1 Refer to schedule on drawings.

.3 Type:

.1 Horizontal complete with oil burner

.4 Cabinet:

.1 1.0 mm thick minimum steel with baked enamel finish.

.2 Suitable for hanging/suspended operation.

.3 Easily removed and secured access doors for components requiring service.

.4 Thermally insulated cabinet.

.5 Heat Exchanger:

.1 Primary: heavy duty aluminized steel tube with aluminum fins.

.2 Secondary: aluminized steel tube with aluminum fins

.3 Warranty: non-prorated 10 years.

.6 Combustion Chamber:

.1 Atmospheric : to manufacturers standard

.2 Sealed type: 100% outside air, to ANSI Z21.64.

.7 Circulation Blower Motor Assembly

.1 Blower: propeller type

.1 Statically and dynamically balanced.

.2 Rubber mounted.

.3 Speed adjustment: adjustable V-belt shieve

.4 Wiring adjustment of multi-speed motor.

.2 Motor: power per drawing schedule, 1140 r/min. single speed, overload protection, adjustable mounts.

.8 Heater Burner:

.1 General: to bear CSA and ULC labels.

.2 Oil Burner:

.1 High pressure atomizing type, certified to CAN/CSA B140.2.1.

.2 Pressure atomizing oil burner nozzle, certified to CSA B140.2.2 and flame retention head.

.3 Single stage fuel pump.

.9 Controls:

.1 General: conform to CSA C22.2 No.24.

.2 Oil firing:

.1 Operating controls: set-back thermostat, fan operating control switch with continuous operating switch, solenoid oil delay valve, burner, draft control.

.2 Safety controls; flame safeguard-cadmium sulphide sensor, fan high limit control switch.

.3 Automatic flue-pipe damper: to CSA B140.14.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions, regulations of authorities having jurisdiction and to CAN/CSA-B139.

.2 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

END OF SECTION

Part 1 GENERAL

1.1 GENERAL

1. This section includes general clauses applicable to the supply and installation of all electrical systems. It is intended to supplement the requirements of Division 01.
2. The Contractor shall provide all labour, materials, tools and equipment required for the work, except such materials and/or equipment that is specified as supplied by Owner.
3. It is the intent of the Drawings and Specifications to provide a complete and workable installation. Any work, fitting and/or necessary material not specifically mentioned or shown on the drawings, but obviously necessary to complete the installation, shall be furnished by the Contractor as if specifically mentioned herein and detailed.

1.2 SITE VISIT

1. The bidding Contractors are encouraged to visit the site prior to construction to examine closely any local and existing conditions which may affect the performance of the work.
2. Arrangements for site visits are to be made with the Project Manager.
3. The bidding Contractors are expected to examine the existing site in detail to determine the specific work required to complete the contract.

1.3 SCOPE OF WORK

1. Installation of electrical systems for the Palace Grande Renovation project, Tender 3, Dawson, Yukon.
2. Work includes but not limited to installation of a new fire alarm system, exit/emergency lighting, distribution equipment, power, lighting, lighting controls, racks, mechanical equipment supply, conduits and tel/data systems for the entire building.

1.4 DRAWINGS AND SPECIFICATIONS

1. The drawings and specifications are complementary each to the other and what is called for by one shall be binding as if called for by both.
2. Should any discrepancy appear between the drawings and specifications or within the drawings or the specifications themselves, which leaves the Contractor in doubt as to

the true intent and meaning of the drawings and specifications, a ruling shall be obtained from the Consultant.

3. Electrical drawings indicate general location and Specifications route to be followed by 'system wiring' which includes; conduits, cables, cable trays and wiring, and do not show all architectural, structural, mechanical and landscape details. In some cases, system wiring is not shown on drawings or is shown diagrammatically in schematic or riser diagrams. The Contractor shall provide system wiring to form a complete operating job. System wiring shall be physically installed to conserve headroom, furring spaces, and to coordinate with all trades and equipment provided.

4. Follow architectural, structural and mechanical drawings for details of work and install electrical systems to coordinate with architectural, structural and mechanical work and details. Refer to architectural and structural drawings for accurate building dimensions.

5. Examine structural, architectural and mechanical drawings and work of all other trades to ensure that work can be satisfactorily carried out without changes to building as shown on the drawings. Conflicts or additional work beyond the work covered by drawings and specifications shall to be brought to attention of the Consultant by the Contractor.

1.5 INSTALLATION

1. The Contractor shall be responsible for prompt installation of his work in advance of concrete pouring, application of architectural finish or similar work.

2. Division 26 is responsible for all work specified as Division 26 in specification Sections 23 09 33 "Electric and Electronic Control System for HVAC".

3. Where interlocks are required for mechanical systems, Division 26 shall install Division 23 supplied relays and cabinets, and provide all line voltage wiring and terminations. Division 26 to coordinate with Division 23.

4. Division 26 Hand-off-Auto switches.

5. Division 25 Trap primer and mechanical equipment.

6. Garage door opener and associated wall mount controls.

7. Automatic door operators and pushbutton installation and wiring.

8. Security door access control and equipment.

9. Mechanical equipment supply.

10. Automatic starters, disconnects, emergency power as shown on the drawings and called for here in.

11. Lighting system and lighting controls.
12. Emergency lighting and exist signs systems.
13. Tel/data systems.
14. Wiring/conduits, main service, distribution systems, etc….
15. All work shown on the drawings and described herein.

1.6 RESPONSIBILITY OF CONTRACTOR

1. Promptly advise the Consultant of any specified equipment, material or installation of same which appears inadequate or unsuitable, in violation of laws, ordinances, rules or regulations of authorities having jurisdiction, or of any necessary items of work omitted from the Contract Documents.
2. During the course of construction, existing conditions which are found to deviate from those indicated on the drawing are to be brought to the attention of the Consultant.

1.7 WORK SCHEDULE

1. Follow specific requirements outlined in Division 01 regarding work schedule, job completion, and the timing of work.

1.8 COORDINATE WITH TRADES

1. In conjunction with the General Contractor and all trades, prepare electrical coordination drawings to determine and coordinate efficient use of available space, proper sequencing of work, and protection of installed work, in order to resolve installations conflicts.
2. Electrical coordination drawings are to be available on-site for use by; the General Contractor and all trades, and shall be available for Consultant's review during all site inspections.
3. Maintain electrical coordination drawings throughout the construction period. Record changes due to modifications and adjustments.
4. Coordination plans shall be made available to the Consultant at the Consultant's request; copy of drawings to be delivered to the Consultant's office within 3 working days of the Consultant's written request to the Contractor.
5. Consultant's review of coordination drawings is for general implementation design only and does not relieve the Contractor from complying with all requirements of

drawings and specifications including coordination with the General Contractor and with all trades.

1.9 VOLTAGE RATINGS

1. Operating voltages: To CAN3-C235, latest edition.
2. Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.10 CODES AND STANDARDS

1. Do complete installation in accordance with CSA C22.1 - 2015 except where specified otherwise.
2. Comply with all CSA electrical bulletins as well as all local rulings in force at the time of tender.
3. Where reference is made to published standards the latest editions and revisions of such standards shall apply.
4. Notify Consultant of changes required by the Electrical Inspection Department prior to making changes.

1.11 PERMITS AND FEES

1. Submit to; the Electrical Inspection Department, the Supply Authorities and the Building Inspection Authorities, the necessary number of drawings and specifications, for examination and approval prior to commencement of work.
2. Pay all fees and coordinate inspections required by the Authorities Having Jurisdiction (AHJ) for work provided by this division.
3. Furnish certificates of acceptance from each AHJ inspection department upon completion of work.
4. Notify the Consultant of changes required by the AHJ Department(s) prior to making changes. Changes required by the AHJ shall be implemented by the Contractor only after written instruction by the Consultant.

1.12 CARE, OPERATION AND START UP

1. Instruct operating personnel in the operation, care and maintenance of equipment as specified in further sections.
2. Provide specific training requirements as specified in further sections.

1.13 MATERIALS AND EQUIPMENT

1. Equipment and materials to be new and carry acceptable agency approval markings.
2. Factory assembled control panels and component assemblies.
3. All work to be executed in a neat and workmanlike manner by qualified tradesmen. Division 26 to keep a competent foreman and all necessary assistants, to the approval of the Consultant and to the approval of the AHJ(s), on the job during the work.
4. All electrical equipment to be CSA or Canadian equivalent Canadian standards approved. Electrical equipment that is shown on the drawings or called for in the specifications that is not CSA or equivalent approved is to be treated by the requirements of Division 26 requirements in one of the following ways:
    1. Make allowance in Contract Price to have the equipment CSA or equivalent approved, or
5. Unless otherwise specifically called for in the specifications, uniformity of manufacturer to be maintained throughout the building for any particular item or type of equipment.
6. The Contractor shall be completely responsible for ascertaining that every item included in Contract complies in all respects with specifications and drawings. Any item of equipment found by Consultant not to comply with specifications and drawings to be replaced at no additional cost with an item or unit of the Consultant's choice.

1.14 RECORD (AS-BUILT) DRAWINGS

1. Reference and follow directions of section 01 77 00; "Closeout Procedures".
2. Neatly record, as the job progresses, day by day, all work as installed. Make these drawings available to the Consultant for inspection and review from time to time as the Consultant sees fit. As-built drawings must be available on-site during all consultants` inspections.
3. Record all changes to contracted work as issued by addendum, site instruction, and change order.
4. Record all system's installations on record drawings. Include:

1. Panel and circuit numbers.
2. Feeder wiring details including; location, conductor gauge, cable assembly and conductor termination details. Required for all panel feeders, MCC units, CDP(s) and service entrances.
3. Conduit and cable tray details including; location, trade size.
4. Boxes, cabinets and consolidation points including; physical dimensions, NEMA type and seismic restraint.
5. Equipment; location, name plate data, overload protection location and trip settings, seismic restraint.
6. All other details required to document the provided systems for use by the owner.

5. Record the location of all electrical equipment; Equipment designation to correspond to field label of equipment. Show connected circuit and panel identification.
6. Record wiring logic diagrams and include written commentary for logic operation.
7. Deliver marked up plans to the Consultant.

1.15 SHOP DRAWINGS AND OPERATING INSTRUCTIONS

1. Submit electronic shop drawings for all equipment and required details including the following:
    1. Electrical Permit
    2. Seismic Restraint and Housekeeping Pads
    3. Service Entrance Equipment
    4. Distribution Equipment
    5. Disconnect Switches
    6. Lighting System and controls
    7. Exit and Emergency Lighting including Mounting Details
    8. Tel/data system, including wiring schematic layout
    9. Fire Alarm System, including layout wiring
    10. Heating Cables and Control
    11. Fire Retardant Compound
    12. Security system, including wiring schematic layout
    13. Where applicable system riser diagram/ wiring diagram to be provided

14. Equipment and materials as required in further sections of the specifications

2. Prior to submission, all shop drawings shall be stamped, dated and signed by the Division 26 Contractor and the General Contractor.

3. Division 26 to review shop drawings and assume responsibility for:

    1. Completeness - including all details specified.
    2. Dimensions and field measurements.
    3. Catalogue numbers and similar data.
    4. Conformance with contract documents.
    5. Colours.
    6. Site conditions.
    7. Interference with mechanical equipment including motor sizes and loads, equipment locations and connections points.

4. Shop drawing submissions to include:

    1. Name of Contractor.
    2. Project name.
    3. All pertinent data.
    4. Dimensions. All dimensions and data to be in metric units.
    5. Weights and center of mass information, where required for seismic purposes.
    6. Colour.
    7. Specification section number.
    8. Additional equipment information as necessary to describe equipment use (example: weatherproof disconnect switch for motor #1).
    9. Contractor's and Division 26's; stamp and signature.

1.16 LOCATION OF OUTLETS

1. Do not allow outlets back-to-back in wall; Allow minimum six inches (150 mm) horizontal clearance between boxes.

2. Where outlets are located on counter tops and adjacent to sinks, confirm exact location of the sink with the plumbing trade prior to rough-in. If a conflict exists with the outlet inform the departmental representative as soon as possible to obtain a new location for the outlet(s). Switches and outlets adjacent to each other to match in elevation.

3. Change location of outlets at no extra cost or credit, providing distance does not exceed ten feet (3050 mm) and information is given before installation.

4. Locate light switches on latch side of doors, ensure switches are inside room. Confirm prior to rough-in. If insufficient room is left by building framing, notify the Consultant for further instruction.

5. Note, drawings indicate design intentions only. Exact locations are the responsibility of the contractor. Provide coordination with all sub-trades for exact connection locations prior to rough-in.

1.17 MAINTENANCE MATERIAL

1. Provide maintenance materials as recommended by equipment suppliers and as specified.

1.18 MOUNTING HEIGHTS

1. Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.

2. If mounting height of equipment is not indicated verify before proceeding with installations.

3. Confirm the height of devices in handicapped facilities before installation.

4. Install electrical equipment at the following centre heights unless indicated otherwise.

    1. Local Light Switches:

        1. General: 1050 mm unless detailed otherwise.

        2. Above top of counters or splash back: 175 mm to match outlets.

    2. Wall receptacles:

        1. General: 450 mm unless detailed otherwise.

        2. Above top of counters or splash back: 175 mm.

        3. In Mechanical Rooms: 1050 mm or as indicated on drawings.

    3. Panelboards: 1800 mm to top or as required by code.

    4. Telephone outlets: 450 mm.

    5. Wall-mounted telephone outlets: 1150 mm.

    6. Telephone outlets above backsplash: 175mm.

    7. Wall-mounted emergency lighting head:

1. General: 2700 mm when ceiling height is 3000 mm or greater, and 300 mm below ceiling height in locations where ceiling is less than 3000 mm.

8. Fire alarm system equipment and devices: as specified in Section 28 31 01 "Fire Alarm System".

1.19 PROTECTION

1. Protect exposed live equipment during construction for personnel safety.
2. Shield and mark live parts eg "Live 120 Volts".

1.20 PENETRATIONS

1. Use pre-manufactured poly pans or approved alternate for any outlet or box located in or through vapour barrier.
2. All penetrations through vapour barrier required for any component installed by Division 26 to be performed in accordance with specification section 07 27 10.
3. Provide fire rating protection as required at all locations where electrical equipment penetrates fire separations.
4. Where cables or conduits pass through floors and fire rated walls, pack space between wiring and sleeve full and seal with caulking compound conforming to ULC-S115, latest revision.
5. Use HILTI FS-ONE Intumescent Firestop Sealant or approved equal. Provide shop drawings for fire sealant.
6. Provide putty pads firestop for all electrical boxes installed in rated walls.

1.21 CLEANING

1. Do final cleaning in accordance with section 01 74 11 "Cleaning".
2. At time for final cleaning, clean lighting lenses, reflectors and other surfaces that have been exposed to construction dust and dirt.

1.22 MECHANICAL WIRING

1. Provide all starters and disconnects unless otherwise specified. Include provision of all starters and disconnects for Division 23 specified equipment unless otherwise detailed or shown that provision is by another Division.

2. Division 26 is to provide all line voltage; wiring, connections, and conduit, work for this project unless otherwise detailed or shown that provision is by another Division. Coordinate with the General Contractor and all Divisions for requirements.

3. Supply and install all line voltage; wiring, connections, over-current devices, disconnect switches and conduit work for all Division 23 control transformers.

4. Division 26 to provide all line voltage; wiring, connections, over-current devices, disconnect switches, starters, over-loads, and conduit work, for all Division 23 supplied and/or installed equipment, unless specified otherwise. Refer to Division 23 specifications and drawings for Division 23 wiring requirements. Note that the Contractor shall be responsible to coordinate with Division 23 and all Divisions prior to rough-in for exact equipment electrical requirements.

5. Wiring and connections below 50 V and which are related to the control systems specified in Division 23 and other Divisions shall remain the responsibility of that specific Division unless noted otherwise as to be provided by Division 26. Provide all line voltage control system interlocks for Division 23 where specified and/or shown on the drawings.

6. Final connections to mechanical equipment are to be made with watertight flexible conduit with watertight connectors, except in hazardous locations where connections shall be made with teck cable and cable glands to suit the environment.

7. All extra low voltage wiring and connections below 50 volts related to the security system shall be the responsibility of Division 26.

8. The contractor to review Division 23.

1.23 TESTS

1. Reference Section 26 05 04 "Contractor Testing”.

1.24 DEMONSTRATION AND INSTRUCTION

1. Reference Section 27 95 01 "Demonstration and Training”.

1.25 IDENTIFICATION

1. Reference Section 26 05 25 "Identification”.

1.26 ACCESSIBILITY

1. Install so as to be readily accessible for adjustment, operation and maintenance. Provide access panels where required in building surfaces.
2. Locate panels in service areas where possible. Do not locate in panelled or special finish walls without prior approval of the Consultant and the Architect.
3. Access panels in ULC fire separations and fire rated walls shall have a compatible fire rating and ULC label. Acquire approval in writing from the local Fire Authority and Building Official where required.
4. Access panels shall be painted with a primer coat, if applicable and then with a finish coat, colour and type to the Consultant's and Architect's approval.

1.27 INSPECTIONS GENERAL

1. The Division 26 Contractor, in coordination with the General Contractor, shall request the Consultant to perform site installation inspections as required by; the General Contract, as established at the pre-construction site meeting and as required to satisfy the Consultant that the Division 26 work, including equipment, materials and installation is provided as specified, as shown and as required.
2. In the absence of a firm inspection schedule the contractor is to notify the Consultant in writing prior to all; boarding and wall covering, of the electrical rough-in.
3. Notification of a required inspection is to be at least 2 days prior to actual inspection time.
4. The Electrical contractor is to ensure that all components of the installation are accessible or furnish accessibility as required by the Consultant.

1.28 SUBSTANTIAL COMPLETION INSPECTION

1. Refer to general specifications.
2. Prior to a substantial completion review being done, Division 26 shall submit all of the following to the Consultant:
    1. A complete list of all materials pertaining to Division 26, not on-site and required to complete the project; as assessed by the Division 26 Contractor in coordination with the General Contractor.
    2. Fire Alarm Verification Report.
    3. **Contractor Testing and commissioning reports..**
    4. Record Drawings; complete to date of submission.

5. O&M Manual draft; complete to date of submission.

6. Transmittal letters indicating all spare parts, tools, etc. turned over to the Owner as specified.

3. The following requirements in addition to the submission requirements above shall be demonstrated as operational and complete prior to granting of Substantial Completion:

1. Emergency and Exit Lighting System.

2. Intrusion Detection.

3. Fire Alarm System.

4. Seismic Restraint Systems.

5. Other Items Effecting Life Safety and Items Effecting Fire Safety.

1.29 FINAL ACCEPTANCE INSPECTION

1. Refer to requirements of the General Contract.

2. Prior to the contractor requesting final acceptance, the Division 26 in coordination with the General Contractor, shall submit to the Consultant the following:

1. A written report indicating action completed to correct all Substantial Inspection deficiencies.

_____ END _____

Part 1 GENERAL

1.1 GENERAL INSTRUCTIONS

1. This section of the specification forms a part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
2. Where specified and as required, coordinate with other Division contractors to test and record, equipment and systems operation.

1.2 RELATED WORK

1. "Common Work Results Electrical" 26 05 01
2. "Demonstration and Instruction" 26 79 00

Part 2 PRODUCTS

2.1. SCOPE OF WORK

1. Test and check all portions of the electrical systems for correct operation.
2. All test results shall be tabulated, signed and inserted into the Maintenance Manuals in the correlating system section's sub-section heading 'Test Results'.
3. Specific tests and procedures outlined in this section and in the referenced sections are in addition to normal visual and mechanical inspections prior to placing equipment in service.
4. Where required and where directed by the Consultant obtain copies of factory tests for comparative results.
5. Where directed by the Consultant, demonstrate field tests for equipment and system operation.

Part 3 EXECUTION

3.1. TESTING AGENCY AND/OR PERSONNEL

1. All testing and commissioning will be performed by the contractor's forces unless indicated otherwise.
2. This Division is responsible for coordinating with the Consultant for Consultant's witness of the work detailed in this section and in the referenced sections.
3. Provide the Consultant with one journeyman; electrician or where a specialized sub-trade is required provide one specialized tradesman, as needed to gain access to

equipment for testing, demonstration, removal and replacement of covers, wires and cables, etc.

4. All deficient equipment/devices shall be replaced and retested to the approval of the Consultant.

5. All covers, access doors opened for inspection to be replaced by the Contractor.

6. The costs for testing and test equipment will be the responsibility of the Contractor.

3.2. TESTING AND INSPECTION REPORTS

1. Inspection and test results to be recorded on a suitable form which shall be furnished by the Contractor.

2. Upon completion of the project, the Contractor shall assemble a complete set of test and inspection results and report and insert in the operation and maintenance manuals.

3.3. TEST APPARATUS EQUIPMENT AND LABOUR

1. The Contractor to be responsible for furnishing all apparatus and labour required for the test operations.

2. Division 26 to designate a senior experienced individual fully familiar with the project to demonstrate, test and report the electrical systems' operations

Part 4 SYSTEMS

4.1. GROUNDING TEST

1. As per section 26 05 28. Electrical contractor to perform grounding test in the presence of the departmental representative. Once accepted, test results to be included in the operation and maintenance manual by electrical contractor.

4.2. ELECTRICAL DISTRIBUTION SYSTEM

1. Before energizing any portion of the new electrical system, perform megger ohmmeter tests on include all distribution feeders, panelboard feeders and motor feeders.

2. Test readings to conform to the Canadian Electrical Code. Test results to be logged, tabulated and incorporated into operating and maintenance manuals.

4.3. MECHANICAL EQUIPMENT

1. In cooperation with the mechanical contractor, take clip-on ammeter readings and motor terminal voltage readings on all phases of all mechanical equipment motors with motors operating under normal full load conditions.
2. Test readings shall be submitted complete with heater overload sizes, motor electrical characteristics including frame type, voltage and phase, and name plate data. Insert list in each Operation and Maintenance Manual.
3. Confirm motor rotation direction with Division 23 (or other specific Division as required) and record motor rotational direction.
4. Contractor to perform tests to the satisfaction of the Departmental representative.

4.4. DEVICES

1. Test all receptacles for proper polarity, circuitry and grounding.
2. Provide contractors test results in Operation and Maintenance manuals. Test result form to be contractor declaration that all receptacles have been tested and are operational.

4.5. LIGHTING AND LIGHTING CONTROLS

1. Test all lighting circuits, lighting control and lighting fixtures as indicated following, as specified in specific equipment sections and as recommended by the equipment manufacturer(s). Include all; manual switches, daylight controls, motion sensors and all other automatic controls and accessories.
2. Perform testing and commissioning for replaced fixture, carry all the testing cost in the bid price.
3. Provide contractors test results in operation and maintenance manuals. Test results to include lighting circuit ampacities for reconnected fixtures, and contractor declaration that each lighting fixture and control apparatus has been tested and is operating as specified.

4.6. EXIT AND EMERGENCY LIGHTING AND UNIT EQUIPMENT

1. Test all emergency; lighting circuits, controls and unit battery packs as following, as specified in specific equipment sections and as recommended by the equipment manufacturer(s).
2. Test and record each remote head voltage under full load operating conditions.
3. Test unit equipment operation including full load voltage and as recommended by the manufacturer for equipment operation for code required rated output. Note that:

1. General emergency lighting requirements are 30 minutes.
2. Electrical Rooms and Mechanical room are 2 hours.

4.7. FIRE ALARM SYSTEM

1. Test the fire alarm system including all auxiliary and peripheral control equipment and systems as specified in the specific sections and as recommended by the equipment manufacturer(s).
2. Testing to include Contractor witness of required mechanical systems shutdown on fire alarm signal.
3. Testing to include Contractor witness of signal to the community fire department or ULC approved Fire Alarm monitoring station. Signal testing to be witnessed by local fire department staff. Include fire department witness name and signature on Contractor's test results.
4. Fire alarm testing is in addition to the verification, contractor to test the system as described above and in section 28 prior to the verification, carry the cost of test and the verification as described in section 28 in the bid price. Submit test result for approval before the verification.

4.8. HEATING CABLES AND CONTROLS

1. Test the heating cable insulation resistance; megger test. Allow for additional testing as directed by the departmental representative.
2. Test the heating cables and heating cable control system as specified in the specific sections and as recommended by the equipment manufacturer(s).

4.9. ADDITIONAL TESTS AS REQURIED BY THE DEPARTMENTAL REPRESENTATIVE

1. Make additional system tests as directed by the Consultant. Make allowance in bid price to provide an additional 8 journeyman man hours to test and document electrical systems as directed by the Consultant. Include allowance in bid price to provide Contractor test results in O+M manual.
2. Test all tel/data system and documents in the O&M manuals Allow for additional testing as directed by the departmental representative.

END

Part 1 GENERAL

1.1 WIRE DE-RATING

1. 16 A minimum wire ampacity capacity after applicable de-rating factors.

1.2 AUXILIARY SYSTEMS

1. Refer to specific specifications sections for wire and cable requirements for auxiliary systems.
2. Follow equipment manufacturer's wiring and cabling recommendations.

Part 2 PRODUCTS

2.1. BUILDING WIRES

1. Stranded for #10 AWG and larger for power wiring. Stranded for all control wiring.
2. Minimum size:
    1. #12 AWG for power and lighting in suites,
    2. #14 AWG stranded for control,
    3. #12 AWG for emergency lighting.
3. Copper conductors only: size as indicated and as required for installation de-rating, with 600 V minimum insulation, 1000 V insulation where shown on the drawings, of chemically cross-linked thermosetting polyethylene material rated R90, RW90 or RWU90.

2.2. ARMOURED CABLES

1. Conductors: insulated, copper, minimum size to be #12 AWG.
2. Type AC90.
3. Armour: interlocking type fabricated from aluminum strip.
4. Armoured cables shall be permitted where allowed by code for lighting 'drop' connections to single lighting fixtures only, where the AC cable drop connection is:
    1. Completely concealed behind architect finish,
    2. Less than 2000 mm in total length,
    3. A dedicated drop cable from conduit box to a single fixture (fixture to fixture wiring by AC cabling is not permitted).

2.3. CONTROL CABLES

1. Type LVT: 2 soft annealed copper conductors, sizes as indicated or where size has not been indicated provide wire conductor size as required by code and as required by the equipment manufacturer, LVT cables shall have thermoplastic insulation, outer covering of cotton braid thermoplastic jacket, and armour of closely wound aluminum wire.
2. Low energy 300 V control cable:
    1. Conductors: solid, multi-conductor, insulated, copper, minimum size #18 AWG.
    2. Insulation: 105 C flame retardant PVC.
    3. Outer Jacket: 105 C flame retardant PVC.
    4. Optional Armour: interlocked aluminum or galvanized steel with or without overall jacket.

Part 3 EXECUTION

3.1. BUILDING WIRING

1. Install building wires as follows:
    1. In conduit systems in accordance with Section 26 05 34.
    2. In surface and lighting fixture raceways in accordance with Section 26 05 36.
    3. To the approval of the Departmental representative.
2. AC cabling where specified in this section, the drawings, and only where permitted by code.

3.2. INSTALLATION OF FEEDERS

1. Panel and motor feeders larger than #10 AWG to be continuous and without splice from the breaker or starter to the panel or disconnect.

3.3. TESTING

1. Provide contractor testing as specified in section 26 05 04 "Contractor Testing”.
2. Insert test result data in O+M manuals.

3.4. AS-BUILT INFORMATION

1. All wiring information shall be provided on the as-built drawings

_____ END _____

Part 1 GENERAL

1.1 RELATED WORK

1. “Common Work Results Electrical" - 26 05 01.
2. General Requirements: Division 01.
3. Finishes: Division 09.

Part 2 PRODUCTS

2.1. IDENTIFICATION GENERAL

1. Refer to equipment sections for specific requirements.
2. Clearly identify switchboards, power distribution centres, cable tray, power panels, distribution panels, lighting panels, disconnect switches, starters, control stations, contactors, motor control centres, low voltage terminal cabinets, junction boxes, remote On/Off switches, light switches, motors and transformers by permanent nameplates described below.
3. Panels: identify the panels as shown on drawings, and as per schedules, and the main voltage using labels.
4. Terminal cabinets and pull boxes: indicate the system and the voltages using labels.
5. Remote On/Off switches: indicate areas being served or equipment controlled.
6. Cable tray: identify to voltage being carried in tray (or portion thereof) using lamicoid nameplates.
7. Light switches: identify area being controlled using manufacturer standard product.

2.2. LAMICOID NAMEPLATES

1. Label all equipment using lamicoid nameplates as follows:
    1. Labels to be white background with 10 mm black letters, mounted in conspicuous locations on the surface of the equipment, except in finished areas locate labels in flush panels mounted on panel front inside enclosure.
    2. Labels to include equipment description and circuit number. Equipment description shall correspond to Contractor's as-built drawings.
    3. Labels for all; panelboards, starters, disconnect switches, terminal cabinets and communication terminal cabinets. Labels to indicate system and/or voltage characteristics and equipment name (example: Panel A, 120/208 V, 3 PH).

4. Provide a complete list of nameplates for review and approval by the Departmental representative, prior to placement of fabrication order. (Shop Drawing Review).
5. Wording on nameplates to be approved prior to manufacture.
6. Labels subject to the Departmental representative's approval.

2.3. PANEL SCHEDULES

1. Provide type written panel directories to be included with panels installed.
2. Labels to include:
    1. The size of overcurrent,
    2. The area served (ie: "Rooms 122, 123 outlets"),

2.4. COLOUR CODING

1. Exposed conduits in mechanical and electrical rooms and exposed conduits above removable ceilings and where they enter or leave a box to be colour coded. Option is to paint all conduit fittings.
2. All junction boxes, pull boxes, panels and their covers shall be painted according to the colour coding schedule.
3. Colour coding of this equipment is to provide an easy and consistent means of identification of all electrical systems.
4. Colour Code Schedule:
    1. 120/208 V - Power, Lighting Grey.
    2. 120/208 V - Emergency (UPS) Grey with 50 mm black letters.
    3. 347/600 V - Power, Lighting Sand.
    4. Telephone System Black.
    5. Data Communication - DDC Yellow.
    6. Fire Alarm, Security Red.
5. All conduits entering or leaving these enclosures shall be identified by tape markers.

2.5. COLOUR CODING OF CONDUCTORS

1. All conductors to be colour coded throughout the building with same colour applying to the same phase throughout. Colour coding to be by insulation colour or permanently applied colour banding at termination ends. Color coding to be as follows:
    1. Equipment Bonding: Green.
    2. Neutral Conductor: White.
    3. 120/208 Phase Wires: Red/Black/Blue.
    4. 347/600 Phase Wires: Orange/Brown/Yellow.
2. Each system to follow its own colour coding. If system of same colour coding terminates in same piece of equipment, each system to be identified to which system it belongs.

Part 3 EXECUTION

3.1. CONDUIT IDENTIFICATION

1. All cable and conduit for electrical systems to be identified within 200 mm of exiting panel locations, pull box locations, within 200 mm of where they enter or leave a room or non-accessible ceiling space, and 4 m on centre within an area.

3.2. JUNCTION BOX

1. All pull and junction boxes to be labeled as to use.
2. Where boxes are exposed thermal tape labels are acceptable.
3. Where boxes are concealed in T-bar ceiling marker pen is acceptable.
4. The splicing of conductors inside junction boxes allowed in this specification shall be done with Weidmuller SAK-10 or equivalent terminals

3.3. IDENTIFICATION OF CONDUCTORS

1. At all distribution centres, pull boxes, wireways, etc., feeder conductors of each feeder group to be neatly laced or clipped into a feeder group with each conductor identified as to load fed.

END

Part 1 GENERAL

1.1 REFERENCE STANDARDS

1. Complete grounding work to CSA C22.1 2015.

1.2 SCOPE OF WORK

1. Refer to drawings for extent of grounding in addition to code requirements.
2. Provide an electrical system ground with an earth ground maximum resistance as specified in this section; Tests.

Part 2 PRODUCTS

2.1. MATERIALS

1. Grounding equipment to CSA C22.2 No. 41 (R2015); Grounding and Bonding Equipment.

2.2. EQUIPMENT

1. Clamps for grounding of conductor, size as required:
2. Grounding rod clamps to be high press or chemical bond only. Bolt-on clamps are not acceptable for grounding rod connections.
3. Circuit and equipment grounding conductors: stranded copper, soft annealed, size as indicated or as required by code.
4. Insulated grounding conductors to Section 26 05 21.
5. Copper ground bus 50 mm X 200 mm X 6 mm, mounted on insulated standoff brackets, for connection of grounds.

2.3. MANUFACTURERS

1. Acceptable manufacturers: Burndy Corp., Erico Inc. Cadweld Div., Federal Pioneer Ltd., McGraw Edison, other alternates to the departmental representative approval only.

Part 3 EXECUTION

3.1. INSTALLATION GENERAL

1. Install complete permanent, continuous, system and circuit, equipment, grounding systems, including electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of Owner, and local authority having jurisdiction over installation.
2. Install connectors to manufacturer's instructions.
3. Protect exposed grounding conductors from mechanical injury.
4. Make buried connections, and connections for lightning protection using copper welding by thermit process.
5. Use mechanical connectors for grounding connections to equipment provided with lugs.
6. Soldered joints not permitted.
7. Comply with requirement of CSA C22.2 and Canadian Electrical Code.

3.2. CIRCUIT GROUND CONDUCTORS

1. Install grounding bushings, grounding studs and grounding jumpers at all distribution centres, pull boxes, motor control centres, panelboards where separate grounding conductors are indicated or required by code.
2. Install grounding connection to typical equipment included in, but not necessarily limited to the following list:
    1. Service equipment.
    2. Transformers.
    3. Switch gear.
    4. Duct systems.
    5. Motor frames.
    6. Distribution panels.
    7. Outdoor lighting.
    8. Water service entrance.
    9. Sprinkler tree.
    10. Cable tray system.
    11. Where directed by the departmental representative.

3. Bonding Jumpers: green insulation, sized by Electrical Code Table 16A&B, sized for over current device protecting the circuit. Connect to grounding bushings on conduit, to lugs on boxes, tubs and other enclosures. Connection to neutral made only at service entrance and at secondary of distribution transformer.

4. Install bonding wire as required by Code in all flexible conduit connected at each end to a grounding bushing, solderless lug, clamp, cup washer and screw.

5. Integral bond conductor to be installed in all conduits with the exclusion of the utility to main service switch conduit(s).

3.3. GAS AND FUEL PIPE GROUNDING

1. All interior metallic gas piping which may become energized is to be made electrically continuous and to be bonded not less than #6 AWG in accordance with requirements of Canadian Electrical Code.

3.4. METALLIC WASTE WATER PIPE GROUNDING

1. Each metallic waste water piping system to the building to be grounded by bonding it to the Grounding interior metallic water supply system by copper bonding jumper of not less than #6 AWG as per the Canadian Electrical Code.

3.5. TELEPHONE AND DATA SYSTEM GROUNDING

1. Install the following ground wires:

    1. 1 - #2 AWG to telephone backboard.

    2. 1 - #14 AWG to all device conduits.

3.6. SECURITY SYSTEM

1. Install 1 - #6 AWG to electrical room ground bus.

3.7. ELECTRICAL SYSTEM GROUNDING

1. Provide grounding conductor(s) in main service disconnect switch to solidly ground the system. Grounding conductors minimum as shown.

3.8. CABLE TRAY BONDING

1. Install cable tray bonding conductor at intervals of not greater than 15 m by a green insulation copper bonding conductor sized to meet the requirements of the Electrical Code Table 16 but in no case shall be smaller than #6 AWG.

3.9. AS-BUILT INFORMATION

1. All grounding system information shall be provided on the as-built drawings.
2. Provide:
    1. Grounding and bonding locations.
    2. Grounding and bonding conductor gauge and type.
    3. Additional installation detail(s) as required to document the installation.

Part 4 TESTS

4.1. TESTS

1. Building system ground: measure system ground resistance with earth ground meggar tester; install additional ground rods and conductors as required for ground resistance less than 25 ohms.
2. Provide field test results in O+M manual.

END

Part 1 GENERAL

1.1 REFERENCE WORK

1. Seismic Restraint: Section 26 05 48.

Part 2 PRODUCTS

2.1. SUPPORT CHANNELS

1. U shape, size 41 mm x 41m m, 2.5 mm thick or 25 mm x 25 mm x 2.5 mm, surface/suspended, set in poured concrete walls and ceilings as indicated and as required.

2.2. MANUFACTURERS

1. Acceptable manufacturers: Burndy Ltd., Electrovert Ltd., Unistrut Ltd, Alternates to the departmental representative approval only.

Part 3 EXECUTION

3.1. INSTALLATIONS

1. All equipment and conduits larger than 19 mm in any dimension shall be securely attached to building structure by means of channel support. Single conduits 19 mm or smaller may be attached directly to the building structure.
2. Other than lay-in fixtures, equipment shall not be fastened to T-bar ceilings.
3. Secure equipment to poured concrete with expandable inserts.
4. Support equipment, conduit or cables using clips, spring-loaded bolts, cable clamps designed as accessories to basic channel members.
5. Fasten exposed conduit or cables to building construction or support system using straps.
    1. One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.
    2. Two-hole steel straps for conduits and cable larger than 50 mm.
    3. Beam clamps to secure conduit to exposed steel work.
6. Suspended support systems.
    1. Support individual cable or conduit runs with 10 mm dia threaded rods and spring clips.

2. Support 2 or more cables or conduits on channels supported by 10 mm dia threaded rod hangers where direct fastening to building construction is impractical; channel support to be sized for minimum of 25% future support capacity.

7. For surface-mounting of two or more conduits, use channels; channel support to be sized for minimum of 25% future support capacity.

8. Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

9. Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

10. Do not use wire lashing or perforated strap to support or secure raceways or cables.

11. Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.

12. Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END

Part 1 GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

1. Submit shop drawings and product data for cabinets in accordance with Section 26 05 01.
2. Flush mount boxes and cabinets shall be provided with covers that finish the box or cabinet in a cosmetically complete transition to architectural surroundings; openings left by poor fit to architectural surroundings will not be accepted.
3. Where boxes and where cabinets are installed in fire separations and fire rated walls provide fire protection rated materials, equipment and installation as required.

Part 2 PRODUCTS

2.1. JUNCTION AND PULL BOXES

1. Welded steel construction with screw-on flat covers for surface mounting as applicable in; attic spaces, crawlspaces, electrical rooms and mechanical rooms.
2. Covers with a 25 mm minimum extension around all edges for flush-mounted pull boxes and flush mount junction boxes.

2.2. CABINETS

1. Sheet steel cabinet with hinged door, latch, lock mechanism and back-pan.
2. Covers with a 25 mm minimum extension around all edges for flush-mounted cabinets

Part 3 EXECUTION

3.1. JUNCTION, PULL BOXES AND CABINET INSTALLATION

1. Install pull boxes in inconspicuous, but accessible spaces.
2. Mount cabinets with top not higher than 2000 mm above finished floor.
3. Provide pull boxes at 30m intervals along conduit runs, or when cumulative conduit bends reach 360 degrees.
4. Do not install junction boxes or pull boxes in architectural detailed wall, ceiling or floor finishes unless specifically shown on the drawings or without the written approval of the Architect.
5. Where specified and as where shown; prime and paint boxes and covers.

3.2. IDENTIFICATION

1. Provide identification lamicoid labels that indicate system name, voltage and phase in accordance with Section 26 05 01.

_____ END _____

Part 1 GENERAL

1.1 DESCRIPTION

1. Provide outlet boxes as required to enclose devices, permit pulling conductors and for wire splices.

1.2 REFERENCE

1. Reference Section 26 05 25 "Identification".

Part 2 PRODUCTS

2.1. OUTLET AND CONDUIT BOXES - GENERAL

1. Size boxes in accordance with CSA C22.1-15, Section 12.
2. 102 mm square or larger outlet boxes as required for special devices.
3. Gang boxes where wiring devices are grouped. Do not use sectional boxes.
4. Blank cover plates for boxes without wiring devices; covers to match surrounding device covers; to the approval of the Departmental representative.
5. Install barriers where outlets for more than one system are grouped.
6. Install properly sized boxes at the rough in stage. Box extensions will not be permitted.

2.2. SHEET STEEL OUTLET BOXES

1. 102 mm square flush outlet boxes for flush device installations in walls c/w extension and plaster rings as required.
2. 102 mm square or octagonal outlet boxes for lighting fixture outlets.

2.3. SURFACE CONDUIT BOXES - WP

1. Cast FS or FD aluminum boxes with factory- threaded hubs and mounting feet for surface wiring of switches and receptacle in outdoor locations.

2.4. FITTINGS GENERAL

1. EMT couplings and connectors to carry agency Approval acceptable for Yukon.
2. Knock-out fillers to prevent entry of foreign materials.

3. Conduit outlet bodies for conduit up to 32mm and pull boxes for larger conduits.

Part 3 EXECUTION

3.1. INSTALLATION

1. Support boxes independently of connecting conduits.
2. Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.
3. For flush installations, mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.
4. Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not allowed.

3.2. AS-BUILT INFORMATION

1. All outlet boxes and conduit boxes information shall be provided on the as-built drawings.
2. For pull boxes provide:
    1. Box location.
    2. Box type.
    3. Additional installation detail(s) as required to document the installation.

END

Part 1 GENERAL

1.1 LOCATION OF CONDUITS

1. Drawings do not indicate all conduit runs. Those indicated are diagrammatic only.
2. Note that where required so by drawings conduit is to be routed in a specific manner.
3. Exact conduit installation location to be determined on-site, to the approval of the departmental representative.

1.2 REFERENCE

1. Reference Section 26 05 25 "Identification”.

Part 2 PRODUCTS

2.1. CONDUITS

1. Rigid metal conduit: to CSA C22.2 No. 45.
2. Electrical metallic tubing (EMT) conduit: to CSA C22.2 No. 83.
3. Liquid tight flexible metal conduit: to CSA C22.2 No. 56.

2.2. CONDUIT FASTENINGS

1. One hole straps for conduits 35 mm or smaller.
2. Two hole straps for conduits larger than 35 mm.
3. Channel type supports for two or more conduits run in parallel and in close proximity.

2.3. CONDUIT FITTINGS

1. Manufactured and approved for use with conduit specified.
2. Factory bends required for conduits greater than 32mm diameter.

Part 3 EXECUTION

3.1. INSTALLATION

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

2. Liquid tight flexible metal conduit permitted if concealed or in service rooms, and the distance is less than 2000mm, and only where used for individual connection of specific equipment. Connecting fixture to fixture with liquid tight flexible metal conduit is not permitted.

3. Conceal all conduits except as otherwise noted.

4. Surface mount conduit shall be acceptable in electrical room; mechanical rooms; LAN rooms, fan room, hallway where is not covered by T-Bar, shop area “both sides”; and above the T-bar ceilings. Surface conduit in other areas requires the departmental representatives approval.

5. Run all conduits parallel or perpendicular to building lines.

6. Group conduits where possible and fasten to common channel support.

7. Do not pass conduits through structural members without written approval from a Structural Departmental representative.

8. Where conduits pass through nonstructural concrete, core the concrete with a diamond cutting tool or to approval of the Departmental representative.

9. Do not locate conduits to less than 75 mm parallel to steam or hot water lines. Maintain a minimum 75mm clearance where conduit is run parallel to steam or hot water lines. Maintain a minimum of 25 mm clearance at crossovers.

10. Size conduits to suit application and to code. Conduit sizes on drawings are minimum only based on design standards. The Contractor shall confirm all equipment requirements with shop drawings prior to rough-in of conduits.

11. Provide 2 mm stranded nylon pull cord in empty conduits to facilitate future wire pull.

3.2. AS-BUILT INFORMATION

1. All conduit information shall be provided on the as-built drawings.

2. Provide:

    1. Conduit trade size.

    2. Conduit location.

    3. Additional installation detail(s) as required to document the installation box and cabinet size (dimensions) and NEMA rating.

END

Part 1 GENERAL

1.1 RELATED WORK

1. "Fastenings and Supports For Electrical Systems": Section 26 05 29.

1.2 WORK INCLUDED

1. Electrical equipment to operate without objectionable noise or vibration. If, in the Departmental representative's opinion, equipment is operating with excessive noise or vibration, equipment and isolation system shall be improved at no additional cost.

1.3 WORK INCLUDED

1. Provide seismic restraint and anchorage for all electrical equipment and services in accordance with the current edition of the National Building Code of Canada, 2010 edition, Subsection 4.1.9. and table 4.1.9.E. as well as per BC Electrical Contractors Association Seismic Restraint Manual, 1st Edition.
2. All support equipment shall be tested in an independent testing agency or shall be certified by a Departmental representative Licensed to practice in Yukon to demonstrate that the equipment meets the requirements of all Codes and Bylaws. Submit the seismic departmental representative letter for review before substantial.
3. All seismic bracing to be certified by a departmental representative licensed to practice in the Yukon. Carry the cost of the seismic departmental representative in the bid price.
4. Seismic restraint departmental representative to be conduct at least one site visit in person.

1.4 SHOP DRAWINGS

1. Submit shop drawings in accordance with Section 26 05 01.

Part 2 PRODUCTS

2.1. CONDUITS

1. Liquid-tight flexible metal conduit, size as indicated.

2.2. STRUCTURAL BASES

1. Structural steel rail base, sized for application, complete with isolation elements attached to base brackets, pre-drilled holes to receive equipment anchor bolts.

2.3. SEISMIC CONTROL MEASURES

1. General:
    1. Seismic control systems to work in all directions.
    2. Fasteners and attachment points to resist same maximum load as seismic restraint.
    3. Drilled or power driven anchors and fasteners not permitted.
    4. No equipment, equipment supports or mounts to fail before failure of structure.
    5. Supports made of cast iron or threaded pipe not permitted.
    6. Seismic control measures not to interfere with integrity of fire stopping.
2. Static Equipment:
    1. Anchor equipment to equipment supports. Anchor equipment supports to structure.
    2. Suspended equipment:
        1. Use one or more of following methods depending upon site conditions and or as indicated:

            3.2.2.1.1. Install tight to structure.

            3.2.2.1.2. Cross brace in all directions.

            3.2.2.1.3. Brace back to structure.

            3.2.2.1.4. Cable restraint system.
    3. Seismic Restraints:
        1. Cushioning action to be gentle and steady.
        2. Shall never reach metal-like stiffness.
3. Vibration Isolation Equipment:
    1. Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

2. Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

4. Conduit:

1. Hangers longer than 300mm; brace at each hanger.

2. To be compatible with requirements of anchoring of piping systems.

5. Bracing Methods:

1. To approval of Departmental representative.

2. Structural angles or channels.

3. Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

2.4. T-BAR FIXTURES

1. As per BC Electrical Contractors Association Seismic Restraint Manual, 1st Edition: Fluorescent Light fixture - Figure 4.26.

Part 3 EXECUTION

3.1 INSTALLATION

1. Install vibration isolation in accordance with manufacturer's instructions and adjust mountings to level equipment.

2. Ensure electrical connections to isolated equipment do not reduce system flexibility, and that conduit does not transmit vibrations through walls and floors.

3. If inadequate isolation is provided, improve isolation to the satisfaction of the Departmental representative at no additional cost.

4. Seismic control measures to meet NBC-2010 and the requirements of the Authorities having Jurisdiction.

5. Drilled or power driven anchors not permitted for use with seismic control measures.

6. Division 26 to reference and comply with all requirements listed in specification section 23 05 49 "Seismic Restraint Systems”.

3.2. ISOLATION SCHEDULE

1. Motor driven equipment: liquid-tight flexible metal conduit.

_____ END _____

1.1 RELATED WORK

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

1.2 RELATED SECTIONS

.1 Section 01 91 13 - General Commissioning

.2 Section 01 91 31 - Commissioning Plan

.3 Section 01 91 33 - Commissioning Forms

.4 Section 01 91 41 - Commissioning Training

.5 Section 23 08 00 - Commissioning of Mechanical Systems

1.3 INTENT

.1 This Section specifies electrical requirements relating to the commissioning of components, equipment and systems specified within Division 26, 27 and 28.

.2 Commissioning of electrical components and systems is of the utmost importance to ensure the successful operation of the building electrical systems. The systems will not be considered complete until all systems have been demonstrated to work precisely in accordance with the Contract requirements and a percentage witnessed by the Commissioning Authority.

.3 Responsibility for the satisfactory completion of the system and the subsequent demonstration of systems to the requirements of the commissioning rests with the Division 26 sub-contractor. The Division 26 sub-contractor is to provide and pay for any specialist supervision, inspection and testing as required to complete the work described with the exception of the other members of the Commissioning Team.

.4 The commissioning agent can be part of the contracting team or an independent third party. If the commissioning agent is part of the contracting team, this individual can only participate in the construction of the facility as a Commissioning Agent.

.5 Fully cooperate with the Commissioning Authority.

.6 Refer to related sections for additional requirements.

.7 The electrical Commissioning process consists of:

.1 Review by the electrical commissioning agent of all contractor submittals.

.2 Completion and acceptance of Pre-Functional Check sheets (PC) for the specified Electrical Equipment. Submit to the Commissioning Authority for review and recommended acceptance.

.3 Completion and acceptance of Functional Performance Tests (FPT) for the specified building systems. FPT will be directed by the commissioning agent and witnessed by the Commissioning Authority. The FPT tests will be performed by the Division 26 sub-contractor.

.4 Review by the Commissioning Authority of all training procedures and operations and maintenance manuals.

.5 Completion of a 10 month warranty performance review by the Commissioning Authority.

.6 Completion of a Systems Manual by the Commissioning Agent and submitted to the Commissioning Authority for recommended acceptance.

.8 Except where otherwise specified, the Division 26 sub-contractor is to arrange and pay for the testing and related requirements specified in this and related Sections.

.9 If test results do not conform with applicable requirements, repair, replace or adjust or balance components and systems. Repeat testing as necessary until acceptable results are achieved.

.10 This Section is to be read in conjunction with related Sections which specify specific portions of electrical starting and testing work.

1.4 COMMISSIONING TEAM

.1 The cooperation of all trades is essential for an efficient and planned process. A team comprising the following is recommended:

.1 Commissioning Authority retained by owner.

.2 General Contractor.

.3 Electrical Contractor's Supervisor.

.4 Electrical Consultant.

.5 Property Manager.

.6 Mechanical Trades: especially Controls Contractor and TAB Agency.

.7 Authorities having jurisdiction where applicable.

1.5 SITE REPORTING

.1 Site hard copies of all Commissioning forms will be provided by the commissioning authority and maintained by the commissioning agent for use by the commissioning team.

.2 The commissioning agent and the Division 26 sub-contractor will be responsible for recording all data gathered on site on the hard copy forms as specified.

1.6 FINAL REPORT

.1 The commissioning authority will be responsible for compiling the final report.

.2 The commissioning agent shall provide upon request within 14 days a completed single copy of any required test sheets, warranties, start up and systems commissioning sheets as requested by the commissioning authority for compiling within the final report.

.3 3 Copies of the final report will be provided to the property manager

1.7 PROCESS

.1 The commissioning process commenced during design and will proceed through construction and post construction to the following general process and schedule:

.1 Design: through design review and planning processes have been completed. These are detailed in the appended commissioning plan.

.2 Construction:

.1 Within 30 days of award of the contract a Commissioning kick-off teleconference meeting will be held.

.2 Submittal reviews will be completed by the commissioning agent to ensure conformance to the design criteria, and submitted to the Commissioning Authority.

.3 Throughout the course of construction the commissioning agent is to complete all specified contractor proving tests forms and submit the necessary documentation. The Commissioning Authority will witness this testing at their discretion.

.4 Throughout the course of construction the commissioning agent is to complete the Pre-Functional Check sheets for each specified system/ equipment for which they are responsible.

.5 A minimum 60 days prior to the start of the Functional Performance Tests a site testing schedule will be developed by the

commissioning agent in cooperation with the Commissioning Authority. At this time copies of all Functional Performance Test Check sheets will be made available.

.6 During the last three months of the construction process there will be a monthly commissioning meeting to review the construction schedule and commissioning requirements.

.7 Within 30 days of the start of the startup, check-out and commissioning verification process a dedicated Test Planning and Scheduling meeting will be completed to coordinate the commissioning verification process.

.8 Upon completion of the construction the design Consultant will identify that the building startup and checkout is completed and the systems are suitable for verification.

.3 Commissioning Verification

.1 Verification of testing required by the Division 26 documents by the Commissioning Authority.

.2 Sample review and acceptance by the Commissioning Authority of the Pre-Functional Check sheets (PC) for the specified Electrical Equipment completed by the commissioning agent.

.3 Completion and acceptance of all Functional Performance Tests (FPT) for the specified building systems. The FPT testing will be directed by the Commissioning Agent and witnessed by the Commissioning Authority. The FPT testing will be performed by the commissioning agent.

