



Public Works and Government Services Canada

Requisition No: EZ899-170554

DRAWINGS & SPECIFICATIONS
for

Transport Canada Penticton Airport
Air Terminal Building (ATB) Boiler Replacement

Project No: R.077022.001

APPROVED BY:

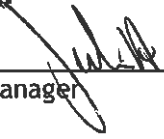

Regional Manager, AES

2016-06-08
Date


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2016-05-20
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TENDER:


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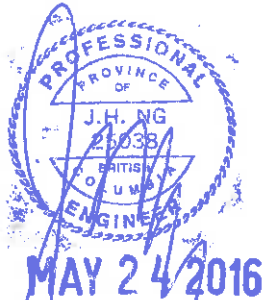
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CONSULTANTS – SEAL & SIGNATURE

Discipline

Seal / Signature / Date

Mechanical
(Prime)



Electrical



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- E-101 ELECTRICAL POWER AND LIGHTING

END OF PROJECT DRAWING LIST

PART 1 GENERAL

1.1 SUMMARY OF WORK

- .1 Work to be performed under this Contract includes, but is not limited to, the following items covered further in this section:
 - .1 Refer to Section 01 11 00 Summary of Work.
 - .2 Provide a detailed work plan including a project schedule and phasing. This detailed work plan shall be submitted to the Departmental Representative for review to verify that there will be no interruption of service.

1.2 WORK RESTRICTIONS

- .1 Specified in Section 01 14 00

1.3 CONSTRUCTION WORK SCHEDULE

- .1 Commence work immediately upon official notification of acceptance of offer and complete the work within 9 weeks from the date of such notification.
- .2 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Substantial Certificate and Final Certificate as defined times of completion are of essence of this contract.
- .3 Submittal:
 - .1 Submit to Departmental Representative within 10 working days of Award of Contract, a Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of construction progress.
 - .2 Identify each trade or operation.
 - .3 Show dates for delivery of items requiring long lead time.
 - .4 Departmental Representative will review schedule and return one copy.
 - .5 Re-submit two (2) copies of finalized schedule to Departmental Representative within five (5) working days after return of reviewed preliminary copy.
- .4 Project Scheduling Reporting:
 - .1 Update Project Schedule on bi-weekly basis reflecting activity changes and completions, as well as activities in progress.
 - .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

.5 Project Meetings:

- .1 Discuss Project Schedule at bi-weekly site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays with their remedial measures will be discussed and negotiated.
- .3 Before submitting first progress claim submit breakdown of Contract price in detail as directed by Departmental Representative and aggregating contract price. After approval by Departmental Representative cost breakdown will be used as basis for progress payments. Only PWGSC paper work is acceptable.

1.4 SUBMITTAL PROCEDURES

- .1 Specified in Section 01 33 00.

1.5 HEALTH AND SAFETY

- .1 Specified in Section 01 35 33.

1.6 ENVIRONMENTAL PROCEDURES

- .1 Fires and burning of rubbish on site not permitted.
- .2 Do not bury rubbish and waste materials on site unless approved by Departmental Representative.
- .3 Do not dispose of waste or volatile materials such as oil, paint thinner or mineral spirits into waterways, storm or sanitary systems.
- .4 Control disposal of run-off of water containing suspended materials or other harmful substances in accordance with local authority requirements. Construct settlement ponds and silt fences as required by the Provincial Environmental authority.
- .5 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.
- .6 Under no circumstances dispose of rubbish or waste materials on adjoining property.

1.7 REGULATORY REQUIREMENTS

- .1 Specified in Section 01 41 00.

1.8 QUALITY CONTROL

- .1 Specified in Section 01 45 00.

1.9 TEMPORARY UTILITIES

- .1 Installation and Removal:
 - .1 Provide temporary utilities controls in order to execute work expeditiously.
 - .2 Remove from site all such work after use.
- .6 Fire Protection:
 - .1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.

1.10 CONSTRUCTION FACILITIES

- .1 Installation and Removal:
 - .1 Provide construction facilities in order to execute work expeditiously.
 - .2 Remove from site all such work after use.
- .3 Hoisting:
 - .1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.
 - .2 Hoists to be operated by qualified operator.
 - .3 Protection of pedestrian and vehicles shall be provided by the contractor when hoisting operation impact any pedestrian or vehicular right-of-way.
 - .4 Inform of, and coordinate with, the Departmental Representative when any such work will occur.
- .4 Site Storage/Loading:
 - .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
 - .2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.
- .5 Construction Parking:
 - .1 Make good damage to existing roads used for access to project site.
 - .2 Build and maintain temporary access where required and provide snow removal during period of Work.
 - .3 Park vehicles outside perimeter fence in designated parking areas.

- .6 Contractor's Site Office and enclosure:
 - .1 Provide office of size to accommodate site meetings and Contractor's operations.
 - .2 Provide a clearly marked and fully stocked first-aid case in a readily available location.
 - .3 Provide temporary fenced area to enclose site and operations.
- .7 Equipment, Tools and Material Storage:
 - .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.
- .8 Sanitary Facilities:
 - .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
 - .2 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures. Permanent facilities may be used on approval of Departmental Representative.

1.11 TEMPORARY BARRIERS AND ENCLOSURES

- .1 Hoarding:
 - .1 Erect temporary site enclosure using new 1.8 m high temporary construction fencing. Provide lockable truck gate. Maintain fence in good repair.
- .2 Enclosure of Structure:
 - .1 Provide temporary weathertight enclosures and protection for exterior openings until permanently enclosed. Design enclosures to withstand wind pressure. Provide lockable entry as required for moving personnel equipment and materials.
 - .2 Provide temporary enclosures to secure building from entry of unauthorized personnel during construction period.
- .3 Guardrails and Excavations:
 - .1 Provide secure, rigid guard rails and barricades around deep excavations, open edges of floors and roofs etc.
 - .2 Provide as required by governing authorities.
- .4 Access to Site:
 - .1 Maintain immediate local access roads in clean condition used during work of this contract.

- .5 Protection for Off-Site and Transport Canada Property:
 - .1 Protect surrounding TC property from damage during performance of Work.
 - .2 Be responsible for damage incurred.
- .6 Protection of Building Finishes:
 - .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
 - .2 Provide necessary screens, covers, and hoardings.
 - .3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.
 - .4 Be responsible for damage incurred due to lack of or improper protection.

1.12 COMMON PRODUCT REQUIREMENTS

- .1 Reference Standards:
 - .1 If there is question as to whether any product or system is in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
 - .2 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.
 - .3 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.
- .2 Quality:
 - .1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
 - .2 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.
 - .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.

- .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.
- .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 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
 - .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
 - .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
 - .8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
 - .9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.
- .4 Transportation:
 - .1 Pay costs of transportation of products required in performance of Work.
 - .2 Transportation cost of products supplied by Departmental Representative will be paid for by Departmental Representative. Unload, handle and store such products.

.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 Notify Departmental Representative, in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative may establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

.6 Quality of Work:

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

.7 Co-ordination:

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

8 Concealment:

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

.9 Remedial Work:

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner neither to damage nor to put at risk any portion of Work.
- .10 Location of Fixtures:
 - .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
 - .2 Inform Departmental Representative of conflicting installation. Install as directed.
 - .3 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.
- .11 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.
- .12 Fastenings - Equipment:
 - .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
 - .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
 - .3 Bolts may not project more than one diameter beyond nuts.
 - .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.
- .13 Protection of Work in Progress:
 - .1 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Departmental Representative.

.14 Existing Utilities:

- .1 Where work involves breaking into or connecting to existing services, carry out work at times directed by governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.
- .2 Before commencing work, establish location and extent of service lines in areas of work and notify Departmental Representative of findings.
- .3 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.
- .4 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .5 Record locations of maintained, capped and re-routed services lines.

.15 Contractors Options for Selection of Products:

- .1 Products specified by "Prescriptive" specifications: select any product meeting or exceeding specifications.
- .2 Products specified under "Acceptable Products" (used for complex Mechanical or Electrical Systems): select any one of the indicated manufacturers, or any other manufacturer meeting or exceeding the Prescriptive specifications and indicated Products.
- .3 Products specified by performance and referenced standard: select any product meeting or exceeding the referenced standard.
- .4 Products specified to meet particular design requirements or to match existing materials: use only material specified Approved Product. Alternative products may be considered provided full technical data is received in writing by Departmental Representative in accordance with "Instructions to Bidders".
- .5 When products are specified by a referenced standard or by Performance specifications, upon request of Departmental Representative, obtain from manufacturer an independent laboratory report showing that the product meets or exceeds the specified requirements.

.16 Substitution after award of Contract:

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

- .2 Proposals for substitution may only be submitted after Contract award. Such request must include statements of respective costs of items originally specified and the proposed substitution.
- .3 Proposals will be considered by the Departmental Representative if:
 - .1 products selected by tenderer from those specified are not available;
 - .2 delivery date of products selected from those specified would unduly delay completion of Contract, or
 - .3 an alternative product to that specified, which is brought to the attention of and considered by Departmental Representative as equivalent to the product specified, and will result in a credit to the Contract amount.
- .4 Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on the project. Pay for design or drawing changes required as result of substitution.
- .5 Amounts of all credits arising from approval of the substitutions will be determined by the Departmental Representative, and the Contract price will be reduced accordingly.

1.13 EXAMINATION AND PREPARATION

- .1 Existing Services:
 - .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
 - .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.
- .2 Location of Equipment and Fixtures:
 - .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
 - .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
 - .3 Inform Departmental Representative of impending installation and obtain approval for actual location.
 - .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.14 EXECUTION REQUIREMENTS

- .1 Preparation:
 - .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
 - .2 After uncovering, inspect conditions affecting performance of Work.
 - .3 Beginning of cutting or patching means acceptance of existing conditions.
 - .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
 - .5 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.
- .2 Execution:
 - .1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.
 - .2 Fit several parts together, to integrate with other Work.
 - .3 Uncover Work to install ill-timed Work.
 - .4 Remove and replace defective and non-conforming Work.
 - .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
 - .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
 - .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
 - .8 Cut rigid materials using purpose made saw or core drill. Pneumatic or impact tools not allowed on brittle materials without prior approval.
 - .9 Restore work with new products in accordance with requirements of Contract Documents.
 - .10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
 - .11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material, full thickness of the construction element.

- .12 Refinish surfaces to match adjacent finishes: For continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.
- .13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.15 CLEANING

- .1 Project Cleanliness:
 - .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
 - .2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
 - .3 Clear snow and ice from access to building.
 - .4 Provide on-site containers for collection of waste materials and debris.
 - .5 Provide and use clearly marked separate bins for recycling. Refer to- Construction/Demolition Waste Management And Disposal.
 - .6 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.
 - .7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
 - .8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
 - .9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
 - .10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.
- .2 Final Cleaning:
 - .1 When Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
 - .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
 - .3 Prior to final review, remove surplus products, tools, construction machinery and equipment.

- .4 Remove waste products and clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .6 Clean lighting reflectors, lenses, and other lighting surfaces.
- .7 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .8 Wax, seal, vacuum clean, shampoo or prepare floor finishes, as recommended by manufacturer.
- .9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .10 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .11 Remove dirt and other disfiguration from exterior surfaces.
- .12 Sweep and wash clean paved areas.
- .13 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .14 Clean roofs, downspouts, and drainage systems.
- .15 Remove snow and ice from access to building.

1.16 CONSTRUCTION/DEMOLITION WASTE MANAGEMENT AND DISPOSAL

- .1 Specified in Section 01 74 19

1.17 CLOSEOUT PROCEDURES

- .1 Specified in Section 01 77 00

1.18 CLOSEOUT SUBMITTAL

- .1 Specified in Section 01 78 00

1.19 DEMONSTRATION AND TRAINING

- .1 Demonstration and Training:
 - .1 Demonstrate operation and maintenance of equipment and systems to maintenance personnel following interim Completion and prior to date of final certificate of completion
- .2 Departmental Representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.20 GENERAL COMMISSIONING

- .1 Commission installed systems prior to Demonstration and Training.

END OF SECTION

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract includes:
 - .1 Demolition and removal of existing boilers associated piping, valves, pumps, and expansion tank in the Penticton Air Terminal Building (ATB) Mechanical Room.
 - .2 The installation of two new condensing boilers;
 - .3 The installation of three new boiler pumps;
 - .4 The installation of three new zone circulating pumps;
 - .5 New hot water piping, fittings, and valves for the boiler system;
 - .6 New boiler vents and vent doghouse;
 - .7 Installation of a new expansion tank;
- at the Penticton ATB and further identified as the “Work”.

1.2 WORK SEQUENCE

- .1 Construction period shall be determined in coordination with the Departmental Representative and site manager.
- .2 Maintain fire access/control.

1.3 CONTRACTOR USE OF PREMISES

- .1 Access to this site is restricted and will need to be coordinated with the facility's site manager to perform the work. Refer to Specification Section
- .2 Co-ordinate use of premises under direction of Departmental Representative.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

1.4 EXISTING SERVICES

- .1 Notify Departmental Representative, governing authorities 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 services including power and communications services. Adhere to approved schedule and provide notice to affected parties.

1.5 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.

- .2 Specifications.
- .3 Addenda.
- .4 Reviewed Shop Drawings.
- .5 List of Outstanding Shop Drawings.
- .6 Change Orders.
- .7 Other Modifications to Contract.
- .8 Field Test Reports.
- .9 Copy of Approved Work Schedule.
- .10 Health and Safety Plan and Other Safety Related Documents.
- .11 Other documents as specified.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 35 13.13 - Special Procedures for Airport Facilities.

1.2 SECURITY:

- .1 The contractor shall be cognizant of the following access restrictions unique to Air Terminal Buildings in general and the Penticton ATB in particular:
 - .1 Terminal Operations and Security: Access to some portions of the ATB is restricted, including but not limited to the Departure Holding and Screening areas, Control Tower, and communication equipment rooms. Access to these areas in the presence of a commissionaire, or at fixed non-operating hours, must be coordinated and approved ahead of the work to be performed.
 - .2 Tower Operation and Security: Access to any portions of the roof or the presence of tall equipment (such as cranes and hoists) that may affect tower operations must be coordinated with the Departmental Representative, and approved ahead of such work being performed.
- .2 At construction start-up meeting:
 - .1 Discuss the nature and extent of all activities involved in the Project.
 - .2 Establish mutually acceptable security procedures in accordance with this instruction and ATP's particular requirements.
- .3 The Contractors' responsibilities:
 - .1 Ensure that all construction employees are aware of the Penticton ATP's security requirements.
 - .2 Co-operate with all ATP personnel (including Airlines, CBSA, and NAVCAN personnel) in ensuring that security requirements are observed by all construction employees.

1.3 SERVICE INTERRUPTIONS:

- .1 Notify Departmental Representative of intended interruption of power, communication and water services and provide schedule of interruption times.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours of notice for necessary interruption of services throughout course of work. Keep duration of interruptions to a minimum. Coordinate interruptions with local authority having jurisdiction and local residences and businesses affected by the disruption.

1.4 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance. Make arrangements with Departmental Representative to facilitate work as stated.

- .2 Maintain existing services where indicated and provide for personnel and vehicle access.
- .3 Where security is reduced by Work, provide temporary means to maintain security.
- .4 Contractor to provide sanitary facilities. Keep facilities clean.

1.5 HOURS OF WORK:

- .1 Perform work during normal working hours of the ATB 06:00 to 22:00, Monday through Friday.
- .2 When it is necessary, arrange in advance with Departmental Representative to work outside of normal working hours.

1.6 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.
- .2 For all public areas, provide for access by pedestrian and vehicular traffic on and around site where work is in progress.

1.7 EXISTING SERVICES

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative a minimum of 5 working days 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 personnel and vehicular traffic.

1.8 SPECIAL REQUIREMENTS

- .1 Coordinate scheduling requirements for all noise generating Work with the Departmental Representative
- .2 Ensure that Contractor 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 Deliver materials to the site Monday to Friday between 08:00 to 17:00 hours unless otherwise approved by Departmental Representative.

1.9 SECURITY CLEARANCES

- .1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will be required to enter premises.
- .2 Personnel shall carry identification approved by Departmental Representative at all times for the duration of the Work.

1.10 SECURITY ESCORT

- .1 Personnel employed on this project must be escorted when executing work in non-public areas during normal working hours. Personnel must be escorted in all areas after normal working hours.

1.11 BUILDING SMOKING ENVIRONMENT

- .1 Smoking is not permitted inside any buildings. Comply with smoking restrictions for smoking outside the ATB.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 78 00 - Closeout Submittals.

1.2 ADMINISTRATIVE

- .1 Submit to Departmental Representative submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Work affected by submittal shall not proceed 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 shall be considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.
- .11 Maintain a submittal log.

1.3 SHOP DRAWINGS AND PRODUCT DATA

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

- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow 14 working 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 any revisions other than those requested.
- .6 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .7 Submissions shall 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 one electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .10 Submit one electronic copy 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. Notwithstanding the foregoing, submit full shop drawings including but not limited to the following items: toilet partitions, washroom accessories (provide layout drawing), detention and commercial doors and frames, detention windows, and chain link fencing.
- .11 Delete information not applicable to project.
- .12 Supplement standard information to provide details applicable to project.
- .13 Shop drawings will be reviewed by the Departmental Representative for general conformance with the design concept of the project and general compliance with information given in the Contract Documents. The Departmental Representative will signify the status of the review by stamping and dating the electronic copy accordingly, in one of the following manners:
 - .1 Reviewed
 - .2 Reviewed as Noted
 - .3 Revise and Resubmit
 - .4 Not Reviewed

The Departmental Representative will return the electronic copy to the Contractor for their use and for copying for record keeping purposes and for distribution to Subcontractors and to suppliers.

- .14 The Contractor shall distribute copies of the returned shop drawings by the Departmental Representative as **“Reviewed,” “Reviewed as Noted”** to the Site Office and to the offices of Subcontractors, and suppliers.
- .15 Shop drawings stamped **“Revise and Resubmit”** or **“Not Reviewed”** will be returned and shall be corrected and resubmitted to the Departmental Representative following the requirements stated above.
- .16 Only shop drawings stamped **“Reviewed”** and **“Reviewed as Noted”** shall be used on the site and used for fabrication and installation of work. All other shop drawings shall be considered as being not reviewed and shall not be used on site or for fabrication and installation of work.
- .17 Conform to review comments and stamped instructions of each shop drawing reviewed.
- .18 Only drawings noted for revision and re-submission need be resubmitted. Include revisions required by previous reviews before re-submission of shop drawings.
- .19 No new details or information shall be added to shop drawings after they have been fully reviewed.
- .20 No work dependent on shop drawing information shall proceed until review is given and verification received from the Departmental Representative. Be responsible for work performed prior to receipt of reviewed shop drawings. No review comments shall be construed as authorization for Changes in the Work.
- .21 Each Subcontractor or supplier shall fabricate work exactly as shown on shop drawings and if shop practice dictates revision, shall revise shop drawings and resubmit.
- .22 File one copy of each finally revised and corrected shop drawing on site.
- .23 Consider this article the minimum requirement. Further instruction contained in any particular specification section governs for that section of the Work.
- .24 Shop drawings must be in Metric measurement.
- .25 The review of shop drawings by the Departmental Representative is for sole purpose of ascertaining conformance with general concept. 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 all requirements of construction and Contract Documents. 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 all sub-trades.

- .26 The Contractor will have a system in place to allow the Departmental Representative, Contractor and its Subcontractors to have electronic access to the project submittals, shop drawings, project communication and latest drawings on file through a internet site. The Contractor and its Subcontractors are required to access the system to obtain the latest drawings on which their shop drawings will be based. If shop drawings are submitted based on out dated drawings shop drawings will be returned without further action. The users of the electronic system, once entered into the system, will be informed electronically of updated drawings available to them on the system. Photo copies of the Departmental Representatives design drawings will not be accepted.
- .27 The Departmental Representative's CADD files shall not be used by the Contractor, its Subcontractors or Suppliers for use in preparing shop drawings.
- .28 A copy of final reviewed shop drawings in electronic format shall be included in operating and maintenance manuals specified under Section 01 78 00.

1.4 SAMPLES

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

1.5 CERTIFICATIONS

- .1 When specified in individual specification sections, submit certification by manufacturer to the Departmental Representative to indicate material or Product conforms to or exceeds specified requirements.
- .2 Certificates may be recent or previous test results on material or Product, but must be acceptable to the Departmental Representative.

1.6 MANUFACTURER'S FIELD REPORTS

- .1 Submit reports for the Departmental Representative's benefit as contract administrator.
- .2 Submit reports in duplicate within 10 days of observation, to the Departmental Representative for information.
- .3 Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.

1.7 PROGRESS DIARY

- .1 Keep a permanent, written record on the site of the progress of the Work. Keep record open to the inspection of the Departmental Representative, and copies shall be furnished to the Departmental Representative upon request.
- .2 The diary shall record all pertinent data such as:
 - .1 Daily weather conditions.
 - .2 Commencement, progress and completion of various portions of the Work.
 - .3 Dates of all site meetings.
 - .4 Dates of visits or inspections by government authorities, inspectors, utility companies and any other visitors to the site.
 - .5 Record of work force employed.
 - .6 Information required by Contractor or Subcontractor. Clarifications requested and answers received.
 - .7 Materials causing delay.
 - .8 Actions or events causing delay.
- .3 Record of all quality control inspections and fire safety inspections including corrective actions taken.

1.8 PHOTOGRAPHS

- .1 When requested by the Departmental Representative: Provide a digital photographic record/history of the progress of the Work, per the Departmental Representative's instructions.

1.9 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 14 00 - Work Restrictions.

1.2 GENERAL PROTECTION

- .1 Do not disrupt airport business except as permitted by Departmental Representative
- .2 Provide temporary protection for safe handling of public, personnel, pedestrians and vehicular traffic when any of the Work impacts any pedestrian or vehicular right-of-way.
- .3 Provide barricades and lights where directed by Departmental Representative.

1.3 MOVEMENT OF EQUIPMENT AND PERSONNEL

- .1 In areas of airport not closed to aircraft traffic:
 - .1 Obtain Departmental Representative's approval on scheduling of Work.
 - .2 Control movements of equipment and personnel as directed by Departmental Representative.
 - .3 Provide qualified field personnel at locations designated by Departmental Representative to relay signals from airport traffic control tower to equipment and personnel wishing to cross live traffic areas.
 - .4 Immediately obey signals from airport traffic control tower.

1.4 TERMINAL OPERATIONS AND SECURITY:

- .1 Access to some portions of the ATB is restricted, including but not limited to the Departure Holding and Screening areas, Control Tower, and communication equipment rooms. Access to these areas in the presence of a commissionaire, or at fixed non-operating hours, must be coordinated and approved ahead of the work to be performed.

1.5 TOWER OPERATION AND SECURITY:

- .1 Access to any portions of the roof or the presence of tall equipment (such as cranes and hoists) that may affect tower operations must be coordinated with the Departmental Representative, and approved ahead of such work being performed.

1.6 UNSERVICEABLE AREAS

- .1 Mark off areas made unserviceable for aircraft by Work of this Contract by providing highly visible danger markings by day and red lights by night.
- .2 Open flames and flammable fuels are not permitted.

- .3 Park equipment not in use and stockpile materials so that stockpile tops are below 50 to 1 ratio from ends of useable landing strip and below 20 to 1 ratio from sides of aircraft traffic areas.
- .1 Mark tops with red lights as directed by Departmental Representative.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 References

- .1 Government of Canada.
 - .1 Canada Labour Code - Part II
 - .2 Canada Occupational Health and Safety Regulations.
- .2 National Building Code of Canada (NBCC-2015):
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 Canadian Standards Association (CSA) as amended:
 - .1 CSA Z797-2009 Code of Practice for Access Scaffold
 - .2 CSA S269.1-1975 (R2003) Falsework for Construction Purposes
 - .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures
- .4 Fire Protection Engineering Services, HRSDC:
 - .1 FCC No. 301, Standard for Construction Operations.
 - .2 FCC No. 302, Standard for Welding and Cutting.
- .5 American National Standards Institute (ANSI):
 - .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.
- .6 Province of British Columbia:
 - .1 Workers Compensation Act Part 3-Occupational Health and Safety.
 - .2 Occupational Health and Safety Regulation

1.2 Related Sections

- .1 Refer to the following current NMS sections as required:
 - .1 Section 00 01 50 General Requirements

1.3 Workers' Compensation Board Coverage

- .1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.
- .2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

1.4 Compliance with Regulations

- .1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.
- .2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

1.5 Submittals

- .1 Submit to Departmental Representative submittals listed for review in accordance with Section 00 01 33.
- .2 Work effected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Health and Safety Plan.
 - .2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
 - .3 Copies of incident and accident reports.
 - .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .5 Emergency Procedures.
- .4 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 10 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.
- .5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.
- .6 Submission of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:
 - .1 Be construed to imply approval by the Departmental Representative.
 - .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
 - .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.6 Responsibility

- .1 Assume responsibility as the Prime Contractor for work under this contract.
- .2 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .3 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable Federal, Provincial, Territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 Health and Safety Coordinator

- .1 The Health and Safety Coordinator (Registered Occupational Hygienist, Certified Industrial Specified Hygienist) must:
 - .1 Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.
 - .2 Be responsible for implementing, daily enforcing, and monitoring the site specific Health and Safety Plan.
 - .3 Be on site during execution of work.

1.8 General Conditions

- .1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.
- .2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
 - .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.
 - .2 Secure site at night time or provide security guard as deemed necessary to protect site against entry.

1.9 Regulatory Requirements

- .1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.
- .2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.

1.10 Work Permits

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

1.11 Filing of Notice

- .1 The General Contractor is to complete and submit a Notice of Project as required by Provincial authorities.
- .2 Provide copies of all notices to the Departmental Representative.

1.12 Health and Safety Plan

- .1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.
- .2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:
 - .1 Primary requirements:
 - .1 Contractor's safety policy.
 - .2 Identification of applicable compliance obligations.
 - .3 Definition of responsibilities for project safety/organization chart for project.
 - .4 General safety rules for project.
 - .5 Job-specific safe work, procedures.
 - .6 Inspection policy and procedures.
 - .7 Incident reporting and investigation policy and procedures.
 - .8 Occupational Health and Safety Committee/Representative procedures.
 - .9 Occupational Health and Safety meetings.
 - .10 Occupational Health and Safety communications and record keeping procedures.
 - .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.
 - .3 List hazardous materials to be brought on site as required by work.
 - .4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
 - .5 Identify personal protective equipment (PPE) to be used by workers.
 - .6 Identify personnel and alternates responsible for site safety and health.
 - .7 Identify personnel training requirements and training plan, including site orientation for new workers.

- .3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.
- .4 Revise and update Health and Safety Plan as required, and re-submit to the Departmental Representative.
- .5 Departmental Representative's review: the review of Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

1.13 Emergency Procedures

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:
 - .1 Designated personnel from own company.
 - .2 Regulatory agencies applicable to work and as per legislated regulations.
 - .3 Local emergency resources.
 - .4 Departmental Representative.
- .2 Include the following provisions in the emergency procedures:
 - .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
 - .2 Evacuate all workers safely.
 - .3 Check and confirm the safe evacuation of all workers.
 - .4 Notify the fire department or other emergency responders.
 - .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
 - .6 Notify Departmental Representative.
- .3 Provide written rescue/evacuation procedures as required for, but not limited to:
 - .1 Work at high angles.
 - .2 Work in confined spaces or where there is a risk of entrapment.
 - .3 Work with hazardous substances.
 - .4 Underground work.
 - .5 Work on, over, under and adjacent to water.

- .6 Workplaces where there are persons who require physical assistance to be moved.
- .4 Design and mark emergency exit routes to provide quick and unimpeded exit.
- .5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

1.14 Hazardous Products

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.
- .2 Where use of hazardous and toxic products cannot be avoided:
 - .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents.
 - .2 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when tenants have left the building.

1.15 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.

1.16 Electrical Lockout

- .1 Develop, implement and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.
- .2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have procedures available for review upon request by the Departmental Representative.

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

1.17 Overloading

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

1.18 Falsework

- .1 Design and construct falsework in accordance with CSA S269.1.

1.19 Scaffolding

- .1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA Z797-2009 Code of Practice for Access Scaffold and BC Occupational Health and Safety Regulations.

1.20 Confined Spaces

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

1.21 Power-Actuated Devices

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

1.22 Fire Safety and Hot Work

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

1.23 Fire Safety Requirements

- .1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.24 Fire Protection and Alarm System

- .1 Do not obstruct, shut-off or leave inactive at the end of a working day or shift, the fire protection and alarm systems.
- .2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.

- .3 Be responsible/liable for costs incurred from the fire department, the Departmental Representative, and the tenants, resulting from false alarms.

1.25 Unforeseen Hazards

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

1.26 Posted Documents

- .1 Post legible versions of the following documents on site:
 - .1 Health and Safety Plan.
 - .2 Sequence of work.
 - .3 Emergency procedures.
 - .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
 - .5 Notice of Project.
 - .6 Floor plans or site plans. Must be posted in a non-inmate access area and locked up when not being used.
 - .7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
 - .8 Workplace Hazardous Materials Information System (WHMIS) documents.
 - .9 Material Safety Data Sheets (MSDS).
 - .10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.
- .2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.
- .3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

1.27 Meetings

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

1.28 Correction of Non-Compliance

- .1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.
- .3 The Departmental Representative may issue a "stop work order" if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order".

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

- .1 Perform Work in accordance with National Building Code of Canada 2010 (NBC) including all amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
 - .1 Contract documents;
 - .2 Specified standards, codes, and referenced documents.

1.2 SECURITY REQUIREMENTS

- .1 Comply with the requirements in section 01 14 10 Work Restrictions.
- .2 Comply with any additional operational requirements established by the Penticton ATB.

1.3 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions.
- .2 Smoking is permitted on the site outside the perimeter fence in a designated area.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Inspection and testing, administrative, and enforcement requirements.
- .2 Quality control program.
- .3 Mill tests.
- .4 Equipment and system adjust and balance.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.

1.3 GENERAL

- .1 At Project commencement, establish quality assurance benchmarks and quality expectations for all workers and Subcontractors to follow.
- .2 The Specification identifies a minimum level of quality, exceed this minimum level.
- .3 Identify a person in the employ of the Contractor to monitor Work quality and to report quality assurance steps being taken, identified or discovered disparities, and corrective action taken.
- .4 Submit written reports monthly to the Departmental Representative, to accompany progress claims.
- .5 Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- .6 Comply with manufacturer's instructions, including each step in sequence. Should manufacturer's instructions conflict with Contract Documents, request clarification from Departmental Representative before proceeding.
- .7 Comply with specified standards as minimum quality for the work except where more stringent tolerance, codes, or specified requirements indicate higher standards or more precise workmanship.
- .8 Perform work with persons qualified to produce required and specified quality.

1.4 QUALITY CONTROL PROGRAM

- .1 Prepare all test results in triplicate and provide copies of all tests concurrently to the Departmental Representative and Contractor.
- .2 All test results shall specify at least the following data:
 - .1 Type of test.

- .2 Dates of sampling, testing and reporting.
- .3 Personnel involved.
- .4 Location of test (with sketch if required).
- .5 Specified requirements.
- .6 Test results.
- .7 Remarks regarding conformance with Contract Documents.
- .3 Provide written test results to the Departmental Representative within 12 hours of tests. If the tests are completed on Site, provide the Departmental Representative with field memo summarizing results immediately following testing.
- .4 Minimum testing requirements shall be in accordance with all applicable bylaws, regulations, standards, building codes and requirements of authorities having jurisdiction.

1.5 INSPECTION

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

1.6 INDEPENDENT INSPECTION AGENCIES

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

- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and re-inspection.

1.7 ACCESS TO WORK

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

1.8 PROCEDURES

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.9 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Departmental Representative may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Departmental Representative.

1.10 REPORTS

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

- .2 Provide copies to Subcontractor of work being inspected or tested manufacturer or fabricator of material being inspected or tested.

1.11 MILL TESTS

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

1.12 EQUIPMENT AND SYSTEMS

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

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Materials Source Separation Program (MSSP): Consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .2 Recyclable: Ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.
- .3 Recycle: Process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .4 Recycling: Process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .5 Reuse: Repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from re-modeling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
- .6 Salvage: Removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .7 Separate Condition: Refers to waste sorted into individual types.
- .8 Source Separation: Acts of keeping different types of waste materials separate beginning from first time they became waste.
- .9 Waste Audit (WA): Detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction. Indicates quantities of reuse, recycling and landfill.
- .10 Waste Reduction Workplan (WRW): Written report which addresses opportunities for reduction, reuse, or recycling of materials.

1.2 DOCUMENTS

- .1 Maintain at job site, one copy of following documents:
 - .1 Waste Audit.
 - .2 Waste Reduction Workplan.
 - .3 Material Source Separation Plan.

1.3 MATERIALS SOURCE SEPARATION

- .1 Before project start-up prepare Materials Source Separation Program (MSSP) and provide containers to deposit re-usable and/or recyclable materials of the following:
 - .1 Gypsum Board.
 - .2 Insulation.
 - .3 Acoustical ceiling panels.
 - .4 Metals.
 - .5 Wood.
 - .6 Cardboard.
 - .7 Plastics
 - .8 Other materials as indicated in technical sections.
- .2 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form:
 - .1 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.
 - .2 For each material reused, sold or recycled from project, include amount and the destination.
 - .3 For each material land filled or incinerated from project, include amount of material and identity of landfill, incinerator or transfer station.
- .3 Implement Materials Source Separation Program (MSSP) for waste generated on project in compliance with methods as approved by Departmental Representative.
- .4 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .5 Locate separated materials in areas which minimize material damage.
- .6 Provide inventory of quantities of demolition materials to be salvaged for reuse, recycling, or disposal.

1.4 DIVERSION OF MATERIALS

- .1 Create a list of materials for separation from the general waste stream and stockpiled in separate containers, in compliance with fire regulations and to Departmental Representative's approval.
- .2 Mark containers and provide instruction on disposal practices.

1.5 STORAGE, HANDLING AND APPLICATION

- .1 Conform to Waste Reduction Work Plan.
- .2 Handle waste materials not being reused, salvaged or recycled in accordance with authority having jurisdiction and fire regulations.
- .3 Collect, handle, store on site and transport off-site, all materials in separated condition, to an approved and authorized recycling facility.
- .4 Provide Departmental Representative with receipts indicating quantity of material delivered to landfill.
- .5 Except as specified otherwise, materials removed from the site become the contractor's responsibility.
- .6 On-site sale of salvaged/recycled material is not permitted.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

- .1 Section 01 78 00 - Closeout Submittals.
- .2 Section 01 91 13 - Commissioning.

1.3 INSPECTION AND DECLARATION

- .1 Project Phasing:
 - .1 The contractor shall submit a plan that inspects completed work at the completion of each phase, corrects the work prior to proceeding to the next phase of the work.
- .2 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Departmental Representative's Inspection.
- .3 Departmental Representative's Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
- .4 Completion: submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted, and balanced and are fully operational.
 - .4 Certificates required by authorities having jurisdiction.
 - .5 Commissioning of all systems: Final commissioning reports have been submitted to the Departmental Representative.
 - .6 Operation of systems has been demonstrated to Departmental Representative's personnel.
 - .7 Work is complete and ready for Final Inspection.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 45 00 - Quality Control.
- .2 Section 01 77 00 - Closeout Procedures.

1.2 SUBMISSION

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 Copy will be returned after final inspection, with Departmental Representative's comments.
- .3 Revise content of documents as required prior to final submittal.
- .4 Two weeks prior to Interim Completion of the Work, submit to the Departmental Representative four final copies of operating and maintenance manuals in English.
- .5 Hard copies of the Operating and Maintenance Manual System are required as specified under clause 1.3. Provide 4x copies.
- .6 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .7 If requested, furnish evidence as to type, source and quality of products provided.
- .8 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .9 Pay costs of transportation.

1.3 FORMAT HARD COPY MANUALS

- .1 Organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.

- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on CD.

1.4 CONTENTS - EACH VOLUME

- .1 Table of Contents: provide title of project;
 - .1 date of submission;
 - .2 names, addresses, and telephone and fax numbers of Contractor, Subcontractors, Suppliers with name of responsible parties;
 - .3 schedule of products and systems, indexed to content of volume.
 - .4 copy of hardware schedule and paint schedules, complete with the actual manufacturer, supplier and identification names and numbers.
 - .5 all extended guarantees, warranties, maintenance bonds, certificates, letters of guarantees, registration cards, as called for in the various sections of the specification.
 - .6 complete set of all final reviewed shop drawings.
 - .7 certificates of inspection by authorities having jurisdiction.
 - .8 test reports and certificates as applicable.
 - .9 complete set of as constructed drawings.
- .2 For each product or system:
 - .1 list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- .6 Training: Refer to Section 01 91 41 - Demonstration and Training.

1.5 'AS CONSTRUCTED' DRAWINGS AND SAMPLES

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

- .2 Specifications;
- .3 Addenda;
- .4 Change Orders and other modifications to the Contract;
- .5 Reviewed shop drawings, product data, and samples;
- .6 Field test records;
- .7 Inspection certificates;
- .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Departmental Representative.
- .6 Provide an electronic copy of as constructed drawings.

1.6 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings provided by Departmental Representative.
- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.

- .6 Details not on original Contract Drawings.
- .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.7 EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include all test and balancing reports.
- .15 Additional requirements: As specified in individual specification sections.

1.8 MATERIALS AND FINISHES

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

1.9 SPARE PARTS

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.10 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in the Operating and Maintenance Manuals.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.11 SPECIAL TOOLS

- .1 Provide special tools, in quantities specified in individual specification section.

- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

1.12 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 the applicable item of work.
- .4 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.
- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Co-execute submittals when required.
- .7 Retain warranties and bonds until time specified for submittal.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to Performance Verification of components, equipment, sub-systems, systems, and integrated systems.
- .2 Related Requirements
 - .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 Mechanical Commissioning
 - .5 Section 23 08 01 Performance Verification
 - .6 Section 26 05 00 Common Work Results for Electrical
- .3 Acronyms:
 - .1 Cx - Commissioning
 - .2 CxA – Commissioning Authority (appointed by Owner)
 - .3 CxAg – Commissioning Agent (appointed by Mech. Contractor)
 - .4 CxMgr – Commissioning Manager (appointed by Prime Contractor)
 - .5 EMCS - Energy Monitoring and Control Systems.
 - .6 O M – Operating and Maintenance (staff)
 - .7 OMM - Operation and Maintenance Manuals
 - .8 PI - Product Information.
 - .9 PV - Performance Verification.
 - .10 TAB - Testing, Adjusting and Balancing.

1.2 REFERENCES

- .1 CSA Standard Z320 -2011 Building Commissioning
- .2 ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems

1.3 DEFINITIONS

- .1 Owner's Commissioning Authority (CxA) – an individual identified by the owner to lead the commissioning team in the implementation of the commissioning process. If deemed necessary, this role may be appointed

- to an individual within the owner's organization, a third party company, or other specialist firm.
- .2 Contractor's Commissioning Agent (CxAg) – a specialist retained by the mechanical contractor to execute mechanical commissioning activities. Respectively, an electrical commissioning agent may be retained depending on the electrical project requirements.
 - .3 Prime Contractor's Commissioning Manager (CxMgr) – an individual appointed by the prime contractor to manage the daily commissioning activities occurring within the general contract. Typically this role is merged in with the Prime contractor's site supervisor, with common activities delegated to the mechanical commissioning agent.
 - .4 Commissioning Team – the group responsible for planning, implementing and executing the commissioning activities throughout the project phases. The commissioning team will typically include the Commissioning Authority, Commissioning Agents, Commissioning Manager, sub-contractors, equipment suppliers, O&M personnel, Owner' representative, and Departmental Representative.

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 OMM.
 - .3 Effectively train O M staff.
- .2 Contractor(s) assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be operated 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 the design consultant, to meet the Project functional and operational requirements.

- .4 Commissioning Manager and Commissioning Agent(s) shall coordinate their commissioning activities to avoid redundancy and inefficiencies.
- .5 Commissioning Manager (prime contractor) shall be the main point of contact for daily management of all commissioning activities, and shall be responsible for ensuring all activities and deliverables are collected and submitted to the Commissioning Authority as described herein.

1.5 COMMISSIONING OVERVIEW

- .1 Section 01 91 31 - Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built systems are constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .6 Commissioning Authority will issue the recommended Interim Acceptance letter when:
 - .1 Completed Cx documentation has been received, reviewed for suitability.
 - .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 non-functional system, including related systems as deemed required by the Commissioning Authority, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by 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 the 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, and systems are 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 the 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 recommended 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 [2] 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 [2] weeks prior to start of Cx.

- .3 Submit proposed Cx procedures to Commissioning Authority and obtain recommended approval at least [2] weeks prior to start of Cx.
- .4 Provide supplemental support documentation relating to the Cx process as required by Commissioning Authority.

1.10 COMMISSIONING DOCUMENTATION

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use. Contractor's Cx Agent shall submit their proposed Cx Forms for review by the Cx Authority, prior to implementation.
- .2 Commissioning Authority to review and recommend approval of Cx documentation.
- .3 Provide completed and reviewed Cx documentation to Commissioning Authority.

1.11 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Review and approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training (Systems demonstrations).

1.12 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings. Minimum of [5] Cx meetings: Kickoff (60%) , 75% progress, 90% progress, 100% progress and final.
- .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, Cx Manager and/or Cx Agent to call a Cx kickoff 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 Meetings will be chaired by the Cx Manager and/or the Cx Agent, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at kickoff (60%) and subsequent Cx meetings and as required.

1.13 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.

1.14 WITNESSING OF STARTING AND TESTING

- .1 Provide [2] weeks notice prior to commencement to allow adequate presence of relevant witnesses.
- .2 Commissioning Authority may need to witness start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.15 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for review and recommended approval by Commissioning Authority.
 - .3 Arrange for Commissioning Authority to witness tests.
 - .4 Obtain written review 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 submit for review to the 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.

1.16 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain recommended approval from Commissioning Authority after distinct phases have been completed and before commencing next phase.
- .4 Document the required tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by 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 recommended by the Commissioning Authority.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures recommended by the Commissioning Authority.
 - .3 If evaluation report concludes that major damage has occurred, Commissioning Authority shall reject equipment use.
 - .1 Rejected equipment to be removed from site and replace with new.

- .2 Subject new equipment/systems to specified start-up procedures.

1.17 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up check lists.
 - .4 Start-up reports,
 - .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

1.18 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 review 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.

1.19 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.

1.20 START OF COMMISSIONING

- .1 Notify Commissioning Authority at least [2] weeks prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.21 INSTRUMENTS / EQUIPMENT

- .1 Submit to Cx Authority for review and recommended 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.

1.22 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under actual and/or 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.

1.23 WITNESSING COMMISSIONING

- .1 Commissioning Authority to witness activities and verify results.

1.24 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 [1] week of test and with Cx report.

1.25 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, secure, and seasonal sensitive equipment and systems before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

1.26 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 reviewed by Commissioning Authority in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.27 EXTENT OF VERIFICATION

- .1 Provide manpower and instrumentation to verify up to 75% of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of the 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 the Commissioning Authority.

1.28 REPEAT VERIFICATIONS

- .1 Assume costs incurred by Commissioning Authority for third and subsequent verifications where:
 - .1 Verification of reported results that fail to receive the Cx Authority 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.

1.29 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.

1.30 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of the Commissioning Authority.
- .2 Report problems, faults or defects affecting Cx to the Commissioning Authority in writing. Stop Cx until problems are rectified. Proceed with recommended approval from the Commissioning Authority.

1.31 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 reviewed by the Commissioning Authority.

1.32 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.

1.33 TRAINING / SYSTEMS DEMONSTRATION

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

1.34 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.35 OCCUPANCY

- .1 Cooperate fully with Departmental Representative, Commissioning Authority and Airport Manager during stages of acceptance and occupancy of facility.

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

1.37 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.38 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.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.
- .2 Related Requirements
 - .1 Section 01 91 13 General Commissioning Requirements
 - .2 Section 01 91 33 Commissioning Forms
 - .3 Section 01 91 41 Commissioning Training
 - .4 Section 23 08 00 Mechanical Commissioning
 - .1 Section 23 08 01 Performance Verification
 - .2 Section 26 05 00 Common Work Results for Electrical

1.2 REFERENCES

- .1 CSA Standard Z320 -2011 Building Commissioning
- .2 ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems

1.3 GENERAL

- .1 Provide a fully functional mechanical and electrical system:
 - .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 Owner Representatives, Airport Manager and O&M personnel have been fully trained in aspects of installed systems.
 - .3 Optimized life cycle costs.
 - .4 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this section means "Commissioning".
- .3 Use this Cx Plan as master planning document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.

- .3 Sets out deliverables relating to O&M, process and administration of Cx.
- .4 Describes process of verification of how built works meets the Owner's project 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 CxA – Commissioning Authority (Consultant)
 - .3 CxAg – Commissioning Agent (Contractor)
 - .4 EMCS - Energy Monitoring and Control Systems.
 - .5 O M – Operating and Maintenance (staff)
 - .6 OMM - Operation and Maintenance Manuals
 - .7 PI - Product Information.
 - .8 PV - Performance Verification.
 - .9 TAB - Testing, Adjusting and Balancing.
 - .10 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
 - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
 - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.4 DEVELOPMENT OF 100% CX PLAN

- .1 Cx Plan to be 95% completed before the start of commissioning in the construction phase.
- .2 Cx Plan to be 100% completed [2] weeks prior to the start of commissioning activities, take into account:
 - .1 Approved shop drawings and product data.

- .2 Approved changes to contract.
- .3 Contractor's project schedule.
- .4 Cx schedule.
- .5 Requirements of Contractor, sub-contractor, suppliers.
- .6 Project construction team's and Cx team's requirements.
- .3 Submit completed Cx Plan to Commissioning Authority, obtain written review and recommended approval.

1.5 REFINEMENT OF CX PLAN

- .1 During construction phase, revise, refine and update Cx Plan (as needed) to include:
 - .1 Changes resulting from Client program modifications.
 - .2 Approved design and construction changes.
- .2 Revise, refine and update as needed during the 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 Departmental Representative to maintain overall responsibility for the project, and communicates directly with the Commissioning Authority and Commissioning Manager.
- .2 Commissioning Authority shall report to the Departmental Representative and reviews all commissioning activities and deliverables prior to project handover.
- .3 Commissioning Manager (prime contractor) is main point of contact between members of commissioning team, and manages the daily commissioning activities that may occur. Cx Manager shall collect Cx documentation from Cx Agents, and submit to the Commissioning Authority for review.
- .4 Commissioning Agent (mechanical) executes the mechanical specific Cx activities. Electrical trade may retain an electrical Cx Agent as needed. Cx Agent reports to the Cx Manager, and/or may report directly to the Cx Authority.
- .5 Project Manager will select Cx Team consisting of following members:
 - .1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.

- .2 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
 - .1 Review of Cx documentation from operational perspective.
 - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
 - .3 Protection of health, safety and comfort of occupants and O M personnel.
 - .4 Monitoring of Cx activities, training, development of Cx documentation.
 - .5 Work closely with members of Cx Team.
- .3 Commissioning Authority is responsible for:
 - .1 Overseeing and reviewing Cx.
 - .2 Monitoring Cx activities.
 - .3 Witnessing, verifying accuracy of reported results.
 - .4 Witnessing and verifying TAB and other tests.
 - .5 Reviewing OMM
 - .6 Reviewing and ensuring implementation of final Cx Plan.
 - .7 Reviewing performance verification results of installed systems and equipment
 - .8 Reviewing implementation of Training Plan.
- .4 Construction Team: prime contractor, contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
 - .1 Testing.
 - .2 TAB.
 - .3 Performance of Cx activities.
 - .4 Delivery of training and Cx documentation.
 - .5 Assigning Commissioning Manager as point of contact with Commissioning Authority, Departmental Representative, and PWGSC Cx Manager for administrative and coordination purposes.
- .5 Contractor's Cx agent executes specified Cx activities including:

- .1 Demonstrations.
- .2 Training.
- .3 Testing.
- .4 Preparation, submission of test reports.
- .6 Owner's Representative, Airport Manager, O&M Manager:
represents lead role in Operation Phase and onwards and is
responsible for:
 - .1 Receiving facility.
 - .2 Day-To-Day operation and maintenance of facility.

1.7 CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
 - .1 Installation contractor/subcontractor:
 - .1 Equipment and systems except as noted.
 - .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
 - .1 To include performance verification.
 - .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
 - .4 Specialist Cx agency:
 - .1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Cx specialists on this project.
 - .5 Client: responsible for intrusion and access security systems.
 - .6 Ensure that Cx participant:
 - .1 Could complete work within scheduled time frame.
 - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O M personnel, including:
 - .1 Modify ventilation rates to meet changes in off-gassing.
 - .2 Changes to heating or cooling loads beyond scope of EMCS.
 - .3 Changes to EMCS control strategies beyond level of training provided to O M personnel.
 - .4 Redistribution of electrical services.

- .5 Modifications of fire alarm systems.
- .6 Modifications to voice communications systems.
- .7 Provide names of participants to the Commissioning Authority and details of instruments and procedures to be followed for Cx [2] weeks prior to starting date of Cx for review and recommended approval.

1.8 RISK ASSESSMENT

- .1 Not used.

1.9 EXTENT OF CX

- .1 Cx Structural and Architectural Systems:
 - .1 Not applicable.
- .2 Commission mechanical systems and associated equipment:
 - .1 Plumbing systems:
 - .1 Backflow devices.
 - .2 HVAC systems:
 - .1 Hydronic Heating systems
 - .2 Boilers
 - .3 Pumps
 - .4 HVAC Controls and graphics
 - .3 Noise and vibration control systems for mechanical systems.
 - .1 Boilers
 - .2 Pumps
 - .4 Seismic restraint and control measures.
 - .1 Boilers
 - .2 Pumps
 - .3 Ceiling and wall mount piping
 - .4 Ceiling and wall mount mechanical equipment
- .3 Commission electrical systems and equipment:
 - .1 Low voltage below 750 V:
 - .1 Low voltage equipment.
 - .2 Low voltage distribution systems.
 - .3 Emergency boiler shutdown.

- .2 Lighting systems:
 - .1 Lighting equipment.
 - .2 Distribution systems.
 - .3 Emergency lighting systems, including battery packs.

1.10 DELIVERABLES RELATING TO O M PERSPECTIVES

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

1.11 DELIVERABLES RELATING TO THE CX PROCESS

- .1 General:
 - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
 - .1 Cx as used in this section includes:
 - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
 - .2 Factory inspections and performance verification tests.
- .3 Deliverables; provide:
 - .1 Startup, pre-Cx activities and documentation for systems, and equipment.
 - .2 Completed installation checklists.
 - .3 Completed product information (PI) report forms.
 - .4 Completed performance verification (PV) report forms.

- .5 Results of Performance Verification Tests and Inspections.
- .6 Description of Cx activities and documentation.
- .7 Description of Cx of integrated systems and documentation.
- .8 Tests witnessed by Commissioning Authority and/or PWGSC Design Quality Review Team:
- .9 Tests performed.
- .10 Training (Systems Demonstrations) Plans.
- .11 Cx Reports.
- .12 Prescribed activities during warranty period.
- .4 Contractor's Commissioning Agent to witness and review tests and reports of results prior to providing to Cx Mgr and Cx Authority.

1.12 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up inspections: by Cx Agent prior to permission to start-up and rectification of deficiencies to Commissioning Authority's satisfaction.
 - .2 Cx Agent to use approved check lists.
 - .3 Cx Agent will monitor and/or perform all 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 by Cx Authority and does not form part of Cx specifications.
 - .6 Departmental Representative will monitor some of these inspections and tests.
 - .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - ARCHITECTURAL AND STRUCTURAL:
 - .1 Not applicable.
- .3 Pre-Cx activities - MECHANICAL:
 - .1 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 reviewed by the contractor's Cx Agent prior to submitting to the Cx Manager and Cx Authority.
- .2 EMCS:
 - .1 EMCS trending to be available as supporting documentation for performance verification.
 - .2 Perform point-by-point testing in parallel with start-up.
 - .3 Carry out point-by-point verification.
 - .4 Demonstrate performance of systems, to be witnessed by the Commissioning Authority prior to start of [30] day Final Acceptance Test period.
 - .5 Perform final Cx and operational tests during demonstration period and [30] day test period.
 - .6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".
- .4 Pre-Cx activities - ELECTRICAL:
 - .1 Low voltage distribution systems under 750 V:
 - .1 Requires independent testing agency to perform pre-energization and post-energization tests.
 - .2 Lighting systems:
 - .1 Emergency lighting systems:
 - .1 Tests to include verification of lighting levels and coverage, initially by disrupting normal power.

1.13 START-UP

- .1 Start up components, equipment and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:
 - .1 Boilers
 - .2 Pumps
- .3 Commissioning Agent to monitor some of these start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of Commissioning Authority.

- .4 Performance Verification (PV):
 - .1 Contractor's Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to Commissioning Authority.
 - .2 Contractor's Cx Agent to use procedures modified from generic procedures to suit project requirements.
 - .3 Contractor's Cx Agent to witness and review reported results using approved PI and PV forms.
 - .4 Contractor's Cx Agent to review completed PV reports and provide to Cx Mgr and Cx Authority.
 - .5 Commissioning Authority reserves right to verify up to 50% of reported results at random.
 - .6 Failure of randomly selected item shall result in rejection of PV report or report of system start up and testing.

1.14 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency using procedures developed by the Commissioning Authority or alternate procedures proposed by the Contractor's commissioning agent and reviewed by the Cx Authority prior to commencement.
- .2 Commissioning Manager to monitor daily Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .4 Contractor's Commissioning Agent to witness, review reported results of, Cx activities and forward to Cx Manager and Cx Authority for recommended approval.
- .5 Commissioning Authority reserves the right to verify up to 50% percent of reported results at no cost to contract.

1.15 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency using procedures developed by the Commissioning Authority and/or alternate procedures proposed by the Contractor's commissioning agent and reviewed by the Cx Authority prior to commencement.
- .2 Tests to be witnessed by the Cx Authority and documented on approved report forms by the Cx Agent.
- .3 Upon satisfactory completion, Cx agent to prepare Cx Report, to be reviewed by the owner's Commissioning Authority for recommended approval.

- .4 Commissioning Authority reserves the right to verify up to 50% percent of reported results at no cost to contract.
- .5 Integrated systems to include:
 - .1 Hydronic and associated systems forming part of integrated HVAC systems:
 - .2 Emergency boiler shut-down.
- .6 Identification:
 - .1 In later stages of Cx, before hand-over and acceptance Contractor's commissioning agent to co-operate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, and main systems.

1.16 INSTALLATION CHECK LISTS (ICL)

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

1.17 PRODUCT INFORMATION (PI) REPORT FORMS

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

1.18 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.

1.19 DELIVERABLES RELATING TO ADMINISTRATION OF CX

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

1.20 CX SCHEDULES

- .1 Cx Manager and Cx agent to prepare detailed Cx Schedule and submit to Commissioning Authority for review at the 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: within [2] weeks after award of contract, before construction starts.

- .3 Cx agents' credentials: within [2] weeks after award of contract.
- .4 Cx procedures: within [2] weeks after award of contract.
- .5 Cx Report format: within [2] weeks after award of contract.
- .6 Discussion of heating/cooling loads for Cx: within [2] weeks after award of contract.
- .7 Submission of list of instrumentation with relevant certificates: [3] weeks before start of Cx.
- .8 Notification of intention to start TAB: [3] weeks 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: [2] weeks before start of Cx.
- .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed [1] week before start of integrated system Cx.
- .12 Identification of deferred Cx.
- .13 Implementation of training plans.
- .14 Cx of control systems: after Cx of related systems is completed and [2] weeks before proposed date of Cx these systems.
- .15 Cx reports: within [1] week upon successful completion of Cx.
- .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Owner's Representative, and/or Airport Manager.
- .3 Within [10] months in Cx schedule for verification of performance in all seasons and wear conditions.
- .2 Upon review of Cx activities, incorporate Cx Schedule into Construction Schedule.
- .3 Prime Contractor, Contractor's Cx agent, and Commissioning Authority will monitor progress of Cx against this schedule.

1.21 CX REPORTS

- .1 Cx Manager shall submit reports of tests, reported by the Cx Agent, to the Cx Authority who will review and 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 the Commissioning Authority.

1.22 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 Deferred seasonal testing.
 - .3 Deferred testing due to security and access restrictions.

1.23 TESTS TO BE PERFORMED BY OWNER/USER

- .1 None is anticipated on this project.

1.24 TRAINING PLANS

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

1.25 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.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Commissioning forms to be completed for equipment, system and integrated system.
- .2 Related Requirements
 - .1 Section 01 91 13 General Commissioning Requirements
 - .2 Section 01 91 31 Commissioning Plan
 - .3 Section 01 91 41 Commissioning Training
 - .4 Section 23 08 00 Mechanical Commissioning
 - .5 Section 23 08 01 Performance Verification
 - .6 Section 26 05 00 Common Work Results for Electrical

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 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Commissioning Authority. Check lists will be required during Commissioning and will be included in the Operations & Maintenance Manual (OMM) at completion of project.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and

pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the OMM at completion of work.

- .2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Commissioning Authority recommended approval.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

- .1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.
- .2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.
- .3 Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's approval.

1.5 SAMPLES OF COMMISSIONING FORMS

- .1 Commissioning Agent shall submit proposed PV forms to Cx Authority for review prior to implementation.
- .2 Revise items on Commissioning forms to suit project requirements.

1.6 COMMISSIONING FORMS

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
 - .1 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
 - .2 Confirm operation as per design criteria and intent.
 - .3 Identify variances between design and operation and reasons for variances.
 - .4 Verify operation in specified normal and emergency modes and under specified load conditions.
 - .5 Record analytical and substantiating data.
 - .6 Verify reported results.
 - .7 Form to bear signatures of recording technician and reviewed and signed off by Cx Agent.

- .8 Submit immediately after tests are performed.
- .9 Reported results in true measured SI unit values.
- .10 Provide Commissioning Authority with originals of completed forms.
- .11 Maintain copy on site during start-up, testing and commissioning period.
- .12 Forms to be both hard copy and electronic format with typed written results for insertion into the OMM.

1.7 LANGUAGE

- .1 English.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 This Section specifies roles and responsibilities of Commissioning Training.
- .2 Related Requirements
 - .1 Section 01 91 13 General Commissioning Requirements
 - .2 Section 01 91 31 Commissioning Plan
 - .3 Section 01 91 33 Commissioning Forms
 - .4 Section 23 08 00 Mechanical Commissioning
 - .5 Section 26 05 00 Common Work Results for Electrical

1.2 TRAINEES

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Airport 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 Cx Manager and/or Cx Agent will provide:
 - .1 Descriptions of systems.
 - .2 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
 - .1 Start-Up, operation, shut-down of equipment, components and systems.
 - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
 - .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .3 Contractor and equipment manufacturer to provide instruction on:
 - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

- .1 Training to be detailed and duration to ensure:

- .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
- .2 Effective on-going inspection, measurements of system performance.
- .3 Proper preventive maintenance, diagnosis and trouble-shooting.
- .4 Ability to update documentation.
- .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

- .1 Instructors to be responsible for content and quality.
- .2 Training materials to include:
 - .1 "As-Built" Contract Documents.
 - .2 Operating Manual.
 - .3 Operating & Maintenance Manual.
 - .4 TAB and PV Reports.
- .3 Departmental Representative, PWGSC Commissioning Manager, Cx Authority, Owner's Representative and Airport Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Training session shall include a group walkthrough of the renovation area.
- .6 Supplement training materials:
 - .1 Multimedia presentations (Powerpoint, PDF)
 - .2 Manufacturer's training videos

1.6 SCHEDULING

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours, training sessions to be [4] 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 Departmental Representative, Commissioning Authority, and/or Owner's Representative.

1.8 TRAINING CONTENT

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
 - .1 Review of facility and occupancy profile.
 - .2 Functional requirements.
 - .3 System philosophy, limitations of systems and emergency procedures.
 - .4 Review of system layout, equipment, components and controls.
 - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
 - .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
 - .7 Maintenance and servicing.
 - .8 Trouble-shooting diagnosis.
 - .9 Inter-Action among systems during integrated operation.
 - .10 Review of O M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

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 Removal and or salvage of designated construction.
- .2 Disposal of materials.

1.2 RELATED SECTIONS

- .1 Section 00 01 50 – General Instructions
- .2 Appendix Section – Hazardous Building Materials Assessment

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA S350-M1980(R1998), Code of Practice for Safety in Demolition of Structures.
- .2 National Building Code of Canada (NBCC-2015)

1.4 GENERAL

- .1 Submit detailed schedule for any and all work affecting the existing building. Consult with Departmental Representative regarding work required. Submit schedule minimum 10 calendar days prior to scheduled work.
- .2 Comply with requirement of Section 01 74 19 Waste Management and Disposal.

1.5 SCHEDULING

- .1 Submit with the project schedule a coordinated complete series of drawings diagrams, details and supporting data clearly showing sequence of demolition and removal work, reconstruction, occupant moves required, material storage, temporary barriers for all phases of the demolition construction work.
- .2 Perform noisy, malodorous, dusty, work as directed by the Departmental Representative.

1.6 SITE CONDITIONS

- .1 Review the Project Specific Hazardous Building Materials Assessment for the Penticton Airport Air Terminal Building Boiler Replacement with the Departmental Representative.
 - .1 Remove hazardous materials in a manner consistent with the Occupational Health & Safety Regulation, General Hazard Requirements of the Work Safe BC, and other applicable regulations. Changes to the Work will be dealt in accordance with the provisions of the Contract Documents.

- .2 Handle and dispose of all hazardous and banned materials in accordance with the Special Waste Regulation, and Regional and Municipal regulations. These hazardous and banned materials include but are not limited to asbestos, drywall (banned from disposal), Polychlorinated Biphenyls (PCBs), abandoned chemicals (gasoline, pesticides, herbicides, flammable and combustible substances), freon from cooling equipment, lead-based paints, smoke detectors, and mercury containing switches.
- .2 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.
- .3 Notify Departmental Representative minimum 5 working days before disrupting building access or services.
- .4 The Contractor shall accept the site as it exists and will be responsible for all deconstruction work as required.

1.7 DEMOLITION PROCEDURES

- .1 Materials: As specified in Product sections; match existing Products and work for patching and extending work.
- .2 Employ skilled and experienced installer to perform alteration work.
- .3 Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- .4 Remove, cut, and patch Work in a manner to minimize damage and to provide means of restoring Products and finishes to original condition.
- .5 Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with a neat transition to adjacent finishes.
- .6 Where new Work abuts or aligns with existing, provide a smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- .7 When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and submit recommendation to Departmental Representative for review.
- .8 Where a change of plane of 6 mm or more occurs, submit recommendation for providing a smooth transition; to Departmental Representative for review. Request instructions from the Departmental Representative.

- .9 Patch or replace portions of existing surfaces which are damaged, lifted, discoloured, or showing other imperfections.
- .10 Finish surfaces as specified in individual Product sections.

1.8 PROTECTION

- .1 Prevent movement, settlement, or other damage to adjacent structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.
- .2 Keep noise, dust, and inconvenience to occupants to a minimum. Noisy work will only be permitted at times agreed to and accepted by the Departmental Representative.
- .3 Protect building mechanical and electrical systems, services and equipment.
- .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
- .5 Do not overload any portion of the structure with material or equipment.
- .6 Where existing load bearing partitions are to be removed, do not commence work until new support structure is installed, inspected and approved by the Departmental Representative.
- .7 Cease operations and notify the Departmental Representative if safety of any adjacent work or structure appears to be endangered. Take all precautions to support the structure. Do not resume operations until reviewed with the Departmental Representative.
- .8 Ensure safe passage of building occupants around area of demolition. Remove debris and clean areas of access immediately.
- .9 Conduct demolition to minimize interference with adjacent and occupied building areas.

1.9 QUALITY ASSURANCE

- .1 Salvage or Demolition Firm: Company (ies) must be experienced and specializing in performing the work of this section with documented experience in similar types of deconstruction work.
- .2 Qualifications of Workers: Provide a supervisor who shall be present at all times during the deconstruction work and who shall be thoroughly familiar with the work required and who shall direct all work. Provide one (1) person on site who is responsible for maintaining the safety barriers and protection of the workers and the public.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 PREPARATION

- .1 Inspect building & site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Provide, erect, and maintain temporary barriers security partitions at locations indicated agreed to with the Departmental Representative.
 - .1 Erect and maintain temporary partitions to prevent spread of dust, odours, and noise to permit continued occupancy. Refer to demolition drawings. The extent of the partitions required may exceed the information shown on the phasing drawing or demolition drawings.
- .3 Erect and maintain weatherproof closures for exterior openings.
- .4 Protect existing materials which are not to be demolished.
- .5 Prevent movement of structure; provide bracing and shoring.

3.2 PROTECTION

- .1 Maintain public safety and traffic control precautions at all times during the demolition work, using properly trained qualified persons to control all Contractor's activities, vehicles, equipment, traffic and all public pedestrian and vehicles traffic that are coming to and from the site or passing along the vicinity of the site access locations.
- .2 Prevent movement, settlement, or damage to adjacent structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.
- .3 Keep noise, dust, and inconvenience to occupants to minimum.
- .4 Protect building systems, services and equipment.
- .5 Do Work in accordance with Section 01 35 29 - Health and Safety.

3.3 SITE REMOVALS

- .1 Remove items as indicated.

3.4 DEMOLITION

- .1 The electrical, BSCS, or mechanical services MUST NOT be terminated within the building at any time. Notify the building Departmental Representative of any requirements for partial termination of services in accordance with Division 1 requirements. Keep down time at a minimum.
- .2 Remove parts of existing building to permit new construction. Sort materials into appropriate piles for reuse, recycling, or disposal.
 - .1 Demolish in an orderly and careful manner. Protect existing supporting structural members.

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

.3 Remove temporary Work.

3.5 DISPOSAL

.1 Dispose of removed materials, to appropriate recycling facilities except where specified otherwise, in accordance with authority having jurisdiction.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Work and conditions common to Division 23

1.2 RELATED SECTIONS

- .1 Section 01 35 29 - Health and Safety Requirements
- .2 Section 23 08 00 - Commissioning of Mechanical Systems
- .3 Section 23 05 49 - Seismic Restraints

1.3 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.4 WORK INCLUDED

- .1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein, in complete accordance with applicable codes and ordinances.
- .2 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available.
- .3 Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.
- .4 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .5 The most stringent requirements of this and other mechanical sections shall govern. Should inconsistencies exist such as the drawings disagreeing within themselves or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed and furnished unless otherwise ordered by the Departmental Representative in writing during the bidding period.
- .6 All work shall be in accordance with the Project Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .7 Provide seismic restraints for all required equipment, piping and ductwork.
- .8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Departmental Representative. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories.

1.5 SUSTAINABLE REQUIREMENTS

- .1 Follow instructions and initiatives such as pollution preventions and recycling of materials, packaging and debris.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Specified in Section 01 74 19 Waste Management and Disposal

1.7 COORDINATION

- .1 Check drawings of all trades to verify space and headroom limitations for work to be installed.
- .2 Coordinate work with all trades and make changes to facilitate a satisfactory installation.
- .3 The drawings indicate the general location and route to be followed by the piping and ductwork. Where details are not shown on the drawings or only shown diagrammatically, the pipes and ductwork shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines.
- .4 All ducts and pipes in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All pipes and ducts shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.

1.8 HOISTS AND SCAFFOLDS

- .1 Provide all necessary interior movable or roller scaffolds, platforms, lifts and ladders for the installation of the mechanical work.

1.9 INSPECTION OF WORK

- .1 The Departmental Representative shall inspect all work prior to it being concealed. All piping below ground must be approved prior to covering.
- .2 All work shall be approved by all authorities having jurisdiction.
- .3 All openings shall be sealed appropriately in particular in fire rated walls and floors. Sealing shall be inspected prior to covering.

1.10 PERMITS

- .1 Obtain all required permits and pay all fees therefore and comply with all Provincial, Municipal, Federal and other legal regulations and bylaws applicable to the work.
- .2 Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.11 CODES, REGULATIONS AND STANDARDS

- .1 Division 23 work shall conform to the following codes, regulations and standards, and all other codes in effect at the time of award of Contract, and any others having jurisdiction. The latest revision of each code and standard shall apply unless otherwise specified in the contract documents:
 - .1 Canadian Gas Association
 - .1 National Standard of Canada CAN/CGA-B149.1-15. - Natural Gas Installation Code.
 - .2 Canadian Standards Association
 - .1 CSA Standard C22.1- Canadian Electrical Code.
 - .2 CSA Standard B51- Boiler, Pressure Vessel and Pressure Piping Code.
 - .3 National Research Council of Canada
 - .1 NRCC 56190 National Building Code of Canada 2015.
 - .4 SMACNA Publications
 - .1 Guidelines for seismic restraints of mechanical systems.
- .2 Where these specifications specifically indicate requirements more onerous than the aforementioned codes, these specifically indicated requirements shall be incorporated into the work.

1.12 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.
- .2 Take note of any extended warranties specified.
- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period described in Division 01 and General conditions, which shall include one (1) complete summer and one (1) complete winter of uninterrupted operation. Warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.
- .4 This Contractor shall, at their own expense, promptly investigate any mechanical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the guaranty-warranty.

1.13 ENERGY CONSUMPTION

- .1 The Departmental Representative may reject equipment submitted for approval or review on basis of performance or energy consumed or demanded.

1.14 WORKMANSHIP

- .1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by the Departmental Representative and the Trade.
- .2 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.
- .3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

1.15 PERFORMANCE VERIFICATION OF INSTALLED EQUIPMENT

- .1 Installed mechanical equipment whose performance is questioned by the Departmental Representative, may be subject to performance verification as specified herein.
- .2 When performance verification is requested, equipment shall be tested to determine compliance with specified performance requirements.
- .3 The Departmental Representative will determine by whom testing shall be carried out. When requested, the contractor shall arrange for services of an independent testing agency.
- .4 Testing procedures shall be reviewed by the Departmental Representative.
- .5 Maintain building comfort conditions when equipment is removed from service for testing purposes.
- .6 Promptly provide the Departmental Representative with all test reports.
- .7 Should test results reveal that originally installed equipment meets specified performance requirements; the Departmental Representative will pay all costs resulting from performance verification procedure.
- .8 Should test results reveal that equipment does not meet specified performance requirements, equipment will be rejected and the following shall apply:
 - .1 Remove rejected equipment. Replace with equipment, which meets requirements of Contract Documents including specified performance requirements.
 - .2 Replacement equipment will be subject to performance verification as well; using the same testing procedures on originally installed equipment.
 - .3 Contractor shall pay all costs resulting from performance verification procedure.

1.16 SHOP DRAWINGS/PRODUCT DATA

- .1 Per Section 01 33 00
- .2 Process
 - .1 Shop drawings/product data shall be submitted for all H.V.A.C. equipment and materials.
 - .2 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Departmental Representative.
 - .3 Do not order equipment or material until the Departmental Representative has reviewed and returned shop drawings.
 - .4 Shop drawings shall be reviewed by the General Contractor and Mechanical Sub-Contractor indicating that the shop drawings have been reviewed, co-ordinated with the work and that the shop drawings are submitted without qualifications. Shop drawings shall bear the 'reviewed' stamp dated and initialled by the General Contractor and Mechanical Sub-Contractor prior to submitting the shop drawings to the Departmental Representative. Shop drawings, which do not bear the contractors and sub-trades 'reviewed' stamp, initials and date will be rejected and sent back as 'not reviewed'.
 - .5 Submit samples, in addition to drawings, of all items, which in the Departmental Representative's judgment, can be better examined for capacity, quality, finish or detail by sample rather than by drawings. Samples shall be submitted before equipment or material is ordered.
 - .6 If shop drawings are rejected technically after 2 submissions, the Contractor at no additional expense to the Departmental Representative shall revert to the product as instructed by the Departmental Representative.
- .3 Content
 - .1 Shop drawings submitted title sheet. Identify section and paragraph number.
 - .2 Data shall be specific and technical.
 - .3 Identify each piece of equipment.
 - .4 Information shall include all scheduled data.
 - .5 Material for maintenance and operating manuals is not suitable.
 - .6 Advertising literature will be rejected.
 - .7 The project shall be identified on each document.

- .8 Information shall be given in S.I. units (Imperial Units optional, in brackets).
- .9 The shop drawings/product data shall include:
 - .1 Clearly mark submittal material using arrows, underlining or circling to show differences from specified ratings, capabilities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps, seals, material, finish, or painting.
 - .2 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with mounting point loads.
 - .3 Mounting arrangements.
 - .4 Detailed drawings of bases, supports and anchor bolts.
 - .5 Capacity and performance characteristics indicated on performance curves for fans and pumps.
 - .6 Sound Power Data, for all noise generating equipment and where requested.
 - .7 Motor efficiencies on motors 1H.P. and larger.
 - .8 List of the manufacturers and figure numbers for all valves, traps and strainers.
 - .9 Control explanation and internal wiring diagrams for packaged equipment.
 - .10 Control system drawings including a written description of control sequences relating to the schematic diagrams.
 - .11 Submit as a shop drawing, an electrical equipment list for any equipment supplied by the mechanical contractor or his subtrades. The list is to be submitted in a timely fashion so that the electrical contractor can utilize the list as a final check prior to ordering motor control centres, starters, or disconnects. The list is to indicate the following:
 - .1 The horsepower size and number of motors.
 - .2 The minimum circuit amps (MCA) for packaged equipment such as heat recovery units, chillers, etc.
 - .3 The voltage and phase of the motors.
 - .4 Whether or not a starter or a disconnect is included as part of the package.

- .4 Format
 - .1 Black line prints 216 mm x 280 mm or 280 mm x 430 mm.
 - .2 Larger drawings may be submitted on reproducible sepia with space for stamps and signatures - master set plus one working copy.
 - .3 An assembly of related components, e.g. grilles, registers and diffusers or radiation with sheet metal cabinets, etc. between covers with the contents, identified by model number, listed on the front cover with item identification numbers.
 - .4 A brochure for plumbing fixtures between covers with the contents named with model numbers listed on the front cover with item identification numbers.
- .5 Number of copies
 - .1 Provide number of copies indicated in Section 01 33 00 - Submittal Procedures.
- .6 Coordination
 - .1 Where mechanical equipment requires electrical connections, power or other services, the shop drawings shall also be circulated through the Electrical Contractor (or other "services" contractor(s)) prior to submission to the DCC Representative.
- .7 Keep one (1) copy of shop drawings and product data, on site, available for reference.

1.17 DUCT AND PIPE MOUNTED CONTROL EQUIPMENT

- .1 The following automatic control equipment will be supplied by the Controls Contractor, under Division 23, but installed by the appropriate trade sections of the Mechanical Contract:
 - .1 Automatic control valves.
 - .2 Temperature control wells.
 - .3 Pressure tappings.
 - .4 Flow switches.
 - .5 Static pressure sensors.

1.18 SPARE PARTS

- .1 Provide spare parts as follows:
 - .1 One glass for each gauge glass installed.
 - .2 One filter cartridge for each filter installed.

1.19 PROJECT CLOSE-OUT REQUIREMENTS

- .1 Per Section 01 77 00

- .2 The project closeout requirements are specifically listed in each section of this specification. The following is a summary of those requirements. Refer to detailed specifications in each section for further, detailed requirements. All life safety systems must be operational and tested and demonstrated to the Departmental Representative.

.1 Controls:

- .1 Controls system completion report (check sheets).
- .2 Controls system final electrical approval certificate.
- .3 As built control drawings.
- .4 Control training signed off by Departmental Representative (Indicate dates of training in letter and attendance).
- .5 List of control manuals and documents turned over.
- .6 Printed copy of control program and database (printed to disk in word format is acceptable).
- .7 Disc of control system database.

.2 Heating

- .1 Boiler Inspection Branch certificates.
- .2 Gas fired appliances/gas line/pressure piping certificate.
- .3 Registration certificates for all pressure vessels.
- .4 Pressure test reports for heating lines.
- .5 Seismic inspection report.
- .6 Valve tag chart.
- .7 As built drawings.
- .8 Welding certificate and x-ray reports.
- .9 Flushing and cleaning of piping report.

.3 Manufacturer's start-up and other reports including:

- .1 Water Balance.
- .2 Commissioning.
- .3 Fire stop letter of assurance.
- .4 Hot water boilers
- .5 Heating chemical treatment.

1.20 SUBSTANTIAL PERFORMANCE REQUIREMENTS

- .1 Before the Departmental Representative is requested to make an inspection for substantial performance of the work:

- .1 Commission all systems and prove out all components, interlocks and safety devices.
- .2 Submit a letter certifying that all work (including calibration of instruments and balancing of systems) is complete, operational, clean and all required submissions have been completed.
- .3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
- .2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:
 - .1 All reported deficiencies have been corrected.
 - .2 Testing and balancing completed.
 - .3 Operating and Maintenance Manuals completed.
 - .4 "As Built" Record Drawing ready for review.
 - .5 System Commissioning has been completed and has been verified by the Departmental Representative.
 - .6 All demonstrations to the Departmental Representative have been completed.
- .3 The work will not be considered to be substantially complete until the following requirements have been met:
 - .1 All items listed in .1 and .2 above have been completed.
 - .2 Boiler Installation Inspection – Certificate of inspections.
 - .3 Gas Inspection - Certificate of inspection.
 - .4 Seismic letters of Assurance and final inspection report.
 - .5 Certificate of Substantial Performance.
 - .6 Signed off copy of final inspection report.

1.21 OPERATING AND MAINTENANCE MANUALS

- .1 Provide operation and maintenance data for incorporation into a complete project manuals.
- .2 Definition: detailed information and records of individual products provided by manufacturer or supplier as part of project requirements, and of systems, describing operation and maintenance of each item.
- .3 Operating data to include:
 - .1 Environmental and other control schematics for each system.

- .2 Description of each system and its controls.
- .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
- .4 Operating instruction for each system and each component.
- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .4 Maintenance data shall include:
 - .1 Servicing, maintenance, operating and trouble-shooting instructions for each item of equipment.
 - .2 Equipment manufacturer's performance data sheets.
 - .3 Equipment performance verification test results.
- .5 Approvals:
 - .1 Submit (2) drafts of Operating and Maintenance Manual to the Departmental Representative for approval. Submission of individual data will not be accepted unless so directed by the Departmental Representative.
 - .2 Make any changes in submission as may be required and re-submit as directed.

1.22 RECORD DRAWINGS

- .1 Site records:
 - .1 Provide and maintain sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur.
 - .2 On a weekly basis, transfer information to reproducible using services of skilled draftsman revising reproducible to show all work as actually installed.
 - .3 Make these drawings available for reference purposes and to inspection at all times.

Part 2 Products

NOT USED

Part 3 Execution

3.1 CONCEALMENT

- .1 Conceal all piping, ductwork and conduit in partitions, walls, crawlspace and ceiling spaces, unless otherwise noted.

- .2 Do not install piping and conduit in outside walls or roof slabs unless specifically directed, in which case, install them with the building insulation between them and the outside face of the building.

3.2 ACCESSIBILITY

- .1 Install all work so as to be readily accessible for adjustment, operation and maintenance. Furnish access doors where required in building surfaces for installation by building trades. Refer to item "Access Doors".

3.3 PROTECTION OF WORK

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.
- .2 Mask machined surfaces. Secure covers over equipment openings and open ends of piping, ductwork and conduits, as installation work progresses.
- .3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finish.

3.4 CUTTING, PATCHING, DIGGING, CANNING AND CORING

- .1 Lay out all cutting, patching, digging, canning and coring required to accommodate the mechanical services. Coordinate with other Divisions.
- .2 Refer to drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls. Openings through structural members of the building shall not be made without the approval of the Departmental Representative.
- .3 Be responsible for correct location and sizing of all openings required under Division 23, including pipe sleeves and duct openings. Allow oversized openings for fire dampers and pipe penetrations where insulation is specified.
- .4 Verify the location of existing service runs and steel reinforcing within existing concrete floor and walls prior to core drilling and/or cutting. Repairs to existing services and structural components damaged as a result of core drilling and cutting is included in this section of the work.
- .5 Be responsible for all cutting, patching, digging, canning and coring required to accommodate the mechanical services.
- .6 All openings shall be core drilled or diamond saw cut.

3.5 FASTENING TO BUILDING STRUCTURE

- .1 General:
 - .1 Do not use inserts in base material with a compressive strength less than 13.79 MPa.

- .2 All inserts supporting piping shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.
- .2 Types:
 - .1 Cast-in-place type:
 - .1 Channel type - Burndy, Canadian Strut, Unistrut, Cantruss or Hilti Channel.
 - .2 Wedge type galvanized steel concrete insert, rated for the duty, for up to 200 mm pipe size.
 - .3 Universal type malleable iron body insert, rated for the duty, for up to 200 mm pipe size.
 - .4 Screw concrete insert, rated for the duty, for up to 300 mm pipe size.
 - .2 Drilled, mechanical expansion type:
 - .1 Heavy duty anchor for use in concrete with compressive strength not less than 19.6 MPa.
 - .2 Stud anchor for concrete. (Do not use in seismic restraint applications).
 - .3 Drop-in anchor for concrete.
 - .4 Sleeve Anchor (medium and light duty) for concrete and masonry.
 - .5 Pin bolt (light duty) for concrete and masonry.
 - .3 Drilled, adhesive type:
 - .1 Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.
 - .2 Anchor rod with a 2 part adhesive system.
 - .3 For use in concrete housekeeping bases (in vertical downward position) where the distance to the edge of the concrete base could cause weakness if a mechanical expansion type anchor were used.
 - .4 Rod assemblies shall extend a minimum of 50 mm into the concrete slab below the housekeeping bases.
- .3 Note:
 - .1 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.

- .2 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.

3.6 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

- .1 All piping, tubing, ducts, wiring, conduits, etc. passing through rated fire separations shall be smoke and fire proofed with ULC approved materials in accordance with CAN4-S115-M85 and ASTM E814 standards and which meet the requirements of the Building code in effect. This includes new services, which pass through existing rated separations, and also all existing services, which pass through a new rated separation or existing separations whose rating has been upgraded.

3.7 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

- .1 All piping, tubing, ducts, wiring, conduits, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent the passage of smoke and/or transmission of sound. Refer to "pipe sleeve" clause in this section for packing and sealing of pipe sleeves.

3.8 PIPE SLEEVES

- .1 Provide pipe sleeves for all piping passing through rated walls and floors. Sleeves to be concentric with pipe.
- .2 Pipes and ducts passing through fire rated separations that have no fire resistance (non-rated separations) do not require a sleeve, but the insulation at the separation should be wrapped with 0.61 mm thick galvanized sheet steel band to which to apply the flexible caulking compound to.
- .3 Pipe sleeves for floors and interior walls shall be minimum 0.61 mm thick galvanized sheet steel with lock seam joints.
- .4 Pipe sleeves for perimeter walls and foundation walls shall be cast iron sleeve or Schedule 40 steel pipe with annular fin continuously welded at midpoint and protruding 150 mm beyond sleeve diameter. Annular fin shall be embedded into centre of wall.
- .5 Pipe sleeves for wet or washdown floor areas such as washrooms, janitors rooms and mechanical equipment rooms shall be Schedule 40 steel pipe.
- .6 Except as otherwise noted pipe sleeves are not required for holes formed or cored in interior concrete walls or floors.
- .7 Pipe sleeves shall extend 50 mm above floors in unfinished areas and wet areas and 6 mm above floors in finished areas.
- .8 Pipe sleeves shall extend 25 mm on each side of walls in unfinished areas and 6 mm in finished areas.
- .9 Pipe sleeves shall extend 25mm beyond exterior face of building. Caulk with flexible caulking compound.

- .10 Sleeve Size: 12 mm clearance all around, between sleeve and pipe or between sleeve and pipe insulation.
- .11 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- .12 Packing of Sleeves:
 - .1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and pipe or between sleeve and pipe insulation shall be caulked with waterproof fire retardant non-hardening mastic.
 - .2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.9 ESCUTCHEONS AND PLATES

- .1 Provide on pipes and conduits passing through finished walls, partitions, floors and ceilings.
- .2 Plates shall be stamped steel, split type, chrome plated, or stainless steel, concealed hinge, complete with springs, suitable for external dimensions of piping/insulation. Secure to pipe or finished surface. For all pipes passing through suspended ceilings and uninsulated piping passing through walls. Outside diameter shall cover opening or sleeve.
- .3 Where pipe sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.
- .4 Do not install escutcheons and plates in concealed locations.

3.10 EQUIPMENT SUPPORTS

- .1 Provide stands and supports for equipment and materials supplied.
- .2 Concrete bases shall be a minimum of 100 mm thick, or as noted and shall project at least 150 mm outside the bedplate, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.
- .3 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise those 25 above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout.
- .4 Construct equipment supports of structural steel or steel pipe. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.
- .5 Support ceiling hung equipment with rod hangers and/or structural steel.