.4 Additional commissioning meetings as specified.

.2 Contractor's representatives to be present for all Commissioning of systems that falls within the scope of their work.

.3 Unless otherwise specified in writing by the Contractor all testing and related requirements specified herein will be performed prior to the issue of the Substantial Performance Certificate.

1.8 PRE-COMMISSIONING

.1 All startups, balancing and adjustment as specified in Divisions 01, 26, 27, and 28 are to be completed prior to commencement of the Functional Performance Tests (FPT).

1.9 COORDINATION

.1 It is the responsibility of the Division 26 contractor to coordinate with the commissioning agent, all sub-trades, manufacturers, suppliers and other specialists as required to ensure all phases of work shall be properly organized prior to commencement of each particular testing procedure. Establish all necessary manpower requirements.

.2 Where any components or systems require testing prior to starting, ensure that such work has been completed and approved prior to starting of these components and systems.

1.10 SEASONAL CONSTRAINTS

.1 Notwithstanding all-inclusive requirements specified in this Section an additional separate cycle of Commissioning may be necessitated at a later time for components and systems whose full operation is dependent on seasonal conditions.

.2 The Division 26 commissioning agent responsibilities with respect to such Commissioning activities will be the same as all activities specified in this Section.

1.11 COMMISSIONING MEETINGS

.1 Provide the appropriate representation at the scheduled commissioning meetings as follows:

.1 Pre-commissioning kick-off meeting.

.2 FPT startup meeting.

.3 Commissioning wrap-up meeting.

1.12 PRESIDING AUTHORITIES

.1 Procedures defined in this section may duplicate verification conducted by Authorities having jurisdiction. To facilitate expedient turnover of building, arrange for authorities to witness procedures in a manner that avoids unnecessary duplication of tests.

.2 Obtain certificates of approval, acceptance and comply with rules and regulation of Authorities having jurisdiction. Provide originals of all certificates to the Consultant, and include a copy in the O&M manuals.

1.13 CORRECTION OF DEFICIENCIES

.1 Correct all contract deficiencies found during Commissioning.

1.14 COMPLIANCE

.1 Failure to follow the specific instructions defined herein pertaining to correct starting procedures may result in re-evaluation of components by independent

testing agency selected by the Commissioning Authority at the Contractor's expense. Should results reveal components have not been started in accordance with specified requirements, components may be rejected. If rejected, remove components from site and replace. Replacement components shall also be subject to full starting procedures, using same procedures specified on the originally installed components.

1.15 WITNESSING OF CONTRACTOR PROVING TESTS

.1 The Commissioning Authority may witness selected Contractor starting, testing, adjusting, balancing and cleaning procedures.

.2 Advise the Commissioning Authority in advance that starting, testing, adjusting, balancing or cleaning processes are ready to commence. Consult with the Commissioning Authority to determine which procedures he may elect to witness. Provide advanced notice prior to commencement of each procedure or series of procedures to allow the Commissioning Authority to arrange for witnessing of tests as required.

.3 The commissioning agent to submit to the Commissioning Authority all testing, startup, adjusting, balancing and cleaning reports on successful review by the Consultant.

1.16 ADDITIONAL TESTING CONDUCTED BY COMMISSIONING AUTHORITY

.1 The Commissioning Authority may select and conduct at random: components, systems and/or integrated systems to be re-tested in addition to the specified tests.

.2 Testing of any component, system, or integrated system by the Commissioning Authority does not reduce the Division 26 commissioning agent's obligations for complete testing and start-up of systems as specified.

.3 The Division 26 commissioning agent will provide, without cost, support for these tests, including:

.1 Qualified personnel to operate the appropriate components, systems and/or integrated systems.

.2 Making all test equipment and instrumentation available to the Commissioning Authority.

.4 The Division 26 commissioning agent can choose to witness any testing conducted by the Commissioning Authority.

.5 Should any component or system fail under additional testing completed by Commissioning Authority the Division 26 sub-contractor will correct the deficiency and retest to the satisfaction of the Commissioning Authority at the Contractor's expense.

1.17 SPECIALIZED AGENCIES AND TESTING LABORATORIES

.1 All reports generated by special testing agencies or testing laboratories shall be submitted by the Division 26 sub-contractor to the Commissioning Authority.

.2 All agencies and testing laboratories shall be pre-approved by the Consultant with acceptable facilities and qualifications.

.3 Include a copy of all such reports in O&M manuals.

Part 2 Products

2.1 TESTING INSTRUMENTS

.1 Provide two-way radios, ladders, tools, instruments and other equipment as required to complete the program and as outlined in this specification.

.2 Provide all safety equipment required for personnel involved in the starting, testing, adjusting and balancing program.

.3 Use instruments supplied or calibrated by approved laboratory or manufacturer .Show the Commissioning Authority the current calibration certificate for each instrument to be used. Provide a copy of the calibration certificates with test reports.

Part 3 Execution

3.1 GENERAL

.1 All Division 26 startups, balancing and adjustment to be completed prior to commencement of Functional Performance Tests including the following:

.1 Fire alarm verification;

.2 Megger testing and connection torque of feeder cables;

.3 Soil resistance and ground impedance testing.

.4 Operational testing of all components in power distribution system;

.5 Operation of lighting control system;

.6 VFD programming and operation tests;

.7 Motor control operations, settings protective devices;

.8 Full operational testing of intrusion alarm system;

.9 Lighting systems and lighting controls;

.10 Receptacles testing;

.11 Heat trace and controllers;

.12 Electrical Panels and Panel directories;

.13 Main service and new breakers thermal imaging / testing.

.14 Testing of emergency lighting (battery-type);

3.2 PRE-FUNCTIONAL CHECKLISTS (PC'S)

.1 Pre-Functional Checklists are the process to ensure the specified equipment is installed to the contract requirements. To complete this work a database of the checklists is completed by the Commissioning Agent. The Division 26 sub-contractor shall then complete the PC's during the course of construction. When commissioning commences the Commissioning Authority will verify the validity of selected sample PC's prior to commencing performance tests. This process ensures that the equipment and systems are correctly installed prior to actually testing their operation.

.2 Specifically the PC process shall follow these steps:

.1 The Commissioning Agent will complete the PC forms using an approved database and hard copies will be provided to the Division 26 sub-contractor at the commissioning kick-off meeting.

.2 Where the commissioning agent identifies missing PC's they are to advise the Commissioning Authority in writing. The Commissioning authority works with the commissioning agent to generate the missing verification forms within 21 days.

.3 During the course of construction the Division 26 commissioning agent shall complete the Contractor portion of the PC forms, and submit to the commissioning authority.

.4 Minimum 14 days prior to commencing any performance tests the Division 26 commissioning agent shall submit the completed hard copies of the forms for review by the Commissioning Authority. The Commissioning Authority will advise the Division 26 commissioning agent of any missing information which the Division 26 commissioning agent shall rectify in a timely manner. It is recommended, however, that the Cx agent prepare the PC's during the course of construction and submit t hem as they are completed during site review meetings.

.5 Upon receipt and acceptance off all PC's and when the design Consultants advise that the buildings are ready for Commissioning the Commissioning Team under the direction of the Commissioning Authority shall verify all or a selected portion thereof for the completed PC's.

.6 Any deficiencies in the PC's shall be corrected in a timely manner by the Division 26 subcontractor.

3.3 FUNCTIONAL PERFORMANCE TESTS (FPT's)

.1 Functional performance tests (FPT's) are the process to ensure the systems operate to the contract requirements. To complete this work real time 100% point testing of all systems is completed by the Division 26 Cx agent under the direction and witness of the Commissioning Authority and/or team.

.2 Prior to the FPT's commencing all Division 26 sub-contractor's and manufacturers startup and proving tests specified elsewhere are to be completed and approved.

.3 Prior to the FPT's commencing all PC's are to be completed and approved.

.4 FPT's shall be first conducted by the Division 26 sub-contractor independent of the Commissioning Team and then re-conducted and witnessed by the Commissioning Authority and/or team based on the mutually agreed schedule developed by the Commissioning Agent as indicated elsewhere in the specifications.

.5 The FPT forms will be generated by the Commissioning Agent from an approved data base and provided to the Commissioning authority for review a minimum 30 days prior to commencing the functional performance testing.

.1 Where the Division 26 commissioning agent identifies missing FPT forms they are to advise the Commissioning Authority in writing. The Commissioning authority works with the commissioning agent to generate the missing FPT forms within 21 days.

3.4 BUILDING OPERATIONAL SEMINAR

.1 Subsequent to the substantial completion and as a component of the commissioning, the Commissioning Agent will provide a 4-hour seminar on the "Building Operation" to the operating and maintenance personnel describing the intended operation of the building electrical systems. Provide one senior tradesperson familiar with the complete building electrical systems to assist in this training session.

.2 A written and illustrated building winterization and de-winterization procedure will be demonstrated at this time.

END OF SECTION

Part 1 GENERAL

1.1 Scope

.1 This specification describes the electrical, mechanical, environmental, agency and reliability requirements for three phase, variable frequency drives (VFD) as specified herein and as shown on the contract drawings.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with Section 26 05 01 "Common Work Results Electrical".

.2 Indicate:

- .1 Dimensioned outline drawing.
- .2 Starter size and type.
- .3 Layout of components.
- .4 Schematic diagram.
- .5 Power and control connection diagram(s).
- .6 Typical harmonic currents.

1.3 Operation and Maintenance Data

.1 Provide operation and maintenance data for adjustable frequency drives for incorporation into manual specified in Section 26 05 01.

.2 Include operation and maintenance data for each type and style of drive.

.3 Include manufacturer’s recommended renewal parts list.

1.4 Qualifications

.1 For the equipment specified herein, the manufacturer shall be IS0 9001certified.

.2 The supplier of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Departmental representative, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

2.1. PRODUCTS

1. Product of Acceptance

.1 Variable Frequency Drives shall be on the basis of Schneider Electric Altivar 61 Series for function and quality.

.2 Products that are in compliance with the specification and manufactured by others will be considered as "Approved Equal" only if pre-approved by the Departmental representative fourteen (14) days prior to bid date.

.3 Alternate suppliers shall submit documentation showing itemized compliance to the specifications and experience specific to the proposed VFD including a list showing details of the installation, application, location, contact name and telephone number of at least ten (10) users.

.4 Naming specific venders does not imply acceptance of their standard products nor relieve them from meeting these specifications in their entirety.

2. Adjustable Frequency Drive Features

.1 The VFD shall be rated for 208 Vac with optional input voltages of 240, 380 and 480 Vac.

.2 The VFD shall provide microprocessor-based control for three-phase induction motors.

.3 The controller's full load output current rating shall be based on 50° (CT) / 40° C (VT) ambient and 10 kHz switching frequency below 30Hp CT) / 40 Hp (VT) and 3.6 kHz 30Hp (CT) / 40 Hp (VT) and above to reduce motor noise and avoid increased motor losses.

.4 The VFDs shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. Variable Current Source VFDs are not acceptable. Insulated Gate Bipolar Transistors (IGBTs) shall be used in the inverter section. Bipolar Junction Transistors, GTOs or SCRs are not acceptable. The VFDs shall run at the above listed switching frequencies and upon over temperature shall fold back the switching frequency to reduce the operating temperature. The VFD shall return to the rated switching frequency after the over-temperature condition has passed.

.5 The VFDs shall have an efficiency at full load and speed that exceeds 95% for VFDs below 15 Hp and 97% for drives 15 Hp and above. The efficiency shall exceed 90% at 50% speed and load.

.6 The VFDs shall maintain the line side displacement power factor at no less than 0.96, regardless of speed and load.

.7 The VFDs shall have a one (1) minute overload current rating of 150% and a two (2) second overload current rating of 250% for constant torque drives. The VFDs shall have a one (1) minute overload current rating of 110% for variable torque drives.

.8 The VFDs shall be capable of operating of operating any NEMA design B squirrel cage induction motor, regardless of manufacturer, with a horsepower and current rating within the capacity of the VFD.

.9 The VFDs shall limit harmonic distortion reflected onto the utility system by utilizing the standard 3% nominal impedance integral ac three-phase line reactor.

.10 The VFDs shall be able to start into a spinning motor. The VFDs shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFDs shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.

.11 Standard operating conditions shall be:

.1 Incoming Power: Three-phase, 208 Vac (+10% to -15%) and 60 Hz (+/-5 Hz) power to a fixed potential DC bus level.

.2 Frequency stability of +/-0.05% for 24 hours with voltage regulation of +/-I% of maximum rated output voltage.

.3 Speed regulation of +/- 0.5% of base speed.

.4 Load inertia dependant carryover (ride through) during utility loss.

.5 Insensitive to input line rotation.

.6 Humidity: 0 to 95% (non-condensing and non-corrosive).

.7 Altitude - 0 to 3,300 feet (1000 meters) above sea level.

.8 Ambient Temperature: -10 to 50º C (CT) , -10 to 40º C

.9 Storage Temperature: -40º C to 60º C.

3. Control Functions

.1 Frequently accessed VFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the VFD. The VFDs shall have a 3 line alphanumeric programmable display with status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not acceptable, and particularly those that use alphanumeric code and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.

.2 Standard advanced programming and trouble-shooting functions shall be available by using a personal computer's RS-232 port and WindowsTM based software. In addition the software shall permit control and monitoring via the VFD's RS232 port. The manufacturer shall supply a diskette with the required software. An easily understood instruction manual and software help screens shall also be provided. The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information as outlined in this section through section 18.

.3 The operator shall be able to scroll through the keypad menu to choose between the following:

.1 Monitor

.2 Operate

.3 Parameter setup

.4 Actual parameter values

.5 Active faults

.6 Fault history

.7 LCD contrast adjustment

.8 Information to indicate the standard software and optional features software loaded.

.4 The following setups and adjustments, at a minimum, are to be available:

.1 Start command from keypad, remote or communications port

.2 Speed command from keypad, remote or communications port

.3 Motor direction selection

.4 Maximum and minimum speed limits

.5 Acceleration and deceleration times, two settable ranges

.6 Critical frequency avoidance

.7 Torque limit

.8 Multiple attempt restart function

.9 Multiple preset speeds adjustment

.10 Catch a spinning motor start or normal start selection

.11 Programmable analog output

.12 DC brake current magnitude and time

.13 Proportional/Integral process controller

4. System Interfaces

.1 Inputs - A minimum of six (6)programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided with the following available as a minimum:

.1 Remote manual/auto

.2 Remote start/stop

.3 Remote forward/reverse

.4 Remote preset speeds

.5 Remote external trip

.6 Remote fault reset

.7 Process control speed reference interface, 4-20mAdc

.8 Potentiometer and 0-10 Vdc speed reference interface

.9 RS232 programming and operation interface port

.10 Serial communications port

.2 Outputs - A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1)programmable analog output shall be provided, with the following available at minimum.

.1 Programmable relay outputs with one (1) set of Form C contacts for each, selectable with the following available at minimum:
- .1 Fault
- .2 Run
- .3 Ready
- .4 Reversing
- .5 Jogging
- .6 At speed
- .7 In torque limit
- .8 Motor rotation direction opposite of commanded
- .9 Over temperature

.2 Programmable open collector output with available 24Vdc power supply and selectable with the following available at minimum:

- .1 Fault
- .2 Run
- .3 Ready
- .4 Reversing
- .5 Jogging
- .6 At speed
- .7 In torque limit
- .8 Motor rotation direction opposite of commanded
- .9 Over temperature

.3 Programmable analog output signal, selectable with the following available at minimum:
- .1 Output current
- .2 Input frequency
- .3 Motor speed
- .4 Motor torque
- .5 Motor power
- .6 Motor voltage
- .7 DC link voltage

5. Monitoring and Displays

.1 The VFD's display shall be a LCD type capable of displaying three (3) lines of text and the following thirteen (13) status indicators:
- .1 Run
- .2 Forward

.3 Reverse

.4 Stop

.5 Ready

.6 Alarm

.7 Fault

.8 Local

.9 Panel

.10 Remote

.11 Hand

.12 Auto

.13 Off

.2 The VFD's keypad shall be capable of displaying the following monitoring functions at a minimum:

.1 Output frequency

.2 Output speed

.3 Motor current

.4 Motor torque

.5 Motor power

.6 Motor voltage

.7 DC-link voltage

.8 Heatsink temperature

.9 Total operating days counter

.10 Operating hours (resetable)

.11 Total megawatt hours

.12 Megawatt hours (resetable)

.13 Voltage level of analog input

.14 Current level of analog input

.15 Digital inputs status

.16 Digital and relay outputs status

.17 Motor temperatures rise, percentage of allowable.

6. Protective Functions

.1 The VFD shall include the following protective features at minimum:

.1 Overcurrent

.2 Overvoltage

.3 lnverter fault

.4 Undervoltage

.5 Phase loss

.6 Output phase loss

.7 Under-temperature

.8 Overtemperature

.9 Motor stalled

.10 Motor over-temperature

.11 Motor underload

.12 Logic voltage failure

.13 Microprocessor failure

.14 DC injection braking

.2 The VFD shall provide ground fault protection during power-up, starting, and running. VFDs with no ground fault protection during running are not acceptable.

7. Diagnostic Features

.1 Fault History.

.1 Record and log faults

.2 Indicate the most recent first, and store up to 9 faults.

8. Mandatary Features

.1 HMCP or thermal magnetic breaker to provide a disconnect means. Operating handle shall protrude the door. The disconnect shall not be mounted on the door. The handle position shall indicate ON, OFF, and TRIPPED condition. The handle shall have provisions for padlocking in the OFF position with at least three (3) padlocks. Interlocks shall prevent unauthorized opening or closing of the VFD door with the disconnect handle in the ON position. This shall be defeatable by maintenance personnel.

.2 AC input line current limiting fuses shall provide a means of disconnecting the VFD from the line under fault conditions.

.3 Three contactor bypass shall include a drive input disconnect, an VFD input isolation contactor, bypass contactor and an VFD output contactor that is electrically and mechanically interlocked with a bypass contactor. This circuit shall include control logic, status lights and motor overcurrent relays. The complete bypass system (Inverter-Off-Bypass) (Hand-Off-Auto with Inverter-Bypass) selector switch(s), and inverter/bypass pilot lights shall be (packaged with the VFD) (packaged in a separate enclosure). The unit may be set up for (Manual) (Automatic) bypass operation upon an VFD trip.

.4 AC output contactor to provide a means for positive disconnection of the drive output from the motor terminals.

.5 Fused space heaters with thermostat for oversize enclosures to minimize condensation potential upon drive shutdown.

.6 Laminated plastic or steel nameplate engraved with user's identifying name or number for oversize enclosures.

.7 Pneumatic process follower allowing motor speed control proportional to a 3-15 PSIG pneumatic signal.

.8 120 Vac control to allow VFD to interface with remote dry contacts.

.9 Motor overcurrent relay to provide motor overcurrent sensing of a given level of load current.

.10 Input isolation transformers, separately mounted, with NEMA 1 enclosure.

.11 Motor dv/dt filter for use on motor cable runs exceeding 50 ft at 600 Vac (100 feet for 480 Vac).

.12 Dynamic braking control circuitry shall be provided to decelerate the motor faster than the internal losses can absorb. Dynamic braking shall cause an optional resistor bank, when specified, to be switched onto the dc link as required to absorb the regenerative energy. This shall allow the fastest controlled deceleration and/or stop without an over-voltage condition.

Resistor bank, when specified, shall be located external to the drive enclosure to prevent overheating of the drive.

.13 Resistor bank for dynamic braking load.

.14 Graphical keypad

.1 The operator interface shall consist of a LCD keypad located on the front of the VFD. Features shall include:

.1 Twelve (12) pushbuttons for selection, display, and modification of the VFD characteristics as follows:

.1 Scroll left
.2 Scroll right
.3 Scroll up/increase
.4 Scroll down/decrease
.5 Parameter
.6 Monitor
.7 Page
.8 Operate
.9 Enter
.10 Reset
.11 Start
.12 Stop

.2 The keypad LCD panel shall provide a choice of 8 lines of text or a 64x128 pixel graphical display of key waveforms or a combination of both.

.3 The operator shall be able to scroll through the keypad menu to choose between the following screens:

.1 Monitor
.2 Operate
.3 Parameter setup
.4 Actual parameter values
.5 Operating parameter trends menu for selection of parameters for graphical trend display.
.6 Active faults
.7 Fault history

.8 LCD adjustment

.9 Info/files selection to indicate the standard software and optional features software loaded

.15 Communication card for interface_ with (Johnson N2) (Modbus RTU) (DeviceNet) (Interbus-S) Profibus-DP) (Lonworks) (Staefa) control system.

.16 Provide an input EMI filter to minimize conducted electrical noise to meet the requirements of IEC 61800-3.Specification writer to select as required

9. Enclosure

.1 The VFD enclosure shall be NEMA 1. The VFD shall have complete front accessibility with easily removable assemblies.

.2 The VFD enclosure shall be NEMA 12.

10. Spare Parts

.1 The main logic board, keypad and power supply board shall be supplied as spares, one for each different part number supplied.

11. Support

.1 The VFD manufacturer shall maintain, as part of a national network, departmental representative service facilities to provide start-up service, emergency service calls, repair work, service contracts, maintenance and training of customer personnel

12. Factory Testing

.1 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL, CSA and NEMA standards.

.1 All printed circuit boards shall be functionally tested via automatic test equipment prior to unit installation.

.2 All final assemblies shall be tested at full load with application of line-to-line and line-to-ground bolted faults. The Variable Frequency Drive shall trip electronically without device failure.

.3 After all tests have been performed, each VFD shall undergo a burn-in test. The drive shall be burned in at 100% inductive or motor load without an unscheduled shutdown.

.4 After the burn-in cycle is complete, each VFD shall be put through a motor load test before inspection and shipping.

13. Installation

.1 VFD's to be factory installed where shown on the drawings to the approval of the Departmental Representative.

14. Field Quality Control

.1 Provide the services of a qualified manufacturer's employed Field Service Technician to assist the Contractor in installation and start-up of the equipment specified under this section. Field Service personnel shall be factory trained with periodic updates and have experience with the same model of VFD's on the job site. Sales representatives will not be acceptable to perform this work. The manufacturer's service representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, installation as specified in manufacturer's installation instructions, wiring, application dependant adjustments, and verification of proper VFD operation.

.2 The following minimum work shall be performed by the Contractor technical direction of the manufacturer's service representative.

.1 Inspection and final adjustments.

.2 Operational and functional checks of VFDs and spare parts.

.3 The contractor shall certify that he has read the drive manufacturer's installation instructions and has installed the VFD in accordance those instructions.

.3 The Contractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made.

15. Maintenance Warranty Service

.1 Warranty period shall be 24 months from the date of start-up, not to exceed 30 months from the date of shipment, and include all parts and labor.

16. Field Testing

.1 Optional field testing
The inverter manufacturer shall perform harmonic measurements at the point where the utility feeds multiple customers (PCC) to verify compliance with IEEE519-1992. A report of the voltage THD and current TDD shall be sent to the departmental representative. The contractor shall provide labor, material, and protection as needed to access the test points. The readings shall be taken with all drives and all other loads at full load, or as close as field conditions allow.

17. Training

.1 The Contractor shall provide a training session for up to owner's representatives for normal workdays with a maximum of trips at a job site location determined by the owner. Training and instruction time shall be in addition to that required for start-up service.

.2 The training shall be conducted by the manufacturer's qualified representative.

.3 The training program shall consist of the following:

.1 Instructions on the proper operation of the equipment.

.2 Instructions on the proper maintenance of the equipment.

_____ END _____

Part 1 GENERAL

1.1 SHOP DRAWINGS

1. Submit shop drawings in accordance with Section 26 05 01 "Common Work".
2. Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

Part 2 PRODUCTS

2.2. PANEL BOARDS

1. Panelboards: to CSA C22.2-15 No. 29
2. Panelboards: mains, number of circuits, and number and size of branch circuit breakers, as indicated.
3. Tin plated aluminum bus or silver plated copper bus with full size 100% rated neutrals.
4. Mains to match existing.
5. Finish trim for all panelboards with hinged door assembly as standard. Provide door lock for all flush mount panelboards.
6. Provide equipment identification in accordance with Section 26 05 25 "Identification".
7. Complete circuit directory with typewritten legend showing location and load of each circuit for all new panelboards.
8. Existing circuits to be traced and included in new panel directories.
9. Provide typewritten panel directories.
10. Sized for full width breakers.
11. All surface mounted panels to be provided with drip-shield.
12. All panelboards to have isolated neutral bus.
13. All panelboards to be seismically rated for minimum of Zone 3 area.
14. Provide: sub-feed lugs, and interconnect wiring as required. Note that sub-feed wiring neutrals to be installed through common raceway as hot conductor sub-feed connections.
15. Integral transient surge suppression unit where specified or shown on the drawings.
16. All panels to be rated for use in sprinklered area.

2.3. BACKBOARDS

1. All surface mounted panelboards to be mounted on 19 mm G1S painted plywood backboards. Paint to be fire retardant grey colour. Back boards to be provided by general contractor; refer to section 06 01 11 "Rough Carpentry - Short Form" for further details.

2.4. EQUIPMENT

1. Provide equipment identification in accordance with Section 26 05 25 "Identification".
2. Complete circuit directory with typewritten legend showing location of each circuit.
3. Panelboards: current capacity, minimum circuits, mounting method, integral transient surge suppression systems, and main breakers as indicated on the drawings and as specified.

2.5. BREAKER GENERAL

1. GFEDP breakers for 30 mA equipment protection.
2. GFCI breakers for 5 mA personnel protection.
3. Manufacturer's tie-locks for critical and code required systems:
    1. Fire alarm.
    2. ULC approved communicators (and security equipment) used for fire alarm communication.

2.6. MANUFACTURERS

1. Acceptable manufacturers: Schneider Electric, Eaton and Siemens.

Part 3 EXECUTION

3.1. INSTALLATION

1. Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
2. Install surface-mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
3. Install flush-mount panelboard in wall framing. Report to the general contractor and to the Architect during rough-in where wall framing depth does not allow flush mount of electrical tub trim. General contractor to provide architectural trim around panel tub, increased depth of framed wall or other increased framing depth work to the approval

of the architect. Contractor to request written instructions from the Architect prior to implementation of trim or wall depth increase work.

4. Coordinate with the General Contractor for the provision of continuous fire rated wall, ceiling and floor assemblies where panelboards are flush mount in fire separations and fire rated partitions.

5. Mount panelboards to height specified in Section 26 05 01 "Common Work", 26 24 17 "Panelboards" or as indicated.

6. Connect loads to circuits.

7. Connect neutral conductors to common neutral bus with respective neutral identified.

8. All panelboard feeders to be continuous without splice.

9. All panelboards to have minimum three 19 mm spare conduits to the ceiling space and three spare 19 mm conduits to the floor space below the panelboard location (where applicable space is preset). Spare conduits to be run to a free and clear location to the approval of the departmental representative.

3.2. TESTING

1. Provide contractor testing as specified in Section 26 05 04 "Contractor Testing”.

3.3. AS-BUILT INFORMATION

1. All panelboard information shall be provided on the as-built drawings.

_____ END _____

Part 1 GENERAL

1.1 SCOPE

1. To install service entrance equipment to the approval of the departmental representative and the local supply authority and inspection authorities.

1.2 SHOP DRAWINGS

1. Submit shop drawings in accordance with Section 26 05 01.
2. Drawings to include:
    1. Floor/wall anchoring method and foundation lofts.
    2. Dimensioned cable entry and exit locations.
    3. Dimensioned position and ampacity of bus.
    4. Overall length, height, and depth.
    5. Dimensioned layout of internal and front panel mounted components.

1.3 RELATED WORK

1. Plywood backboard: Section 06 10 00- Rough Carpentry.

1.4 MAINTENANCE DATA

1. Provide maintenance data for incorporation into maintenance manual specified in Section 26 05 01.

1.5 MAINTENANCE MATERIAL

1. Provide maintenance materials in accordance with Section 26 05 01.

Part 2 PRODUCTS

2.1. POWER SUPPLY

1. Power supply: 120/208V 3-phase, 4 wire, grounded neutral, 60 Hz supplied from college existing main service, ampacity rating as indicated.

2.2. BACKBOARDS

1. All surface mounted panelboards to be mounted on 19 mm G1S painted plywood backboards. Paint to be fire retardant grey colour. Back boards to be provided by general contractor; refer to section 06 01 11 "Rough Carpentry - Short Form" for further details.

2.3. BREAKERS

1. Moulded case circuit breakers, quick make, quick break type, for manual and automatic operation with temperature compensation for 40 degrees Celsius. Use common trip breakers with single handle for multi-pole applications. Full width breakers to suit application and to match panels.

2.4. EQUIPMENT IDENTIFICATION

1. Label all panelboards with lamicoid labels as to voltage, phase and panel number.
2. A distribution single line drawing reflecting the as built condition to be provided by Division 26. This single line drawing is to be mounted in solid frame with protective transparent cover and installed in a conspicuous location in the main electrical room. Minimum size to be 11"x17".

2.5. POWER SUPPLY AUTHORITY METER

1. Existing authority meter, supply costumer power quality meter on main switch gear only.

2.6. MANUFACTURERS

1. Acceptable manufacturers: Siemens, Eaton and Schneider Electric.

Part 3 EXECUTION

3.1. INSTALLATION

1. Install panelboard flush or surface as indicated.
2. Install all surface panelboards on channel supports and plywood backboards.
3. Install seismic restraint measures as required.
4. Install breakers in panelboards.
5. Install grounding and bonding conductors and connections.
6. Connect loads to circuits.

7. Connect neutral conductors to common neutral bus with respective neutral identified.
8. Install distribution single line drawing.
9. Panel feeders to be free of splices throughout length.

3.2. TESTING

1. Provide contractor testing as specified in Section 26 05 04 "Contractor Testing".

3.3. AS-BUILT INFORMATION

1. All distribution system information shall be provided on the as-built drawings.

_____ END _____

Part 1 GENERAL

1.1 SUMMARY

.1 This Section includes transient voltage surge suppressors (TVSS) for service entrance low-voltage power (< 600 Volts) equipment.

.2 Refer to drawings for general installation information. Follow manufacturer's recommendations for final installation requirements.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 260501 Common work results electrical.

.2 Product Data: Include operating voltage, rated capacities and operating temperature and further items as per part 2 of this section; Products.

.3 Product Certifications: Signed by manufacturers of transient voltage suppression devices, certifying that products furnished comply with the following testing and labelling requirements:

.1 UL 1449, 2nd Edition and UL1283 Listing and classifications.
.2 Shall be tested to UL 1449 Maximum Short Circuit Rating of 25 KAIC.

.4 Field Test Reports. Written reports of tests specified in part 3 of this section; Execution. Include the following:

.1 Test procedures used.
.2 Test results that comply with requirements
.3 Failed test results and corrective action taken to achieve requirements.

.5 Maintenance Data: Transient voltage suppression devices to include installation instructions, operation and maintenance manuals. Provide 2 copies of maintenance data to the owner at substantial completion.

.6 Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

.1 Product must be made by a company engaged in the manufacture of such devices for a minimum of ten years.

.2 Source Limitations: Obtain suppression devices from a single manufacturer.

.3 Product Options: Drawings indicate size, dimensional requirement, and electrical performance of suppressors and are based on the specific system indicated. Other manufacturers' products complying with requirements may be considered by the departmental representative/owner if submitted more than 14 days prior to bid. Samples may be required for review process prior to consideration of approval.

.4 Electrical Components, Devices and Accessories: Listed and labelled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

.5 IEEE Compliance: Comply with ANSI/IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits" and test devices in accordance with ANSI/IEEE C62.45, "IEEE Guide for Surge Suppressor Testing".

.6 NEMA Compliance: Comply with NEMA LS-1 "Low Voltage Surge Protective Devices".

.7 UL Compliance: Listed to UL 1449, 2nd Edition "Transient Voltage Surge Suppressors" and UL1283 "Electromagnetic Filters". Unit shall be cULus listed.

.8 C22.1 Canadian Electrical Code compliance.

1.4 EQUIPMENT START-UP

.1 Placing into Service: Do not energize or connect service entrance equipment or panel boards to their sources until the surge protective devices are installed and connected. Do not single phase, hi-pot or megger Service Entrance Equipment without disconnecting the surge protective device, as damage may result from these procedures to the surge protective device.

1.5 SERVICE CONDITIONS

.1 Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:

.1 Maximum Continuous Operating Voltage: Not less than 115 % of nominal system operating voltage for 120/208 VAC Wye systems.
.2 Operating Temperature: -40 to +185 degrees F (-40 to +85 degrees C)
.3 Humidity: 0 to 95 %, non-condensing.
.4 Altitude: Less than 20,000 feet (6,000 m) above sea level.

1.6 EQUIPMENT LOCATION

.1 Coordinate location of field mounted surge suppressor to allow adequate clearances for maintenance, clearance per Canadian Electrical Code C22.1 and all local codes.

1.7 WARRANTY

.1 General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

.2 Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of surge suppressors that fail in materials or workmanship within ten years (120 months) from date of Substantial Completion or 126 months from date of manufacture. Warranty shall include parts and labour.

Part 2 PRODUCTS

2.1. MANUFACTURES

.1 Manufacturers: Subject to compliance with requirements of this specification listed herein, provide products by one of the following manufacturers:

.1 Intermatic, Inc.

.2 This specification is performance based, and any other vendors who desire approval to bid this project shall provide written documentation of any deviations from this specification, which shall be included in product submittal. Alternate manufacturers include:

.1 Hubbell
.2 Ditek
.3 Sycom

2.2. 2.2 SERVICE ENTRANCE TYPE SUPPRESSION

.1 Surge Protective Device Description: With the following features and accessories:

.1 LED indicator lights for power and protective status.

.2 Utilizing metal oxide varistor technology.

.3 Integral EMI/RFI Filter providing up to 54 dB of attenuation from 20 kHz to 100 MHz.

.4 Internal surge fuses rated at a minimum of 200 KA interrupting capacity.

.5 Including thermal protection for each component, which is continuously monitored.

.6 Internal surge module easily replaceable.

.7 Integral Form C Contacts for remote indication of suppression status via connection to building management system (BMS provided by others).

.8 Integral Audible Alarm with silence switch.

.9 NEMA 3R style enclosure suitable for indoor or outdoor installation.

.2 Single Impulse Surge Current Capacity shall be as follows:

System Configuration	Line to Neutral	Line to Ground	Line to Line	Neutral to Ground
120 Volt Single Phase	30 KA	30 KA	N/A	30 KA
120/240 Volt Single Phase	30 KA	30 KA	30 KA	30 KA
120/208 Volt Three Phase Wye	30 KA	30 KA	30 KA	30 KA
120/240 Volt High Leg Delta	30 KA	30 KA	30 KA	30 KA

.3 UL 1449 Suppressed Voltage Ratings (SVR) as follows:

Mode	120 Volt Single Phase	120/240 Volt Single Phase	120/208 Volt Wye	120/240 Volt HLD
L-N	367 V	417 V	383 V	384 V / 608 V
L-G	416 V	397 V	407 V	400 V / 617 V
N-G	334 V	335 V	329 V	330 V
L-L	N/A	639 V	624 V	632 V

.4 Part Number as follows for appropriate voltage:

Voltage	Intermatic Part Number
120 VAC Single Phase	IG1201ECS
120/240 VAC Single Phase	IG2401ECS
120/208 VAC Wye	IG2083ECY
120/240 VAC High Leg Delta	IG2403ECD

Part 3 EXECUTION

3.1. INSTALLATION OF SURGE PROTECTIVE DEVICES

.1 Install devices at service entrance, distribution panels, and panelboards as indicated on electrical single line drawing.

.2 Provide multi-pole, 100 Amp breaker as a dedicated disconnect for the suppressor at Service Entrance location, unless otherwise indicated on drawings.

.3 Install devices per manufacturer's instructions with conductors between suppressor and points of attachment as short and as straight as possible. Do not mount internal to switchgear to facilitate ease of future maintenance and/or replacement.

3.2. CONNECTIONS

.1 Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3. FIELD QUALITY CONTROL

.1 Testing: Perform the following field quality control testing:

.1 After installing the surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements.

.2 Complete start-up checks and voltage verifications according to manufacturer's written instructions.

.3 Perform visual and mechanical inspection on each unit. Certify with written report in O+M manuals that units are installed per manufacturer's recommendations.

.2 Repairs or replace malfunctioning units. Retest after repairs or replacements are made.

_____ END _____

Part 1 GENERAL

1.1 SHOP DRAWINGS

1. Submit shop drawings in accordance with Section 26 05 01.
2. Submit shop drawings for all wiring devices.

Part 2 PRODUCTS

2.1. SWITCHES

1. Manually operated spec grade AC switches. Greengate or approved equal. Refer to lighting controls for more details.
2. 20 A, 120 V single pole or double pole and three-way or four-way switches as indicated. Greengate or approved equal. Refer to lighting controls for more details.
3. Switches complete with terminal holes for 5 mm wiring, silver alloy contacts, suitable for back or side wiring.
4. Toggle operated, fully rated for tungsten filament and fluorescent lamps and HP rated for motor loads where indicated and applicable.
5. Switches of one manufacturer throughout project, unless otherwise specified.
6. Toggle colour to be white.

2.2. RECEPTACLES

1. Duplex receptacles, **Industrial Series Extra Heavy Duty Specification Grade Commercial grade**, CSA type 5-15 R, 125 V, 15A U ground, suitable for back and side wiring. Standard of acceptance: Leviton 5262-sgw or approved equal.
2. Weatherproof receptacles and ground fault protection as required and where indicated.
3. Other receptacles with ampacity and voltage as indicated.
4. Receptacles of one manufacturer throughout project unless otherwise approved by the Consultant.
5. Install all receptacles in the vertical plane unless otherwise noted.
6. GFI type to be equal to leviton 5-20R w7899 or equivalent.
7. Receptacles to be black unless otherwise approved by the Departmental representative.
8. All receptacles to be complete with all accessories (cover plates, screw, terminations, etc…) for complete operational system.
9. Label all receptacles with appropriate circuit number.

2.3. COVER PLATES

1. Sheet steel utility box cover for wiring device installed in surface mounted utility box.
2. Black plastic, 1 mm thick, cover plate for receptacles, switches and devices mounted in flush boxes.
3. Receptacles installed in a wet/damp location must have an enclosure and covers that are weatherproof whether an attachment plug cap is inserted or not.
4. Metal Cast "FS" type cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes. Attachment with 4 mounting screws to box.
5. Provide cover plates for all wiring devices from one manufacturer throughout project.

Part 3 EXECUTION

3.1. SWITCHES

1. Install switches in gang type outlet box when more than one switch is required in one location.
2. Install switches and receptacles in gang type outlet box when a switch(s) and receptacle(s) are shown at the same location and at the same plane.
3. Mount switches at height specified in Section 26 05 01 or as indicated.

3.2. RECEPTACLES

1. Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.
2. Mount receptacles at height specified in Section 26 05 01 or as indicated.
3. Where split receptacle has one portion switched, mount vertically and switch upper portion. Provide labeling on cover plate to indicate switched receptacle.
4. Receptacles throughout are to have separate neutrals for each circuit.
5. Receptacles and receptacle wiring is to be traced, and labelled with the appropriate circuit number.

3.3. 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. Install exterior cover plates with thread lug compound on all screws; Silicone or Copper base.

4. label all receptacle covers for panel ID and circuits number's

3.4. TESTING

1. Provide contractor testing as specified in section 26 05 04 "Contractor Testing".

_____ END _____

Part 1 GENERAL

1.2 SHOP DRAWINGS

1. Submit shop drawings in accordance with Section 26 05 01.

Part 2 PRODUCTS

2.1. BREAKERS GENERAL

1. Full width bolt-on moulded case circuit breakers: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
2. Common-trip breakers: with single handle for multi-pole applications.
3. Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
4. Trip settings on main MCC's breakers with adjustable trips to range from 3-8 time current rating for all breakers more than 200A capacity.
5. Circuit breakers with interchangeable trips, as indicated.
6. HID rated breakers for HID circuits.
7. GFEDP breakers for 30 mA equipment protection.
8. GFCI breakers for 5 mA personnel protection.
9. Manufacturer's tie-locks for critical and code required systems:
    1. Fire alarm.
    2. ULC approved communicators (and security equipment) used for fire alarm communication.
10. Unless specifically called for, split breakers are not to be used.
11. Moulded case bolt in branch circuit breakers must be min. 10KA interrupting capacity.
12. Main breakers supplying the building normal power, main MCC breaker and transformer breaker must be min. 65KA interrupting capacity on both sides.

2.2. THERMAL MAGNETIC BREAKERS

1. Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3. MANUFACTURERS

1. Acceptable manufacturers: To match panels.

Part 3 EXECUTION

3.1. INSTALLATION

1. Install circuit breakers as indicated.

3.2. TESTING

1. Provide contractor testing as specified in section 26 05 04 - Contractor Testing.
2. Insert test result data in O+M manuals.

3.3. AS-BUILT INFORMATION

1. All breaker information shall be provided on the as-built drawings.
2. Provide:
    1. Equipment locations.
    2. Equipment identification for reference to shop drawings.
    3. Additional installation detail(s) as required to document the installation.

END

Part 1 GENERAL

1.1 SHOP DRAWINGS

1. Submit shop drawings in accordance with Section 26 05 01.

1.2 O&M MANUALS

1. Submit 5 copies of appropriate O&M data including data sheets for all equipment as well as manufacturers recommended maintenance procedures. All data to be 8½ x 11" format.

Part 2 PRODUCTS

2.1. EQUIPMENT

1. Enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No. 4-1974.
2. Fuse holder assemblies to CSA C22.2 No. 39-1972.
3. Fusible and non-fusible disconnect switch in CSA enclosure.
4. Provision for padlocking in "off" switch position.
5. Fuses as indicated.
6. Fuse holders in each switch suitable without adaptors, for type of fuse as indicated.
7. Quick-make, quick-break action.
8. "On/Off" switch position indication on switch enclosure cover.
9. Weatherproof as required.
10. Sprinkler proof in sprinklered areas.

2.2. BACKBOARDS

1. All surface mounted disconnect switches to be mounted on 19 mm G1S painted plywood backboards. Paint to be fire retardant grey colour.

2.3. EQUIPMENT IDENTIFICATION

1. Indicate name of load controlled with a lamicoid label.

2.4. MANUFACTURERS

1. Acceptable manufacturers: Cutler Hammer, Siemens, Schneider or approved equal.

Part 3 EXECUTION

3.1. INSTALLATION

1. Install disconnect switches complete with fuses where indicated.
2. Inspect and test equipment prior to application of power to the switches. Record inspection and test results.

3.2. TESTING

1. Provide contractor testing as specified in section 26 05 04 - Contractor Testing.
2. Insert test result data in O+M manuals.

3.3. AS-BUILT INFORMATION

1. All disconnect switch information shall be provided on the as-built drawings.
2. Provide:
    1. Equipment locations.
    2. Equipment identification for reference to shop drawings.
    3. Seismic restraint system where applicable
    4. Additional installation detail(s) as required to document the installation.

END

Part 1 General

1.1 SECTION INCLUDES

.1 Three phase Uninterruptible Power Systems (UPS).

1.2 RELATED SECTIONS

.1 Section [01 33 00 - Submittal Procedures].

.2 Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.3 Section [01 78 00 - Closeout Submittals].

.4 Section [26 05 01 - Common Work Results - Electrical].

.5 Section [26 33 16 - Battery Racks].

1.3 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI S1.13-[1995(R1999)], Measurement of Sound Pressure Levels in Air.

.2 ANSI S1.4-[1983(R2001) with Amd. S1.4A-1995], Specification for Sound Level Meters.

.2 Canadian Standards Association (CSA International)

.1 CSA C813.1-[01], Performance Test Method for Uninterruptible Power Supplies.

1.4 SYSTEM DESCRIPTION

.1 System to consist of:

.1 Rectifier Section;

.2 Invertor Section;

.3 Battery Section;

.4 Bypass switch;

.5 Controls and meters;

.2 System to use normal power supply mains and battery to provide continuous, regulated ac power to isolated load.

.3 Equipment to operate continuously and unattended.

.4 Ensure that Uninterruptible Power Systems (UPS) is compatible with equipment that it feeds (VFD and Motors)

□

1.5 SYSTEM PERFORMANCE

.1 Normal operation:

.1 System operates on mains power when mains voltage is within +/-10% of nominal value and mains frequency is between 59.5 and 60.5 Hz.

.2 Battery operation:

.1 System transfers automatically to battery operation.

.1 When manually selected at control panel;

.2 When mains power fails;

.3 When mains voltage varies more than 10% from nominal or mains frequency varies more than 0.5 Hz from 60 Hz;

.4 When mains power is restored and mains voltage is within 10% of nominal and mains frequency is within 0.3 Hz of 60 Hz, system automatically resynchronizes with mains;

.5 Slew rate of frequency during transition period of system output automatically synchronizing with mains and return to its internal frequency to be set between 0.5 to 1.0 Hz per second.

.3 Bypass operation:

.1 For maintenance purposes, system can be bypassed automatically by manual selection at control panel to connect load directly to ac mains. Transfer without load interruption and leaving inverter energized.

.2 Load transfer from mains back to system automatically by manual selection at control panel when maintenance completed.

.3 Automatic transfer of load to mains in not more than 1/4 cycle including sensing with inverter left energized but disconnected from load in case of:

.1 Inverter overloaded;

.2 Short circuit in load;

.4 Automatic retransfer of load to system without load interruption when above conditions disappear.

.5 Automatic transfer of load to mains in not more than 1/4 cycle including sensing and shutdown of inverter in case of inverter internal malfunctions.

.6 Automatic transfer of load to mains without load interruption and inverter shutdown in case of:

.1 Over temperature harmful to system.

.2 Loss of forced ventilation.

.3 Low voltage of dc supply to inverter.

.7 Bypass capable of closing onto and withstanding momentary fault current of 800% of rating for 0.01 s.

□

1.6 SYSTEM PROTECTION

.1 Circuit breakers in system used to isolate it from load and from mains for safe working on equipment, and for manual blocking of bypass automatic control to prevent inadvertent operation of bypass during Work on inverter.

.2 Automatic circuit breakers and protection included in:

- .1 Ac input to rectifier;
- .2 Battery input;
- .3 Bypass circuit input;
- .4 Inverter output.

.3 Surge suppressors:

- .1 To protect system against supply voltage switching transients;
- .2 To protect internal circuits where necessary against voltage transients.

.4 Current limiting devices, with panel front indication of device operation, to protect inverter SCR's.

.5 Suitable devices, with panel front indication of device operation, to protect rectifier diodes.

.6 Failure of circuit or component not to cause equipment to operate in dangerous or uncontrolled mode.

1.7 SHOP DRAWINGS

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

.2 Include:

- .1 Outline sketch showing arrangement of cubicles, meters, controls, recommended aisle spaces, battery rack, battery arrangement and dimensions.
- .2 Shipping weight
- .3 Schematic diagram showing interconnection of rectifier, inverter, battery, bypass switch, meters, controls and indicating lamps.
- .4 Description of system operation, referenced to schematic diagram, for:
  - .1 Manual control during initial start-up and load transfer to bypass and back to inverter output;
  - .2 Inverter;
  - .3 Bypass;
- .5 System performance and reliability:
  - .1 Consider any deviation from the required output power waveform as failure in UPS and include estimate, with supporting calculations, of the Mean Time Between Failures (MTBF) expressed in hours.
  - .2 Provide estimate with supporting data for Mean Time to Repair factor (MTTR).

□

.6 Full load kVA output at [unity] power factor.

.7 Efficiency of system at 25%, 50%, 75% and 100% rated load.

.8 Type of ventilation: natural or forced.

.9 Battery:

.1 Number of cells;

.2 Maximum and minimum voltages;

.3 Type of battery;

.4 Type of plates;

.5 Catalogue data with cell trade name and type;

.6 Size and weight of each cell;

.7 Cell charge and discharge curves of voltage, current, time and capacity;

.8 Derating factor for specified temperature range;

.9 Nominal ampere hour capacity of each cell;

.10 Maximum short circuit current;

.11 Maximum charging current expected for fully discharged condition;

.12 Recommended low voltage limit for fully discharged condition;

.13 Expected life.

.10 Inverter:

.1 Type and catalogue number;

.2 Dc current at minimum battery voltage to produce full load ac output.

.11 Rectifier:

.1 Type and capacity, with catalogue number;

.2 Battery charging sequence;

.3 Current-time data for Silicon Controlled Rectifier (SCR) protective devices;

.4 Guaranteed noise level;

.5 Estimated life;

.6 Metering;

.7 Alarms.

.12 Manufacturer's field experience with UPS of similar ratings including departmental representative expertise, manufacturing facilities and listing of UPS units manufactured and installed during last 5 years including model, customer, location and installation dates.

.13 Evaluation of Canadian content.

.14 Heat losses at no load, 25%, 50%, 75% and 100% of rated output, in kW.

.15 Cooling air required in m^3/s.

.16 List of recommended spare parts, tools and instruments with catalogue numbers and current prices.

.17 Typical operation and maintenance manual.

.18 Description of factory test facilities.

.19 Manufacturer's maintenance capabilities including:

□

.1 Willingness to undertake maintenance contract;

.2 Number of trained personnel available;

.3 Location of trained personnel and repair facilities.

1.8 QUALITY ASSURANCE

.1 Submit for approval to Departmental representative indicating and recording instruments calibration certificates, including meters installed as part of system, in accordance with Section 01 33 00 - Submittal Procedures.

1.9 CLOSEOUT SUBMITTALS

.1 Provide data for incorporation into operation and maintenance manual specified in Section [01 78 00 - Closeout Submittals].

.2 Submit interim, draft final, and final Operation and Maintenance (OM) Manual. Final manual approved by Departmental representative. Submit interim copies to Departmental representative prior to notification of factory test date.

.3 Operation and Maintenance Manual to include:

.1 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operations maintenance and repair.

.2 Technical data:

.1 Approved shop drawings;

.2 Characteristic curves for automatic circuit breakers and protective devices;

.3 Project data;

.4 Technical description of components;

.5 Parts lists with names and addresses of suppliers.

1.10 GUARANTEE

.1 For Work of this Section 26 33 53 - Uninterruptible Power Systems Static, 12 month warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to 3 years.

.2 Contractor hereby warrants battery against defects in material and workmanship in accordance with GC 24, but for 3 years. This warranty is for 100% replacement for first year and prorated in equal yearly decreasing increments for remaining [19] years until expiration of warranty at end of 3 years from date of Certificate of Substantial Performance.

1.11 SYSTEM START-UP

.1 Arrange with Departmental representative:

.1 For factory service departmental representative to supervise start-up of system, checking, adjusting and testing on site;

□

.2 For instruction of personnel on theory, construction, installation, operation and maintenance of system:

.1 After installation and during site testing;

.2 At factory during shop testing.

.2 Advise on:

.1 Expected failure rate of equipment;

.2 Type of expected failures;

.3 Estimated time between major overhauls based on 20 year equipment life;

.4 Estimated cost of major overhaul based on current costs and excluding travelling expenses;

.5 Type and cost of test equipment needed for fault isolating and performing preventive maintenance.

Part 2 PRODUCTS

2.1 UNINTERRUPTIBLE POWER SYSTEM

.1 Input power:

.1 Three phase 120 V, 208 wire, grounded neutral, 60 Hz.

.2 Normal supply from ac mains.

.2 Output power:

.1 Three phase, 120 V, 208 wire, grounded neutral, 60 Hz.

.2 Full load output at [0.8] power factor lagging 10 kVA.

.3 Overload capability: 125% of rated full load current at 0.8 power factor and rated voltage for 10 min.

.4 Frequency - nominal 60 Hz:

.1 Adjustable from 58.5 to 61.5 Hz.

.2 Maximum variation from set value under load changes, including transients, not to exceed 0.3 Hz.

.3 Drift from set value - after two months normal operation within ambient temperature range of 0 degrees to 40 degrees C, not to exceed 0.6 Hz.

.5 Duration of full load output after mains failure not less than [15] min.

.6 Output voltage control:

.1 Continuously adjustable on load at least 5% from rated value.

.2 Voltage regulation: voltage not to change by more than 2% as load increases gradually from zero to 100%, or for specified duration of full load after mains failure.

.3 Transient voltage change not to exceed +/-10% of rated voltage upon 50% sudden load change, loss or return of ac input voltage to system

□

when fully loaded or transfer of full load from inverter to bypass and vice versa, and return to normal within 3 Hz.

.4 Harmonics over entire load range:

.1 Total rms value not to exceed 5% rms value of total output voltage.

.2 Single harmonic not to exceed 3% of total output voltage.