3.11 EQUIPMENT RESTRAINTS

- .1 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .2 As specified in Section 23 05 49.

3.12 EQUIPMENT INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated bearings.
- .3 Pipe equipment drains to floor drains.
- .4 Line up equipment, rectangular cleanouts and similar items with building walls wherever possible.

3.13 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other Divisions.

3.14 MISCELLANEOUS METAL

- .1 Be responsible for all miscellaneous steel work relative to Division 23 of the Specifications, including but not limited to:
 - .1 Support of equipment
 - .2 Hanging, support, anchoring, guiding and relative work as it applies to piping, ductwork, hot water storage tanks, expansion tanks, fans and mechanical equipment.
 - .3 Earthquake restraint devices - refer to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
 - .4 Access platforms, ladders and catwalks.
 - .5 Pipe anchor and/or support posts.
 - .6 Ceiling ring bolts - secure to structure or steel supports.
- .2 All steel work shall be prime and undercoat painted ready for finish under Painting trade. Refer to drawings for details.

3.15 FLASHING

- .1 Flash and counterflash where mechanical equipment passes through weather or water proofed walls, floors, and roofs.
- .2 Flash, vent and soil pipes projecting 75 mm minimum above finished roof surface with lead worked 25 mm minimum into hub, 200 mm minimum

clear on side with minimum 600 x 600 mm sheet size. For pipes through outside walls turn flange back into wall and caulk.

- .3 Flash floor drains over finished areas with lead 250 mm clear on sides with minimum 900 x 900 mm sheet size. Fasten flashing to drain clamp device.
- .4 Provide curbs for mechanical roof installations 350 mm minimum high above roof insulation. Flash and counterflash with galvanized steel, soldered and made waterproofed.
- .5 Provide continuous lead or neoprene safes for built-up mop sinks, and shower stalls 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.

3.16 DELECTRIC COUPLINGS

- .1 On all "OPEN" systems provide wherever pipes of dissimilar metals are joined.
- .2 Provide insulating unions for pipe sizes NPS 2 and under and flanges for pipe sizes over NPS 2.
- .3 Provide felt or rubber gaskets to prevent dissimilar metals contact.
- .4 Standard of Acceptance: Capital, Walter Vallet, EPCO.

3.17 PAINTING

- .1 Clean exposed bare metal surfaces supplied under Division 23 removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .2 Paint all pipe hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.
- .3 Repaint all marred factory finished equipment supplied under Division 23, which is not scheduled to be repainted, to match the original factory finish.
- .4 Natural gas and fire protection piping shall be painted for identification purposes over their entire lengths throughout all exposed areas and in the mechanical room(s) as follows:
 - .1 Gas: Yellow
- .5 Painting of all equipment and materials, supplied under Division 23, installed in mechanical equipment areas and inside finished areas of the building or exposed outside the building, is included under Painting trade specifications.
- .6 Painting by Painting trade shall be in accordance with the following Colour Schedule for Mechanical Equipment Areas:

| Item | Primer (Note **) | Colour Finish |
|--|---------------------------------------|----------------------------------|
| • not galvanized | 1. Damp-proof Red 2. Zinc Chromate | Grey |
| • galvanized | Clear blue undercoat | White (2 coats) |
| • plenum access doors and 200 mm around doors | Clear blue undercoat | Grey |
| Exposed Misc. Metal (supplied under this contract) | 1. Damp-proof Red 2. Zinc Chromate | To be determined on site |
| Guards – Belt and Coupling | 1. Damp-proof Red 2. Zinc Chromate | To match equipment |
| Handrails | Red Primer | Aluminum |
| Insulation Covering (on piping, tanks, heat exchangers, breeching, etc.) | White Primer | White |
| Motors (electric) | | To match associated equipment |
| Piping (uninsulated) | | |
| • gas (natural) | Red Primer | Yellow |
| • services other than above | Red Primer | White |
| Pot Feeders (Chemical) | Red Primer | Aluminum |
| Tanks (steel), Air Receivers and Supports | 1. Damp-proof Red 2. Zinc Chromate | White or Manufacturer's Standard |
| Valve Bodies (uninsulated) | | |
| • hot water heating, antifreeze heating | Red Primer | Aluminum (high temp.) |
| • services other than above | Red Primer | To match associated piping |

Note ** 1. Denotes first primer coat and 2. Denotes second primer coat.

3.18 EQUIPMENT PROTECTION AND CLEAN-UP

- .1 Protect equipment and material in storage, on site and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping systems.
- .2 All mechanical equipment stored on site shall be kept in a dry, heated and ventilated storage area.
- .3 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign material.
- .4 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .5 Provide, install and maintain 30% efficient temporary filters to return and exhaust air openings from ceiling spaces to prevent air born dust from entering ducts, plenums and coils. Install filters to return air grilles when fans are operated and building is not at a clean condition.

3.19 START-UP

- .1 Before starting the plant, provide a certificate stating that the plant is ready for start-up and the following conditions have been met.
 - .1 All safety controls installed and fully operational.
 - .2 Qualified personnel available to operate the plant.
 - .3 Permanent electrical connections made to all equipment.
 - .4 Boiler(s) started up and adjusted by manufacturer's representatives.
 - .5 All mechanical equipment rooms, including plenums, vacuum cleaned.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Bases, pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 RELATED SECTIONS

- .1 Section 23 05 49 - Seismic Restraint

1.3 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-2007, Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A125-1996 (R2007), Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-10, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-07a, Specification for Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .4 Thermal Insulation Association of Canada (TIAC)

1.4 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 and ASME B31.1.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

- .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
- .2 Performance Requirements:
 - .1 Design supports, platforms, catwalks, hangers, to withstand seismic events as specified Section 23 05 49 - Seismic Restraint.

1.5 SUBMITTALS

- .1 Submittals: in accordance with the Submittal Procedure requirements in Section 01 33 00.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.
- .3 Shop drawings: submit drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.
- .4 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .5 Quality Control Check Sheets
- .6 Closeout Submittals: Provide all applicable close-out submittals per Section 01 78 00.

1.6 QUALITY CONTROL

- .1 General:
 - .1 Contractor to be responsible for quality control of the products and installation in this section.
 - .2 Quality Control Program Submittals:
 - .1 Quality Control Check Sheet
 - .2 Check sheets to include the following information:
 - .1 Pipe or ductwork system
 - .2 Equipment number, make and model, including weights

- .3 Pipe support type and spacing
- .4 Pipe support finish (corrosion protection, painted)
- .5 Details of pipe attachment to structure
- .6 Hanger details at pipe insulation (where applicable and specified)
- .7 Comments on seismic installation
- .3 For each tabulated item, state the following:
 - .1 Does the item comply with the specification?
Yes/No/Not Applicable.
 - .2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 GENERAL

- .1 Provide hangers and supports to secure equipment in place, prevent vibration, protect appropriate against damage from earthquake, maintain grade, provide for expansion and contraction and accommodate insulation.
- .2 Provide insulation protection saddles on all insulated piping.
- .3 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP58.
- .4 Set inserts in position in advance of concrete work. Use grid system in equipment rooms.
- .5 Support from (top of) structural members. Where structural bearings do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members, as necessary.
- .6 Do not suspend from metal deck.

2.2 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.3 WALL SUPPORTS

- .1 Horizontal and Vertical pipe adjacent to wall.
 - .1 Exposed pipe wall support for lateral movement restraint.
 - .2 Galvanized or other non corrosive finish.
 - .3 Channel type support - Burndy, Canadian Strut, Cantruss or Unistrut, type support.
 - .4 Angle iron wall brackets (galvanized or other non corrosive finish) with specified hangers.

2.4 FLOOR SUPPORTS

- .1 Horizontal pipe.
 - .1 Do not support piping from the floor unless specifically indicated.
- .2 Vertical pipe.
 - .1 Mid-point of risers between floor slabs - adjustable fabricated steel supports. Refer to Section 23 05 49 - Seismic Restraints.

2.5 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.
- .2 Calculations shall be signed and sealed by Professional Engineer certified in BC.

2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.7 OTHER EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports from structural grade steel
- .2 Submit structural calculations with shop drawings, signed and sealed by Professional Engineer certified in British Columbia.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.

- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, and as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25 % of total load.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 RELATED SECTIONS

- .1 Section 23 05 49 - Seismic Restraints

1.3 REFERENCES

- .1 National Building Code of Canada (NBC) - 2015

1.4 SUBMITTALS

- .1 Provide shop drawings in accordance with the Submittal Procedure requirements in Section 01 33 00.
 - .1 Drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada. Provide Letters of Assurance (Schedule-C).
 - .2 Provide separate shop drawings for each isolated system complete with performance and product data.
 - .3 Provide detailed drawings of seismic control measures for equipment and piping.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.
- .3 Manufacturer's Reports
- .4 Closeout Submittals: Provide all applicable close-out submittals per Section 01 78 00.

Part 2 Products

2.1 GENERAL

- .1 Provide vibration isolation on all motor driven equipment with motors of 1/2 HP and greater power output (as indicated on the motor nameplate) and on piping and ductwork, as specified herein. For equipment less than 1/2 HP, provide vibration isolation grommets at the support points.
- .2 Provide seismic restraint for all equipment including all seismic restraint related hardware (bolts and anchors) from point of attachment to equipment through to and including attachment to structure. The required anchors shall be indicated on the shop drawings and shall be clearly identified for the correct location and so as to be readily identified after installation. Provide clear instructions for their installation. Refer to Section 23 05 49 - Seismic Restraints.

- .3 Place isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the centre of gravity of the equipment. Include height of centre of gravity on shop drawings. Otherwise, design for increased forces on the supports, and submit design calculations with shop drawings for approval.
- .4 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified. Use dynamic stiffness correction factors for elastomers and do not exceed 60 durometer.
- .5 Isolators and restraining devices, which are factory supplied with equipment, shall meet the requirements of this section.
- .6 Use ductile materials in all vibration and seismic restraint equipment.
- .7 Follow Structural Engineer's instructions for drilled inserts re: installation of anchors.
- .8 Provide flexible connectors between equipment and piping where required by manufacturers to protect equipment from stress and reduce vibration in the piping system. Meet connector manufacturer's installation specifications as well as equipment manufacturer's requirements.
- .9 Coordinate with Electrical Division 26 for the provision of a minimum 180° hanging loop of flexible conduit for all electrical connections to isolated equipment.
- .10 Supply all isolators fully assembled and clearly labelled with full instructions for installation by the contractor.

2.2 ISOLATORS - GENERAL

- .1 Supply all of the vibration isolation equipment by one approved supplier with the exception of isolators, which are factory installed and are standard equipment with the machinery. Confirm with manufacturer that these factory-installed isolators meet the seismic requirements of this specification.
- .2 Select isolators at the supplier's optimum recommended loading and do not load beyond the limit specified in the manufacturer's literature.
- .3 Provide hot dipped galvanized housings and neoprene coated springs, or other acceptable weather protection, for all isolation equipment located out of doors or in areas where moisture may cause corrosion.

Part 3 Execution

3.1 INSTALLATION

- .1 Execute the work in accordance with the specifications and, where applicable, in accordance with the manufacturer's instructions and only by workmen experienced in this type of work.

- .2 Isolate variable frequency drive controller using isolators or soft grommets such that structure borne noise transmission to occupied space is less than airborne noise transmission. Controller supplier to provide all isolation, including wiring connections, to control flanking noise transmission. Provide isolation meeting all seismic requirements.

3.2 INSPECTIONS

- .1 The supplier shall provide assistance to the contractor as necessary during the course of installation of isolation equipment.
- .2 The supplier shall inspect the complete installation after system startup and establish that the isolators for each piece of equipment are properly installed and adjusted. Correct any mal-performance. The supplier shall submit a statutory declaration to the Departmental Representative stating that the complete vibration isolation installation is installed in accordance with his drawings and instructions and operates to his satisfaction.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Seismic restraint systems (SRS) for statically supported and vibration isolated equipment and systems; including mechanical and process equipment, mechanical and process distribution systems, fire protection, both vibration isolated and statically supported.

1.2 REFERENCES

- .1 SMACNA – Seismic Restraint Manual – Guidelines for Mechanical Systems.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .3 National Building Code of Canada (NBC) – 2010

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.
- .2 SRS: acronym for Seismic Restraint System.

1.4 SCOPE OF WORK

- .1 Provide restraint on all piping, ductwork, equipment and machinery, which is part of the building mechanical and process systems to prevent injury or hazard to persons and equipment and to retain equipment in its normal position in the event of an earthquake. This specification covers equipment, which is not specifically covered in SMACNA.
- .2 Provide all seismic restraint related hardware, (including bolts and anchors) from point of attachment to equipment through to and including attachment to structure.
- .3 When equipment is mounted on concrete housekeeping pads, and / or concrete curbs the anchor bolts shall extend through the pad into the structure.
- .4 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .5 Seismic restraints may only be omitted where permitted by SMACNA.
- .6 Designed by Professional Engineer specializing in design of SRS and registered in Province of British Columbia. Provide Letters of Assurance (Schedule-C).

1.5 SUBMITTALS

- .1 Submittals: in accordance with the Submittal Procedure requirements in Section 01 33 00.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.
- .3 Shop drawings: submit drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.
 - .1 Note that the shop drawings must be specific to this project, with reference and drawings showing attachment to the existing or new structure.
 - .2 Seismic Engineer to visit site to survey the existing conditions, before submitting the shop drawings.
 - .3 Generic shop drawings that do not reflect the actual site conditions, will be rejected.
- .4 Submit design data including:
 - .1 Full details of design criteria.
 - .2 Working drawings (prepared to same standard of quality and size as documents forming these tender documents), materials lists, schematics, full specifications for components of each SRS to be provided.
 - .3 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
 - .4 Separate shop drawings for each SRS and devices for each system, equipment.
 - .5 Identification of location of devices.
 - .6 Schedules of types of SRS equipment and devices.
 - .7 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
 - .8 Installation procedures and instructions.
 - .9 Design calculations including restraint loads to NBC and Supplement.
 - .10 Detailed work sheets, tables.
 - .11 Detailed design of SRS including complete working drawings prepared to same standard of quality and size as Contract

Documents, materials lists, design calculations, schematics, specifications.

- .5 Quality assurance submittals: Submit the following in accordance with the requirements in Section 01 33 00.
 - .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.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .6 Certificate of Compliance from Contractor's Seismic Engineer (refer to Clause 3.5.1).
- .7 Closeout Submittals: Provide all applicable close-out submittals per Section 001 78 00.

Part 2 Products

2.1 SRS MANUFACTURER

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

2.2 GENERAL

- .1 SRS to provide gentle and steady cushioning action and avoid high impact loads.
- .2 SRS to restrain seismic forces in every direction.
- .3 Fasteners and attachment points to resist same load as seismic restraints.
- .4 SRS of Piping systems compatible with:
 - .1 Expansion, anchoring and guiding requirements.
 - .2 Equipment vibration isolation and equipment SRS.
- .5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .6 Attachments to reinforced concrete structure:
 - .1 Use high strength mechanical expansion anchors.
 - .2 Drilled or power driven anchors not permitted.
- .7 Seismic control measures not to interfere with integrity of firestopping.

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

- .1 Floor-mounted equipment, systems:
 - .1 Anchor equipment to equipment supports.
 - .2 Anchor equipment supports to structure.

- .3 Use size of bolts scheduled in approved shop drawings.
- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Install tight to structure.
 - .2 Cross-brace in every direction.
 - .3 Brace back to structure.
 - .4 Slack cable restraint system.
 - .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
 - .3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

- .1 Floor mounted equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Vibration isolators with built-in snubbers.
 - .2 Vibration isolators and separate snubbers.
 - .3 Built-up snubber system approved by Departmental Representative, consisting of structural elements and elastomeric layer.
 - .2 SRS to resist complete isolator unloading.
 - .3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
 - .4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.
- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Slack cable restraint system.
 - .2 Brace back to structure via vibration isolators and snubbers.

2.5 SLACK CABLE RESTRAINT SYSTEM (SCS)

- .1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.
- .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
- .3 Hanger rods to withstand compressive loading and buckling.

Part 3 Execution

3.1 GENERAL

- .1 It is the responsibility of the contractor to ascertain that an appropriate size device be selected for each individual piece of equipment.
- .2 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .3 The following are guidelines for some items not covered in SMACNA but certified shop drawings should still be submitted. Note that this list is not intended to cover all equipment requiring restraints.

3.2 AIR TERMINALS

- .1 Where air terminals are installed in mechanical grid ceilings, provide at least two 12 ASWG galvanized steel wire seismic security bridles per air terminal tied either to the building structure or to ceiling hanger wires.
- .2 Attach security bridles at opposite corners of each air terminal and in such a manner that the air terminal cannot fall.
- .3 Provide all necessary brackets for attachment of security bridles to the air terminals.

3.3 NON-ISOLATED FLOOR MOUNTED EQUIPMENT

- .1 Not used.

3.4 ISOLATED PIPING AND EQUIPMENT

- .1 Install cables using appropriate grommets, shackles, and other hardware to ensure alignment of the restraints and to avoid bending the cables at connecting points.
- .2 Connect slack cable restraints to ceiling hung equipment in such a way that the axial projection of the wires passes through the centre of gravity of the equipment.
- .3 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), and tie back to the ceiling slab at an angle not exceeding 45 degrees to the slab.
- .4 On piping systems, provide transverse slack cable restraints at a maximum spacing of 10 m and longitudinal restraints at 20 m maximum spacing, or as limited by anchor/slack cable performance. For pipes greater than NPS10, reduce transverse restraint spacings to 6.0 m.
- .5 Small pipes may be rigidly tied to big pipes for restraint, but not the reverse.
- .6 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe connected perpendicular to it, provided the bracing

is installed within 600 mm of the elbow or T, and if the connected pipe is the same or smaller in size. Do not use branch lines to restrain main lines.

- .7 Provide flexibility in piping joints or sleeves where pipes pass through building seismic or expansion joints.
- .8 At vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the centre of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed the transverse spacings discussed above for horizontal pipes, with guide clearance not exceeding 3 mm.
- .9 Vary adjacent spacing of restraints on a piping run by 10% to 30% to avoid coincident resonances.
- .10 Install restraints at least 50 mm clear of all other equipment and services.
- .11 Adjust restraint cables such that they are not visibly slack, or such that the flexibility is approximately 40 mm under thumb pressure for a 1.5 m cable length (equivalent ratio for other cable lengths). Adjust the clearance at cable strap/spacer piece restraints to not exceed 6 mm.
- .12 Provide transverse and axial restraints as close as practical to a vertical bend.
- .13 At steel trusses, connect to top chords and follow truss manufacturer's instructions.
- .14 The maximum spacing between transverse and longitudinal restraints for piping and ductwork shall be 25% less than specified in SMACNA for SHL A.

3.5 FIELD QUALITY CONTROL

- .1 Inspection and Certification:
 - .1 SRS: inspected and certified by Contractor's Seismic Engineer (who signed shop drawings) upon completion of installation.
 - .2 Provide written report to Departmental Representative with certificate of compliance.
- .2 Commissioning Documentation:
 - .1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

3.6 CLEANING

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 RELATED SECTIONS

- .1 Not used.

1.3 REFERENCES

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.
- .3 Shop drawings to indicate the following:
 - .1 Legend of proposed identification details for each system.
 - .2 Details of proposed nameplates, labels and tags.
- .4 Samples:
 - .1 Provide a sample of a typical nameplate, label and tag for review and approval of Departmental Representative.
 - .2 Provide a mock up of each type of piping identification.
- .5 Quality Control Check Sheets.
- .6 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual.

1.5 QUALITY CONTROL

- .1 General:
 - .1 Contractor to be responsible for quality control of the products and installation in this section.
 - .2 Submit all information and material required for the Quality Management System, in accordance with the Submittal Procedure requirements in Section 01 33 00
 - .3 Quality Control Program Submittals:
 - .1 Quality Control Check Sheet

- .4 Quality Control Check Sheet:
 - .1 Prepare and maintain Quality Control Check Sheets.
 - .2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.
 - .3 Check sheets to be filled in and submitted for review, prior to substantial completion.
 - .4 Tabulated check list including the following:
 - .1 Equipment number and type
 - .2 System type
 - .3 Equipment and system location
 - .4 Identification completed
 - .5 Spacing as specified
 - .6 Visible from all areas
 - .7 Match existing identification
 - .8 Corrosion resistant nameplates, tags and ties
 - .9 Valve schedule and identification chart
 - .5 For each tabulated item, state the following:
 - .1 Does the item comply with the specification? Yes/No/Not Applicable.
 - .2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 GENERAL

- .1 There are areas in this project where the relative humidity levels will be high.
- .2 Select an identification system that is appropriate for such an environment.

2.2 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Lamacoid nameplate, mechanically fastened to each piece of equipment by manufacturer.
- .2 Include ULC, (Underwriters' Laboratories Canada) or CSA, (Canadian Standards Association) registration logos and those of other agencies, as required by the respective agencies.
- .3 Nameplates shall be located so that they are easily read. Do not insulate or paint over nameplates.
- .4 Lettering and numbers raised or recessed.

- .5 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.3 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic (lamacoid), matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

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

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.
- .5 Identify all systems and areas or zones of building being serviced.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1.
 - .1 Paint all natural gas piping yellow.
 - .2 Sprinklers: to NFPA 13.
 - .1 Paint all sprinkler piping red.
 - .3 Standpipe and hose systems: to NFPA 14.
 - .1 Paint standpipe and hose system piping red.

2.5 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Departmental Representative.

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

| Background colour: | Legend, arrows: |
|--------------------|-----------------|
| Yellow | BLACK |
| Green | WHITE |
| Red | WHITE |

.3 Background colour marking and legends for piping systems:

| Contents | Background colour marking | Legend |
|---------------------|---------------------------|--------|
| Natural gas | to Codes | |
| Gas regulator vents | to Codes | |

2.6 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: black, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, DAMPERS, CONTROLLERS

.1 White lamacoid tags with 12 mm engraved identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 LANGUAGE

.1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

- .1 Provide identification only after painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas, in mechanical rooms, equipment rooms, crawlspace: at not more than 15 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas, service spaces and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with UV rated plastic tie wraps.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Testing, Adjusting and Balancing (TAB) is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for all HVAC, plumbing and some specific process systems in the facility.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 SUBMITTALS

- .1 Submittals: in accordance with the Submittal Procedure requirements in Section 01 33 00.
- .2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.
- .3 Qualifications of TAB Company and Personnel.
- .4 Submit, prior to commencement of TAB:
 - .1 Proposed methodology and procedures for performing TAB if different from referenced standard.
- .5 Test Reports: submit certified test reports from approved TAB Company indicating compliance with specifications for specified performance characteristics and physical properties. Include as follows:
 - .1 Pre-TAB review – confirmation of the adequacy of provisions of TAB
 - .2 List of any standards or procedures that differ from specified standards
 - .3 Preliminary TAB Report
 - .4 Statutory declaration certifying that the TAB procedures have been completed
 - .5 Final TAB Report
- .6 Quality Control Check Sheet, itemizing all reports and certificates.

1.3 QUALIFICATIONS OF TAB COMPANY AND PERSONNEL

- .1 Testing, Adjusting and Balancing Company shall meet the following qualifications:
 - .1 Minimum of ten years of recent experience in testing and balancing of mechanical systems, for a variety of industrial processes and systems.

- .2 The senior site technologist/technician must have a minimum of ten years TAB experience of similar industrial projects.
- .3 Submit names of personnel to perform TAB to the Departmental Representative within 30 days of award of contract.
- .4 Provide documentation confirming qualifications, successful experience.
- .5 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 National Environmental Balancing Bureau (NEBB), Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-2006.
- .6 Use TAB Standard provisions, including checklists, and report forms; submit final report at the completion of the project. Include report in the maintenance manual.
- .7 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .8 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .9 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.4 PURPOSE OF TAB

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

- .4 Note that there is some overlap in responsibility between this section and Section 23 08 00 - Commissioning - Mechanical Systems.

1.5 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.6 CO-ORDINATION

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

1.7 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to the Departmental Representative the adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to the Departmental Representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 OPERATION OF SYSTEMS DURING TAB

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

1.9 START OF TAB

- .1 Notify Departmental Representative seven (7) days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
 - .1 Provisions for TAB installed and operational.
- .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.

- .4 Isolating and balancing valves installed, open.
- .5 Calibrated balancing valves installed, at factory settings.
- .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

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

1.11 ACCURACY TOLERANCES

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

1.12 INSTRUMENTS

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

1.13 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.14 TAB REPORT

- .1 Format in accordance with SMACNA Guidelines.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 4 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index and index tabs.
- .4 Include final TAB report in maintenance manual.

1.15 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide personnel and instrumentation to verify up to 30% of reported results.

- .3 Number and location of verified results as directed by Departmental Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.16 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, and ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.17 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.
- .2 Include final TAB report in the maintenance manual.

1.18 TAB GENERAL

- .1 Standard: TAB to most stringent of this section or TAB standards of NEBB or ASHRAE.
- .2 Do TAB of following systems, equipment, components, controls:
 - .1 Hydronic Hot Water System
- .3 The TAB agency shall be responsible to the Contractor but report jointly to the Departmental Representative and the Contractor. Report in writing to the Departmental Representative any lack of cooperation and any discrepancies or items not installed in accordance with the contract documents.
- .4 Procedures shall be in general accordance with AABC's National Standards for Field Measurement and Instrumentation and ASHRAE Standards.
- .5 The TAB agency shall agree to perform spot checks, where requested, in the presence of the Departmental Representative.
- .6 Work with the TAB agency to:
 - .1 Ensure that all mechanical systems are complete and ready to be balanced and provide sufficient time for testing and balancing prior to substantial performance.
 - .2 Make corrections to achieve system balance without delay, include all corrections made during the balancing procedure on "As Built" Drawings. Mechanical Contractor to provide "As Built" information to the balancing agency before balancing commences.

- .3 Maintain all systems in full operation during the complete testing and balancing period.
- .4 Employ control technicians to make adjustments to the control systems to facilitate the balancing process.
- .7 The controls contractor and TAB agency are to allow for checking and making adjustments during the 12 month warranty period, when weather conditions provide natural loads and in cases where complaints arise.
- .8 Submit a draft balance report to the Departmental Representative for approval and submit approved copies to the agency preparing the O & M manuals for inclusion in each operating and maintenance manual. Provide field notes in the balancing report to clearly identify unusual conditions, problem areas and report on any cases where the specified flow rates or conditions could not be achieved by adjustment. Identify outstanding problems that cannot be corrected by the balancing team or that will not be corrected by the installing trades (e.g. in cases where additional balancing dampers are required).
- .9 Submit a statutory declaration to the Departmental Representative, certifying that the testing and balancing procedures have been completed, that complete factual reports have been distributed and that directions have been given to the Contractor to correct faults and omissions and, finally, that follow-up testing, after correction of faults and omissions, has been completed and recorded. Reports to be signed by the senior member of the TAB agency.
- .10 The Balancing Agency shall include for 10 (ten) days of return visits for readjustment of systems after the building is occupied and used.

1.19 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Quality assurance: as for systems specified in this section.

1.20 POST-OCCUPANCY TAB

- .1 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 2 months of termination of Warranty Period.
- .2 Include for two days on site for checking and system balance modifications during each visit.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

1 MECHANICAL FORMS

1.1 MF 100 Check List – Submissions to Departmental Representative

| ITEM | CHECKED BY | DATE |
|--|-------------------|-------------|
| 10 WORKING DAYS BEFORE CLOSE OF SUBTRADE TENDER – Request for addition of acceptable manufacturers | | |
| 10 DAYS AFTER AWARD OF THE CONTRACT – List of equipment suppliers and subtrades – Detailed price breakdown (MF 120, 121, 122) | | |
| A.S.A.P. – Product & Fabrication samples (MF 131) – Shop Drawings | | |
| WITH EACH APPLICATION FOR PROGRESS PAYMENT – Price breakdown (MF 120, 121, 122) | | |
| PRIOR TO CLOSING IN CEILINGS & SHAFTS – Duct and pipe test data – Piping Test Data (MF 141) | | |
| PRIOR TO STARTING SYSTEMS – Checklists for start-up (MF 151, 152, 153) | | |
| PRIOR TO COMMISSIONING SYSTEMS – Checklists for operation (MF 151, 152, 153) – Commissioning schedule | | |
| PRIOR TO DEMONSTRATION OF SYSTEMS – Demonstration agenda | | |
| 10 DAYS PRIOR TO SUBSTANTIAL PERFORMANCE INSPECTION – Submission of items listed on Form MF-188 | | |
| WHEN REQUESTING INSPECTION OF OUTSTANDING WORK – Certificate of total completion (MF 192) – Checklist of work remaining (MF 191) – Checklists of Demonstrations (MF 181, 182) | | |

1.2 MF 120 Progress Claim Summary – Division 23

CLAIM NO: _____
FOR MONTH _____
OF: _____

| ITEM | PRICE | WORK TO DATE | | PREVIOUS WORK | | THIS MONTH | |
|---|-------|--------------|----|---------------|----|------------|----|
| | | % | \$ | % | \$ | % | \$ |
| <u>Base Contract Summary</u> | | | | | | | |
| - HVAC | | | | | | | |
| | | | | | | | |
| - Cash Allowances | | | | | | | |
| Total Base Contract | | | | | | | |
| <u>Change Order Summary</u> | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Total Change Orders | | | | | | | |
| Total Contract: | | | | | | | |
| Amount due less 10% mechanics lien holdback | | | | | | | |

NOTES:

Submit this form as called for on MF 100 for tender price breakdown and for each progress claim.

1.3 MF 121 Detailed Price Breakdown – HVAC

CLAIM NO: _____
FOR MONTH OF: _____

| ITEM | | PRICE | WORK TO DATE | PREVIOUS WORK | THIS MONTH |
|---|---------------|-------|--------------|---------------|------------|
| <u>Mechanical</u> | | \$ | % | \$ | % |
| Mobilization & Permits | | | | | |
| Air Handling Equipment | Matl. Lab. | | | | |
| HVAC Piping & Equipment | Matl. Lab. | | | | |
| Insulation – Piping & Equipment | Matl. Lab. | | | | |
| SUBTOTAL | | | | | |
| <u>Sheet Metal</u> | | | | | |
| Air Terminal & Access | Matl. | | | | |
| Ductwork | Matl. Lab. | | | | |
| Insulation – Ductwork | Matl. Lab. | | | | |
| Duct Cleaning | Lab. | | | | |
| Testing & Balancing | Lab. | | | | |
| SUBTOTAL | | | | | |
| <u>Refrigeration</u> | Matl. Lab. | | | | |
| SUBTOTAL | | | | | |
| <u>Controls</u> | Matl. Lab. | | | | |
| SUBTOTAL | | | | | |
| <u>Finishing</u> | | | | | |
| Commissioning & Demonstration Maintenance Manuals | | | | | |
| SUBTOTAL | | | | | |
| TOTAL | | | | | |

NOTES:

- .1 Submit this form as called for on MF 100 for tender price breakdown and with each progress claim.
- .2 Submit a separate form for each item listed on MF 120.

1.4 MF 122 Detailed Price Breakdown - Plumbing

CLAIM NO: _____
FOR MONTH OF: _____

| ITEM | | PRICE | WORK TO DATE | | PREVIOUS WORK | | THIS MONTH | |
|-------------------------|---------------|-------|--------------|----|---------------|----|------------|----|
| Plumbing | | \$ | % | \$ | % | \$ | % | \$ |
| Domestic Water | Matl. Lab. | | | | | | | |
| Fixtures & Equipment | Matl. Lab. | | | | | | | |
| Plumbing Insulation | Matl. Lab. | | | | | | | |
| TOTAL | | | | | | | | |

NOTES:

- .1 Submit this form as called for on MF 100 for tender price breakdown and with each progress claim.
- .2 Submit a separate form for each item listed on MF 120.

[illegible]

1.6 MF 151 Check List - Start-up and Operation Requirements - Air Systems

System: _____

| ITEM | CHECKED BY | DATE |
|---|------------|------|
| <u>Prior To Start-Up</u> Safety Controls Installed & Operational Control And Smoke Dampers Operational Permanent Electrical Connections Made Fan Drives Aligned By Millwright Fan Rooms & Plenums Vacuum Cleaned Equipment Lubricated Building Swept & Clear Of Dust All Filters Installed Operating & Maintenance Data Available | | |
| <u>During Start-Up</u> Qualified Operator In Charge Supply Ducts Blown Out Using Fans R.A. & Exhaust Ducts Blown Out Using Fans | | |
| <u>During Subsequent Operation</u> Qualified Operator In Charge Ensure That The Building Has Remained Clean Equipment Maintained Lubrication Maintained & Logged | | |

NOTES:

- .1 This is a brief checklist and does not cover all procedures, which may be advisable in a particular case. Additional information is available from equipment suppliers.
- .2 Prior to starting or operating each system complete the appropriate section of this form and submit it to the Departmental Representative.
- .3 Submit completed copies of this form for each system with the certificate of substantial performance.

1.7 MF 152 Check List - Start-up and Operation Requirements – Water / Glycol Systems

System: _____

| ITEM | CHECKED BY | DATE |
|--|------------|------|
| <u>Prior To Start-Up</u> Safety Controls Installed & Operational Permanent Electrical Connections Made Equipment Lubricated System Flushed Out Operating & Maintenance Data Available Boiler Inspector Notified Chemical Treatment Agency Notified | | |
| <u>During Start-Up</u> Qualified Operator In Charge Chiller Manufacturers Rep. Present | | |
| <u>Prior to Operation</u> Boiler inspectors Approval Obtained Report from Chemical Treatment Agency Submitted | | |
| <u>During Operation</u> Qualified Operator In Charge Equipment Maintained Lubrication Maintained & Logged Chemical Treatment Maintained And Logged | | |

NOTES:

- .1 This is a brief checklist and does not cover all procedures, which may be advisable in a particular case. Additional information is available from equipment suppliers.
- .2 Prior to starting or operating each system complete the appropriate section of this form and submit it to the Departmental Representative.
- .3 Submit completed copies of this form for each system with the certificate of substantial performance.

1.8 MF 170 Certificate of Testing and Balancing

I hereby declare that I _____

I am an employee/a principal of _____

And certify that the testing and balancing procedures specified under Division 23 have been satisfactorily completed and I hereby certify that complete factual reports have been distributed.

SIGNED _____ DATE _____

NOTES:

.1 This certificate must be submitted prior to substantial performance.

1.9 MF 171 Certificate of Duct Cleanliness

I hereby certify that I _____

I am an employee/a principal of _____

And have personally witnessed that the following duct systems have been vacuumed as necessary, are now clean and have been resealed with access panels in place at all cleaning openings in the ductwork.

| <u>FAN NO.</u> | <u>SYSTEM DESCRIPTION</u> |
|----------------|---------------------------|
|----------------|---------------------------|

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be submitted prior to substantial performance.

1.10 MF 172 Certificate of Fire Damper Inspection

I hereby certify that I _____
am an employee/a principal of _____

And that all fire dampers have been tested by removing the fusible link and witnessing closure of the damper.

SIGNED _____ DATE _____

- Contract drawings supplied by: _____
- Latest addendum number or date of plans used: _____

NOTES:

1. This certificate must be submitted prior to substantial performance.

1.11 MF 173 Certificate of Penetrations Through Separations

I hereby certify that I _____
am an employee of _____

And have personally witnessed that all mechanical (HVAC & Plumbing) service penetrations through fire separations (rated & non-rated) and sound separations in the following areas have been properly sealed in accordance with the specified requirements.

| AREA | SIGNED | DATE |
|--------|--------|------|
| Level: | | |
| Level: | | |
| Level: | | |
| Level: | | |
| Level: | | |
| Level: | | |
| Level: | | |
| Level: | | |
| Level: | | |

NOTES:

- .1 This certificate must be submitted prior to substantial performance.

1.12 MF 174 Certificate of Seismic Restraint Installation

I hereby declare that I _____
am an employee/a principal of _____

And certify that the seismic restraint of all mechanical equipment, piping and ductwork specified under Division 23 has been satisfactorily completed and that the installation meets the requirements of the B.C. Building Code as it relates to seismic restraint.

SIGNED _____ DATE _____

NOTES:

.1 This certificate must be submitted prior to substantial performance.

1.13 MF 175 Certificate of Vibration Isolation

I hereby declare that I _____
am an employee/a principal of _____

And certify that the vibration isolation installation specified under Division 23 has been satisfactorily completed.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be submitted prior to substantial performance.

1.14 MF 180 Check List & Record – Items to be Handed to Departmental Representative

| ITEM | RECEIVED | DATE |
|--|----------|------|
| Chemical Test Kit | | |
| Control Drawings (Framed/Plasticized) | | |
| Fan Belts – Spare Sets | | |
| Filters - Spare Sets (Panel and Final) | | |
| Identification Schedule (Framed) | | |
| Maintenance Program (Schedules & Cards) | | |
| Master Key For B.A.S. Field Panels | | |
| Salvaged Materials (Attach List) | | |
| Spare Chemicals | | |
| Test Thermometer | | |
| Thermostat Keys | | |
| Valve List (Framed) | | |
| Water flow meter for liquid flow measuring devices | | |
| Differential Pressure Meter for Circuit Setting Balance Valves (15715) | | |
| P/T Plug Master Test Kit (15715) | | |

NOTES:

- .1 Copies of this form to be submitted to the Departmental Representative with all items signed off prior to substantial performance.

1.15 MF 181 Check List – Demonstration of Air Handling Systems

System: _____

| ITEM | CONTRACTOR | | DEPARTMENTAL REPRESENTATIVE | |
|--------------------------------|------------|------|-----------------------------|------|
| | SIGNED | DATE | SIGNED | DATE |
| Review of System Concept | | | | |
| Review of Maintenance Manual | | | | |
| Review of System Balance | | | | |
| Troubleshooting | | | | |
| Points of required Maintenance | | | | |
| Access to Equipment | | | | |
| Location of Control Devices | | | | |
| All Electric Interlocks | | | | |
| All Alarms | | | | |
| Temperature Control | | | | |
| Humidity Control | | | | |
| Air Pressure Control | | | | |
| Air Volume Control | | | | |

NOTES:

- .1 Contractor to submit copies of this form with each appropriate item signed and dated by the person having overall charge of commissioning prior to substantial performance. (See MF 190).
- .2 Departmental Representative to sign off each item during the demonstration.
- .3 Contractor to strike out items where they do not apply to the systems being demonstrated.
- .4 Interlocks and controls to be demonstrated by following the descriptions and diagrams in the contract documents and proving that all controls function as required.
- .5 Where multiple identical controls are installed (thermostats) the Departmental Representative may elect to only witness sample items, but the person having charge of commissioning is expected to have checked all of them.

1.16 MF 182 Check List – Demonstration of Heating Water System

System: _____

| ITEM | CONTRACTOR | | DEPARTMENTAL REPRESENTATIVE | |
|--------------------------------|------------|------|-----------------------------|------|
| | SIGNED | DATE | SIGNED | DATE |
| Review of System Concept | | | | |
| Review of Maintenance Manual | | | | |
| Review of System Balance | | | | |
| Review of Chemical Treatment | | | | |
| Troubleshooting | | | | |
| Points of required Maintenance | | | | |
| Access to Equipment | | | | |
| Location of Control Devices | | | | |
| All Electric Interlocks | | | | |
| All Alarms | | | | |
| Temperature Control | | | | |
| Pressure Control | | | | |
| Volume Control | | | | |

NOTES:

- .1 Contractor to submit copies of this form with each appropriate item signed and dated by the person having overall charge of commissioning prior to substantial performance (See MF 190).
- .2 Departmental Representative to sign off each item during the demonstration.
- .3 Contractor to strike out items where they do not apply to the systems being demonstrated.
- .4 Interlocks and controls to be demonstrated by following the descriptions and diagrams in the contract documents and proving that all controls function as required.
- .5 Where multiple identical controls are installed (thermostats) the Departmental Representative may elect to only witness sample items, but the person having charge of commissioning is expected to have checked all of them.

1.17 MF 188 Check List – Substantial Completion Submissions - HVAC

| SECTION | ITEM | CHECKED |
|----------|--|---------|
| 23 05 00 | Boiler Inspection Certificate | |
| 23 05 00 | Gas Inspection Certificate | |
| 23 05 00 | Equipment Extended Warranties Certificates | |
| 23 05 00 | Lubrication of Equipment Checklist | |
| 23 05 00 | Penetrations through Separations Certificate (MF-173) | |
| 23 05 93 | Air and Liquid Balancing Report | |
| 23 06 02 | Testing & Balancing Certificate (MF 170) | |
| 23 06 02 | Fire Damper Inspection Certificate (MF 172) and Checked Drawings | |
| 23 08 00 | Commissioning Report and Checklists | |
| 23 05 00 | Operating & Maintenance Manuals | |
| 23 05 00 | Record Drawings | |
| 23 05 00 | Maintenance Program | |
| 23 05 00 | Demonstration to Operating Staff agenda | |
| 23 05 54 | Identification Schedules | |
| 23 06 02 | Vibration Isolation Installation Certificate. (MF-175) | |
| 23 06 02 | Seismic Restraint Installation Certificate. (MF-174) | |
| 23 25 00 | Chemical Treatment and Cleaning Report for Piping Systems | |
| 23 52 00 | Boiler Start-up Test Reports | |
| 23 31 00 | Duct Leakage Test Reports | |
| 23 31 00 | Duct Cleanliness Certificate (MF 171) | |
| 23 06 02 | Demonstrations Checklists (MF 181, 182) | |
| 23 06 02 | Items handed to Departmental Representative Checklist (MF 180) | |
| 23 06 02 | Substantial Performance Certificate (MF(190) | |
| 23 06 02 | Checklist of work remaining after Substantial (MF 191). | |

NOTES:

- .1 This list is provided as a checklist and may not include all substantial completion requirements.

1.18 MF 189 Check List – Substantial Completion Submissions- Plumbing

| SECTION | ITEM | CHECKED |
|---------|--|---------|
| | Backflow prevention station test certificate | |

NOTES:

- .1 This list is provided as a checklist and may not include all substantial completion requirements.

1.19 MF 190 Certificate of Substantial Performance Division 22, 23

I hereby certify that I _____

am an employee / a principal /an agent

of _____

and have personally witnessed the following with regard to the mechanical systems work specified on the above project and that to the best of my knowledge except as noted on MF 191 (attached);

- The installation is complete and as specified.
- The systems have been commissioned and operate satisfactorily.
- Every control sequence and every control performs as specified.
- The systems are clean.
- All of the required submissions have been made to the Departmental Representative.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be completed and submitted to the Departmental Representative prior to substantial performance.
- .2 If it is apparent during this inspection that the systems or their operation are seriously deficient then all reasonable costs of any subsequent inspections shall be deducted from the contract sum.

1.20 MF 191 Check List – Work Remaining After Substantial Performance

| | | COMPLETION | | |
|----------|-------------|------------|------|---------------|
| ITEM NO. | DESCRIPTION | CLAIMED BY | DATE | VERIFIED DATE |
| | | | | |
| | | | | |
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NOTES:

- .1 This form must be filled in and submitted to the Departmental Representative prior to substantial performance.
- .2 Items arising out of this inspection will be added to the list by the Departmental Representative. Copies of the complete list will be circulated to the Departmental Representative and the Prime Contractor.
- .3 The Contractor may include estimated values against the outstanding work but determination of the actual amounts to be held will be made by the Departmental Representative.
- .4 The Contractor shall sign off each item as it is completed and submit the list monthly to the Departmental Representative. When all items are signed off the completed list shall be submitted with the certificate of total performance MF-192.

1.21 MF 192 Certificate of Total Performance – Division 22, 23

I hereby certify that I _____
am an employee / a principal / an agent

of _____

and have personally witnessed that each item of outstanding work on the checklist and record of work remaining after substantial completion MF 191 (attached) has been satisfactorily completed and I hereby certify that the Mechanical systems work specified on the above project is complete.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be completed and submitted to the Departmental Representative prior to substantial performance.
- .2 If it is apparent during this inspection that the systems or their operation are seriously deficient then all reasonable costs of any subsequent inspections shall be deducted from the contract sum.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation of thermal insulation for HVAC piping.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .3 Section 07 84 00 – Fire stopping
- .4 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B209M-04, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-05ae1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-05, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547-07e1, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-02, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-04e1, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-07, Surface Burning Characteristics of Building Materials and Assemblies.

1.4 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit following shop drawing information:
 - .1 Pipe insulation: manufacturer's catalogue literature
 - .2 Installation requirements
 - .3 Schedule of all piping systems and proposed insulation types, thicknesses and finishes.

1.6 MANUFACTURERS' INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures used, and installation standards achieved.

1.7 QUALIFICATIONS

- .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions recommended by manufacturer.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.

- .1 Maximum flame spread rating: 25.
- .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 or ASTM C547.
 - .2 Maximum "k" factor: to CAN/ULC-S702.

2.1 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.

2.2 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Air drying on mineral wool, to ASTM C449/C449M.

2.3 VAPOUR RETARDER LAP ADHESIVE

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

2.4 INDOOR VAPOUR RETARDER FINISH

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

2.5 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.6 JACKETS

- .1 Aluminum:
 - .1 To ASTM B209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Smooth.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: Stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.7 FIRE STOPPING AND SMOKE SEAL MATERIALS

- .1 References:
 - .1 CAN4-S115-M, Standard Method of Fire Tests of Firestop Systems.
 - .2 ASTM E814 Standard Method of Fire Tests and Through-Penetration Firestops.
 - .3 1997 Certifications Listings Intertek Testing Services N.A. Ltd. (Warnock Hersey).
 - .4 Underwriters Laboratories of Canada. Listing of Equipment and Materials Vol. 3 Fire Resistance Ratings -Revision 4/95.
- .2 Work Included:
 - .1 Furnish all labour, material, equipment and services necessary to supply and install firestopping and smoke seals around mechanical service piping and duct penetrations through fire rated wall and floor assemblies, as indicated and as specified.
- .3 Quality Assurance:
 - .1 The work of this section shall be carried out only by an approved specialist firm, employing skilled tradesmen experienced in firestopping and smoke seal application and approved, licensed and supervised by the manufacturer of fire stopping materials.
 - .2 All work to be of the highest quality according to best trade practice and in strict accordance with manufacturer's printed specifications.
- .4 Submittals:
 - .1 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation.
 - .2 Submit manufacturers' product data for materials and prefabricated devices. Include assembly/location design system number references with copies of test information. Construction details should accurately reflect actual job conditions.
 - .3 For building assemblies which do not correspond to any previously tested and rated assemblies, submit proposals based on related designs using accepted fireproofing design criteria.
- .5 Materials:
 - .1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of ULC CAN4-S115 and not to exceed opening sizes for which they are intended.

- .2 Service penetration assemblies and design numbers: Certified by ULC in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19. 1997 Certification Listings Intertek Testing Services N.A. Ltd. (Warnock Hersey).
- .3 Service penetration firestop components: Certified by ULC in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC or equivalent approved tests by Warnock Hersey.
- .4 Fire resistance rating of installed fire stopping assembly shall be not less than the fire resistance rating of surrounding floor and wall assembly.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

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

3.2 INSTALLATION

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

3.1 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: [A-1].
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code [1501-H].
- .3 Thickness of insulation as listed in following table.

- .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
- .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

| Application | Temp °C | TIAC code | Insulation thickness (mm) | | | | | |
|-------------------|----------|-----------|---------------------------|-------|------|-----|------|----|
| Pipe sizes (NPS) | | | Up to 1 | 1¼ -2 | 2½-4 | 5-6 | 6½-8 | >8 |
| Hot Water Heating | 60 - 94 | [A-1] | 25 | 38 | 38 | 38 | 38 | 38 |
| Hot Water Heating | up to 59 | [A-1] | 25 | 25 | 25 | 25 | 38 | 38 |

- .4 Finishes:
 - .1 Exposed indoors: Aluminum jacket.
 - .2 Exposed in mechanical rooms: Canvas or Acrylic jacket.
 - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
 - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
 - .5 Outdoors: Water-proof aluminum jacket.
 - .6 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.2 INSULATION PACKING OF PIPE SLEEVES

- .1 Tightly pack the space between all pipe sleeves and pipe or between pipe sleeve and pipe insulation with mineral wool insulation - Thermal Ceramics to full depth of sleeve to prevent transmission of sound and/or passage of smoke.

END OF SECTION

1 GENERAL

1.1 Related Work and Sections

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
 - .1 Section 01 91 13 - General Commissioning Requirements
 - .2 Section 01 91 31 - Commissioning Plan
 - .3 Section 01 91 33 - Commissioning Forms
 - .4 Section 01 91 41 - Commissioning Training
 - .5 Section 23 05 00 - Common Work Results for HVAC
 - .6 Section 23 08 01 - Performance Verification
 - .7 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

1.2 Quality Assurance

- .1 CSA Standard Z320 -2011 Building Commissioning.
- .2 ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems.
- .3 ASHRAE Guideline 1.1-2007 HVAC&R Technical Requirements for the Commissioning Process.

1.3 General

- .1 Be responsible for the performance and commissioning of all equipment supplied under the sections of Division 23. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.
- .2 In consultation with the Commissioning Manager (Prime Contractor), ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems. Coordinate mechanical commissioning activities with the Cx Manager to avoid redundancies and inefficiencies. The mechanical commissioning agent shall report to the Cx Manager and assist the Cx Manager with mechanical commissioning activities as they directly relate to the Cx Manager activities noted in Division 01 sections.
- .3 See Division 01 specifications for project commissioning definitions, acronyms, roles and responsibilities.

1.4 Commissioning and Demonstration

- .1 Provide the services of an approved independent specialist firm (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 and fire protection system that are affected by this renovation.
- .2 The cooperation of all trades and the project team is essential for an efficient and planned process. A team comprising the following is recommended:
 - .1 Departmental Representative
 - .2 Owner's Commissioning Authority
 - .3 Prime Contractor's Commissioning Manager
 - .4 Division 23 Mechanical Trades (including Controls)
 - .5 Division 26 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 Division 23 plus Division 26 interface as applicable.
 - .5 Regular meetings shall be held during the commissioning process. Minutes of the meetings shall be issued to all contractors involved, the Commissioning Authority, Consultants and the Owners Representatives. Meeting times shall be coordinated with the Cx Manager.
 - .6 Plan the work to be specific in respect of personnel, schedule, review and factory tests.
 - .1 Personnel: Assign direct overall charge of commissioning to a person (the commissioning agent) 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 Commissioning Authority and Owner and issuing certificates 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 [2] weeks of commencing with the project work, the person having direct overall charge of mechanical Cx shall review design intent and intended commissioning procedures with the Cx Manager, Cx Authority and Consultant. Six [6] weeks 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 agent.
 - .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 Cx Authority and Consultant 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 (Factory) 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 Cx 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.
- .7 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 (see also Section 23 06 02).
 - .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 Filter systems installed and sealed in place.
 - .6 Adjusting vibration isolation and seismic restraints.
 - .7 Alignment of drives (direct and belt).
 - .8 Control function checks, including all alarms.
 - .9 Self-diagnostic packaged control items checked.
 - .10 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 and liquid systems as specified in this section.
 - .2 Set up all automatic control valves/dampers and automatic temperature control devices.
 - .3 Plug all air pressure and flow measuring holes.
 - .4 Adjust vibration isolators and earthquake restraints as necessary.
 - .5 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations.
 - .6 Verification of water tightness of all roof and exterior wall penetrations.
 - .7 Verification of backflow device operation.
 - .8 Verification that all drain connections do not leak and are sloped.
 - .9 Testing and debugging of B.M.S. (Building Management System).
 - .10 Set up and test all alarm protective devices.
 - .11 Calibration and adjustment of the smoke venting and pressurization systems.
 - .12 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 motor 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 Commissioning Authority 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 Operability of randomly selected fire dampers.
 - .4 Operation of all equipment and systems, under each mode of operation.
 - .5 B.M.S. control features.
 - .6 Automatic controls.
 - .7 Pumps.
 - .8 Boilers and associated gas fuel systems.
 - .9 Expansion Tanks.
 - .10 Air Separators.
 - .11 Filtration systems.
- .2 At the completion of Phase 3, the Contractor shall submit the following to the Commissioning Authority:
 - .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 B.C. Boiler Inspection Dept. approval of boiler, pressure vessels and pressure piping installations.
 - .4 B.C. Gas Inspection Dept. approval of boiler on gas firing.

- .5 Record drawings as specified, update to include changes resulting from commissioning.
- .6 A statement confirming completion of B.M.S. acceptance test, Section 23 09 01.
- .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 Representative upon completion.
 - .3 For Demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to Section 23 09 01 (Controls General).
- .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 and Owner Representative which documents any problems that have arisen and correction action required.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 23 08 00 – Mechanical Commissioning
- .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

1.2 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests:
 - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
 - .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
 - .1 Pump operation.
 - .2 Boiler operation.
 - .3 Pressure bypass open/closed.
 - .4 Control pressure failure.
 - .5 Maximum heating demand.
 - .6 Boiler failure.

1.3 HYDRONIC SYSTEM CAPACITY TEST

- .1 Perform hydronic system capacity tests after:
 - .1 TAB has been completed
 - .2 Verification of operating, limit, safety controls.
 - .3 Verification of primary and secondary pump flow rates.
 - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

- .6 Heating system capacity test:
 - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
 - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
 - .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
 - .2 Test procedures:
 - .1 Open fully heating coil and radiation control valves.
 - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
 - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

1.4 NATURAL GAS SYSTEMS

- .1 Operation tests:
 - .1 Measure gas pressure at gas meter outlet and at burner manifold.
 - .2 Verify details of temperature and pressure compensation at meter.
 - .3 Verify settings, operation, venting of high and low pressure cut-outs, alarms.
 - .4 Check terminals of vents for gas pressure regulators.

1.5 REPORTS

- .1 Provide TAB reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.6 TRAINING

- .1 Provide adequate time and resources to train the facility operators (4 personnel maximum, one time only) on the operation and maintenance of the following:
 - .1 Single boiler operating as a stand-alone unit.
 - .2 Multiple boiler units operating as a lead-lag cascade system.
 - .3 Determination of HWR-T based on system demand and OA-T.
 - .4 Pump VFD controllers operating from the most demanding (lowest) pressure differential sensors.
 - .5 System scheduling.
 - .6 Allow a minimum of 4 hours.

| | |
|---------------|------------------|
| Part 2 | Products |
| 2.1 | NOT USED |
| Part 3 | Execution |
| 3.1 | NOT USED |

END OF SECTION

1 GENERAL

1.1 Related Work

- .1 Section 23 05 00 – Common Work Results for HVAC
- .2 Section 23 09 93 – Controls Sequences of Operations
- .3 Section 23 09 94 – Controls Points List for HVAC
- .4 Section 26 05 00 – Common Work Results for Electrical
- .5 Section 26 05 21 – Wiring and Cables (0-1000V)

1.2 Scope of Work

- .1 The new Hydronic Boilers (B-1 and B-2) shall be provided with the manufacturer's standard unit controllers, as well as the manufacturer's "Master" controller which shall provide lead/lag, backup and cascade controls for the 2 boilers and their respective boiler pumps (BP-1 and BP-2), with a further gateway to enable existing boiler B-3 and its new boiler pump (BP-3) as a further Lag stage.
- .2 Zone Circulation Pumps P-1, P-2, and P-3 shall have integrated/on-board ECM speed controls which shall take the new pressure differential transmitter signals as inputs.
- .3 All points as listed in Section 23 09 94 – Points List for HVAC Controls, as well as all points referenced in Section 23 09 93 – Controls Sequences shall be made available to the existing Building Automation System (JCI Metasys) installed on the Penticton Air Terminal Building.
- .4 Controls contractor shall be responsible to perform all additions, updates, and modifications to the existing BAS system, including all logic, loops, and the graphic user interfaces to reflect and perform the new equipment and control sequences.
- .5 The new system shall be fully integrated with the existing BAS and the operator interface shall be through the existing operator's work station.

1.3 General

- .1 The control system is to be fully microprocessor based.
- .2 The controls system is to be complete with all necessary control components and connections to achieve the specified functions and to permit the H.V.A.C. systems to perform properly in the manner described and as hereinafter specified.
- .3 The controls contractor shall furnish all materials, including all central computer hardware and software, operator input/output peripherals, standalone DDC panels, automation sensors and controls, wiring. The controls contractor shall be responsible for the design, installation, supervision and labour services, calibration, all software programming, and checkout necessary for a complete and fully operational Building Automation System.
- .4 The control system is to be set up and adjusted to achieve optimum operation of the H.V.A.C. system. This includes sequencing, timing and readjustment, as required. Modifications to the sequence of operation using points indicated will

not be considered as extra to the Contract. These modifications to continue through the construction period, commissioning period and warranty period as required to achieve optimum operation of the mechanical system.

- .5 This Section is a performance specification clarified in certain sections to establish minimum standard of equipment, installation or level of control. The specification describes the basic functions required but not all of the installation details or components. This Trade is expected to have sufficient experience to be able to design and estimate the cost of an appropriate control system. Materials and work necessary to achieve a satisfactory result will not be considered extra to the contract.
- .6 The contractor shall review all contract documents and visit the site if possible, prior to the closing date of the tender and site confirm the requirements regarding the routing of interconnecting transmission network, etc.
- .7 When preparing shop drawings, review the proposed sequences, suggest improvements and review these with the Departmental Representative.
- .8 Work with the other parties involved in commissioning, assess how the programming can be modified to improve function, review this with the Departmental Representative and modify the programming as instructed by the Departmental Representative.
- .9 The control system shall be a modular, flexible and fully commissioned Direct Digital Control (DDC) System.
- .10 Items identified in the sequence of operation as being under DDC control but which are not included in the points list shall be included in the DDC system.

1.4 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00
- .2 Shop drawings shall include:
 - .1 Control centre layouts.
 - .2 Manufacturer's descriptive technical literature for all equipment and devices.
 - .3 Interconnection schematics.
 - .4 Wiring and piping diagrams.
 - .5 One-line diagram from sensor and control points to Field Interface device and/or standalone DDC panel including all components and cables.
 - .6 Terminal cabinets, including termination listing.
 - .7 Written description indicating sequence of operation. Shop drawings will be rejected if the written description is not included with the submission. Sequences should reference English descriptors and labels for each point described.
 - .8 All input/output points which shall include the following information associated with each point.
 - .1 Sensing element type and location.
 - .2 Details of associated field wiring schematics and schedules.

- .3 Software and programming details.
- .9 Detailed block diagrams of transmission trunk routing and configuration.
- .10 Valve and damper schedules indicating size, configuration, capacity and locations. If size varies greater than 10%, obtain approval of Departmental Representative.
- .11 Copies of all system graphics complete with system specific point labels.

1.5 Warranty

- .1 Refer to General Conditions.
- .2 The system including all hardware and software components shall be warranted for a period of one year following the date of final acceptance. Any manufacturing defects arising during this warranty period shall be corrected without cost to the Departmental Representative.
- .3 All applicable software as detailed in this specification shall be updated by the Controls Contractor free of charge during the warranty period. This will ensure that all system software will be the most up-to-date software available from the Controls Contractor. All future patches to the software shall be made available to the Departmental Representative.
- .4 Repairs required by a total system failure, or the malfunction of any priority portion of the system shall be considered an emergency repair, and shall be performed within eight (8) hours of the report of the failure.
- .5 Repairs of a non-emergency nature shall be promptly repaired on the next normal business day.
- .6 Provide written assurance that a local service centre will be maintained with a complete stock of replacement parts, and capable of servicing any and all troubles in the system.
- .7 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.
- .8 Take note of and provide any extended warranties specified.

2 MATERIALS

2.1 Electrical Components, Wiring and Conduit

- .1 By Control Contractor (Division 23):
 - .1 All control system components to make a complete and operable system, except those supplied as part of packaged equipment controls, but including all auto-sequencing devices and electrical interlocks required to accomplish the sequences specified hereafter. Refer to the electrical equipment schedule, the electrical drawings and the electrical specification, which describes the limits of the extent to the work in Division 26 serving mechanical systems. Materials, equipment, connections and power not provided by Division 26 but required for the Control System shall be provided under this section.
 - .2 All control circuit transformers (120/1/60 or 24/1/60 as required by device).

- .3 All control wiring and metallic conduit for mechanical system controls.
- .4 Supply, installation and connection of all electric control items including: damper motors, relays, outside sensors, sub-master control circuits, safety devices, electric thermostats, aquastats, flow switches, wiring to terminal strips, proportional controllers, controllers, etc.
- .5 All wiring and conduit from power distribution system to any control devices needing power (including B.M.S components)
- .6 Be responsible for coordinating with Division 26.
- .7 Electrical work installed under Division 23 shall be to the standards specified under Division 26.
- .2 By Division 26:
 - .1 All power wiring and conduit from power distribution system up to and including connection to all motors and starters.
 - .2 All disconnect switches required (unless specified in schedules as being integral with equipment).
 - .3 All motor protection switches, stop-start switches, magnetic starters, contactors and hand-off-automatic selector switches except those supplied as part of packaged equipment.
 - .4 Terminal strips within the motor control centres (MCC) for control connections.
 - .5 Fire alarm signals.
- .3 Note:
 - .1 All magnetic starters for equipment shall have the following features supplied under Division 26:
 - .1 Hand-off-automatic selector or on-off selector, or start-stop buttons in cover with hand-automatic bridge if applicable.
 - .2 Pilot light.
 - .3 120 volt coils.
 - .4 120 volt control transformer.
 - .5 Four auxiliary dry contacts for interlocks; two normally open and two normally closed.
 - .2 The Controls Contractor is responsible for reading Division 26 plans and specifications to determine scope of responsibility and standards.
- .4 Wiring:
 - .1 Wire:
 - .1 Line voltage power or switched power wiring - #12 gauge copper wire minimum.
 - .2 Line voltage control wiring - #14 gauge copper wire, length not to exceed 50 meters; #12 gauge copper wire, lengths exceeding 50 meters.

- .3 Low voltage - minimum #22 gauge wire as directed by applicable electrical codes and requirements. 24 gauge wire for thermostat cables
- .2 Cable:
 - .1 Data transmission cable shall be minimum #18 gauge twisted pairs (shielding as per manufacturers recommendations).
- .3 Note:
 - .1 Run carrier system parallel to building lines.
 - .2 Support conduit carrier system every one meter independent of piping, ductwork and equipment.
 - .3 All wiring shall be concealed in finished spaces.
 - .4 Seal all penetrations through fire separations or walls as per code requirements.
 - .5 Identify all junction box covers with control company label.
 - .6 Identify with colour bands, all conduits at all junction and pullboxes, at both sides of wall and floors and at not more than 7.5 m [25 Ft] intervals along the length. Identification bands to be sprayed on and not less than 100mm [4"] wide. Bands to be pink in colour unless in conflict with Division 26 colours.
 - .7 Use colour coded conductors.
 - .8 Adhere to all applicable electrical codes and regulations.
 - .9 Obtain electrical permit.
 - .10 For non-CSA equipment where required by electrical code, submit to Inspection Authorities and obtain approval prior to installation of equipment on site.

2.2 Equipment Supplied for Installation Under Other Sections

- .1 The following equipment shall be supplied under this section but installed under the appropriate trade sections of Division 23:
 - .1 Automatic control dampers.
 - .2 Pressure tappings.
 - .3 Static pressure sensors.
- .2 The Controls Subcontractor shall be responsible for arranging, coordinating and supervising the installation of the above devices in a suitable manner and readily accessible location.

3 EXECUTION

3.1 Alarms - General

- .1 No alarm shall be triggered for a device until the device has been started and is in stable operation. Use software time delays to achieve this effect.

- .2 Generate an alarm on the B.M.S. if any equipment is not in the intended operating condition or if any analog input is not within the intended operating range.

3.2 Identification

- .1 Identify all controls with symbols relating directly to the control diagram. Use plasticized tags, engraved brass, aluminum, metalphoto or lamicaid labels and secure them to, or adjacent to, the control devices with key chains or cable ties.
- .2 All manual switches supplied by this trade, unless they come with standard nameplates, shall be labelled with engraved lamicaid plastic nameplates to clearly indicate the service. Wording on nameplates shall be subject to approval by the Departmental Representative.
- .3 Where "day" and "night" thermostats are adjacent to one another they shall be labelled with engraved lamicaid plastic nameplates.
- .4 Mount an input/output layout sheet within each main DDC panel. This sheet shall include the name of the points connected to each controller channel.
- .5 Identify all DDC panels and associated devices with symbols relating directly to the control diagram. Provide durable wire labels for each input and output point with the following information:
 - .1 Point descriptor.
 - .2 Point type and channel number.
 - .3 Corresponding DDC panel number.

3.3 System Commissioning and Calibration

- .1 Program each standalone DDC panel immediately following installation.
- .2 Set up and calibrate all control loops and sensors during the initial start-up of the systems and check, recalibrate and readjust as necessary during the Departmental Representative's Demonstration and Instruction period.
- .3 Upon completion of the installation, perform all necessary testing and debugging operations satisfactorily.
- .4 Perform all modifications and alterations as required to correct any deficiencies noted during these tests.
- .5 Check sensor calibration and control system operation during the first heating season and prior to the first cooling season.
- .6 Following each visit submit printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each DDC panel.

3.4 Verification of System Commissioning

- .1 Preliminary Tests
 - .1 After installation of each part of the system and completion of mechanical and electrical hook-up, perform tests to confirm correct installation and functioning of equipment.
 - .2 Notify the Departmental Representative in writing at least seven days before testing is to take place stating the following:

- .1 Location and part of system to be tested.
 - .2 Describe testing procedure and anticipated results.
 - .3 Provide all necessary testing equipment and personnel.
 - .4 Provide portable 2-way radios for communications during demonstrations. Provide three units on the same frequency and of sufficient power and quality as to be useful throughout the building.
 - .5 Perform tests in presence of the Departmental Representative.
 - .6 Demonstrate the proper operation of each component.
 - .7 Correct any deficiencies and re-test in the presence of the Departmental Representative, until designated part of the system performs satisfactorily.
- .2 Final Operational Acceptance Test
 - .1 A final operational test of not less than thirty (30) consecutive days, twenty-four (24) hours per day, shall be conducted on the complete and total installed and operational Control System to demonstrate that it is functioning properly in accordance with all requirements of this specification. The correct operation of all monitored and controlled points shall be demonstrated as well as the operation and capabilities of all sequences, reports, specialized control algorithms, diagnostics, and all other software. If the equipment operates at an average effectiveness level (AEL) of at least 95% during the performance test period of thirty (30) consecutive calendar days, it will be deemed to have met the Acceptable Standard of Performance, and final acceptance of the system shall be made, provided the contractor has satisfied all other requirements of this specification. In the event the required AEL is not reached during the initial thirty (30) consecutive calendar day period, the final operational acceptance test period shall be extended on a day-to-day basis until the required AEL is reached for thirty (30) consecutive calendar days. The average effectiveness level (AEL) is defined as the ratio between the total thirty-day test period less any system downtime accumulated within that period, and the thirty-day test period. Downtime shall result whenever the control system is unable to fulfill all required functions detailed within this specification due to any malfunction of either BMS hardware or software. Any defect of hardware or software shall be corrected when it occurs before the test may be resumed. Downtime created by non-BMS equipment or activities will not be considered as downtime for the AEL calculation.

3.5 Maintenance Service During the Warranty Period

- .1 The Contractor shall provide all services, materials and equipment necessary for the maintenance of the entire Control System, for a period concurrent with the warranty period. Any necessary material required for the maintenance work shall be provided by the Contractor.
- .2 The Controls Contractor shall provide one minor inspection per quarter or as required by the manufacturer and two major inspections per year, and all service for the required maintenance.

- .3 Major Inspections: these inspections shall include but not be limited to the following:
 - .1 Work as detailed hereinafter for minor inspections.
 - .2 Clean all peripheral equipment, CPU, interface panels, multiplexing panels and microprocessor interior and exterior surfaces.
 - .3 Provide signal, voltage and system isolation checks of all CPU, interface panels, multiplexing panels and peripherals.
 - .4 Provide mechanical adjustments, new ribbons and necessary maintenance on printers.
 - .5 Check and/or calibrate each field input/output device.
 - .6 Run system software diagnostics as required.
- .4 Minor Inspections: These inspections shall include but not be limited to the following:
 - .1 Provide visual and operational checks to all CPU, peripheral equipment, interface panels, multiplexing panels, and field devices.
 - .2 Change filter and check fan for all CPU's peripheral equipment as required.
 - .3 Provide complete back up of BMS system.
 - .4 Regular service calls: these calls shall be performed during regular working hours, 8:00 a.m. to 4:30 p.m. Monday through Friday excluding legal holidays.
- .5 Emergency Service: the Departmental Representative will initiate service calls when there is indication that the control system is not functioning properly. The Contractor shall have qualified control personnel available during the warranty period to provide service to the "critical" control system components whenever required at no additional cost to the Departmental Representative. The Contractor shall furnish the Departmental Representative with a telephone number where the service mechanic can be reached at all times. The service mechanic shall be on the job ready to service the control system within the next eight (8) hours, after receiving a request for service and the work shall be performed continuously until the control system is back in reliable operating condition. Repairs of a non-emergency nature shall be promptly repaired on the next normal business day.
- .6 Records and Logs: records and logs shall be kept of each maintenance task.
- .7 System Modifications: recommendations for system modification shall be provided in writing to the Departmental Representative. No system modification, including operating parameters and control settings, shall be made without prior approval.
- .8 Software: provide implementation of all software maintenance updates. These shall be accomplished as required and full coordination with control system supervisory personnel shall be maintained.

END OF SECTION

PART 1 Related Sections

- .1 Refer to Section 23 09 01 Controls General Requirements
- .2 Refer to Section 23 09 94 Controls Points List for HVAC

PART 2 Products

- .1 Refer to Section 23 09 01 Control Systems General Requirements

PART 3 Execution

3.1 HVAC CONTROL OBJECTIVES

- .1 Program the system to meet the following objectives:
 - .1 Temperature:
 - .1 Control the space temperature in each occupied space.
 - .2 Provide adequate heating capacity to all coils at a minimum HWS-T, while maximizing the temperature differential between HWS-T and HWR-T.
 - .2 Energy:
 - .1 Provide no more heating than is essential during Normal Operation.
 - .3 Operation:
 - .1 Systems shall remain under BMS control during all times of the day.
 - .2 Systems shall remain under BMS control during all operating conditions (unoccupied mode, occupied mode)

3.2 MONITORING

- .1 The existing BAS shall monitor the following conditions and parameters as a minimum:
 - .1 Each boiler's status
 - .2 Each boiler's firing rate (as % of full capacity)
 - .3 Each boiler's supply water temperature
 - .4 Each boiler's return water temperature
 - .5 Each boiler pump's status
 - .6 Hot water supply temperature downstream of supply manifold
 - .7 Each boiler pump's speed (as % of full speed)
 - .8 Each zone circulation pump's status
 - .9 Each zone pump's speed (as % of full speed)

- .10 Each zone return water temperature
- .11 Differential pressure across each zone circulation pump
- .12 Outdoor air temperature

3.3 ALARMS AND SAFETIES

- .1 Gas shut-off (solenoid) valve and boiler kill-switch button (refer to contract drawings)

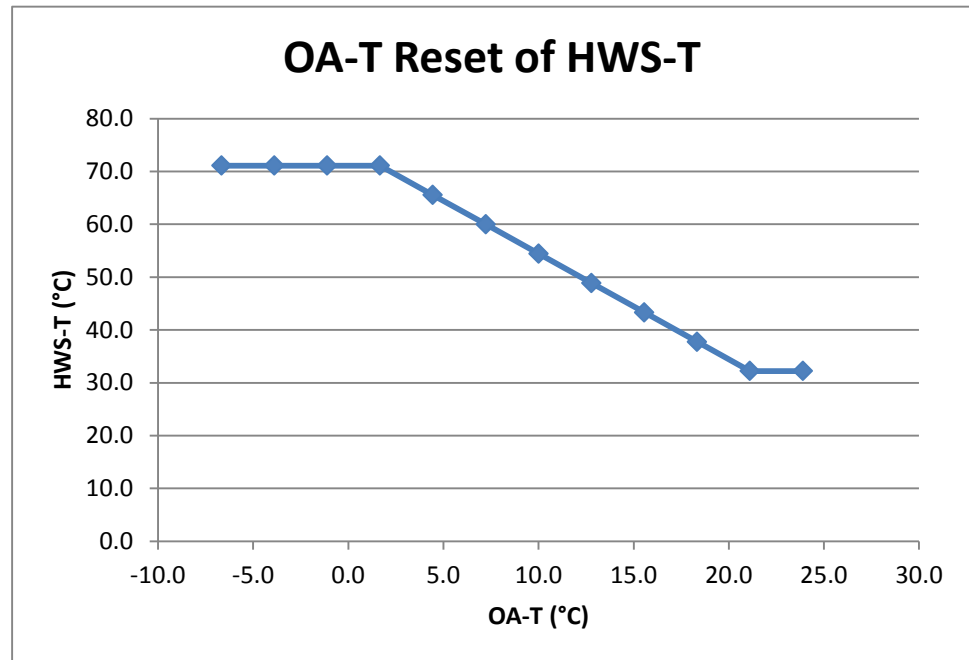
PART 4 Equipment and Subsystems Control

4.1 CENTRAL BOILER SYSTEM CONTROL

- .1 Scope:
 - .1 New boilers B-1, B-2, and existing boiler B-3 (formerly B-EX)
 - .2 Boiler pumps P-B1, P-B2, P-B3
- .2 Components:
 - .1 Boiler supply and return water temperature sensors (well-type)
 - .2 Outdoor air temperature sensor
- .3 Controls:
 - .1 System Start/Operation
 - .1 Each boiler shall be interlocked to its associated boiler pump so that when any boiler is enabled by the boiler's Central/Master Controller, the boiler's pump shall start prior to starting the boiler's purge and firing cycle.
 - .2 The boiler's Central/Master Controller shall perform all Lead, Lag, Back-Up, and Optimal Cascade functions for all 3 boilers as follows:
 - .1 Lead: Master Controller shall alternate between B-1 and B-2 as the lead boiler for each system shut-down and "call for heat" cycle.
 - .2 Lag-Optimal Cascade: The Master Controller shall control boiler sequences such that the Lag boiler (either B-1 or B-2) shall start to fire when the Lead boiler reaches its optimum fire rate (25-50% of capacity), and both boilers shall modulate upwards in tandem as heating demand increases.
 - .3 B-3 Lag: When both B-1 and B-2 are at full capacity and the HWS-T cannot be maintained at HWS-T set-point, B-3 shall be enabled.
 - .4 Back-up: Upon failure of the Lead boiler, the Lag boiler shall become the Lead boiler.

.2 Hot water supply temperature (HWS-T) reset:

- .1 Initially, the Master Controller shall set HWS-T based on the schedule below:



- .2 Per Section 23 05 93 Testing, Adjusting and Balancing, the controls contractor and TAB agency are to allow for checking and making adjustments at least twice during the 12 month warranty period, when weather conditions provide natural loads and in cases where complaints arise.
- .3 During peak winter conditions, determine the optimal maximum HWS-T.
- .4 During the intermediate season, determine the optimal slope of the schedule above.
- .3 Boiler Pump Speed Control:
- .1 Each boiler controller shall control its associated boiler pump to maintain a constant temperature difference (ΔT) between the boiler's supply and return hot water temperatures:
- .2 Initially set at $\Delta T = 19^{\circ}\text{C}$ (35°F).
- .3 During peak winter conditions, determine the optimal ΔT (highest possible while still satisfying all zones' heating demand) across the boilers.

4.2 ZONE CIRCULATION PUMP CONTROL

- .1 Scope:
 - .1 New boilers B-1, B-2, and existing boiler B-3
 - .2 Zone Circulation pumps P-1, P-2, P-3
 - .3 Zone Thermostats and Baseboard Heater
 - .4 Heating Coil at Zone 3 serving Tower AHU.
- .2 Components:
 - .1 Boiler supply and return water temperature sensors (well-type)
 - .2 Zone thermostats
 - .3 Pressure differential sensor
- .3 Controls:
 - .1 System Start/Operation:
 - .1 On any call for heat from a zone thermostat or the Tower AHU, the associated zone circulation pump shall start.
 - .2 The call for heat shall also be sent to the Central/Master Boiler Controller to enable boiler heating.
 - .2 Zone Circulation Pump Speed Control:
 - .1 Each zone circulation pump's speed shall be controlled by the pump's on-board speed controller to maintain a constant pressure differential ΔP across the pump's discharge and suction.
 - .2 The ΔP set-point shall be determined from the TAB report as the zone's total pressure drop at the rated pump flow, when all coil valves are at their full open position.

4.3 BASEBOARD RADIATION UNIT CONTROL

- .1 The existing control strategy for the baseboard wall-fin heaters shall remain. The existing wall-fin controls are non-DDC based.

END OF SECTION

1 GENERAL

1.1 Related Sections

- .1 Refer to Section 23 09 01 Controls General Requirements
- .2 Refer to Section 23 09 93 Controls Sequence of Operation

1.2 General

- .1 The following points list indicates the input and output points that shall be connected to the Building Automation System (BAS). Any additional points that are noted in Section 23 09 93 to be under DDC control shall also be included as if they were on the points list.
- .2 Program alarms as specified in the points list and sequences with user adjustable alarm thresholds. Provide descriptors for all programmed alarms which can be accessed via the graphics at the Operator Work Station (OWS).
- .3 Refer to Section 23 09 01 for specification of devices.

1.3 Device Legend

- .1 RTS = Room Temperature Sensor
- .2 DTS = Duct Temperature Sensor
- .3 ITS = Immersion temperature Sensor
- .4 ATS = Averaging Duct Temperature Sensor
- .5 OTS = Outdoor Temperature Sensor
- .6 HS = Humidity Sensor
- .7 DPT = Differential Pressure Transmitters
- .8 SPT = Static Pressure Transmitter
- .9 VPT = Velocity Pressure Transmitter
- .10 PSW = Pressure Switch
- .11 TSW = Temperature Switch
- .12 IPT = Current / Pneumatic Transducer
- .13 CR = Current Relay
- .14 ER = Electric Relay
- .15 PR = Pneumatic Relay
- .16 FSW = Flow Switch
- .17 ESW = End Switch
- .18 DME = Damper Actuator Modulating Electronic
- .19 DTE = Damper Actuator Two Position Electronic
- .20 DMI = Damper Actuator Modulating Incremental Control
- .21 VME = Valve Actuator Modulating Electronic

- .22 VTE = Valve Actuator Two Position Electronic
- .23 VMI = Valve Actuator Modulating Incremental Control
- .24 MFT = VAV Box Flow Transmitter
- .25 FMS = Electronic Flow Measuring Station
- .26 WFS = Water Flow Measuring Station

1.4 Table Legend

- .1 **DI** = DIGITAL INPUT; **DO** = DIGITAL OUTPUT; **AI** = ANALOG INPUT; **AO** = ANALOG OUTPUT; **X** = TUC POINT; **H** = HIGH ALARM; **L** = LOW ALARM; **S** = STATUS ALARM

1.5 INPUT/OUTPUT POINTS LIST

- .1 Provide full integration into the existing controls and connect to all new points.
- .2 System: Boilers (B-1, 2, and 3) and Boiler Pumps (P-B1, P-B2 and P-B3)
 - .1 Provide full integration of the boiler components to the existing BAS.

| Unit No. | Point Description | INPUT | | OUTPUT | | Controller | Alarm | Notes |
|----------|-------------------------|-------|----|--------|----|------------|-------|-------|
| | | DI | AI | DO | AO | | | |
| B-1 | Boiler B-1 enable | | | X | | BOILER | | |
| B-1 | Boiler B-1 status | X | | | | BOILER | FAIL | |
| B-2 | Boiler B-2 enable | | | X | | BOILER | | |
| B-2 | Boiler B-2 status | X | | | | BOILER | FAIL | |
| B-3 | Boiler B-3 enable | | | X | | BOILER | | |
| B-3 | Boiler B-3 status | X | | | | BOILER | FAIL | |
| B-1 | Boiler B-1 firing rate | | | | X | BOILER | | |
| B-1 | Boiler B-1 HWS-T | | X | | | BOILER | | |
| B-1 | Boiler B-1 HWR-T | | X | | | BOILER | | |
| B-2 | Boiler B-2 firing rate | | | | X | BOILER | | |
| B-2 | Boiler B-2 HWS-T | | X | | | BOILER | | |
| B-2 | Boiler B-2 HWR-T | | X | | | BOILER | | |
| B-3 | Boiler B-3 firing rate | | | | X | BOILER | | |
| B-3 | Boiler B-3 HWS-T | | X | | | BOILER | | |
| B-3 | Boiler B-3 HWR-T | | X | | | BOILER | | |
| B-1 | B-1 Lead Boiler | X | | | | BOILER | | BI |
| B-2 | B-2 Lead Boiler | X | | | | BOILER | | BI |
| P-B1 | Boiler Pump P-B1 status | X | | | | BOILER | FAIL | |
| P-B1 | Boiler Pump P-B1 enable | | | X | | BOILER | | |
| P-B1 | Boiler pump P-B1 speed | | | | X | BOILER | | f(ΔT) |

| Unit No. | Point Description | INPUT | | OUTPUT | | Controller | Alarm | Notes |
|----------|--------------------------------|-------|----|--------|----|------------|-------|---------------|
| | | DI | AI | DO | AO | | | |
| | command | | | | | | | |
| P-B1 | Boiler pump P-B1 ECM status | | X | | | BOILER | HI/LO | |
| P-B2 | Boiler Pump P-B2 status | X | | | | BOILER | FAIL | |
| P-B2 | Boiler Pump P-B2 enable | | | X | | BOILER | | |
| P-B2 | Boiler pump P-B2 speed command | | | | X | BOILER | | $f(\Delta T)$ |
| P-B2 | Boiler pump P-B2 ECM status | | X | | | BOILER | HI/LO | |
| P-B3 | Boiler Pump P-B3 status | X | | | | BOILER | FAIL | |
| P-B3 | Boiler Pump P-B3 enable | | | X | | BOILER | | |
| P-B3 | Boiler pump P-B3 speed command | | | | X | BOILER | | $f(\Delta T)$ |
| P-B3 | Boiler pump P-B3 ECM status | | X | | | BOILER | HI/LO | |

.3 System: Secondary Heating Loop Circulation Pumps

| Unit No. | Point Description | INPUT | | OUTPUT | | Controller | Alarm | Notes |
|----------|----------------------------------|-------|----|--------|----|------------|-------|---------------|
| | | DI | AI | DO | AO | | | |
| P-1 | Zone circulation pump P-1 status | X | | | | PUMP | FAIL | |
| P-1 | Zone circulation pump P-1 enable | | | X | | BAS | | |
| P-1 | Zone 1 circ. pump speed command | | | | X | PUMP | | $f(\Delta P)$ |
| P-1 | Zone 1 circ. pump P-1 ECM status | | X | | | PUMP | HI/LO | |
| P-2 | Zone circulation pump P-2 status | X | | | | PUMP | FAIL | |
| P-2 | Zone circulation pump P-2 enable | | | X | | BAS | | |
| P-2 | Zone 2 circ. pump speed command | | | | X | PUMP | | $f(\Delta P)$ |
| P-2 | Zone 2 circ. pump P-2 ECM status | | X | | | PUMP | HI/LO | |
| P-1 | Zone circulation pump P-3 status | X | | | | PUMP | FAIL | |
| P-1 | Zone circulation pump P-3 enable | | | X | | BAS | | |
| P-1 | Zone 3 circ. pump speed command | | | | X | PUMP | | $f(\Delta P)$ |
| P-1 | Zone 3 circ. pump P-3 ECM status | | X | | | PUMP | HI/LO | |

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for piping, valves and fittings for gas fired equipment.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .3 Section 01 78 00 - Closeout Submittals
- .4 Section 23 05 05 - Installation of Pipework
- .5 Section 23 08 01 - Performance Verification

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.18-01 (R2005), Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ASME B16.22-01 (R2005), Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - .4 ASME B18.2.1-96 (R2005), Square and Hex Bolts and Screws Inch Series.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
 - .1 CAN/CSA B149.1HB-05, Natural Gas and Propane Installation Code Handbook.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Indicate the following shop drawings:
 - .1 Valves.
 - .2 Pressure reducing valves
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS 2 1/2 and over, plain end.
- .2 Copper tube: to ASTM B837.

2.2 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: non-metallic flat.
- .4 Brazing: to ASTM B837.