.5 Proper angular phase relation maintained within 4 electrical degrees at up to 20% load unbalance.

.7 Efficiency: Overall system efficiency at rated load with battery fully charged not less than [75] %.

.8 Interference suppression:

.1 If UPS equipment generates electromagnetic rf interference at levels which adversely affects other equipment in vicinity, install suppression circuits or shielding as required to eliminate such interference.

.2 If harmonics reflected back to mains from rectifier adversely affect other loads connected to same bus, install suppression circuits to prevent that condition.

2.2 ELECTRICAL REQUIREMENTS

.1 In accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 No battery, other than main battery incorporated in design.

.3 Wires number tagged or colour coded with same designation on drawings. Tags: non deteriorating type.

.4 Variable resistors: fine adjustment, rheostat type.

.5 Phasing marked on input and output terminals, viewed from front of equipment:

.1 Left to right;

.2 Top to bottom;

.3 Front to back.

.6 Indicator lamps: long life incandescent or neon, rated for continuous duty, with sockets having adequate heat dissipation of lamps and dropping resistor if used.

.7 Solid state circuits used where more reliable than mechanical timers or control relays.

.8 Standard components available from commercial sources used throughout, with 10 years minimum shelf life.

.9 Small components, related to specific function, removable plug-in modular sub- assembly or printed circuit card.

.10 Heavy sub-assemblies easily accessible, or slide on runners of anti-friction material, and have flexible leads and bolted connections.

□

.11 Components and sub-assemblies accurately made for interchangeability.

2.3 ENCLOSURE

.1 Dead front free standing sheet steel minimum 2.5 mm thick, CSA Enclosure 1.

.2 Access preferably from front only, or from front and rear.

.3 Meters, indicating lamps and controls group mounted in panel front.

.4 Panel front enclosed by hinged doors to prevent tampering and to protect instruments and controls during shipping. Doors formed wrap-around type, rigid, to open and close smoothly, locking type handle with 2 keys. Hinges to permit doors to be lifted off cubicle.

.5 Cubicle height not to exceed 1.8 m.

.6 External cable connections at top of cubicle through bolted plate for drilling at site to suit.

.7 Ambient temperature range during operation -20 degrees C to +40 degrees C. Natural or forced ventilation as required. For forced ventilation power from inverter output and fan directly driven by single phase motor mounted on vibration isolators. Each enclosure to have redundant fans, with fan failures alarmed. Air inlet and outlet openings protected with screens and metal guards.

.8 Disposable air filters on fan cooled enclosures. Method of attachment and opening locations to make removal convenient and safe.

.9 Maximum operating sound level not to exceed 80 db(A) as measured on sound level meter with A weighting and slow response, at distance of 1.8 m.

.10 Enclosure frames interconnected by ground bus with ground lug for connection to ground.

2.4 RECTIFIER

.1 Input power supply from:

.1 Ac mains;

.2 Input disconnect: bolt-on moulded case three pole air circuit breaker, quick make, quick break type for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.

.3 Isolating transformer: connected between ac input and rectifier input

.4 Surge suppressor: to protect equipment from supply voltage switching transients.

.5 Rectifier:

.1 Silicon controlled rectifier assembly or sealed silicon diodes.

.6 Filter: for rectifier dc output.

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.7 Fuse: to protect dc output.

.8 Meters:

.1 Dc voltmeter, switchboard type, accuracy +/-2% of full scale, to measure rectifier output voltage.

.2 Dc ammeter, switchboard type, accuracy +/-2% of full scale, to measure rectifier output current.

.9 Adjustments and controls:

.1 Line voltage adjusting taps to allow for +/-10% variation from nominal.

.2 Manual adjustment of float voltage with range of +/-5%.

.3 Manual adjustment of equalizing voltage.

.4 Automatic current limiting on rectifier adjustable between 80 and 120% of normal rating.

.5 Provision to disconnect rectifier from inverter and battery if rectifier dc output exceeds safe voltage limits of battery.

.10 Metres, adjustments and controls to be grouped on front panel.

.11 Performance of rectifier:

.1 Automatically maintain battery in fully charged state while mains power available, and maintain dc float voltage within +/-1% of setting, no load to full load, during mains voltage variations up to +/-10%.

.2 Battery charging rate such that after battery has provided full load power output for specified duration, charger returns battery to 95% of fully charged state in 4 hours.

.3 Automatic equalize charging circuit to initiate equalize charging of battery for 24 hours after discharge of 5% of ampere hour battery rating.

.4 Manually initiated equalize charging feature with automatic timer adjustable from 0 to 24 hours to return unit to float charge.

2.5 INVERTER

.1 Input power supply from:

.1 Rectifier dc output;

.2 Battery dc output.

.2 Input disconnect: bolt-on moulded case, single pole, circuit breaker, quick make, quick break type, for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.

.3 Input filter: with separately fused computer grade capacitor banks and indicator lights, to eliminate inverter source noise and restrictions on input cable length.

.4 Power stage: high frequency switching type, dual cooled disc type silicon controlled rectifier (SCR). Components, solid state devices capable of satisfactory operation under ambient conditions of -35 degrees C to +55 degrees C.

□

.5 Logic module:

.1 Integrated circuit logic.

.2 Silicon semiconductors.

.3 Plug-in modules.

.4 Gold plated plug-in connector.

.5 Front accessible field adjustments for voltage and frequency.

.6 Front accessible test points: suitably protected coded pin jacks.

.7 Frequency reference module.

.8 Current limiting module, automatic high speed by controlled reduction of output voltage.

.9 Voltage regulator.

.6 Output filter: output of high frequency switching stage contains elements of carrier frequency which are filtered to low harmonic sine wave.

.7 Metres:

.1 Ac voltmeter: switchboard type, accuracy +/-2% of full scale, to measure inverter output voltage with [7] position selector switch to select phase to neutral, [phase to phase], off.

.2 ac ammeter: switchboard type, accuracy +/-2% of full scale, to measure inverter output current with [4] position selector switch to select [each] phase and off.

.3 Wattmeter: switchboard type, accuracy +/-2% of full scale to measure inverter load.

.4 Frequency meter: switchboard type, scale 58 to 62 Hz, pointer type, to measure inverter output frequency.

.5 Synchroscope: with switch to check inverter output potential against supply mains potential.

.8 Output disconnect: bolt-on, moulded case, three pole circuit breaker, quick make, quick break type, for manual or automatic operation, temperature compensated for 40 degrees C ambient, magnetic instantaneous trip element.

.9 Metres and controls: grouped on front panel.

2.6 BATTERY

.1 Battery type and electrical characteristics:

.1 Discharge current to supply inverter at full load output, for [15] min.

2.7 STATIC BYPASS SWITCH

.1 Two solid state closed circuit automatic transfer switches.

.2 Logic unit with three normal source voltage sensors, which monitor overvoltage undervoltage and loss of voltage.

.3 High speed automatic transfer from normal voltage to alternate source when:

□

.1 Normal source voltage lost: transfer time and sensing 1/4 cycle;

.2 Normal source: undervoltage at 80% of nominal value; adjustable.

.3 Normal source: over voltage at 110% of nominal value.

.4 Loss of normal source static switch continuity.

.5 Short circuit on normal source [blows normal source fuse] [trips normal source breaker].

.4 Return to normal source:

.1 When normal source remains within return voltage limits of 95% to 110% of nominal value (adjustable) for approximately 1 s timing interval, circuit checks voltage balance and phase synchronization, then initiates return with zero switching time.

.5 Switch position lights and contacts.

.6 Synchronizing verification light.

.7 Manual reset pushbutton.

.8 Transfer test switch.

.9 Alternate power source monitor light.

.10 Accessories:

.1 Manual bypass switch for maintenance and testing without load disturbance.

.2 Continuity monitor: automatic transfer to alternate source in event of static switch discontinuity.

.3 Alternate power source loss alarm contacts.

.11 Alarms: audible alarm when any mode light shows red. Silence pushbutton not to extinguish trouble light.

2.8 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 For major components such as ac input breaker, inverter breakers, bypass switch: size 4 nameplates.

Part 3 Execution

3.1 INSTALLATION

.1 Locate UPS cubicles, battery rack and battery as indicated.

.2 Locate and install remote mode lights and alarm cabinet[s] as indicated.

□

.3 Assemble and interconnect components to provide complete UPS as specified.

.4 Connect ac mains to main input terminal.

.5 Connect UPS output to load.

.6 Start-up UPS and make preliminary tests to ensure satisfactory performance.

3.2 TESTING

.1 Perform tests in accordance with Section [26 05 01 - Common Work Results - Electrical] [and] [CSA-C813.1].

.2 Provide:

.1 Competent field personnel to perform test, adjustments and instruction on UPS equipment.

.2 Dummy load adjustable to 150% of system rated output.

.3 Notify Departmental Representative within 10 working days in advance of test date.

.4 Tests:

.1 Inspection of cubicles, battery rack and battery.

.2 Inspection of electrical connections.

.3 Inspection of installation of remote mode lights and alarms.

.4 Demonstration of system start-up and shut-down.

.5 Run UPS for minimum period of [4] hours at full rated load to demonstrate proper operation with ac mains input, emergency generator input, no ac input.

.6 Discharge battery by operating UPS with ac mains open for specified duration of full load. Record readings of temperature of each cell.

.7 Recharge battery automatically with full rated load on UPS for [4] hours and record readings of voltage of each cell.

END

□

Part 1 GENERAL

1.1 SHOP DRAWINGS

1. Submit shop drawings in accordance with Section 26 05 01.

1.2 SCOPE OF WORK

1. Provide all controls and connections as required for power supply and control on the heat trace system(s)
2. All components of the heat trace system must be manufactured by the same supplier.
3. It is the responsibility of Division 26 to coordinate with Division 23 specifications for heating cable requirements. Control equipment is to match heating cable manufacturer or be an approved equal.

Part 2 PRODUCTS

2.1 PIPE TRACING HEATING CABLES

1. Heat trace cable and controls supplied and installed by Division 26.
2. Heat trace cable to be self-regulating.
3. Pipe insulation supplied and installed by Division 23.
4. Heat trace megger testing by Division 26.
5. Heat trace controls and accessories including temperature sensors, splice kits and end kits are supplied by the same manufacturer as the heating cable. Coordinate material and equipment supply with Division 23. Division 26 to make allowance in bid price to supply al controls and accessories for the heat trace cabling system.
6. Acceptable manufacturers: Suitable for pipe system as specified in Division 23, to the approval of the Consultant.

2.2 CONTROLS

1. Thermostat control and switch control as shown on the drawings, and as required by code.
2. Three point controller: Low Temp alarm, High Temp alarm and Control Temperature.
3. Thermostat controller by same manufacturer as heat trace product.
4. Provide control boxes as detailed on the drawings sized to suit equipment supplied.
5. All control wiring minimum #14 stranded wire.

2.3 OVER-CURRENT DEVICES

1. All heat trace breakers to be ground fault type with minimum 30mA sensitivity. Supply and install breakers as required. Controllers with integral 30mA trip acceptable in place of GFEPD breakers.

Part 3 EXECUTION

2.1 INSTALLATION

2. Install complete operational system including pilot lights.
3. Ensure that manufacturers recommendations and installation guides are followed.
4. Make all power and control connections as required.
5. Heat trace not to be installed in contact with flammable materials.
6. Local thermostat sensor as the drawings detail and as per manufacturers recommendations.
7. Label all terminations, thermostats, switches and controllers.

2.2 CONTROLS

1. Mount controls in weatherproof boxes on wall as shown. Alternatively, with the approval of the Consultant, mount the controls in an inconspicuous location in the building.
2. Temperature setting to the approval of the Mechanical Consultant. Contractor to confirm temperature setting requirements with the Mechanical Consultant. Temperature settings to be included in the O+M manuals.

2.3 INSPECTION

1. Departmental Representative to witness the placement of the sensing bulbs and heat trace cabling before cover.

2.4 TESTING

1. Perform tests in accordance with Section 26 42 10.
2. Use 500V megger to test cables for continuity and insulation value and record reading before, during and after installation.

3. Perform 500V megger test of each line to ground. Perform other test as recommended by the manufacturer.

4. Where resistance values of 50 mega-ohms or less are measured, stop work and advise the Departmental Representative.

5. Record results. Keep on file for Consultants review.

2.5 O&M MANUALS

1. One copy of the test results to be placed in the O+M manuals.

2. One copy of manufacturers recommendations on the installation to be included in the manuals.

END

Part 1 GENERAL

1.1 RELATED WORK

1. Common Work Results Electrical Section 26 05 01.

1.2 SHOP DRAWINGS

1. Submit shop drawings in accordance with Section 26 05 01.

1.3 FIXTURE CATALOGUE REFERENCE

1. The fixture catalogue numbers listed may not include all required accessories to provide a complete installation of the fixtures as intended or as required. The description of each fixture should be carefully read prior to quoting the Tender price and shall include all such necessary accessories and characteristics. The Contractor shall be entirely responsible for furnishing all lighting requirements shown on the drawings and as specified.

1.4 SCOPE OF WORK

1. Provide lighting fixtures and accessories for all outlets as listed in the fixture schedule, as shown on drawings, and as required to provide a complete lighting system for the Palace Grande Renovation Tender 3.
2. **Maintaining the historical appearance of the public area of the theater is of the utmost importance.** Original Edison type lamps in the public area are to remain.
3. Lighting fixtures shall be structurally well-designed and constructed, using new parts and materials of the highest commercial grade available.
4. Ground all lighting equipment to the grounding system.
5. Verify all ceiling types and finishes before ordering fixtures and provide fixtures suitable for mounting in or on ceilings being installed in each area, as specified. Where fixture types specified are not suitable for ceiling being installed, obtain written instruction from the Departmental representative before ordering fixtures.
6. Verify all ceiling dimensions before ordering fixtures and provide fixtures suitable for mounting in or on walls being installed in each area, as specified. Where fixture types specified are not suitable for ceiling/wall dimension being installed, obtain written instruction from the Departmental representative before ordering fixtures.
7. Install seismic restraint on all fixtures. Installation detail as per BC Electrical Contractors Association Seismic Restraint Manual, 1st Edition.

8. Provide lighting control as indicated on the drawings, in the fixture schedule and as described in the specifications

1.5 ALTERNATE FIXTURES

1. Fixtures specified indicate the design standard requirements. Fixtures which entirely meet or exceed the design standard, **at the discretion of the Departmental representative and to the Departmental representative approval**, shall be considered as an alternate equivalent. At any time after close of tender the Departmental representative finds that the alternate equivalent does not perform or provide the electrical, lighting output or architectural equivalence to the specified fixture, the Contractor shall provide and bear all costs to provide the specified fixture.

1.6 STAIR LIGHTING

1. Stair lighting shall be of high flexibility, waterproof, and temperature sustainable.
2. Operating voltage 12VDC.
3. Vertical beam angle to be no less than 45°.
4. Stair lighting shall have a minimum rated lifespan of 50000 hours.
5. Stair lighting to contain a minimum 60 LEDs per meter, and be cuttable every 3 LEDs or 5cm.
6. Contractor shall provide only ULC listed product.

Part 2 PRODUCTS

2.1. MOUNTING HARDWARE

1. Division 26 to provide all factory hardware as required for suspended fixtures.
2. Suspension method as per drawing details and manufacturers requirements and recommendations.
3. Provide shop drawings for all mounting hardware.

2.2. LAMPS

1. As per fixture schedule and to match fixtures.
2. All high pressure sodium and metal halide lamps to be coated, unless otherwise called for in fixture schedule.

2.3. LUMINAIRES

1. Fixtures as shown on fixture schedule and as specified.

2.4. BALLASTS

1. All ballasts shall have power factor correction to 90% or more.
2. Ballasts as per fixture schedule and as specified.
3. Fluorescent ballasts shall be instant start electronic ballasts, equipped with thermal overload protection and 10% or less Total Harmonic Distortion (>10% THD).
4. H.I.D. ballasts to be high power factor, epoxy encased "super quiet" ballast assemblies for all ballast-mounted interior fixtures.
5. All ballasts on exterior fixtures to be rated -30° C.

2.5. GUARANTEE

1. Replace ballasts that fail or exceed their original noise level rating within 12 months of substantial completion.
2. Replace any lamps that fail within 3 months of substantial completion.

2.6. LIGHTING CONTROL

1. As shown on the drawings and as specified

Part 3 EXECUTION

3.1. INSTALLATION

1. Locate and install luminaries as indicated. Luminare locations in mechanical rooms to suit mechanical systems layout; provide fixture hangers and fixture layout to suit the mechanical equipment and to provide a illumination for the complete room.
2. Install T-Bar fixtures at locations shown.
3. Short section of AC90 where concealed behind architectural finishes is acceptable for single fixture drops. Using AC90 fixture to fixture is not acceptable.
4. All fixtures in straight rows, parallel to building lines and as shown on the drawings.
5. Make connections to lighting control as specified in section 26 09 24, as detailed in this section and as detailed on the drawings.

3.2. WIRING

1. Connect luminaries to lighting circuits as shown and as required.
2. Ensure that installed lighting circuit ampacities are suitable for wiring gauge and over-current protection. Where required for voltage drop increase conductor gauge and conduit sizing to suit.
3. Provide 2 wire circuits for all fluorescent and all HID lighting; sharing neutral conductors is not acceptable.
4. Provide manual lighting control locations as shown and as required.
5. Provide automatic lighting control and integration to other control systems as shown and as specified.
6. Provide LED Driver for all LED Luminaries and for all fixtures required to be controlled, LED driver to match controls and perform the functions called for in the design.

3.3. TESTING

1. Provide contractor testing as specified in section 26 05 04 - "Contractor Testing".
2. Insert test result data in O+M manuals.

3.4. AS-BUILT INFORMATION

1. All lighting system information shall be provided on the as-built drawings.
2. Provide:
    1. Equipment locations.
    2. Equipment identification for reference to shop drawings.
    3. Seismic restraint system where applicable.
    4. Cabling and wiring information including wire labels and designators.
    5. Additional installation detail(s) as required to document the installation.
    6. Controls schematic and sequence of operations, provide detailed operation instruction in the O&M manuals, and shall be used for the training purposes.

_____ END _____

Part 1 GENERAL

1.1 GENERAL INSTRUCTIONS

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

1.2 RELATED WORK

1. General Requirements: Section 26 05 01.
2. Contractor Testing: Section 26 05 04.

Part 2 PRODUCTS

2.1. SCOPE

1. Provide on-site demonstration of all electrical systems to the owner and the owner's representatives.
2. Provide on-site operating instructions of all provided electrical systems to the owner and the owner's representatives.
3. Division 26 to designate a senior experienced individual fully familiar with the project to coordinate and chair each demonstration and instruction session.
4. Division 26 Contractor shall be responsible for keeping a 'Demonstration and Instructions of Electrical Systems' Record Log. Include Record Log copies of each session in each electrical operations and maintenance manual.
5. Division 26 Contractor to make allowance in tender price to provide a minimum of 3, 4 hour sessions for demonstration and training of Owner designated personnel.

Part 3 EXECUTION

3.1. SITE TOURS

1. Provide a Contractor guided walk-through tour to allow Owner designated personnel to familiarize themselves with all provided electrical systems.
2. Coordinate timing of demonstrations and instructions with the Owner to ensure that designated personnel have a minimum of five (5) working days notice prior to conducting each demonstration and instruction session. Follow all additional instructions in the general contract.
3. Division 26 to keep a log of all site tour demonstration and instruction sessions conducted. Log shall include tour date, persons and firms represented and names,

signatures and comments to those present. Copies of same shall be tabulated and included in electrical operations and maintenance manuals, with demonstration log sheets.

4. The Contractor shall provide the on-site services of all sub-trade designates to demonstrate and instruct the Owner's personnel in the specialized systems. The sub-trade designates shall be senior personnel fully trained and competent in the installation and in the operation of the system.

3.2. SYSTEMS INCLUDED IN ELECTRICAL DEMONSTRATION AND INSTRUCTION

1. Unless otherwise indicated, provide sessions in Electrical to fully demonstrate and familiarize the owner and the owner's representatives with electrical systems, electrical operations and the general maintenance requirements for all provided electrical systems.

2. Operations and Maintenance Manuals shall be used on-site for all demonstration and instruction sessions.

3. Where demonstration and instructions sessions show that additional work or information is necessary to provide a complete and useable Maintenance Manual for user and maintenance staff, the Contractor shall provide the necessary changes and resubmit the O+M manuals for Departmental representative's review prior to the Contractor's manuals turn over to the Owner.

4. Systems Include:

    1. Maintenance Manuals.
    2. Disconnect switches.
    3. Surge protection equipment.
    4. MCC’s and Panel boards.
    5. Contactors.
    6. Lighting fixtures and controls.
    7. Exit and emergency lighting.
    8. Fire alarm.
    9. Data and voice.
    10. Motors and starters.
    11. Intrusion detection system.
    12. Additional systems where directed by the departmental representative

_____ END _____

Part 1 GENERAL

1.1 DESCRIPTION OF SYSTEM

1. New, single stage, Class A, or completely supervised and addressable Fire Alarm system in the Palace Grande Theater.
2. System to approval of Fire Marshall and applicable CSA and ULC standards and codes.
3. Isolation modules as per drawing details and ULC standards.
4. The system shall actively poll each addressable device and associated wiring to confirm that the device and associated wiring is functional. Loss of this signal at the Fire Alarm Control Panel shall result in a trouble indication at the FACP, Annunciators, and (where required) the Fire Alarm Monitoring Station.
5. The system shall be arranged with minimum 20 percent spare capacity in any Notification Appliance Circuits or otherwise device circuit.

1.2 SCOPE OF WORK

1. New fire alarm panel with a new intelligent reporting, microprocessor controlled fire detection control system complete with new alarm initiating and notification devices, auxiliary control devices including interface relays, reverse polarity modules and outputs, power supplies including batteries, wiring, Operation and Maintenance documentation including record drawings, and operational training. All equipment for this work to be supplied by Division 26 contractor.
2. Provide all devices and equipment as indicated on the drawings and specified herein as required to provide a complete and operational system. Equipment to include, but is not limited to the following:
    1. Trouble system devices.
    2. Manual alarm stations, smoke and heat detectors to suit application.
    3. Audible and visual signal devices.
    4. End-of-line devices.
    5. Ancillary devices.
    6. Power supply facilities.
    7. Annunciators and zone maps.

8. Provide relay units to initiate fan shutdown on alarm.
9. All panel modules.
10. All software programming as required.
11. All panel modules.
12. All wiring and connections.
13. Provision for connection to system monitoring.

3. The contractor is to include in hard copy and in Microsoft Word or Excel format (disk copy) a list of all fire alarm devices, modules and complete panel description. List to include the device number used in software and as recorded on the as-built drawing. Device numbers to correspond to fire alarm verification device numbers. Include hard and soft copies with the O&M manual submission.
4. Install new zones and annunciator panel as shown.
5. Provide labour to install and connect owner provided fire alarm communicator. Test communication to approval of Owner's representative on site and Departmental representative.

1.3 REFERENCES

1. Factory Mutual Research Corporation for Property Conservation - Approval Guide.
2. CAN/ULC-S524 Installations of Fire Alarm Systems.
3. ULC-S525 Audible Signal Appliances, Fire Alarm.
4. CAN/ULC-S527 Control Units, Fire Alarm.
5. ULC-S528 Manually Actuated Signaling Boxes, Fire Alarm.
6. CAN/ULC-S529 Smoke Detectors, Fire Alarm.
7. ULC-S530 Heat Actuated Fire Detectors, Fire Alarm.
8. CAN/ULC-S531 Smoke Alarms.
9. CAN/ULC-S536 Inspection and Testing of Fire Alarm Systems.
10. CAN/ULC-S537 Verification of Fire Alarm Systems.
11. DFC No. 310(M) Computer Systems.
12. DFC No. 410(M) Fire Alarm Systems.
13. NBC National Building Code of Canada 2010.

14. CSA-B44 safety code for elevators and escalators.

15. All references to the latest edition of these standards.

1.4 SHOP DRAWINGS

1. Submit shop drawings on accordance with Section 26 05 01.

2. Include manufacturer supplied battery load calculations. One copy for O&M manual.

3. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

4. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit.

5. Provide with shop drawings the following: Complete manufacturer's literature on system including operating concepts, maintenance procedures, schematics, and block diagram. This literature shall, upon receiving acceptance by the Departmental representative, be included in the project operating and maintenance manuals

1.5 OPERATING AND MAINTENANCE INSTRUCTIONS

1. Provide operating and maintenance instruction.

2. Provide with shop drawings and following: Complete manufacturer's literature on system including operating concepts, maintenance procedures, schematics, and block diagram. This literature shall, upon receiving acceptance by the Departmental representative, be included in the project operating and maintenance manuals.

1.6 AS-BUILT DRAWINGS

1. Show all wiring and connections on the as built drawings.

1.7 WARRANTY / SERVICE

1. Contractor responsible for this division is to include is as part of the base tender price; a guarantee stating:

1. System service is to be provided within 24 hours of request for service during the warranty period.
2. Full warrant on new system to be provided for the duration of 1 year from the date of final acceptance of work.
3. During this warranty period the contractor is to repair and replace all such defective work and other work to the new system which fails or becomes defective during the term of the warranty, provided that such failure is not cause by improper usage or physical damage.
4. Should the system installer fail to comply with sub-item 1 above, work will be pre-formed by others at this contractor's expense.

2. Warranty date will commence from the date of the final acceptance of this work.

Part 2 PRODUCTS

2.1. MATERIALS - GENERAL

1. Equipment ULC listed and labeled.
2. Equipment supplied by a single manufacturer.
3. Audible devices to ULC-S528.
4. Manual fire alarm stations to ULC-S528.
5. Thermal detectors to ULC-530.
6. Smoke detectors to CAN/ULC-S529.
7. All equipment and components shall be new, and the manufacturer's current model.
8. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

2.2. OPERATION OF SYSTEM

1. Refer to Appendix A for "Fire Alarm Ancillary System Description"
2. Stage One operation:
    1. In any area of the building, an alarm is caused by actuation of any of the following devices:

1. A manual break glass stations, or
2. A thermal detector, or
3. A smoke detector, or
4. A sprinkler flow device is activated,

2. When the alarm is triggered the following shall occur where applicable:
   1. Activate signal to sound and activate visual signals throughout the facility.
   2. Signaling devices shall be capable of being manually silenced throughout the building from the FAP or the annunciator.
   3. Illuminated light to indicate the zone of the alarm initiating device at each annunciator panel.
   4. Shut down all mechanical air handling systems.
   5. Door hold-open and electromagnetic hold-close devices shall release.
   6. Release security systems on all automatic and power assisted doors in the building.
   7. Release security systems on all interior corridors electromagnetic lock doors in the building during alarm.
   8. Override all hardwired to the multiplexer speakers in the building (Class rooms speaker).
   9. Release security systems and all mag-locks on all doors in the building during alarm.
   10. Activate elevator controls and invoke homing.
   11. Provide visual indication at all LCD annunciators.
   12. Send alarm signal to remote location (remote location shall be the college main offsite monitoring, coordinate with owner/YTG for offsite monitoring).

2.3. OPERATION OF FIRE ALARM TROUBLE INDICATION

1. Should any of the following fire alarm system trouble conditions occur:
   1. An open circuit in extended wiring, or
   2. A ground on extended wiring, or

3. Any device or module is removed/disconnected, or
4. Loss of normal power or disconnection of DC back-up, or
5. A supervisory trouble device is activated.

2. The system will perform the following:
   1. Light a trouble light at the panel to indicate the applicable condition and the zone affected, and
   2. Sound a trouble buzzer at the fire alarm panel and each annunciator, and
   3. Cause coded sets of contacts to change status to enable signaling of the appropriate trouble condition to a remote point.

2.4. CONTORL PANEL

1. Single stage class A addressable panel complete with 640-charactor display, CSA Enclosure, lockable concealed hinged door, full viewing window, flush lock and 2 keys.
2. Suitable for alarm, trouble and supervisory signals from intelligent reporting deices encoded on class A signaling Line Circuit.
3. Initiation Device Circuits (IDC) to be wired class A using addressable deices as part of the SLC circuit.
4. Notification Appliance Circuits (NAC) to be wired class B circuit. NAC audible circuits shall be such that there is a minimum of one audible circuit per wing of the building (workshop or Academic).
5. Single stage alarm panel, pulse rate panel for signal stroke output to single control panel.
6. Standard of acceptance: NOTIFIER NFS2-640 complete with CAB series cabinet. Alternate must be approved by the departmental representative before tender closing, submit shop drawing for alternate min. 10 days before tender closing.

2.5. POWER SUPLY

1. 120 V, ac, 60 Hz input, 24 V, dc output from rectifier to operate alarm and signal circuits, with standby power of gel cell batteries minimum expected life of 4 years, sized in accordance with CEC-2015.
2. Load calculation to be submitted with shop drawing submittal.

3. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:
    1. Ground Fault LED
    2. AC Power Fail LED
    3. NAC on LED (4)

2.6. MANUAL ALARM STATIONS

1. Manual alarm stations: pull lever, break glass, wall-mounted semi-flush or surface type, Single-stage with additional normally open switch to ULC - S528.

2.7. FIRE ALARM COMMUNICATOR

1. Provide ULC approved two channel (cell/fixed line) communicator to owner's approval.
2. Contractor shall install communicator to the approval of product manufacture, to applicable code.
3. Provide 2 data cables terminate as required, from tel/data backboard to the communicator for outgoing signals, outgoing signal must dial out the same offsite monitoring station for the college.

2.8. SMOKE DETECTORS

1. Smoke Detectors: Multi criteria smoke detector (six sensitivity levels, detector to provide the following detection: IR sensing for flames, photo electric smoke detection, thermal detection, CO detection). Base assembly with integral red alarm lamp, and terminals for remote relay alarm lamp as required. Smoke detectors to CAN/ULC - S529.
2. Provide duct type smoke detectors as shown. Provide sampling tubes and enclosures to suit installation. Provide test button and LED indicator.
3. Provide beam type detectors as shown. Install to manufacturer recommendation standard of acceptance: Notifier FSB series.
4. Provide detector bases with additional dry contactors for elevator return function. Supply and install all wiring for operational elevator return.

2.9. THERMAL DETECTORS

1. Thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57° C, rate of rise 8.3° C per minute as required. Thermal detectors to ULC - 530. Confirm exact type with departmental representative prior to order.

2.10. VISUAL SIGNAL DEVICES

1. Provide visual signal devices in locations as shown on the drawings.
2. Visual signals to be synchronized.
3. Visual signal devices to ULC - S528.
4. Design Standard: NOTIFIER WHEELOCK RSS SERIES complete with WHEELOCK SYNC MODULE.

2.11. FAULT ISOLATION MODULES

1. Provide a minimum of two (2) Fault Isolation Modules between each fire alarm zone, as required by the NBC-2010, to protect the rest of the loop.
2. Fault Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop.
3. Short circuit isolation shall be installed per floor and for every 25 devices within the floor where class A loops are utilized.
4. Fault Isolation Modules shall limit the number of modules or detectors that may be rendered inoperative by short circuit fault on SLC Loop.
5. When the short circuit condition is corrected the isolation module should automatically reconnect the isolated section of the SLC Loop.
6. LED indicators on the Fault Isolation Module shall provide visual confirmation for a fault condition or a normal operational status.
7. Design Standard: NOTIFIER ISO-X Fault Isolator Module.
8. **Base Isolation Modules are required for each detection (heat/smoke) device.**

2.12. CONTORL RELAY MODULE

1. Each relay circuit shall be capable of being activated (change in state) by any initiating device or from any combination of initiating devices.
2. The relay module shall provide green ON/OFF LEDs and yellow LEDs (indicates disabled status of the relay).
3. The module shall provide a momentary switch per relay circuit that may be used to manually turn the relay ON/OFF or to disable the relay.
4. The control relay module shall be provided with removable wiring terminal blocks for ease of installation and service.

2.13. ANNUNCIATOR

1. LED and minimum 80 character LCD display complete with system acknowledge, signal silence and system reset buttons, local piezo sounder with alarm trouble resound. LED display to annunciate all Alarm and supervisory zones as per fire alarm riser.

2.14. DOOR HOLD OPEN

1. Fail Safe operation, release door on fire alarm signal.
2. Door hold open deices 120V: Notifier FM series.

2.15. END-OF-LINE DEVICES

1. End-of-line devices to control supervisory current in alarm circuits and signaling circuits, sized to ensure correct current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel.
2. Mount EOL devices in separate box with labels indicating zone. For addressable devices on single zone per device end of line may be installed in device box.

2.16. AS-BUILT RISER DIAGRAM

1. Provide Fire Alarm System Coloured Zone Plan: in glazed frame, black lettering, to approval of the Departmental representative, minimum size 11" X 17" inches. Professional drafting quality in CADD or equivalent reproduction;

one copy for each maintenance manual. One copy directly adjacent to each annunciator panel. One copy directly adjacent to the fire alarm control panel. All fire alarm zone plans to be permanently affixed at each location. Carry the cost of professional drafting for the zone plans in the bid price.

Part 3 EXECUTION

3.1. INSTALLATION

1. Installation to CAN/ULC - S524-14.
2. Install system in conduit.
3. Install new devices to approval of Fire Marshall and applicable CSA and ULC standards and codes.
4. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.
5. Locate and install remote relay units to control fan shut down.
6. Locate alarm panel and annunciator where shown on the drawing.
7. Connect devices to zones as shown.
8. Install fire alarm riser diagram adjacent to the fire alarm control panel.
9. Install “Fire Alarm Ancillary System Description” in a glass frame, adjacent to the fire alarm control panel.

3.2. BRANCH CIRCUIT

1. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 30 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded.
2. Branch circuit breaker feeding the fire alarm Backup to the control panel shall be provided with a permanent breaker tie to hold it in the on position.

3.3. WIRING METHOD

1. New wiring only, all wiring must be inside EMT conduits.

2. Provide all wiring for fire alarm system c/w R-90 crosslink polyethylene insulation as allowed by codes.

3. Provide the following sizes:

    1. 120V A.C.: minimum #12 AWG.

    2. Alarm initiating circuits: Non-metallic sheathed ULC listed minimum FT-4 rated, fire alarm circuit cable minimum #18 AWG, minimum 6 conductors installed in conduit.

    3. Horn circuit cable: minimum #14 AWG.

    4. Annunciator circuits: Non-metallic sheathed ULC listed, fire alarm circuit cable minimum #18 AWG, minimum 6 conductors installed in conduit.

    5. Size all horn circuit wiring for maximum 5% voltage drop at maximum load at last device in run.

4. Provide Departmental representative, at time of completion of project, a copy of a drawing showing connections made and numbering of wires.

5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or back-boxes, except where conduit entry is specified by the manufacturer.

3.4. DEVICE LOCATIONS

1. Location of outlets for fire alarm devices shall be approximately as shown on the drawings and as set out in CSA standard ULC S524.

2. Location of outlets shall be subject to change, without extra cost, provided information is given prior to installation. No extra amount will be paid, for extra labour and materials, for relocating outlets up to 3m from their original locations, nor will credits be anticipated where relocation up to 3m reduces materials and labour. Other cases will be considered on their individual merits.

3. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

4. Where devices are grouped together (i.e. horns, pull stations and end-of-line resistors), they shall be aligned vertically.

5. Locate detectors centrally in rooms and corridors, unless lights and/or mechanical devices interfere. Check relocation with the Departmental representative before proceeding.

6. Mount heat detectors out of line of direct heat and minimum 3m from unit heaters.

7. Maintain minimum 600mm clear in all directions around smoke detectors.

8. Where detectors are located on split elevation ceiling locate detectors on high part of ceilings. Locate detectors 900mm from peak in peaked ceiling spaces. Maintain minimum 600mm clear in all directions around detectors. Advise the Departmental representative, at the rough-in stage, if there are areas of the finished ceiling which do not have adequate smoke detector coverage for the type of detector supplied.

9. Promptly advise the Departmental representative prior to rough-in if the smoke detector locations shown on the drawing do not match the highest part of the ceiling.

10. Do not locate smoke detectors within 1 meter of air outlets. Maintain at least 600mm radius clear space on ceiling below and around detectors.

3.5. DEVICE NUMBERING

1. Provide device listing including device number, part number and device location on CD-ROM in excel format to departmental representative. Copy to be included in O&M manuals. Device number to correspond with device number on verification report. Description of device locations to be coordinated with Owner prior to programming of system.

2. Label all devices to indicate device #, loop # and zone #.

3.6. MOUNTING HEIGHTS

1. All mounting heights are to the equipment centre line unless otherwise indicated:

    1. Manual pull-stations: 1100 mm.

    2. Annunciator, display or control legend: 1800mm maximum to top.

    3. Audible devices: where allowed not less than 2300 mm or 300mm from ceiling to top of horn where ceiling is low.

4. Visual signal devices general: between 2000 - 2400mm to strobe light or 300mm from ceiling to top of strobe where ceiling is low.

5. End-of-the-line resisters: 1700 mm.

3.7. MANUAL ALARM STATIONS

1. Locate and install manual alarm stations as indicated and connect to alarm circuit wiring.

2. Ensure that final location is clear of door swings and that device is located in a logical location so that the device is acceptable to evacuating occupants.

3.8. AUDIBLE AND VISUAL SIGNAL DEVICES

1. Locate and install Horn/strobe devices as indicated and connect to signaling circuits.

3.9. SMOKE DETECTORS

1. Check smoke detector location as per Specification, drawings and to the approval of the departmental representative.

2. Locate and install smoke detectors and connect to alarm circuit wiring.

3. Mount smoke detectors associated with smoke control doors, on the ceiling on either side of the doors; typically 1200mm (4' 0") from door. Do not mount detectors closer than 900mm (3' 0") or farther than 1500mm (5' 0") from the doors.

4. Coordinate onsite for installation of duct type smoke detectors. Install sampling tubes and enclosures to suit installation. Make connections to LED indicator.

3.10. TESTS AND COMMISSIONING CONTRACTOR

1. Test all initiating, signaling, ancillary, annunciation and control zones.

2. Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors transmit alarm to control panel and actuate alarm and ancillary devices.

3. Test each signal device and each signal circuit.

4. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

5. Check all annunciator panels to ensure zones are shown and actuated correctly. Ensure that each smoke detector and zone is properly annunciated.

6. Simulate grounds and breaks on new and renovated alarm and signaling devices and circuits to ensure proper operation of trouble signals.

7. Test to include witness of any and all fan shutdown, kitchen equipment under hood fan shut down and magnetic door hold open devices.

8. Tests to be carried out by the contractor or the contractor's agent.

9. Contractor to submit to departmental representative, copy of Contractor provided Test and commissioning report to departmental representative prior to verification. Report to include test documentation for all devices. Report to be in Word or Excel (or equivalent) format.

3.11. TESTS AND COMMISSIONING VERIFICATION AGENT

1. Verify all zones, signal, alarm, and annunciation which have been installed or modified in any fashion.

2. Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors transmit alarm to control panel and actuate first stage alarm, general alarm and ancillary devices. Test to be carried out as per CAN/ULC-S524-06.

3. Test each signal device and each signal circuit.

4. Check the Fire Alarm panel display to ensure zones are shown and actuated correctly. Ensure that each smoke detector is properly annunciated.

5. Simulate grounds and breaks on alarm and signaling devices and circuits to ensure proper operation of trouble signals.

6. Tests to be carried out by the contractor force and fire alarm technician, in the presence of a representative from the departmental representative’s office. The test shall be complete, submit the test report to the departmental representative for approval.

7. Verification to include the operation of the monitoring station connections.

8. Verification to include a witness of the ventilation system shutdown on fire alarm.

9. The contractor will be responsible for correcting deficiencies in the contractor's work that are reported by the verification agent.

10. Fire alarm verifier to certify zone plan drawing. Certification to be included on fire alarm verification report.

11. **Agent: A team consisting of the departmental representative (designer), a licensed electrician installer and verification by a fire alarm company technician (scenario #1 by ULC).**

12. Contractor to carry the cost of all the parties for the verification in the bid price including the departmental representative (design engineer's rep) time, travel and overnight expenses for each trip required.

13. Contractor to coordinate with the sprinkler technician for sprinkler testing.

14. Contractor to allow for verification of the ancillary systems, as described in Appendix A.

15. Coordinate and allow for journeyperson time to assist the verification of the ancillary systems with GHL Consultant Ltd., as per Alternate Solution to Building Code Compliance.

3.12. AS-BUILT DRAWINGS

1. Record all wiring, pipe runs and junction box locations on the as built drawings. Include wire gauge, conduit size and junction box size.

2. Show all connections and splices on as built drawings.

3. As-built drawings to show ladder diagram of operation detailing input signals to programmed output functions for programmed systems.

4. As-built drawings to show fire alarm zoning, device addresses and the location of each field device of the fire alarm system including fault isolation modules, ancillary devices and control panels.

5. As-built drawings to show room and corridor numbers (Specific area identification).

6. As-built drawings to show wiring diagrams of interconnection of field devices, control units, transponders, annunciators and power supplies external to control units or transponders.

7. As-built drawings to show all line voltage branched circuit connections including ancillary connections. Include panel identification, circuit number and over-current size.

8. 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 ELECTRICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).

9. Submit completed record drawings with Operating and Maintenance Manuals to Departmental representative for approval and make corrections as directed.

10. Carry the cost of professional drafting on AutoCAD for the As-Built in the bid price.

Part 4 FIRE ALARM OPERATIONAL DESCRIPTIONS

4.1 SMOKE EVACUTATION SYSTEM - GENERAL

1. The smoke evacuation system utilizes fans to exhaust smoke from the stage area of the theatre to the exterior of the building through ventilation ducts in the attic space. The exhaust fans are started by the fire alarm system when certain input conditions are made.

2. The smoke evacuation system is driven by two ceiling mounted 2HP exhaust fans which are configured to run simultaneously when called to start by the fire alarm system.

3. The exhaust fans are fitted with variable frequency drives (VFD) which control the speed of the fans.

4. The VFD’s receive a 4-20mA input signal which governs the operating speed. The control signal is provided by Div.25. The speed of the fans is dictated by building pressures monitored by the Div. 25 control HVAC system.

5. An uninterruptable power supply (UPS), located in the mechanical room supplies power to the exhaust fans. The UPS is rated to provide emergency power for 10 minutes under utility power fail conditions.

4.2 SMOKE EVACUATION SYSTEM INITIATION

1. The smoke evacuation system will be activated in two ways. Both ways also initiate an alarm condition on the fire alarm system and cause a fire alarm to sound in the building.

2. By operation of a manual pull stations that are located at each side of the stage area. The manual pull stations are intended to be used by staff or performers in the event of a fire on stage. The operation of the pull station will start the fans immediately and cause a fire alarm condition so that the building will be evacuated. The manual pull station will have a lamacoid label which clearly identifies its purpose.

3. By operation of either of six smoke detectors located in the attic above the stage area. This will start the fans immediately and cause a fire alarm condition so that the building can be evacuated.

4.3 PERFORMACNCE WITH THEATRICAL SMOKE

1. Theatrical smoke that is used during performances has been known to cause nuisance fire alarms by triggering smoke detectors. During a live event where the presence of theatrical smoke is anticipated, a smoke evacuation system bypass timed switch may be operated by authorized personnel. The manual bypass timed switch will be located adjacent to the alarm panel. The bypass timer will have a lamacoid label which clearly identifies its purpose.

2. The operation of the bypass timer will disconnect the smoke detectors in the attic, so to prevent unnecessary activation of the smoke evacuation system should these detectors be triggered by theatrical smoke. The timer will automatically reset to auto (end bypass) after an adjustable period of time between 0-6 hours.

3. The operation of the manual bypass timer will not affect the operation of the smoke evacuation system manual pull stations located in the stage area.

4. The bypass timer shall be fitted with a red pilot light to indicate that the system is in bypass mode and will not operate automatically. An additional red pilot light will be located at the fire alarm panel to indicate that the system is in bypass mode.

5. The smoke evacuation system will also be re enabled by authorized personal once the event or the use theatrical smoke has completed and before time out.

6. During the time the system is in automatic bypass the fire alarm panel will register a trouble. Switching back to automatic will reset the trouble.

7. A hand/off/auto (HOA) manual shut down switch will be provided in proximity to the fire alarm annunciator mechanical room outside door and will shut down the fans in the off position of the HOA switch. The switch is

intended to be used by fire fighter where it is desirable to shut off the smoke exhaust fans during a fire. The HOA switch will have a lamacoid label which clearly identifies its purpose.

8. The HOA switch "Hand" position is intended to be used by fire fighter where it is desirable to start the smoke exhaust fans manually during or after a fire has occurred.

4.4 FIRE PANEL WINTER OPERATION

1. A manual switch will be located within proximity of the fire alarm panel, which will be operated for winter operations

2. In Winter Mode (off season) all smoke detectors will be disconnected throughout the theatre, including the smoke evacuation smoke detectors but excluding the mechanical room smoke detectors. Disconnecting smoke detectors will prevent smoke detector false alarm and trouble in extreme cold temperatures.

3. In Winter Mode the system will prevent a trouble signal from the deluge system valve which will be closed during the winter season.

4. In Winter Mode the system will not show trouble due to the disconnections.

5. The winter operation switch will be accompanied by a red warning light indicating winter operation and have a lamicoid label which clearly identifies its purpose.

4.5 OPERATION OF THE DELUGE SYSTEM

1. The deluge valve will be normally closed and the operating solenoid will be powered open by the fire alarm system. Two conditions must be met in order for the fire alarm system to activate the deluge valve. When these two conditions are simultaneously met, the deluge valve solenoid will energize and allow water flow.

    1. Activation of one of two rate of rise heat detectors located above the stage area. And;

    2. The loss of air pressure in the dry sprinkler system.

PART 1 GENERAL

1.1 Related Sections

.1	Section	33 46 13.01	Foundation Drainage
.2	Section	31 05 16	Aggregate Materials
.3	Section	31 22 13	Rough Grading

1.2 References

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM C 117, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D 422-63, Standard Test Method for Particle-Size Analysis of Soils.

.4 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³) (600 kN-m/m³).

.5 .6 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.2 CSA-A3001, Cementitious Materials for Use in Concrete.

.3 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.4 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 Definitions

.1 Excavation classes: one class of excavation will be recognized; common excavation.

.1 Rock : solid material in excess of 1.00m ³ and which cannot be removed by means of heavy duty mechanical excavating equipment with a 1.0m³ bucket. Frozen material not classified as rock.

.2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

.2 Topsoil:

.1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material.

.3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

.4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.

.5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

.6 Unsuitable materials:

.1 Weak, chemically unstable, and compressible materials.

.2 Frost susceptible materials:

.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 and ASTM C 136: Sieve sizes to CAN/CGSB-8.1.

.2 Coarse grained soils containing more than 10 % by mass passing 0.075 mm sieve.

.7 Controlled Low Strength Materials: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 Submittals

.1 Inform Owner's Representative at least 4 weeks prior to commencing work, of proposed source of fill materials and provide access for sampling.

.2 Submit 70 kg samples of type of fill specified including representative samples of excavated material.

.3 Ship samples as directed by Owner's Representative in tightly closed container to prevent contamination.

1.5 Quality Assurance

.1 Qualification Statement: submit proof of insurance coverage for professional liability.

.2 Submit design and supporting data at least two weeks prior to commencing work.

.3 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of BC, Canada.

.4 Keep design and supporting data on site.

.5 Engage services of qualified professional Engineer who is registered or licensed in Yukon, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.

.6 Health and Safety Requirements:

.1 Construction activities shall be in accordance with Section 01 35 33 - Health and Safety Requirements.

1.6 Waste Management And Disposal

.1 Divert excess materials for reuse or disposal as directed by Departmental Representative.

1.7 Existing Conditions

.1 Buried services:

.1 Before commencing work establish location of buried services on and adjacent to site.

.2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.

.3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.

.4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.5 Prior to beginning excavation Work, notify applicable Departmental Representative, establish location and state of use of buried utilities and structures.

.6 Confirm locations of buried utilities by careful soil hydrovac methods.or as otherwise approved by the departmental representative

.7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing/re-routing.

.9 Record location of maintained, re-routed and abandoned underground lines.

.10 Confirm locations of recent excavations adjacent to area of excavation.

.2 Existing buildings and surface features:

.1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by the Work.

.2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.

.3 Where required for excavation, cut roots or branches as directed by Departmental Representative.

PART 2 PRODUCTS (

2.1 Materials

.1 Type 1 fill shall be as follows:

.1 Well graded sand and/or gravel.

.2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.

Sieve Designation (mm)	Percent passing
25	100
19	80 to 100
9.5	50 to 85
4.75	35 to 70
2.36	25 to 50
1.18	15 to 35
0.300	10 to 30
0.075	0 to 5

.2 Type 2 fill: 5 mm minus bedding sand with maximum 5% passing the 75 μm sieve.

.3 Selected material from excavation or other sources shall be approved by the Owner's Representative for intended use, unfrozen and free from rocks. A limit of 19-25 mm aggregate size should be used in the crawl space areas.

PART 3 EXECUTION

3.1 Temporary Erosion And Sedimentation Control

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 Site Preparation

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.3 Preparation/Protection

.1 Protect existing features.

.2 Keep excavations clean, free of standing water, and loose soil.

.3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.

.4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.

.5 Protect buried services that are required to remain undisturbed.

3.4 Stripping Of Topsoil

.1 Begin topsoil stripping of areas as directed by the Departmental Representative after area has been cleared of brush, weeds and grasses and removed from site.

.2 Strip topsoil to depths as directed by Departmental Representative.

.1 Do not mix topsoil with subsoil.

.3 Stockpile in locations as directed by Departmental Representative.

.1 Stockpile height not to exceed 2 m and should be protected from erosion.

.4 Dispose of unused topsoil off site.

3.5 Stockpiling

.1 Stockpile fill materials in areas designated by Departmental Representative.

.1 Stockpile granular materials in manner to prevent segregation.

.2 Protect fill materials from contamination.

.3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.6 Cofferdams, Shoring, Bracing And Underpinning

.1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 33 - Health and Safety Requirements.

.2 During backfill operation:

.1 Unless otherwise indicated or directed by Departmental Representative, remove sheeting and shoring from excavations.

.2 Do not remove bracing until backfilling has reached respective levels of such bracing.

.3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500mm above toe of sheeting.

3.7 Dewatering And Heave Prevention

.1 Riprap and headwall installation are to be done in dry conditions.

.2 Keep excavations free of water while Work is in progress.

.3 Provide for Departmental Representative's review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.

.4 Avoid excavation below groundwater table if quick condition or heave is likely to occur.

.1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.

.5 Protect excavations against flooding and damage due to surface run-off.

.6 Dispose of water in a manner not detrimental to public and private property, or portion of Work completed or under construction.

.1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

.7 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.8 Excavation

.1 Excavate to lines, grades, elevations and dimensions as indicated.

.2 Remove concrete, masonry, paving, walks demolished foundations and rubble and other obstructions encountered during excavation.

.3 Excavation must not interfere with bearing capacity of adjacent foundations.

.4 Do not disturb soil within branch spread of trees or shrubs that are to remain.

.1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.

.5 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

.6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.

.7 Restrict vehicle operations directly adjacent to open trenches.

.8 Dispose of surplus and unsuitable excavated material off site.

.9 Do not obstruct flow of surface drainage or natural watercourses.

.10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.11 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.

.12 Correct unauthorized over-excavation as follows or as otherwise directed by the departmental representative:

.1 Fill under bearing surfaces and footings with Type 1 fill compacted to not less than 100% of corrected Standard Proctor maximum dry density.

.2 Fill under other areas with Type 1 fill compacted to not less than 97% of corrected Standard Proctor maximum dry density.

.13 Hand trim, make firm and remove loose material and debris from excavations.

.1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

.2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.

3.9 Bedding And Surround Of Underground Services

.1 Place and compact granular material for bedding and surround of underground services as indicated.

.2 Place bedding and surround material in unfrozen condition.

3.10 Backfilling

.1 Do not proceed with backfilling operations until completion of following:

.1 Departmental Representative has inspected and approved installations.

.2 Departmental Representative has inspected and approved of construction below finish grade.

.3 Inspection, testing, approval, and recording location of underground utilities.

.4 Removal of concrete formwork.

.5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.

.3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground or as directed by the departmental representative.

.4 Do not use backfill material which is frozen or contains ice, snow or debris.

.5 Place backfill material in uniform layers not exceeding 200mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.6 Backfilling around installations,

.1 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.

.2 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 0.30 m.

.7 Backfill within crawl space to consist of the following:

.1 Levelling gravel course, 19-25mm drain rock should be used as surfacing material.

3.11 Restoration

.1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.

.2 Replace topsoil as directed by Departmental Representative.

.3 Reinstate lawns to elevation which existed before excavation.

.4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.

.5 Clean and reinstate areas affected by Work as directed by Departmental Representative.

.6 Use temporary plating to support traffic loads over Controlled low-strength materials fill for initial 24 hours.

.7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

3.12 Contractor's responsibility

.1 The contractor is responsible for temporary dewatering of excavations and temporary shoring and/or sloping of excavations.

.2 Temporary excavation slopes shall be sloped or shored in accordance with Worksafe Yukon regulations.

END OF SECTION

APPENDIX A
Asbestos Abatement Closure Report

Stantec Consulting Ltd.
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Tel: (604) 436-3014
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November 19, 2015
File: 123220349

Attention: Heather McDermott
Public Works and Government Services Canada, Pacific Region
219 - 800 Burrard Street,
Vancouver, BC V6Z 2V8

Dear Ms. McDermott:

Reference: Asbestos Abatement Closure Report – Floor Joist Cavity Vermiculite, Selected Exterior Cement Panels and Localized Areas of Mechanical Pipe Insulation
Palace Grand Theatre, Third and King Street, Dawson City, YT

Stantec Consulting Ltd. (Stantec) was retained by Public Works and Government Services Canada (PWGSC) on behalf of Parks Canada to provide monitoring of asbestos abatement activities conducted within the Palace Grand Theatre located at Third and King Street, Dawson City, YT (subject building), for the purpose of assessing whether various identified asbestos-containing materials (ACMs) were removed from the subject building in accordance with applicable territorial and federal guidelines and/or regulations, and the project specifications.

1 BACKGROUND

The subject building consists of a three-storey theatre with a crawlspace. ACMs were previously identified within the subject building as detailed in the following assessment report prepared by Stantec:

- Stantec Report No. 123220212 entitled *Hazardous Building Materials Assessments; Palace Grand Theatre Dawson City, YT* dated March 18, 2015 (Pre-Renovation Assessment).

Stantec utilized the information outlined in the report referenced above to prepare technical specifications for abatement (removal and disposal) of specific ACMs to facilitate seismic and other upgrades within the building, in accordance with applicable territorial and federal Occupational Health and Safety regulations. Through a project tendering process that was convened by PWGSC and Parks Canada, and that included similar work at other sites in Dawson City, YT, Energy North Construction (Energy North) was retained by PWGSC to perform abatement of the selected ACMs within the subject building.

As a measure of diligence, Stantec was retained by PWGSC to provide monitoring services during abatement activities, to assess whether work was completed and identified ACMs were removed in accordance with the requirements of the following:

- Canada Labour Code Part II – Canada Occupational Health and Safety Regulations (Canada Labor Code)

Reference: Asbestos Abatement Closure Report – Floor Joist Cavity Vermiculite, Selected Exterior Cement Panels and Localized Areas of Mechanical Pipe Insulation
Palace Grand Theatre, Third and King Street, Dawson City, YT

- The Government of the Yukon's *Occupational Health and Safety Act* and the *Yukon Occupational Health Regulations* (Yukon OHS Reg.)
- The Parks Canada Asbestos Management Directive

1.1 ASBESTOS ABATEMENT SCOPE OF WORK

As indicated in the project specifications prepared by Stantec, the original scope for asbestos abatement included removal and disposal of asbestos-containing vermiculite insulation from the floor joist cavity as well as removal and disposal of asbestos-containing mechanical pipe wrap in the mechanical room (and adjacent washroom/janitor's closet). Additional information provided by Parks Canada and/or Stantec in the project specifications was as follows:

- Crawlspace area is approximately 446 square metres. Vermiculite depth within the floor joist cavity was approximately 128 mm. Estimated volume of vermiculite for removal was 50 m^3.
- The crawlspace is accessible through a floor hatch located beneath the stage. This access is to be used for emergency entry/egress only. Main access point was to be created from the exterior.
- Plywood was attached to the underside of the main floor joists, comprising the ceiling of the crawlspace (floor joist cavity). Asbestos-containing vermiculite was present on top of the plywood.
- Building utilities were attached to or hung from the plywood including, but not limited to, HVAC ducting; sprinklers and associated pipes for fire suppression; electrical wires and conduit.
- Asbestos-containing pipe wrap on two domestic water lines (approximately 50 lineal feet) was present within the southwest corner of the Mechanical Room and Rooms 116 (women's washroom), 117 (janitor's room) and 118 (men's washroom).

Upon project initiation, it was determined that removal and disposal of the HVAC ducting throughout the crawlspace would be added to the scope of work for Energy North.

Based on this scope addition as well as additional assessment and sampling conducted by Stantec (detailed in Section 2.2, below), abatement of the following additional ACMs was added to the scope of work during abatement due to changing project requirements and/or discovery of new (previously concealed) materials):

- The lower 900 mm of asbestos cement panel around the exterior walls.
- Mastic on ducting to be removed from the crawlspace, which was concealed beneath fiberglass duct insulation.
- Additional vermiculite discovered in the following locations:
  - The separate floor joist cavity of the West emergency stairwell.
  - The separate floor joist cavity of the East emergency stairwell.
  - The floor joist cavity below the boiler room mixed with fiberglass batt insulation.
- Furnace duct seam tape present in the crawlspace below the boiler room, concealed behind fiberglass batt insulation.

Reference: Asbestos Abatement Closure Report – Floor Joist Cavity Vermiculite, Selected Exterior Cement Panels and Localized Areas of Mechanical Pipe Insulation
Palace Grand Theatre, Third and King Street, Dawson City, YT

2 ASBESTOS ABATEMENT MONITORING

Stantec conducted monitoring of asbestos abatement work within the subject building from August 1, 2015 to September 15, 2015. The following general observations were made, related to procedures that were used in accordance with the project specifications and applicable regulations and directives:

- Crawlspace work areas – removal of ducting (including mastic and seam tape), and vermiculite:
  - The work area was enclosed using polyethylene sheeting and operated under negative air pressure throughout work.
  - The work area was accessed through a single entry port, constructed around an access hatch created in the exterior building skirting and partitioned from the adjacent areas using a 3-stage decontamination chamber.
  - Workers inside the crawlspace enclosure wore protective coveralls, rubber work boots, and powered air purifying respirators equipped with P-100 cartridges. Workers bagging waste from the vacuum truck wore protective coveralls, rubber work boots, and half-mask respirators equipped with P-100 cartridges.
  - Asbestos-contaminated fiberglass batt insulation (in those limited areas where such was present in the floor joist space) was bagged by hand, where asbestos-containing vermiculite insulation was removed using a vacuum truck.
- Areas for removal of asbestos-containing pipe wrap:
  - Asbestos-containing pipe wrap was removed using glove bag procedures. The work area was segregated using asbestos warning tape and workers wore protective coveralls, rubber boots and half-mask respirators equipped with P-100 cartridges.
- Areas for removal of asbestos-containing exterior asbestos cement panels
  - Asbestos-containing cement panels were removed using low risk abatement procedures. The work area was segregated using asbestos warning tape and workers wore protective coveralls, rubber boots and half-mask respirators equipped with P-100 cartridges.

2.1 ASBESTOS ABATEMENT AIR SAMPLING

The analytical results of air samples collected during the above-noted asbestos abatement activities within the subject building are attached in Appendix A. In general, the air sample results indicated airborne fibre concentrations within applicable exposure limits, throughout the project.

In addition to the above, the Yukon OH&S Reg. indicates that safe removal of asbestos abatement work area enclosures can proceed, and the work areas can be re-occupied by unprotected persons, if the measured fibre in air concentration within work areas is less than 0.2 fibres/cc subsequent to the completion of abatement activities. Federal entities, including PWGSC, typically reference a clearance level of 0.01 fibres/cc. Post-abatement samples were

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collected and compared to the latter clearance level as a measure of diligence. Post-abatement air sampling was conducted on the following dates within the subject building:

- August 1, 2015 to determine if air transfer from the crawlspace through the access hatch beneath the stage had caused contamination of the theatre.
- August 18, 2015 following mechanical pipe wrap abatement.
- September 15th, 2015 following crawlspace abatement.

All post-abatement air samples collected indicated fibre in air concentrations less than 0.01 fibres/cc.

2.2 SUMMARY OF ADDITIONAL SAMPLING

As indicated above, various additional suspected ACMs were uncovered during abatement work, for which sampling was conducted by Stantec. Stantec also collected various samples of soil within the crawlspace, to determine the extent of vermiculite contamination within the soil.

Suspected ACM samples collected were submitted to one of the following:

- General bulk samples: EMSL Canada Inc. (EMSL) in Mississauga, Ontario for analysis of asbestos content using polarized light microscopy (PLM) with dispersion staining, in accordance with the United States Environmental Protection Agency (EPA) 600/R-93/116 method. EMSL's analytical laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).
- Soil samples: Wes-Har Asbestos Analysis and Consulting Ltd. of Richmond, British Columbia (Wes Har) for analysis of asbestos content (presence/absence only) in accordance with the National Institute for Occupational Safety and Health (NIOSH) Analytical Method 9002 *Asbestos (bulk) by PLM* for fibrous/mineral components. Wes-Har is accredited through the American Industrial Hygiene Association's Bulk Asbestos Proficiency Analytical Testing (BAPAT) and Industrial Hygiene Proficiency Analytical Testing (IHPAT) programs.

Certificates of analysis for the samples outlined below are attached in Appendix B, for reference. The results of samples collected are summarized in Table 2.2, below.

Reference: Asbestos Abatement Closure Report – Floor Joist Cavity Vermiculite, Selected Exterior Cement Panels and Localized Areas of Mechanical Pipe Insulation
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Table 1.2 Summary of Additional Sampling
Palace Grand Theatre, Third and King Street, Dawson City, YT

Material	Results	Scope Implication
White wrap on duct seams throughout the crawlspace	**No asbestos detected** in all three samples submitted (S-02A to S-02C)	No further action required.
Duct mastic present in the crawlspace concealed behind fiberglass duct insulation	**2% chrysotile asbestos detected** in the first of three samples submitted (S-03A to S-03C)	Added to the scope of abatement work to be completed within the crawlspace.
Parging located on sprinkler lines in the crawlspace	**No asbestos detected** in all three samples submitted (S-04A to S-04C)	No further action required.
Furnace duct seam tape present in the crawlspace below the boiler room concealed behind fiberglass batt insulation	**40% chrysotile asbestos detected** in the first of three samples submitted (PG-DT-01A,B,C)	Added to the scope of abatement work to be completed within the crawlspace.
Soil sampled off the surface of the floor of the crawlspace	**Chrysotile asbestos detected** (not quantified) in all three samples submitted (BS-01 to BS-03)	To be left in place.
Soil floor of the crawlspace to a depth of 4 inches	**Chrysotile asbestos detected** (not quantified) in all six samples submitted (S-01 to S-06)	To be left in place.

2.2.1 Soil Sampling

Soil samples were initially collected to determine the extent of potential vermiculite contamination in the crawlspace soil, considering the amount of leakage that was observed to be coming from the floor joist spaces in various locations during project set-up activities.

Upon receipt of results from the first set of soil samples collected, it was noted that although asbestos contamination was detected in 3 of 3 samples, the form of asbestos present was chrysotile (a serpentine asbestos form), which is not consistent with the form(s) present in vermiculite (an amphibole asbestos form—typically identified as actinolyte or tremolite). Further, Wes-Har's analyst indicated that the asbestos contamination appeared to be consistent with debris from mechanical insulation—none of which was identified or previously reported to be present within the crawlspace.

While discussions were underway regarding whether or not, and to what extent, to remove the asbestos-contaminated soil within the crawlspace, Stantec proceeded with supplemental sampling to confirm whether or not the contamination was "on the surface" of the soil (i.e., only the top 2 inches), or whether the contamination appeared to go deeper into the soil. As indicated in the table above, chrysotile asbestos was detected in 6 of 6 supplemental samples collected at approximately 4 inches in depth, in locations throughout the crawlspace.

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At this point, given the logistical difficulties associated with safely removing the asbestos-contaminated soil from the crawlspace, and as the planned seismic upgrade project (which would have required significant soil disturbance) was put on hold, it was decided that completion of vermiculite removal throughout the crawlspace would proceed, but that the additionally identified soil contamination (chrysotile) would be left and managed-in-place, until such time as the overall plan for the subject building could be determined.

2.3 POST-ABATEMENT VISUAL INSPECTIONS

During the post-abatement visual inspections, identified ACMs and associated debris appeared to have been removed to the extent required by the project specifications and/or to the extent possible. Where minor deficiencies were observed by Stantec, Energy North was notified and addressed those deficiencies to the satisfaction of Stantec.

Additional information pertaining to final visual inspections in each abatement area is summarized below:

- Crawlspace work areas – removal of ducting (including mastic and seam tape), and vermiculite:
  - Some vermiculite particles were observed to remain in the spaces between the beams that make up the floor joists. This debris cannot reasonably be removed without removing/demolishing these components of the floor. As such, the material was encapsulated with a lock-down agent and left in place.
  - In addition to the above, re-instatement of insulation to the floor joists will reportedly be achieved through installing a layer of closed cell foam sprayed initially, to provide a good seal, with the cavities to be covered with a gypsum-based board. This would effectively encapsulate remaining vermiculite insulation debris such that it could not be released into the crawlspace.
  - Soil present in throughout the crawlspace is considered to be asbestos-contaminated based on the sampling outlined above.
- Areas for removal of asbestos-containing pipe wrap:
  - It is believed that the asbestos-containing pipe wrap is still present within a drywall bulkhead located in the men's washroom adjacent to the women's washroom and janitor's closet. This bulkhead was not removed to access and remove the asbestos-containing pipe wrap suspected to be contained within.
- Areas for removal of asbestos-containing exterior asbestos cement panels
  - Only the lower 900 mm of cement panels were removed from selected locations around the exterior of the building, as indicated on the sketches in Appendix C.
    Additional asbestos-containing cement panel cladding remains on the exterior of the subject building including below the corridor windows on the east side of the building.

Reference: Asbestos Abatement Closure Report – Floor Joist Cavity Vermiculite, Selected Exterior Cement Panels and Localized Areas of Mechanical Pipe Insulation
Palace Grand Theatre, Third and King Street, Dawson City, YT

3 CONCLUSIONS AND RECOMMENDATIONS

Based on our observations made throughout the project as well as our observations of site conditions as of September 15, 2015, the herein referenced ACMs were removed from the subject building in accordance with the requirements of the project specifications, the Parks Canada Asbestos Directive and applicable territorial and federal regulations.

The following should be noted:

- Limited amounts of asbestos-containing vermiculite debris should be expected to remain in spaces between the beams that make up the floor joists. The remaining vermiculite debris within the floor joist cavity have been effectively encapsulated with a lock down agent and left in place. Additional encapsulation using closed-cell foam and gypsum board is expected to be conducted at a later date.
- Asbestos-containing exterior cement board cladding remains in place and in good condition in areas where this material was not removed as part of this project.
- Asbestos-containing mechanical insulation is expected to remain on one mechanical pipe in the bulkhead of the men's washroom located adjacent to the women's washroom and janitor's closet.
- Other ACMs (and hazardous building materials), as identified in the Pre-Renovation Assessment and not removed during the work outlined in this report, remain within the subject building.
- The soil present in the crawlspace is considered to be asbestos-contaminated. As such:
  - The crawlspace area should be considered a "restricted access zone" for the immediate future, and clearly marked as such.
  - No entry to the crawlspace should be conducted, unless absolutely necessary.
  - If entry is conducted, appropriate personal protective equipment (PPE), work and decontamination procedures must be used. As specific guidance documents for asbestos abatement work in the Yukon have not been published, it is recommended that PPE and procedures consistent with Moderate Risk asbestos abatement work (as outlined by various OHS regulatory bodies, including WorkSafeBC and Alberta OHS) be used. This would include the following, at a minimum:
    - Wearing a properly fitted half-mask respirator with HEPA or P-100 cartridges
    - Wearing impervious coveralls with booties (e.g. Tyvek)
    - Utilizing appropriate decontamination procedures (drop sheet with wash-bucket [warm water and soap] for respirator, hands and face; coveralls to be left in crawlspace as waste).
  - If work that will specifically remove and/or disturb soil is required, a risk assessment must be conducted by a qualified person such that PPE and procedures appropriate for the work can be documented and employed.

Reference: Asbestos Abatement Closure Report – Floor Joist Cavity Vermiculite, Selected Exterior Cement Panels and Localized Areas of Mechanical Pipe Insulation
Palace Grand Theatre, Third and King Street, Dawson City, YT

4 CLOSURE

This report has been prepared by Stantec Consulting Ltd. on behalf of and for the exclusive use of Public Works Government Services Canada and Parks Canada.

The information and recommendations contained in this document are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Recommendations presented in this document should not be construed as legal advice.

The interpretations presented herein represent the best judgment of the assessor based on current environmental and health and safety regulations and standards. Any use which a third party makes of this report is the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

We trust this information meets your present requirements. Should you have any questions or require additional information, please contact the undersigned.

Regards,

STANTEC CONSULTING LTD.

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Attachments:
Appendix A: Certificates of Analysis – Asbestos Abatement Air Samples
Appendix B: Summary of Results of Analysis of Bulk Samples for Asbestos
Appendix C: Floor Plans Showing Locations of Asbestos-containing Cement Panels

APPENDIX A
CERTIFICATES OF ANALYSIS – ASBESTOS ABATEMENT AIR SAMPLES

CERTIFICATE OF ANALYSIS

Analysis of Airborne Fibre Concentration Using Phase Contrast Microscopy (PCM) - NIOSH 7400 A Method

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/1/2015
DATE OF ANALYSIS: 8/1/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
BLANK	8/01/15	Field Blank	0	0.00	0.00	< 5.5	100	0.007854	385	< 0.06	< 7	**N/A**	N/A
AC-01	8/01/15	Air clearance - Northwest of crawlspace access hatch on stage	183	16.38	2997.54	6.0	100	0.007854	385	0.06	8	**0.001**	0.01
AC-02	8/01/15	Air clearance - Northeast of crawlspace access hatch on stage	182	16.38	2981.16	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.001**	0.01

Notes:

1 **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
4 **8-hour OEL for workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
6 **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
7 **Samples analysed in accordance with NIOSH 7400 A Method.**
8 **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
9 **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
10 **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

David Siemens, BAIE. IRSST Counter 2130551
Analyst

CERTIFICATE OF ANALYSIS

Analysis of Airborne Fibre Concentration Using Phase Contrast Microscopy (PCM) - NIOSH 7400 A Method

Stantec Consulting Ltd
325 - 25th Street SE
Calgary, AB T2A 7H8
Tel:(403) 716-8000 Fax:(403) 716-8049
www.stantec.com

CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/4/2015
DATE OF ANALYSIS: 8/4/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-01	8/03/15	Occupational - on worker removing duct insulation from crawlspace (worker wearing full face respirator)	24	3.58	85.92	32.0	100	0.007854	385	0.32	41	**0.183**	10

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for workers wearing full-face respirators with P100 cartridges (protection factor = 100) is 20 fibres/cc (10 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/5/2015
DATE OF ANALYSIS: 8/5/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-02	8/04/15	Occupational - on worker removing cement board from mechanical room exterior walls (worker wearing half-face respirator)	40	3.58	143.20	15.0	100	0.007854	385	0.15	19	**0.051**	1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 2 fibres/cc (1 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/6/2015
DATE OF ANALYSIS: 8/6/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-03	8/05/15	Occupational - on worker removing duct work from crawlspace (worker wearing half-face respirator)	26	3.58	93.08	45.0	100	0.007854	385	0.45	57	**0.237**	1
AS-04	8/05/15	Ambient - in theatre above work area	360	3.58	1288.80	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.002**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 2 fibres/cc (1 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/7/2015
DATE OF ANALYSIS: 8/7/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-05	8/06/15	Occupational - on worker setting up crawlspace containment (worker wearing half-face respirator)	52	1.61	83.72	7.0	100	0.007854	385	0.07	9	**0.041**	1
AS-06	8/06/15	Occupational - on worker removing cement board (worker wearing half-face respirator)	25	3.58	89.50	9.0	100	0.007854	385	0.09	11	**0.049**	2.5
AS-07	8/06/15	Ambient - in theatre above work area	462	2.26	1044.12	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.003**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 2 fibres/cc (1 fibres/cc action level).**
3. **Yukon's OH&S Regulations reference an 8-hour OEL for chrysotile asbestos of 0.5 fibres/cc. Action level set at 50%, or 0.25 fibres/cc.fibres/cc.**
4. **8-hour OEL for chrysotile asbestos for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 5 fibres/cc (2.5 fibres/cc action level).**
5. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
6. **Samples analysed in accordance with NIOSH 7400 A Method.**
7. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
8. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
9. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/8/2015
DATE OF ANALYSIS: 8/8/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
BLANK	8/07/15	Field Blank	0	0.00	0.00	< 5.5	100	0.007854	385	< 0.06	< 7	**N/A**	N/A
AS-08	8/07/15	Occupational - on worker setting up containment (half-face respirator)	25	3.58	89.50	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.030**	1
AS-09	8/07/15	Ambient - in theatre above work area	448	2.26	1012.48	6.5	100	0.007854	385	0.07	8	**0.003**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 2 fibres/cc (1 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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Analyst

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/9/2015
DATE OF ANALYSIS: 8/8/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-10	8/08/15	Occupational - on worker setting up drop sheets adjacent to vermiculite removal area (PAPR)	30	3.58	107.40	< 5.5	100	0.007854	385	< 0.06	< 7	< **0.025**	100
AS-11	8/08/15	Occupational - on worker removing vermiculite (PAPR)	21	2.26	47.46	102.0	47	0.007854	385	2.17	276	**2.242**	100
AS-12	8/08/15	Occupational - on worker operating Vac Loader (half-face respirator)	51	3.58	182.58	< 5.5	100	0.007854	385	< 0.06	< 7	< **0.015**	1
AS-13	8/08/15	Ambient - in theatre above work area	340	2.26	768.40	11.0	100	0.007854	385	0.11	14	**0.007**	0.1
AS-14	8/08/15	Ambient - clean room	322	2.26	727.72	< 5.5	100	0.007854	385	< 0.06	< 7	< **0.004**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 2 fibres/cc (1 fibres/cc action level).**
3. **8-hour OEL for amphibole amosite asbestos for workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
4. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
5. **Samples analysed in accordance with NIOSH 7400 A Method.**
6. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
7. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
8. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

David Siemens, BAIE. IRSST Counter 2130551
Analyst

CERTIFICATE OF ANALYSIS

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/10/2015
DATE OF ANALYSIS: 8/10/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
Blank	8/09/15	Blank	0	0.00	0.00	< 5.5	100	0.007854	385	< 0.06	< 7	**N/A**	N/A
AS-15	8/09/15	Occupational - on worker setting up drop sheets adjacent to vermiculite removal area (PAPR)	27	2.26	61.02	7.0	100	0.007854	385	0.07	9	**0.056**	100
AS-16	8/09/15	Occupational - on worker removing vermiculite (PAPR)	25	2.26	56.50	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.026**	100
AS-17	8/09/15	Occupational - on worker operating Vac Loader (half-face respirator)	25	2.26	56.50	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.022**	1
AS-18	8/09/15	Ambient - in theatre above work area	475	2.26	1073.50	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.001**	0.1
AS-19	8/09/15	Ambient - clean room	482	2.26	1089.32	14.0	100	0.007854	385	0.14	18	**0.006**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 2 fibres/cc (1 fibres/cc action level).**
3. **8-hour OEL for amphibole amosite asbestos for workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
4. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
5. **Samples analysed in accordance with NIOSH 7400 A Method.**
6. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
7. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
8. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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Analyst

CERTIFICATE OF ANALYSIS

Analysis of Airborne Fibre Concentration Using Phase Contrast Microscopy (PCM) - NIOSH 7400 A Method

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/11/2015
DATE OF ANALYSIS: 8/11/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-20	8/10/15	Occupational - on worker setting up drop sheets adjacent to vermiculite removal area (PAPR)	23	2.26	51.98	13.0	100	0.007854	385	0.13	17	**0.123**	100
AS-21	8/10/15	Ambient - in theatre above work area	484	2.26	1093.84	6.0	100	0.007854	385	0.06	8	**0.003**	0.1
AS-22	8/10/15	Ambient - clean room	478	1.61	769.58	11.0	100	0.007854	385	0.11	14	**0.007**	0.1

Notes:

1 **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
3 **8-hour OEL for amphibole amosite asbestos for workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
4 **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
5 **Samples analysed in accordance with NIOSH 7400 A Method.**
6 **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
7 **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
8 **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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CERTIFICATE OF ANALYSIS

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/12/2015
DATE OF ANALYSIS: 8/12/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
Blank	8/11/15	Blank	0	0.00	0.00	< 5.5	100	0.007854	385	< 0.06	< 7	**N/A**	N/A
AS-23	8/11/15	Occupational - on worker removing vermiculite (PAPR)	22	2.26	49.72	29.0	100	0.007854	385	0.29	37	**0.286**	100
AS-24	8/11/15	Occupational - on worker operating Vac Loader (half-face respirator)	48	2.26	108.48	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.025**	1
AS-25	8/11/15	Ambient - in theatre above work area	463	2.26	1046.38	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.003**	0.1
AS-26	8/11/15	Ambient - clean room	469	1.61	755.09	10.0	100	0.007854	385	0.10	13	**0.006**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 2 fibres/cc (1 fibres/cc action level).**
3. **8-hour OEL for amphibole amosite asbestos for workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
4. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
5. **Samples analysed in accordance with NIOSH 7400 A Method.**
6. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
7. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
8. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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CERTIFICATE OF ANALYSIS

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/13/2015
DATE OF ANALYSIS: 8/13/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-27	8/12/15	Occupational - on worker removing vermiculite (PAPR)	23	2.26	51.98	100.0	73	0.007854	385	1.37	174	**1.292**	100
AS-28	8/12/15	Occupational - on worker operating Vac Loader (half-face respirator)	49	3.58	175.42	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.015**	1
AS-29	8/12/15	Ambient - in theatre above work area	475	2.26	1073.50	22.0	100	0.007854	385	0.22	28	**0.010**	0.1
AS-30	8/12/15	Ambient - clean room	460	1.61	740.60	6.0	100	0.007854	385	0.06	8	**0.004**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 2 fibres/cc (1 fibres/cc action level).**
3. **8-hour OEL for amphibole amosite asbestos for workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
4. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
5. **Samples analysed in accordance with NIOSH 7400 A Method.**
6. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
7. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
8. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/14/2015
DATE OF ANALYSIS: 8/13/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
Blank	8/13/15	Blank	0	0.00	0.00	< 5.5	100	0.007854	385	< 0.06	< 7	**N/A**	N/A
AS-31	8/13/15	Occupational - on worker removing cement board vermiculite (half-face respirator)	41	3.58	146.78	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.018**	2.5
AS-32	8/13/15	Occupational - on worker removing vermiculite (PAPR)	21	2.26	47.46	75.0	100	0.007854	385	0.75	95	**0.775**	100
AS-33	8/13/15	Occupational - on worker operating Vac Loader (half-face respirator)	51	2.26	115.26	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.023**	1
AS-34	8/13/15	Ambient - in theatre above work area	426	2.26	962.76	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.003**	0.1
AS-35	8/13/15	Ambient - clean room	431	1.61	693.91	7.0	100	0.007854	385	0.07	9	**0.005**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **Yukon's OH&S Regulations reference an 8-hour OEL for chrysotile asbestos of 0.5 fibres/cc. Action level set at 50%, or 0.25 fibres/cc.fibres/cc.**
3. **8-hour OEL for amphibole amosite asbestos for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 2 fibres/cc (1 fibres/cc action level).**
4. **8-hour OEL for chrysotile asbestos for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 5 fibres/cc (2.5 fibres/cc action level).**
5. **8-hour OEL for amphibole amosite asbestos for workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
6. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
7. **Samples analysed in accordance with NIOSH 7400 A Method.**
8. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
9. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
10. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

David Siemens, BAIE. IRSST Counter 2130551
Analyst

CERTIFICATE OF ANALYSIS

Analysis of Airborne Fibre Concentration Using Phase Contrast Microscopy (PCM) - NIOSH 7400 A Method

Stantec Consulting Ltd
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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/15/2015
DATE OF ANALYSIS: 8/15/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-36	8/14/15	Occupational - on worker removing vermiculite (PAPR)	20	2.26	45.20	41.0	100	0.007854	385	0.41	52	**0.445**	100
AS-37	8/14/15	Occupational - on worker operating Vac Loader (half-face respirator)	43	3.58	153.94	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.018**	1
AS-38	8/14/15	Ambient - in theatre above work area	459	2.26	1037.34	8.0	100	0.007854	385	0.08	10	**0.004**	0.1
AS-39	8/14/15	Ambient - clean room	455	1.61	732.55	9.0	100	0.007854	385	0.09	11	**0.006**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos for workers wearing half-face respirators with P100 cartridges (protection factor = 10) is 2 fibres/cc (1 fibres/cc action level).**
3. **8-hour OEL for amphibole amosite asbestos for workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
4. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
5. **Samples analysed in accordance with NIOSH 7400 A Method.**
6. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
7. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
8. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

David Siemens, BAIE. IRSST Counter 2130551
Analyst

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/18/2015
DATE OF ANALYSIS: 8/16/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-40	8/15/15	Occupational - on worker removing vermiculite (PAPR)	21	2.26	47.46	101	78	0.007854	385	1.29	165	**1.337**	100
AS-41	8/15/15	Ambient - in theatre above work area	455	2.26	1028.30	11.0	100	0.007854	385	0.11	14	**0.005**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/18/2015
DATE OF ANALYSIS: 8/17/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
Blank	8/16/15	Blank	0	0.00	0.00	< 5.5	100	0.007854	385	< 0.06	< 7	**N/A**	N/A
AS-42	8/16/15	Occupational - on worker removing vermiculite (PAPR)	20	2.26	45.20	15.0	100	0.007854	385	0.15	19	**0.163**	100
AS-43	8/16/15	Ambient - in theatre above work area	483	2.26	1091.58	26	78	0.007854	385	0.33	42	**0.015**	0.1
AS-44	8/16/15	Ambient - clean room	460	1.61	740.60	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.004**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

David Siemens, BAIE IRSST Counter 2130551
Analyst

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/18/2015
DATE OF ANALYSIS: 8/18/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-45	8/17/15	Occupational - on worker removing vermiculite (PAPR)	21	2.26	47.46	13.0	100	0.007854	385	0.13	17	**0.134**	100
AS-46	8/17/15	Ambient - in theatre above work area	495	2.26	1118.70	6.5	78	0.007854	385	0.08	11	**0.004**	0.1
AS-47	8/17/15	Ambient - clean room	497	1.61	800.17	10.0	100	0.007854	385	0.10	13	**0.006**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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Analyst

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/19/2015
DATE OF ANALYSIS: 8/19/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AC-03	8/18/15	Air Clearance - boiler room	185	16.71	3091.35	8.0	100	0.007854	385	0.08	10	**0.001**	0,01
AC-04	8/18/15	Air Clearance - outside janitors closet	214	16.71	3575.94	15	100	0.007854	385	0.15	19	**0.002**	0,01
AS-48	8/18/15	Ambient - outside pipe wrap removal work area	244	6.20	1512.80	13	100	0.007854	385	0.13	17	**0.004**	0,25
AS-49	8/18/15	Occupational - on worker removing pipe wrap (full-face)	94	2.38	223.72	15.0	100	0.007854	385	0.15	19	**0.033**	25
AS-50	8/18/15	Occupational - on worker cleaning crawlspace containment (PAPR)	24	2.26	54.24	8.0	100	0.007854	385	0.08	10	**0.072**	100
AS-51	8/18/15	Ambient - in theatre above work area	457	2.26	1032.82	5.5	78	0.007854	385	0.07	9	**0.003**	0.1
AS-52	8/18/15	Ambient - clean room	233	1.61	375.13	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.007**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **Yukon's OH&S Regulations reference an 8-hour OEL for chrysotile asbestos of 0.5 fibres/cc. Action level set at 50%, or 0.25 fibres/cc.fibres/cc.**
3. **8-hour OEL for amphibole amosite asbestos when workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
4. **8-hour OEL for chrysotile asbestos when workers wearing Full-face respirators with P100 cartridges (protection factor = 100) is 50 fibres/cc (25 fibres/cc action level).**
5. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
6. **Samples analysed in accordance with NIOSH 7400 A Method.**
7. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
8. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
9. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

David Siemens, BAIE IRSST Counter 2130551
Analyst

CERTIFICATE OF ANALYSIS

Analysis of Airborne Fibre Concentration Using Phase Contrast Microscopy (PCM) - NIOSH 7400 A Method

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 8/20/2015
DATE OF ANALYSIS: 8/20/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
Blank	8/19/15	Blank	0	0.00	0.00	< 5.5	100	0.007854	385	< 0.06	< 7	**N/A**	N/A
AS-53	8/19/15	Occupational - on worker cleaning crawlspace containment (PAPR)	24	2.26	54.24	8.0	100	0.007854	385	0.08	10	**0.072**	100
AS-54	8/19/15	Ambient - in theatre above work area	457	2.26	1032.82	5.5	78	0.007854	385	0.07	9	**0.003**	0.1
AS-55	8/19/15	Ambient - clean room	233	1.61	375.13	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.007**	0.1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos when workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

David Siemens, BAIE IRSST Counter 2130551
Analyst

CERTIFICATE OF ANALYSIS

Analysis of Airborne Fibre Concentration Using Phase Contrast Microscopy (PCM) - NIOSH 7400 A Method

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CLIENT: Parks Canada
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DATE OF REPORT: 8/22/2015
DATE OF ANALYSIS: 8/22/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
Blank	8/21/15	Blank	0	0.00	0.00	< 5.5	100	0.007854	385	< 0.06	< 7	**N/A**	N/A
AS-56	8/21/15	Occupational - on worker bagging ducting with ACM mastic (full-face)	40	3.58	143.20	20.0	100	0.007854	385	0.20	25	**0.068**	25

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for chrysotile asbestos of 0.5 fibres/cc. Action level set at 50%, or 0.25 fibres/cc.fibres/cc.**
2. **8-hour OEL for chrysotile asbestos when workers wearing full-face respirators with P100 cartridges (protection factor = 100) is 50 fibres/cc (25 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

Keith Irwin, IRSST Counter No. 2120588
Analyst

CERTIFICATE OF ANALYSIS

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 9/12/2015
DATE OF ANALYSIS: 9/12/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-57	9/11/15	Ambient - in theatre above work area	317	3.53	1119.01	7.5	78	0.007854	385	0.10	12	**0.004**	0.1
AS-58	9/11/15	Ambient - clean room	320	3.53	1129.60	12.0	100	0.007854	385	0.12	15	**0.005**	0.1
AS-59	9/11/15	Occupational - on worker removing vermiculite (PAPR)	22	3.53	77.66	102.0	79	0.007854	385	1.29	164	**0.815**	100
AS-60	9/11/15	Occupational - on worker operating vac loader (half-face)	50	3.53	176.50	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.015**	1

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos when workers wearing half-mask respirators with P100 cartridges (protection factor = 10) is 2 fibres/cc (1 fibres/cc action level).**
3. **8-hour OEL for amphibole amosite asbestos when workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
4. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
5. **Samples analysed in accordance with NIOSH 7400 A Method.**
6. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
7. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
8. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

David Siemens, BAIE IRSST Counter 2130551
Analyst

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CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 9/13/2015
DATE OF ANALYSIS: 9/13/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
Blank	9/12/15	Blank	0	0.00	0.00	< 5.5	100	0.007854	385	< 0.06	< 7	**N/A**	N/A
AS-61	9/12/15	Ambient - in theatre above work area	373	3.53	1316.69	16.5	100	0.007854	385	0.17	21	**0.006**	0.1
AS-62	9/12/15	Ambient - clean room	366	3.53	1291.98	106.0	22	0.007854	385	4.82	613	**0.183**	0.1
AS-63	9/12/15	Occupational - on worker removing vermiculite (PAPR)	18	3.53	63.54	102.0	78	0.007854	385	1.31	167	**1.009**	100

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos when workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

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DATE OF REPORT: 9/14/2015
DATE OF ANALYSIS: 9/14/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
AS-64	9/13/15	Ambient - in theatre above work area	354	3.53	1249.62	29	100	0.007854	385	0.29	37	**0.011**	0.1
AS-65	9/13/15	Ambient - clean room	346	3.53	1221.38	6.5	100	0.007854	385	0.07	8	**0.003**	0.1
AS-66	9/13/15	Occupational - on worker cleaning crawlspace (PAPR)	18	3.53	63.54	20.0	100	0.007854	385	0.20	25	**0.154**	100

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos when workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.01 fibres/cc, as referenced in Alberta's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

David Siemens, BAIE IRSST Counter 2130551
Analyst

CERTIFICATE OF ANALYSIS

Analysis of Airborne Fibre Concentration Using Phase Contrast Microscopy (PCM) - NIOSH 7400 A Method

Stantec Consulting Ltd
235 25th Street SE
Calgary, AB T2A 7H8
Tel:(403) 716-8000 Fax:(403) 716-8049
www.stantec.com

CLIENT: Parks Canada
SITE: Palace Grand Theatre

DATE OF REPORT: 9/15/2015
DATE OF ANALYSIS: 9/15/2015
PROJECT #: 123220349

CONTRACTOR: Energy North

SAMPLE	SAMPLING DATE	LOCATION	SAMPLING TIME (min)	FLOW RATE (L/min)	VOLUME	FIBRE COUNT	# of FIELDS	GRATICULE AREA	FILTER AREA	FIBRES/ FIELD	DENSITY (fibres/mm^2)	FIBRE LEVEL (fibre/cc)	ACTION LEVEL (fibre/cc)
Blank	9/14/15	Blank	0	0.00	0.00	< 5.5	100	0.007854	385	< 0.06	< 7	**N/A**	N/A
AS-67	9/14/15	Ambient - in theatre above work area	369	3.53	1302.57	29.5	100	0.007854	385	0.30	38	**0.011**	0.1
AS-68	9/14/15	Ambient - clean room	361	3.53	1274.33	31.0	100	0.007854	385	0.31	39	**0.012**	0.1
AS-69	9/14/15	Occupational - on worker removing vermiculite (PAPR)	10	3.53	35.30	15.0	100	0.007854	385	0.15	19	**0.208**	100
AC-03	9/15/15	Air clearance - northeast quadrant of crawlspace	202	14.53	2935.06	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.001**	0.2
AC-04	9/15/15	Air clearance - northwest quadrant of crawlspace	201	14.53	2920.53	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.001**	0.2
AC-05	9/15/15	Air clearance - southeast quadrant of crawlspace	204	14.53	2964.12	18.0	100	0.007854	385	0.18	23	**0.003**	0.2
AC-06	9/15/15	Air clearance - southwest quadrant of crawlspace	195	14.53	2833.35	< 5.5	100	0.007854	385	< 0.06	< 7	**< 0.001**	0.2

Notes:

1. **Yukon's OH&S Regulations reference an 8-hour OEL for amphibole amosite asbestos of 0.2 fibres/cc. Action level set at 50%, or 0.1 fibres/cc.fibres/cc.**
2. **8-hour OEL for amphibole amosite asbestos when workers wearing PAPR respirators with P100 cartridges (protection factor = 1000) is 200 fibres/cc (100 fibres/cc action level).**
3. **Post-Abatement air monitoring test results should be less than 0.2 fibres/cc, as referenced in Yukon's OH&S Regulations.**
4. **Samples analysed in accordance with NIOSH 7400 A Method.**
5. **Limit of Detection (LOD) 7 Fibres/mm^2 or 5.5 fibres counted in 100 fields.**
6. **Limit of Quantitation (LOQ) 100 Fibres/mm^2.**
7. **Samples will be retained for a period of 30 days after receipt and will be disposed of unless notified in writing.**

David Siemens, BAIE IRSST Counter 2130551
Analyst

APPENDIX B
SUMMARY OF RESULTS OF ANALYSIS OF BULK SAMPLES FOR ASBESTOS

EMSL Canada Inc.
2756 Slough Street, Mississauga, ON L4T 1G3
Phone/Fax: 289-997-4602 / (289) 997-4607
http://www.EMSL.com torontolab@emsl.com

EMSL Canada Or	551508543
CustomerID:	55JACQ30L
CustomerPO:	123220349
ProjectID:	

Attn: **Keith Irwin**
Stantec Consulting, Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone:	(604) 412-3004
Fax:	
Received:	08/10/15 3:30 PM
Analysis Date:	8/10/2015
Collected:	

Project: **123220349**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
S-02A *551508543-0001*	CRAWLSPACE-WHITE DUCT WRAP	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
S-02B *551508543-0002*	CRAWLSPACE-WHITE DUCT WRAP	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
S-02C *551508543-0003*	CRAWLSPACE-WHITE DUCT WRAP	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
S-03A *551508543-0004*	CRAWLSPACE-BROWN DUCT MASTIC	Brown Non-Fibrous Homogeneous		98% Non-fibrous (other)	**2% Chrysotile**
S-03B *551508543-0005*	CRAWLSPACE-BROWN DUCT MASTIC				**Stop Positive (Not Analyzed)**
S-03C *551508543-0006*	CRAWLSPACE-BROWN DUCT MASTIC				**Stop Positive (Not Analyzed)**

Analyst(s)

Nicole Dimou (1)
Romeo Samson (3)

Matthew Davis
or other approved signatory

Initial report from 08/11/2015 09:13:31

EMSL Canada Inc.

2756 Slough Street Mississauga, ON L4T 1G3
Phone/Fax: 289-997-4602 / (289) 997-4607
http://www.EMSL.com / torontolab@emsl.com

EMSL Canada Order 551508539
Customer ID: 55JACQ30L
Customer PO: 123220349
Project ID:

Attn: Keith Irwin
Stantec Consulting, Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Collected:
Received: 8/10/2015
Analyzed: 8/10/2015

Proj: 123220349

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: S-04A ***Lab Sample ID:*** **551508539-0001**
Sample Description: CRAWLSPACE- SPRINKLER PARGING

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	8/10/2015	Brown	0%	100%	None Detected	

Client Sample ID: S-04B ***Lab Sample ID:*** **551508539-0002**
Sample Description: CRAWLSPACE- SPRINKLER PARGING

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	8/10/2015	Brown	0%	100%	None Detected	

Client Sample ID: S-04C ***Lab Sample ID:*** **551508539-0003**
Sample Description: CRAWLSPACE- SPRINKLER PARGING

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	8/10/2015	Brown	0%	100%	None Detected	

Analyst(s):

Nicole Dimou PLM (1)
Romeo Samson PLM (2)

Reviewed and approved by:

Matthew Davis
or Other Approved Signatory

None Detected = <0.5%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Initial report from: 08/11/201509:10:32

EMSL Canada Inc.

2756 Slough Street Mississauga, ON L4T 1G3
Phone/Fax: 289-997-4602 / (289) 997-4607
http://www.EMSL.com / torontolab@emsl.com

EMSL Canada Order 551509729
Customer ID: 55JACQ30N
Customer PO: 123220408
Project ID:

Attn: Keith Irwin
Stantec Consulting, Ltd.
4370 Dominion Street
5th Floor
Burnaby, BC V5G 4L7

Proj: 123220349

Phone: (604) 436-3014
Fax: (604) 436-3752
Collected:
Received: 9/11/2015
Analyzed: 9/14/2015

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: PG-DT-01A ***Lab Sample ID:*** **551509729-0001**

Sample Description: DT-01 PALACE GRAND CRAWLSPACE/WHITE WOVEN DUCT TAPE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	9/14/2015	Gray	0%	60%	**40% Chrysotile**	

Client Sample ID: PG-DT-01B ***Lab Sample ID:*** **551509729-0002**

Sample Description: DT-01 PALACE GRAND CRAWLSPACE/WHITE WOVEN DUCT TAPE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	9/14/2015				Stop Positive (Not Analyzed)	

Client Sample ID: PG-DT-01C ***Lab Sample ID:*** **551509729-0003**

Sample Description: DT-01 PALACE GRAND CRAWLSPACE/WHITE WOVEN DUCT TAPE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	9/14/2015				Stop Positive (Not Analyzed)	

Client Sample ID: PO-L-01 ***Lab Sample ID:*** **551509729-0004**

Sample Description: OLD POST OFFICE/GREY LINOLIUM

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	9/14/2015	Brown/Gray	0.0%	100%	None Detected	

Analyst(s):

Arabee Sathiaseelan PLM (1)
PLM Grav. Reduction (1)

Reviewed and approved by:

Matthew Davis
or Other Approved Signatory

None Detected = <0.5%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Initial report from: 09/14/201513:04:38

Wes-Har Asbestos Analysis & Consulting Ltd.

Asbestos in Dust/Debris/Wipes Report

For Stantec [Burnaby]
500 - 4730 Kingsway,
Burnaby, BC, V5H 0C6

Location : Palace Grand, Dawson, YT

Project : 123220349

14476	Palace	Sample Location / Description	Result(s)	Analyzed	Analyst	AFD
1	BS-01	Vermiculite in Soil, Palace Grand Crawlspace * Subjected To An Ashing, Sieving and Filtering Procedure	DNQ Chrysotile Asbestos DNQ Cellulose Fibres DNQ Fibrous Glass DNQ Quartz DNQ Micaceous Material DNQ Non-fibrous	Aug 6 2015	GN	.T.
2	BS-02	Vermiculite in Soil, Palace Grand Crawlspace * Subjected To An Ashing, Sieving and Filtering Procedure	DNQ Chrysotile Asbestos DNQ Cellulose Fibres DNQ Fibrous Glass DNQ Hair Fibres DNQ Quartz DNQ Micaceous Material DNQ Non-fibrous	Aug 6 2015	GN	.T.
3	BS-03	Vermiculite in Soil, Palace Grand Crawlspace * Subjected To An Ashing, Sieving and Filtering Procedure	DNQ Chrysotile Asbestos DNQ Cellulose Fibres DNQ Fibrous Glass DNQ Quartz DNQ Micaceous Material DNQ Non-fibrous	Aug 6 2015	GN	.T.

Comments

Fibrous / Mineral Components Analyzed In Accordance With The NIOSH ASBESTOS (bulk) by PLM Method 9002 [15 August 1994]
AFD Means - Asbestos Fibres Detected; T - Present
LP Means - Precent : Layer or Phase of Whole Sample
DNQ Means - Detected Not Quantitated
< Means - Less Than
Samples Submitted Will Be Retained For 30 Days After Receipt And Will Be Disposed Of Thereafter Unless Otherwise Notified In Writing
Sample Submitted By Stantec [Burnaby]

August 06, 2015 [Facsimile]

G. Nawrocki
Analyst

H. McKnight
Reviewed By

123220349 . BS-01 Palace Grand, Dawson, YT Vermiculite in Soil Crawlspace wh14476 . 01

submitted sample

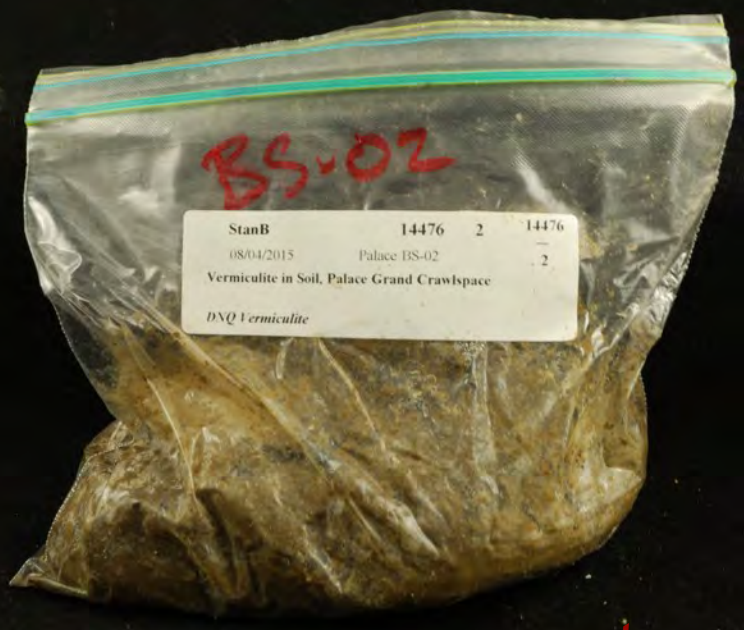
chrysotile asbestos

washed, sieved & filtered

stereo binocular microscopy ~ 25x

123220349 . BS-02 Palace Grand, Dawson, YT Vermiculite in Soil Crawlspace wh14476 . 02

submitted sample



chrysotile asbestos

washed, sieved & filtered

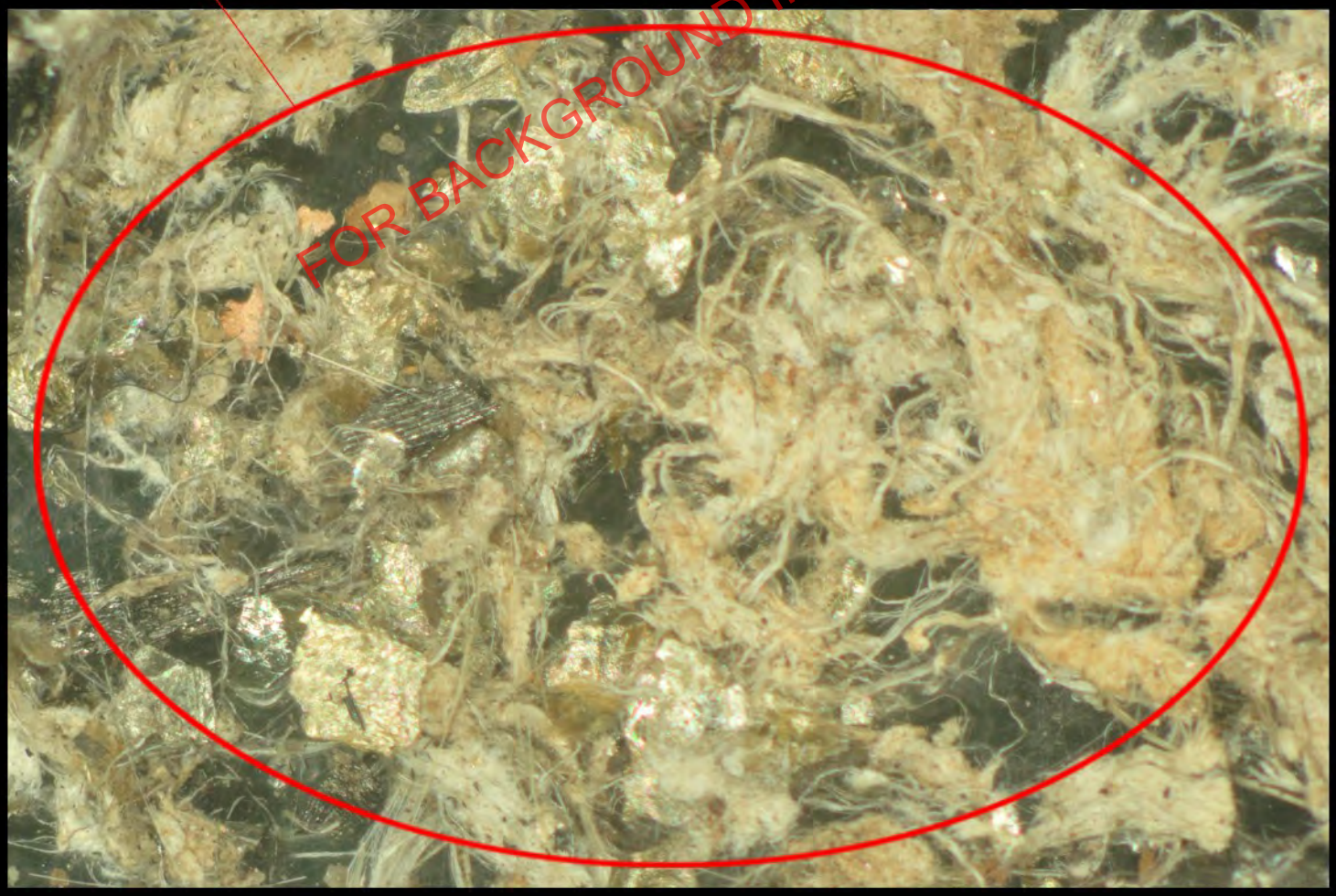
stereo binocular microscopy ~ 25x

123220349 . BS-03 Palace Grand, Dawson, YT Vermiculite in Soil Crawlspace wh14476 . 03

submitted sample

chrysotile asbestos

washed, sieved & filtered



stereo binocular microscopy ~ 25x

Wes-Har Asbestos Analysis & Consulting Ltd.