2.3 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
 - .3 Welding: butt-welding fittings.
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
 - .5 Bolts and nuts: to ASME B18.2.1.
 - .6 Nipples: schedule 40, to ASTM A53/A53M.
- .2 Copper pipe fittings, screwed, flanged or soldered:
 - .1 Cast copper fittings: to ASME B16.18.
 - .2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

- .1 Provincial Code approved, lubricated plug type.
- .2 NPS 2 and under, screwed.
- .3 NPS 2-1/2 and over, flanged.
- .4 Suitable for the temperature to which exposed.
- .5 Certified by Canadian Gas Association (CGA).

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING

- .1 Install gas piping in accordance with Section 23 05 05 - Installation of Pipework and CAN/CSA B149.1.
- .2 Ream pipe ends. Clean scale and dirt, inside and outside before and after assembly.
- .3 During construction, protect all openings in piping and equipment, by capping or plugging to prevent entry of dirt.
- .4 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .5 Slope piping down in direction of flow to low points.
- .6 Use eccentric reducers at pipe size change installed to provide positive drainage.

- .7 Provide clearance for access for maintenance of equipment, valves and fittings.
- .8 Use dielectric type fittings where buried service enters and connects to building piping.
- .9 Joints:
 - .1 Gas service inside building - screw or weld NPS 2 and under. Weld NPS 2-1/2 and over.
 - .2 Gas service in ceiling plenums - weld all sizes.
 - .3 Gas service outside building - weld all sizes below ground.
- .10 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.
- .11 Paint all exposed and exterior gas piping.

3.3 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by DFO Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.
- .3 Install valve on the main gas service entering the building. Valve to have locking lugs.

3.4 CONNECTIONS TO EQUIPMENT

- .1 Install unions or flanges in connections to all equipment and specialty components.
- .2 Arrange piping connections to allow ease of access and for removal of equipment.
- .3 Align and independently support piping connections adjacent to equipment to prevent piping stresses being transferred.

3.5 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
- .2 Notify the DFO Representative and the Inspection Authority having jurisdiction, 48 hours in advance of intended test date.
- .3 Examine piping for leaks. Remake all leaking connections and joints.
- .4 Submit final gas inspection certificate.

.5 Performance Verification:

- .1 Refer to Section 23 08 01 - Performance Verification.

3.6 ADJUSTING

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.

.2 Pre-Start-Up Inspections:

- .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
- .2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.7 CLEANING

- .1 Cleaning: in accordance with Section 23 08 02 - Cleaning and Start-Up, CAN/CSA B149.1, supplemented as specified.
- .2 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.
- .3 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation of Hydronic Specialties Equipment.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .3 Section 01 78 00 - Closeout Submittals
- .4 Section 23 08 01 - Performance Verification

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME-04, Boiler and Pressure Vessel Code.
- .2 American Society for Testing and Materials, (ASTM).
 - .1 ASTM A47/A47M-99 (2004), Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A516/A516M-06, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .3 ASTM A536-84(2004), Specification for Ductile Iron Castings.
 - .4 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA International).
 - .1 CSA B51-03 (R2007), Boiler, Pressure Vessel, and Pressure Piping Code.

1.4 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 for:
 - .1 Expansion tanks
 - .2 Air Separators
 - .3 Air vents
 - .4 Valves
 - .5 Strainers
 - .6 Suction diffusers
 - .7 Pressure reducing and relief valves
 - .8 Temperature and Pressure Gauges

- .2 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY STORAGE AND DISPOSAL

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling

Part 2 Products

2.1 DIAPHRAGM TYPE EXPANSION TANK

- .1 Vertical steel pressurized diaphragm type expansion tank.
- .2 EPDM Diaphragm sealed in elastomer suitable for 115 ° C operating temperature.
 - .1 Tank to be suitable for glycol system
- .3 Working pressure: 860 kPa with ASME stamp and certification.
- .4 Identification plate showing:
 - .1 Manufacturer's name.
 - .2 Capacity in litres.
 - .3 Hydraulic test pressure.
 - .4 Working pressure.
 - .5 Code stamping and ASME registered design.
- .5 Air pre-charged to 84 kPa (initial fill pressure of system).
- .6 Base mount for vertical installation.
- .7 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.
- .8 Renewable diaphragm.
- .9 Capacity and size: Refer to drawing schedules.

2.2 VALVES

- .1 Provide valves with an ANSI/ASME Class 125 service rating, which for 66°C, the pressure rating is 1207 kPa. Valves in sizes larger than 25 mm (1") and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be furnished by the same manufacturer as the grooved pipe joint and fitting system.

- .2 Gate Valve:
 - .1 Gate valves 65 mm 2-1/2" and smaller shall conform to MSS SP-80 Class 125 and shall be bronze with wedge disc, rising stem and threaded, soldered, or flanged ends.
 - .2 Gate valves 80 mm 3" and larger shall conform to MSS SP-70, Class 125, cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.
- .3 Globe and Angle Valve:
 - .1 Globe and angle valves 65 mm 2-1/2" and smaller shall conform to MSS SP-80, Class 125.
 - .2 Globe and angle valves 80 mm 3" and larger shall conform to MSS SP-85, Class 125.
- .4 Check Valve:
 - .1 Check valves 65 mm 2-1/2" and smaller shall conform to MSS SP-80.
 - .2 Check valves 80 mm 3" and larger shall conform to MSS SP-71, Class 125.
- .5 Butterfly Valve:
 - .1 Butterfly valves shall conform to MSS SP-67, Type 1 and shall be either the wafer or lug type.
 - .2 Valves smaller than 200 mm 8" shall have throttling handles with a minimum of two locking positions.
 - .3 Valves 200 mm 8" and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators.
- .6 Plug Valve:
 - .1 Plug valves 50 mm 2" and larger shall conform to MSS SP-78, have flanged or threaded ends, and have cast iron bodies with bronze trim.
 - .2 Valves 50 mm 2" and smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing.
 - .3 Valve shall be lubricated, non-lubricated, or tetrafluoroethylene resin-coated type.
 - .4 Valve shall be resilient, double seated, trunnion mounted with tapered lift plug capable of 2-way shutoff.
 - .5 Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug.
 - .6 Valves 200 mm 8" or larger shall be provided with manual gear operators with position indicators.

- .7 Ball Valve Full port design:
 - .1 Ball valves 15 mm 1/2 inch and larger shall conform to MSS SP-72 or MSS SP-110 and shall be cast iron or bronze with threaded, soldered, or flanged ends.
 - .2 Valves 200 mm 8" or larger shall be provided with manual gear operators with position indicators. Ball valves may be provided in lieu of gate valves.
- .8 Square Head Cocks Provide copper alloy or cast-iron body with copper alloy plugs, suitable for 125 psig water working pressure.
- .9 Calibrated Balancing Valves:
 - .1 Copper alloy or cast iron body, copper alloy or stainless internal working parts.
 - .2 Provide valve calibrated so that flow can be determined when the temperature and pressure differential across valve is known.
 - .3 Valve shall have an integral pointer which registers the degree of valve opening.
 - .4 Valve shall function as a service valve when in fully closed position.
 - .5 Valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation.
 - .6 Provide valve bodies with tapped openings and pipe extensions with positive shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable differential pressure meter connections to verify the pressure differential.
 - .7 Provide metal tag on each valve showing the liters per second gallons per minute flow for each differential pressure reading.
- .10 Automatic Flow Control Valves:
 - .1 Valve shall automatically maintain the constant flow indicated on the design drawings. Valve shall modulate by sensing the pressure differential across the valve body.
 - .2 Valve shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Provide valve that controls the flow within 5 percent of the tag rating.
 - .3 Valve materials shall be the same as specified for the ball or plug valves.

- .4 Provide valve that are electric type as indicated. Valve shall be capable of positive shutoff against the system pump head, valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings and differential meter, suitable for the operating pressure specified. Provide the meter complete with hoses, vent, integral metering connections, and carrying case as recommended by the valve manufacturer.
- .11 Pump Discharge Valve (Triple-Duty Valves):
 - .1 Valve shall perform the functions of a non-slam check valve, a manual balancing valve, and a shutoff.
 - .2 Valve shall be of cast iron or ductile iron construction with bronze and/or stainless steel accessories.
 - .3 Provide an integral pointer on the valve which registers the degree of valve opening. Flow through the valve shall be manually adjustable from bubble tight shutoff to full flow.
 - .4 Valves smaller than 50 mm 2" shall have NPT connections. Valves 50 mm 2" and larger shall have flanged or grooved end connections.
 - .5 Valve design shall allow the back seat for the stem to be replaced in the field under full line pressure.
- .12 Pressure Relief Valve: Valve shall prevent excessive pressure in the piping system when the piping system reaches its maximum heat buildup.
 - .1 ANSI Z21.22/CSA 4.4 and shall have cast iron bodies with corrosion resistant internal working parts.
 - .2 The discharge pipe from the relief valve shall be the size of the valve outlet unless otherwise indicated.
- .13 Combination Pressure and Temperature Relief Valves: ANSI Z21.22/CSA 4.4, copper alloy body, automatic re-seating, test lever, and discharge capacity based on AGA temperature steam rating.
- .14 Drain Valves: MSS SP-80 gate valves. Valve shall be manually-operated, 20 mm ¾" pipe size and above with a threaded end connection. Provide valve with a water hose nipple adapter.
- .15 Air Venting Valves:
 - .1 Manually-operated general service type air venting valves, brass or bronze valves that are furnished with threaded plugs or caps.
 - .2 Automatic type air venting shall be the ball-float type with brass/bronze or brass bodies, 300 series corrosion-resistant steel float, linkage and removable seat.

- .3 Air venting valves on water coils shall have not less than 3 mm 1/8 inch threaded end connections
 - .4 Air venting valves on water mains shall have not less than 20 mm 3/4 inch threaded end connections.
 - .5 Air venting valves on all other applications shall have not less than 15 mm 1/2 inch threaded end connections.
- .16 Vacuum Relief Valves ANSI Z21.22/CSA 4.4

2.3 PIPE LINE STRAINER

- .1 NPS 2 and under: bronze body to ASTM B62, screwed connections, Y pattern.
- .2 NPS 2 1/2 and over: cast iron body to ASTM, Class 30, flanged connections.
- .3 NPS 2 and over: Y or T type with ductile iron body to ASTM A536 or malleable iron body to ASTM A47M, grooved ends.
- .4 Blowdown connection: NPS 1.
- .5 Basket Screen: stainless steel or brass with 1.19 mm perforations.
- .6 Working pressure: 860 kPa.
- .7 Acceptable Products:
 - .1 Armstrong, Erwel, Kitz, Mech-Line, Muesco, Spirax/Sarco, Toyo, Victaulic.

2.4 PRESSURE REDUCING STATION – COLD WATER

- .1 Screwed, bronze or cast iron body, suitable to 1380 kPa, composition seat.
- .2 Each reducing station to include:
 - .1 Gate valve, strainer, union, pressure reducing valve, union, gate valve.
 - .2 Bypass with globe valve.
 - .3 20 mm relief valve.
- .3 Acceptable Products:
 - .1 Cashco, Watts.

2.5 Pressure and Vacuum Gauges,

- .1 ASME B40.100 with throttling type needle valve or a pulsation dampener and shut-off valve.
- .2 Provide gauges with 115 mm 4.5 inch dial, brass or aluminum case, bronze tube, and siphon. Gauge shall have a range from 0 kPa 0 psig to approximately 1.5 times the maximum system working pressure.
- .3 Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

2.6 Temperature Gauges:

- .1 Temperature gauges shall be the industrial duty type and be provided for the required temperature range.
- .2 Provide gauges with fixed thread connection, dial face gasketed within the case; and an accuracy within 2 percent of scale range. Gauges shall have Celsius scale in 1 degree Fahrenheit scale in 2 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable.
- .3 Rigid stem type temperature gauges shall be provided in thermal wells located within 1.5 m 5 feet of the finished floor.
- .4 Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 1.5 to 2.1 m 5 to 7 feet above the finished floor or in locations indicated.
- .5 Remote element type temperature gauges shall be provided in thermal wells located 2.1 m 7 feet above the finished floor or in locations indicated.
- .6 Stem Cased-Glass: Stem cased-glass case shall be polished stainless steel or cast aluminum, 229 mm 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.
- .7 Bimetallic Dial: Bimetallic dial type case shall be not less than 89 mm 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment.
- .8 Liquid-, Solid-, and Vapor-Filled Dial: Liquid-, solid-, and vapor-filled dial type cases shall be not less than 89 mm, 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.
- .9 Thermal Well: Thermal well shall be identical size, 15 or 20 mm 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 15 mm 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 25 mm 1 inch.

Part 3 Execution

3.1 GENERAL

- .1 Install as indicated and to manufacturer's recommendations.
- .2 Run drain lines and blow off connections to terminate above nearest drain.
- .3 Maintain proper clearance to permit service and maintenance.
- .4 Should deviations beyond allowable clearances arise, request and follow DFO Representative's directive.

- .5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 AIR VENTS – AUTOMATIC – HIGH CAPACITY TYPE

- .1 Install automatic high capacity air vents at each high point in the piping systems and where shown on the drawings.
- .2 Install on tees and not on horizontal pipe runs or elbows.
- .3 Install a 12 mm minimum isolating gate valve ahead of each air vent, unless air vent has an integral shut-off valve.
- .4 Fit all vents on top of an air-collecting chamber.
- .5 Pipe all air vent discharge connections separately, to the nearest building drain, using 6 mm hard drawn copper tube. Label ends with permanent labels.
- .6 Pipe all air vent discharge connections, (except for glycol) separately, to a water-tight solder jointed, 1.2 mm copper drain pan, using 6 mm (1/4") hard drawn copper tube where exposed and soft copper where concealed. Label ends with permanent labels.
- .7 Pipe all air vent discharge connections from the glycol circuit, separately back to the glycol mixing tank, using 6 mm hard drawn copper tube.

3.3 AIR VENTS – MANUAL – HIGH CAPACITY

- .1 Install manual air vents at high points in the piping systems where shown on the drawings.
- .2 Install on tees and not on horizontal pipe runs or elbows.
- .3 Install isolating gate valve ahead of each vent valve.
- .4 Pipe air vent discharge connections to nearest building drain.

3.4 AIR SEPARATOR

- .1 Install on suction side of system circulation pump.

3.5 STRAINERS

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.
- .4 Install ahead of each automatic control valve larger than NPS 1 and as indicated.
- .5 Provide isolation valves on either side of strainer, to permit cleaning without draining the system.

3.6 EXPANSION TANKS – DIAPHRAGM TYPE

- .1 Adjust expansion tank pressure as indicated.
- .2 Install gate valve in system connection.
- .3 Install globe valve in tank drain connection.

3.7 PRESSURE REDUCING STATIONS – COLD WATER

- .1 Install water make-up stations for each hot water, chilled water and other closed water systems where shown on the drawings.
- .2 Pipe relief valve to drain.

3.8 PRESSURE SAFETY RELIEF VALVES - WATER

- .1 Install pressure relief valve(s) on each heat exchanger to prevent over pressuring.
- .2 Select relief valves to relieve full heat input of the heat supply side.
- .3 Pipe relief valve to drain.
- .4 Where one line vents several relief valves, cross sectional area shall equal sum of individual vent areas.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for steel piping, valves and fittings for hydronic systems.

1.2 RELATED SECTIONS

- .1 Section 23 05 00 – Common Work Results for Mechanical
- .2 Section 23 21 14 – Hydronic Specialties
- .3 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B16.1-2005, Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.3-2006, Malleable Iron Threaded Fittings.
 - .3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
 - .4 ASME B16.9-2007, Factory-Made Wrought Buttwelding Fittings.
 - .5 ASME B18.2.1-1996 (R2005), Square and Hex Bolts and Screws (Inch Series).
 - .6 ASME B18.2.2-87(2005), Square and Hex Nuts (Inch Series).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A47/A47M-2004, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A536-2004, Standard Specification for Ductile Iron Castings.
- .3 American Water Works Association (AWWA).
 - .1 AWWA C111-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 American National Standards Institute (ANSI)/American Welding Society (AWS)
 - .1 ANSI B31, Standard of Pressure Piping.

1.4 SUBMITTALS

- .1 Shop Drawings:

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit the following shop drawings:
 - .1 Manufacturers' literature for piping and fittings.
- .2 Close-out Submittals.
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal.
 - .1 Separate waste materials for reuse and recycling in accordance with Section

Part 2 Products

2.1 PIPE

- .1 Steel Pipe:
 - .1 Schedule 40 to ASTM A53 Grade B for the following systems:
 - .1 Hot water heating
 - .2 Relief valve vents

2.2 PIPE JOINTS – STEEL PIPING

- .1 NPS 2 and under: screwed fittings, except where otherwise noted, with teflon tape and rectroseal teflon paste or pipe dope.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W47.1.
- .3 Flanges: raised face, steel weld neck, lap or back-welded slip on type. Use flat face for attachment to cast iron valves.
- .4 Bolts and Nuts, carbon steel: to ASME B18.2.1 and ASME B18.2.2.
- .5 Flange gaskets:
 - .1 To AWWA C111.
 - .2 Up to 860 kPa system pressure - non-asbestos gaskets for mating surfaces.
 - .3 Over 860 kPa system pressure - stainless steel spiral wound non-asbestos gaskets.

2.3 PIPE FITTINGS – STEEL PIPE

- .1 Pipe fittings, screwed, flanged or welded:
 - .1 Cast iron pipe flanges: Class 125 to ANSI B16.1.
 - .2 Cast iron screwed fittings: Class 125 to ANSI B16.3.

- .3 Steel pipe flanges and flanged fittings: to ANSI B16.5.
- .4 Steel butt-welding fittings: to ANSI B16.9a.
- .5 Unions, malleable iron ground joint type: Class 150 to ANSI B16.3.

2.4 VALVES

- .1 Connections: Per specification Section 23 21 14 Hydronic Specialties

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING INSTALLATION

- .1 Ream pipe ends. Clean scale and dirt, inside and outside before and after assembly. Remove foreign material from piping.
- .2 During construction, protect all openings in piping and equipment, by capping or plugging to prevent entry of dirt.
- .3 Screw or weld (unless otherwise specified) all piping systems up to NPS 2.
- .4 Weld (unless otherwise specified) all piping systems NPS 2-1/2 and over.
- .5 Install piping to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.
- .6 Avoid piping in exterior walls unless otherwise directed. If required, install this piping protected from the outside by the building insulation and vapour barrier.
- .7 Maintain a minimum of 25 mm space between adjacent flanges or pipe insulation, whichever has the larger diameter.
- .8 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .9 Saddle type branch fittings may be used on mains, if branch line is half size or smaller than main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .10 Use long radius elbows.
- .11 Install all thermometer wells and immersion sensor wells specified under the Controls Section. Where wells will restrict flow in small diameter pipes (NPS 1-1/2 and smaller) install a section of oversized pipe at least NPS 2.
- .12 Remake leaking joints using new materials, do not caulk or cement leaking threaded joints.
- .13 Use eccentric reducers at pipe size changes, flush on top side, to permit positive venting and drainage.

- .14 Do not use thread protection couplings, close nipples, running nipples or street elbows.
- .15 Install dielectric type unions or flanges on "OPEN" type systems, where copper piping connects to steel. eg. domestic hot water tanks.
- .16 Avoid locating water and drain piping over electrical equipment. Where this is unavoidable, provide galvanized drip pans under such pipe and weld piping and fittings. Provide drain and piping from drip pans to satisfactory floor drain.
- .17 Bull head tees shall not be used for converging flows.
- .18 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .19 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
- .20 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .21 Assemble piping using fittings manufactured to ANSI standards.

3.3 PIPE GRADING

- .1 Grade all piping to provide positive drainage and venting. Slope as follows:
 - .1 Supply mains and branches - up in the direction of flow, minimum 1:480.
 - .2 Return mains and branches - down in the direction of flow, minimum 1:480.
 - .3 Reverse return supply and return mains - up in the direction of flow, minimum 1:480 .
 - .4 Grade horizontal drainage and vent piping down in direction of flow, 2% minimum.
 - .5 On closed system, equip low points with 20 mm drain valves. Provide, at high points on lines and on equipment connections, collecting chambers and high capacity float operated air vents.

3.4 SOLDERING AND BRAZING

- .1 Pressure fluid systems - with chemical treatment (heating, chilled and condenser water). BRAZE with silver base brazing alloy, 538°C melting point.
- .2 Pressure fluid systems - without chemical treatment, (heat recovery, domestic water). SOLDER with 95/5 tin-antimony.
- .3 Non-pressure systems, (drains) SOLDER with 95/50 tin-antimony.

3.5 CONNECTIONS TO EQUIPMENT AND TO EXISTING PIPING

- .1 Install union grooved couplings or flanges at connections to all equipment and specialty components and at all connecting points to existing systems which, for reasons of separation for testing, will require to be blank flanged or capped.
- .2 Install removable sections of pipe or 300 mm spool pieces on the suction side of end suction pumps and where required for ease of maintenance.
- .3 Connect to equipment in accordance with manufacturer's instruction unless otherwise noted.
- .4 Arrange piping connections to allow ease of access and for removal of equipment.

3.6 EXPANSION OF PIPING

- .1 Install all piping systems with due regard and provision for expansion avoiding strain or damage to equipment and building. Pay particular attention to piping running horizontal across building expansion joints and provide adequate expansion and contraction for all such piping.
- .2 Only major expansion configuration and fittings have been shown on the drawings. Provide all required additional compensators, loops and swing connections.
- .3 Provide anchors, where shown. Anchors shall be fabricated from mild steel plate and structural steel angle and channel sections, in accordance with ANSI B.31.
- .4 Expansion loops shall be of all welded construction with long radius elbows.
- .5 Install expansion loops, cold sprung 50% of the calculated expansion.
- .6 Install at least 3 elbows in all branch connections. Where space does not permit 3 elbows, install braided flexible pipe connectors in accordance with manufacturers' recommendations. 3 elbow branch connections shall have sufficient developed length to ensure that excessive stresses are not generated in the piping and in no case less than 900mm.

3.7 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install butterfly valves on chilled water and condenser water lines only.
- .3 Install gate, ball or butterfly valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .4 Install globe valves for balancing and in by-pass around control valves as indicated.
- .5 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.

- .6 Install swing check valves in horizontal lines on discharge of pumps and as indicated.
- .7 Install chain operators on valves NPS 2 1/2 and over where installed more than 2400 mm above floor in Boiler Rooms and Mechanical Equipment Rooms.

3.8 CIRCUIT BALANCING VALVES

- .1 Install circuit balancing valves as indicated.

3.9 FILLING OF SYSTEM

- .1 Refill system with clean water, adding water treatment as specified.

3.10 FIELD QUALITY CONTROL

- .1 Testing:
 - .1 Test system in accordance with Section 23 05 00 - Common Work Results for Mechanical.
- .2 Balancing:
 - .1 Balance water systems to within plus or minus 5% of design output.
 - .2 Refer to Section 23 05 93 – Testing, Adjusting and Balancing for HVAC for applicable procedures.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IES Standard 90.1-2013, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 CSA Group
 - .1 CAN/CSA-B214-12, Installation Code for Hydronic Heating Systems.
- .3 Electrical Equipment Manufacturers Association of Canada (EEMAC)
- .4 National Electrical Manufacturers' Association (NEMA)
 - .1 NEMA MG 1-2011, Motors and Generators.

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 each pump and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.
- .3 Shop Drawings:
 - .1 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps for incorporation into manual.
- .3 Submit 4 copies of operation and maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:

- .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect hydronic pumps from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove in accordance with Section 01 74 19 – Waste Management and Disposal.

Part 2 Products

2.1 EQUIPMENT

- .1 Size and select components to: CAN/CSA-B214.

2.2 IN-LINE CIRCULATORS

- .1 Volute: Cast iron radially split, with screwed or flanged design suction and discharge connections.
- .2 Impeller: stainless steel.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135 degrees C.
- .5 Coupling: rigid; integral pump and motor
- .6 Motor: ECM with permanent magnet rotor, and with integrated controls.
- .7 Capacity: as indicated
- .8 Design pressure: 860 kPa.

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 hydronic pump 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.

3.2 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 INSTALLATION

- .1 Install hydronic pumps to: CAN/CSA-B214.
- .2 In line circulators: install as indicated by flow arrows.
 - .1 Support at inlet and outlet flanges or unions.
 - .2 Install with bearing lubrication points accessible.
- .3 Ensure that pump body does not support piping or equipment.
 - .1 Provide stanchions or hangers for this purpose.
 - .2 Refer to manufacturer's installation instructions for details.
- .4 Pipe drain tapping to floor drain.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge test cocks.

3.4 START-UP

- .1 General:
 - .1 In accordance with Section 23 08 00 - Commissioning – Mechanical Systems; supplemented as specified herein.
 - .2 In accordance with manufacturer's recommendations.
- .2 Procedures:
 - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
 - .2 After starting pump, check for proper, safe operation.
 - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .4 Check base for free-floating, no obstructions under base.
 - .5 Run-in pumps for 12 continuous hours minimum.
 - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
 - .7 Eliminate air from scroll casing.
 - .8 Adjust water flow rate through water-cooled bearings.
 - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
 - .10 Adjust alignment of piping and conduit to ensure true flexibility.

- .11 Eliminate cavitation, flashing and air entrainment.
- .12 Adjust pump shaft seals, stuffing boxes, glands.
- .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .15 Verify lubricating oil levels.

3.5 PERFORMANCE VERIFICATION (PV)

- .1 General:
 - .1 Verify performance in accordance with Section 23 08 00 - Commissioning – Mechanical Systems; supplemented as specified herein.
- .2 Verify that manufacturer's performance curves are accurate.
- .3 Ensure valves on pump suction and discharge provide tight shut-off.
- .4 Net Positive Suction Head (NPSH):
 - .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
 - .2 Measure using procedures prescribed in Section 23 08 00 - Commissioning – Mechanical Systems.
- .5 Multiple Pump Installations - Series and Parallel:
 - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .7 Commissioning Reports: in accordance with Section 23 08 00 - Commissioning – Mechanical Systems, reports supplemented as specified herein. Reports to include:
 - .1 Record of points of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
 - .2 Use Report Forms specified in Section 23 08 00 - Commissioning – Mechanical Systems.
 - .3 Pump performance curves (family of curves).

3.6 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 Waste Management:
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation of hot water heating boilers:

1.2 RELATED SECTIONS

- .1 Section 23 05 00 – Common Work Results for Mechanical
- .2 Section 23 21 16 – Hydronic Systems: Steel
- .3 Section 23 21 14 – Hydronic Specialties
- .4 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
- .5 Section 23 08 00 – Mechanical Commissioning

1.3 REFERENCES

- .1 American Boiler Manufacturer's Association (ABMA)
- .2 American National Standards Institute (ANSI)
 - .1 ANSI Z21.13-2005/CSA 4.9a-2005, Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- .3 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 2004.
- .4 Canadian Gas Association (CGA)
 - .1 CAN1-3.1-77 (R2006), Industrial and Commercial Gas-Fired Package Boilers.
 - .2 CAN/CSA-B149.1-15, Natural Gas and Propane Installation Code.
- .5 Canadian Standards Association (CSA International)
 - .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.
- .6 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

1.4 SUBMITTALS

- .1 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.
 - .2 Indicate the following:
 - .1 General arrangement showing dimensions, terminal points, instrumentation test connections.

- .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
- .3 Boiler weight distribution, anchor bolt arrangements.
- .4 Piping hook-ups.
- .5 Equipment electrical drawings.
- .6 Burners and controls.
- .7 All miscellaneous equipment.
- .8 Flame safety control system.
- .9 Breeching and stack configuration.
- .10 Stack emission continuous monitoring system to measure CO, O₂, NO_x, SO₂, stack temperature and smoke density of flue gases.
- .3 Engineering data to include:
 - .1 Boiler efficiency at 25%, 50%, 75%, and 100% of design capacity.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .3 Closeout Submittals:
 - .1 Submit operation and maintenance data for incorporation into manual

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEEA, TDGA, and applicable Provincial regulations.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling.

1.7 MAINTENANCE

- .1 Extra materials:
 - .1 Special tools for burners, manholes, handholes and Operation and Maintenance.
 - .2 Spare parts for 1 year of operation.

Part 2 Products

2.1 GENERAL

- .1 Packaged condensing boiler: complete with burner and necessary accessories and controls, and ready for attachment of water supply, return and drain piping, fuel piping, electrical connections, and chimney connection. UL/ULC labelled.
- .2 Designed and constructed in accordance with ASME Code requirements.
- .3 CRN (Canadian Registration Number), to CSA B51.
- .4 Boiler/burner package to bear ULC or CGA label.
- .5 Electrical components CSA approved.
- .6 Boilers to be test fired before shipment and to be registered with the Provincial Authorities.
- .7 Include erection and wiring diagrams and an operating and maintenance manual with boiler package.
- .8 Check all available drawings and ensure that the boiler proposed will fit in the space allotted and can be maintained and operated in a normal manner without difficulty.
- .9 Performance:
 - .1 In accordance with American Boiler Manufacturers Association (ABMA).
 - .2 Capacity: Refer to equipment schedules.
 - .3 Boiler efficiency: 95%.
- .10 Electrical:
 - .1 Power: 120 V, 1 phase, 60 Hz.
 - .2 Controls: 120 V, 1 phase, 60 Hz.
 - .3 Electrical components: CSA approved.
- .11 Controls: factory wired. Enclosed in Electrical and Electronic Manufacturers' Association of Canada (EEMAC) 1 steel cabinet.

- .12 Thermal insulation:
 - .1 50 mm thick mineral fibre. Seal insulation at handholes, manholes, mudholes, piping connections with insulating cement or asphaltic paint. Finish with heat resisting paint.
- .13 Jackets: heavy gauge metal, finished with heat resisting paint.
- .14 Mounting:
 - .1 Structural steel base, lifting lugs.
- .15 Anchor bolts and templates:
 - .1 Supply manufacturer's standard for seismically rated installation
- .16 Start-up, instruction, on-site performance tests: 2 days.
- .17 Trial usage:
 - .1 Departmental Representative may use boilers for test purposes prior to acceptance and commencement of warranty period.
 - .2 Supply labour, materials and instruments required for tests.
- .18 Temporary use by contractor:
 - .1 Contractor may use boilers only after written approval from Departmental Representative.
 - .2 Monitor and record performance continuously. Keep log of maintenance activities carried out.
 - .3 Refurbish to as-new condition before final inspection and acceptance.

2.2 HOT WATER BOILERS – CONDENSING FIRE TUBE TYPE

- .1 Construction:
 - .1 Each boiler shall be a self-contained packaged type, complete with accessories, mounted on a structural steel base or a steel base which is integral to the boiler shell.
 - .2 Boiler shall conform to the commercial design used by the manufacturer and shall permit free thermal expansion without placing undue stress on any part of the boiler.
 - .3 Boiler which experiences the formation of condensate within the flue gas shall be specifically designed for condensing application.
 - .4 Boiler shall withstand the corrosive effects of condensate for each part which may be in contact with the condensate at all possible operating conditions.
 - .5 Boiler shall be provided with a separate air intake, exhaust, and condensate drain.

- .6 Boiler shall be designed to withstand the water temperature differentials anticipated at the required operating conditions without experiencing any damage due to thermal shock.
- .7 Boiler shall be furnished with an adequate number of tappings and inspection openings to facilitate internal boiler inspection and cleaning.
- .8 Boiler shall be complete with a heavy gauge insulated metal jacket, finished with heat resistant enamel paint.
- .9 All exposed boiler components such as down comers and drum ends to be insulated.
- .10 Provide secure attachment points for seismic anchoring.
- .2 Boiler Accessories:
 - .1 Provide all standard trim items and controls as described in the manufacturer's published product specification including the following:
 - .1 Flue gas thermometer.
 - .2 Thermometer and pressure gauge.
 - .3 Water temperature control operator.
 - .4 High limit safety control with manual reset.
 - .5 Low water cutoff with manual reset (manual reset should not be necessary after electrical power interruption).
 - .6 ASME safety relief valve.
 - .7 Electronic combustion safety control
 - .8 Ignition transformer.
 - .9 Modulating burner unit.
- .3 Gas Burner and Control Equipment
 - .1 Boiler shall be furnished with a forced draft, flame retention gas burner.
 - .2 Burner shall be complete with integral motor and blower for supplying sufficient combustion air.
 - .3 Provide all standard trim items and controls as described in manufacturers published product specification including the following:
 - .1 Flue gas thermometer.
 - .2 Thermometer and pressure gauge.

- .3 Water temperature control operator.
- .4 High limit safety control with manual reset.
- .5 Low water cutoff with manual reset. Manual reset should not be necessary after electrical power interruption. One normally open set of dry contacts for alarm signal to the EMCS.
- .6 ASME safety relief valve(s) to release entire boiler capacity.
- .7 Automatic gas valve operator.
- .8 Auxiliary safety shut-off valve.
- .9 Pilot solenoid valve.
- .10 Pilot ignition assembly.
- .11 Ignition transformer.
- .12 Main manual gas shut-off valve.
- .13 Pilot cock.
- .14 Pilot and main gas pressure regulators.
- .15 Air safety switch.
- .16 Electronic combustion safety control with UV sensor.

2.3 AUXILIARIES

- .1 Provide auxiliaries for each boiler and to meet ANSI/ASME requirements.
- .2 Hot water boilers:
 - .1 Pressure gauge: 90 mm diameter complete with shut-off cock.
 - .2 Thermometer: 115 mm diameter range 10 to 150 degrees C.
 - .3 Isolating gate valves: on supply and return connections.
 - .4 Drain valve: NPS 2.
 - .5 Stack thermometer: range 65 to 400 degrees C.
 - .6 Outdoor Air Temperature Sensor: to reset operating temperature controller.
 - .7 One 1 set of cleaning tools.
- .3 Pot type chemical feeder.

2.4 EMISSION CONTROL

- .1 Rate of discharge of air contaminants from boiler not to exceed:
 - .1 For nitrogen oxides expressed as nitrogen dioxide:
 - .1 22 ng/J of heat input when fired with gaseous fuel.
 - .2 For carbon monoxide, 125 ng/J of heat input.

2.5 OTHER REQUIREMENTS

- .1 Start Up Service – Hot Water Boilers:
 - .1 After boiler installation is completed, the manufacturer shall provide the services of a field representative for starting the unit and training the operator. A factory approved and authorized start-up report shall be submitted to the customer/user at the time of start-up.

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.
- .2 Make required piping and electric connections including any control wiring between boiler control panel and oil pump starter.
- .3 Pipe relief valves and air vent on hot water boilers to floor drain.
- .4 Do not deviate from required service and maintenance clearances.
- .5 Mount unit level.
- .6 Natural gas fired installation to CAN1-B149.1-05.
- .7 Manufacturers' representative to:
 - .8 Certify Installation.
 - .9 Provide start-up and burner adjustment service
 - .10 Carry out on-site performance verification tests.
 - .11 Provide maintenance and operating instructions.
 - .12 Test reports to be submitted for review and inclusion in maintenance manuals.

3.2 INSTALLATION

- .1 Install in accordance with ANSI/ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.
- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .4 Mount unit level using specified vibration isolation in Section 23 05 48 - Vibration and Seismic Controls.
- .5 Pipe hot water relief valves full size to nearest drain.

- .6 Pipe blowdown/drain to floor drain.
- .7 Natural gas fired installations - in accordance with CAN/CSA-B149.1.

3.3 MOUNTINGS AND ACCESSORIES

- .1 Safety valves and relief valves:
 - .1 Run separate discharge from each valve.
 - .2 Terminate discharge pipe as indicated.
 - .3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.

3.4 FIELD QUALITY CONTROL

- .1 Commissioning:
 - .1 Manufacturer to:
 - .1 Certify installation.
 - .2 Start up and commission installation.
 - .3 Carry out on-site performance verification tests.
 - .4 Demonstrate operation and maintenance.
 - .2 Provide Departmental Representative at least 24 hours' notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS & SUMMARY

- .1 The General Conditions, Supplements and Amendments shall govern this Section (read in conjunction with Instructions to Tenderers / Bidders). This section covers items common to all Electrical sections and is intended only to supplement the requirements of Division 01.
- .2 Reference to "Electrical Divisions" shall mean all sections of Division 26 in the Master Format or the Canadian Master Specifications.
- .3 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.
- .4 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.
- .5 The most stringent requirements of this and other electrical sections shall govern.
- .6 All work shall be in accordance with the project Drawings and Specifications and their intent complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .7 Provide seismic restraints for all required equipment and wiring systems.
- .8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories
- .9 Coordinate electrical commissioning scope with the Commissioning Manager (prime contractor) and the Owner's Commissioning Authority. Participate in commissioning activities as a proactive member of the project commissioning team. See Division 01 specifications for project commissioning definitions, acronyms, roles and responsibilities.

1.2 REFERENCES

- .1 Install in accordance with CSA C22.1 (current adopted edition) - except where specified otherwise.
- .2 Refer to CSA C22.1 Appendix A "Safety Standards for Electrical Equipment" for applicable codes and the related revisions
- .3 Refer to CSA C22.1 Pages xxix - xxxii for related 'Reference Publications'

- .4 Refer to NBCC Table 1.3.1.2 for applicable codes and the related revisions.
- .5 Comply with Local Electrical Bulletins and by-laws relating to the Authority having Jurisdiction.
- .6 Install overhead and underground systems in accordance with CSA C22.3 No.1 (current adopted edition) - except where specified otherwise.
- .7 Preferred Voltage Levels for AC Systems, 0-50,000V in accordance with CAN3-C235 (current adopted edition)
- .8 CSA Standard Z320 -2011 Building Commissioning

1.3 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235- current edition
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SUBMITTALS

- .1 Submittals to be in accordance with Division 01.
- .2 Product Data: submit WHMIS MSDS in accordance with Section 00 01 50 General Instructions.
- .3 Shop Drawings:
 - .1 Submit shop drawings, product data and samples in accordance with Division 01. The submission shall be reviewed, signed and processed as described in Division 01.
 - .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
 - .3 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.
 - .4 Content
 - .1 Shop drawings submitted title sheet.
 - .2 Data shall be specific and technical.

- .3 Identify each piece of equipment.
- .4 Information shall include all scheduled data.
- .5 Advertising literature will be rejected.
- .6 The project and equipment designations shall be identified on each document.
- .7 Information shall be given in metric units.
- .8 The shop drawings/product data shall include:
 - .1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weights and mounting point loads.
 - .2 Mounting arrangements.
 - .3 Detailed drawings of bases, supports and anchor bolts.
 - .4 Control explanation and internal wiring diagrams for packaged equipment.
 - .5 A written description of control sequences relating to the schematic diagrams.
- .4 Format
 - .1 PDF submitted via e-mail.
 - .2 Bill of Quantities for related components, identified by model number, listed on the front cover with item identification numbers.
- .5 Coordination
 - .1 Where electrical equipment requires support or backing by other trades or mechanical connections, the shop drawings shall also be circulated through the other "services" contractor(s) prior to submission to the Departmental Representative.
- .6 Keep one [1] copy of shop drawings and product data, on site, available for reference.
- .7 Quality Control: in accordance with Section 00 01 50 General Instructions.
 - .1 Provide CSA certified equipment and material. Where CSA certified equipment and/or material is not available, submit such equipment and/or material to the authority having jurisdiction for special approval before delivery to site.
 - .2 Submit test results of installed electrical systems and instrumentation.

- .3 Submit, upon completion of Work, the electrical “load balance” report.
- .8 Permits and Fees:
 - .1 Submit to Electrical Inspection Department, Local Fire Authorities and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain all required permits and pay all fees.
 - .2 Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 00 01 50 General Instructions.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial and/or Territorial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings: in accordance with Section 00 01 50 General Instructions.
 - .1 Site Meetings: as part of Manufacturer's Field Services: schedule site visits, to review Work, at stages listed below:
 - .1 At time of initial shop drawing submission to confirm any existing conditions and to coordinate with the project schedule and any cross discipline requirements.
 - .2 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
 - .3 During progress of Work at key schedule points as determined.
 - .4 At commissioning.
 - .5 Upon completion of Work, after cleaning is carried out.
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 4 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and/or recycling in accordance with Section 00 01 50 General Instructions.

1.8 SYSTEM START-UP

- .1 Refer to Division 01, and as follows.
- .2 Instruct Departmental Representative and operating personnel in the operation, care and maintenance of equipment.
- .3 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components, where required in these specifications.
- .4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 00 01 50 General Instructions.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.11 DRAWINGS AND MEASUREMENTS

- .1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural and Structural drawings.
- .2 Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Departmental Representative where definite locations are not indicated.
- .3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.
- .4 Where imperial units have been indicated in brackets [] following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.

1.12 PROJECT COORDINATION

- .1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Owner, without the Departmental Representative's written approval.
- .2 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.
- .3 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Departmental Representative and all affected parties.
- .4 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Departmental Representative of space problems before installing any material or equipment. Demonstrate to the Departmental Representative on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.13 SPRINKLER PROOF REQUIREMENTS

- .1 All equipment and wiring systems shall be sprinklerproof standard where sprinkler fire protection systems are installed.
- .2 New Panel C to be protected by non-combustible driphood to inhibit water ingress into electrical equipment. Exposed conduits connected to equipment to utilize watertight connectors. Top entry to be avoided where possible
- .3 In particular panel board shop drawings shall be certified 'sprinkler proof' design.

1.14 EQUIPMENT RESTRAINT

- .1 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

1.15 REUSED EQUIPMENT

- .1 Where existing equipment is being relocated and re-used, check and report on the condition to the Departmental Representative before reinstallation. Protect and carefully store equipment designated for reuse.

1.16 SEQUENCE OF WORK

- .1 Before interrupting major services notify the Departmental Representative well in advance and arrange an acceptable schedule for the interruptions.
- .2 Before interrupting any services complete all preparatory work as far as reasonably possible and have all necessary materials on site and prefabricated (where practical) and work continuously to keep the length of interruption to a minimum.
- .3 Include for the cost of all work that may be required out of regular hours to minimize the period of service interruption when modifying the existing systems.
- .4 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

1.17 BUILDING OPERATION DURING CONSTRUCTION

- .1 In order to minimize operational difficulties for the existing building staff, the various trades must cooperate with the owner throughout the entire construction period and particularly ensure that noise is minimized.
- .2 Convenient access for the staff and public to the building must be maintained at all times. Minor inconvenience and interruption of services will be tolerated, provided advance notice is given, but the Contractor will be expected to coordinate his work, in consultation with the owner, so

the operation of the facility can be maintained as nearly normal as possible.

1.18 EXISTING SERVICES

- .1 Protect all existing services encountered. Every effort has been made to show the known existing services. However, the removal of concealing surfaces may reveal other existing services. Work with the Departmental Representative staff to trace the originating source and points served. Obtain instructions from the Departmental Representative when existing services require relocation or modifications, other than those already indicated in the Contract Documents.
- .2 Arrange work to avoid shutdowns of existing services. Where shutdowns are unavoidable, obtain the Departmental Representative approval of the timing, and work to minimize any interruptions.
- .3 Shutdowns, to permit connections, to be coordinated with the maintenance staff.
- .4 In order to maintain existing services in operation, temporary relocations and wiring may be required.
- .5 Be responsible for any damages to existing systems by this work.
- .6 The interruption of utility services to permit tie-ins shall be arranged through the Departmental Representative. Application must be received in writing at least seven (7) calendar days prior to the date required for the shutdown. Service shutdowns shall only be carried out by Physical Plant and will normally be scheduled to occur during evenings or weekends. The Owner reserves the right to withhold permission for a reasonable period with respect to any shutdown, if the shutting-off of a service interferes with essential building operations.

1.19 SALVAGE

- .1 All conduit, wiring and equipment which becomes redundant and is no longer required due to the work in this Contract shall be completely removed.
- .2 All existing items which need to be removed, and which have a reasonable salvage value, shall be carefully removed and handed over to the Departmental Representative. Handing over to the Departmental Representative includes moving to Departmental Representative's designated storage place on site. These items shall not become the property of the Contractor. Obtain a written receipt from the Departmental Representative detailing each of the items handed over.
- .3 Remove all redundant material not required by the Departmental Representative from the site.

1.20 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01.
- .2 Take note of any extended warranties specified.
- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance.
- .4 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the warranty.

1.21 TENDER INQUIRIES

- .1 All contractor queries during the tender period shall be made in writing to the Departmental Representative. Contractor queries will be collected and suitable addenda will be issued for clarification. No verbal information will be considered valid or issued by the Departmental Representative's office during tender. All tender queries may be faxed, mailed or couriered to the Departmental Representative's office. No telephone questions will be answered.

1.22 EXAMINATION

- .1 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specification and the drawing, or in the drawing. Obtain written clarification from the Departmental Representative if work affecting the installation is not clear. Where this is not done in advance, allow in the tender sum for providing the more costly alternative.

1.23 RESPONSIBILITIES

- .1 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.
- .2 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Departmental Representative during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.
- .3 Protect equipment and material from the weather, moisture, dust and physical damage.
- .4 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Departmental Representative.

- .5 Protect all existing services encountered. Obtain instructions from the Departmental Representative when existing services require relocation or modification.
- .6 Refinish damaged or marred factory finish to factory finish.
- .7 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his trade to the approval of the Departmental Representative.

1.24 PROGRESS CLAIM AND CHANGEORDER BREAKDOWNS

- .1 Submit price breakdowns ten (10) days after the award of contract,
- .2 In particular cases more detail may be necessary to properly assess a change order or progress claims. This additional information could include all suppliers and all sub-contractors when requested by the Departmental Representative. Provide details for each section of the electrical work listed for each separate electrical change order item exceeding \$10,000.00.
- .3 Mark-up information is required for change orders but is optional on the original tender price.
- .4 Progress claims will not be certified nor payment made beyond 90% of the overall Electrical contract until commissioning and verification of the systems are complete. This procedure is to allow for any necessary deficiency holdbacks on items which do not become apparent until the systems are commissioned.

1.25 PROJECT CLOSE-OUT REQUIREMENTS

- .1 Refer to detailed specifications in each section for detailed requirements. Record drawings to be submitted to Departmental Representative and all life safety systems must be operational, verified and tested and demonstrated to Departmental Representative prior to issuance of Schedule C.

1.26 SUBSTANTIAL PERFORMANCE REQUIREMENTS

- .1 Before the Departmental Representative is requested to make an inspection for substantial performance of the work:
 - .1 Commission all systems and prove out all components, interlocks and safety devices.

- .2 Submit a letter certifying that all work is complete for the intended use, operational, clean and all required submissions have been completed.
- .3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
- .2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:
 - .1 All reported deficiencies have been corrected.
 - .2 Operating and Maintenance Manuals completed.
 - .3 "As Built" Record Drawing ready for review.
 - .4 Systems Commissioning has been completed and has been verified by Departmental Representative.
 - .5 All demonstrations to the owner have been completed.
- .3 Letters of Assurance will not be issued until the following requirements have been met:
 - .1 All items listed in .1 above have been completed or addressed.
 - .2 Certificate of Penetrations through separations.
 - .3 Provincial or City Electrical Inspection - Certificate of inspection.
 - .4 Seismic Engineer's letter of Assurance and final inspection report (As required).
 - .5 Certificate of Substantial Performance.
 - .6 Signed off copy of Departmental Representative's final inspection report.
 - .7 Fire alarm verification.

1.27 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS

- .1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.
- .2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of Division 26 (electrical) work have been met and verified.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Division 01 and as follows.
- .2 Material and equipment to be CSA certified. Where CSA certified material or equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.
- .3 Where equipment or materials are specified by technical description only, they are to be of the best commercial quality available for the intended purpose.
- .4 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Provide all power and control wiring, conduit, wire, fittings, disconnect switches, motor starters, for all mechanical equipment unless otherwise specified.
- .2 Ground all motors to conduit system with separate grounding conductor in flexible conduit or bonding conductor in the flexible conduit.
- .3 Connections shall be made with watertight flexible conduit with watertight connectors.
- .4 Control wiring and conduit standards are specified in the Electrical Divisions. Refer to Mechanical Divisions for scope of work and particular details.

2.3 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify all electrical equipment including but not limited to starters, disconnects, remote ballasts and controls with nameplates and labels as follows:
- .2 Nameplates:
 - .1 Lamicoid 3 mm [0.125"] thick plastic engraving sheet, white face, black core, self adhesive unless specified otherwise. Provide white face, red core for all essential distribution equipment.

.2 Nameplate Sizes:

| | | | |
|--------|-------------|---------|--------------------|
| Size 1 | 10 x 50 mm | 1 line | 3 mm high letters |
| Size 2 | 12 x 70 mm | 1 line | 5 mm high letters |
| Size 3 | 12 x 70 mm | 2 lines | 3 mm high letters |
| Size 4 | 20 x 90 mm | 1 line | 8 mm high letters |
| Size 5 | 20 x 90 mm | 2 lines | 5 mm high letters |
| Size 6 | 25 x 100 mm | 1 line | 12 mm high letters |
| Size 7 | 25 x 100 mm | 2 lines | 6 mm high letters |

.3 Typical Labelling:

.1 Panelboard & CDP – 5 lines

- .1 Line 1 – Panel/CDP designation – Size 4 lettering
- .2 Line 2 – eg 225A, 120/208V, 3 phase 4W – Size 2 lettering
- .3 Line 3 – Feeder: eg 4#3 – 35mm C – Size 2 lettering
- .4 Line 4 – Origin eg: Main Elect. Room – Size 2 lettering

.2 Distribution Circuit Breakers – 4 lines

- .1 Line 1 – Main Circuit Breaker – Size 4 lettering
- .2 Line 2 – Feeder: eg 4#3 – Size 2 lettering
- .3 Line 3 – Origin: eg K1 Sub-station – Size 2 lettering

.3 Label colours unless otherwise indicated:

- .1 120/208V labels: white letters on black base.
- .2 347/600V labels: Black letters on white base.

.4 Wording on nameplates to be approved prior to manufacture.

.5 Allow for average of twenty-five (25) letters per nameplate.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

.8 Transformers: indicate capacity, primary and secondary voltages.

- .3 Labels:
 - .1 Identify each outlet, starter, disconnect and all items of fixed equipment with the appropriate panel and circuit number origin by means of a small but good quality vinyl, self-laminating label such as T & B E-Z Code WSL, Dymo Letratag or Brother P-Touch equivalent printable markers. Embossed Dymo or any labels with edges and corners that are prone to lift will be rejected. Confirm location of labels with Departmental Representative before installing. Circuit numbers to agree with Record Drawings.
- .4 Provide plastic covered panel directory with circuits and areas served typed in, and mounted on inside of door. Directory to conform to Record Drawings.

2.5 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.6 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

- .1 Colour code conduits, metallic sheathed cables, pullboxes and junction boxes.
- .2 Code with 25 mm plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor and at 15 m intervals.
- .3 Colour coding to be as follows unless otherwise specified:

| SYSTEM | MAJOR BAND | MINOR BAND | CHARACTERS |
|------------------|-------------|------------|------------|
| 347/600V Normal | Dark Blue | | |
| 120/208V Normal | Light Blue | | |
| Ground | Dark Green | | GR |
| Fire Alarm | Red | | FA |
| Emg Voice Paging | Red | Dark Green | EP |
| Computer/Data | Light Green | | COM |
| Telephone | Light Green | Black | TEL |
| General Intercom | Light Green | Yellow | IC |

| SYSTEM | MAJOR BAND | MINOR BAND | CHARACTERS |
|---------------------|-------------|------------|------------|
| Low Level Paging | Light Green | White | PA |
| Building Alarm | Purple | White | BA |
| BAS (Digital) | White | Green | BCD |
| BAS (110V) | White | Black | BCH |
| BAS (LV) | White | Blue | BCL |
| PLC (Digital) | White | Brown | PLC |
| Low Voltage Control | White | Yellow | LVC |

2.7 FINISHES

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside and at least two coats of finish enamel.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original finish.
- .3 Clean and prime paint exposed hangers, racks, fastenings to prevent rusting. Finish painting shall be provided by Division 09.
- .4 Paint outdoor electrical equipment "equipment green" finish.
- .5 Paint indoor switchgear and distribution enclosures light gray unless otherwise indicated in particular specification sections for specialised or emergency power equipment.

2.8 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other Divisions.

2.9 FASTENING TO BUILDING STRUCTURE

- .1 General:
 - .1 Do not use inserts in base material with a compressive strength less than 13.79 MPa [2000 psi] [refer to structural drawings].
 - .2 All inserts supporting conduit racks shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.
- .2 Types:
 - .1 Cast-in-place type:
 - .1 Channel type - Burndy, Canadian Strut, Unistrut, Cantruss or Hilti Channel, or equivalent.
 - .2 Wedge type galvanized steel concrete insert, Grinnell Fig. 281 for up to 200 mm [8"] pipe size.

- .3 Universal type malleable iron body insert, Grinnell Fig. 282 for up to 200 mm [8"] pipe size.
- .2 Drilled, mechanical expansion type:
 - .1 Hilti HSL or UCAN LHL, or equivalent heavy duty anchor for use in concrete with compressive strength not less than 19.6 MPa [2840 psi].
 - .2 Hilti Kwik-Bolt or UCAN WED, or equivalent stud anchor for concrete. (Do not use in seismic restraint applications).
 - .3 Hilti HDI or UCAN IPA, or equivalent drop-in anchor for concrete.
 - .4 Hilti or UCAN Sleeve Anchor, or equivalent. (medium and light duty) for concrete and masonry.
 - .5 Hilti ZBP or UCAN Zamac, or equivalent pin bolt (light duty) for concrete and masonry.
- .3 Drilled, adhesive type:
 - .1 Hilti HVA or UCAN, or equivalent Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.
 - .2 Hilti HY150 or equivalent consisting of anchor rod with a 2 part adhesive system.
 - .3 For use in concrete housekeeping bases (in vertical downward position) where the distance to the edge of the concrete base could cause weakness if a mechanical expansion type anchor were used.
 - .4 Rod assemblies shall extend a minimum of 50 mm [2"] into the concrete slab below the housekeeping bases.
- .3 Note:
 - .1 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.
 - .2 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.
 - .3 Where specifically called for, drills shall include a dust vacuum system, Hilti SAV Dust Vacuum System; or equivalent.

2.10 EQUIPMENT SUPPORTS

- .1 Provide stands and supports for equipment and materials supplied.

- .2 Lay out concrete bases and curbs required under Electrical Divisions. Coordinate with Concrete Divisions.
- .3 Concrete bases shall be a minimum of 100 mm [4"] thick, or as noted and shall project at least 150 mm [6"] outside the equipment base, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.
- .4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25mm [1"] above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout - Embeco or In-Pakt; or equivalent.
- .5 Construct equipment supports of structural steel. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.
- .6 Support ceiling hung equipment with rod hangers and/or structural steel.

2.11 MISCELLANEOUS METAL

- .1 Be responsible for all miscellaneous steel work relative to Electrical Divisions of the Specifications, including but not limited to:
 - .1 Support of equipment.
 - .2 Hanging, support, anchoring, guiding and relative work as it applies to wiring raceways and electrical equipment.
 - .3 Earthquake restraint devices - refer also to "Seismic Restraint" sections
 - .4 Bridle rings - secure to structure or steel supports.
- .2 All steel work shall be primed and undercoat painted ready for finish under the related Division.

2.12 MAINTENANCE MATERIALS AND CABINET

- .1 Provide maintenance materials in accordance with Division 01 and specified in appropriate Sections.

2.13 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into maintenance manual specified in Division 01 and as follows.
- .2 Include in operations and maintenance data:
 - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

- .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
- .3 Wiring and schematic diagrams.
- .4 Names and addresses of local suppliers for items included in maintenance manuals.
- .3 Include in the manual the following major sections:
 - .1 Title page (in plastic cover).
 - .2 Comprehensive description of the operation of the systems, including the function of each item of equipment within the system.
 - .3 Detailed instructions for the normal maintenance of all systems and equipment installed including procedures and frequency of operational checks and service and troubleshooting instructions.
 - .4 Local source of supply for each item of equipment.
 - .5 Wiring and control diagrams.
- .4 The manual information shall be bound in a three "D-ring" hard back reinforced vinyl covered ("bar lock" post type where more than 50mm [2"] rings required) binder c/w index tab separators to divide the different sections. The binder cover shall be black with white lettering. Printing of the binder cover shall be completed before the binder is manufactured and the wording shall be approved by the Departmental Representative before printing.
- .5 Submit a draft copy to the Departmental Representative for review thirty (30) days prior to start up of the systems and equipment.
- .6 Submit three (3) copies in the final approved form.

2.14 PROJECT RECORD DRAWINGS

- .1 Provide project record documents as specified in Division 01 as further called for in this Division.
- .2 During the construction period, keep on Site a clean set of drawings marked up to reflect the "As-Built" state, for examination by the Departmental Representative on a regular basis. Include elevations and detailed locations of buried services, empty conduit systems and junction and pull boxes.
- .3 At the time of "substantial performance" CAD files will be provided by the Departmental Representative. The Electrical Division shall include all associated costs to obtain and complete the CAD Record Drawings including retaining the services of an approved CAD draftsman to transfer all changes to amend the CAD files in the latest version of AutoCAD. Include all revisions and change orders.

- .4 Submit the "Record Drawing" CAD files and one set of plots to the Departmental Representative prior to Total Performance of the contract.
- .5 Note: The Contractor will be required to sign a standard Stantec / Contractor agreement entitled "Authorization to Use CAD drawing files". The agreement restricts the use of the CAD files to the purpose of "as-built" only and determines the editing procedures.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturers nameplates and CSA labels to be visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit and protruding 50 mm [2"].
- .2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .3 Install roof jacks where conduit and cables penetrate roofs. Apply sealant after installation.
- .4 All cables and conduits to be installed concealed in finished areas.

3.4 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to the required values and settings to provide a fully coordinated system.

3.5 FIELD QUALITY CONTROL

- .1 Load and Balance:
 - .1 Measure voltage and phase & neutral currents to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .2 Conduct and pay for the following tests:
 - .1 Circuits originating from branch distribution panels.

- .2 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .3 Systems: fire alarm system for all affected devices.
- .4 Main ground resistance (at all grounding locations).
- .5 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.
 - .2 Furnish manufacturer's certificate or letter conforming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
 - .3 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .4 Schedule site visits to review Work.
- .5 Reports:
 - .1 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

3.6 CLEANING

- .1 Do final cleaning in accordance with Division 01.
- .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.
- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .4 Clean and prime paint exposed non-galvanised hangers, racks, fastenings to prevent rusting. Coordinate finish painting with Division 09.

3.7 WORKMANSHIP

- .1 Workmanship shall be in accordance with well established practice and standards accepted and recognized by the Departmental Representative and the Trade.
- .2 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.
- .3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

3.8 PROTECTION OF WORK

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.
- .2 Mask machined surfaces. Secure covers over equipment openings and open ends of equipment and conduit, as the installation work progresses.
- .3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finish.

3.9 PROTECTION OF ELECTRICAL EQUIPMENT

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts, e.g. "LIVE 120 VOLTS".
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

3.10 CONCEALMENT

- .1 Conceal wiring and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.
- .2 Do not install wiring and conduit on outside walls or on roofs unless specifically directed.

3.11 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

- .1 All cabling, wiring, conduits, cable trays, etc. passing through rated fire separations shall be smoke and fire stopped to a ULC or cUL tested assembly system, in accordance with CAN4-S115-95, that meets the requirements of the Building code in effect.

- .2 Fire resistance rating of installed firestopping assembly shall not be less than fire resistance rating of surrounding assembly indicated on Architectural drawings. Where this is not indicated assume a minimum of one hour for walls and two hours for floors.
- .3 Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions. The Applicator shall be approved, licensed and supervised by the manufacturer in the installation of firestopping and are to follow the requirements of a rated system as detailed above.
- .4 Contractors are expected to submit system information detailing firestopping product, backing, penetrant, penetrated assembly, Fire (F) and Temperature (T) rating, and ULC or cUL system number.
- .5 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be repenetrated.
- .6 Allow openings for 100% capacity of raceway or 200% capacity of J-hooks.
- .7 Provide split systems where existing cables are involved.
- .8 Provide Firestopping approval certificate in including a Building Code / By-Law Schedule B-1, B-2 & C-B signed by a BC registered Professional Engineer. Submit a letter certifying that all work is complete and in accordance with this specification.

3.12 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

- .1 All cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.13 CONDUIT SLEEVES

- .1 Provide conduit sleeves for all conduit and wiring passing through rated walls and floors. Sleeves to be concentric with conduit or wiring.
- .2 Except as otherwise noted conduit sleeves are not required for holes formed or cored in interior concrete walls or floors.
- .3 Conduit sleeves shall extend 50 mm [2"] above floors in unfinished areas and wet areas and 6 mm [1/4"] above floors in finished areas.
- .4 Conduit sleeves shall extend 25 mm [1"] on each side of walls in unfinished areas and 6 mm [1/4"] in finished areas.
- .5 Conduit sleeves shall extend 25mm [1"] beyond exterior face of building. Caulk with flexible caulking compound.

- .6 Sleeve Size: 12 mm [1/2"] clearance all around, between sleeve and conduit or wiring.
- .7 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- .8 Packing of Sleeves:
 - .1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and conduit shall be caulked with waterproof fire retardant non-hardening mastic.
 - .2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.14 ACCESSIBILITY AND ACCESS PANELS

- .1 Install all equipment, controls and junction boxes so as to be readily accessible for future modification, adjustment, operation and maintenance as appropriate.
- .2 Provide access panels where required in building surfaces. Do not locate access panels in panelled or special finish walls, without prior approval of the Departmental Representative.
- .3 Access panels in U.L.C. fire separations and fire walls shall have a compatible fire rating and U.L.C. label. Acquire approval in writing from the local fire authority if required.
- .4 Access panels shall be painted with a primer coat if applicable and then with a finish coat, colour and type to the Departmental Representative's approval.
- .5 Locate equipment and junction boxes in service areas wherever possible.

3.15 EQUIPMENT INSTALLATION

- .1 Provide means of access for servicing equipment.
- .2 CSA identification and equipment labels to be clearly visible after installation.

3.16 CUTTING, PATCHING, DIGGING, CANNING , CORING & CONCRETE

- .1 Lay out all cutting, patching, digging, canning and coring required to accommodate the electrical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.
- .2 Be responsible for all cutting, patching, digging, canning and coring required to accommodate the electrical services.
- .3 Be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.

- .4 Verify the location of existing and planned service runs and structural components within concrete floor and walls prior to core drilling and/or cutting. Repairs to existing services and structural components damaged as a result of core drilling and cutting is included in this section of the work.
- .5 Openings through structural members of the building shall not be made without the approval of the Structural Engineer.
- .6 Openings in Concrete:
 - .1 Be responsible for the layout of all openings in concrete, where openings are not left ready under previous contract.
 - .2 All openings shall be core drilled or diamond saw cut.
 - .3 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.
 - .4 Refer to structural drawings for locations of steel reinforcing.
 - .5 Be responsible for repairing any damage to steel reinforcing.
- .7 Openings in building surfaces other than concrete:
 - .1 Lay out all openings required.
- .8 Poured concrete for duct encasements, pole bases, transformer pads and housekeeping pads shall be provided by other Divisions, coordinated and supervised by the Electrical Divisions.
- .9 Precast concrete items such as transformer pad bases, pull boxes and light pole bases to be provided and installed by the Electrical Divisions unless otherwise specified.
- .10 Excavation and backfilling will be provided by other Divisions. This Division to superintend the work and provide all layouts and parameters.

3.17 PAINTING

- .1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .2 Paint all hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.
- .3 Repaint all marred factory finished equipment supplied under the Electrical Divisions, to match the original factory finish.
- .4 Coordinate with Division 09.

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 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with Section 00 01 50 General Instructions.
- .2 Do verification requirements in accordance with Section 00 01 50 General Instructions.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4 PCB (POLYCHLORINATED BIPHENYLS)

- .1 Carefully remove any electrical items containing PCB's (eg light fixture ballasts) from equipment or fixtures to be renovated or demolished. Removed items (containing PCB's) to be catalogued and stored on site in approved labelled storage containers in accordance with regulations.

1.5 SCOPE

- .1 The Electrical Division to take note that the demolition and renovation will be done in an occupied building that is normally occupied during the day. Maintain electrical and communication systems as required to minimize services disruption.
- .2 The Electrical Division to also take note of the dust containment requirements as outlined in the architectural and front end specification.
- .3 Electrical tender documents do not show all existing luminaires, wiring devices, conduit, boxes or wire. Conduit routing and wire grouping is not known. During demolition, the Electrical trade(s) are to deactivate all existing electrical and communication systems affected in such a manner that complete systems are not deactivated and system circuits affected in party wall partitions to be reactivated immediately on a temporary or permanent basis as site conditions dictate.
- .4 Any discrepancies appearing on the drawings or in this specification are to be brought to the attention of the Departmental Representative who will provide instruction.

- .5 Where devices are not shown on the new plans in walls that are not being removed, such devices are to be reinstated and remain.

1.6 SCHEDULING

- .1 Refer to Prime Consultant divisions.

1.7 EXAMINATION

- .1 Refer to Prime Consultant divisions.

1.8 PHASING

- .1 Refer to Prime Consultant divisions.

1.9 PROTECTION

- .1 Refer to Prime Consultant divisions.

Part 2 Products

2.1 STANDARDS

- .1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

Part 3 EXECUTION

3.1 DEMOLITION

- .1 Demolition to be carried out in strict conformance to provincial, local and municipal authorities and Part 8 of the B.C. Building Code current edition.
- .2 All redundant electrical components in the areas of demolition excluding those specifically identified in the following clauses shall become the property of the Electrical Division and shall be removed from site.

3.2 DISRUPTION TO OPERATIONS

- .1 Contractor to issue a scheduled shutdown time and coordinate installation of the new equipment as appropriate. All equipment installed and modified requires testing before start-up.
- .2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment.

3.3 REUSE OF EXISTING COMPONENTS

- .1 Existing components may be reused only where so specifically indicated on the drawings or in the specifications, however in all cases all wiring shall be new and no splicing shall be permitted at any location.

3.4 DISTRIBUTION OF CIRCUITS

- .1 Circuit: power, voice/data, fire alarm, control etc. which are disrupted during demolition and are essential, to be made good immediately. The Electrical Trade(s) to identify these circuits to the Departmental

Representative. Specific tasks involving the demolition of essential circuits will require that the contractor to obtain permission from the Owner before proceeding.

3.5 ABANDONED CONDUIT, WIRE AND EXISTING CIRCUITS

- .1 All abandoned conduit and wire to be removed and disposed of by the Electrical Divisions.
- .2 Remove all accessible (eg. Surface) wiring and cables back to source.
- .3 Remove abandoned outlets and raceway, even if in or behind drywall, where they are located behind millwork or in locations unsuitable for reuse i.e. not at standard heights for switches or outlets.
- .4 All remaining circuits to be rerouted as required and suitably secured to the building structure.
- .5 Any cabling, including voice/data wiring, presently resting on any suspended ceiling system to be removed as part of the renovation process and shall be neatly bundled, protected and permanently secured to building structure. No cabling is permitted to rest on the ceiling system.

3.6 EXCAVATION AND CUTTING DAMAGE

- .1 Circuits disrupted by floor cutting or drilling (ie. buried cables) to be brought to the attention of the Departmental Representative. Obvious systems disturbed because due care and attention was not followed, shall be repaired immediately at no additional cost to owner.

3.7 FIRE ALARM SYSTEM

- .1 Construction/demolition activities in existing building may require that certain fire alarm devices are protected from construction dust, damage etc. Coordinate with the Departmental Representative as required to protect components of the fire alarm system to prevent nuisance operation and alarms.
- .2 Provide, install and test temporary heat detectors in the area of construction where the construction area is not protected by an active supervised fire protection sprinkler system. The "construction" detectors to be removed and discarded at the end of the project.
- .3 Provide temporary replacement of smoke detectors with heat detectors including interim programming and testing and final re-verification to minimize false alarms and to ensure other occupants of the building are protected.
- .4 Maintain existing fire alarm system in areas under construction where practical. Relocate, rewire and provide interim connections as required while installing the new system to replace the existing. Provide temporary

fire alarm devices and audible signals to suit any temporary EXITing provisions.

- .5 Contractor to check in with the Departmental Representative at the start and end of each working day to confirm the fire alarm status in the area of work. Arrange for the related fire alarm zone card or area to be deactivated either to suit the progress of the work and/or where dust will be present on a day to day basis. Bag and protect fire detectors in dusty areas during construction. Remove any bagging at the end of the work day. Any existing detectors subject to construction dust to be immediately vacuumed and marked to be replaced at the end of the project. Any fire alarm devices subject to moisture to be replaced immediately.
- .6 The fire alarm system is to be fully functional in the area of construction when the contractor is neither on site nor after the contractors normal work hours. (ie overnight, holidays, weekends)

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 TERMS OF REFERENCE

- .1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated. Refer to "Site Services" Section for allowable site conduits as an alternative to steel.
- .2 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 system volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 1000 volt having a PVC jacket with FT-4 flame spread rating. Tech cable may be used for exterior condensing unit feeders, cables to be routed using existing pathways where possible.
- .3 Flexible armoured cabling (BX) shall not be used for the general wiring system other than final drops to recessed light fixtures in concealed locations.
- .4 Provide all control wiring except HVAC controls as specified in Mechanical Divisions.
- .5 Refer to Mechanical Schedule(s) for detailed responsibilities.
- .6 Non-metallic sheathed wiring is not to be used on this project.

1.3 PRODUCT DATA

- .1 Provide product data in accordance with Division 01.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

Part 2 Products

2.1 WIRING & CABLES – GENERAL

- .1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.
- .2 Insulation to be 600 volt RW90XLPE (X link) for the general building wiring in conduit.

- .3 Use RWU90XLPE for underground installations.
- .4 Armoured (BX) cable may only be utilized for recessed tee bar luminaire drops from ceiling mounted outlet boxes. "Tite Bite" connectors and their counterparts of other manufacturers shall not be used. Use anti-short connectors. Cable from luminaire to luminaire is discouraged. Allow nominally 900mm [3'] extra cable looped and supported in the ceiling space to permit fixture relocations of one tile space.
- .5 Conductors to be colour-coded. Conductors No.10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 gauge and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a minimum of 50 mm at terminations, junctions and pullboxes and conduit fittings. Conductors not to be painted.

2.2 TECK 90 CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors: copper and sized as indicated.
- .3 Insulation: Chemically cross-linked thermosetting polyethylene rated type RW90XLPE,600V
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: flat galvanized steel.
- .6 Overall covering: PVC jacket with FT-4 flame spread rating. PVC flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.
- .7 Fastenings:
 - .1 One (1) hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two (2) or more cables.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors: Watertight approved for TECK cable

2.3 ARMoured CABLE (BX)

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90 600 V rated.
- .3 Armour: interlocking type fabricated from galvanized steel.
- .4 Anti-short connectors.

2.4 ALUMINUM SHEATHED CABLE

- .1 Conductors: insulated copper, size as indicated.
- .2 Insulation: type RA90 rated 600 V.
- .3 Sheath: aluminum applied to form continuous smooth or corrugated seamless sheath.
- .4 Outer jacket of PVC applied over sheath for direct burial and wet locations.
- .5 Fastenings for aluminum sheathed cable:
 - .1 One hole aluminum straps to secure surface cables 25 mm and smaller. Two hole steel straps for cables larger than 25 mm. Use aluminum strap only with single conductor cable.
 - .2 Channel type supports for two or more cables.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.

2.5 LOW VOLTAGE CONTROL CABLES

- .1 Type LVT: soft annealed copper conductors, with thermoplastic insulation, outer covering of thermoplastic jacket. Minimum size #18 AWG.
- .2 Unless otherwise specified wiring to be multicore individually identified and colour coded with grey sheath enclosed in conduit or (EMT).

2.6 WIRE & BOX CONNECTORS

- .1 Pressure type wire connector current carrying parts to be copper and sized to fit conductors used.
- .2 Fixture type splicing connector current carrying parts to be copper sized to fit conductors 10 AWG or less.
- .3 Bushing stud connectors to EEMAC 1Y-2 and suitable for stranded copper conductors
- .4 Clamps or connectors for armoured cable, flexible conduit, as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Install all cables and wiring.
- .2 Conductor length for parallel feeders to be identical. Provide permanent plastic nametag indicating load fed.
- .3 Group Teck, Armoured, MI & Sheathed cables on channels wherever possible.
- .4 Lace or clip groups of feeder conductors at all distribution centres, pullboxes, and termination points.

- .5 Wiring in walls should typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls should be avoided unless indicated.
- .6 All grounding conductors and straps to be copper. All bonding conductors to have green insulation jacket.
- .7 Colour coding to be strictly in accordance with Section 16010 [26 05 00].
- .8 Provide sleeves where cables enter or exit cast concrete or masonry.
- .9 Power wiring up to and including No.6 gauge shall be spliced with nylon-insulated expandable spring-type connectors. Large conductors shall be spliced using split-bolt or other compression type connectors wrapped with cambric tape then PVC tape.
- .10 Wires shall be sized for 2% maximum voltage drop to farthest outlet on a loaded circuit. Increase home run cable size to meet these requirements.
- .11 All branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .12 Install all control cables in conduit.
- .13 Provide numbered wire collars for all control wiring. Numbers to correspond to control drawing legend. Obtain wiring diagram for control wiring of other Divisions.

3.2 VOLTAGE REGULATION

- .1 The drawings are diagrammatic and indicate the general routing of conduit runs and not exact routing, either horizontally or vertically.
- .2 Branch circuit conductor sizes shall be #12 AWG or larger based on the Canadian Electrical Code CSA 22.1 Section 8, which allows a maximum 3% voltage drop for branch circuits.

3.3 WIRE & BOX CONNECTORS

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65
 - .2 Install fixture type connectors and tighten. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
- .2 Transformer grounding shall comply with CSA C22.2 No.41.
- .3 All grounding conductors to be stranded soft annealed copper unless otherwise noted.
- .4 Install complete grounding and bonding system in accordance with Canadian Electrical Code and local inspection authority requirements.

1.4 TESTING REQUIREMENTS

- .1 Perform ground continuity and resistance tests using method appropriate to site conditions.
- .2 Any third party testing agency costs for the testing and reporting shall be included in the Electrical Division base tender and shall be carried out by a pre-approved testing agency.

1.5 ADDITIONAL SCOPE

- .1 Refer to drawings for extent of grounding in addition to code requirements.

Part 2 Products

2.1 MATERIALS

- .1 Grounding equipment to: CSA C22.2 No.41.

2.2 EQUIPMENT

- .1 Clamps for grounding of conductor, size as required.
- .2 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified or required to be green.

2.3 INSTALLATION GENERAL

- .1 Expand existing complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories to suit new equipment.
- .2 Provide ground wire in EMT conduits installed in grade or below slabs.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit. Provide a ground conductor in all flexible conduit and secure to system grounding lugs at both the equipment and source.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.
- .11 Provide a bonding conductor appropriately sized within each raceway routed within the building.
- .12 All bonding and grounding connections to be compression type unless noted otherwise.
- .13 Expand existing system as required to provide complete grounding and bonding system as indicated and as required by Canadian Electrical Code and the local electrical inspection authorities.
- .14 All components shall be securely and adequately bonded and where required to accomplish this, bonding jumpers, grounding studs and bushings shall be used.
- .15 Ensure that all raceways, terminal panels, etc. for fire alarm, etc. are securely and adequately bonded and provide grounding conductor to main ground bus where called for or when required.
- .16 All interior metallic gas piping which may become energized to be made electrically continuous and to be bonded in accordance with requirements of Canadian Electrical Code.

- .17 Bond all low tension equipment with #6 AWG bonding conductor.
- .18 All metallic conduits longer than 1m in length, containing a single grounding or bonding conductor, shall be bonded as per the Canadian Electrical Code.

2.4 EQUIPMENT GROUNDING OR BONDING

- .1 Install grounding or bonding connections to typical equipment included in, but not necessarily limited to following list. Switchgear, duct systems, frames of motors, starters, control panels and distribution panels.

2.5 MECHANICAL EQUIPMENT GROUNDING

- .1 Provide a #6 ground conductor from the mechanical room ground bus to each VFD
- .2 Ground wires to be installed in all conduit serving motor feeder circuits and to extend to ground screws on junction and outlet boxes for bonding.

2.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions.
- .3 Carry out all tests required by the Electrical Inspection Authority and provide all required reports and copied to the Departmental Representative. Include all associated costs.
- .4 Ensure test results are satisfactory before energizing the electrical system.

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCES

- .1 All conduits and accessories to be manufactured and certified by the related CSA standard.

1.4 SCOPE

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- .2 Conceal all conduits where possible in finished areas. Conduits may be surface mounted either only where indicated or in service areas accessible only to authorized personnel.
- .3 If a finished area is concrete (existing) or concealment is not practical, obtain ruling from Departmental Representative where exposed wiremold may be substituted.
- .4 Note particular requirements for routing of conduits where detailed.
- .5 Provide polypropylene pull cord in all "empty" conduits.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.
- .2 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 41mm [1.5"] and smaller. Use two hole steel straps to conduits larger than 41mm [1.5"].
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 10mm [3/8"] threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings manufactured for use with conduits specified. Coating same as conduit.
- .2 Provide factory "ells" where 90 degree bends are required for 27mm [1"] and larger conduits.
- .3 EMT couplings and connectors shall be steel, or Regal Die-cast zinc alloy. Couplings used on conduit containing fire-rated cable shall be steel. Regular die-cast alloy fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all connectors unless there is no chance of burrs. Provide water-tight connectors in damp or wet locations and for surface equipment (e.g. Panelboards, MCC's, etc) in rooms that are fire sprinkler protected.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable linear expansion.
- .2 Water-tight expansion fittings: with integral bonding jumper, suitable for linear expansion and 21mm [3/4"] deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

2.5 RIGID P.V.C. CONDUIT

- .1 Conduit: rigid non-metallic conduit of un-plasticized polyvinyl chloride as manufactured C.G.E. "Sceptre" or equal.
- .2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied by conduit manufacturer.
- .3 Solvent: as recommended by conduit manufacturer.

2.6 OUTLET AND CONDUIT BOXES IN GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm [4"] square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped. Do not use sectional boxes.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347V outlet boxes for 347V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.
- .7 Bushing and connectors with nylon insulated throats.
- .8 Knock-out fillers to prevent entry of foreign materials.

- .9 Conduit outlet bodies for conduit up to 35 mm[1.25"]. Use pull boxes for larger conduits.
- .10 Double locknuts and insulated bushings on sheet metal boxes.

2.7 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm [3" x 2" x 1.5"] or as indicated. Larger 102 mm square x 54mm deep [4"x 2"] outlet boxes (No. 52151 or 52171) to be used when more than one conduit enters one side. Provide extension and plaster rings as required.
- .2 For larger boxes use GSB solid type as required.
- .3 Boxes for surface mounted switches, receptacles, communications, telephone to be 100mm square No. 52151 or 52171 with Taylor 8300 series covers; or equivalent.
- .4 Lighting fixture outlets: 102 mm [4"] square outlet boxes (No 52151, 52171 or 72171) or octagonal outlet boxes (No 54151 or 54171).
- .5 102 mm [4"] square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

2.8 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

Part 3 Execution

3.1 CONDUIT - GENERAL

- .1 Generally use electrical metallic tubing (EMT) in the building interior and in above grade slabs except where subject to mechanical injury or where otherwise indicated.
- .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Set out the work and coordinate with other services prior to installation. Maintain access to junction and pull boxes.
- .3 Where practical conceal conduits.
- .4 Any conduit exposed in finished areas to be free of unnecessary labels and trade marks.
- .5 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.
- .6 Ensure grounding continuity in all conduit systems.
- .7 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.

- .8 Use rigid galvanized steel (RGS) threaded conduit where the installation is subject to mechanical injury. In any event, use RGS conduit for surface installations up to 1.5m [5'] above the finished floor.
- .9 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.
- .10 Unless otherwise noted and where practical, all conduits to be routed through the ceiling space rather than in, or below, slabs or floor structures to facilitate future changes.
- .11 Conduits in walls should typically drop (or loop) vertically from above to better facilitate future renovations. Generally conduits from below and horizontal conduits in walls and concrete structures should be avoided unless indicated.
- .12 All branch circuit conduit, home-runs and communication/data conduits to be minimum 21 mm [3/4"] diameter unless otherwise indicated.
- .13 Generally use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: eg where conduits emerge from ground level slab.
- .14 Conduits are not permitted in terrazo or concrete toppings.
- .15 Cap turned up conduits to prevent the entrance of dirt or moisture during construction.
- .16 Locate conduits more than 75mm [3"] parallel to steam or hot water lines with a minimum of 25mm [1"] at crossovers.
- .17 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Conduits bent more than this or kinked to be replaced.
- .18 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.
- .19 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.
- .20 Damaged conduits to be repaired or replaced.
- .21 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.
- .22 Conduits shall not pass through structural members except as indicated.
- .23 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types or to comply with Code.
- .24 Conduits and ducts crossing building expansion joints shall have approved conduit expansion fittings to suit the type of conduit used.
- .25 Seal conduits with approved sealant where conduits are run between heated and unheated areas.

- .26 Seal openings with approved sealant where conduits, cables, or cable trays pierce fire separations.
- .27 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits are installed, wall openings shall be closed with material compatible with the wall construction and/or to meet any fire separation integrity.
- .28 Where drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels, or equivalent.
- .29 Use "Condulet" fittings for power and telephone type conduit terminations in lieu of standard boxes where box support is not provided.
- .30 Provide necessary roof jacks or flashing where conduits pass through roof or watertight membranes. Apply approved sealant to maintain membrane integrity.
- .31 Use liquid tight flexible metal conduit for connection to motors, and other vibrating equipment and transformers.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with minimum 1.5m [5'] clearance.
- .3 Conduits to be run in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended and/or surface channels.
- .5 Surface conduits will not be accepted in finished areas unless detailed.

3.3 SURFACE RACEWAYS

- .1 Where practical provide regularly spaced device outlets and factory pre-cut raceway covers and cover plates. Field install outlets where factory installation is not possible due to delivery issues or irregularly spaced outlet requirement. In this event covers may be field cut with proprietary factory cover shear equipment with sharp blades.
- .2 Raceways shall be free of burrs inside and out.
- .3 Covers to be matching colour, smooth, free of burrs and parallel with no gaps.
- .4 Preserve and organize the space within the wireway to facilitate multiple wiring runs and future additions. In finished areas and where practical, conduit to feed the surface raceway from a box recessed behind and via grommetted openings to the back of the surface raceway. Maintain pullbox access as required by the Canadian Electrical Code.

3.4 BOXES INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Ceiling outlet boxes to be provided for each surface mounted fixture or row of fixtures installed in other than T bar ceilings with removable tiles.
- .3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material. Remove upon completion of work.
- .4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm [0.25"] of opening.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not to be used.
- .6 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.
- .7 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.
- .8 No sectional or handy boxes to be installed.
- .9 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain integrity of the vapour barrier and insulation to prevent condensation through boxes.
- .10 Coordinate location and mounting heights of outlets above counters, benches, splash-backs and with respect to heating units and plumbing fixtures. Coordinate with architectural details.
- .11 Outlets installed back to back in party stud walls to be off-set by one stud space.
- .12 Refer to wiring device and communication specification sections and to architectural layouts for mounting heights of outlet boxes.
- .13 Separate outlets located immediately alongside one another to be mounted at exactly the same height above finished floor. Similarly, outlets mounted on a wall in the same general location at varying heights to be on the same vertical centre-line unless otherwise noted.
- .14 Where outlet boxes penetrate through a fire separation, ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire.

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 PLANT ASSEMBLY

- .1 Install circuit breakers in panelboards before shipment from plant.
- .2 Install and prewire low voltage relays assemblies where indicated.
- .3 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .4 New Panelboard to be square D

Part 2 Products

2.1 PANELBOARDS, DOORS AND TRIMS

- .1 Panelboards: to CSA C22.2 No. 29 and product of one manufacturer.
- .2 Bus and breakers rated for 10 KA symmetrical, minimum, interrupting capacity or as indicated.
- .3 Tin plated aluminum bus with full size neutral.
- .4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number.
- .5 Mains, number of circuits and number and size of branch circuit breakers as indicated.
- .6 Provide all necessary connectors and mounting hardware in every space to facilitate installation of future breakers. Provide blank fillers for all spaces.
- .7 Concealed hinges and concealed trim mounting screws, hinged locking door with flush catch.
- .8 Panelboards to have flush doors. (Gasketed where required).
- .9 Provide two keys for each panelboard and key similar voltage panelboards alike.

- .10 Panel tubs to be typically 600mm [20"] wide.
- .11 Provide "sprinkler-proof" design in areas where sprinkler fire protection is installed. In any event, all surface mounted enclosures to be complete with sprinkler drip cover.