Asbestos in Dust/Debris/Wipes Report

For Stantec [Burnaby]
500 - 4730 Kingsway,
Burnaby, BC, V5H 0C6

Location : Palace Grand Theatre, Dawson City, Yukon

Project : 123220349

14517	PalaceG	Sample Location / Description	Result(s)	Analyzed	Analyst	AFD
1	S-01	Soil from Depth of 4", Palace Grand Crawlspace	DNQ Chrysotile Asbestos DNQ Cellulose Fibres DNQ Quartz DNQ Micaceous Material DNQ Non-fibrous	Aug 26 2015	GN	.T.
		* Subjected To An Ashing, Sieving and Filtering Procedure				
2	S-02	Soil from Depth of 4", Palace Grand Crawlspace	DNQ Chrysotile Asbestos DNQ Cellulose Fibres DNQ Fibrous Glass DNQ Quartz DNQ Micaceous Material DNQ Non-fibrous	Aug 26 2015	GN	.T.
		* Subjected To An Ashing, Sieving and Filtering Procedure				
3	S-03	Soil from Depth of 4", Palace Grand Crawlspace	DNQ Chrysotile Asbestos DNQ Cellulose Fibres DNQ Quartz DNQ Micaceous Material DNQ Non-fibrous	Aug 26 2015	GN	.T.
		* Subjected To An Ashing, Sieving and Filtering Procedure				
4	S-04	Soil from Depth of 4", Palace Grand Crawlspace	DNQ Chrysotile Asbestos DNQ Cellulose Fibres DNQ Fibrous Glass DNQ Quartz DNQ Micaceous Material DNQ Non-fibrous	Aug 26 2015	GN	.T.
		* Subjected To An Ashing, Sieving and Filtering Procedure				
5	S-05	Soil from Depth of 4", Palace Grand Crawlspace	DNQ Chrysotile Asbestos DNQ Cellulose Fibres DNQ Quartz DNQ Micaceous Material DNQ Non-fibrous	Aug 26 2015	GN	.T.
		* Subjected To An Ashing, Sieving and Filtering Procedure				
6	S-06	Soil from Depth of 4", Palace Grand Crawlspace	DNQ Chrysotile Asbestos DNQ Cellulose Fibres DNQ Quartz DNQ Micaceous Material DNQ Non-fibrous	Aug 26 2015	GN	.T.
		* Subjected To An Ashing, Sieving and Filtering Procedure				

Comments

Fibrous / Mineral Components Analyzed In Accordance With The NIOSH ASBESTOS (bulk) by PLM Method 9002 [15 August 1994]
AFD Means - Asbestos Fibres Detected; T - Present
LP Means - Precent : Layer or Phase of Whole Sample
DNQ Means - Detected Not Quantitated
< Means - Less Than
Samples Submitted Will Be Retained For 30 Days After Receipt And Will Be Disposed Of Thereafter Unless Otherwise Notified In Writing
Sample Submitted By Stantec [Burnaby]

August 26, 2015 [Facsimile]

G. Nawrocki — Analyst

H. McKnight — Reviewed By

123220349 . S-01 Soil from Depth of 4" Palace Grand Crawlspace wh14517 . 1

chrysotile

ashed & sieved stereo binocular microscopy ~ 50x

123220349 . S-02 Soil from Depth of 4" Palace Grand Crawlspace wh14517 . 2

chrysotile

ashed & sieved stereo binocular microscopy ~ 25x

123220349 . S-03 Soil from Depth of 4" Palace Grand Crawlspace wh14517 . 3

chrysotile

ashed & sieved stereo binocular microscopy ~ 75x

123220349 . S-04 Soil from Depth of 4" Palace Grand Crawlspace wh14517 . 4

chrysotile

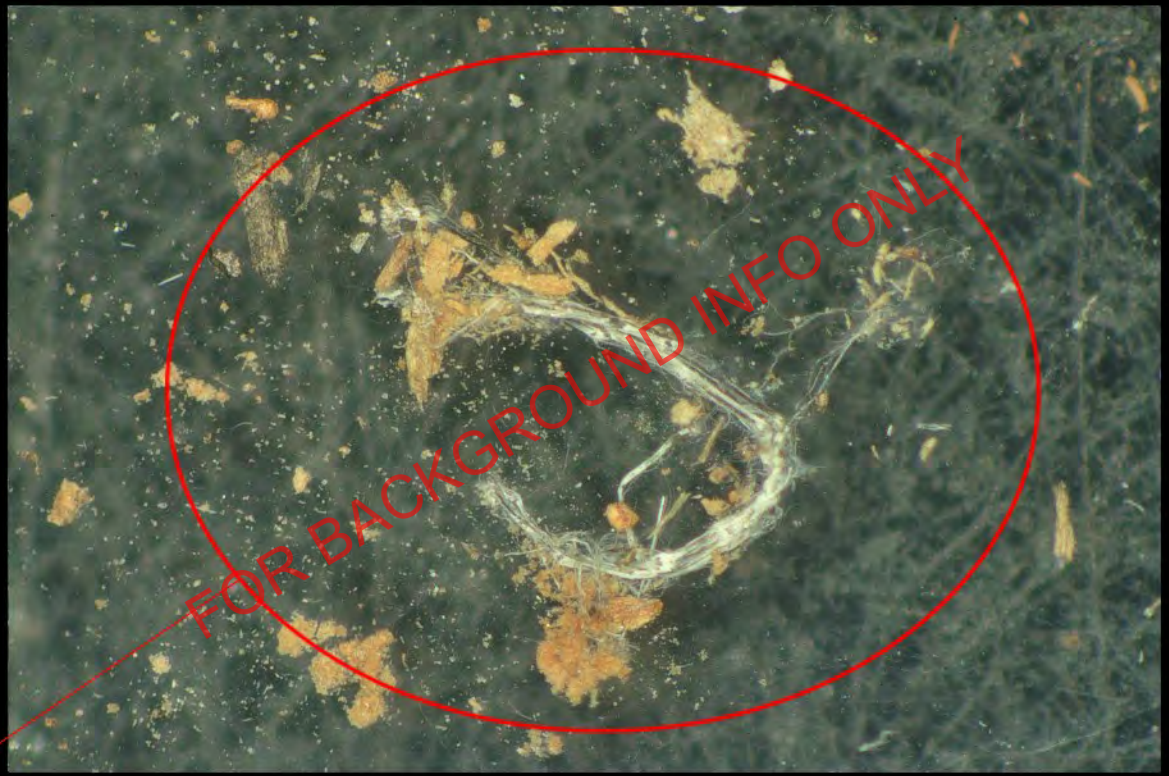
ashed & sieved stereo binocular microscopy ~ 25x

123220349 . S-05 Soil from Depth of 4" Palace Grand Crawlspace wh14517 . 5

chrysotile

ashed & sieved stereo binocular microscopy ~ 50x

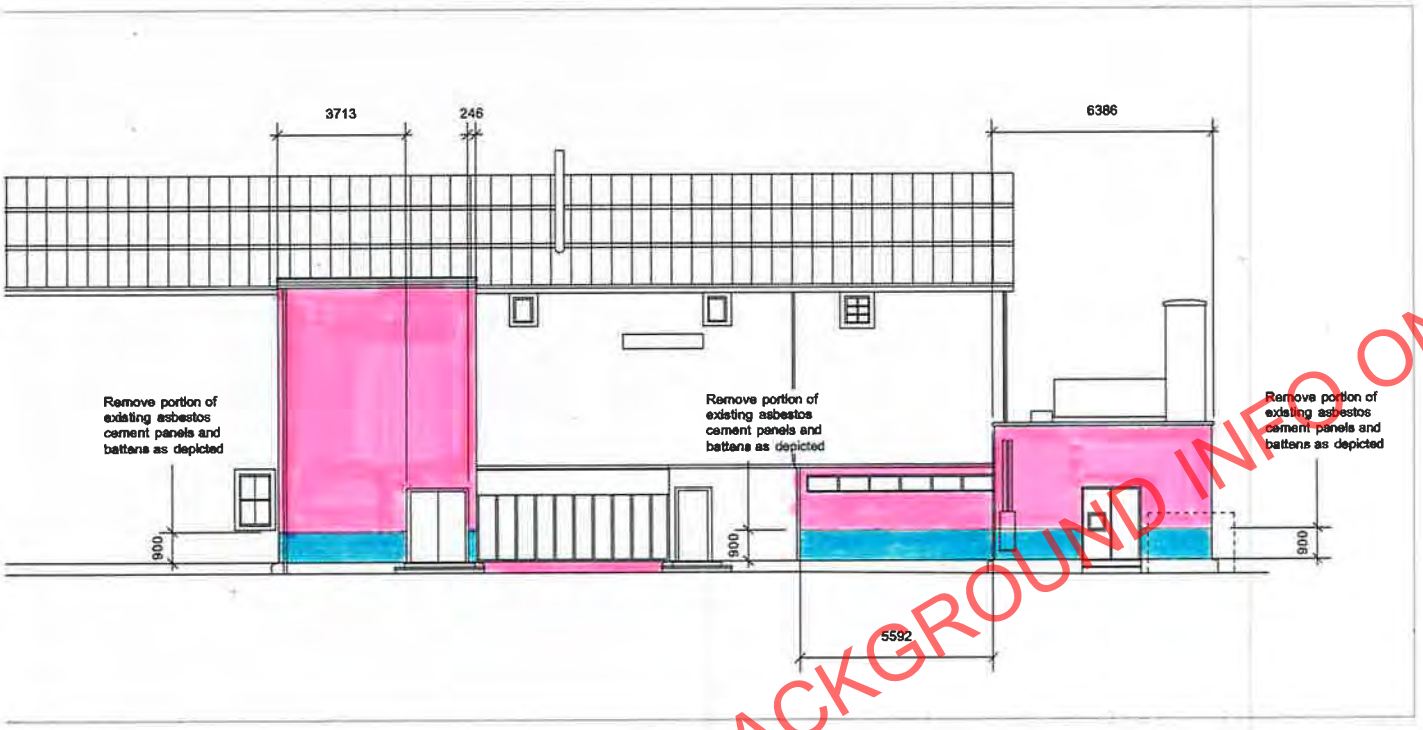
123220349 . S-06 Soil from Depth of 4" Palace Grand Crawlspace wh14517 . 6



chrysotile

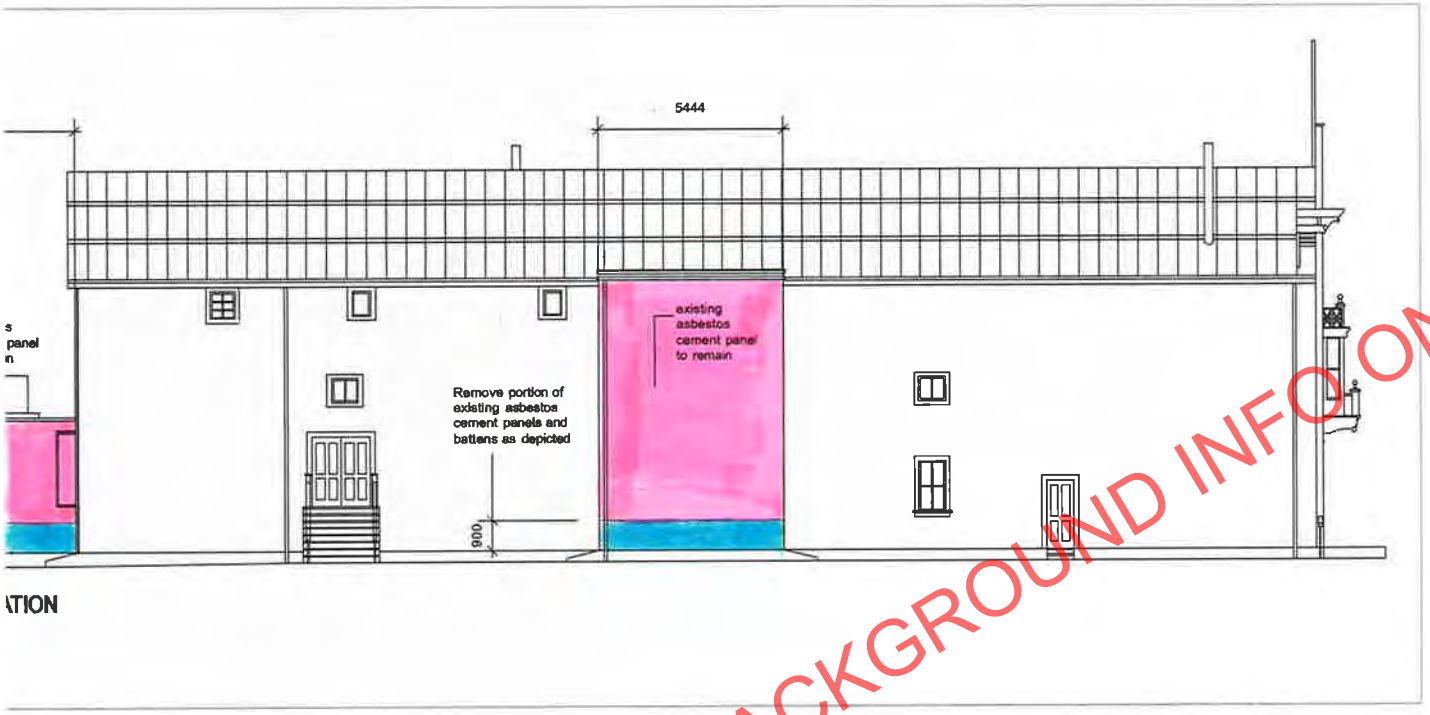
ashed & sieved stereo binocular microscopy ~ 50x

APPENDIX C
FLOOR PLANS SHOWING LOCATIONS OF ASBESTOS-CONTAINING CEMENT PANELS

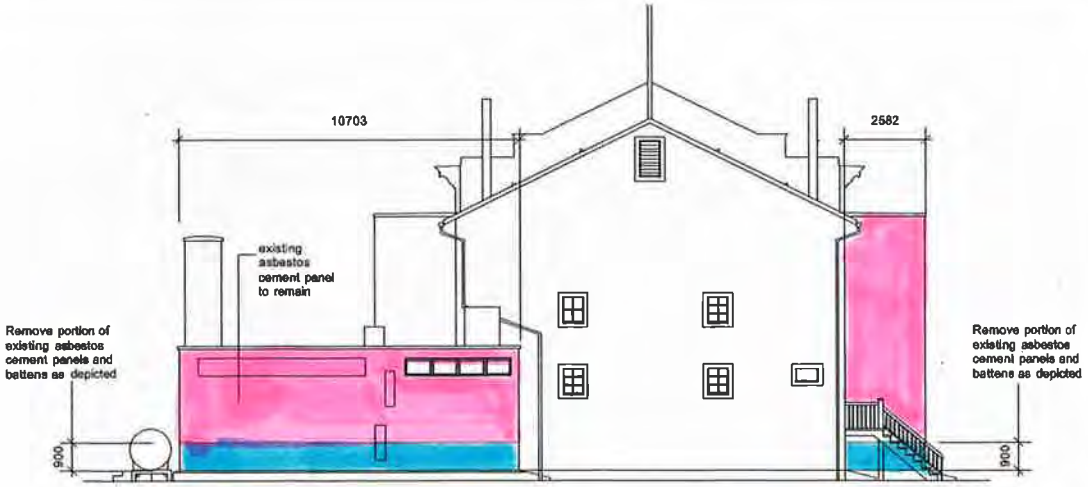


- location where asbestos-containing cement panels were removed.

- location where asbestos-containing cement panels remain



NORTH ELEVATION
SCALE: NTS



SOUTH ELEVATION
SCALE: NTS

APPENDIX B
Hazardous Building Materials Assessment

Hazardous Building Materials Assessments

Palace Grand Theatre
Dawson City, YT

Prepared for:
Public Works and Government Services Canada
219 – 800 Burrard Street
Vancouver, BC V6Z 2V8

Prepared by:
Stantec Consulting Ltd.
500 – 4730 Kingsway
Burnaby, BC, V5H 0C6
Tel: (604) 436-3014
Fax: (604) 436-3752

Project No.: 123220212

March 18, 2015

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LIST OF APPENDICES

Executive Summary

Stantec Consulting Ltd. (Stantec) was retained by Public Works and Government Services Canada (PWGSC) to conduct a hazardous building materials assessments within the Palace Grand Theatre located in Dawson City, YT (subject building).

The purpose of the assessment was to check for potential hazardous building materials that may require special attention for ongoing operations and/or during renovations in accordance with the requirements of the Canada Labour Code, Part II (Canada Labour Code), the Yukon Workers' Compensation Health and Safety Board (WCB) and the current version of the Yukon Territory *Occupational Health and Safety Act and Regulations* (YT OHS Reg.).

The hazardous building materials considered included asbestos-containing materials (ACMs), lead, including lead-containing paints (LCPs), polychlorinated biphenyls (PCBs), mercury-containing items, ozone-depleting substances (ODSs), mould-impacted building materials and silica.

Based on Stantec's review of previous documentation regarding hazardous building materials as well as our current visual assessment and the laboratory analyses performed on samples collected, hazardous building materials were identified within the subject building.

A summary of our findings and recommendations is presented below. Recommendations pertaining to the handling, removal, transportation and disposal of identified hazardous materials are provided in Section 6 of this report.

It should be noted that this summary is subject to the same restrictions and limitations as presented in Section 4.0 (Assessment Limitations) and Section 7.0 (Closure). The information provided is to be read in conjunction with the remainder of this report.

Summary of Identified Hazardous Building Materials
Identified ACMs • Vermiculite insulation present between the floor joists throughout the ground floor (analytical results for samples collected by others were reviewed on-site). – Vermiculite debris observed in joist spaces of perimeter walls in the crawlspace (joist spaces themselves are insulated with fiberglass batt) – expected to be releasing from the floor joist spaces. • Exterior cement panels present on the walls of the Mechanical Room and the emergency stairwells (east and west, and building paper materials directly behind those cement wall panels. • White woven flex duct connectors found in the Mechanical Room, between the main furnace units and primary furnace ducting (one on each of the four furnaces). • White fibrous liner/gasket found in mechanical room on circular furnace hatches (one on each of the four furnaces). • White furnace gasket found in Mechanical Room between furnace and red burner box. • White pipe wrap found in the southwest corner of the Mechanical Room and on two domestic water lines running through rooms 116 (women's washroom),117 (janitor's room) and 118 (men's washroom). – This material may be present in concealed spaces in locations throughout the building. However, limited domestic piping was observed • Joint compound on gypsum walls and ceilings (where present) throughout. • Fibrous (paper like) mechanical insulation debris found in the crawl space – One piece of debris was found directly beneath the hatch under the stage. The entire piece of debris was collected as our sample – Similar debris was not observed elsewhere, but not all areas of crawlspace were accessible. Unless otherwise noted, the materials listed above were observed to be in good condition. The following building materials were observed to be present but not sampled to preserve their integrity, and are listed as presumed asbestos-containing materials (PACMs): • Roofing materials • Insulation inside fire rated doors • Fire curtain (indicated on drawings reviewed)
Lead • Grey paint on furnace ducts in the mechanical room is lead-containing. • Grey paint on mechanical room walls and ceiling (gypsum board and/or plywood) is lead-containing. In addition to paint, lead is present/may be present in the following materials throughout the subject building: • Lead-acid batteries used in emergency lighting • Older electrical wiring materials and sheathing • Solder used on domestic water lines, in bell fittings for cast iron pipes and in electrical equipment • Vent and pipe flashings
PCBs • One fluorescent light fixture was observed in the mechanical room. Based on the construction date of the subject building and the apparent vintage of the fixture, the ballast within this fixture may contain PCBs.
Mercury • One (1) mercury-containing thermostat was observed in the mechanical room. • Mercury vapour is expected be present in the fluorescent light tubes in one fixture observed in the mechanical room.
Mould • Frost and ice was observed on drywall walls and around window frames in various locations throughout the building. When this melts, the resulting moisture that will impact porous materials in the areas (e.g. paper facings of drywall) can create conditions conducive to mould growth.

Summary of Identified Hazardous Building Materials
Ozone-Depleting Substances • The roof was not accessed as part of this assessment due to snow cover and lack of safe access. It was reported by site personnel that there is one HVAC unit located on the roof of the mechanical room that contains the ODS refrigerant R-22.
Silica • Silica is expected to be present in ceramic tiles, concrete, cement and masonry block and interior wall finishes observed in various locations.

Abbreviations

AAS	Atomic Absorption Spectrometry
ACGIH	American Conference of Governmental Industrial Hygienists
ACM	asbestos-containing material
AIHA	American Industrial Hygiene Association
AMP	Asbestos Management Plan
CFC	chlorofluorocarbon
EMSL	EMSL Canada Inc.
EPA	Environmental Protection Agency
FHR	*Federal Halocarbon Regulations*
HVAC	heating, ventilation and air conditioning
kg	kilogram
LCP	lead-containing paint
m^3	cubic metre
mg	milligram
NVLAP	National Voluntary Laboratory Accreditation Program
ODS	ozone-depleting substance
OEL	occupational exposure limit
PACM	presumed asbestos-containing material
PCB	polychlorinated biphenyl
PLM	polarized light microscopy
ppm	parts per million

PWGSC	Public Works and Government Services Canada
Stantec	Stantec Consulting Ltd.
SWP	Safe Work Practice
WCB	Yukon Workers' Compensation Health and Safety Board
YT OHS Reg.	Yukon Territory *Occupational Health and Safety Act and Regulations*

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Public Works and Government Services Canada (PWGSC) to conduct a hazardous building materials assessments within the Palace Grand Theatre, Dawson City, YT (subject building).

The purpose of the assessment was to check for potential hazardous building materials that may require special attention for ongoing operations and/or during renovations in accordance with the requirements of the Canada Labour Code, Part II (Canada Labour Code), the Yukon Workers' Compensation Health and Safety Board (WCB) and the current version of the Yukon Territory *Occupational Health and Safety Act and Regulations* (YT OHS Reg.).

The hazardous building materials considered included asbestos-containing materials (ACMs), lead, including lead-containing paints (LCPs), polychlorinated biphenyls (PCBs), mercury-containing items, ozone-depleting substances (ODSs), mould-impacted building materials and silica.

The site work was conducted by Keith Irwin of Stantec on January 21 and 22, 2015.

2.0 BACKGROUND

The subject building was reportedly constructed in 1962 as a replica of an original building that was constructed in 1899. This time period (1962) is consistent with those dates when hazardous building materials were commonly used in construction and/or may be present including, but not limited to ACMs, LCPs, PCBs, mould, mercury, ODSs, and silica.

In addition, Stantec understands that although various sampling records were on-file that indicated the presence of asbestos-containing cement products and asbestos-containing vermiculite within the building, comprehensive documentation and/or reports regarding hazardous building materials were not on file.

Stantec further understands that PWGSC is planning renovations within the subject building. As a measure of diligence in updating records while maintaining compliance with the requirements of the Canada Labour Code, the WCB and the current version of the YT OHS Reg. pertaining to the identification of hazardous materials for ongoing operations and management as well as prior to planned renovation activities, PWGSC retained Stantec to conduct this assessment.

3.0 SCOPE AND METHODOLOGY

Keith Irwin of Stantec conducted a visual assessment within the subject building on January 21 and 22, 2015. Site work was conducted in general compliance with the requirements of the Canada Labour Code, the WCB, the current version of the YT OHS Reg. and Stantec's safe work practices (SWPs).

Mechanical systems, structures and finishes of the subject building were visually examined to determine the suspected presence of ACMs, lead including LCPs, PCBs, mercury, ODSs, mould, and silica. Where building materials were suspected but not confirmed to contain asbestos, lead (in paint), or mould samples were collected for analysis to confirm or deny the presence of these hazardous materials. Based on analytical results, visually similar materials were referenced to specific analyzed samples to reduce the number of samples collected.

Additional background information and the methodology used for the determination of presence or absence of each specific hazardous material considered in this assessment are outlined in the following sections.

3.1 ASBESTOS

The common use of friable (materials which, when dry, can be easily crumbled or powdered by hand pressure) ACMs in construction generally ceased voluntarily in the mid-1970s but was only banned through legislation by the late 1980s. Friable asbestos was used in many building products, primarily high temperature insulations, spray-applied structural fireproofing, and a material known as vermiculite that was commonly used as block wall insulation and may be contaminated with asbestos fibres. Asbestos was also used in many non-friable manufactured products such as floor tiles, ceiling tiles, Transite cement products, and various other construction materials. Some cement products currently used in the construction of buildings may still contain asbestos.

The presence of asbestos in federal workplaces, and pertaining to federally regulated workers is governed by the Canada Labour Code. The presence of asbestos in the workplace in the Yukon pertaining to territorially regulated workers is governed by the WCB, with provisions published in the current version of the YT OHS Reg. As both federally regulated workers and territorially regulated workers (e.g., contractors) are expected to carry out work activities within the subject building, and as the territorial regulations are generally more prescriptive pertaining to asbestos (and generally include the requirements noted in the Canada Labour Code), this assessment was conducted to meet the requirements of the current version of the YT OHS Reg.

According to current version of the YT OHS Reg., ACM means any material which is found to contain any asbestos.

Based on this criterion, a visual assessment of accessible areas was undertaken in order to check for the presence of materials suspected of containing asbestos. Locations to collect discrete bulk asbestos samples of suspect building materials were identified. Samples of representative materials were then collected at these locations.

Multiple samples were collected from each "homogenous application" of observed suspected ACMs (materials suspected to contain asbestos that are uniform in material type, colour, texture application and estimated installation date) and submitted to EMSL Canada Inc. (EMSL) in Mississauga, Ontario for analysis of asbestos content using polarized light microscopy (PLM) with dispersion staining, in accordance with the United States Environmental Protection Agency (EPA) 600/R-93/116 method.

The number of samples to be collected for each homogenous application of a suspected ACM was based on accepted occupational hygiene standards and protocols, along with the assessor's experience and understanding of the consistency of that building material's application.

EMSL's analytical laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

3.1.1 Sample Results Interpretation

When asbestos is detected in any concentration in one of the samples within a set that was collected to represent a "homogenous application" of a particular material, the entire sample set and the entire application of that material is then considered to be an ACM.

In addition to the above, a "positive stop" option was used during the laboratory analysis of the building material samples submitted for asbestos analysis. The "positive stop" option is utilized by the laboratory when asbestos is detected in any concentration in one of the samples within a set that was collected to represent a "homogenous application" of that material. At this point, further analysis of subsequent samples within the set is deemed to be unnecessary (as the entire set will be considered an ACM, per above), and the remainder of the samples within the set are not analyzed.

3.1.2 Potential Asbestos-Containing Vermiculite Insulation

As part of the assessment, Stantec assessed the subject building for areas where vermiculite insulation, a potential ACM, would likely be present. This included making note of and assessing attic spaces, floor cavities and masonry or brick walls, which are typical areas where vermiculite is found.

3.1.3 Asbestos Sampling Quality Assurance/Quality Control

Sampling activities pertaining to asbestos were conducted in accordance with Stantec's SWPs, which take into account current territorial regulations pertaining to such work (i.e., sampling procedures, required number of samples, and laboratory analytical procedures).

Representative bulk samples were collected of accessible suspect ACMs in sufficient quantities for laboratory analyses. Suspect ACM samples were sealed in polyethylene zip-lock bags labeled with the sample number, suspect material description, and sample location. As part of sampling procedures, sampling tools were cleaned between sample collection events to avoid the potential for cross-contamination of samples.

Sample bags were compiled in order and placed into a single container accompanied with a Chain of Custody form outlining the project information, date, building location, number of samples, and sample description. Samples were submitted to the analytical laboratory in a sealed container via courier.

3.2 LEAD

Lead may be used in its pure metallic form or combined chemically with other elements to form lead compounds. Metallic lead is used to make products such as electric storage batteries, ammunition, lead solder, radiation shields, pipes, and sheaths for electric cables. Metallic lead is sometimes combined with other metals such as copper, tin, and antimony as lead alloys for use in the manufacture of a variety of metal products. Lead is commonly found in buildings in the solder used on copper domestic pipes, in the caulking on bell fittings of cast iron drainage pipes and in electrical equipment.

The presence of lead-containing materials (other than paint) was assessed through visual means.

With respect to paint, the lead content of interior paint was limited to 0.5% by weight (equivalent to 5,000 mg/kg or ppm) in 1976 under the Federal *Hazardous Products Act,* which governs the import, export and distribution of hazardous products in Canada. In 2005, the *Hazardous Products Act* had reduced the criteria for surface coatings (including paint) to 600 mg/kg (600 ppm) to define them as "lead-containing". This criterion has since (2010) been reduced to 90 ppm.

However, with respect to potential lead exposures associated with disturbance to surfaces coated with lead-containing products, various occupational health and safety administrations have indicated that working with materials coated with paint that has a lead content that exceeds 600 ppm can lead to exposures in excess of 50% of the occupational exposure limit (OEL) for lead, when the OEL is 0.05 mg/m^3 (the OEL for lead in the Yukon, according to the current version of the YT OHS Reg., is 0.15 mg/m^3).

Prior to disposal, Yukon Environment recommends that analytical results for building materials should be compared to the territorial soil guideline value of 1,000 ppm as found in the *Contaminated Sites Regulations*. As such, and given that the OEL for lead in the Yukon is three times that of jurisdictions that reference 600 ppm as lead-containing, Stantec will reference the 1,000 ppm value in defining paints as "lead-containing" as the most applicable criteria.

Based on this criterion, samples of suspected LCPs were collected from major paint applications, and were collected to substrate, where possible, in sufficient quantity to conduct analyses for total lead content. Samples collected were placed into separate, sealed, and labeled polyethylene bags, and submitted to EMSL for analyses of total lead content using Flame Atomic Absorption Spectrometry (AAS) (SW 846 3050B*/7000B).

EMSL's analytical laboratory is also accredited by the American Industrial Hygiene Association (AIHA) Environmental Lead Laboratory Approval Program.

3.3 POLYCHLORINATED BIPHENYLS

PCBs were used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. In fluorescent fixtures, PCBs were usually found within the small capacitors inside the ballast that controls the lamp. The *Federal Chlorobiphenyls Regulation SOR/91-152*, prohibited the use of PCBs in electrical equipment manufactured after July 1, 1980.

The presence of PCB-containing equipment was assessed through visual means. With respect to fluorescent lamp ballasts, due to the risk of electrical shock associated with dismantling operating fixtures, fluorescent lamp ballasts were not removed to view identification numbers/information.

The total number of fluorescent lamp ballasts that may contain PCBs within the subject building was approximated.

Suspected PCB-containing electrical equipment can be visually inspected and compared to the Environment Canada reference guide entitled "*Identification of Lamp Ballasts Containing PCBs, Report EPS 2/CC/2*", dated August 1991 (PCB Guide).

3.4 MERCURY

Mercury is commonly found in buildings as mercury vapour lighting, thermostats/thermometers with mercury-containing glass ampoules, electrical switches and can also be found in minor amounts in fluorescent lamp tubes and vapour bulbs and may be present in stable forms in adhesives. Exposure to mercury in workplaces is governed by the WCB.

The presence of mercury and mercury-containing equipment was assessed through visual means.

3.5 MOULD

Moist building materials may provide suitable conditions for mould growth, and the removal of building materials impacted by mould growth may require workers with specific training and experience using work procedures that have been developed to protect workers and work areas from exposure to elevated concentrations of airborne mould.

The presence of suspect visible mould was assessed through visual means. Material observed with dark-colored staining and/or a textured and discolored appearance is described as "suspect mould". Mould identified visually is defined as "suspect mould" unless it is confirmed as mould by laboratory analysis.

3.5.1 Mould Reference Guidelines

With respect to mould and/or moisture, the visual assessment procedures utilized during this project were based on the recommendations provided in the documents listed below:

- Standard Construction Document CCA 82 *Mould Guidelines for the Canadian Construction Industry*, Canadian Construction Association, 2004 (referred to as CCA 82).
- *Guidelines on Assessment and Remediation of Fungi in Indoor Environment*, New York City Department of Health, Bureau of Environmental and Occupational Disease Epidemiology, April 2000 (referred to as the NYC Guidelines).
- *Fungal Contamination in Public Buildings: Heath Effects and Investigation Methods*, Federal-Provincial Committee on Environmental and Occupational Health, 2004 (referred to as the Health Canada Guide).
- *Indoor Air Quality in Office Buildings: A Technical Guide*, Report of the Federal-Provincial Advisory Committee on Environmental and Occupational Health, 1995 (referred to as the IAQ Guide).
- *Bioaerosols: Assessment and Control*, American Conference of Governmental Industrial Hygienists (ACGIH), 1999 (referred to as the ACGIH Report).

3.6 OZONE-DEPLETING SUBSTANCES

Chlorofluorocarbons (CFCs) and other ODSs are often found in refrigeration units associated with air-conditioning or other refrigeration equipment. In September 1987, 47 countries agreed to the Montreal Protocol on Substances that Deplete the Ozone Layer. Disposal of ODSs are regulated in the Yukon by the Yukon Government's *Special Waste Regulations* (2010) and the *Federal Halocarbon Regulations*, 2003 (FHR 2003).

The presence of ODSs and equipment containing these materials was assessed through visual means.

3.7 SILICA

Silica, also referred to as free crystalline silica, is found in concrete, cement, mortar, ceramic wall and floor tiles, stucco finishes and acoustic ceiling tiles. Prolonged exposure to, and inhalation of free crystalline silica, may result in respiratory disease known as silicosis, which is characterized by progressive fibrosis of the inner lung tissue and marked shortness of breath or impaired lung function.

Exposure to silica dust is governed by the WCB, with applicable exposure limits indicated in the current version of the YT OHS Reg., depending on the type of silica to be considered (quartz, cristobalite or tridymite).

The presence of silica was assessed through visual means.

4.0 ASSESSMENT LIMITATIONS

This report has been prepared for the exclusive use of the PWGSC for the purpose of assessing general conditions in the subject building. Any use that a third party makes this report, or reliance on, or decisions to be made on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

In preparation of this report, Stantec used professional judgment based on experience. The work was conducted in accordance with generally accepted professional standards. Stantec relied on information gathered during the site investigation and laboratory analytical reports.

This report reflects the observations made within accessed areas of the subject building and the results of analyses performed on specific materials sampled during the assessment. Analytical results reflect the sampled materials at the specific sample locations.

Sampling was conducted pertaining to suspected ACMs and suspected LCPs only. The assessment for the presence of other hazardous building materials was visual in nature, and was conducted pertaining to readily visible surfaces within accessible spaces only. Concealed spaces were inspected via existing access panels, where present.

As safe access was not possible due to snow cover, the roof of the subject building was not included in this assessment. Limited comments will be made regarding materials present on the roof and any comments made will be based on information reported to Stantec by site personnel.

Due to limitations on the agreed to scope of work for this project as well as physical limitations in accessing concealed areas and limitations associated with working in occupied/operational spaces, there are specific limitations to the information that can be provided to each hazardous building material considered in this assessment, as outlined below.

4.1 ASBESTOS

Suspected ACMs that were not sampled include, but are not limited to, the following (where present, based on building construction or as otherwise noted):

- Roofing materials and materials/equipment present on the roof
- Sub-grade materials
- Interior components of mechanical equipment (e.g., inner linings or gaskets in boilers)
- Interior components of heating, ventilation and air conditioning (HVAC) units
- Heat protection materials inside mechanical installations (e.g., gaskets) and light fixtures (e.g., paper backing in sealed incandescent fixtures)
- Flooring material concealed beneath ceramic tile, brickwork, hardwood flooring, and/or concealed beneath existing sub-floors
- Drywall and/or wall plaster and associated finish materials concealed behind new and/or additional walls or ceilings
- Woven tape inside duct connection joints or inner ducting insulation
- Materials within wall cavities, hard ceiling cavities or crawlspaces
- Insulation materials inside fire doors

If encountered during demolition or other activities, any suspected ACMs not identified within this report should be presumed to contain asbestos and handled as such until otherwise proven, through analytical testing.

4.2 LEAD

Assessment for the presence of lead or lead-containing materials was visual in nature, and was conducted pertaining to readily visible surfaces within accessible spaces of the subject building only. The presence of lead or lead-containing materials in inaccessible areas not assessed included, but was not limited to: ceiling spaces, wall cavities, crawlspaces, and buried materials.

With respect to paint, samples of suspected LCPs were collected within the subject building only from surfaces of major paint applications where visually different paint colours and/or types were identified. Although the surfaces where samples were collected may be covered with more than one coat of paint, the paint samples are described by the surface (visible) colour only.

Attempts were made to represent all layers of paint in the samples collected. As analytical results are referenced to the surface paint colour only, the lead content of all painted surfaces similar to that represented by the surface paint colour will be presumed to be the same, regardless of differing sub surface paints, if any.

4.3 POLYCHLORINATED BIPHENYLS

Due to height restrictions and the risk of electrical shock in handling operational light fixtures, the ballasts present in the fixtures observed within the subject building were not removed for comparison to the PCB Guide.

Conclusions and recommendations regarding the presence of PCBs within the subject building are based on Stantec's limited observations in combination with information provided by staff regarding lighting renovations (where requested by Stantec based on observations) and is presented to provide guidance regarding the likelihood that PCB-containing equipment is or is not present within the subject building. The exact extent and/or number of fluorescent lamp ballasts containing PCBs, if any, within the subject building will not be commented on.

4.4 MERCURY

Visual assessment for the presence of mercury-containing equipment within the subject building was conducted in accessible areas only. The presence of mercury or mercury-containing equipment in inaccessible areas includes, but is not limited to: ceiling spaces, wall cavities, and crawlspaces, or as internal parts of HVAC mechanisms.

4.5 MOULD

Visual assessment for the presence of suspected visible mould and/or suitable conditions for mould growth (e.g., moist and/or water-stained building materials) were conducted in accessed portions of the subject building only. The assessment was not intrusive in nature and included visual assessment of exposed surfaces and closer inspection of known problem areas.

The conclusions made in this report provide description(s) of the potential source(s) of moisture within the subject building that may have led to suitable conditions for mould growth, only in those cases where potential source(s) of moisture were identified. These conclusions will not necessarily identify all sources of moisture leading to suitable conditions for mould growth within the subject building or within the impacted area(s).

This assessment does not constitute a building envelope/building systems assessment for any of the subject building, which would include an intrusive investigation to assess the internal condition, potential moisture sources, and expected remaining service life of the various components and systems comprising the envelope of a building.

4.6 OZONE DEPLETING SUBSTANCES

Visual assessment for the presence of ODSs within the subject building was conducted in accessible areas only. The presence of ODS-containing equipment in inaccessible areas including, but not limited to, ceiling spaces, wall cavities and crawlspaces, was not assessed. In addition, portable equipment that may contain ODSs (refrigerators, drink coolers, etc.) was not considered as part of this assessment.

4.7 SILICA

Visual assessment for the presence of silica-containing materials within the subject building was conducted in accessible areas only. The presence of potential silica-containing materials in inaccessible areas including, but not limited to, ceiling spaces, wall cavities and crawlspaces was not assessed.

5.0 FINDINGS

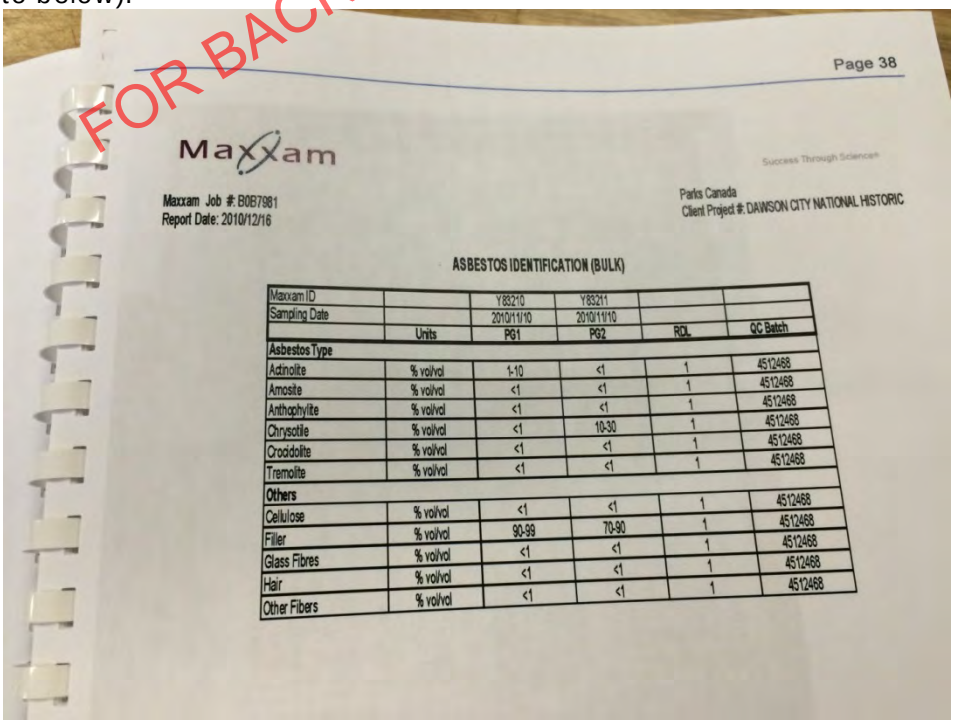
Floor plans showing bulk sample locations and locations of identified hazardous materials (where practical) are provided in Appendix A.

The results of the assessment for each of the considered hazardous materials are provided in the following sub-sections.

5.1 ASBESTOS

Visual observations and/or records provided to Stantec on-site indicated that the following materials were previously identified as asbestos-containing:

- Vermiculite insulation present between the floor joists throughout the ground floor
  - Analytical results from Maxxam Analytics for samples collected by others were reviewed on-site, and indicated this material to be asbestos-containing (see sample PG1 in the photo below).



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Maxxam

Success Through Science®

Maxxam Job #: B0B7981
Report Date: 2010/12/16

Parks Canada
Client Project #: DAWSON CITY NATIONAL HISTORIC

ASBESTOS IDENTIFICATION (BULK)

Maxxam ID		Y83210	Y83211		
Sampling Date		2010/11/10	2010/11/10		
	Units	PG1	PG2	RDL	QC Batch
Asbestos Type					
Actinolite	% vol/vol	1-10	<1	1	4512468
Amosite	% vol/vol	<1	<1	1	4512468
Anthophyllite	% vol/vol	<1	<1	1	4512468
Chrysotile	% vol/vol	<1	10-30	1	4512468
Crocidolite	% vol/vol	<1	<1	1	4512468
Tremolite	% vol/vol	<1	<1	1	4512468
Others					
Cellulose	% vol/vol	<1	<1	1	4512468
Filler	% vol/vol	90-99	70-90	1	4512468
Glass Fibres	% vol/vol	<1	<1	1	4512468
Hair	% vol/vol	<1	<1	1	4512468
Other Fibers	% vol/vol	<1	<1	1	4512468

As part of the current assessment, Stantec collected representative samples of various suspected ACMs. The materials sampled by Stantec included the following:

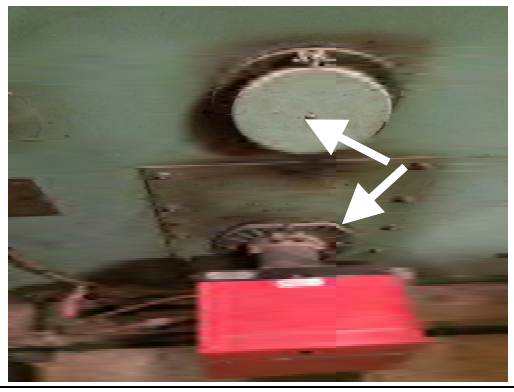
- Exterior cement panel
- Woven flex duct connector
- Fibrous liner
- Head shield
- Furnace gasket
- Pipe wrap
- Duct wrap
- Duct mastic
- Building paper
- Mechanical gasket
- Ceramic tile grout
- Sheet flooring
- Dry wall joint compound
- Fibrous debris

Sixty-seven samples of the above-noted suspected ACMs were collected within the subject building and submitted to EMSL for analysis of asbestos content and nature. A summary of the sample types, locations and analytical results is presented in in Appendix B. Copies of the certificates of analysis provided by EMSL for the suspected ACM samples submitted are included in Appendix C.

Based on our observations of building construction (estimated vintage of interior finishes and uniformity of building material use) and on our interpretations of the results of suspected ACM samples collected during this assessment, the materials presented in Table 1, below were identified as ACMs within the subject building.

Table 1 Summary of Identified ACMs, Palace Grand Theatre, Dawson City, YT

Identified ACM Description		Photo
Vermiculite insulation present between the floor joists throughout the ground floor.		
Condition	Good where concealed within floor space. Vermiculite debris (poor condition) observed in joist spaces of perimeter walls in the crawlspace (joist spaces themselves are insulated with fiberglass batt) – expected to be releasing from the floor joist spaces.	
% Type	1-10% Actinolite (according to Maxxam Analytics record reviewed on-site)	
Friability	Friable	

Identified ACM Description		Photo
Exterior cement panels present on the walls of the Mechanical Room and the emergency stairwells (east and west), and building paper behind those cement wall panels		
Condition	Good	
% Type	15% Chrysotile in cement board; Trace (<0.25% Chrysotile) in building paper	
Friability	Non-friable	
White woven flex duct connectors found in the Mechanical Room between the main furnace units and primary furnace ducting (one on each of the four furnaces)		
Condition	Good	
% Type	60% Chrysotile	
Friability	Non-friable	
White fibrous liner/gasket found in mechanical room on circular furnace hatches (one on each of the four furnaces)		
Condition	Good	
% Type	50% Chrysotile	
Friability	Friable	
White furnace gasket found in Mechanical Room between furnace and red burner box		
Condition	Good	
% Type	1.3% Chrysotile	
Friability	Non-Friable	

Identified ACM Description		Photo
White pipe wrap found in the southwest corner of the Mechanical Room and on two domestic water lines running through rooms 116 (women's washroom),117 (janitor's room), 118 (men's washroom). May be present in concealed spaces in locations throughout the building. However, limited domestic piping was observed.		
Condition	Good	
% Type	20% Chrysotile	
Friability	Non-Friable	
Joint compound on gypsum walls and ceilings (where present) throughout		
Condition	Good	
% Type	2% Chrysotile	
Friability	Friable	

Identified ACM Description		Photo
Fibrous (paper like) mechanical insulation debris found in the crawl space. NOTE: One piece of debris was found directly beneath the hatch under the stage. The entire piece of debris was collected as our sample		No Photo.
Condition	Debris	
% Type	50% Chrysotile	
Friability	Friable	

5.1.1 Assessment for Vermiculite Insulation

As part of the assessment, Stantec assessed the subject building for additional areas where vermiculite insulation, a potential ACM, would likely be present outside of the areas mentioned above (joist spaces of the ground floor and in the crawlspace as debris). This included making note of and assessing accessible attic spaces and floor cavities which are typical areas where vermiculite is found. No evidence of vermiculite was observed in the attic, and the other floors were constructed such that they did not appear to have a space where vermiculite would be present. However, floorboards were not destructively assessed on other floors to confirm.

5.1.2 Presumed Asbestos-Containing Materials

The following building materials were observed to be present but not sampled to maintain their integrity and/or due to lack of safe access, and are listed as presumed asbestos-containing materials (PACMs):

- Roofing materials
- Insulation materials in fire rated doors
- Fire curtain (indicated to be present in reports reviewed on-site)

These materials were observed to be in good condition. Sampling of these materials was not part of the scope of work as determined by Stantec's understanding of the Project. As these materials are known to have been manufactured with asbestos, they should be presumed to be asbestos-containing unless proven otherwise by laboratory analysis.

5.1.3 Materials with less than 0.25% Asbestos Detected

According to current version of the YT OHS Reg., ACM means any material which is found to contain any asbestos.

Less than 0.25% asbestos was detected in three samples of building paper collected from the exterior of the subject building. It should be noted that this material is present directly behind and in contact with identified asbestos-containing cement panels. The trace amounts of asbestos detected in the samples of the building paper are not likely indicative of the material itself containing asbestos, but are likely the result of contamination/transfer from the overlying

asbestos-containing cement panels. However, due to the presence of detectable concentrations of asbestos in the building paper samples collected, this material (building paper) should be considered as an ACM. However, this should only be the case in those locations where building paper is present directly behind asbestos-containing cement panels.

5.2 LEAD

Stantec collected five paint chip samples of suspected LCPs within the subject building and submitted the samples to EMSL for analysis of lead content. A summary of the sample types, locations and analytical results is presented in Table 2, below. A copy of the certificate of analysis provided by EMSL for the suspected LCP samples submitted is included in Appendix D.

Table 2 Suspected LCP Sample Collection and Analysis Summary, Palace Grand Theatre, Dawson City, YT

Sample Number	Paint Description	Location	Result (ppm Lead)	Lead Containing (Yes/No)
P-01	Grey	Furnace duct	3,600	Yes
P-02	Black	Stage walls	<90	No
P-03	White	Emergency stairwell	240	No
P-04	Grey	Mechanical room walls and ceiling	1,700	Yes
P-05	Grey	Exterior trim	90	No

Based on our observations and interpretations of previous reports as well as the results of suspected LCP samples collected as part of this assessment, the paint type presented in Table 3, below was identified as an LCP.

Table 3 Summary of Identified LCPs, Palace Grand Theatre, Dawson City, YT

Lead-Containing Material Description	Photo
Grey paint on furnace ducts in the mechanical room This paint was observed to be in poor condition (flaking and peeling) in various locations.	
Grey paint on mechanical room walls and ceiling This paint was observed to be in good condition (minimal flaking, bubbling, and peeling)	

In addition to paint, lead is present/may be present in the following materials throughout the subject building:

- Lead-acid batteries used in emergency lighting
- Older electrical wiring materials and sheathing
- Solder used on domestic water lines, in bell fittings for cast iron pipes and in electrical equipment
- Vent and pipe flashings

5.3 POLYCHLORINATED BIPHENYLS

One fluorescent light fixture was observed in the mechanical room. Based on the construction date of the subject building and the apparent vintage of the fixture, the ballast within this fixture may contain PCBs.

5.4 MERCURY

Mercury vapour is likely to be present in the fluorescent light tubes in the one fluorescent light fixture observed in the mechanical room. In addition, one mercury containing thermostat was also observed in the mechanical room as indicated on the floor plan drawings in Appendix A.

5.5 MOULD

Observations made by Stantec associated with mould and moisture impacted building materials are presented below in Table 4.

Table 4 Summary of Microbial Contamination Observations, Palace Grand Theatre, Dawson City, YT

Suspect Mould and/or Moisture Impacted Building Material Observed	Photo
Frost and ice was observed on drywall walls and around window frames in various locations throughout the building. When this melts, the resulting moisture that will impact porous materials in the areas (e.g. paper facings of drywall) can create conditions conducive to mould growth.	

5.6 OZONE DEPLETING SUBSTANCES

The roof was not accessed as part of this assessment.

It was reported by site personnel that there is one HVAC unit located on the roof of the mechanical room that contains the ODS refrigerant R-22.

5.7 SILICA

Silica is expected to be present in ceramic tiles, concrete, cement and masonry block and interior wall finishes observed in various locations.

6.0 RECOMMENDATIONS

The recommendations pertaining to the requirements for each of the hazardous materials included in this assessment are presented in the sub-sections below.

6.1 ASBESTOS

Based on the visual assessment and results of laboratory analyses and review of previous documentation, Stantec recommends the following with regards to ACMs in the subject building

- Identified ACMs in good condition can be managed in place. When they are to be impacted by planned renovation/demolition activities they should be removed prior to the onset of these activities, in accordance with the requirements of the Canada Labour Code, the WCB and the current version of the YT OHS Reg. It is expected that this will require the involvement of an experienced asbestos abatement contractor.
- Prior to renovation and/or demolition activities that would disturb them, undertake testing of PACMs that may be impacted to determine their asbestos content. Confirmed asbestos materials should be handled accordingly.
- Should a material suspected to contain asbestos fibres become uncovered during renovation/demolition activities, all work in the areas that may disturb the material should be stopped. Samples of the suspect material should be submitted for laboratory analysis to determine if asbestos fibres are present. Confirmed asbestos materials should be handled in accordance with applicable guidelines and regulations.
- Due to the confirmed presence of asbestos within the subject building, and in accordance PWGSC requirements, an asbestos exposure control plan (also known as an Asbestos Management Plan [AMP] or asbestos operations and management plan) should be developed and implemented for the subject building. The AMP would serve to compile the available data, results and reports regarding the presence, extent, handling, removal, and disposal of ACMs within the subject building. The AMP would also provide sections for information regarding future sampling and analysis of suspected ACMs, if required, asbestos-abatement projects, if undertaken, and other information regarding the management of asbestos within the subject building.
- Suspected ACMs deemed visually similar to the ACMs identified in this report should be considered asbestos-containing and handled as such, unless proven otherwise, through analytical testing.
- Ensure asbestos containing waste is handled, stored, and disposed of in accordance with the requirements of the *Federal Transportation of Dangerous Goods Regulation* and Yukon *Environment Special Waste and Solid Waste Regulations* document entitled *Asbestos Disposal* (2010).