2.2 BREAKERS

- .1 All breakers to be bolt on type, moulded case, non adjustable and non interchangeable trip, single, two and three pole, 120/208(240)V or 347/600V and with trip free position separate from "On" or "Off" positions.
- .2 Two and three pole breakers to have common simultaneous trip and able to be located in any circuit position within the panelboard. Minimum interrupting rating of breakers to be as follows:
 - .1 347/600V panelboards - 14,000 Amps at 347 volts.
 - .2 120/208V panelboards - 10,000 Amps at 250 volts.
- .3 Main breaker to be separately mounted at top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Provide at least 10% spare 15 Amp single pole breakers whether indicated or not.

2.3 PANELBOARD IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Nameplate for each panelboard size 5 (2 line) engraved as indicated and include panel designation and voltage/phase.
- .3 Complete circuit directory with typewritten card(s) located in slide-in plastic pocket(s) fixed to the back of the related door. Directory card to indicate the panel designation, mains size, voltage/phase and the location and load controlled of each circuit. Include a "letter sized" paper copy of each directory in the project maintenance manual.
- .4 Provide a plasticized typewritten information card fixed to the back of the each panel door. Information card to indicate the panel designation and location, feeder type and size and locations of any controlling contactors and feeder pullboxes. Include a "letter sized" paper copy of each information card in the project maintenance manual.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.
- .2 Mount panelboards to height given in Section 26 05 00 or as indicated.

- .3 Connect new and existing loads to circuits as indicated.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

Part 1 General

1.1 RELATED WORK

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

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Waste Management and Disposal.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 00.
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Wiring diagram for each type of starter.
 - .6 Interconnection diagrams.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide data for incorporation into maintenance manual specified in Section 01 78 00 and Section 26 05 00.
- .2 Include operation and maintenance data for each type and style of starter.

1.5 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 26 05 00.
- .2 Provide listed spare parts for each different size and type of starter:
 - .1 2 contacts, stationary.
 - .2 2 contacts, movable.
 - .3 1 contact, auxiliary.
 - .4 1 control transformer.

- .5 1 operating coil.
- .6 2 fuses.
- .7 4 indicating lamps.

Part 2 Products

2.1 MATERIALS

- .1 Starters: to CSA C22.2 No.14.
- .2 Half size starters not acceptable.

2.2 MANUAL MOTOR STARTERS

- .1 Single phase manual motor starters of size, type, rating and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.
 - .2 One overload heater, manual reset, trip indicating handle.
 - .3 Flush mounted in finished areas.
 - .4 Pilot light.
- .2 Accessories:
 - .1 Toggle switch labelled as indicated.
 - .2 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Three pole adjustable overload relay(s) with single phase protection feature
 - .3 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .4 Wiring and schematic diagram inside starter enclosure in visible location.
 - .5 Provide a fixed 10 point terminal strip for all controls.
 - .6 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
 - .7 Control transformers to be line voltage to 120 V of sufficient VA to handle operating coil and associated auxiliary controls. Provide primary and secondary HRC fusing.
 - .8 Provide fused circuit and terminal blocks.
 - .9 Provide the following accessories:

- .1 Hand-off-auto selector switches, start/stop/reset buttons or on/off control as indicated.
 - .2 Loads served labelled as indicated.
 - .3 Indicating lights: standard type and colour as indicated.
 - .4 2-N/O and 2-N/C spare auxiliary contacts in addition to the holding contacts unless otherwise indicated.
 - .5 Support facilities for load sensing ring type CT on Phase C of motor circuit
- .2 Two (2) sets of auxiliary contacts - normally Open in addition to standard auxiliary holding contacts supplied with each contactor making a total of three (3) auxiliary contacts. One (1) set of auxiliary contacts to be convertible to normally closed.
- .3 CEMA 1 enclosure unless otherwise indicated.

2.4 COMBINATION STARTERS

- .1 In addition to "Full Voltage Magnetic Starters" above, provide 3 pole magnetic trip moulded case breaker (MCP) and operating handle with lock-off facility.
- .2 Enclosure "Opening" to be restricted by use of a defeater screw unless switch is in "Off" Position.

2.5 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 5 engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters.
- .2 Connect power and control as indicated.
- .3 Provide interlocking between starters where required.
- .4 Select overload settings to suit full load current of motors installed that may differ from the design loads. Confirm with other Divisions.
- .5 Ensure correct control fuses and overload devices elements installed.
- .6 Provide disconnects at all equipment.

3.2 CONTROL TERMINAL SECTION

- .1 Extend control wiring as indicated on typical wiring diagram from each motor control module to control terminal section. All terminals to be number coded and otherwise suitably identified to indicate which section or module of motor control centre they are associated with and their function. Control wiring diagrams of each typical type with conductor identification clearly shown to be affixed to interior cover of control terminal section.
- .2 Control terminal section to house all controls, relays and time delay relays associated with the mechanical control systems and control systems such as fire alarm.

3.3 CURRENT TRANSFORMERS (CTS)

- .1 All CTs and associated equipment for current monitoring of mechanical equipment to be supplied and installed by the Electrical Division.
- .2 Wire all secondaries of CTs to terminal strip in control terminal section of CT and provide jumper to opposite side of terminals.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 and manufacturer's instructions.
- .2 Operate controls, switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

End of Section

Part 1 General

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated on not on the contract drawings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CAN/CSA C22.2 No.4, Enclosed Switches.
 - .2 CSA C22.2 No.39, Fuseholder Assemblies.

1.3 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 29 Health and Safety Requirements.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.5 PRODUCT DATA

- .1 Submit product data in accordance with Section 26 05 00.

Part 2 Products

2.1 DISCONNECT EQUIPMENT

- .1 "Heavy Duty" class, enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No.4
- .2 Fuseholder assemblies to CSA C22.2 No.39.
- .3 Fusible and non-fusible disconnect switch in CSA enclosure.
- .4 Provision for padlocking in off switch position.
- .5 Fuses as indicated. Allow for Class J or L for general circuits, Class RK5 for transformer, motor or other high inrush current circuits
- .6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.

- .7 Quick-make, quick-break action.
- .8 ON-OFF switch position indication on switch enclosure cover.
- .9 Provide an auxiliary switch with dry contacts on all elevator disconnects and as required by the Elevator Code. Review elevator shop drawings to confirm any additional requirements.
- .10 Weatherproof as required.

2.2 EQUIPMENT IDENTIFICATION

- .1 Indicate name of load controlled on size 4 name plate to Section 26 05 00.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses where indicated or required.
- .2 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated or not on the contract drawings.

3.2 MOTOR PLUG/RECEPTACLE AND QUICK DISCONNECTS

- .1 Motor quick disconnects do not negate the requirement for a switched safety disconnect as specified in this Division. A separate disconnect is still required unless the Departmental Representative has given a special pre-approved circumstance.

END OF SECTION

APPENDIX



SNC • LAVALIN

HAZARDOUS BUILDING MATERIALS ASSESSMENT

Penticton Airport Terminal Building, 3000 Airport Road, Penticton, BC

March 31, 2016
Project 636476

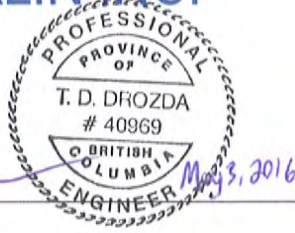
Prepared for:

Public Works and Government Services Canada

SNC-LAVALIN INC.

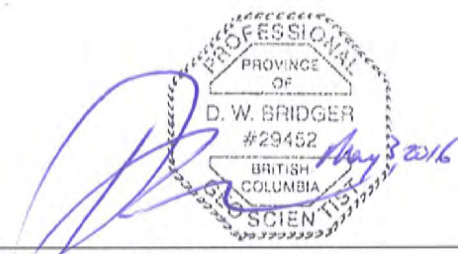
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EXECUTIVE SUMMARY

On behalf of Public Works and Government Services Canada (PWGSC), SNC-Lavalin Inc. (SNC-Lavalin) has completed a pre-renovation non-destructive hazardous building materials survey (HBMS) of the airport terminal building located at 3000 Airport Road, Penticton, BC. PWGSC requested the HBMS in preparation for renovations which are planned in the near future.

Between March 28 and 30, 2016, SNC-Lavalin completed a room-by-room survey of the accessible areas of the airport terminal building to quantify suspected designated substances and hazardous materials, and collect representative samples for laboratory analysis of select materials for asbestos and lead content.

The survey and sampling program identified asbestos in the following building materials: drywall joint compound, vinyl floor tiles, concrete pipes, bell and spigot cast iron pipe joint packing, gaskets, pipe thread sealant, window putty, HVAC ducting mastic, tar and exterior ceiling and wall texture coat.

Potential asbestos-containing materials may be present in the following building materials: vermiculite insulation, fire doors, electrical wiring, gaskets and underground piping.

Analytical results confirmed the presence of lead-based paints in 31 of the 49 paint samples collected throughout the interior and exterior of the building. As per PWGSC direction, no leachate analyses were carried out.

The survey and sampling program also identified the following other designated substances or hazardous materials of potential concern:

- Potentially polychlorinated biphenyls (PCB)-containing fluorescent and high intensity discharge (HID) light ballasts throughout the interior and exterior of the building.
- Ozone depleting substances (ODS)-containing air conditioning units, water cooling units, refrigerator/freezer units and other refrigeration equipment.
- Confirmed/potential lead-containing materials (lead-acid batteries, lead solder, lead roof vent pipes, and lead packing in bell and spigot piping).
- Fire extinguishers (compressed gas) mounted on the interior walls and stored in rooms throughout the building.
- Miscellaneous potentially hazardous consumer products including paint, oil, propane and various chemicals and cleaning products.
- Liquid mercury in thermostats located in select rooms of the building.

- Silica potentially in concrete, ceramic tiles, ceiling tiles, mortar, and drywall, where present in the building.

While effort was made to identify all hazardous building materials, a number are suspected to be hidden/inaccessible in the building. Surveys in conjunction with renovation activities are recommended to identify such materials.

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1: Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC19

Appendices

- I Drawings:
 - 636476-BM1 – Sample Location Plan – First Floor
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- II Photographs
- III Laboratory Analytical Report (IATL)
- IV Laboratory Analytical Report (Maxxam)

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1 INTRODUCTION

On behalf of Public Works and Government Services Canada (PWGSC), SNC-Lavalin Inc. (SNC-Lavalin) has completed a pre-renovation non-destructive hazardous building materials survey (HBMS) of the airport terminal building located at 3000 Airport Road, Penticton, BC (the "Site"). SNC-Lavalin understands that the purpose of the work was to complete a non-destructive HBMS of the building (with exception to the Hold Room and Air Control Building) to identify potential materials of concern. At the time of the survey, the terminal was active; however, the areas of the building were unoccupied during the assessment.

All work was completed as per the *Hazardous Materials Assessment Consulting Services Task Authorization – EZ113-150642/003/PWY* under Task Authorization No. 70034882 (Amend 1).

2 SCOPE OF WORK

Between March 28 and 30, 2016, SNC-Lavalin personnel observed the interior and exterior of the Site to identify the potential existence of the following regulated materials:

- asbestos;
- lead paint;
- polychlorinated biphenyls (PCB);
- ozone depleting substances (ODS);
- miscellaneous solid and liquid wastes;
- liquid mercury;
- radiological sources and/or substances;
- silica; and
- mould and/or moisture.

The scope of work for the HBMS excluded the following materials: formaldehyde; carbon monoxide; radon; volatile organic compounds; biological hazards (e.g., rodent droppings); very short-lived low-level radioactive waste; and, indoor air quality pollutants.

Representative samples were collected and laboratory analysis completed for suspected asbestos-containing materials (ACMs) and lead-containing paint. The survey was completed based on the expectation that portions of the building would be renovated in the future. As such, non-destructive sampling methods were utilized to inspect and where appropriate, collect samples of materials of interest. Effort was made to identify materials of potential concern within hidden or concealed spaces; however, due to the non-destructive nature of the survey, inspection and sampling was limited to the extent that was possible without causing obvious and/or irreparable damage to building materials in active areas of the building that could not be feasibly repaired within the scope of this work program. For samples that were collected, effort was made to obtain the samples from discrete locations or locations where the building materials were already in poor condition.

The following sections provide a summary of the results, SNC-Lavalin's recommendations with regard to the Site, details of the regulatory framework related to regulated building materials, and the methodology used to complete the survey. Limitations and/or exclusions are also discussed in the following sections as they relate to the work program results.

3 SUMMARY

Based on the results of the survey, there are regulated building materials located on the Site requiring specific procedures prior to renovation activities for: handling; abatement; demolition; and disposal, as outlined in Table 1. The sample locations are presented on Drawings 636476-BM1 and 636476-BM2, included as Appendix I. Select photographs of the sample locations are included in Appendix II. Copies of the laboratory analytical reports for the results of the asbestos and lead analyses are included in Appendices III and IV, respectively.

A summary of the regulated building materials identified on the Site is as follows:

Asbestos-Containing Materials:

- **Asbestos-containing drywall joint compound** was identified in Rooms 106A, 120, 124, 125, and 130. Due to the variability in drywall joint compound results, all drywall joint compound in the building should be treated as ACM.
- **Asbestos-containing light grey vinyl floor tiles** were identified in Rooms 106B (within the small wall compartment on the west wall, north of the building entrance), 109, 112, 114, 125, and 129. Similar coloured asbestos-containing vinyl floor tile debris was identified in the northeast flooring vent in Room 120. All similar coloured vinyl floor tiles should be considered ACM.
- **Asbestos-containing green vinyl floor tiles (and associated black mastic adhesive)** were identified in Rooms 127, 128A, 128B, 132, 133, 134, 135, 136. All similar coloured vinyl floor tiles should be considered ACM.
- **Asbestos-containing grey vinyl floor tiles (and associated black mastic adhesive)** were identified in Rooms 123 and 124. All similar coloured vinyl floor tiles should be considered ACM.
- **Asbestos-containing light brown vinyl floor tiles** were identified in Room 129 beneath the lockers on the north and south walls. All similar coloured vinyl floor tiles should be considered ACM.
- **Asbestos-containing tan vinyl floor tiles** were identified in Rooms 115, 116A, 117, and 119. All similar coloured vinyl floor tiles should be considered ACM.
- **Asbestos-containing grey concrete pipe** was identified in the crawlspace of Room 127. The same pipe was observed sticking out of the ground (vertical) and capped on the exterior of the west side of the building adjacent Room 133. Similar piping may be present in other areas of the crawlspace, walls spaces and/or ceiling spaces, or buried beneath the ground.

- **Asbestos-containing bell and spigot cast iron pipe joint packing** was identified in one joint attached to the asbestos-containing concrete pipe in the crawlspace of Room 127. Similar inaccessible piping joints may be present in other areas of the crawlspace, walls spaces and/or ceiling spaces.
- **Asbestos-containing gaskets** were identified in the crawlspace of Room 127 and in the mechanical room (Room 137), both of which were grey gaskets. All similar gaskets should be treated as ACM. Due to the limited access to working pipe joints, limited sampling could be completed.
- **Asbestos-containing pipe thread sealant** was identified in Rooms 124 and 143 on the fire sprinkler lines. All fire sprinkler line pipe thread sealant should be considered ACM.
- **Asbestos-containing white floor leveling compound** was identified beneath the vinyl floor tiles in Room 123. The extent of the floor leveling compound could not be determined based on the non-destructive nature of the survey. If any similar compound is identified in the building, it should be treated as ACM.
- **Asbestos-containing grey window putty** was identified in Rooms 120 (northeast corner) and 117 (east side of room), of which the windows are adjoining. All similar window putty should be considered ACM.
- **Asbestos-containing grey window putty** was identified on the upper windows in Room 106A above Room 143. All similar putty on the upper windows in the building should be treated as ACM.
- **Asbestos-containing red mastic** was identified on HVAC ducting in the crawlspace of Room 136. There may be similar mastic that was inaccessible during the survey in other areas of the crawlspace and ceiling spaces; if similar mastic is identified, it should be treated as ACM.
- **Asbestos-containing tar** was identified by the base of the doorframe of the southeast door of Room 110. All similar tar should be considered ACM.
- **Asbestos-containing exterior ceiling and wall texture** was identified on the south and west exterior walls and ceiling (carport area on the south end of the building). All similar exterior texture coat should be considered ACM.

Suspect Asbestos-Containing Materials:

- Vermiculite contaminated with asbestos may also be present in wall cavities and ceiling spaces within the building. No vermiculite was encountered during the survey; however, the absence of vermiculite insulation could not be confirmed in all areas during the survey. If encountered during renovations, vermiculite insulation must be handled as ACMs unless testing confirms otherwise.

- Fire doors to the entrances of Rooms 137 and 138 may contain asbestos-containing filler material. No other fire doors were identified at the Site; however, if any similar fire doors are identified, they should be treated as ACM.
- Electrical wiring insulation throughout the building may contain ACMs; however, this material was not sampled due to safety concerns with live electrical wiring.
- ACMs within equipment; no dismantling of equipment was completed and therefore, inspection and sampling of gaskets in operating equipment/piping was limited. Similarly, only the exterior of electrical equipment in the building, including switch boxes, was visually inspected for potential asbestos containing insulating panels (i.e., no opening of electrical boxes and no sampling), due to possible related safety concerns.
- Asbestos-containing cement pipes could be present at the Site as one ACM pipe was observed in the crawlspace. The identification of potential ACMs below ground was not within the scope of this report, and should be addressed during any excavation at the Site.

Lead-Based Paint:

- **Lead-containing light brown and blue paint** was identified on the door of Rooms 125 and 130.
- **Lead-containing brown and blue paint** was identified on the door and window frames of Room 125.
- **Lead-containing white paint** was identified on the walls of Room 125.
- **Lead-containing green paint** was identified on the door frame of Rooms 127 and 135.
- **Lead-containing grey paint** was identified on the wall panels in Room 127.
- **Lead-containing beige paint** was identified on the wall trim in Room 120.
- **Lead-containing white and off-white paint** was identified on the walls of Room 106A (collected above Room 143). Similar paint colours were identified in Rooms 102, 105A, and 106B.
- **Lead-containing light blue and white paint** was identified on the door frame of Room 109.
- **Lead-containing exterior yellow paint** was identified on a steel pipe on the roof.
- **Lead-containing exterior grey paint** was identified on the wall of the raised portion of the roof.
- **Lead-containing exterior white paint** was identified on the soffit of the raised portion of the roof.
- **Lead-containing exterior black paint** was identified on the ladder to the raised portion of the roof located on the south west side.
- **Lead-containing exterior dark brown paint** was identified on the window trim on the east side of the raised portion of the roof.

- **Lead-containing exterior white, tan and light grey paint** was identified on the concrete foundation (above ground portion).
- **Lead-containing exterior blue paint** was identified on the exterior walls of the building.
- **Lead-containing exterior dark brown paint** was identified on the door frame to Room 125.
- **Lead-containing pink paint** was identified on the walls and ceiling of Room 128B.
- **Lead-containing grey floor paint** was identified in Room 138.
- **Lead-containing beige paint** was identified on the walls of Room 137 and 138.
- **Lead-containing grey primer paint** was identified on the wall in the ceiling space of Room 142.
- **Lead-containing light brown paint** was identified on the door frame of Room 132.
- **Lead-containing red paint** was identified on the window frames on the west wall of Room 106B.
- **Lead-containing brown paint** was identified on the door to the wall cabinet in Room 106B (north of the main entrance, Room 101).
- **Lead-containing yellow paint** was identified in the wall cabinet in Room 106B.
- **Lead-containing yellow paint** was identified on the door frame of Room 112.
- **Lead-containing beige paint** was identified on the walls and pipes in Room 110B.

Based on these results, all materials found at the Site of similar colours as identified above should be considered as lead-containing.

PCB Materials:

- **Potentially PCB-containing light ballasts (fluorescent and high intensity discharge [HID])** were identified throughout the interior and exterior of the building.

Ozone Depleting Substances (ODS):

R404a Refrigerant (Non-ODS)

- Room 162 – One (1) ice maker and one (1) freezer.

R134a Refrigerant (Non-ODS)

- Room 162 – One (1) refrigerator;
- Room 161 – One (1) cooler;

- Room 151B – One (1) water cooler;
- Room 110A – One (1) refrigerator;
- Room 113 – One (1) water cooler;
- Room 116A – One (1) refrigerator;
- Room 116B – One (1) freezer; and
- Room 140 – One (1) water cooler (black) and one (1) refrigerator.

R410a Refrigerant (Non-ODS)

- Room 136 – One (1) wall mounted air conditioning unit; and
- Room 162 – One (1) air conditioning unit.

R22 Refrigerant (ODS)

- Room 161 – One (1) upright cooler; and
- Room Roof – Six (6) air conditioner units (2, 4, 5, 6, 7, and 8).

Unknown Refrigerant (Suspect ODS [no ID tag accessible])

- Room 113 – One (1) refrigerator;
- Room 134 – One (1) refrigerator; and
- Room 140 – One (1) water cooler (white).

Miscellaneous Solid and Liquid Wastes:

- **Lead-based batteries** were identified in Room 127:
 - Two (2) batteries (one in each fire control box) on the west wall;
 - Eight (8) car sized batteries on the south wall; and
 - One (1) battery in the control box on the east wall.
- **Potential lead-based batteries** were identified in the following locations:
 - Room 125 – Fire control box;
 - Room 138 – Electrical equipment and/or control boxes that were inaccessible during the survey; and

- Rooms 102, 109, 106B, 112, and 127 – Emergency lighting boxes.
- **Potential lead-containing soldering equipment and supplies** was identified in Room 133.
- **Potential lead-containing copper pipe solder joints** were identified throughout the building. Copper pipe joints may be hidden in the crawlspace, wall and ceiling spaces and could not be identified due to the non-destructive nature of the survey.
- **Potential lead-containing bell and spigot cast iron pipe joint packing** was identified in the crawlspace of Room 127.
- **Potential lead-containing roof vent pipes** were identified on the exterior roof.
- **Approximately twelve (12) fire extinguishers** were identified in Rooms 105B, 107, 110, 114, 116A, 124, 127, 135, 136, 138 and 162.
- **Various cleaning supplies** were identified in Room 128A (janitor's storage room).
- **Flammable storage box** was identified containing small quantities of various paints, oils, propane, etc.
- **Nine (9) Sinclair canisters** were identified in Room 135. The canisters appeared empty and contents unknown (no additional labels).

Liquid Mercury:

- **Four (4) mercury-containing thermostats** were identified in Rooms 110 (two thermostats), 140 and 142.

Silica:

- Silica may be present throughout the building in the following materials:
 - Concrete floors;
 - Ceramic tiles;
 - Ceiling tiles;
 - Mortar; and
 - Drywall.

4 RECOMMENDATIONS

SNC-Lavalin understands that PWGSC intends to renovate and/or deconstruct various portions of the building that was surveyed.

When PWGSC undertakes demolition or deconstruction activities, then known and suspect ACMs that were identified must be removed by a qualified contractor in accordance with applicable federal and provincial regulations.

WorkSafeBC suggests that improper removal of paint with a lead concentration of 600 mg/kg or more can result in airborne lead concentrations that exceed 50% of the airborne lead exposure limit of 0.05 mg/m³; this would trigger the requirement for an employer to file a Notice of Project Lead (NOPL) and the development and implementation of an exposure control plan and safe work procedures prior to any work being completed.

There is the potential for lead exposure for high risk individuals in the event that lead-based paint with lead concentrations >90 mg/kg is burned and/or becomes airborne during renovation, deconstruction/demolition activities such as cutting, grinding, etc. Therefore, these individuals should be excluded from the work area whenever lead-based paint is being disturbed by work activities to minimize potential lead exposure to these individuals.

The waste generated from removal of paint and surface coatings may be hazardous. Given the possible need for off-site disposal of waste material during renovations, laboratory analysis for preliminary waste characterization of select samples (concentrations of metals in the leachate) may be required. Based on discussions with PWGSC, this sampling was specifically excluded from the assessment. If leachate analysis (Toxicity Characteristic Leaching Procedure [TCLP]) is required for disposal of materials containing hazardous lead concentrations, SNC-Lavalin will be available to collect and submit additional samples, as required.

Suspected silica-containing material, such as the buildings concrete floors, ceramic tiles, ceiling tiles, mortar and drywall, must be managed appropriately. Parts 5, 6 and 20 of the *Occupational Health and Safety Regulation* (OHSR) set out occupational exposure guidelines and controls for silica dust to eliminate, reduce, or manage workers' exposure risk. WorkSafeBC identifies the requirement to develop an exposure control plan to protect workers from overexposure to airborne silica dust in excess of 50% of the exposure limit (i.e., crystalline silica has an OHSR occupational exposure limit of 0.025 mg/m³).

If PWGSC undertakes renovations or deconstruction activities at the Site, PWGSC should require that the qualified contractors (i.e., abatement, demolition and/or disposal contractors) submit the following documentation to PWGSC to verify that the qualified contractors have acted in a responsible manner in accordance with the existing applicable regulations:

- Notice of project for work involving asbestos (NOPA) to be filed with WSBC prior to asbestos abatement;
- NOPL to be filed with WSBC prior to lead abatement;
- Site-specific work procedures for materials of concern (asbestos and lead procedures are included with NOPA and NOPL);
- Letter stating that the ODS recovery, liquid mercury and PCB disposal work, if required, was completed; and
- Relevant Waste Disposal Manifests.

The above documentation should be retained by PWGSC to verify compliance with the applicable regulations. The information supplied by the contractor(s) should include, but not be limited to the above list.

5 REGULATORY FRAMEWORK

Federal and provincial regulations require that regulated building materials be properly identified and managed to prevent potential exposure to workers. In addition, a more intrusive survey is required to identify materials of concern prior to renovations, salvage, or demolition of a building or structure. These materials must be properly controlled, removed, and/or disposed of at a suitably permitted facility in accordance with the applicable federal and provincial regulations. The following federal and provincial regulations relate to these materials:

Federal

- Various Regulations made under the *Canadian Environmental Protection Act (CEPA)*, 1999, S.C. 1999, c. 33, as amended up to February 26, 2015 and current to October 15, 2015, including specialized handling and/or disposal requirements for materials including lead, PCBs, mercury, halocarbons (ODSs and Non-ODSs), radiological sources and/or substances and solid/hazardous wastes. Regulations include the following:
 - Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).
 - Federal Halocarbon Regulations, 2003 (SOR/2003-289) and Regulations Amending the Federal Halocarbon Regulations, 2003 (SOR/2009-221).
 - Interprovincial Movement of Hazardous Waste Regulations (SOR/2002-301).
 - Ozone-Depleting Substances Regulations, 1998 (SOR/99-7).
 - PCB Regulations (SOR/2008-273).
 - PCB Waste Export Regulations, 1996 (SOR/97-109).
 - Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations, 2008 (SOR/2008-197).
- *Transportation of Dangerous Goods (TDG) Act*, 1992, S.C. 1992, c. 34, as amended up to February 26, 2015, Transportation of Dangerous Goods Regulations (SOR/2001-286) requires that dangerous goods including radioactive materials must be transported in accordance with the provisions of the Act and regulations.
- *Hazardous Products Act* (R.S.C., 198, c. H-3), as amended up to February 11, 2015, prohibits the sale or importation of UFFI into Canada.
- *Surface Coating Materials Regulations*, SOR/2005-109, as amended up to June 20, 2011, issued under the Canada Consumer Product Safety Act (S.C. 2010, c. 21), requires the concentration of total lead present in a surface coating material to be not more than 90 mg/kg.

- *Human Resources Social Development Canada (HRSDC), Canada Labour Code Part II, Canada Occupational Health and Safety Regulations, Part X, Hazardous Substances*, as amended, requires that all hazardous substances in the workplace, including asbestos, be identified and controlled to minimize potential exposure to workers. Under the Canada Labour Code Part II definitions, a “hazardous substance” includes a controlled product and a chemical, biological, or physical agent that, by reason of a property that the agent possess, is hazardous to the safety or health of a person exposed to it.
- *Mould Guidelines for Canadian Construction Industry - CCA82, Canadian Construction Association, 2004*, provides guidance on minimizing and abating mould growth.
- *The Nuclear Safety and Control Act (1997, c.9), Nuclear Substances and Radiation Devices Regulations (SOR/2000-207)* applies to nuclear substances and sealed sources, including devices such as smoke detectors.

Provincial

- *WorkSafeBC Occupational Health and Safety Regulation (OHSR), BC Reg. 296/97*, includes amendments up to B.C. Reg. 30/2015, August 4, 2015, requires that materials including any asbestos, lead, or other heavy metal or toxic substance, and flammable or explosive materials that may be handled, disturbed or removed during demolition must be identified and removed or safely contained prior to demolition. In addition, a copy of the observation report identifying these materials must be available at the work site.
- *Environmental Management Act (EMA), B.C. Reg. 54/2016 / March 2, 2016, Ozone Depleting Substances (ODS) and Other Halocarbons Regulation, BC Reg. 387/99*, including amendments up to BC Reg. 317/2012, requires ODS to be recovered from equipment prior to disposal.
- *Hazardous Waste Regulation (HWR), B.C. Reg. 63/88*, including amendments up to B.C. Reg. 63/2009, requires all Hazardous Wastes (HW) must be properly managed and disposed of.

We note that at the time of this report, the provincial OHSR defines ACM as any manufactured article or other material which contains 0.5% or more asbestos by weight and vermiculite insulation containing any amount of asbestos. Other federal and provincial legislation defines ACM as containing 1% or more asbestos by weight. Therefore, for the purposes of this report the more stringent criterion of 0.5% has been used to identify ACM.

Federal and provincial guidelines limit lead concentrations in paint to 90 mg/kg for high risk individuals (i.e., pregnant women and children), and any concentrations that exceed this limit would be considered a lead based paint. WorkSafeBC suggests that improper removal of paint with a lead concentration of 600 mg/kg or more can result in airborne lead concentrations that exceed 50% of the airborne lead exposure limit of 0.05 mg/m³; this would trigger the requirement for an employer to file a NOPL and the development and implementation of an exposure control plan and safe work procedures prior to any work being completed. Therefore, for the purposes of this report, paint is

identified as lead based if the total lead concentration is >90 mg/kg as per the federal regulations, and if the paint contains lead concentrations >600 mg/kg, an exposure control plan may be required if the paint is disturbed in such a manner that workers could be exposed to lead at >50% of the exposure limit.

There are no special disposal requirements for materials coated with lead paint unless the lead is found to be leachable in excess of the regulated standard of 5 mg/L in the HW regulations while considering the entire mass of the object the paint is coating.

Radioactive materials are listed under the current Federal TDG Act and Regulations. Substances with a specific radioactivity greater than 70 kBq/kg are considered Class 7 (Radioactive Materials) within the TDG Act and Regulations and must be transported in accordance with the provisions of the TDG Act and Regulations. The Nuclear Safety and Control Act (1997, c.9), Nuclear Substances and Radiation Devices Regulations (SOR/2000-207), advises that radioactive substances that do not contain more than 185 kBq of americium 241 or, where it is in a commercial or industrial facility, more than 740 kBq of americium 241 is considered as a radioactive source under the TDG Act and Regulations.

According to the Canadian Nuclear Society, approximately 30 kBq of radioactive material is contained within a typical smoke detector. Therefore, for a commercial facility, the 740 kBq level may be reached if 25 or more radioactive smoke detection devices are collected and stored together.

WorkSafeBC indicates that employers are required under Section 5.54 of the OHSR to develop an exposure control plan when workers are or may be exposed to airborne silica dust in excess of 50% of the exposure limit. Exposure limits vary depending on the type of silica identified.

6 METHODOLOGY

The following sections outline the specific protocols followed when completing the survey. In general, fieldwork included the following tasks:

- A room-by-room visual survey of the accessible portions of the Site to identify, document and quantify suspected designated substances and hazardous materials; and
- Representative sampling and laboratory analysis of select materials for asbestos and lead content.

The following sections outline the specific protocols followed when completing the survey.

6.1 *Asbestos*

The methodology for completing the asbestos assessment was in accordance with WorkSafeBC guidelines and included the identification of suspect materials and collection of an adequate number of representative samples of these materials. All accessible areas of the Site were observed for possible ACM. Accessible wall cavities and roof spaces were also inspected for the possible presence of vermiculite insulation.

Samples were collected with minimum disturbance and sampling locations repaired, where applicable. Sample locations were marked on the building material in discrete locations; where non-discrete locations were sampled, temporary markings were used to identify the sample locations (i.e., tape and sample bags with IDs). Temporary markings were subsequently removed following sample location photographs.

Samples for laboratory analysis to determine asbestos content were collected in sealable plastic bags, labelled and shipped by courier to International Asbestos Testing Laboratories (IATL) in Mt. Laurel, NJ, USA under Chain of Custody protocols. Analysis of bulk samples for determination of asbestos content was performed using polarized light microscopy (PLM) procedures in accordance with the applicable regulations using EPA 600 R-93/116, 1993 Method.

During the survey, a total of 210 samples were collected for analysis of asbestos content.

6.2 *Lead Paint*

Lead-based paint or surface coatings may be present on structures that need to be cut or ground during renovations. The presence of lead-based paint or surface coatings is not an environmental concern but could pose a potential exposure risk to workers in the event that lead-based paint or surface coatings is burned and/or becomes airborne during renovation activities. As such, sampling

of paint or surface coatings was generally limited to most widely applied, suspected lead-based paint colours on building materials and on larger metal building components that might reasonably require torch cutting during building renovation.

Different paint colours may contain different concentrations of lead; therefore, SNC-Lavalin personnel inspected the Site to determine major paint colour(s) that have been applied to surfaces throughout. The approach was to try to obtain samples from structures that may need to be cut, ground, or sanded during renovation or demolition/deconstruction. Factory painted surfaces were not sampled as the paint is applied in thin layers, making it difficult to obtain a sufficient amount of paint to analyse.

Samples were collected in sealable plastic bags, labelled and submitted to Maxxam Analytics in Burnaby, BC (Maxxam) for analysis of lead in paint. Analysis of bulk samples for determination of metals content was performed using Inductively Coupled Plasma, Mass Spectrometry (ICP-MS) procedures

During the survey, 49 samples were collected and submitted to Maxxam for analysis of total lead in accordance with the applicable regulations.

6.3 Polychlorinated Biphenyls (PCBs)

Historical use of PCBs in electrical equipment manufactured in Canada, such as transformers, fluorescent lamp ballasts and capacitors, was common prior to approximately 1977. The use of PCBs was prohibited by the Canadian Environmental Protection Act in heat transfer and electrical equipment installed after August 1977, and in transformers and capacitors installed after June 1980. However, experience has shown that electrical equipment manufactured previously and held in inventory may still be in use.

The survey included observation of accessible areas of the armoury for items or equipment that could possibly contain PCBs, such as fluorescent light fixtures, HID lamps, and oil-filled electrical equipment.

SNC-Lavalin personnel identified and recorded suspect fluorescent light ballasts and electrical equipment potentially containing PCBs.

6.4 Ozone Depleting Substances

SNC-Lavalin personnel observed the interior and exterior spaces of the Site to identify if air conditioning units, refrigerators, freezers, or other sources of ODS exist. If a unit was identified, the

manufacturer's nameplate (if accessible) was observed to determine the type and amount of refrigerant used.

6.5 *Miscellaneous Solid and Liquid Wastes*

The interior and exterior spaces of the armoury were visually observed to identify the presence of other designated substances and hazardous materials, including miscellaneous solid and liquid wastes. Miscellaneous materials of concern include, but are not limited to, materials in larger means of containment, such as oils or fuels in storage tanks or drums, or chemicals that may be present in smaller household containers, such as paints, solvents, cleaners, etc. Materials of concern were identified, photographed and documented.

6.6 *Liquid Mercury*

Mercury has widespread use in commercial/residential products including electrical switches, barometers and thermometers. It also has many commercial, medical and industrial applications. A potential concern of mercury is its persistence in the environment when released at a landfill following disposal. Special considerations must be taken during the disposal of items containing mercury.

The interior of the building was observed for thermostats that may contain small amounts of liquid mercury. The covers of thermostats found were opened to assess the presence of mercury ampoules.

6.7 *Radiological Sources and/or Substances*

Radioactive sources and/or substances may be present in smoke detection devices.

The accessible areas of the Site were observed for potential radiological sources and/or substances and, if found, SNC-Lavalin compiled an inventory. Any remaining radiological sources and/or substances should be properly disposed of by a qualified contractor prior to renovations or demolition/deconstruction.

6.8 *Silica*

Silica occurs naturally as a crystalline material in rock, sand, concrete and cement, and therefore, is likely present in poured concrete slabs/floors, concrete blocks, mortar, plaster, drywall, acoustic ceiling tiles and ceramic tiles. Crystalline silica is significantly more toxic than amorphous silica; however, both are regulated. Crystalline silica dust can be generated through such processes such as breaking, drilling, hammering, blasting, grinding, crushing or sandblasting silica-containing materials. When breathed in, the crystalline silica dust can cause permanent damage to the lungs.

SNC-Lavalin personnel noted materials at the Site that are suspected of containing silica.

6.9 Mould and/or Moisture

SNC-Lavalin personnel observed interior and exterior areas of the Site for the presence of mould and/or moisture. Any suspect areas identified (e.g., beneath sinks or adjacent hot water tanks) were noted and photographed.

7 RESULTS

Details of the results are presented for each regulated material of concern in the following Table 1, below. This information includes recommendations for removal/handling during renovation or demolition/deconstruction activities, where required.