6.1.1 Vermiculite Debris

Asbestos-containing vermiculite debris is present within the crawlspace. Options to address this include the following:

- Sealing any air pathways between the main floor and the crawlspace (or operating the crawlspace under negative pressure with respect to the main floor area) and restricting access to the crawlspace area through locking the access hatchways and posting appropriate signage warning of the presence (and hazards) of asbestos and indicating that only authorized personnel (appropriately trained/qualified) with appropriate personal protective equipment may enter.
- Conducting an abatement project to remove debris within the crawlspace and to seal openings and/or pathways from which this material is being released. It is expected that this will require the involvement of an experienced asbestos abatement contractor.

6.2 LEAD

Lead-containing paint in poor condition should be cleaned-up and/or addressed to mitigate potential for loose paint chips to be released.

For LCPs and lead-containing materials that are to be disturbed and/or removed during renovation/demolition activities (or the above-noted clean-up) ensure compliance with the following:

- Occupational exposure control requirements of the Canada Labour Code and the WCB
- Disposal requirements of Yukon Environment – *Contaminated Sites Regulations* and the Yukon Government *Special Waste Regulations*
- Transportation requirements of the *Federal Transportation of Dangerous Goods Regulation*

Corrective action or remedial work on paint applications containing any concentration of lead should be undertaken in a manner so as to avoid generating fine particulate matter or dust (i.e., avoid sanding). Airborne lead dust or fumes should not exceed the WCB 8-hour OEL of 0.15 mg/m^3 during the removal of paints and products containing any concentration of lead. The use of personal protective equipment is recommended to reduce the potential for over-exposure to lead dust.

6.3 POLYCHLORINATED BIPHENYLS

For continued operations and maintenance, fluorescent lamp ballasts that may contain PCBs can be managed in place, where these items are operating and in good condition. No further action is currently required until 2025, when PCB-containing items will require removal and disposal.

The provisions for PCBs that are indicated below would apply for either renovation or demolition:

- As fluorescent lamp ballasts may contain PCBs, if these items are removed from service, they should be assessed in reference to the PCB Guide.
- If PCB-containing items are identified and require removal, they should be handled, transported, stored and disposed of according to the *Federal Transportation of Dangerous Goods Regulation* and the PCB Regulations (SOR/2008-273).

6.4 MERCURY

For continued operations and maintenance, identified mercury-containing materials can be managed in place. Mercury vapour within light fixtures and/or liquid mercury in thermostat switches or thermometers pose no risk to workers or occupants provided the mercury containers remain intact and undisturbed. No further action is currently required.

For either renovation of demolition, if mercury-containing materials (e.g., thermostats, fluorescent light bulbs) are to be removed from service, ensure all mercury waste is handled, stored and disposed of in accordance with the requirements of the requirements of the Yukon Government *Special Waste Regulations* and the *Transportation of Dangerous Goods Regulation*.

6.5 MOULD

When renovation/demolition work proceeds mould and/or moisture-impacted building materials may be encountered during that process. If those impacted materials are to be removed by hand, demolition workers should be notified of the potential presence of mould and be provided with respiratory protection and/or other personal protective equipment as deemed necessary for the work that they will be conducting.

If significant mould contamination is identified in concealed locations, an experienced mould abatement contractor may be required to assist with removal in accordance with applicable guidelines and standards for such work.

When temperatures within the subject building rise to above freezing, care should be taken to remove any excess moisture or standing water and to avoid wetting of porous materials, which may lead to mould growth on those materials.

6.6 OZONE DEPLETING SUBSTANCES

Reported ODS-containing equipment within the building that is to remain operational (one HVAC unit located on the roof of the mechanical room that reportedly contains the ODS refrigerant R-22) can be managed in place and must be serviced by licensed refrigeration technicians (as defined in the FHR).

If ODS-containing equipment in the building is to be decommissioned, ODSs must be handled, recycled, stored, and/or disposed of in accordance with the requirements of with the requirements of the *Yukon's Ozone Depleting Substances Regulations* and the FHR 2003.

6.7 SILICA

For continued operations and maintenance, identified silica-containing materials can be managed in place.

For renovation or demolition activities, if silica-containing materials are to be disturbed, ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the applicable exposure limits indicated in the current version of the YT OHS Reg. This would include, but not be limited to, the following:

- Providing workers with respiratory protection
- Wetting the surface of the materials to prevent dust emissions
- Providing workers with facilities to properly wash prior to exiting the work area
- Providing dust control to mitigate the potential for demolition dust to escape from the work area into public and/or adjacent areas

7.0 CLOSURE

This report has been prepared by Stantec Consulting Ltd. for the sole benefit of Public Works and Government Services Canada. Any use that a third party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The conclusions presented represent the best judgment of the assessor based on current environmental standards and the site conditions observed on the dates cited within this report. This report is based on, and limited by, circumstances and conditions stated herein, and on information available at the time of preparation of the report. Due to the limited nature of the investigation and the limited data available, Stantec Consulting Ltd. cannot warrant against undiscovered environmental liabilities. It is possible that additional, concealed hazardous materials may become evident during renovation and/or demolition activities within the subject building.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

Closure
March 18, 2015

We trust that the report meets your current requirements. Should you have any questions or concerns regarding the above, please do not hesitate to contact the undersigned.

Respectfully submitted,

STANTEC CONSULTING LTD.

Reviewed by:

Original Signed By

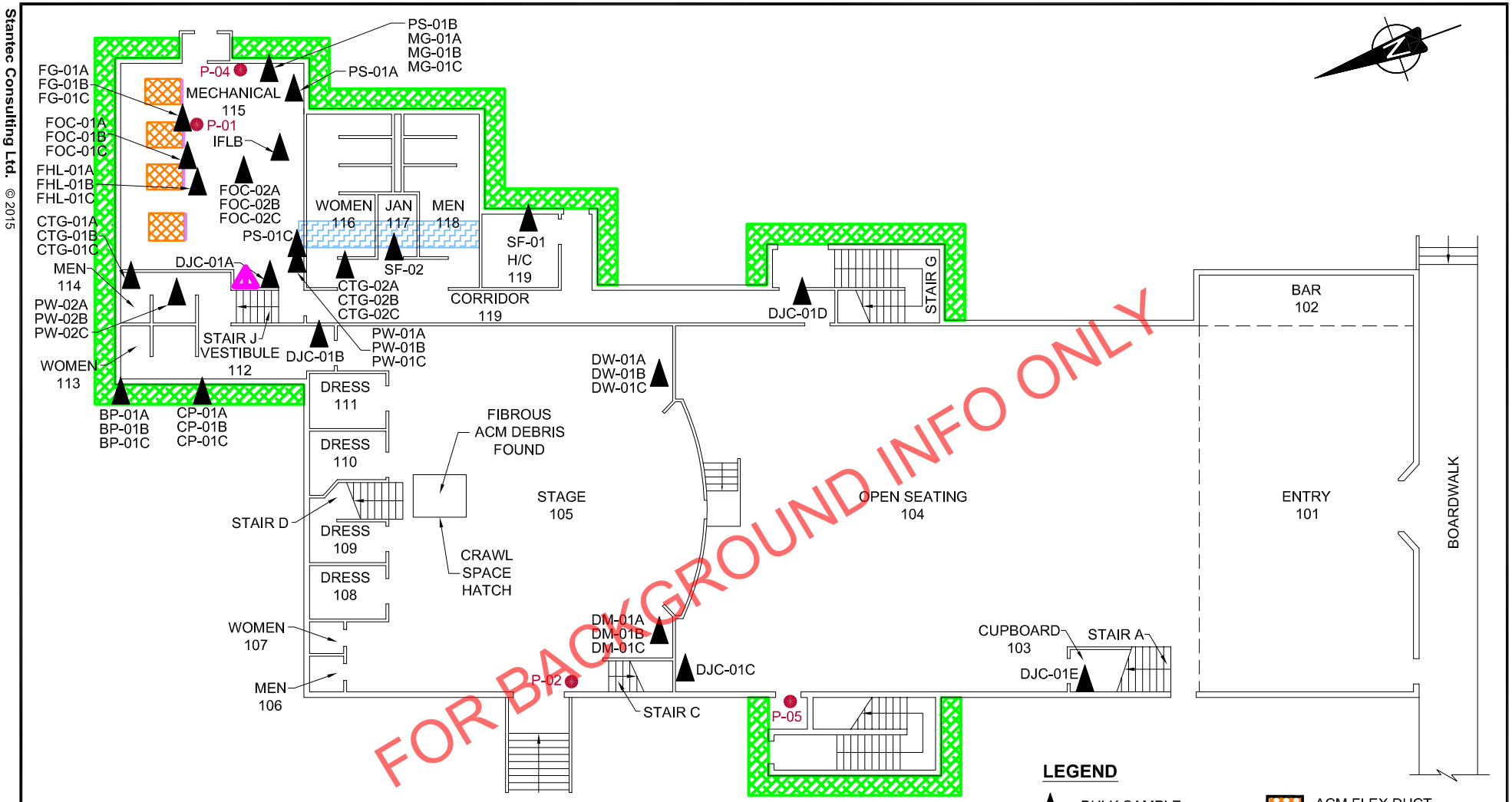
Keith Irwin Dipl. Tech.
Environmental Technologist

Original Signed By

Sean Brigden, B.Sc., P.B.Dipl., CRSP
Project Manager

KI/SB/tt

APPENDIX A
FLOOR PLANS



LEGEND

- BULK SAMPLE
- PAINT CHIP SAMPLE
- ACM CEMENT PANEL AND BUILDING PAPER MATERIALS DIRECTLY BEHIND THOSE PANELS
- ACM FLEX DUCT CONNECTOR
- ACM FIBROUS LINER AND FURNACE GASKET
- ACM PIPE WRAP
- MERCURY-CONTAINING THERMOSTAT

PALACE GRAND THEATRE
GROUND FLOOR

NOTES: **1. ASBESTOS-CONTAINING VERMICULITE INSULATION IS PRESENT BETWEEN THE FLOOR JOISTS THROUGHOUT THE GROUND FLOOR.**
2. ASBESTOS-CONTAINING DRYWALL JOINT COMPOUND IS PRESENT THROUGHOUT.
3. THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

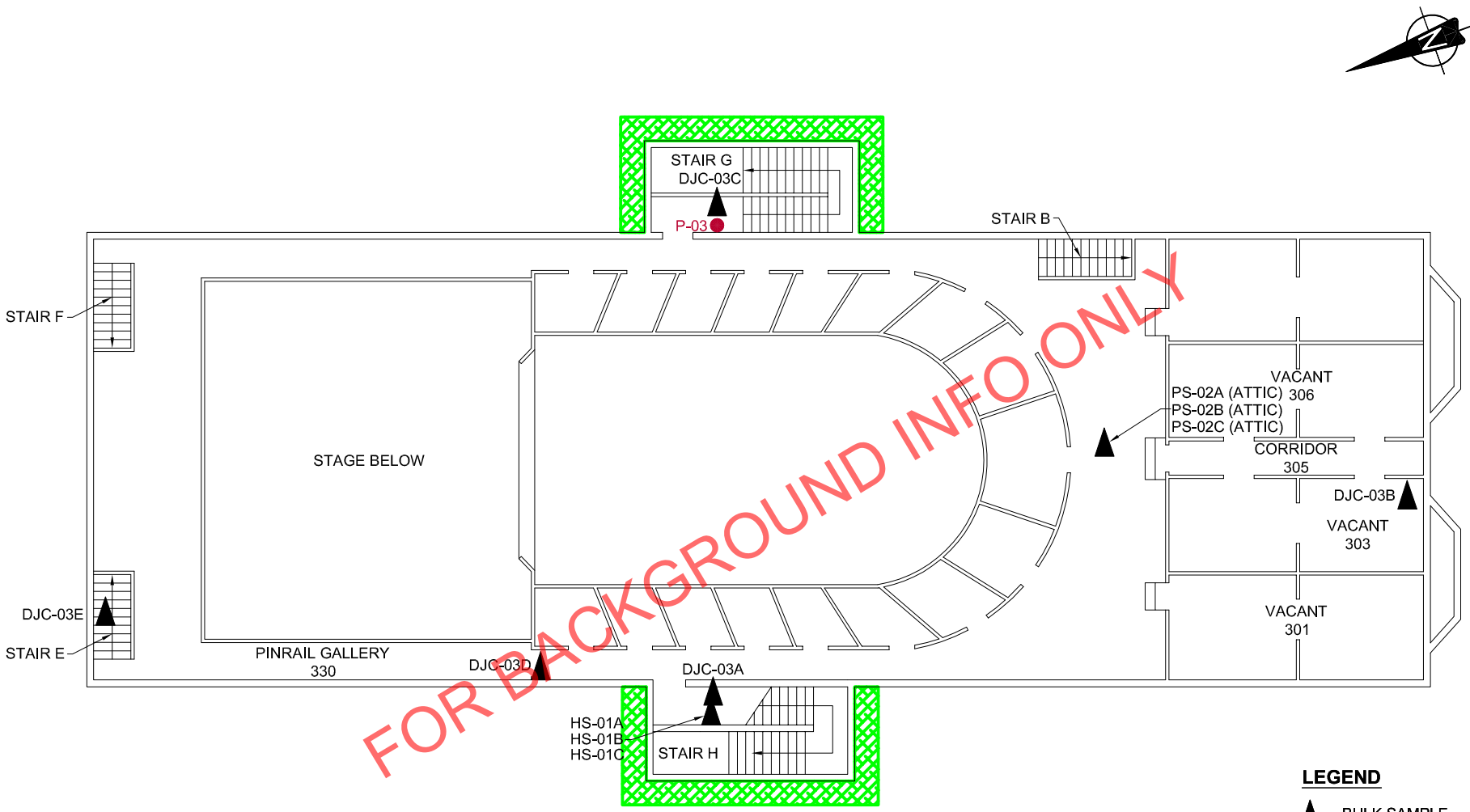
PALACE GRAND THEATRE - DAWSON CITY, YT

Client: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project No.:	123220212
Scale:	N.T.S.
Date:	15/02/27
Dwn. By:	CD DM/VM SL2015020108
App'd By:	SB

Dwg. No.: 1

Stantec



LEGEND

- BULK SAMPLE
- PAINT CHIP SAMPLE
- ACM CEMENT PANEL AND BUILDING PAPER MATERIALS DIRECTLY BEHIND THOSE PANELS

PALACE GRAND THEATRE SECOND FLOOR

NOTE: 1. ASBESTOS-CONTAINING DRYWALL JOINT COMPOUND IS PRESENT THROUGHOUT.

2. THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

PALACE GRAND THEATRE - DAWSON CITY, YT

Client: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project No.:	123220212
Scale:	N.T.S.
Date:	15/02/26
Dwn. By:	CD PK/DM SL2015020104
App'd By:	SB

Dwg. No.: 2

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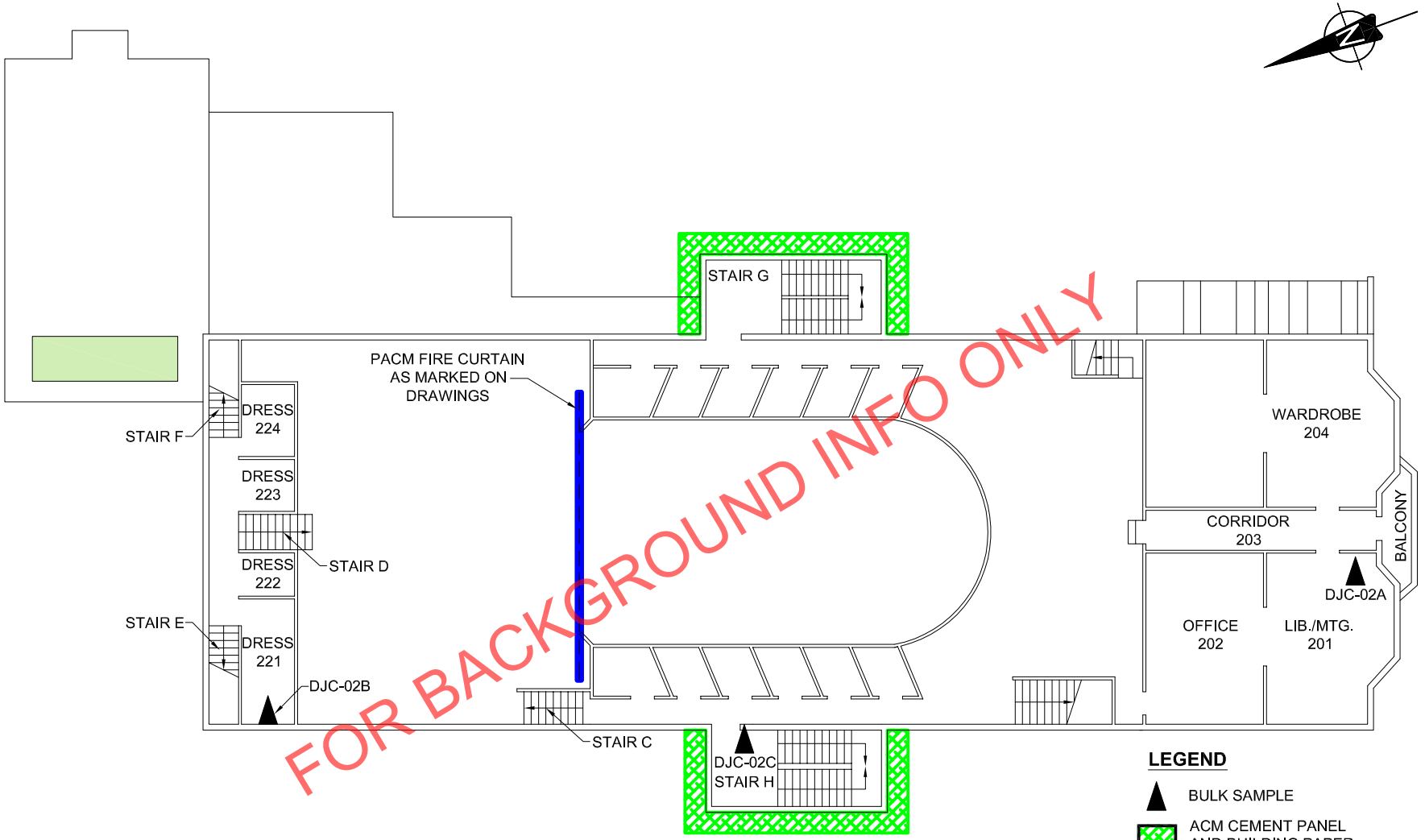

PALACE GRAND THEATRE MEZZANINE FLOOR

LEGEND

- BULK SAMPLE
- ACM CEMENT PANEL AND BUILDING PAPER MATERIALS DIRECTLY BEHIND THOSE PANELS
- REPORTED ODS-CONTAINING HVAC UNIT (R-22)
- PRESUMED ASBESTOS-CONTAINING FIRE CURTAIN

NOTE: 1. ASBESTOS-CONTAINING DRYWALL JOINT COMPOUND IS PRESENT THROUGHOUT.
2. THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

PALACE GRAND THEATRE - DAWSON CITY, YT

Client: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project No.:	123220212
Scale:	N.T.S.
Date:	15/02/26
Dwn. By:	CD PK/DM SL2015010105
App'd By:	SB

Dwg. No.: 3

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APPENDIX B
SUMMARY OF SUSPECTED ACM BULK SAMPLES

Sample Number	Material Description	Sample Location	Results (%/Type Asbestos)
CP-01A	Exterior Cement Panel	West Wall of Mechanical Room	15% Chrysotile
CP-01B	Exterior Cement Panel	West Wall of Mechanical Room	Stop Positive (Not Analyzed)
CP-01C	Exterior Cement Panel	West Wall of Mechanical Room	Stop Positive (Not Analyzed)
FDC-01A	White Woven Flex Duct Connector	Mechanical Room Between Furnaces and Furnace Ducting	60% Chrysotile
FDC-01B	White Woven Flex Duct Connector	Mechanical Room Between Furnaces and Furnace Ducting	Stop Positive (Not Analyzed)
FDC-01C	White Woven Flex Duct Connector	Mechanical Room Between Furnaces and Furnace Ducting	Stop Positive (Not Analyzed)
FDC-02A	Black Rubbery Flex Duct Connector	Mechanical Room on Emergency Generator Exhaust Duct	None Detected
FDC-02B	Black Rubbery Flex Duct Connector	Mechanical Room on Emergency Generator Exhaust Duct	None Detected
FDC-02C	Black Rubbery Flex Duct Connector	Mechanical Room on Emergency Generator Exhaust Duct	None Detected
FHL-01A	White Fibrous Liner	Mechanical Room on Back of Circular Furnace Hatches	50% Chrysotile
FHL-01B	White Fibrous Liner	Mechanical Room on Back of Circular Furnace Hatches	Stop Positive (Not Analyzed)
FHL-01C	White Fibrous Liner	Mechanical Room on Back of Circular Furnace Hatches	Stop Positive (Not Analyzed)
HS-01A	Heat Shield Inside Round Incandescent Light Fixtures	West Second Floor Emergency Stairwell Landing	None Detected
HS-01B	Heat Shield Inside Round Incandescent Light Fixtures	West Second Floor Emergency Stairwell Landing	None Detected
HS-01C	Heat Shield Inside Round Incandescent Light Fixtures	West Second Floor Emergency Stairwell Landing	None Detected
FG-01A	White Furnace Gasket	Mechanical Room on Between Furnace and Red Burner Box	1.3% chrysotile
FG-01B	White Furnace Gasket	Mechanical Room on Between Furnace and Red Burner Box	Stop Positive (Not Analyzed)
FG-01C	White Furnace Gasket	Mechanical Room on Between Furnace and Red Burner Box	Stop Positive (Not Analyzed)
PS-01A	Brown Pipe Sealant	East Corner of Mechanical Room on Piping	None Detected
PS-01B	Brown Pipe Sealant	East Corner of Mechanical Room on Piping	None Detected
PS-01C	Brown Pipe Sealant	East Corner of Mechanical Room on Piping	None Detected

Sample Number	Material Description	Sample Location	Results (%/Type Asbestos)
PS-02A	Light Blue Pipe Sealant	On 2" Sprinkler System in Attic Space	None Detected
PS-02B	Light Blue Pipe Sealant	On 2" Sprinkler System in Attic Space	None Detected
PS-02C	Light Blue Pipe Sealant	On 2" Sprinkler System in Attic Space	None Detected
PW-01A	White Pipe Wrap	South West Corner of Mechanical Room	20% Chrysotile
PW-01B	White Pipe Wrap	South West Corner of Mechanical Room	Stop Positive (Not Analyzed)
PW-01C	White Pipe wrap	South West Corner of Mechanical Room	Stop Positive (Not Analyzed)
PW-02A	Grey Painted Pipe Wrap	Outside of North end men's Washroom	None Detected
PW-02B	Grey Painted Pipe Wrap	Outside of North end men's Washroom	None Detected
PW-02C	Grey Painted Pipe Wrap	Outside of North end men's Washroom	None Detected
DW-01A	Black Duct Wrap	South East Corner of Stage	None Detected
DW-01B	Black Duct Wrap	South East Corner of Stage	None Detected
DW-01C	Black Duct Wrap	South East Corner of Stage	None Detected
DM-01A	Brown Duct Mastic	South East Corner of Stage	None Detected
DM-01B	Brown Duct Mastic	South East Corner of Stage	None Detected
DM-01C	Brown Duct Mastic	South East Corner of Stage	None Detected
BP-01A	Black Building Paper Under Cement Panel on Exterior	West Wall of Mechanical Room	<0.25% Chrysotile
BP-01B	Black Building Paper Under Cement Panel on Exterior	West Wall of Mechanical Room	<0.25% Chrysotile
BP-01C	Black Building Paper Under Cement Panel on Exterior	West Wall of Mechanical Room	<0.25% Chrysotile
MG-01A	Black Mechanical Gasket	Mechanical Room on Red Viking Fitting	None Detected
MG-01B	Black Mechanical Gasket	Mechanical Room on Red Viking Fitting	None Detected
MG-01C	Black Mechanical Gasket	Mechanical Room on Red Viking Fitting	None Detected
CTG-01A	White Ceramic Tile Grout	North End Men's Washroom	None Detected
CTG-01B	White Ceramic Tile Grout	North End Men's Washroom	None Detected
CTG-01C	White Ceramic Tile Grout	North End Men's Washroom	None Detected

Sample Number	Material Description	Sample Location	Results (%/Type Asbestos)
CTG-02A	White Ceramic Tile Grout	North East Outside Women's Washroom	None Detected
CTG-02B	White Ceramic Tile Grout	North East Outside Women's Washroom	None Detected
CTG-02C	White Ceramic Tile Grout	North East Janitor Room	None Detected
SF-01	Tanned Sheet Flooring	North East Handicap Washroom	None Detected
SF-02	Tanned Sheet Flooring	North East Janitor Room	None Detected
DJC-01A	Dry Wall Joint Compound	Mechanical Room at North East Door	2% Chrysotile
DJC-01B	Dry Wall Joint Compound	Hallways Behind Stage at South West Door	Stop Positive (Not Analyzed)
DJC-01C	Dry Wall Joint Compound	Landing in Stairwell C on Main Floor	Stop Positive (Not Analyzed)
DJC-01D	Dry Wall Joint Compound	Corridor Outside Stairwell G on Main Floor	Stop Positive (Not Analyzed)
DJC-01E	Dry Wall Joint Compound	Interior Wall in Stairwell A on Main Floor	Stop Positive (Not Analyzed)
DJC-02A	Dry Wall Joint Compound	East Wall in Library/Meeting Room on Third Floor	2% Chrysotile
DJC-02B	Dry Wall Joint Compound	Landing in Stairwell E on Third Floor	Stop Positive (Not Analyzed)
DJC-02C	Dry Wall Joint Compound	Landing in Stairwell H on Third Floor	Stop Positive (Not Analyzed)
DJC-03A	Dry Wall Joint Compound	Landing in Stairwell H on Second Floor	2% Chrysotile
DJC-03B	Dry Wall Joint Compound	North West Room From Corridor on Second Floor	Stop Positive (Not Analyzed)
DJC-03C	Dry Wall Joint Compound	Landing in Stairwell G on Second Floor	Stop Positive (Not Analyzed)
DJC-03D	Dry Wall Joint Compound	North East Wall in Pin Rail Gallery	Stop Positive (Not Analyzed)
DJC-03E	Dry Wall Joint Compound	Landing in Stairwell E on Second Floor	Stop Positive (Not Analyzed)
CDP-0A	Fibrous Debris	Crawl Space Hatch	50% Chrysotile
CDP-0B	Fibrous Debris	Crawl Space Hatch	Stop Positive (Not Analyzed)
CDP-0C	Fibrous Debris	Crawl Space Hatch	Stop Positive (Not Analyzed)

APPENDIX C
CERTIFICATE OF ANALYSIS – SUSPECTED ACM SAMPLES

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EMSL Canada Order 551500844
Customer ID: 55JACQ30N
Customer PO: 123220212.200
Project ID:

Attn: Keith Irwin
Stantec Consulting, Ltd.
4370 Dominion Street
5th Floor
Burnaby, BC V5G 4L7

Proj: 123220212.200

Phone: (604) 436-3014
Fax: (604) 436-3752
Collected:
Received: 1/26/2015
Analyzed: 2/02/2015

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: CP-01A ***Lab Sample ID:*** **551500844-0001**
Sample Description: WEST WALL OF MECHANICAL ROOM/EXTERIOR CEMENT PANEL

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015	Gray	0%	85%	**15% Chrysotile**	

Client Sample ID: CP-01B ***Lab Sample ID:*** **551500844-0002**
Sample Description: WEST WALL OF MECHANICAL ROOM/EXTERIOR CEMENT PANEL

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

Client Sample ID: CP-01C ***Lab Sample ID:*** **551500844-0003**
Sample Description: WEST WALL OF MECHANICAL ROOM/EXTERIOR CEMENT PANEL

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

Client Sample ID: FDC-01A ***Lab Sample ID:*** **551500844-0004**
Sample Description: MECHANICAL ROOM BETWEEN FURNACES AND FURNACE/DUCTING/WHITE WOVEN FLEX DUCT CONNECTOR

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015	White	5%	35%	**60% Chrysotile**	

Client Sample ID: FDC-01B ***Lab Sample ID:*** **551500844-0005**
Sample Description: MECHANICAL ROOM BETWEEN FURNACES AND FURNACE/DUCTING/WHITE WOVEN FLEX DUCT CONNECTOR

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

Client Sample ID: FDC-01C ***Lab Sample ID:*** **551500844-0006**
Sample Description: MECHANICAL ROOM BETWEEN FURNACES AND FURNACE/DUCTING/WHITE WOVEN FLEX DUCT CONNECTOR

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

Client Sample ID: FDC-02A ***Lab Sample ID:*** **551500844-0007**
Sample Description: MECHANICAL ROOM ON EMERGENCY GENERATOR EXHAUST/DUCT/BLACK RUBBERY FLEX DUCT CONNECTOR

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Gray	0.0%	100%	None Detected	

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EMSL Canada Order 551500844
Customer ID: 55JACQ30N
Customer PO: 123220212.200
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: FDC-02B **Lab Sample ID:** **551500844-0008**

Sample Description: MECHANICAL ROOM ON EMERGENCY GENERATOR EXHAUST/DUCT/BLACK RUBBERY FLEX DUCT CONNECTOR

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Gray	0.0%	100%	None Detected	

Client Sample ID: FDC-02C **Lab Sample ID:** **551500844-0009**

Sample Description: MECHANICAL ROOM ON EMERGENCY GENERATOR EXHAUST/DUCT/BLACK RUBBERY FLEX DUCT CONNECTOR

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Gray	0.0%	100%	None Detected	

Client Sample ID: FHL-01A **Lab Sample ID:** **551500844-0010**

Sample Description: MECHANICAL ROOM ON BACK OF CIRCULAR FURNACE/HATCHES/WHITE FIBROUS LINER

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015	Beige	2%	48%	**50% Chrysotile**	

Client Sample ID: FHL-01B **Lab Sample ID:** **551500844-0011**

Sample Description: MECHANICAL ROOM ON BACK OF CIRCULAR FURNACE/HATCHES/WHITE FIBROUS LINER

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

Client Sample ID: FHL-01C **Lab Sample ID:** **551500844-0012**

Sample Description: MECHANICAL ROOM ON BACK OF CIRCULAR FURNACE/HATCHES/WHITE FIBROUS LINER

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

Client Sample ID: HS-01A **Lab Sample ID:** **551500844-0013**

Sample Description: WEST SECOND FLOOR EMERGENCY STAIRWELL LANDING/HEAT SHIELD INSIDE ROUND INCANDESCENT LIGHT FIXTURES

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Yellow	0.0%	100%	None Detected	

Client Sample ID: HS-01B **Lab Sample ID:** **551500844-0014**

Sample Description: WEST SECOND FLOOR EMERGENCY STAIRWELL LANDING/HEAT SHIELD INSIDE ROUND INCANDESCENT LIGHT FIXTURES

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Yellow	0.0%	100%	None Detected	

Client Sample ID: HS-01C **Lab Sample ID:** **551500844-0015**

Sample Description: WEST SECOND FLOOR EMERGENCY STAIRWELL LANDING/HEAT SHIELD INSIDE ROUND INCANDESCENT LIGHT FIXTURES

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Yellow	0.0%	100%	None Detected	

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EMSL Canada Order 551500844
Customer ID: 55JACQ30N
Customer PO: 123220212.200
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: FG-01A **Lab Sample ID:** **551500844-0016**

Sample Description: MECHANICAL ROOM ON BETWEEN FURNACE AND RED BURNER/BOX/WHITE FURNACE GASKET

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Gray	0.0%	98.7%	**1.3% Chrysotile**	

Client Sample ID: FG-01B **Lab Sample ID:** **551500844-0017**

Sample Description: MECHANICAL ROOM ON BETWEEN FURNACE AND RED BURNER/BOX/WHITE FURNACE GASKET

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015			Positive Stop (Not Analyzed)		

Client Sample ID: FG-01C **Lab Sample ID:** **551500844-0018**

Sample Description: MECHANICAL ROOM ON BETWEEN FURNACE AND RED BURNER/BOX/WHITE FURNACE GASKET

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015			Positive Stop (Not Analyzed)		

Client Sample ID: PS-01A **Lab Sample ID:** **551500844-0019**

Sample Description: EAST CORNER OF MECHANICAL ROOM ON PIPING/BROWN PIPE SEALANT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Brown	0.0%	100%	None Detected	

Client Sample ID: PS-01B **Lab Sample ID:** **551500844-0020**

Sample Description: EAST CORNER OF MECHANICAL ROOM ON PIPING/BROWN PIPE SEALANT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Brown	0.0%	100%	None Detected	

Client Sample ID: PS-01C **Lab Sample ID:** **551500844-0021**

Sample Description: EAST CORNER OF MECHANICAL ROOM ON PIPING/BROWN PIPE SEALANT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Brown	0.0%	100%	None Detected	

Client Sample ID: PS-02A **Lab Sample ID:** **551500844-0022**

Sample Description: ON 2" SPRINKLER SYSTEM IN ATTIC SPACE/LIGHT BLUE PIPE SEALANT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Blue	0.0%	100%	None Detected	

Client Sample ID: PS-02B **Lab Sample ID:** **551500844-0023**

Sample Description: ON 2" SPRINKLER SYSTEM IN ATTIC SPACE/LIGHT BLUE PIPE SEALANT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Blue	0.0%	100%	None Detected	

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EMSL Canada Order 551500844
Customer ID: 55JACQ30N
Customer PO: 123220212.200
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: PS-02C **Lab Sample ID:** **551500844-0024**
Sample Description: ON 2" SPRINKLER SYSTEM IN ATTIC SPACE/LIGHT BLUE PIPE SEALANT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Blue	0.0%	100%	None Detected	

Client Sample ID: PW-01A **Lab Sample ID:** **551500844-0025**
Sample Description: SOUTH WEST CORNER OF MECHANICAL ROOM/WHITE PIPE WRAP

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015	White/Beige	50%	30%	**20% Chrysotile**	

Client Sample ID: PW-01B **Lab Sample ID:** **551500844-0026**
Sample Description: SOUTH WEST CORNER OF MECHANICAL ROOM/WHITE PIPE WRAP

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015				Stop Positive (Not Analyzed)	

Client Sample ID: PW-01C **Lab Sample ID:** **551500844-0027**
Sample Description: SOUTH WEST CORNER OF MECHANICAL ROOM/WHITE PIPE WRAP

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015				Stop Positive (Not Analyzed)	

Client Sample ID: PW-02A **Lab Sample ID:** **551500844-0028**
Sample Description: OUTSIDE OF NORTH END MEN'S WASHROOM/GREY PAINTED PIPE WRAP

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015	Gray/Black/Beige	55%	45%	None Detected	

Client Sample ID: PW-02B **Lab Sample ID:** **551500844-0029**
Sample Description: OUTSIDE OF NORTH END MEN'S WASHROOM/GREY PAINTED PIPE WRAP

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015	Gray/Black/Beige	55%	45%	None Detected	

Client Sample ID: PW-02C **Lab Sample ID:** **551500844-0030**
Sample Description: OUTSIDE OF NORTH END MEN'S WASHROOM/GREY PAINTED PIPE WRAP

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	2/02/2015	Black/Beige	60%	40%	None Detected	

Client Sample ID: DW-01A **Lab Sample ID:** **551500844-0031**
Sample Description: SOUTH EAST CORNER OF STAGE/BLACK DUCT WRAP

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015	Brown/Black/Beige	60%	40%	None Detected	

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Project ID:

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Client Sample ID: DW-01B **Lab Sample ID:** **551500844-0032**
Sample Description: SOUTH EAST CORNER OF STAGE/BLACK DUCT WRAP

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	1/29/2015	Brown/Black/Beige	60%	40%	None Detected	

Client Sample ID: DW-01C **Lab Sample ID:** **551500844-0033**
Sample Description: SOUTH EAST CORNER OF STAGE/BLACK DUCT WRAP

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/02/2015	Black/Beige	60%	40%	None Detected	

Client Sample ID: DM-01A **Lab Sample ID:** **551500844-0034**
Sample Description: SOUTH WEST CORNER OF STAGE/BROWN DUCT MASTIC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Brown	0.0%	100%	None Detected	

Client Sample ID: DM-01B **Lab Sample ID:** **551500844-0035**
Sample Description: SOUTH WEST CORNER OF STAGE/BROWN DUCT MASTIC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Brown	0.0%	100%	None Detected	

Client Sample ID: DM-01C **Lab Sample ID:** **551500844-0036**
Sample Description: SOUTH WEST CORNER OF STAGE/BROWN DUCT MASTIC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Brown	0.0%	100%	None Detected	

Client Sample ID: BP-01A **Lab Sample ID:** **551500844-0037**
Sample Description: WEST WALL OF MECHANICAL ROOM/BLACK BUILDING PAPER UNDER CEMENT PANEL ON EXTERIOR

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Black	0.0%	100%	**<0.25% Chrysotile**	

Client Sample ID: BP-01B **Lab Sample ID:** **551500844-0038**
Sample Description: WEST WALL OF MECHANICAL ROOM/BLACK BUILDING PAPER UNDER CEMENT PANEL ON EXTERIOR

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Black	0.0%	100%	**<0.25% Chrysotile**	

Client Sample ID: BP-01C **Lab Sample ID:** **551500844-0039**
Sample Description: WEST WALL OF MECHANICAL ROOM/BLACK BUILDING PAPER UNDER CEMENT PANEL ON EXTERIOR

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Black	0.0%	100%	**<0.25% Chrysotile**	

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Client Sample ID: MG-01A ***Lab Sample ID:*** **551500844-0040**

Sample Description: MECHANICAL ROOM ON RED VIKING FITTING/BLACK MECHANICAL GASKET

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Black	0.0%	100%	None Detected	

Client Sample ID: MG-01B ***Lab Sample ID:*** **551500844-0041**

Sample Description: MECHANICAL ROOM ON RED VIKING FITTING/BLACK MECHANICAL GASKET

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Black	0.0%	100%	None Detected	

Client Sample ID: MG-01C ***Lab Sample ID:*** **551500844-0042**

Sample Description: MECHANICAL ROOM ON RED VIKING FITTING/BLACK MECHANICAL GASKET

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Black	0.0%	100%	None Detected	

Client Sample ID: CTG-01A ***Lab Sample ID:*** **551500844-0043**

Sample Description: NORTH END MEN'S WASHROOM/WHITE CERAMIC TILE GROUT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/30/2015	White	0%	100%	None Detected	

Client Sample ID: CTG-01B ***Lab Sample ID:*** **551500844-0044**

Sample Description: NORTH END MEN'S WASHROOM/WHITE CERAMIC TILE GROUT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/30/2015	White	0%	100%	None Detected	

Client Sample ID: CTG-01C ***Lab Sample ID:*** **551500844-0045**

Sample Description: NORTH END MEN'S WASHROOM/WHITE CERAMIC TILE GROUT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/30/2015	White	0%	100%	None Detected	

Client Sample ID: CTG-02A ***Lab Sample ID:*** **551500844-0046**

Sample Description: NORTH EAST OUTSIDE WOMEN'S WASHROOM/WHITE CERAMIC TILE GROUT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/30/2015	White	0%	100%	None Detected	

Client Sample ID: CTG-02B ***Lab Sample ID:*** **551500844-0047**

Sample Description: NORTH EAST OUTSIDE WOMEN'S WASHROOM/WHITE CERAMIC TILE GROUT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/30/2015	White	0%	100%	None Detected	

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Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: CTG-02C ***Lab Sample ID:*** **551500844-0048**

Sample Description: NORTH EAST JANITOR ROOM/WHITE CERAMIC TILE GROUT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	1/30/2015	White	0%	100%	None Detected	

Client Sample ID: SF-01 ***Lab Sample ID:*** **551500844-0049**

Sample Description: NORTH EAST HANDICAP WASHROOM/TANNED SHEET FLOORING

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Beige	0.0%	100%	None Detected	

Client Sample ID: SF-02 ***Lab Sample ID:*** **551500844-0050**

Sample Description: NORTH EAST JANITOR ROOM/TANNED SHEET FLOORING

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	1/30/2015	Gray	0.0%	100%	None Detected	

Client Sample ID: DJC-01A ***Lab Sample ID:*** **551500844-0051**

Sample Description: MECHANICAL ROOM AT NORTH EAST DOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	1/29/2015	Beige	0%	98%	**2% Chrysotile**	

Client Sample ID: DJC-01B ***Lab Sample ID:*** **551500844-0052**

Sample Description: HALLWAYS BEHIND STAGE AT SOUTH WEST DOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	1/29/2015				Stop Positive (Not Analyzed)	

Client Sample ID: DJC-01C ***Lab Sample ID:*** **551500844-0053**

Sample Description: LANDING IN STAIRWELL C ON MAIN FLOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	1/29/2015				Stop Positive (Not Analyzed)	

Client Sample ID: DJC-01D ***Lab Sample ID:*** **551500844-0054**

Sample Description: CORRIDOR OUTSIDE STAIRWELL G ON MAIN FLOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	1/29/2015				Stop Positive (Not Analyzed)	

Client Sample ID: DJC-01E ***Lab Sample ID:*** **551500844-0055**

Sample Description: INTERIOR WALL IN STAIRWELL A ON MAIN FLOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	1/29/2015				Stop Positive (Not Analyzed)	

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Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: DJC-02A **Lab Sample ID:** **551500844-0056**

Sample Description: EAST WALL IN LIBRARY/MEETING ROOM ON THIRD FLOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015	Beige	0%	98%	2% Chrysotile	

Client Sample ID: DJC-02B **Lab Sample ID:** **551500844-0057**

Sample Description: LANDING IN STAIRWELL E ON THIRD FLOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

Client Sample ID: DJC-02C **Lab Sample ID:** **551500844-0058**

Sample Description: LANDING IN STAIRWELL H ON THIRD FLOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

Client Sample ID: DJC-03A **Lab Sample ID:** **551500844-0059**

Sample Description: LANDING IN STAIRWELL H ON SECOND FLOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015	Beige	0%	98%	2% Chrysotile	

Client Sample ID: DJC-03B **Lab Sample ID:** **551500844-0060**

Sample Description: NORTH WEST ROOM FROM CORRIDOR ON SECOND FLOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

Client Sample ID: DJC-03C **Lab Sample ID:** **551500844-0061**

Sample Description: LANDING IN STAIRWELL G ON SECOND FLOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

Client Sample ID: DJC-03D **Lab Sample ID:** **551500844-0062**

Sample Description: NORTH EAST WALL IN PINRAIL GALLERY/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

Client Sample ID: DJC-03E **Lab Sample ID:** **551500844-0063**

Sample Description: LANDING IN STAIRWELL E ON SECOND FLOOR/DRY WALL JOINT COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/29/2015			Stop Positive (Not Analyzed)		

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Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Analyst(s):

Jefferson Salvador	PLM (11)
John Biesiadecki	PLM (4) PLM Grav. Reduction (16)
Kate Fee	PLM (2)
Nicole Yeo	PLM (2) PLM Grav. Reduction (8)

Reviewed and approved by:

Matthew Davis
or Other Approved Signatory

None Detected = <0.5%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Calgary, AB

Initial report from: 02/02/201513:16:55

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EMSL Canada Order 551500974
Customer ID: 55JACQ30L
Customer PO: 123220212
Project ID:

Attn: Keith Irwin
Stantec Consulting, Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Collected:
Received: 1/29/2015
Analyzed: 1/30/2015

Proj: 123220212

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: CDP-0A ***Lab Sample ID:*** **551500974-0001**
Sample Description: CRAWL SPACE HATCH/FIBROUS DEBRIS

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/30/2015	Gray	0%	50%	**50% Chrysotile**	

Client Sample ID: CDP-0B ***Lab Sample ID:*** **551500974-0002**
Sample Description: CRAWL SPACE HATCH/FIBROUS DEBRIS

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/30/2015				Stop Positive (Not Analyzed)	

Client Sample ID: CDP-0C ***Lab Sample ID:*** **551500974-0003**
Sample Description: CRAWL SPACE HATCH/FIBROUS DEBRIS

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	1/30/2015				Stop Positive (Not Analyzed)	

Analyst(s):

John Biesiadecki PLM (1)

Reviewed and approved by:

Matthew Davis
or Other Approved Signatory

None Detected = <0.5%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Initial report from: 02/05/201513:58:28

APPENDIX D
CERTIFICATE OF ANALYSIS – SUSPECTED LCP SAMPLES

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EMSL Canada Or	551500839
CustomerID:	55JACQ30L
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ProjectID:	

Attn: **Keith Irwin**
Stantec Consulting, Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Received: 01/26/15 11:23 AM
Collected:

Project: **123220212.200**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Lead Concentration*
P-01	*551500839-0001*		1/28/2015	3600 ppm
	Site: FURNACE DUCT Desc: GREY			
P-02	*551500839-0002*		1/28/2015	<90 ppm
	Site: STAGE WALLS Desc: BLACK			
P-03	*551500839-0003*		1/28/2015	240 ppm
	Site: EMERGENCY STAIRWELL Desc: WHITE			
P-04	*551500839-0004*		1/28/2015	1700 ppm
	Site: MECHANICAL ROOM Desc: GREY			
P-05	*551500839-0005*		1/28/2015	<90 ppm
	Site: EXTERIOR TRIM Desc: GREY			

Lisa Podzyhun
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % 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 that 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 established by the AIHA-LAP, unless specifically indicated otherwise.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 01/30/2015 14:42:05

APPENDIX C
Geotechnical Report-Backround

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a division of Amec Foster Wheeler Americas Limited
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Geotechnical Site Assessment
Proposed Renovation of the Palace Grand Theatre
Dawson City, YT

Submitted to:

Public Works and Government Services Canada
Vancouver, BC

Submitted by:

Amec Foster Wheeler Environment & Infrastructure,
a division of Amec Foster Wheeler Americas Limited

Surrey, BC

18 February 2015

Amec Foster Wheeler File: KA21109

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1.0 INTRODUCTION

Further to our proposal of September 2, 2014, Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler) presents this preliminary geotechnical site assessment report for the proposed renovation of the Palace Grand Theatre in Dawson City, YT. The site location, as shown in Figure 1, is in downtown Dawson City in the valley of the Yukon River.

The theatre was built in 1962 and is modelled on a previous theatre constructed in the time of the Klondike Gold Rush. The three storey theatre is a wood framed building constructed on approximately 250 to 300mm diameter timber piles with an unheated crawl space. Soil-related movement and related distress to the building has been reported over time and accordingly, we have been retained to provide geotechnical input into the building renovation which could include replacement and/or modifications to the existing foundations.

Photo 1: Front/west side of Theatre, viewing northeast

2.0 FIELD WORK

Amec Foster Wheeler visited the site on October 7, 2014, to observe the condition of the theatre and nearby infrastructure and plan out the drilling investigation. The subsurface exploration program was conducted by Amec Foster Wheeler on October 28 and November 14, 2014. Due to a breakdown of the ODEX compressor, the drilling ceased on October 28. Drilling was limited to one borehole on November 14 due to the loss of the ODEX hammer in dense cobbles and boulders at a depth of about 13 m in BH14-01. Drilling conditions in the sand and gravel are

difficult and drilled pile installations will require specialty equipment. Drilling difficulties are described in some of the other reports noted in Section 2.1 below.

Prior to drilling, Amec Foster Wheeler contacted various underground utility operators in Dawson City, including the city operations department, local gas, telephone and electric power companies. A total of four boreholes, BH14-01 to BH14-04 were advanced using a truck-mounted auger drill rig equipped with ODEX to a depth of up to 13 m. The attached Figure 2 is a site plan showing borehole locations.

An Amec Foster Wheeler representative located the boreholes, recorded the soil conditions encountered and collected soil samples. The soil samples were submitted to Amec Foster Wheeler's Surrey Civil Engineering Laboratory to confirm field classifications and to determine the moisture content and other soil properties. Borehole logs are presented in Appendix A. Laboratory test results are presented on the borehole logs.

The boreholes were backfilled with cut material immediately after the drilling was completed and sealed at the surface with bentonite pellets.

Photo 2: Drilling at BH14-01

2.1 Review of Existing Information

The following existing geotechnical information from the vicinity was reviewed as part of our work.

- Palace Grand Theatre, Code Upgrade Assessment
  Number Ten Architecture, March 2014
- Palace Grand Theatre, Structural Assessment
  Stantec, March 2014

- Surficial Geology Map and Summary Report of the Dawson Area, Geological Survey of Canada, NTS 116 B and C
- Geophysical and Borehole Investigations of Permafrost Conditions Associated with Compromised Infrastructure in Dawson and Ross River, Yukon Laxton & Coates, 2010
- Geotechnical Investigation, Fry Recreational Centre, Dawson City, YT Chilkoot Geological Engineers Ltd, 2010
- Discussions of Local Soil Conditions with Parks Canada and City of Dawson Operations Staff
- Original 1962 Structural foundation drawings, S-1 and S-2

3.0 SITE CONDITIONS

3.1 Theatre Building

The theatre fronts on King Street to the south, residential properties to the east and north beyond which are Third Avenue and York Street respectively. To the west is a parking lot beyond which is Second Avenue. The theatre is approximately 36 m X 14 m in plan area with an irregularly shaped, one storey utility room attached to the northeast quadrant. Stairwells have been constructed onto the midpoint of the east and west sides of the theatre building. The west stairwell is visible in Photo 1. The main floor of the theatre is approximately 0.9 m above surrounding grade and underlain by a crawl space. The crawl space has an irregular surface comprised of silt/sand soil.

The building is reportedly heated by forced air circulation from a furnace in the utility room from mid-April to September. The theatre is unheated during the winter months except for the utility room which is heated year round.

Main Theatre

During our visit of October 7, 2014, the following observations were made relating to the main part of the theatre:

- The main part of the theatre itself appears to be in good functional condition without obvious signs of large scale settlement damage.
- Beneath the theatre, the crawl space floor was damp with intermittent puddles. The floor surface was unfrozen and relatively stiff such that it could support foot traffic.
- Past movements of the foundations appear to have occurred in at least two locations on the west side of the building. Beneath the west side of the stage, a pile has rotated/moved upward and laterally about 500 mm so that it is not connected to the overlying structure. Another pile has moved about 25 mm upward beneath the western beam in the main concert hall area, causing a rise in the main floor level at that location. The section of beam connected to the top of this pile had rotated noticeably such that the beam was 5° or more from the horizontal, indicating that the uplift force had a lateral component.

- Cribbing had been placed, reportedly in 2008, on top of gravel pads placed on the crawl space floor, at regular intervals beneath the entire western wall beam of the theatre. The cribs have settled up to about 50 mm, due to settlement of the crawl space floor, relative to the beam such that the top of the cribbing was not everywhere in contact with the beam. Shims had been placed between the top of the cribbing and beam intermittently along the length of the beam. Intermittent gaps were present between the cribbing/shims and overlying beam.
- The crawl space floor has a sub-surface drain which runs from the north/central part of the building to a manhole located beneath the wooden sidewalk near the southeast corner of the building.
- This manhole is 1.65 m deep and is connected to the storm drain beneath King Street. This storm drain is reported to be at similar depth by the City Works Manager. Another storm drain is reported to be at similar depth beneath York Street.
- The theatre has several downspouts. These empty out onto the ground surface outside of the building perimeter.
- The east side of the theatre and utility room has 0.9 m high plywood skirting equipped with vents at approximately one metre intervals. On the south and west sides, there is an approximately 300 mm high boardwalk on the building exterior. There are no skirting vents on the south, west and north sides of the building but the boardwalk and/or skirting is not air tight such that cold air penetrates through gaps in the wooden boards.
- The west side of the building is bordered by an empty lot which could enable windblown snow to accumulate against the west side of the building. The other sides are sheltered somewhat by nearby structures.
- Parks Canada representatives reported that the crawl space of the building was often wet during the summer months such that they were concerned with rotting timbers and mold. Accordingly they periodically vented the crawl space in the summer to alleviate the humidity in the crawl space.
- Further to the third bullet point above, the structural engineer has reported that the existing piles appear to be vertical but the perimeter north/south beams, which rest on top of piles, have rotated such that the base of the beam has moved toward the middle of the building. Accordingly, the perimeter beams and the piles supporting the perimeter beams may require replacement.

Utility Room

With regards to the utility room, we understand that it is in good operational condition with no reported settlement damage to the structure.

The lowest portion of the crawl space floor was beneath the utility room where it contained standing water. The crawl space floor had settled about 0.6 m more beneath the utility room than in the main part of the theatre. For some of the interior utility room piles, unreinforced concrete pads had been constructed around the pile at the original ground surface (the pile continues up to the floor beam another 0.9 m above). The ground beneath the concrete pads had settled about

0.6 m and in one case the concrete had separated from the pile such that there were pieces of concrete on the crawl space floor.

Stairwells

Structural damage is apparent in the east and west emergency stairwells. The east stairwell has settled/rotated away from the main part of the building such that water ingress and related water damage is apparent. Related unevenness in the stairway floor was not obvious.

The west stairwell exhibits similar separation and water damage in the walls. As well, the west side of the stairway is several centimetres lower than the east/building side, indicating that the west foundation of the stairwell has settled relative to the main part of the building.

3.2 Climate

Air temperatures from 1962 to the present were reviewed, and projected near future air temperatures were assessed. It was found that from 1962 to the present, the mean annual air temperature in Dawson has increased by approximately 1.5 ºC (1962-1966 average air temperature was -5.4 ºC; 2010-2014 average air temperature was -3.9 ºC). It was calculated that the average air temperature from 1962 to 2014 was approximately -4.4 ºC.

Prediction of the future annual air temperatures was undertaken with the use of data in the report "Responding to Global Climate Change in Canada's Arctic, Volume II of Canada Country Study: Climate Impacts and Adaptation (1997)." The report assesses potential changes in air temperatures for the period of time from 1992 to 2100 (108 years) assuming that the content of carbon dioxide will be doubled for the given period of time, and that CO_2 in the atmosphere is the major cause of future temperature changes.

The report mentioned above provides an assessment of the increase in the seasonal air temperature for the central Yukon from 1992 to 2100 (108 years) as follows: March-May at 4 ºC (rate 0.037 ºC/year); June-August at 6 ºC (rate 0.056 ºC/year); September-November at 4 º (rate 0.037 ºC/year); and December-February at 3.5 ºC (rate 0.032 ºC/year). Based on the above calculated rates, the increase of the mean annual air temperature from 2014 to 2050 (36 years) was calculated to be in the order of 0.5°C such that the mean annual air temperature in 2050 is expected to be -3.9 ºC.

3.3 Subsurface Conditions

Surficial geology information indicates that the Dawson City town site area consists of fluvial deposits of the Yukon River interlain by similar deposits from the Klondike River. Shallow peat is present on the surface indicative of a swamp environment on the flood plain prior to construction of the town. Dawson City is in the zone of discontinuous permafrost and accordingly frost lenses can be expected particularly in the upper silty soil beneath the peat.

The boreholes encountered fill on top of the peat, over ice rich frozen silt underlain by dense sand and gravel containing zones with cobbles and boulders.

Fill material consisting of silt, sand and gravel was encountered in the upper 0.2 to 0.6 m of all boreholes on the site. Deeper fill, consisting of a mixture of sand, silt, gravel and organics was encountered to a depth of 1.5 m at BH14-03 and 14-04.

Peat was encountered beneath the fill to a depth of up to 2.0 m at BH14-01 and BH14-02. The peat was soft and dark brown and interlayered with grey silt. It was frozen and contained lenses of ice. Excess ice in the form of free water was apparent in the samples after they had thawed. Most of the peat had been disturbed and/or replaced with fill at the locations of BH14-03 and BH14-04.

Silt/Sand was encountered beneath the peat to a depth ranging from 3.5 to 4.1 m. The material was frozen and contained intermittent frost lenses and excess ice. As per the peat, our samples contained free water after they had thawed, indicative of excess ice.

Sand and Gravel was encountered beneath the silt /sand to the explored depth of 13.1 m. The material was frozen but was relatively dry. Our samples revealed no excess ice. The unit contained layers of cobbles and boulders and in general drilling was difficult. Moisture content in the unit was typically less than ten percent. Portions of the sand and gravel were silty with fines content as high as 20%.

Reports from the area indicate that the sand and gravel is a good foundation material. Recent construction projects have involved excavation down to the sand and gravel and replacement with structural fill or piers excavated down through the peat and silt into the sand and gravel.

Bedrock was not encountered on the site, due to difficulties in drilling through the sand and gravel. Bedrock is reported at a depth of 17 m on the recreation centre site and at a similar depth at the MV Keno site, both within a kilometer of the Palace Grand Theatre.

3.4 Groundwater Conditions

Groundwater was not encountered during drilling in late October and early November, 2014. Thaw of marginally frozen ground, due to heat generated by drilling, and related sloughing did occur at some of the boreholes.

Shallow groundwater is expected to be present in the seasonal active layer during the summer and early fall. The depth of the active layer and amount of groundwater is expected to vary depending on the temperature and rainfall experienced during a specific summer.

Groundwater could be present beneath the seasonal frost and above the permafrost within the building footprint.

3.5 Ground Temperature and Ground Ice Conditions

Thermistor strings were installed in two of the boreholes, BH14-01 and BH14-03 to a depth of up to 6.71 m. The strings were installed inside 25 mm diameter standpipes. The annulus between

the standpipe and the hole was backfilled with the sandy portion of the drill cuttings. The standpipe was not backfilled at all so that the thermistor can be removed and re-used if desired.

Temperature readings are provided below. Parks Canada operations staff will continue to read the thermistors periodically over the next year.

Table 3-1: Temperature Readings

Thermistor Location	Depth (m)	Temperature Readings °C					
		Nov 15, 2014	Nov 26, 2014	Dec 3, 2014	Dec 17, 2014	Jan 7, 2015	Jan 14, 2015
Air temp	Surface	-22	-18	-21	-16.0	-38.0	-9.6
BH 14-01	0.15	-7.8	-7.8	-9.2	-9.4	-22.8	-11.3
	0.20	-6.2	-6.9	-8.7	-8.9	-21.5	-11.2
	0.71	-0.9	-0.7	-1.1	-1.8	-6.1	-5.1
	2.21	-1.2	-1.1	-1.1	-1.1	-1.1	-1.1
	3.71	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9
	5.21	-0.9	-0.9	-0.9	-1.1	-1.1	-1.1
	6.71	-0.5	-0.9	-0.9	-0.9	-0.9	-0.9

Thermistor Location	Depth (m)	Temperature Readings °C	
		14-Nov-14	15-Nov-14
Air temp	Surface	-16	-20
BH 14-03	0.1	-11.3	-13.1
	1.6	-0.93	-0.73
	3.1	-0.78	-0.68
	4.6	-0.56	-0.59

Table 3-1 shows ground temperatures outside the footprint of the theatre building. Due to difference in heat balance parameters influencing the ground temperature outside the building from those within the building footprint, the ground temperature in the crawl space of the footprint may or may not differ considerably from that measured in BH 14-01 and BH 14-03. Results of calculations of the ground temperature within the building footprint and a discussion of interior ground temperatures with a comment relative to the thermistor readings are provided in Section 3.6.

High volumetric ice content was encountered in the upper frozen materials consisting of fill, peat and silt as noted by the moisture contents shown on the borehole logs. The underlying sand and gravel unit was frozen as well, but was relatively dry. No excess ice was observed in the sand and gravel in our boreholes.

3.6 Ground Temperature in the Crawl Space

Ground temperature in the crawl space is a function of numerous thermal parameters such as outside air temperature and room temperature, total plan area of the structure, height of the crawl space, total area of ventilation windows, thermal resistance of floor, thermal resistance of skirt, and average wind speed. The above parameters were assessed based on knowledge of the theatre building design, operation details, and climate data.

The following parameters were used for calculation of the ground temperature in the crawl space:

- Mean annual air temperature from 1962 to 2014: -4.4 ^{o}C;
- Mean annual air temperature in the middle of the 21st century: -3.5 ^{o}C;
- Mean annual room temperature in the unheated portion of the theatre from 1962 to 2014: -1.5 ^{o}C;
- Mean annual room temperature in the unheated portion of the theatre in the middle of the 21st century: -0.6 ^{o}C;
- Mean annual room temperature in the utilities section: +20 ^{o}C;
- Average wind speed: 6600 m/h;
- Thermal resistance of wood floor (unheated theatre): 1 m^2 ^{o}C W^{-1};
- Thermal resistance of concrete floor (utilities section): 0.25 m^2 ^{o}C W^{-1};
- Thermal resistance of skirt: 0.25 m^2 ^{o}C W^{-1};
- Total area of ventilation windows: 0.4275 m^2.

Calculations of the ground temperature were carried out with the use of methodology published in Russian Construction Norms and Rules (SNiP 2.02.04-88, Foundations in Permafrost, Appendix 4, pages 38-40).

Results of calculations have shown that the ground temperature within the crawl space at the present time likely ranges from -0.8 ^{o}C to -1 ^{o}C, similar to the temperatures measured at depth in BH 14-01. However, the ground temperature will gradually warm, and at the middle of the 21st century perhaps will be in the order of +0 ^{o}C to -0.3 ^{o}C, based on “Climate Change guidelines”. As a result of the potential increase of the ground temperature, shallow taliks (i.e., thawed zones that never freeze in subsequent winters) can be developed within the building footprint in the future. It is expected that the taliks will contain groundwater following thawing of the ice rich peat and silt. As the talik deepens there is less adfreeze bond on the piles to resist frost-jacking in the freezing active layer. The pile may potentially heave depending on the building dead load applied to the pile. The reduced adfreeze bond may also result in pile settlement under applied load, especially if little end-bearing capacity is mobilized in the sands and gravels.

From the results of the calculations it is concluded that the mean annual permafrost temperature today within the footprint of the theatre building is likely in the order of -0.8 to -1 ^{o}C which is sufficient for the use of adfreeze piles to support the structural load of the building. The mean annual ground temperature within the footprint will gradually be warmed up in the near future to approximately ±0 ^{o}C, unless measures are taken to prevent ground warming.

Geothermal modelling indicates that preservation of the ground temperature within the footprint in a range of approximately -1 °C is possible, if the total area of the ventilation windows is increased to approximately 1.0 m^2. Placement of rigid insulation either over the entire building footprint or around the piles (existing and proposed) is also recommended. The insulation does not change noticeably the mean annual permafrost temperature, but considerably reduces thickness of the active layer and frost-jacking forces. Results of calculations of the active layer with and without insulation are provided below.

3.7 Thickness of the Active Layer in the Crawl Space

If the total area of the ventilation windows will be increased to approximately 1 m^2, the mean annual permafrost temperature within the crawl space was determined to be slightly below freezing ranging likely from -0.8 to -1 °C. The simple Stefan's equation which does not consider influence of the permafrost temperature to the active layer thickness was modified for a soil profile consisting of 2 layers. Based on results of the drilling, it was assumed that the soil profile includes an upper peat layer, 2 m thick, underlain with silt. The physical and thermal properties of the identified soils and thaw index used in calculations are provided in Table 3-2. It was assessed based on data in Section 3.2 that the thaw index in the middle of the 21st century will be approximately 1650 degree-days, just marginally greater than the average thaw index from 1962 to 2014 (1560 degree-days).

Table 3-2: Soil Properties

Soil	Dry Density, kg/m^3	Moisture Content, %	Thermal Unfrozen Conductivity, W/m/°K	Heat Unfrozen Capacity, MJ/m^3/°C	Thaw Index, degree-days
Peat	500	50	0.93	0.77	1650
Silt	1600	35	1.75	1.84	

The calculations were carried out for 3 scenarios: 1) no insulation on the ground surface; 2) a 50 mm thick layer of STYROFOAM insulation on the ground surface; 3) a 100 mm thick layer of STYROFOAM insulation on the ground surface. Results of the calculations are provided in Table 3-3.

Table 3-3: Active Layer Thickness

Scenario	Active Layer Thickness, m
No insulation	2.3
50 mm insulation	1.6
100 mm insulation	1.2

4.0 DISCUSSION

If no mitigation measures are undertaken, long term thaw can occur to a considerable depth beneath the building in the near future, if the premises concerning global warming predictions are accepted. Accordingly, there is a possibility of additional future movements within the upper fill, silt and peat and possibility of jacking of piles that do not have adequate penetration into the sand and gravel. In other words, the frost related movement that has occurred in the past can be expected to continue into the future, and could become worse (as there is less embedment in frozen ground to resist seasonal frost heaving in the upper part of the pile). Saturation of soils with melting water will contribute to an increase of frost heaving in the upper freeze/thaw zone.

Because the building is apparently supported on relatively long piles, settling/heaving movements in the upper soils do not presently impact the stability of such piles and overall integrity of the structure. However, some of the piles may not be deep enough to resist uplift forces due to freeze/thaw of the active layer.

We understand that the cribbing on the west side of the building was installed as a backup measure in 2008 in case lateral/uplift movements of the piles continued or worsened (if the overlying beam became disconnected with the piles it would be supported by the cribbing). It appears that the cribbing is not presently required for support and can be removed following selective remediation/replacement of the affected piles.

With regard to foundation reconstruction, in our opinion, the main foyer, concert hall and stage area are presently in reasonable condition without signs of extreme settlement damage. Subject to implementation of the drainage, insulation and ventilation measures recommended in the following sections, and input from the structural engineer, it may be possible to keep some of the existing pile foundations with some adjustments which could include selective replacement of piles, pile caps and beams to level the building. Entire reconstruction of the foundation involving excavation and replacement of the ice rich permafrost with clean granular fill, temporary re-location and/or large scale lifting of the building is not considered to be necessary.

Similarly, the utility room appears to be in good condition and it may be possible to maintain the existing foundations. The purpose of the aforementioned concrete pads on the original crawl space floor is unclear. Additional lateral support may be required for some of the piles and connections at the top of the piles as directed by the structural engineer. We expect that the mitigation measures described in the following sections will enhance the lateral stability of the existing piles as well.

The 1962 drawings show that the stairwells are each supported on two piles beneath the exterior walls. These piles are too short or otherwise inadequate and have settled and/or moved laterally such that the stairwells have settled/rotated relative to the main part of the theatre. It is our opinion that the stairwells, especially on the west side of the building, are in poor condition and require reconstruction with new foundations.

Surface water and shallow groundwater likely contribute to an increase of permafrost temperature and increase the extent of seasonal and long term thaw. It is our opinion that the situation can be enhanced by improving drainage, regardless of the foundation remediation measures selected. Drainage improvements are also expected to improve the crawl space humidity problem noted in the summer time.

Insulation installed beneath and parallel to the crawl space floor combined with improved ventilation of the crawl space would reduce the thickness of the active layer and frost heave forces acting on the piles.

5.0 RECOMMENDATIONS

5.1 Drainage

The site is poorly drained, with water and general wetness observed in the crawl space. The following drainage improvement measures are expected to reduce the magnitude of seasonal and long term thaw and reduce humidity in the summer time and control mold development.

- Following the implementation of structural improvements, the crawl space should be filled to the desired level (we envisage this to be about 1.0 to 1.2 m below floor level) with clean granular fill containing less than 5% fines. A 19 mm minus crushed sand and gravel would suit this purpose. The fill should be at least 300 mm thick.
- The crawl space surface should be crowned along a north/south line in the middle of the building with a 2% grade down to the east and west.
- Drains, consisting of 150 mm diameter perforated pipe covered with drain rock all wrapped in non-woven geotextile/filter cloth should be installed beneath the crawl space floor at 5 m intervals from north to south. The exact location of the drains is flexible and can be altered to avoid foundations and related insulation. The drains should be at least 300 mm deep, immediately below the insulation which can be installed, and start at the centreline of the crawl space and grade downward toward the east or west building perimeter at a minimum gradient of 2%.
- The existing crawl space drain should be left in place or if convenient, connected into the new drains.
- Following the installation of the drains and granular fill, the crawl space floor should be surfaced with a concrete mud slab. A vapour barrier could be installed beneath the mud slab if desired.
- The crawl space floor drains should connect into a perimeter drain constructed around the building. The perimeter drain should be at least 1 m deep and consist of 300 mm diameter perforated pipe covered in at least 300 mm of drain rock all wrapped in filter cloth. The trench above the drain installation should be filled with a free draining material such as 150 mm minus broken rock.
- The perimeter drain should be installed at a minimum 2% gradient down to the City storm drain beneath King Street. Part of the perimeter drain could connect into the storm drain beneath York Street on the north side of the site if that is convenient. The existing manhole beneath the boardwalk at the southeast corner of the site can be

incorporated into the drainage scheme if desired. Such a measure could reduce the number of new connections required into the city storm drainage system.

- Downspouts, which currently discharge onto the ground, should be connected into the new perimeter drainage network.

5.2 Ventilation and Insulation

The wooden skirting along the east side of the building is about 0.9 m high and has ventilation windows at regular 1 m to 1.5 m intervals. It was assessed that the total area of the ventilation windows is approximately 0.4275 m^2. Mitigation measures should include an increase of the total area of the ventilation windows to 1.0 m^2. Such increase of the ventilation windows allows provision of the permafrost temperature beneath the building in the order of approximately -1 ^oC at least to the middle of the 21st century. The total area of the ventilation windows can be further increased to approximately 1.2 m^2, and the windows be provided with blinds to adjust the open area, if needed. Ventilation windows are not provided along the other sides of the building, which may explain in part why the west side of the building has experienced more freeze/thaw related movements than the east side. If temperatures do not respond as predicted then it would be possible to convert to a forced air system which should include a powerful air intake (fan) which draws external winter air and blows it by a pipe into the crawl space. More engineering recommendations on application of the forced ventilation system can be provided upon request.

Due to considerable heat release from the floor of the utility room, air should be allowed into the crawl space during the summer months (May through September) unless the floor of the utility room is insulated with at least a 25 mm thick layer of STYROFOAM insulation.

It is recommended that the skirting on the west side of the building be constructed in a similar manner to the skirting on the east side (ie: 0.9 m high with ventilation windows at regular intervals, providing the total area of the ventilation windows around the building is at least 0.9 m^2).

In order to reduce the thickness of the active layer, 50 mm or 100 mm thick sheets of Styrofoam SM insulation may be installed about 300 mm below the ground surface over the entire footprint area, or for a distance of 5 m around existing timber piles (and newly installed piles).

5.3 Foundations

For the main theatre building and utility room, we expect that the use of some of the existing timber piles will continue, depending on the findings of the structural engineer. Some select piles on the perimeter of the building, presently augmented with cribbing on the west side, may require replacement, new pile caps, re-setting and/or replacement of overlying beams as directed by the structural engineer.

If required, it may be possible to install new piles at select locations along the west building exterior perimeter, connected by a beam to another new or existing pile further to the east or even to the east perimeter pending input by the structural engineer.

Significant damage was observed in the stairwells which will likely require new foundations and replacement.

We envisage that new piles will be adfreeze piles with the annulus between the pile and hole wall backfilled with sand slurry or grout. The drilling method must be able to drill and case through the sand and gravel. Parts of the existing floor may require removal and replacement to allow equipment access to the building interior, if new interior piles are required.

Driven steel piles, using large equipment that can penetrate the sand and gravel, if predrilled, are not recommended (unless the building is moved onto a new foundation at a nearby site) due to the potential for damage to the building.

Pile foundations should be designed in accordance with the National Building Code of Canada (NBCC) 2010 which is based on Limit States Methodology. This methodology requires determination of pile design parameters for the Ultimate Limit State (determines pile capacity) and Serviceability Limit State (determines pile deformation). Due to the absence of long term strength for ice, the adfreeze pile design is usually governed by the adfreeze bond of the Serviceability Limit State for pile settlement of 1 mm/year. The end bearing resistance usually is not incorporated in the adfreeze pile design due to the uncertainty in ice content and hole conditions at the pile tip depth.

According to the expected soil profile, ice contents and ground temperatures (if mitigation measures will be implemented), adfreeze piles (steel pipe or timber or adfreeze micropiles with diameter not less than 150 mm may be designed applying the following values:

Table 5-1: Ultimate and Serviceability Adfreeze Bonds

Depth of Pile Below Final Grade (m)	Ultimate Bond (kPa)	Serviceability Bond (kPa)
0 to 2 (peat)	0	0
2 to 4 (silt) if insulation 2.3 to 4 if no insulation	100	15
Below 4 (sand and gravel)	150	20

In order to determine the factored geotechnical resistance in compression at the Ultimate Limit State, the Ultimate Adfreeze Bond (Table 5-1) should be multiplied by a geotechnical resistance factor of 0.4. Table 5-1 shows that irrespective of insulation application, the peat layer is ignored for assessment of the adfreeze bond due to a very low serviceability bond.

As was mentioned above, the adfreeze strength under Serviceability Limit States design is controlled by the creep deformation characteristics of ice-rich material and the bond strength to resist uplift on piles due to seasonal frost action. This design capacity is for long-term loading including snow and permanent occupancy loads. Stresses due to short-term live loads, such as wind and daily occupancy loads in effect for less than 50 percent of the time (over a short term),

may be taken as 30 percent greater than the values given above. The adfreeze capacity of the piles should be calculated using the pile-slurry interface (the outside diameter of the pile).

The upper portion of the pile, within the active layer (see Table 3-3), should be coated with arctic heavy grease and wrapped with polyethylene sheets also coated with arctic heavy grease (or equivalent) to reduce the potential for pile uplift forces. A minimum embedment length of the pile should be calculated by a structural engineer based on structural loading, serviceability adfreeze bond provided in Table 5-1, and frost heave stress. The upper (2 m or 2.3 m if no insulation will be placed) portion of the pile should also be considered as laterally unsupported for design purposes, including seismic loading. The minimum centre-to-centre spacing of the designed adfreeze piles should be three pile diameters.

Steel pipe and timber adfreeze piles develop load carrying capacity based on the adfreeze bond between the frozen backfill and the pile material. Where steel pipe piles are used, it is essential that the steel pile below the 2-2.3 m depth be properly cleaned and free of paint, lacquer, oil, grease, dirt and excessive rust to promote the development of a good bond. Round hollow structural section (HSS) steel is recommended as the material for the piles. Alternatively, timber piles may be considered instead of steel. For adfreeze micropiles, the load carrying capacity is based on the adfreeze bond between the grout and the frozen soil.

Adfreeze piles should be installed in pre-drilled oversized holes. To obtain proper backfill of the pile-hole annulus with sand slurry (steel pipe piles and timber piles), it is important to partially backfill about half of the hole with a mixture of non-saline sand and fresh water prior to installing the pile. The pile should then be pushed and vibrated down to the bottom of the hole, at the same time, adding more sand and fresh water mixture around the pile-hole annulus. Piles installed in the manner described above will require a pile hole at least 50 mm in diameter larger than the outside diameter of the pile. If it is impractical to fill half of the hole with the sand slurry prior to placing the pile, then the hole diameter should be in the order of 100 mm larger than the pile diameter to facilitate good slurry placement. If steel piles are adopted, the interior of the piles should also be filled with dry, non-saline sand or fine gravel to 1 m below the final ground elevation or pile cut-off whichever is lower to preclude air circulation inside the pile.

If gravel slurry is used for the backfilling of holes with steel pipe/timber piles, then the hole should be filled with fresh water to about 30 percent of the pile embedment. The pile should then be lowered in the hole, and the pile-hole annulus should be filled up with the gravel (5 mm to 7 mm minus crushed gravel) and fresh water to the ground surface. The inside of the pile (for steel section) should be filled up with gravel to 1 m below the final ground elevation or pile cut-off whichever is lower to preclude air circulation inside the pile.

Sika 100 Arctic grout is recommended if grout will be used for backfilling either steel pipe/timber piles or micropiles.

Freeze-back around the piles may be expected to occur in about one to two months if the piles are installed during late winter or early spring. Freeze-back may take longer to develop the full

capacity of the piles if the piles are installed in later summer. It is recommended that field monitoring of freezing back rate be performed in selected piles using thermistor cables.

Difficult drilling in the frozen sand and gravel containing cobbles/boulders should be expected. A piling rig should have sufficient capability to remove the obstructions and advance through hard material.

In spite of coating the upper portion of the piles with arctic heavy grease and wrapping with polyethylene sheets, the frost heave stress of 110 kPa should be considered as unfactored ultimate force and applied to the thickness of the active layer (Table 3-3). In general, frost heave stress within the influence zone must be resisted by the minimum structural load on the pile plus the shaft resistance within non-heaving founding strata. For assessment of the geotechnical resistance of the adfreeze pile at the Ultimate Limit State, frost heave forces are not considered to be additive to other tension loads and should consider several separate structural load cases. The pile should be designed for the most critical of these cases.

For the assessment of pile displacement (Serviceability Limit State design), the structural designer should check that the displacements due to the applied forces are within acceptable limits. Under Serviceability Limit State conditions, the frost heave forces (110 kPa) should be additive to structural tension loads, and this combination should be assessed. Based on this load combination, the pile settlement or uplift under applicable compression loading should be checked.

We can carry out lateral pile analysis at your request, however, such is additional to the present scope of work.

The existing theatre building is founded on driven timber piles which are believed to be based in the sand and gravel unit. In our opinion, most of these piles are in operational condition and should continue to be used for foundation support of the building. Their depth has not been reported in available records, but is expected to be in the order of 6 to 8m, where the timbers could have met refusal on dense cobble/boulder layers. Some of the piles may have reached refusal at more shallow depth, which can be speculated to explain the performance of some piles.

Two methods of driven timber pile installation might have been used in 1962. The first method involved the drilling of pilot holes, with diameter smaller than the pile, into the sand and gravel using a downhole hammer or tri-cone bit. The second method involved steaming of frozen peat and silt to the top of the sand and gravel. If the first method was used, then the pile embedment is likely slightly greater than the pre-drilled depth and consistent with the range of depths noted above. If steaming was used, the minimum pile embedment is likely 4 m, and likely seated on the sand/gravel layer.

The following parameters should be used to estimate the capacity of the existing timber piles:

- A minimum pile embedment depth of 4m (using the worst case described above);
- An end bearing resistance of 350 kPa in serviceability limit state and 1500 kPa in unfactored ultimate limit state;
- The adfreeze bond values provided in Table 5-1.

Piles that do not meet requirements for location and/or plumbness, or are rotted in more than 10% of their diameter should be cut off at ground level.

5.4 Seismic Considerations

The NBCC requires that structures be designed to resist collapse when subjected to "strong shaking", defined as ground motions with a return period of 1 in 2,475 years (or two percent probability of exceedance in 50 years).

A secondary objective of the code is to limit damage to buildings caused by low to moderate shaking. NBCC has adopted the use of foundation factors dependent on analysis of ground motion histories adjusted for local site conditions, characterized based on the average shear wave velocity and relative density of the earth materials in the uppermost 30 m. Based on the presence of compact to dense sand and gravel below 4 m of ice rich peat and silt, the site should be classified as **Site Class D** in conformance with Table 4.1.8.4 A of the 2010 NBCC.

The geotechnical characterization of seismic site response is based on published ground motions and assumed subsurface stratigraphy and does not take into account potential focusing effects of topography. If it is found that seismic forces govern the design and small changes in the values used significantly alter the design requirements, site specific analysis may be warranted.

Peak Ground Acceleration (PGA) of 0.20 g should be used for Dawson City.

The sand and gravel is not expected to be liquefiable during the design earthquake. The upper materials could liquefy when thawed under both static and design seismic conditions. The recommended drainage, ventilation and insulation measures to reduce seasonal thaw will also enhance seismic performance. The site is relatively flat such that large lateral displacements due to the design earthquake are not anticipated.

6.0 FURTHER WORK

The following further work is underway or recommended in order to finalize the design:

- Discussion with the structural engineer and design team in order to determine the specific location of new piles. Access to these foundations will be an important consideration in the building renovation.
- Discuss with the structural engineer and design team locations of shallow holes to monitor ground temperature with thermistor cables. More details on equipment and

design of the holes will be provided if a decision on implementing of the monitoring study will be made.

- Review/discussion of the ventilation plan for the renovated structure.
- Discussion on pile types and equipment best suited for the site.

7.0 LIMITATIONS AND CLOSURE

The recommendations presented herein are based on a geotechnical evaluation of the findings of the site exploration and other information deemed relevant to the assessment. The material in this report reflects Amec Foster Wheeler's judgement in light of the information available to Amec Foster Wheeler at the time of preparation of the report.

If conditions other than those are noted during subsequent phases of the project, Amec Foster Wheeler should be notified and given the opportunity to review and revise the current recommendations, if necessary. Recommendations presented herein may not be valid if an adequate level of field review is not provided during construction or if relevant code requirements are not met.

This report has been prepared for the exclusive use of Public Works and Government Services Canada for the specific application to the development described within this report. Any use which a third party makes of this report, or any reliance on or decisions made based on it are the responsibility of such third parties. Amec Foster Wheeler accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report. It has been prepared in accordance with general accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

Amec Foster Wheeler trusts this meets your immediate requirements. If you have any questions or require further information, please contact us.

Respectfully submitted,

Amec Foster Wheeler Environment & Infrastructure,
a division of Amec Foster Wheeler Americas Limited

RJ Forsyth, M.B.A., P.Eng.
Associate Geotechnical Engineer
Manager, Surrey Office

Reviewed by

Dr. Ed McRoberts, P.Eng.
Principal Geotechnical Engineer

PROFESSIONAL ENGINEER
YUKON TERRITORY
JOHN D. LAXDAL

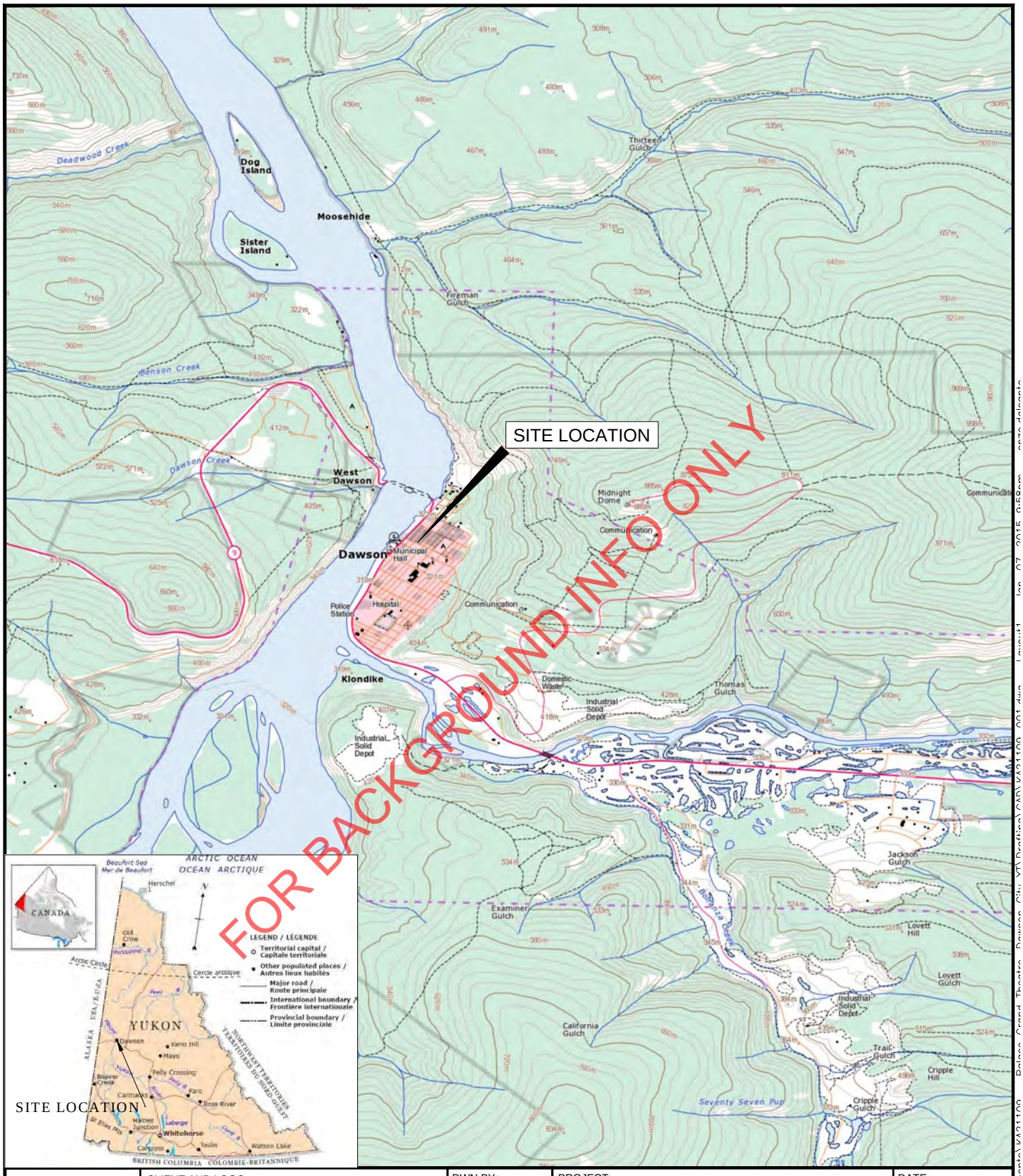
2015.02.23.

John Laxdal, P.Eng.
Senior Associate Geotechnical Engineer
Regional Manager
Southwest British Columbia

February 18, 2015

Dr. Alexandre Tchekhovski, P. Eng.,
Senior Associate Geotechnical and
Permafrost Engineer

FIGURES



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CLIENT AND LOGO:
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Travaux publics et Services gouvernementaux Canada

Amec Foster Wheeler
Environment & Infrastructure
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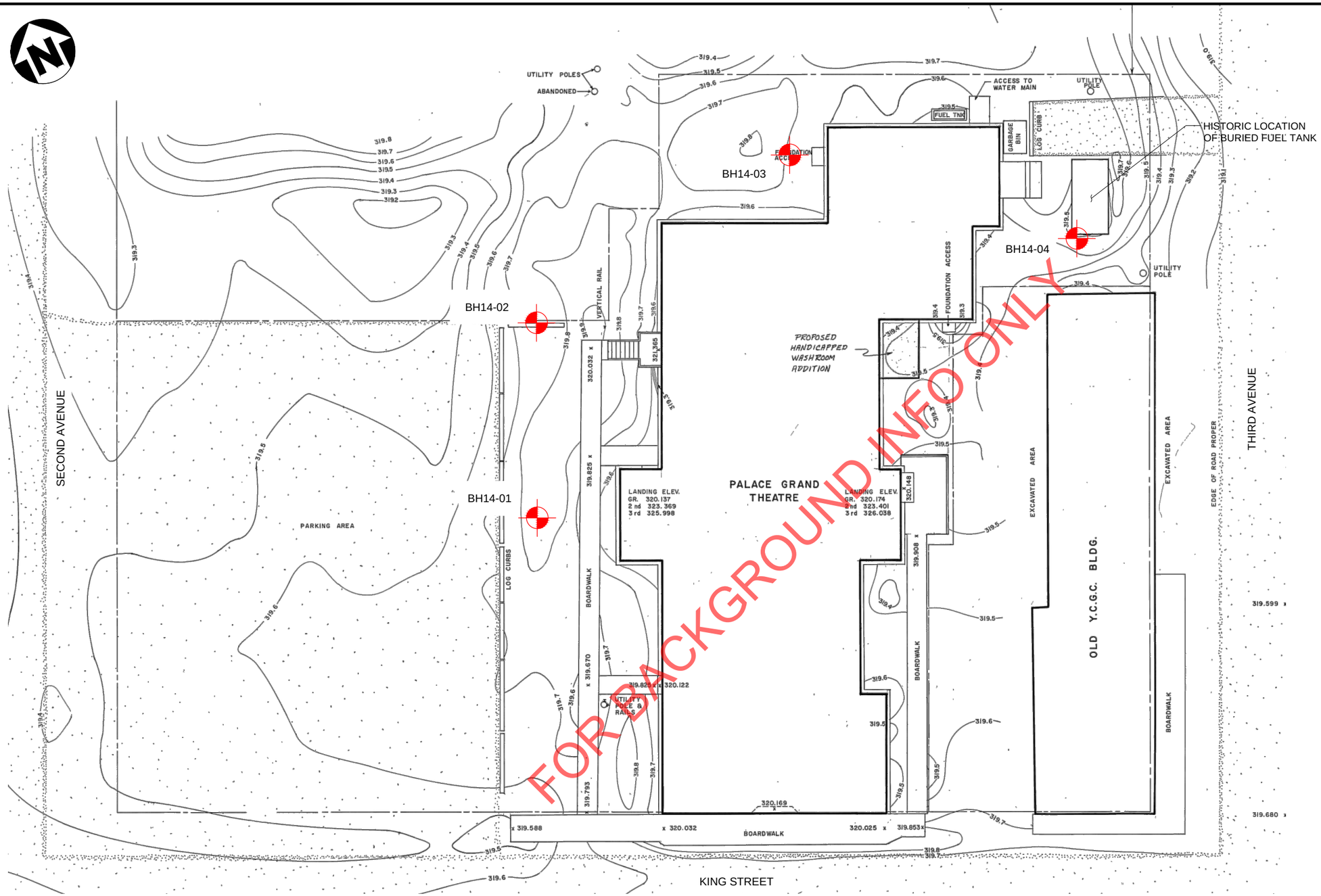
DWN BY:	EDS
CHK'D BY:	BF
DATUM:	NAD 83
PROJECTION:	UTM Zone 7N
SCALE:	NTS

PROJECT:
GEOTECHNICAL SITE ASSESSMENT
PALACE GRAND THEATRE
DAWSON CITY, YT

TITLE:
SITE LOCATION MAP

DATE:	JAN 2015
PROJECT NO:	KA21109
REV. NO:	A
FIGURE NO:	001



NOTE:

LEGEND

APPROXIMATE BOREHOLE LOCATION

MAP SOURCE: PARKS CANADA DRAWING HPKHS 90-P5 SHT 1, REV 1
DETAILS SHOWN ARE APPROXIMATE ONLY.

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DWN BY:	EDS
CHK'D BY:	BF
DATUM:	NAD 83
PROJECTION:	UTM Zone 7N
SCALE:	1:250

PROJECT: GEOTECHNICAL ASSESSMENT
PALACE GRAND THEATRE
DAWSON CITY, YT

TITLE: BOREHOLE LOCATION PLAN

DATE:	JAN 2015
PROJECT NO:	KA21109
REV. NO:	A
FIGURE NO:	001

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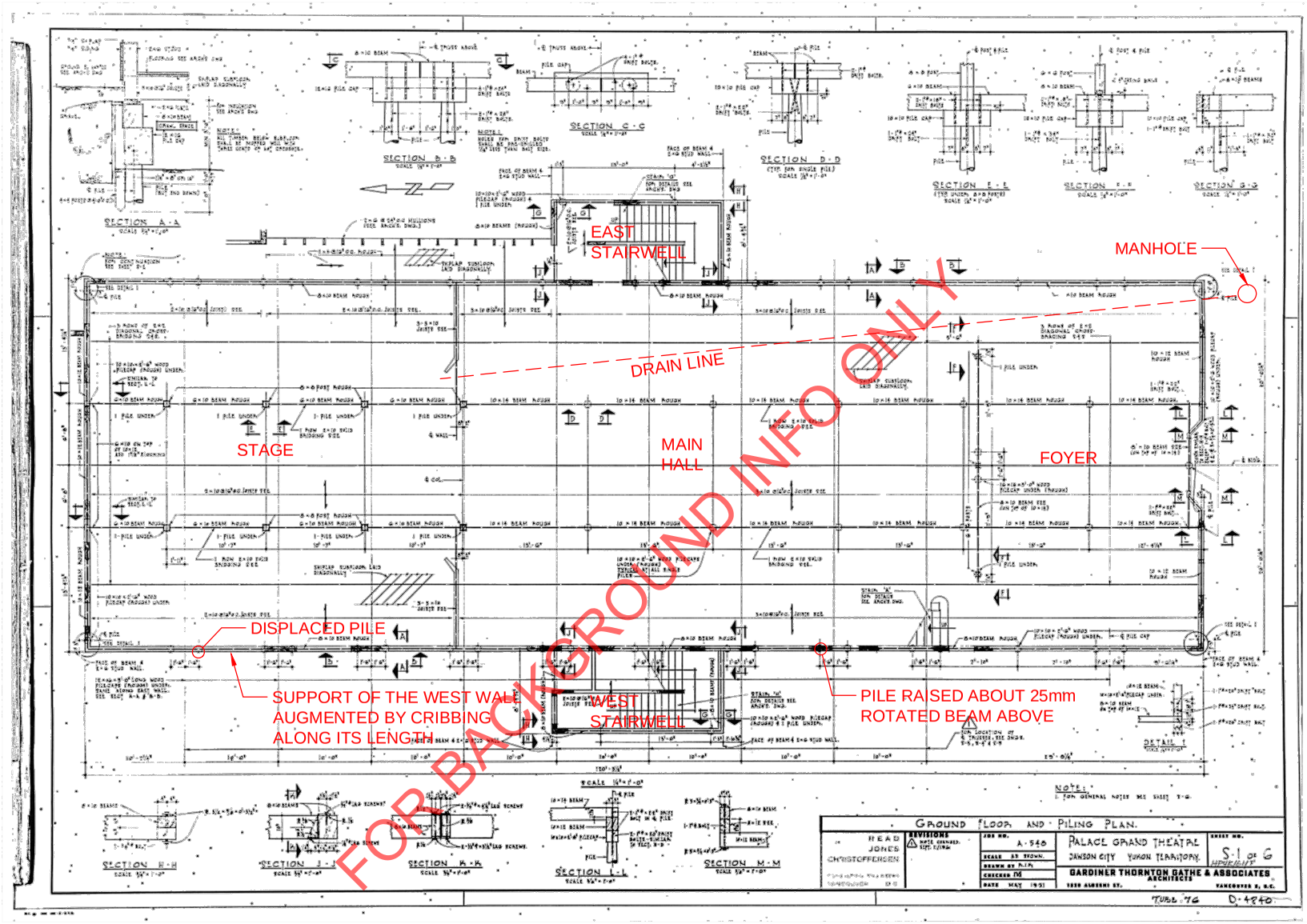

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DWN BY:	EDS
CHK'D BY:	BF
DATUM:	NAD 83
PROJECTION:	UTM Zone 7N
SCALE:	1:200

PROJECT: GEOTECHNICAL ASSESSMENT
PALACE GRAND THEATRE
DAWSON CITY, YT

TITLE: MARK-UP OF 1962 FOUNDATION PLAN

DATE:	JAN 2015
PROJECT NO:	KA21109
REV. NO:	A
FIGURE NO:	003

C:\Users\enzo.del-santo\Documents\KA21109 - Palace Grand Theatre, Dawson City YT\Drafting\CAD\KA21109-03.dwg - 8.5X11-L - Jan. 08, 2015 10:59am - enzo.dalsanto

APPENDIX A
Borehole Logs

BOREHOLE BH14-01

STARTED: 29/10/2014 **FINISHED:** 14/11/2014

DRILLING METHOD: Solid Stem Auger/ODEX

BOREHOLE LOCATION: See Site Plan for BH locaton. BH Collar Elevation is approximate and the datum is referenced from Parks Canada Dwg- HPKHS 90/P5 v01 Exist'g Floor El. 320m.

DEPTH (m)	Elev. 319.5 m+/-	DESCRIPTION OF MATERIALS
0.2	319.3	Fill -Sand & Gravel, tan, (Nbn) well bonded frozen with no excess ice
0.5	319.0	Organic Silt, dark brown, firm - appears thawed, temperature at/near freezing (0°C)
		Peat, soft, dark brown - appears frozen, temperature at/near freezing (0°C), no visible ice, Nf, poorly bonded - silt lense, 0.6 to 0.7m - below 1.5m, Nbe, well bonded with excess ice (free water when thawed)
2.0	317.5	Silt, grey, Nbe, well bonded with excess ice
3.8	315.7	Sand & Gravel, trace to some cobbles, trace boulders, grey Nbn, well bonded frozen with no excess ice - hard drilling, generally rough with occasional smoother thin zones inferred as sand layers - moisture content is of 25mm minus material - buried wood observed, possible log

SAMPLE TYPE AND NUMBER	% Fines < No. 200
G	87
G	36
G	14
G	5.3
G	9.1
G	20

SPT BLOWS PER 152mm

WELL INSTALLTION DETAILS

Su (kPa)
20 60 100 140 180
FIELD VANE P PEN/2 ⊙
PEAK ▲
REMOULDED △

● SPT N ◆ DCPT N
Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

59 147 138

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PROJECT NO.: KA21109
PROJECT: Palace Grand Theater
LOCATION: Dawson City, YT
LOGGED BY: EDS **REVIEWED BY:** BF
SHEET 1 OF 2 **BOREHOLE No. BH14-01**

N-GEO-CONVERT-NO COORDS KA21109 BH LOG.V00.GPJ ALL-1.GDT 12/8/14

BOREHOLE BH14-01

STARTED: 29/10/2014 **FINISHED:** 14/11/2014

DRILLING METHOD: Solid Stem Auger/ODEX

BOREHOLE LOCATION: See Site Plan for BH locaton. BH Collar Elevation is approximate and the datum is referenced from Parks Canada Dwg- HPKHS 90/P5 v01 Exist'g Floor El. 320m.

DEPTH (m)	SPT BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DEPTH Elev. 319.5 m+/-	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
		9.4	G				
					10.7 / 308.8	Sand & Gravel, cobbley, trace boulders - very hard drilling auger lead section and two drill bits damaged, lead auger sections hot from advancement - moisture content is of 25mm minus material - refusal with auger, switch to ODEX	
11			G				
		13	G				
13					13.1 / 306.4	End of Borehole - refusal, ODEX damaged - hole collapsed at completion, thermistor installed to bottom of open hole (6.7m) - moisture content of coarser material is of on 25mm minus material only.	
14							
15							
16							
17							
18							
19							
20							

Su (kPa)
20 60 100 140 180
FIELD VANE P PEN/2 ⊙
PEAK ▲
REMOULDED △
● SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

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PROJECT NO.: KA21109
PROJECT: Palace Grand Theater
LOCATION: Dawson City, YT
LOGGED BY: EDS **REVIEWED BY:** BF
SHEET 2 OF 2 **BOREHOLE No. BH14-01**

N-GEO-CONVERT-NO COORDS KA21109 BH LOG.V00.GPJ ALL-1.GDT 12/8/14

BOREHOLE BH14-02

STARTED: 29/10/2014 **FINISHED:** 29/10/2014

DRILLING METHOD: Solid Stem Auger

BOREHOLE LOCATION: See Site Plan for BH locaton. BH Collar Elevation is approximate and the datum is referenced from Parks Canada Dwg- HPKHS 90/P5 v01 Exist'g Floor El. 320m.

DEPTH (m) | SPT BLOWS PER 152mm | % Fines < No. 200 | SAMPLE TYPE AND NUMBER | SYMBOL | DEPTH Elev. 319.4 m+/- | DESCRIPTION OF MATERIALS | WELL INSTALLTION DETAILS

DEPTH (m)	Elev. 319.4 m+/-	DESCRIPTION OF MATERIALS
0		Fill -Sand & Gravel, grey, (Nbn) well bonded frozen with no excess ice
0.6	318.8	Peat, soft, dark brown - appears thawed above 1m depth and frozen below, temperature at/near freezing (0°C), no visible ice, Nf, poorly bonded
1		- below 1.4m, Nbe, well bonded with excess ice
1.7	317.7	Silt, grey, Nbe, well bonded with excess ice
3.5	315.9	Sand & Gravel, trace to some cobbles, trace boulders, grey Nbn, well bonded frozen with no excess ice - Sand layer with thin silt lensing, 3.8 to 4.2m - hard drilling - moisture content is of 25mm minus material
4.7	314.7	End of Borehole - effective refusal with auger

Su (kPa)
20 60 100 140 180
FIELD VANE P PEN/2 ⊙
PEAK ▲
REMOULDED △
● SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

103

N-GEO-CONVERT-NO COORDS KA21109 BH LOG.V00.GPJ ALL-1.GDT 12/8/14

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PROJECT NO.: KA21109
PROJECT: Palace Grand Theater
LOCATION: Dawson City, YT
LOGGED BY: EDS **REVIEWED BY:** BF
SHEET 1 OF 1 **BOREHOLE No. BH14-02**

BOREHOLE BH14-03

STARTED: 29/10/2014 **FINISHED:** 29/10/2014

DRILLING METHOD: Solid Stem Auger

BOREHOLE LOCATION: See Site Plan for BH locaton. BH Collar Elevation is approximate and the datum is referenced from Parks Canada Dwg- HPKHS 90/P5 v01 Exist'g Floor El. 320m.

DEPTH (m)	DEPTH Elev. 319.5 m+/-	DESCRIPTION OF MATERIALS
		Fill -Sand & Gravel, grey, (Nbn) well bonded frozen with no excess ice
	0.6 318.9	Fill - Mixed Peat with some silt/sand/gravel, dark brown/grey, very soft - appears thawed above 1m depth and frozen below, temperature at/near freezing (0°C), no visible ice, Nf, poorly bonded
	1.5 318.0	Peat/Silt, lensed, dark brown-grey, frozen, Nbe, free water present when sampled thawed
	1.8 317.7	Silt, grey, Nbe, free water present when sampled thawed
	3.4 316.1	Silt/Sand, trace gravel, grey Nbe, free water present when sampled thawed
	4.1 315.4	Sand & Gravel, trace to some cobbles, trace boulders, grey Nbn, well bonded frozen with no excess ice - hard/rough drilling
	4.6 314.9	End of Borehole - effective auger refusal - Hole redrilled Nov 14-2014 for thermistor installation, ice encountered from 3.3 to 4.6m.

DEPTH (m) | SPT BLOWS PER 152mm | % Fines < No. 200 | SAMPLE TYPE AND NUMBER | SYMBOL | WELL INSTALLTION DETAILS

Su (kPa): 20 60 100 140 180
FIELD VANE P PEN/2 ⊙
PEAK ▲
REMOULDED △
● SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

130

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PROJECT NO.: KA21109
PROJECT: Palace Grand Theater
LOCATION: Dawson City, YT
LOGGED BY: EDS **REVIEWED BY:** BF
SHEET 1 OF 1 **BOREHOLE No. BH14-03**

N-GEO-CONVERT-NO COORDS KA21109 BH LOG.V00.GPJ ALL-1.GDT 12/8/14

BOREHOLE BH14-04

STARTED: 29/10/2014 **FINISHED:** 29/10/2014

DRILLING METHOD: Solid Stem Auger

BOREHOLE LOCATION: See Site Plan for BH locaton. BH Collar Elevation is approximate and the datum is referenced from Parks Canada Dwg- HPKHS 90/P5 v01 Exist'g Floor El. 320m.

DEPTH (m) | SPT BLOWS PER 152mm | % Fines < No. 200 | SAMPLE TYPE AND NUMBER | SYMBOL | DEPTH Elev. 319.2 m+/- | DESCRIPTION OF MATERIALS | WELL INSTALLTION DETAILS

DEPTH (m)	Elev. 319.2 m+/-	DESCRIPTION OF MATERIALS
0.3	318.9	Fill -Sand & Gravel, grey, (Nbn) well bonded frozen with no excess ice
		Fill - Mixed Peat/Organic Silt with trace gravel, dark brown, soft - appears thawed, temperature at/near freezing (0°C)
1.5	317.7	Silt some organic silt lenses, grey/brown, firm - appears thawed above 2.7m, temperature at/near freezing (0°C)
		--frozen below 2.7m, Nbe, free water present when sampled thawed
3.7	315.5	Sand & Gravel, trace to some cobbles, trace boulders, grey Nbn, well bonded frozen with no excess ice - hard/rough drilling
4.4	314.8	End of Borehole - effective auger refusal - non-organic odour present, borehole is located near previously existing UST

Su (kPa)
20 60 100 140 180
FIELD VANE P PEN/2 ⊙
PEAK ▲
REMOULDED △
● SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

62

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Surrey, B.C. V4N 3P9

PROJECT NO.: KA21109
PROJECT: Palace Grand Theater
LOCATION: Dawson City, YT
LOGGED BY: EDS **REVIEWED BY:** BF
SHEET 1 OF 1 **BOREHOLE No. BH14-04**

N-GEO-CONVERT-NO COORDS KA21109 BH LOG.V00.GPJ ALL-1.GDT 12/8/14

APPENDIX D
Geotechnical Report-Supplimental

16 November 2015

Amec Foster Wheeler File: KA21109

Professional and Technical Services
PWGSC - Operations, Pacific Region
#641 – 800 Burrard Street
Vancouver, BC V6A 2V8

Attention: **Tom Dunphy**
Senior Project Manager

Dear Mr. Dunphy,

Reference: **Geotechnical Site Assessment**
Additional Discussion and Recommendations
Palace Grand Theatre
Dawson City, YT

Introduction

This letter presents geotechnical engineering input regarding design and construction of several new foundation options for the Palace Grand Theater prepared by CWMM Consulting Engineers Ltd. (CWMM). This information is supplemental to the original Amec Foster Wheeler Geotechnical Site Assessment report of February 15, 2015, all of the original report limitations and conditions apply.

Details

The foundation options prepared by CWMM include Option 1A, 1B, 1C, 2A, and 2B. Details are presented on their drawings S1 through S10, Rev. 0. The option details are summarized in the following Table 1:

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Burnaby, BC V5C 0E4
Tel: 604-294-3811
amecfw.com

Table 1: Foundation Option Details

Option	Details		
1A	Footings	Local excavation as required	Building remains in place
1B	Footings	Local excavation as required	Move building temporarily *or* building remains in place
1C	Footings	Excavate whole building footprint	Move building temporarily
2A	Perimeter rock socket piles, interior piles	Local excavation as required	Move building temporarily
2B	Perimeter rock socket piles outboard of existing piles, no interior piles	Local excavation as required	Building remains in place

Additional borehole drilling was undertaken to obtain information for the rock socket pile options.

It is understood that the final design alternative will be selected based on PWGSC's analysis of risks and costs for each option.

Field and Laboratory Investigation

In order to obtain information for the rock socket pile design, three additional boreholes were drilled on September 24 through 26, 2015. The boreholes were drilled at the locations shown on the Borehole Location Plan, Figure 001, attached. Boreholes BH15-01, 15-02, and 15-03 were drilled to depths of 21.6, 21.3 and 20.6 m respectively. The soil and bedrock conditions encountered are presented on the attached borehole logs.

The depth to bedrock varied from 17.7 to 19.2 m below ground surface. In borehole BH15-02 the bedrock in the depth interval between 18.9 and 21.3 m was cored and the core log is also attached.

All three boreholes were completed with small diameter plastic pipes to allow installation of thermistor strings to facilitate long term monitoring of ground temperatures. Boreholes 15-01 and 15-02 were completed with slotted PVC standpipes to allow measurement of depth to groundwater. The thermistor data is attached.

Samples of soil were recovered during drilling and tested for natural moisture content. The test results are presented on the borehole logs.

The bedrock core was logged in the field and then transported to Amec Foster Wheeler's Surrey BC laboratory for further logging and testing. Two compressive strength tests were performed and the results are attached.

Discussion and Recommendations

General

Excavation of permafrost may be difficult and may require ripping with a crawler tractor or jack hammering in smaller areas. Disposal of the excavated material including peat should be reviewed in relation to applicable regulations.

The experience of the contractor will greatly influence the efficiency, and quality of the project.

Excavation and backfill in summer has the benefit of the availability of unfrozen granular backfill that can readily be placed, moisture conditioned, and compacted. However, since temperatures and solar radiation are higher during the summer, thawing of the permafrost will occur more quickly unless special precautions are taken. Temporary measures such as use of insulating blankets may be desirable to reduce thaw in the excavation sidewalls.

The active layer may contain considerable water that would flow into the excavation. As the excavation sidewalls thaw they will subside/slump and release water. The water will likely be sludgy and turbid. This would likely require settling of the solids to allow release of the water into the receiving environment.

The construction excavation sideslope stability and the need for shoring will be a function of the contractor's methods and procedures. This is commonly considered temporary works and design to satisfy Yukon Workers Compensation Health and Safety Board requirements is left to the contractor.

The crawl space area should be ventilated with 2500-3000 m^3 of outside air per hour from October through March. The vents should be closed April through September.

Building Footprint Excavation/Replacement

Parks Canada has said that this option has been undertaken on other projects in Dawson City. Therefore, experienced contractors should be available and should be prepared to deal with conditions that may be revealed in the excavation.

If the excavation, footing construction, backfill placement and insulation were completed quickly in transverse panels one or two column bays in width, the permafrost would have less time to thaw. If this were done it may be more efficient to use spread footings along the exterior perimeter rather than strip footings.

The footings can be placed on a two metre thick layer of compacted structural fill. A 50 mm thickness of Styrofoam HI40 should be placed above the footings.

Rock Socket Piles

The additional design parameters and recommendations for piles socketed into bedrock are as follows:

- The piles should be socketed a minimum of 2.5 m into bedrock. Bedrock was encountered at depths varying from 17.7 to 19.2 m in the recent boreholes.
- The contractor will need to clean the sockets prior to grouting to achieve proper bond of the grout to the socket.
- Arctic grout or equivalent should be used for the rock socket and other structural concrete that will be in contact with permafrost.
- An ultimate limits states end bearing pressure of 15 MPa and serviceability limit states end bearing pressure of 5 MPa may be used for end bearing for this schist.
- The upper two metres of the piles should be coated with heavy duty grease and wrapped with two layers of polyethylene sheets, also greased.
- Other pile recommendations and conditions as presented in our report of February 18, 2015 are valid.

Lateral pile load analysis was carried out with LPile software with section properties and loading parameters as provided by CWMM. The soil parameters used for LPile analysis for short term loads (30 days) are as follows:

0 – 1.0 m	Free length (crawl space)
1.0 – 2.5/2.8 m	Active layer (organic silt), s_u=6 kPa, E50=0.02
2.5/2.8 – 5.0 m	Permafrost layer (SILT), s_u=1000 x 0.14 / 1.56 = 90 kPa, E50=0.0125
5.0 – 20.2 m	Permafrost layer (SAND and GRAVEL), s_u=2000 x 0.2 / 1.25 = 320 kPa, E50=0.00187
below 20.2 m	Bedrock

Section properties as provided by CWMM are as follows:

- Outside diameter = 300 mm or 350 mm
- Steel pile wall thickness = 10 mm
- Steel pile yield stress = 248 MPa
- Steel pile elastic modulus of = 200 GPa
- Five 20M bars
- Yield stress of bar = 414 MPa
- Elastic modulus of bar = 200 GPa.

The LPile results are attached and a summary of the results is presented in the following table:

Table 2: Lateral Pile Load Analysis

Pile Diameter (mm)	Free Length (m)	Total Length (m)	Thickness of Active Layer (m)	Vertical Load (kN)	Lateral Load (kN)	Lateral Displace-ment (mm)	Max. Bending Moment (kN-m)	Max. Shear (kN)
300	1.0	22.7	1.5	150	12	8	30.6	24.0
300	1.0	22.7	1.8	150	11	8	28.9	23.2
350	1.0	22.7	1.5	150	17	8	44.7	32.2
350	1.0	22.7	1.8	150	16	8	43.9	32.2

Closure

Amec Foster Wheeler should review final drawings and specifications before tender. We trust that this information satisfies your current requirements. Please contact this office if you have questions.

Yours truly,

Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited

YUKON TERRITORY
JOHN D. LAXDAL
PROFESSIONAL ENGINEER

2015.11.16

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Senior Associate Geotechnical Engineer
Regional Manager, Southwest British Columbia

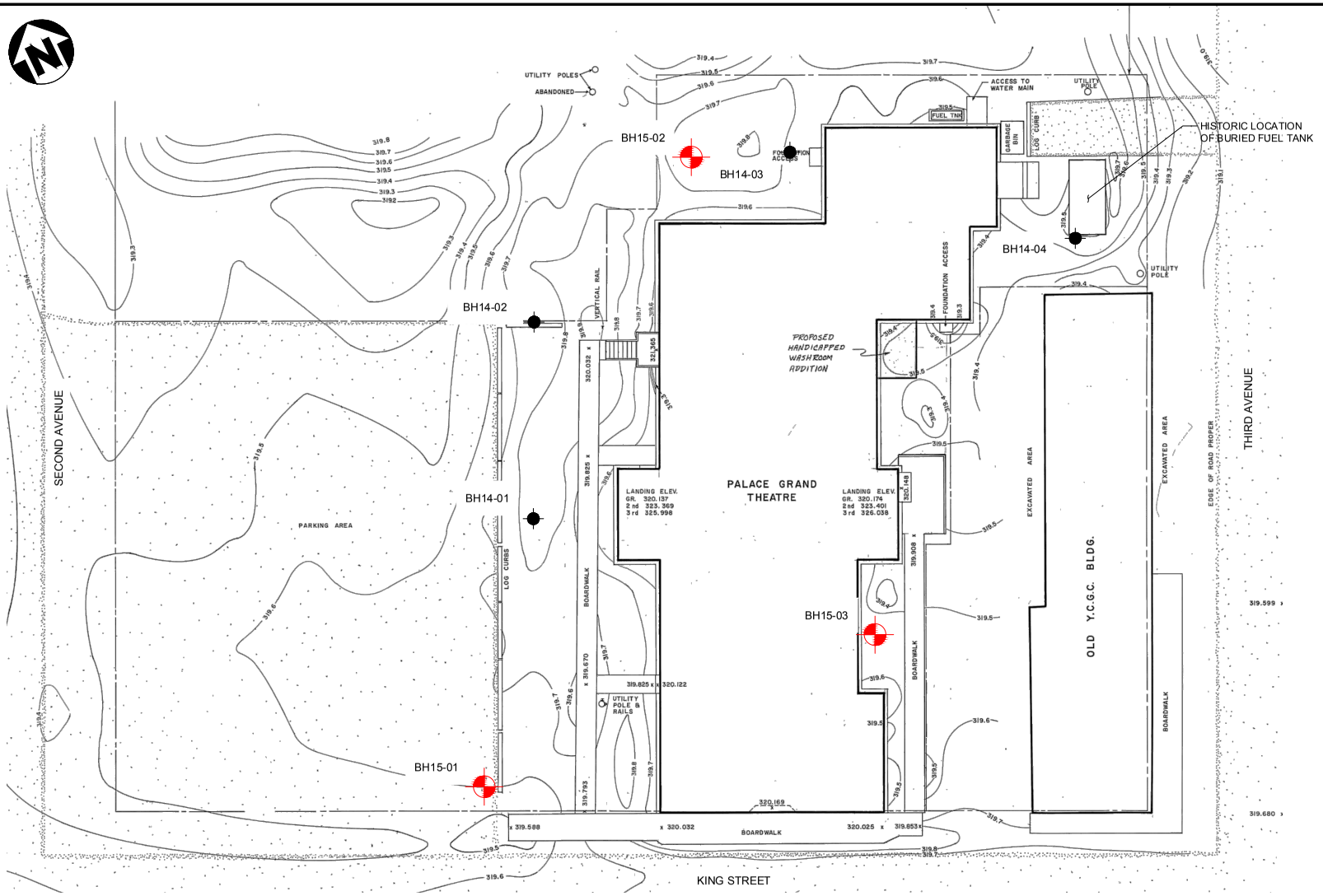
Reviewed by:

Ed McRoberts, Ph.D., P.Eng.
Principal Geotechnical Engineer

November 16, 2015

Alexandre Tchekhovski, Ph.D., P. Eng.
Senior Associate Geotechnical and
Permafrost Engineer

Attachments:
Borehole Location Plan
Borehole Logs – BH15-01, -02, and -03
Core Log
Thermistor data
Compressive strength test results
LPile results



NOTE:

LEGEND

APPROXIMATE BOREHOLE LOCATION, COMPLETED SEP. 2015

APPROXIMATE BOREHOLE LOCATION, COMPLETED OCT. 2014

MAP SOURCE: PARKS CANADA DRAWING HPKHS 90-P5 SHT 1, REV 1
DETAILS SHOWN ARE APPROXIMATE ONLY.

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Environment & Infrastructure

CLIENT AND LOGO:

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

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Tel. 604-295-8657 Fax 604-295-8658

DWN BY:	EDS
CHK'D BY:	JL
DATUM:	NAD 83
PROJECTION:	UTM Zone 7N
SCALE:	1:250

PROJECT: GEOTECHNICAL ASSESSMENT
PALACE GRAND THEATRE
DAWSON CITY, YT

TITLE: BOREHOLE LOCATION PLAN

DATE:	OCT 2015
PROJECT NO:	KA21109.100
REV. NO:	A
FIGURE NO:	001

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BOREHOLE BH15-01

STARTED: 24/09/2015 **FINISHED:** 25/09/2015

METHOD: ODEX

LOCATION: BH elev. is approx. and the datum is from Parks Canada Dwg-90/P5 v01.

COORDINATES (m): N 7105017 **E** 576549

DEPTH (m) | SPT BLOWS PER 152mm | % Fines < No. 200 | SAMPLE TYPE AND NUMBER | SYMBOL | DEPTH Elev. 319 m+/- | **DESCRIPTION OF MATERIALS** | WELL INSTALLATION DETAILS

DEPTH (m)	Elevation	DESCRIPTION OF MATERIALS
0.0		Fill -Sand & Gravel, tan, dry, not frozen
0.8	318.2	Organic Silt to fibrous Peat , dark brown, firm to soft - frozen below 1.8m, no visible ice, Nf, poorly bonded
2.1	316.9	Silt, grey/brown, Nbn to Nbe, well bonded with excess ice to no excess ice
4.0	315.0	Sand & Gravel, trace to some cobbles, trace boulders, trace silt, grey - Nbn, well bonded frozen with no excess ice

Su (kPa): 20 60 100 140 180

FIELD VANE PEAK ▲ P PEN/2 ⊙ TORVANE ▽

HPKHS ■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L% : 10 30 50 70 90

Depth (m)	SPT N
1.5	86
2.5	47
3.5	59
4.5	49
5.5	24
7.5	4
8.5	8
9.5	9

N-GEO-CONVERT-COORD-AFW-TORVANE-BH KA21109.100 BH LOG.V00.GPJ ALL-1.GDT 10/18/15

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Surrey, B.C. V4N 3P9

PROJECT NO.: KA21109.100

PROJECT: Palace Grand Theater

LOCATION: Dawson City, YT

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 3 **BOREHOLE No. BH15-01**

BOREHOLE BH15-01

STARTED: 24/09/2015 **FINISHED:** 25/09/2015

METHOD: ODEX

LOCATION: BH elev. is approx. and the datum is from Parks Canada Dwg-90/P5 v01.

COORDINATES (m): N 7105017 **E** 576549

DEPTH Elev. 319 m+/-

DESCRIPTION OF MATERIALS

DEPTH (m)	SPT BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
10.1		7.6	G		308.9 Sand & Gravel, cobbley, trace to some boulders, trace to some silt with occasional silty layers, grey - Nbn, well bonded frozen with no excess ice	
11						
		7.7	G			
12						
13		12.7	G			
14					- large boulder, effective refusal with ODEX, switch to downhole hammer, no casing	
15						
16						
		8	G			
17						
18			G			
19					19.2 299.8 Bedrock, grey, rock chip and flour return, dry - hard drilling	
20			G			

Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ P PEN/2 ⊙ TORVANE ▽
HPKHS ■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

6 4 8 4 5 3

N-GEO-CONVERT-COORD-AFW-TORVANE-BH KA21109.100 BH LOG.V00.GPJ ALL-1.GDT 10/18/15

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AMEC FOSTER WHEELER
Environment & Infrastructure
18568 - 96 Avenue, Unit 110
Surrey, B.C. V4N 3P9

PROJECT NO.: KA21109.100
PROJECT: Palace Grand Theater
LOCATION: Dawson City, YT
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 2 OF 3 **BOREHOLE No. BH15-01**

BOREHOLE BH15-01

STARTED: 24/09/2015 **FINISHED:** 25/09/2015

METHOD: ODEX

LOCATION: BH elev. is approx. and the datum is from Parks Canada Dwg-90/P5 v01.

COORDINATES (m): N 7105017 **E** 576549

DEPTH / Elev. 319 m+/-

DESCRIPTION OF MATERIALS

DEPTH (m)	SPT BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
21			G		Bedrock, grey, rock chip and flour return, dry - hard drilling *(continued)*	
					21.6 297.4	TD
22					End of Borehole - no sloughing or free water observed during casing withdrawal - thermistor pipe installed to 15m, standpipe piezometer installed to 4.5m	
23						
24						
25						
26						
27						
28						
29						
30						

Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ P PEN/2 ⊙ TORVANE ▽
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

N-GEO-CONVERT-COORD-AFW-TORVANE-BH KA21109.100 BH LOG.V00.GPJ ALL-1.GDT 10/18/15

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18568 - 96 Avenue, Unit 110
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PROJECT NO.: KA21109.100

PROJECT: Palace Grand Theater

LOCATION: Dawson City, YT

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 3 OF 3 **BOREHOLE No. BH15-01**

BOREHOLE BH15-02

STARTED: 25/09/2015 **FINISHED:** 26/09/2015

METHOD: ODEX/Core NQ3

LOCATION: BH elev. is approx. and the datum is from Parks Canada Dwg-HPKHS-90/P5 v01.

COORDINATES (m): N 7105043 **E** 576582

DEPTH (m)	DEPTH Elev. 320 m+/-	DESCRIPTION OF MATERIALS
		Fill -Sand & Gravel, tan, dry, not frozen
	0.6	
	319.4	Peat, fibrous, dark brown, soft - frozen below 1.8m, no visible ice, Nf, poorly bonded
	1.5	
	318.5	Silt, grey/brown, soft/firm above 1.8m - Nbn to Nbe, well bonded with excess ice to no excess ice
	3.4	
	316.6	Sand & Gravel, trace to some cobbles, trace boulders, trace silt, grey - Nbn, well bonded frozen with no excess ice

SPT BLOWS PER 152mm | % Fines < No. 200 | SAMPLE TYPE AND NUMBER | SYMBOL | WELL INSTALLATION DETAILS

Su (kPa): 20 60 100 140 180

FIELD VANE PEAK ▲ P PEN/2 ⊙ TORVANE ▽

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L% : 10 30 50 70 90

50 50 10 3 6

N-GEO-CONVERT-COORD-AFW-TORVANE-BH KA21109.100 BH LOG.V00.GPJ ALL-1.GDT 10/18/15

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Surrey, B.C. V4N 3P9

PROJECT NO.: KA21109.100

PROJECT: Palace Grand Theater

LOCATION: Dawson City, YT

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 3 **BOREHOLE No. BH15-02**

BOREHOLE BH15-02

STARTED: 25/09/2015 **FINISHED:** 26/09/2015

METHOD: ODEX/Core NQ3

LOCATION: BH elev. is approx. and the datum is from Parks Canada Dwg-HPKHS-90/P5 v01.

COORDINATES (m): N 7105043 **E** 576582

DEPTH (m)	SPT BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DEPTH Elev. 320 m+/-	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
10		3.6	G		10.7	Sand & Gravel, trace to some cobbles, trace boulders, trace silt, grey - Nbn, well bonded frozen with no excess ice *(continued)*	
11		7.6	G		309.3	Sand & Gravel, cobbley, trace to some boulders, trace to some silt with occasional silty layers, grey - Nbn, well bonded frozen with no excess ice	
12							
13			G				
14			G				
15							
16			G				
17					17.7		
18			G		302.3	Bedrock - Schist, grey, with visible quartz, unweathered, subhorizontal bedding/foliation, R4-R5, strong to very strong - fractures close to moderately close, generally rough with fresh surfaces	
19			G			- switch to NQ3 diamond coring see Core Log for details	
20							

Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ P PEN/2 ⊙ TORVANE ▽
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

4 ○ 5 ○ 6 ○ 8 ○ 9 ○ 2 ○ 1 ○

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PROJECT NO.: KA21109.100
PROJECT: Palace Grand Theater
LOCATION: Dawson City, YT
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 2 OF 3 **BOREHOLE No. BH15-02**

BOREHOLE BH15-02

STARTED: 25/09/2015 **FINISHED:** 26/09/2015

METHOD: ODEX/Core NQ3

LOCATION: BH elev. is approx. and the datum is from Parks Canada Dwg-HPKHS 90/P5 v01.

COORDINATES (m): N 7105043 **E** 576582

DEPTH (m)	SPT BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DEPTH / Elev. 320 m+/-	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
21					21.3 / 298.7	Bedrock - Schist, grey, with visible quartz, unweathered, subhorizontal bedding/foliation, R4-R5, strong to very strong - fractures close to moderately close, generally rough with fresh surfaces *(continued)*	
22						End of Borehole - no significant free water observed during drilling - sloughing observed during casing withdrawal, likely due to warming from drilling (warming from water and compressed air used to free stuck ODEX casing. - thermistor pipe installed to 14.5m, standpipe piezometer installed to 4.5m	
23							
24							
25							
26							
27							
28							
29							
30							

Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ P PEN/2 ⊙ TORVANE ▽
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

N-GEO-CONVERT-COORD-AFW-TORVANE-BH KA21109.100 BH LOG.V00.GPJ ALL-1.GDT 10/18/15

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PROJECT NO.: KA21109.100
PROJECT: Palace Grand Theater
LOCATION: Dawson City, YT
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 3 OF 3 **BOREHOLE No. BH15-02**

BOREHOLE BH15-03

STARTED: 26/09/2015 **FINISHED:** 26/09/2015

METHOD: ODEX

LOCATION: BH elev. is approx. and the datum is from Parks Canada Dwg-90/P5 v01.

COORDINATES (m): N 7105014 **E** 576577

DEPTH (m) | SPT BLOWS PER 152mm | % Fines < No. 200 | SAMPLE TYPE AND NUMBER | SYMBOL | DEPTH Elev. 319 m+/- | **DESCRIPTION OF MATERIALS** | WELL INSTALLATION DETAILS

DEPTH (m)	Elev. 319 m+/-	DESCRIPTION OF MATERIALS
		Fill -Sand & Gravel, tan, dry, not frozen
	0.4	
	318.6	Fill - Gravel, 35mm+/-, rounded, trace-some sand, tan, dry, not frozen
	1.2	
	317.8	Organic Silt to fibrous Peat , dark brown, firm to soft - frozen below 1.8m, no visible ice, Nf, poorly bonded
	2.1	
	316.9	Silt, grey/brown, Nbn to Nbe, well bonded with excess ice to no excess ice
	4.0	
	315.0	Sand & Gravel, trace to some cobbles, trace boulders, trace silt, grey - Nbn, well bonded frozen with no excess ice

5.4 (% Fines < No. 200)

Su (kPa): 20 60 100 140 180

FIELD VANE PEAK ▲ P PEN/2 ⊙ TORVANE ▽

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L% : 10 30 50 70 90

SPT N: 4, 29, 58, 11, 4, 6, 5

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18568 - 96 Avenue, Unit 110
Surrey, B.C. V4N 3P9

PROJECT NO.: KA21109.100

PROJECT: Palace Grand Theater

LOCATION: Dawson City, YT

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 3 **BOREHOLE No. BH15-03**

BOREHOLE BH15-03

STARTED: 26/09/2015 **FINISHED:** 26/09/2015

METHOD: ODEX

LOCATION: BH elev. is approx. and the datum is from Parks Canada Dwg-HPKHS-90/P5 v01.

COORDINATES (m): N 7105014 **E** 576577

DEPTH (m)	SPT BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DEPTH Elev. 319 m+/-	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS	Su (kPa) 20 60 100 140 180 FIELD VANE PEAK ▲ P PEN/2 ⊙ TORVANE ▽ ■ SPT N ◆ DCPT N Blows/0.3 m W_P% W% W_L% 10 30 50 70 90
10			G		10.7	Sand & Gravel, trace to some cobbles, trace boulders, trace silt, grey - Nbn, well bonded frozen with no excess ice *(continued)*		4
11			G		308.3	Sand & Gravel, cobbley, trace to some boulders, some silt with occasional silty layers, grey - Nbn, well bonded frozen with no excess ice		8
12								
13		23.2	G					11
14								
15		11	G					5
16			G					8
17			G			- damaged ODEX hammer replaced		6
18			G		18.4			4
19					300.6	Bedrock, grey, rock chip and flour return, dry - hard drilling		
20			G					5

N-GEO-CONVERT-COORD-AFW-TORVANE-BH KA21109.100 BH LOG.V00.GPJ ALL-1.GDT 10/18/15

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PROJECT NO.: KA21109.100

PROJECT: Palace Grand Theater

LOCATION: Dawson City, YT

LOGGED BY: EDS **REVIEWED BY:** JL

BOREHOLE BH15-03

STARTED: 26/09/2015 **FINISHED:** 26/09/2015

METHOD: ODEX

LOCATION: BH elev. is approx. and the datum is from Parks Canada Dwg-90/P5 v01.

COORDINATES (m): N 7105014 **E** 576577

DEPTH / Elev. 319 m+/-

DESCRIPTION OF MATERIALS

DEPTH (m)	SPT BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					Bedrock, grey, rock chip and flour return, dry - hard drilling *(continued)*	
20.6						
298.4					End of Borehole - no sloughing or free water observed during casing withdrawal - thermistor pipe installed to 15m	

Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ P PEN/2 ⊙ TORVANE ▽
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

N-GEO-CONVERT-COORD-AFW-TORVANE-BH KA21109.100 BH LOG.V00.GPJ ALL-1.GDT 10/18/15

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Environment & Infrastructure
18568 - 96 Avenue, Unit 110
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PROJECT NO.: KA21109.100
PROJECT: Palace Grand Theater
LOCATION: Dawson City, YT
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 3 OF 3 **BOREHOLE No. BH15-03**

GEOTECHNICAL CORE HOLE LOG

Client: PWGSC
Project: Palace Grand Theatre
Location: Dawson City, YT

Contractor: Midnight Sun Drilling
Type of Dri Diamond Core NQ3

Core Diameter: 45mm±
Azimuth: n/a
Inclination: 0± deg. from vertical

DRILL COLLAR:
Northing: 7105043±
Easting: 576582±
Elevation: 320m± (Geodetic)

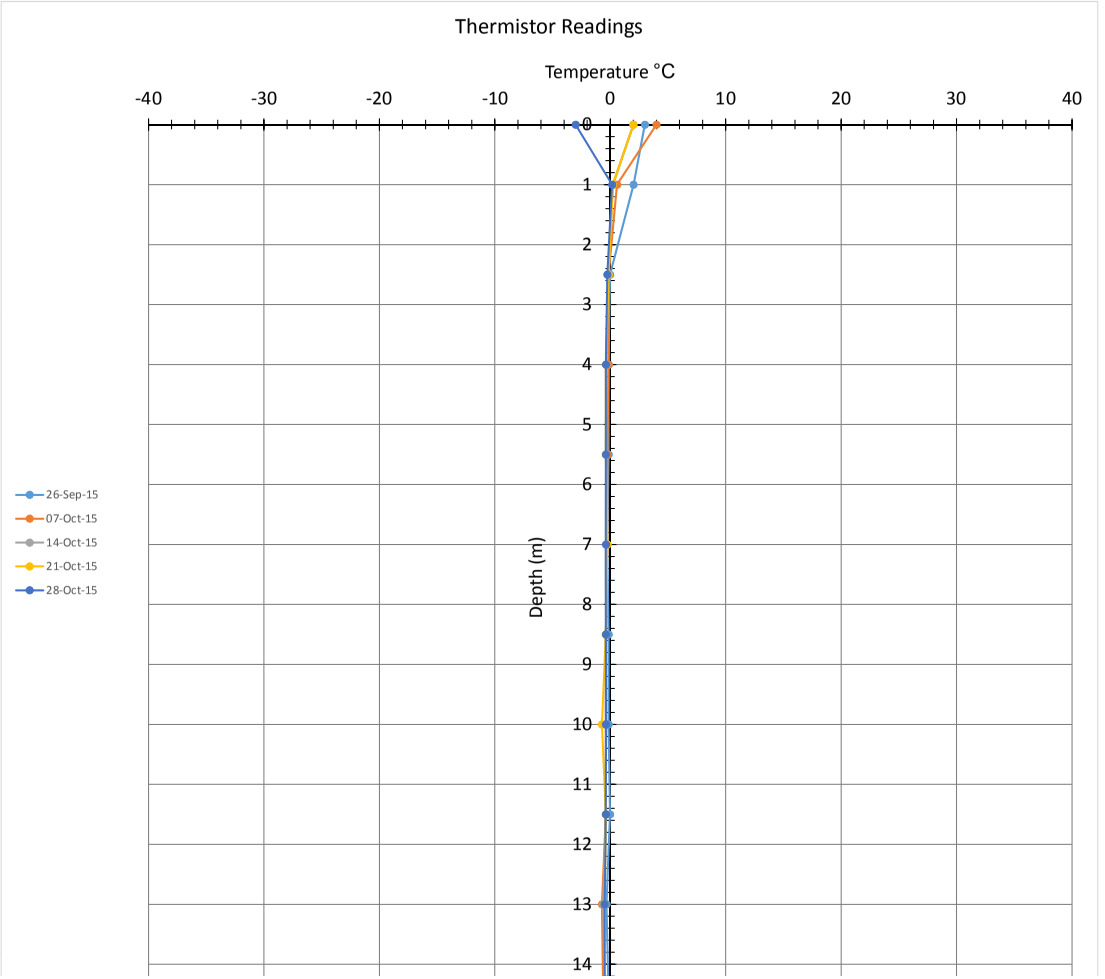
Hole No.: BH15-02
Date Drilled: 09/25/2015
Logged by: EDS
Checked by: BF

RUN	INTERVAL (m)			RECOVERY		RQD		RQD	Fracture		Fracture Condition				Point Load Strength		UCS ASTM D7012 (MPa)	Intact Rock Strength	Geological Description	Photo
	FROM	TO	LENGTH	(m)	%	(m)	%	Rating	Depth (m)	Dip from Horiz.(degrees)	Aper.	Rough	Infill	Wthrg.	Index Is50 (MPa)	Est. UCS (MPa)				(Depths in photos are in meters)
1	18.90	19.81	0.91	0.91	100%	0.37	40%	Poor	18.96, 19.05 and 19.11m	horizontal fractures along bedding caused by drilling	0	fresh	na	na			72.5	R4-R5 Strong to V.Strong	**Schist**, grey, with visible quartz, unweathered, subhorizontal bedding/foliation - fractures close to moderately close, generally rough with fresh surfaces	
									19.17 to 19.19	30	0	rough	none	fresh						
									19.19 to 19.26	70	0	rough	none	fresh						
									19.26	20	0	rough	none	fresh						
									19.30	0 to 5	0	rough	none	fresh						
									19.35 to 19.37	30	1mm	rough	slight intermittent infill and pyrite mineralization	fresh						
									19.42	horizontal	0	rough	slight brown staining in 5mm diameter area	fresh	6.15 Axial	135 Axial				
									19.48	30	0	rough	intermittent quartz infill	fresh	2.28 Diametral	50 Diametral				
									19.58	20	0	rough	none	fresh						
									19.63	sub horizontal break caused by drilling	0	rough	none	fresh						
									19.65	20	0	rough	none	fresh						
									19.67 to 19.70	60	2mm	rough	white quartz	fresh					- from 19.67 to 19.81m bedding is not apparent	
									19.74 to 19.81	70	5mm	rough	white quartz, joint healed in lower portion	fresh						
2	19.81	21.33	1.52	1.52	100%	0.58	38%	poor	19.81 to 20.0	70	8mm	rough	quartz	fresh				R4-R5 Strong to V.Strong	**Schist**, grey, with visible quartz, unweathered, subhorizontal bedding/foliation	
									20.04	horizontal fracture likely caused by drilling	0	rough	none	fresh	5.13 Axial	113 Axial				
									20.12 to 20.19	70	10mm	rough	quartz	fresh					- fractured zone from 19.81 to 20.0m	
									20.72 to 20.74	45	0	rough	none	fresh			118.2		- intermittent quartz stringers from 20.0 to 20.12m	
									20.77 to 20.83	45 and 60	1mm	rough	intermittent white powder	fresh					- fractured zone from 20.19 to 20.62m. Subhorizontal bedding/foliation visible.	
									20.98, 21.13, 21.16, 21.19, 21.22, 21.26, 21.29	horizontal fractures along bedding caused by drilling	0	rough	none	fresh	1.95 Diametral	43 Diametral			- bedding less prominent from 20.62 to 20.92m. Numerous steeply dipping quartz stringers.	
									21.29 to 21.31	45	1mm	rough	intermittent white powder and mineralization	fresh					- below 20.94m subhorizontal bedding/foliation is prominent.	

Note:
- UCS Reference Standard ASTM D5731 and ISRM Suggested Methods for Determining Point Load Strength
- Classification Reference Standard CFEM 2006

Temperature Readings - BH15-02

Thermistor Location BH 15-02	Air Temp (°C)	Thermistor Temperature Readings (°C)									
		Depth (m)									
Date	0	1.0	2.5	4.0	5.5	7.0	8.5	10.0	11.5	13.0	14.5
26-Sep-15	3	2.0	0.0	-0.1	-0.1	-0.3	-0.1	-0.1	0.0	-0.3	-0.1
07-Oct-15	4	0.6	-0.1	-0.1	-0.3	-0.3	-0.4	-0.4	-0.4	-0.7	-0.6
14-Oct-15	2	0.2	-0.1	-0.3	-0.4	-0.3	-0.4	-0.4	-0.4	-0.6	-0.5
21-Oct-15	2	0.2	-0.1	-0.4	-0.4	-0.3	-0.4	-0.7	-0.4	-0.5	-0.5
28-Oct-15	-3	0.2	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.5	-0.5



Amec Foster Wheeler Environment & Infrastructure
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#110 - 18568 - 96th Avenue
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Tel: 604-295-8657
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COMPRESSIVE STRENGTH OF DRILLED CORES REPORT

CLIENT: PWGSC
#219 - 800 Burrard Street
Vancouver, BC V6Z 0B9

Project Number: KA21109.100
Date: 19-Oct-2015

PROJECT: Palace Grand Theatre

Core ID. 1
Location : BH15-02
Depth (m) : 18.95
Sampled By: N/A
Tested By : Giti G.

CORE DESCRIPTION:
Schist

Diameter	44.60	**mm**
Length	80.32	**mm**
L/D Ratio	1.80	

Before Test

After Test

Compressive Strength	72.5	**MPa**

Moisture Condition of Sample:	As received
Loading Time (S):	184
Type and Location of Failure:	Along Vein

Comments:

- compressive strength of core test was conducted according to ASTM D7012
- Limited length of core led to L/D is smaller than 2:1

Yes	x	No		Before & after test photo taken
Yes		No	x	Stress/strain curve made
Yes		No	x	Modulus testing available

Approved By:

John Lexdal, P.Eng.

Amec Foster Wheeler Environment & Infrastructure
Surrey British Columbia
#110 - 18568 - 96th Avenue
Canada, V4N 3P9
Tel: 604-295-8657
Fax: 604-295-8658

COMPRESSIVE STRENGTH OF DRILLED CORES REPORT

CLIENT: PWGSC
#219 - 800 Burrard Street
Vancouver, BC V6Z 0B9

Project Number: KA21109.100
Date: 19-Oct-2015

PROJECT: Palace Grand Theatre

Core ID. 2
Location: BH15-02
Depth (m): 20.62
Sampled By: N/A
Tested By : Giti G.

CORE DESCRIPTION:
Schist

Diameter	44.72	**mm**
Length	99.36	**mm**
L/D Ratio	2.22	

Before Test

After Test

Compressive Strength	118.2	**MPa**

Moisture Condition of Sample:	As received
Loading Time (S):	235
Type and Location of Failure:	Along Vein

Comments:

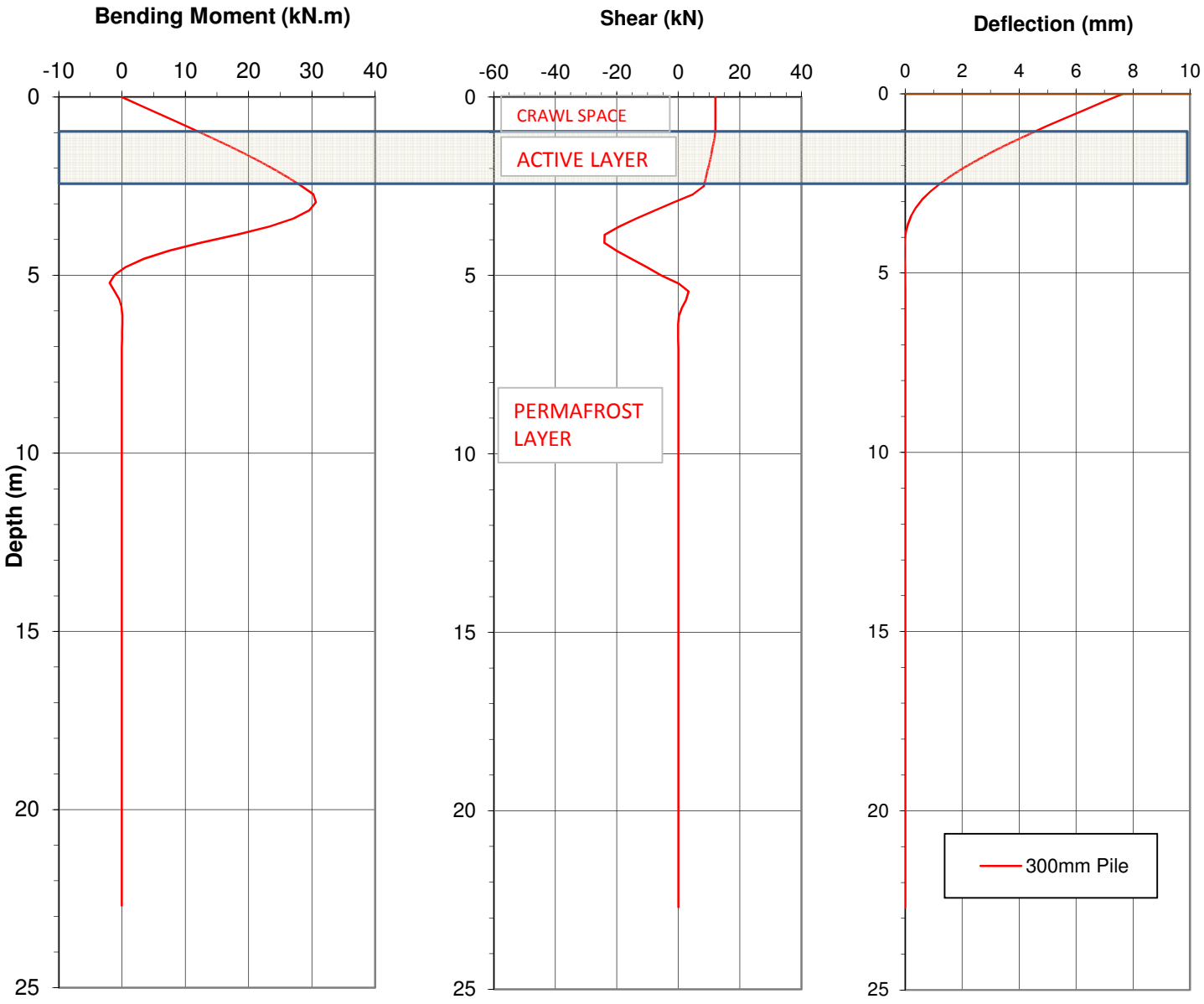
-Compressive strength strength of core test was conducted according to ASTM D7012

Yes	x	No		Before & after test photo taken
Yes		No	x	Stress/strain curve made
Yes		No	x	Modulus testing available

Approved By:

John Laxdal, P.Eng.

Figure 1: LPile Analysis (300mm Pile, 30 Day Load Duration)



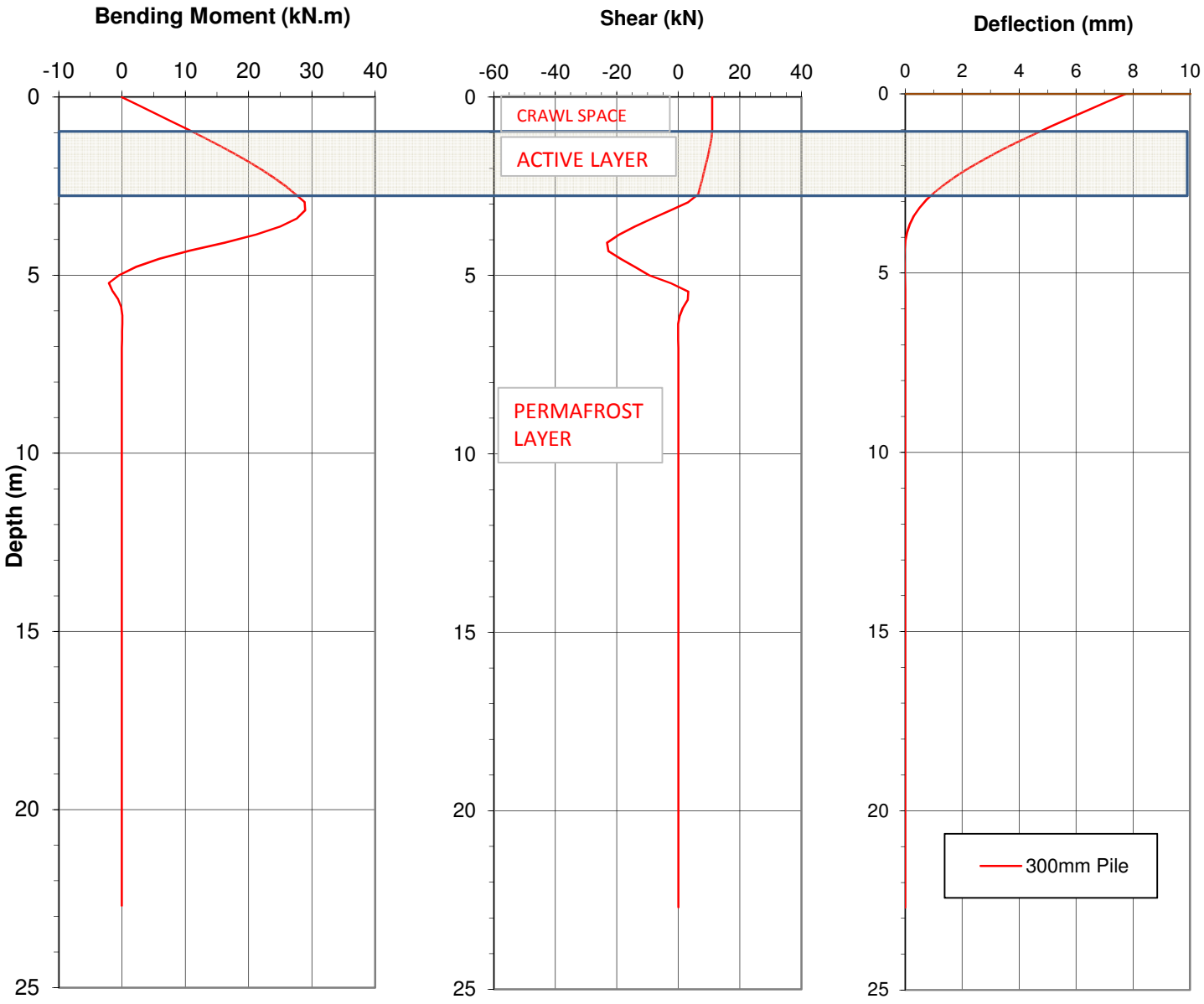
The depth taken from the top of steel pile head, which is 10mm thick and filled with 25MPa concrete and 5-20M bars.

Service Loads:
Max Vertical Compression = 150 kN
Max Lateral Force = 12 kN

Free Length of Pile = 1.0 m
Thickness of Active Layer = 1.5 m
Shear Strength of Active Layer = 6 kPa

Ref: G. S. Crowther (2014), "Lateral Pile Analysis Frozen Soil Strength Criteria", ASCE J. Cold Reg. Eng.

Figure 2: LPile Analysis (300mm Pile, 30 Day Load Duration)



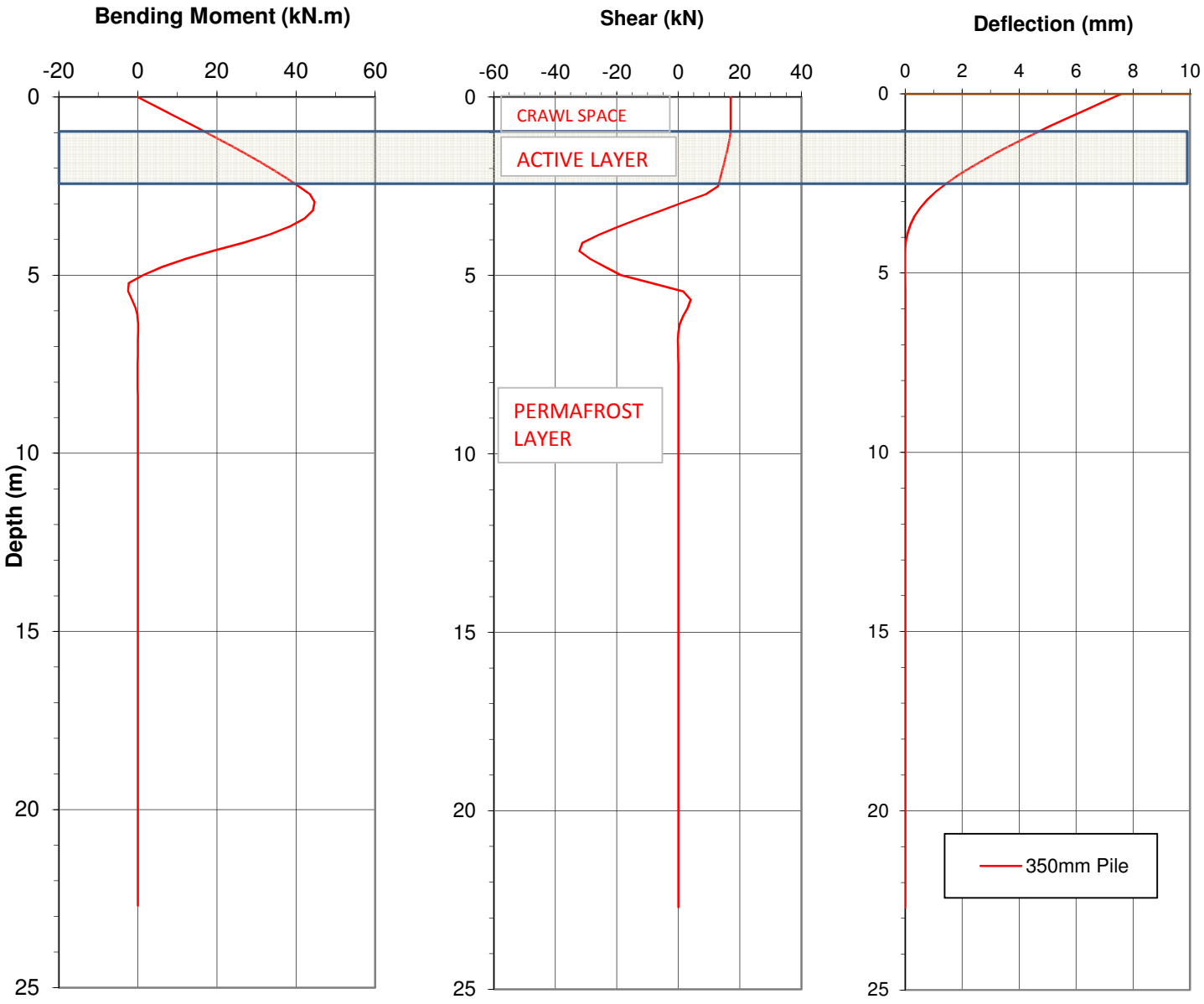
The depth taken from the top of steel pile head, which is 10mm thick and filled with 25MPa concrete and 5-20M bars.

Service Loads:
Max Vertical Compression = 150 kN
Max Lateral Force = 11 kN

Free Length of Pile = 1.0 m
Thickness of Active Layer = 1.8 m
Shear Strength of Active Layer = 6 kPa

Ref: G. S. Crowther (2014), "Lateral Pile Analysis Frozen Soil Strength Criteria", ASCE J. Cold Reg. Eng.

Figure 3: LPile Analysis (350mm Pile, 30 Day Load Duration)



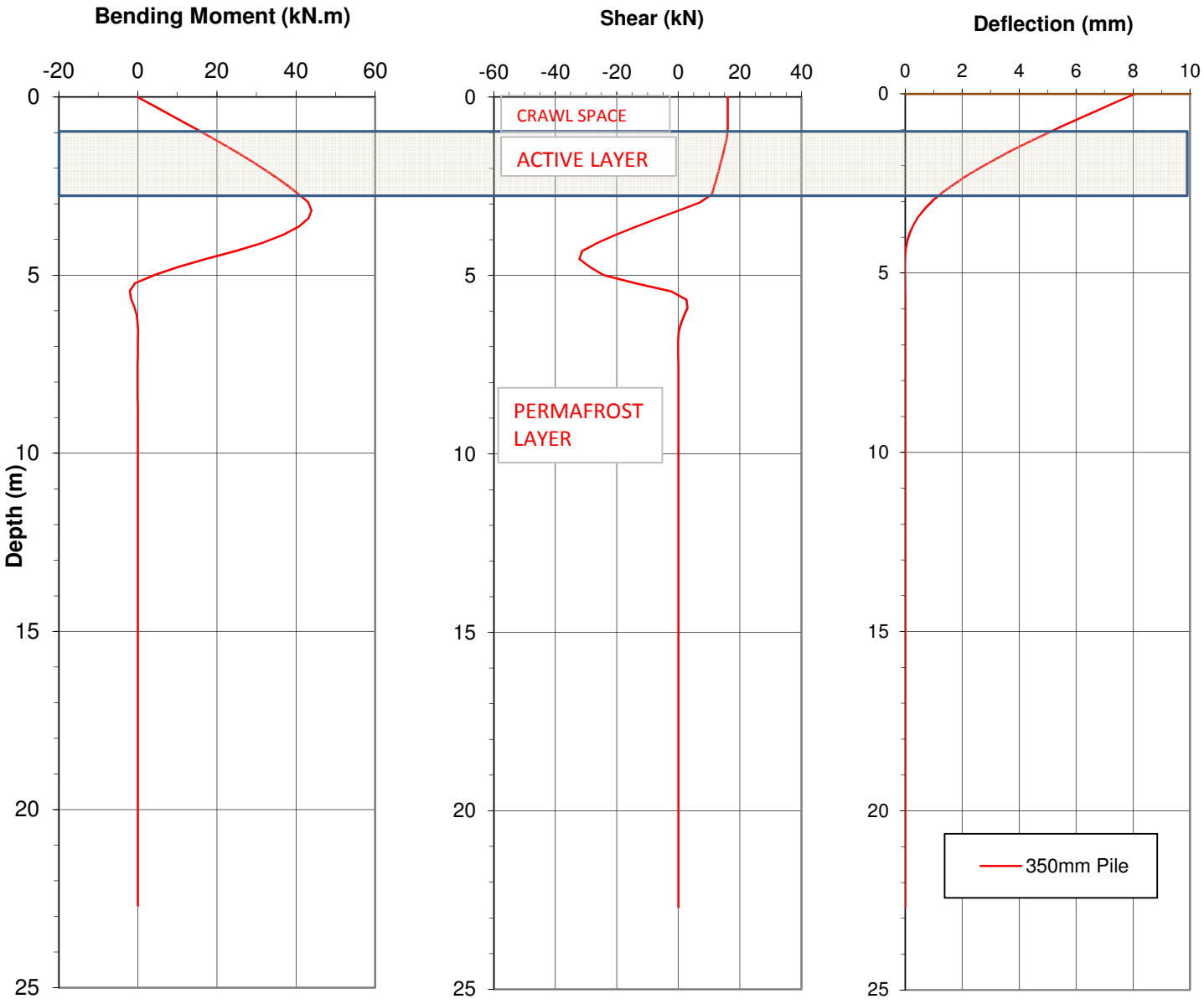
The depth taken from the top of steel pile head, which is 10mm thick and filled with 25MPa concrete and 5-20M bars.

Service Loads:
Max Vertical Compression = 150 kN
Max Lateral Force = 17 kN

Free Length of Pile = 1.0 m
Thickness of Active Layer = 1.5 m
Shear Strength of Active Layer = 6 kPa

Ref: G. S. Crowther (2014), "Lateral Pile Analysis Frozen Soil Strength Criteria", ASCE J. Cold Reg. Eng.

Figure 4: LPile Analysis (350mm Pile, 30 Day Load Duration)



The depth taken from the top of steel pile head, which is 10mm thick and filled with 25MPa concrete and 5-20M bars.

Service Loads:
Max Vertical Compression = 150 kN
Max Lateral Force = 16 kN

Free Length of Pile = 1.0 m
Thickness of Active Layer = 1.8 m
Shear Strength of Active Layer = 6 kPa

Ref: G. S. Crowther (2014), "Lateral Pile Analysis Frozen Soil Strength Criteria", ASCE J. Cold Reg. Eng.