Table 1: Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|--|---|---|
| ASBESTOS-CONTAINING MATERIALS (ACM) | | |
| Suspect ACM Sampled – Asbestos Identified: <ul style="list-style-type: none"> A3 (Layer 1) – Drywall joint compound – Room 125. A4 (Layer 1) – Vinyl floor tiles – off-white with grey streaks – Room 125. A5 – Drywall joint compound – Room 125. A15 (Layer 1) – Green vinyl floor tile – Room 127. A15 (Layer 2) – Black mastic (adhered to Layer 1) – Room 127. A20 – Grey concrete pipe – Room 127 (crawl space). A21 – Oakum bell end cast iron pipe fitting filler attached to asbestos-concrete pipe – Room 127 (crawl space). A23 – Grey gasket – Crawl space Room 127. A28 (Layer 2) – Drywall joint compound – Room 124. A29 – Pipe thread sealant on fire line – Room 124. A34 (Layer 1) – Grey vinyl floor tile – Room 123. A34 (Layer 2) – Black mastic (adhered to Layer 1) – Room 123. A35 (Layer 1) – Black mastic (similar to A34) – Room 123. A35 (Layer 2) – White floor levelling compound – Room 123. A38 – Grey vinyl floor tile – Room 129. A40 – Drywall joint compound under vinyl wall covering – Room 130. A41 – Drywall joint compound in ceiling space – Room 120. A43 – Grey window putty – Room 120. A45 (Layer 1) – Grey vinyl floor tile debris located in floor vent – Room 120. A47 – Drywall joint compound – Room 120. A49 – Grey window putty – Room 106A above Room 143. | Analytical Result: <ul style="list-style-type: none"> 1.1% Chrysotile 0.75% Chrysotile 1.3% Chrysotile 10% Chrysotile 2.5% Chrysotile 15% Chrysotile, 10% Crocidolite 5.1% Amosite 40% Chrysotile 1.1% Chrysotile 0.5% Chrysotile 8.7% Chrysotile 0.5% Chrysotile 0.5% Chrysotile 1.3% Chrysotile 6% Chrysotile 1.2% Chrysotile 1.2% Chrysotile 3.5% Chrysotile 7.2% Chrysotile 0.75% Chrysotile 4.1% Chrysotile | Prior to renovation/demolition, the ACM must be removed by a qualified asbestos removal contractor. Work should be performed in accordance with the OHSR and BC HWR. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations. |

Table 1: Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|--|---|---|
| ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd) | | |
| Suspect ACM Sampled – Asbestos Identified (Cont'd) : <ul style="list-style-type: none"> • A52 – Drywall joint compound – Room 106A above Room 143. • A108 – White ceiling texture – Exterior. • A110 – White wall texture (same as ceiling texture) – Exterior. • A114 – White wall texture (same as ceiling texture) – Exterior. • A116 – White wall texture (same as ceiling texture) – Exterior. • A130 – Grey gasket – Room 137. • A135 (Layer 1) – Off-white vinyl floor tile – Room 132. • A146 – Red mastic on HVAC ducting – Room 136 (crawl space). • A165 – Off-white vinyl floor tile – Room 117. • A168 – Grey window putty – Room 117. • A170 (Layer 1) – Tan vinyl floor tile – Room 119. • A173 – Pipe thread sealant on fire line – Room 143. • A180 (Layer 1) – Grey vinyl floor tile (inside wall compartment) – Room 106B. • A196 (Layer 1) – White vinyl floor tile – Room 112. • A202 (Layer 2) – tar on floor adjacent door step – Room 110. | Analytical Result: <ul style="list-style-type: none"> • 2.4% Chrysotile • 4.1% Chrysotile • 4.7% Chrysotile • 5.0% Chrysotile • 4.8% Chrysotile • 15% Chrysotile • 4.8% Chrysotile • 1.2% Chrysotile • 1.5% Chrysotile • 10% Chrysotile • 1.4% Chrysotile • 1.4% Chrysotile • 1.2% Chrysotile • 3.6% Chrysotile • 2.4% Chrysotile | Prior to renovation/demolition, the ACM must be removed by a qualified asbestos removal contractor. Work should be performed in accordance with the OHSR and BC HWR. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|---|---|---|
| ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd) | | |
| Suspect ACM Sampled – Asbestos NOT Identified: <ul style="list-style-type: none"> A1 – Grey cementitious material beneath baseboard – Room 125. A2 – Black baseboard – Room 125. A3 (Layer 2) – Tan mastic (A2 adhesive) – Room 125. A4 (Layer 2) – Black mastic (Layer 1 adhesive) – Room 125. A4 (Layer 3) – Tan mastic (A2 adhesive) – Room 125. A6 – Grey window putty – Room 125. A7 – Ceiling tile – Room 125. A8 (Layer 1) – Paper insulation backing – Room 125 (ceiling space). A8 (Layer 2) – Tan wall insulation – Room 125 (ceiling space). A9 (Layer 1) – Silver pipe insulation – Room 125 (ceiling space). A9 (Layer 2) – Black tar on pipe insulation – Room 125 (ceiling space). A10 – White cementitious hole filler in west door – Room 125. A11 (Layer 1) – Silver pipe insulation – Room 125 (ceiling space). A11 (Layer 2) – Black tar on pipe insulation – Room 125 (ceiling space). A12 – Grey wall mortar patch for piping/wiring – Room 125 (ceiling space). A13 – Ceiling tile – Room 125. A14 – Grey putty (loose piece) – Room 125 (ceiling space) A16 (Layer 1) – Black baseboard – Room 127. A16 (Layer 2) – Brown mastic (Layer 1 adhesive) – Room 127. A17 (Layer 1) – Black baseboard – Room 127. A17 (Layer 2) – White mastic (Layer 1 adhesive) – Room 127. | Analytical Result: <ul style="list-style-type: none"> non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos | No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|---|---|---|
| ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd) | | |
| Suspect ACM Sampled – Asbestos NOT Identified (Cont'd) : <ul style="list-style-type: none"> • A18 – Red mastic over doorway – Room 127. • A19 – Pipe thread sealant – Room 127 (crawl space). • A22 – Pipe thread sealant – Room 127 (crawl space). • A24 – Grey sill gasket – Room 127 (crawl space). • A25 – Drywall joint compound between plywood joints – Room 127. • A26 – Drywall joint compound on ceiling patch – Room 124. • A27 – Ceiling tile – Room 124. • A28 (Layer 1) – Black baseboard – Room 124. • A28 (Layer 3) – White mastic on baseboard (Layer 1 adhesive) – Room 124. • A30 – Drywall joint compound in skylight – Room 124. • A31 – Ceiling tile (suspended) – Room 123. • A32 – Ceiling tile (at top of ceiling space) – Room 123. • A33 – Yellow glue under carpet – Room 123 • A36 – White mastic between wall panels (north wall) – Room 123. • A37 – Ceiling tile – Room 129. • A39 – Vinyl wall covering – Room 129. • A42 – Drywall joint compound – Room 128. • A44 – Drywall joint compound – Room 120. • A46 – Grey cementitious on base of east door – Room 120. • A48 – Grey grout – Room 130. • A50 – White pipe insulation wrap (ceiling space) – Room 106A above Room 143. • A51 – Ceiling tile – Room 106A above Room 143. | Analytical Result: <ul style="list-style-type: none"> • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos | No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|--|---|---|
| ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd) | | |
| Suspect ACM Sampled – <u>Asbestos NOT Identified (Cont'd)</u> : <ul style="list-style-type: none"> • A53 – Drywall joint compound – Room 106A. • A54 – Grey grout – Room 106A. • A55 – Brown baseboard – Room 109. • A56 (Layer 1) – Brown mastic (A55 adhesive) – Room 109 • A56 (Layer 2) – Drywall joint compound – Room 109. • A57 – Transition strip glue – Room 109. • A58 – Tan glue under carpet – Room 109. • A59 – Drywall joint compound – Room 151A. • A60 – Brown vinyl wall covering – Room 106A • A61 – Baseboard – Room 151A. • A62 – Yellow glue on baseboard – Room 151A. • A63 – Dark grey grout for floor tiles – Room 105A. • A64 – Beige grout – Room 105A. • A65 – Drywall joint compound – Room 105A. • A66 – Tan HVAC duct mastic – above Room 162. • A67 – Pipe thread sealant – above Room 162. • A68 – Ceiling tile – northeast corner of Room 105A. • A69 – Drywall joint compound (drop ceiling) – above Room 162. • A70 – Drywall joint compound (demising wall) – above Room 162. • A71 – Ceiling stipple – Room 106B (sampled above Room 162). • A72 – Ceiling tile around heat detector – above Room 162. • A73 – Ceiling tile (very large holes) – above Room 162. • A74 – Ceiling tile (random holes) – above Room 162. • A75 – Orange HVAC vent mastic – above Room 162. | Analytical Result: <ul style="list-style-type: none"> • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos | No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|---|---|---|
| ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd) | | |
| Suspect ACM Sampled – <u>Asbestos NOT Identified (Cont'd)</u> : <ul style="list-style-type: none"> • A76 – Plywood knot hole filler (northwest corner) – above Room 162. • A77 – Ceiling stipple – Room 106B outside north side of Room 110A. • A78 – Ceiling stipple – Room 106B near Room 146. • A79 (Layer 1) – Ceiling stipple – Room 106B near Room 146. • A79 (Layer 2) – Drywall joint compound on ceiling – Room 106B near Room 146. • A80 – Ceiling stipple – Room 106B near Room 146. • A81 – Ceiling stipple – Room 106B near Room 146. • A82 – Ceiling stipple – Room 106B near Room 146. • A83 – Asphalt roof around vent – south section of Roof. • A84 – Asphalt roof patch – southwest section of Roof. • A85 – Black mastic around vent – south section of Roof. • A86 – Black mastic on base of lead pipe – south section of Roof. • A87 – Black mastic on lead pipe – south section of Roof. • A88 (Layer 1) – Black shingle – southwest section of Roof. • A88 (Layer 2) – Black roof material – southwest section of Roof. • A89 – Grey sealant around concrete light stand base – southeast corner of Roof. • A90 – Black shingle beneath concrete light stand – southeast corner of Roof. • A91 – Mastic around lead pipe opening for ACU2 wiring – Roof. • A92 – Mastic around lead pipe opening for ACU4 wiring – Roof. • A93 – Texture coat on south wall of raised portion of Roof. • A94 – Black mastic around roof vent – northeast of ACU5. | Analytical Result: <ul style="list-style-type: none"> • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos | No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|---|---|---|
| ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd) | | |
| Suspect ACM Sampled – Asbestos NOT Identified (Cont'd) : <ul style="list-style-type: none"> A95 (Layer 1) – Grey mastic adjacent window on west side of raised portion of Roof. A95 (Layer 2) – Clear mastic adjacent window on west side of raised portion of Roof. A96 – Black mastic around electrical conduit entering building on west side of raised portion of Roof. A97 – Dark brown mastic on south end of sloped metal roofing west of raised portion of Roof. A98 – White mastic on security camera mount – Roof over Room 101. A99 – Black mastic on sloped metal roof west of raised portion of Roof. A100 – Tar paper beneath sloped metal roof west of raised portion of Roof. A101 – Tan mastic between foam and wood supports for metal conduit – east portion of raised section of Roof. A102 – Mastic around lead pipe opening for ACU6 wiring – Roof. A103 – Tar paper (bottom of roof profile) – east of ACU7. A104 (Layer 1) – Black/grey shingle – east of ACU7 (roof profile). A104 (Layer 2) – Black roof material (roof profile). A104 (Layer 3) – Black tar (roof profile). A104 (Layer 4) – Brown fibrous roof material (roof profile). A105 – Grey mastic around steel pipe opening for ACU8 wiring – Roof. A106 – Brown tar paper beneath metal roof siding – east side of building outside Room 107 (exterior). | Analytical Result: <ul style="list-style-type: none"> non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos | No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|---|---|---|
| ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd) | | |
| Suspect ACM Sampled – Asbestos NOT Identified (Cont'd) : <ul style="list-style-type: none"> A107 – Black tar on foundation – southwest corner of building (exterior). A109 (Layer 1) – White texture waterproof membrane on building foundation – west side outside Room 133 (exterior). A109 (Layer 2) – Black tar waterproof membrane. A111 – White mastic on metal conduit entering Room 127 (exterior). A112 – tar paper under textured wood siding – southwest corner of building (exterior). A113 – White window mastic – southwest corner of building outside Room 125 (exterior). A115 – Wall texture coat – west side of building (exterior). A117 – Grey baseboard – Room 138. A118 – Yellow mastic (A117 adhesive) – Room 138. A119 – Brown mastic (A117 adhesive) – Room 138. A120 (Layer 1) – Grey transition strip – Room 138. A120 (Layer 2) – Tan mastic (Layer 1 adhesive) – Room 138. A121 – Tan mastic plywood knot hole filler – Room 138 A122 – Red mastic around conduit over door – Room 138. A123 (Layer 1) – Red mastic around conduit in northeast corner – Room 138. A123 (Layer 2) – Off-White foam hole filler around conduit in northeast corner – Room 138. A124 – Pipe thread sealant on fire line – Room 138. A125 – Drywall joint compound – Room 138. | Analytical Result: <ul style="list-style-type: none"> non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos | No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|---|--|--|
| ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd) | | |
| Suspect ACM Sampled – <u>Asbestos NOT Identified (Cont'd)</u> : <ul style="list-style-type: none"> • A126 – Grey cementitious board along east wall behind transformer – Room 138. • A127 – Pipe thread sealant – Room 137. • A128 – Red gasket – Room 137. • A129 – Tan/silver pipe wrap – Room 137. • A131 – White/silver/tan pipe wrap – Room 137. • A132 – Pipe thread sealant – Room 137. • A133 – Black gasket – Room 137. • A134 – Off-white pipe wrap – Room 137. • A135 (Layer 2) – Black mastic (Layer 1 adhesive) – Room 132. • A136 – Pipe thread sealant on fire line – Room 135. • A137 (Layer 1) – Brown transition strip – Room 133. • A137 (Layer 2) – Clear mastic (Layer 1 adhesive) – Room 133. • A138 – Ceiling tile – Room 133.A139 – Ceiling tile – Room 133. • A140 – Grey cementitious wall board behind transformer on south wall – Room 136. • A141 (Layer 1) – Black vinyl floor tile – Room 136. • A141 (Layer 2) – Black mastic (Layer 1 adhesive) – Room 136. • A142 (Layer 1) – Blue vinyl floor tile – Room 136. • A142 (Layer 2) – Black mastic (Layer 1 adhesive) – Room 136. • A143 – Tan paper insulation backing – Room 135. • A144 – Black pipe wrap – Room 136. • A145 (Layer 1) – Black mastic on pipe wrap – Room 136 (crawl space). | Analytical Result: <ul style="list-style-type: none"> • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos | <p>No renovation/pre-demolition requirements necessary.</p> <p>Note:</p> <p>At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations.</p> |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|---|---|---|
| ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd) | | |
| Suspect ACM Sampled – <u>Asbestos NOT Identified (Cont'd)</u> : <ul style="list-style-type: none"> • A145 (Layer 2) – Tan insulation on pipe – Room 136 (crawl space). • A147 – Grey baseboard – Room 139. • A148 – Tan mastic (A147 adhesive) – Room 139. • A149 – Drywall joint compound – Room 139. • A150 – Ceiling tile (hallway) – Room 139. • A151 – Ceiling tile (closet) – Room 139. • A152 (Layer 1) – Green vinyl floor tile – Room 140. • A152 (Layer 2) – Tan mastic (Layer 1 adhesive) – Room 140. • A153 (Layer 1) – White vinyl floor tile – Room 140. • A153 (Layer 2) – Tan mastic (Layer 1 adhesive) – Room 140. • A154 – Drywall joint compound – Room 142. • A155 (Layer 1) – Light grey vinyl floor tile – Room 141. • A155 (Layer 2) – Tan mastic (Layer 1 adhesive) – Room 141. • A156 – Drywall joint compound – Room 142. • A157 (Layer 1) – Light grey vinyl floor tile (west of Room 125) – Room 114. • A157 (Layer 2) – Black mastic (Layer 1 adhesive) – Room 114. • A158 (Layer 1) – Light grey vinyl floor tile (outside doorway to Room 115) – Room 114. • A158 (Layer 2) – Grey mastic (Layer 1 adhesive) – Room 114. • A159 – Green baseboard – Room 115. • A160 – Yellow mastic (A159 adhesive) – Room 115. • A161 – Black mastic on joist in ceiling space – Room 115. • A162 – Drywall joint compound patch in ceiling – Room 115. | Analytical Result: <ul style="list-style-type: none"> • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos | No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|--|--|---|
| ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd) | | |
| Suspect ACM Sampled – <u>Asbestos NOT Identified (Cont'd)</u> : <ul style="list-style-type: none"> • A163 – Drywall joint compound – Room 117. • A164 (Layer 1) – Grey vinyl sheet flooring – Room 116B. • A164 (Layer 2) – Tan mastic (Layer 1 adhesive) – Room 116B. • A165 (Layer 2) – Black mastic (Layer 1 adhesive) – Room 117. • A165 (Layer 3) – Grey cementitious leveling compound – Room 117. • A166 (Layer 1) – Solid grey vinyl floor tile – Room 116A. • A166 (Layer 2) – Black mastic (Layer 1 adhesive) – Room 116A. • A166 (Layer 3) – Clear mastic (Layer 1 adhesive) – Room 116A. • A167 – Cloth pipe wrap – Room 116A. • A169 – Drywall joint compound adjacent window on frame – Room 117. • A170 (Layer 2) – Black mastic (Layer 1 adhesive) – Room 119. • A170 (Layer 3) – Tan mastic (Layer 1 adhesive) – Room 119. • A171 – Drywall joint compound patch on ceiling – Room 143. • A172 – Ceiling tile – Room 143. • A174 – Grey grout on floor – Room 143. • A175 – Under sink coating – Room 143. • A176 – Tan insulation pipe coating (ceiling space) – Room 143. • A177 – Corner protector on post inside entrance – Room 106B. • A178 – Tan mastic (A177 adhesive) – Room 106B. • A179 – Grey floor grout – Room 106B. • A180 (Layer 2) – Black mastic (Layer 1 adhesive) inside wall cabinet – Room 106B. • A181 – Drywall joint compound (on post) – Room 106B. | Analytical Result: <ul style="list-style-type: none"> • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos • non-asbestos | No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

[illegible]

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|--|---|---|
| ASBESTOS-CONTAINING MATERIALS (ACM) (Cont'd) | | |
| Suspect ACM Sampled – Asbestos NOT Identified (Cont'd) : <ul style="list-style-type: none"> A200 (Layer 1) – Tan mastic (carpet adhesive above vinyl floor tile) – Room 111. A200 (Layer 2) – Grey vinyl floor tile – Room 111. A200 (Layer 3) – Black mastic (Layer 2 adhesive) – Room 111. A201 – Fiberboard wall covering (similar to ceiling tile) – Room 110B. A202 (Layer 1) – Black floor tar – Room 110B. A203 – White floor leveling compound – Room 110B. A204 – Tan putty around door – Room 110B. A205 – Grey leveling compound under carpet – Room 151B. A206 – Grey baseboard – Room 151B. A207 – Tan mastic (A206 adhesive) – Room 151B. A208 – Drywall joint compound between sheets of plywood – Room 107. A209 – Red mastic on north wall (east corner) – Room 107. A210 – Drywall joint compound – Room 110A. | Analytical Result: <ul style="list-style-type: none"> non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos non-asbestos | No renovation/pre-demolition requirements necessary. Note: At the time of this report, ACM means any manufactured article or other material, which contains 0.5% or more asbestos by weight as defined in the regulations. |
| Suspect ACMs not sampled: <ul style="list-style-type: none"> Not all wall cavities could be inspected; therefore, there is the potential for vermiculite insulation to be present within wall cavities. Fire doors to the entrances of Rooms 137 and 138 may contain asbestos-containing filler material. Electrical wiring insulation, gaskets and insulating panels throughout the building. Suspect asbestos-concrete pipes below ground. | Analytical Result: <ul style="list-style-type: none"> N/A N/A N/A N/A | Inaccessible areas suspect of containing ACMs should be inspected prior to renovation/deconstruction activities. All suspect ACMs not sampled should be sampled for asbestos content and managed accordingly. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|--|--|--|
| LEAD PAINT (mg/kg) | | |
| Suspect lead-based paint sampled: <ul style="list-style-type: none"> • P1 – Light brown / blue door – Room 125. • P2 – Brown / blue door / window frames – Room 125. • P3 – White wall – Room 125. • P4 – Green door frame– Room 127. • P5 – Grey wall panel – Room 127. • P6 – White door frame – Room 123. • P7 – Blue wall – Room 123. • P8 – Light brown door – Room 129. • P9 – Light brown / blue door – Room 130. • P10 – Beige trim – Room 120. • P11 – Light brown wall – Room 120. • P12 – Off-white – Room 106A (above 143). • P13 – White – Room 106A (above 143). • P14 – Light blue / white door frame – Room 109. • P15 – Light blue walls – Room 151A. • P16 – Beige wall – Room 105A. • P17 – Yellow paint on steel pipe – Roof. • P18 – Grey paint on wall of raised portion – Roof. • P19 – White paint on soffit of raised portion – Roof. • P20 – Black paint on ladder to raised portion – Roof. • P21 – Dark brown window trim on East side of raised portion – Roof. • P22 – White on tar on foundation – Exterior. • P23 – Brown – Exterior. • P24 – Blue – Exterior. | Analytical Result: <ul style="list-style-type: none"> • <u>5,700 mg/kg</u> • <u>8,350 mg/kg</u> • <u>788 mg/kg</u> • <u>8,480 mg/kg</u> • <u>990 mg/kg</u> • < 3 mg/kg • < 15 mg/kg • < 3 mg/kg • <u>1,780 mg/kg</u> • <u>187 mg/kg</u> • < 3 mg/kg • <u>1,570 mg/kg</u> • <u>1,350 mg/kg</u> • <u>461 mg/kg</u> • < 3 mg/kg • 50.4 mg/kg • <u>18,800 mg/kg</u> • <u>732 mg/kg</u> • <u>34,500 mg/kg</u> • <u>337 mg/kg</u> • <u>3,430 mg/kg</u> • <u>4,220 mg/kg</u> • < 15 mg/kg • <u>173 mg/kg</u> | Lead paint was identified containing >90 mg/kg in the majority of samples. If cutting torch, grinding equipment or other work methods are used on the painted areas of the structures that could mobilize lead dust or fumes then high risk individuals such as pregnant women or children should be kept out of the work area. Most of the paint samples were also found to be containing lead concentrations >600 mg/kg . Therefore, an exposure control plan must be implemented if work activities could generate lead dust or fumes. A fog nozzle to wet the area should be used to reduce particles during the demolition process. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|---|---|---|
| LEAD PAINT (mg/kg) (Cont'd) | | |
| <p>Suspect lead-based paint sampled:</p> <ul style="list-style-type: none"> • P25 – Dark brown door frame– Exterior. • P26 – Light grey / white on concrete foundation – Exterior. • P27 – Pink wall and ceiling – Room 128B. • P28 – Grey floor – Room 138. • P29 – Beige wall – Room 138. • P30 – Dark grey plywood wall – Room 138. • P31 – Light grey plywood wall – Room 138. • P32 – Grey plywood wall – Room 138. • P33 – Beige wall – Room 137. • P34 – Grey primer on wall in ceiling space – Room 142. • P35 – Green door frame – Room 135. • P36 – Light brown door frame– Room 132. • P37 – Red / brown door paint – Room 143. • P38 – Beige wall – Room 143. • P39 – Brown door frame paint – Room 143. • P40 – Red window frame (west wall) – Room 106B. • P41 – Brown door to wall cabinet – Room 106B. • P42 – Yellow paint in wall cabinet – Room 106B. • P43 – Beige wall paint – Room 106B. • P44 – Yellow door frame paint – Room 112. • P45 – White trim paint in ceiling space – Room 113. • P46 – Beige – collected from steel pipe – Room 110B. • P47 – Light brown wall – Room 151B. • P48 – Beige – collected from steel pipe – Room 107. | <p>Analytical Result:</p> <ul style="list-style-type: none"> • <u>4,080 mg/kg</u> • <u>2,500 mg/kg</u> • <u>370 mg/kg</u> • <u>2,110 mg/kg</u> • <u>745 mg/kg</u> • 19.5 mg/kg • < 3 mg/kg • < 24 mg/kg • <u>524 mg/kg</u> • <u>130 mg/kg</u> • <u>1,170 mg/kg</u> • <u>4,810 mg/kg</u> • < 3 mg/kg • < 3 mg/kg • < 3 mg/kg • <u>705 mg/kg</u> • <u>952 mg/kg</u> • <u>5,780 mg/kg</u> • 21.5 mg/kg • <u>396 mg/kg</u> • 40.1 mg/kg • <u>667 mg/kg</u> • < 3 mg/kg • < 9 mg/kg | <p>Lead paint was identified containing >90 mg/kg in the majority of samples. If cutting torch, grinding equipment or other work methods are used on the painted areas of the structures that could mobilize lead dust or fumes then high risk individuals such as pregnant women or children should be kept out of the work area. Most of the paint samples were also found to be containing lead concentrations ≥600 mg/kg. Therefore, an exposure control plan must be implemented if work activities could generate lead dust or fumes. A fog nozzle to wet the area should be used to reduce particles during the demolition process.</p> |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|--|---|---|
| LEAD PAINT (mg/kg) (Cont'd) | | |
| Suspect lead-based paint sampled: <ul style="list-style-type: none"> P49 – Light grey door frame – Room 115. | Analytical Result: <ul style="list-style-type: none"> < 18 mg/kg | No renovation/pre-demolition requirements necessary. |
| POLYCHLORINATED BIPHENYLS | | |
| Fluorescent and HID light ballasts were identified/suspected in the following areas: <ul style="list-style-type: none"> Throughout the interior and exterior of the building. | <ul style="list-style-type: none"> Approximately 250 fluorescent lights ballasts were identified (throughout the building). Approximately 15 HID light ballasts were identified (Rooms 106A, 106B and 102). Approximately 6 HID light ballasts were identified on the roof facing air side. | <p>Prior to renovation/demolition remove all light ballasts and/or capacitors. Inspect for PCB-containing and/or suspect PCB-containing ballasts as per Environment Canada publication, <i>Identification of Lamp Ballasts Containing PCBs, Report EPS 2/CC/2</i>, August 1991.</p> <p>Place known or suspect PCB-containing ballasts in an 18-gauge steel painted drum with a close fitting removable steel lid on top of a gasket of PCB-resistant material. The drum is to be supplied by the demolition contractor. Drums should be disposed of in Canada in accordance with HWR.</p> |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|---|---|---|
| OZONE DEPLETING SUBSTANCES | | |
| <p>A total of 23 air conditioning units, water cooling units and refrigerators/freezers were identified on the Site and include the following:</p> <p>Room 162</p> <ul style="list-style-type: none"> Ice Maker. Refrigerator (left unit on west wall). Freezer (right unit on west wall). Air conditioning unit (ceiling space). <p>Room 161</p> <ul style="list-style-type: none"> Cooler (small on south wall, west side). Drink cooler (north wall, east side). Freezer (east wall). <p>Room 151B</p> <ul style="list-style-type: none"> Water cooler. <p>Room 110A</p> <ul style="list-style-type: none"> Refrigerator. <p>Room 113</p> <ul style="list-style-type: none"> Water cooler. Refrigerator. <p>Room 116A</p> <ul style="list-style-type: none"> Refrigerator. | <ul style="list-style-type: none"> 9 oz of R404a refrigerant 21 oz of R134a refrigerant 27 oz of R404a refrigerant 13.1 oz of R410a refrigerant <ul style="list-style-type: none"> 9 oz of R134a refrigerant 17 oz of R22 refrigerant (ODS) No identification tag <ul style="list-style-type: none"> 1.23 oz of R134a refrigerant <ul style="list-style-type: none"> 1.76 oz of R134a refrigerant <ul style="list-style-type: none"> 1.66 oz of R134a refrigerant Tag inaccessible <ul style="list-style-type: none"> 1.59 oz of R134a refrigerant | <p>ODS refrigerants (i.e., R22) should be recovered by qualified personnel and disposed of in accordance with Regulations made under CEPA.</p> <p>Non-ODS refrigerants (R134a and R404a) were identified on the site which contains hydrofluorocarbons (HFC) that are regulated in the Federal Halocarbon Regulations as per item 11 (HFC) of Schedule 1 – List of Halocarbons. As a result, halocarbon-containing Non-ODS refrigerants should be recovered by qualified personnel and disposed of in accordance with Federal Regulations.</p> |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|--|--|---|
| OZONE DEPLETING SUBSTANCES (Cont'd) | | |
| <u>Room 116B</u> Freezer. <u>Room 134</u> <ul style="list-style-type: none"> Refrigerator. <u>Room 136</u> <ul style="list-style-type: none"> Wall mounted air conditioning unit. <u>Room 140</u> <ul style="list-style-type: none"> Water cooler (white). Water cooler (black). Refrigerator. <u>Roof</u> <ul style="list-style-type: none"> Air Conditioning Unit 2 Air Conditioning Unit 4 Air Conditioning Unit 5 Air Conditioning Unit 6 Air Conditioning Unit 7 Air Conditioning Unit 8 | <ul style="list-style-type: none"> 4.2 oz of R134a refrigerant <ul style="list-style-type: none"> No identification tag <ul style="list-style-type: none"> 22.9 oz of R410a refrigerant <ul style="list-style-type: none"> No refrigerant listed on ID tag 32 g of R134a refrigerant 75 g of R134a refrigerant <ul style="list-style-type: none"> 7 lbs 0 oz of R22 refrigerant 4 lbs 12 oz of R22 refrigerant 7 lbs 0 oz of R22 refrigerant 8 lbs 6 oz of R22 refrigerant 7 lbs 9 oz of R22 refrigerant 3 lbs 3 oz of R22 refrigerant | <p>ODS refrigerants (i.e., R22) should be recovered by qualified personnel and disposed of in accordance with Regulations made under CEPA.</p> <p>Non-ODS refrigerants (R134a and R404a) were identified on the site which contains hydrofluorocarbons (HFC) that are regulated in the Federal Halocarbon Regulations as per item 11 (HFC) of Schedule 1 – List of Halocarbons. As a result, halocarbon-containing Non-ODS refrigerants should be recovered by qualified personnel and disposed of in accordance with Federal Regulations.</p> |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|--|--|---|
| MISCELLANEOUS SOLID AND LIQUID WASTES | | |
| <ul style="list-style-type: none"> • Lead-based batteries were identified in the following Rooms: <ul style="list-style-type: none"> ➤ 125 – Potential lead-based batteries in the fire control box on the north wall. ➤ 127 – Two (2) lead-based batteries (one in each fire control box on the west wall); eight (8) lead-containing batteries (car sized) on the south wall; one (1) lead-based battery in the control box on the east wall. ➤ 138 – Additional lead-based batteries may be present in other electrical equipment and/or control boxes that were not accessible during the survey. • Approximately five (5) potential lead-based batteries may be present in the emergency lighting boxes located in the following Rooms: <ul style="list-style-type: none"> ➤ 102 – North wall. ➤ 109 – South wall. ➤ 106B – West wall, north of the front entrance. ➤ 112 – East wall over the south doorway. ➤ 127 – East wall, southeast corner. • Soldering equipment located in Room 133. • Potential lead-containing bell and spigot cast iron pipe joint packing was identified in the crawlspace of Room 127. | <ul style="list-style-type: none"> • Potential for lead containing material. • Lead containing material. • Potential for lead containing material. • Potential for lead containing material. • Potential for lead containing material. • Potential for lead containing material. • Potential for lead containing material. | <p>These materials must be removed prior to demolition. However, if these materials are to be disposed of or recycled, it is the responsibility of the qualified contractor to correctly identify and characterize the wastes observed and dispose of or recycle appropriately.</p> |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|---|---|--|
| SOLID AND LIQUID WASTES (Cont'd) | | |
| <ul style="list-style-type: none"> • Copper piping solder joints located throughout the building. • Potential lead-containing roof vent pipes located on the exterior roof. • Approximately 12 fire extinguishers were identified in Rooms 105B, 107, 110, 114, 116A, 124, 127, 135, 136, 138, and 162. • Various cleaning supplies located in Room 128A (janitor's storage room). • Flammable storage box in Room 135 containing various paints, oils, propane, etc. • Nine (9) Sinclair canisters (appeared empty – unknown contents [no additional labels]) in Room 135. | <ul style="list-style-type: none"> • Potential for lead containing material. • Potential for lead containing material. | These materials must be removed prior to demolition. However, if these materials are to be disposed of or recycled, it is the responsibility of the qualified contractor to correctly identify and characterize the wastes observed and dispose of or recycle appropriately. |
| LIQUID MERCURY | | |
| <ul style="list-style-type: none"> • Four (4) mercury-containing thermostats were observed in the building at the following locations: <ul style="list-style-type: none"> ➤ Room 110 – Two (2) thermostats on the north wall (northeast corner). ➤ Room 140 – East wall. ➤ Room 142 – South wall. | <ul style="list-style-type: none"> • Two (2) ampoules of mercury; one ampoule in each thermostat. • One (1) ampoule of mercury. • One (1) ampoule of mercury. | The mercury containing ampoules must be removed prior to renovation/demolition and reused, recycled or disposed of in accordance with the BC HWR and applicable Regulations made under CEPA. |
| RADIOLOGICAL SOURCES AND SUBSTANCES | | |
| No suspect radiological sources or substances were observed. | <ul style="list-style-type: none"> • None identified. | No renovation/pre-demolition requirements necessary. |

Table 1 (Cont'd): Detailed Inventory of Regulated Materials – 3000 Airport Road (Airport Terminal Building), Penticton, BC

| Issue / Location | Results | Renovation/Pre-Demolition Requirement |
|--|---|--|
| SILICA | | |
| <p>Silica may be present throughout the building in the following materials:</p> <ul style="list-style-type: none"> • Concrete floors • Ceramic tiles • Ceiling tiles • Mortar • Drywall | <ul style="list-style-type: none"> • N/A | <p>If the material is to be cut, ground, drilled or broken up during renovation/demolition, then airborne silica particles may be released. Therefore, an exposure control plan must be implemented if work activities could generate silica dust.</p> |
| MOULD AND/OR MOISTURE | | |
| None was identified. | <ul style="list-style-type: none"> • N/A | No renovation/pre-demolition requirements necessary. |

8 NOTICE TO READER

This report has been prepared by SNC-Lavalin Inc. (SNC-Lavalin) for Canada, who has been party to the development of the scope of work for this project and understands its limitations¹. Copyright of this report vests with Her Majesty the Queen in Right of Canada. This report was prepared in accordance with a services contract between SNC-Lavalin and Canada, including General Conditions 2035 of the Standard Acquisition Clauses and Conditions (SACC) Manual.

This report is intended to provide information to Canada to assist it in making business decisions. SNC-Lavalin is not a party to the various considerations underlying the business decisions, and does not make recommendations regarding such business decisions.

The findings, conclusions and recommendations in this report have been developed in a manner consistent with the level of skill normally exercised by environmental professionals currently practising under similar conditions in the area. The findings contained in this report are based, in part, upon information provided by others. If any of the information is inaccurate, modifications to the findings, conclusions and recommendations may be necessary.

The findings, conclusions and recommendations presented by SNC-Lavalin in this report reflect SNC-Lavalin's best judgement based on the site conditions at the time of the site inspection on the date(s) set out in this report and on information available at the time of preparation of this report. Substances other than those described may exist within the site, reported substance parameters may exist in areas of the site not investigated, and concentrations of substances greater or less than those reported may exist between sample locations.

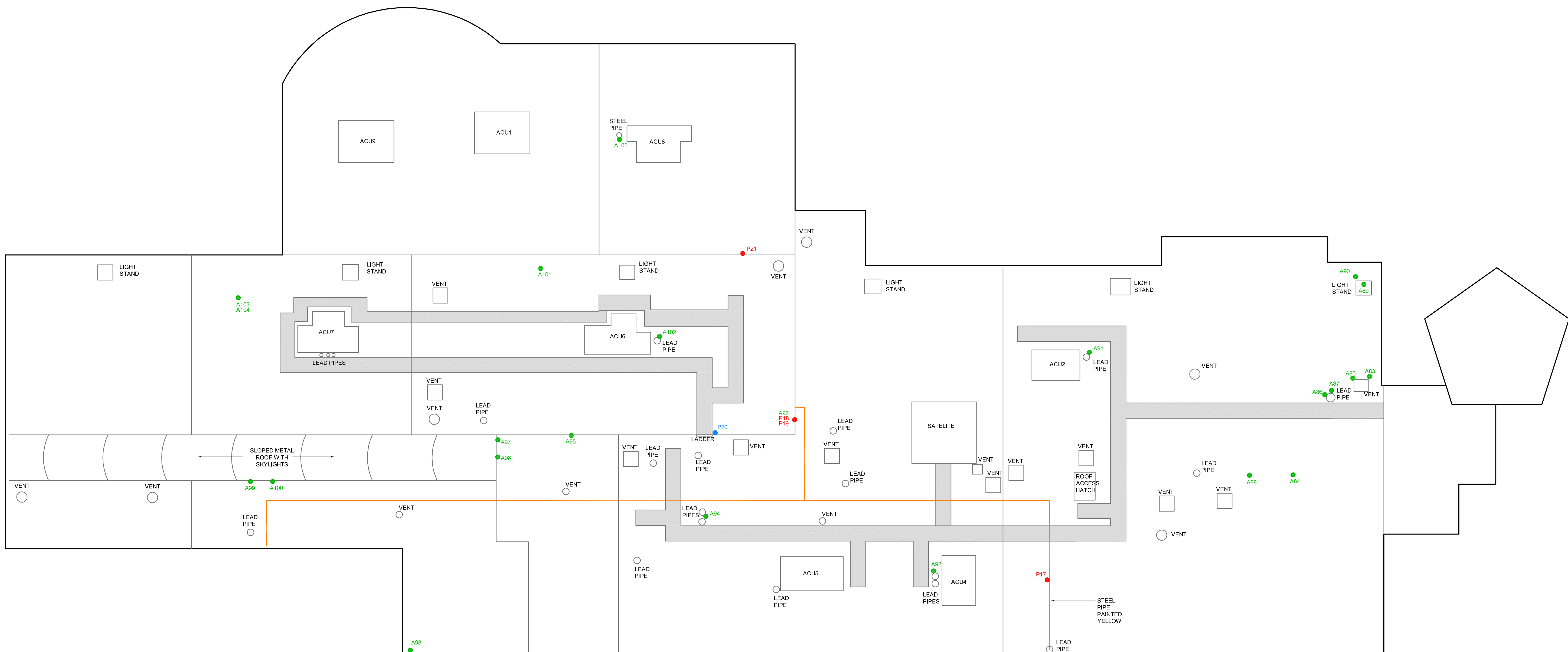
The findings and conclusions of this report are valid only as of the date of this report. If site conditions change, new information is discovered, or unexpected site conditions are encountered in future work, including excavations, borings, or other studies, the findings, conclusions and/or recommendations of this report should be re-evaluated. It is recommended that users of this report should engage a suitably qualified professional to assist in interpreting the significance, if any, of the findings.

¹ © Her Majesty the Queen in Right of Canada (2015)

APPENDIX I

Drawings:

- 636746-BM1 – Sample Location Plan – First Floor
- 636746-BM2 – Sample Location Plan – Roof



SAMPLE LOCATION PLAN - ROOF PLAN

LEGEND



- | | |
|-----|--|
| A13 | ASBESTOS SAMPLE WITH CONCENTRATION LESS THAN 0.5% |
| A14 | ASBESTOS SAMPLE WITH CONCENTRATION GREATER THAN OR EQUAL TO 0.5% |
| P18 | PAINT SAMPLE WITH LEAD CONCENTRATION LESS THAN OR EQUAL TO 90 mg |
| P23 | PAINT SAMPLE WITH LEAD CONCENTRATION GREATER THAN 90 mg AND LESS THAN 600 mg |
| P17 | PAINT SAMPLE WITH LEAD CONCENTRATION GREATER THAN OR EQUAL TO 600 mg |

NOTES

1. ORIGINAL DRAWING IN COLOUR.
2. LOCATION OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED ON SITE. NOT ALL UTILITIES MAY BE SHOWN.

REFERENCE DRAWINGS

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| CLIENT NAME: PUBLIC WORKS AND GOVERNMENT SERVICES | PROJECT LOCATION: 109-3000 AIRPORT ROAD PENTICTON, BC |
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| TITLE: | SAMPLE LOCATION PLAN - ROOF PLAN |
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|-------------|---------------------|--------------------|------------------------|
| DWN BY: AJK | SCALE: 1:1000 | DATE: 2016-03-03 | DWG No: REV.: 0 |
| CHK'D: TDD | PLOT: 20160502.1024 | CADFILE:636476-BM3 | 636476-BM2 |

PATH: P:\CURRENT PROJECTS\PWGSC\636476-PENTICTON AIRPORT\4.0 EXECUTION\4.5 GIS AND DRAWING\CAD\636476-BM3.DWG

APPENDIX II

Photographs



Photograph 1: West side of building (front entrance on right) – Facing southeast.



Photograph 2: North side of building – Facing east.



Photograph 3: Front (west) side of building – Facing north.



Photograph 4: South end of building – Facing north.



Photograph 5: East side of building (Rooms 105B/107 on left, new hold room on right) – Facing northwest.



Photograph 6: Airside (east) arrivals entrance – Facing northwest.



Photograph 7: Roof – Facing north towards raised portion of roof.



Photograph 8: Roof – Facing south (standing west of raised portion of roof).



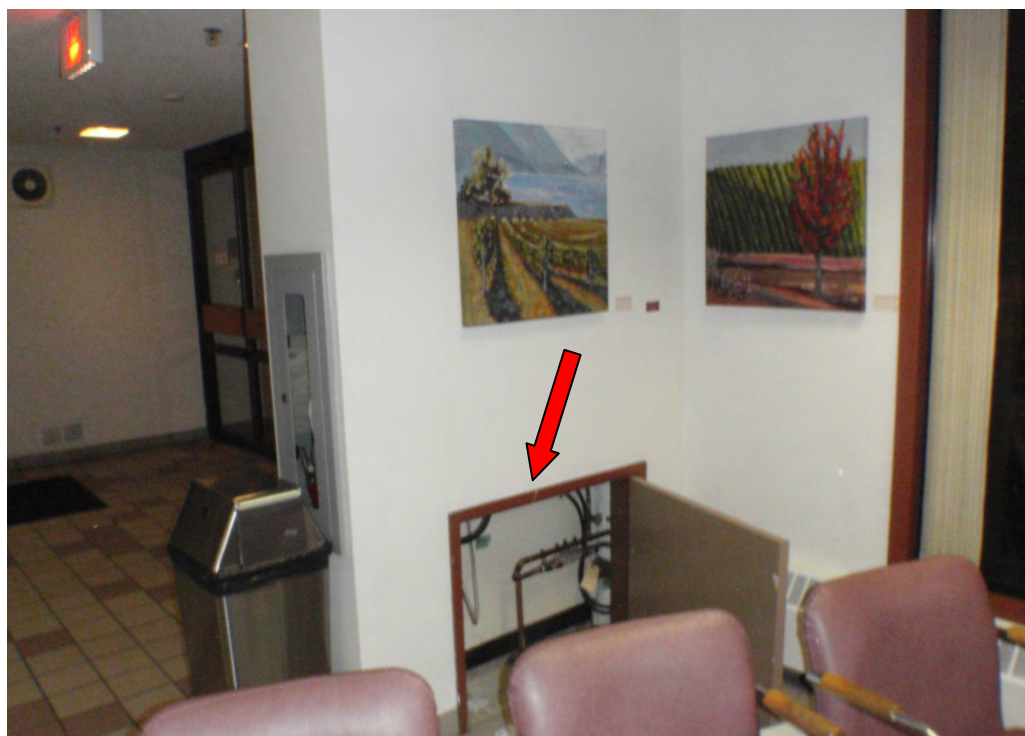
Photograph 9: Raised portion of roof – Facing north..



Photograph 10: Room 106A – Air Canada and West Jet counters – Facing southeast.



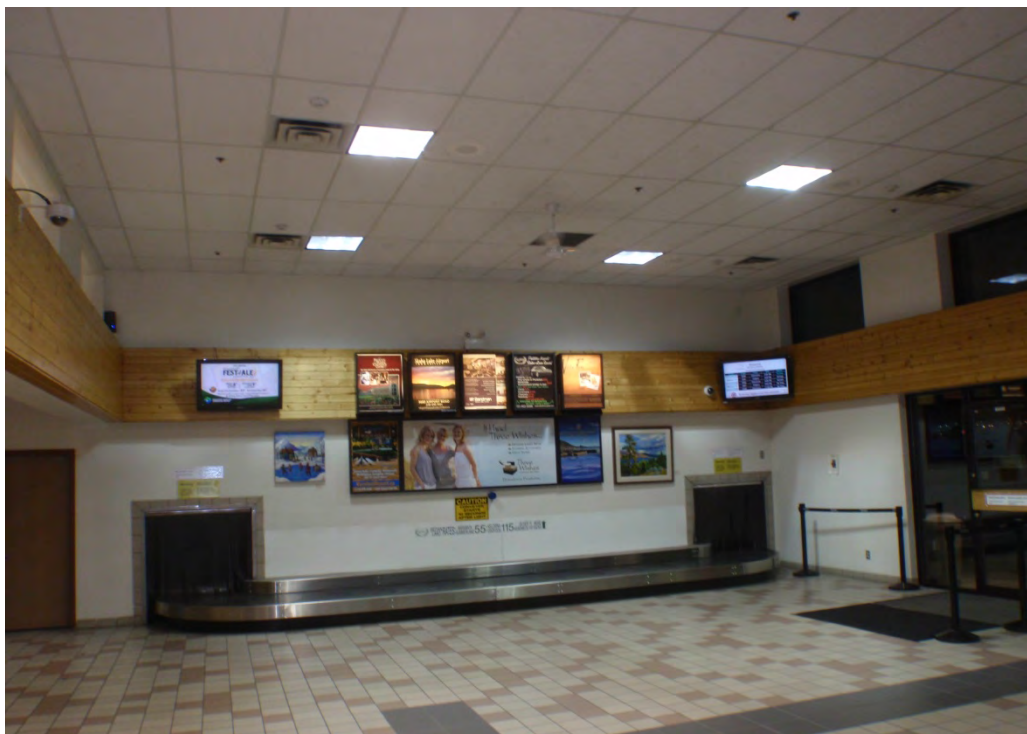
Photograph 11: Room 106B (north of entrance and west of restaurant) – Facing south.



Photograph 12: Wall compartment in Room 106B (south wall), north of entrance – Facing southwest.



Photograph 13: Room 106B – Facing north (arrivals area in right of photo).



Photograph 14: Room 102 (arrivals) – Facing north towards baggage claim carousel.



Photograph 15: Room 160 (restaurant) – Facing southeast.



Photograph 16: Room 105A (security waiting area) – Facing east.



Photograph 17: Room 127 crawlspace with asbestos-containing concrete pipe.



Photograph 18: Room 136 crawlspace.



Photograph 19: Asbestos-containing concrete pipe (capped) on west side of building.



Photograph 20: Room 135 – Flammable storage box.



Photograph 21: Room 135 Sinclair canisters – unknown contents.



Photograph 22: Typical lead-acid battery in fire control box (Room 127).



Photograph 23: Room 127 lead-containing batteries.



Photograph 24: Typical emergency light with potentially lead-containing battery (Room 127).



Photograph 25: Typical mercury-containing thermostat (Room 142).



Photograph 26: Typical rooftop air conditioning unit.



Photograph 27: Typical potential lead-containing roof vent pipe.



Photograph 28: Asbestos-containing drywall joint compound in Room 125 (**Sample A3**).



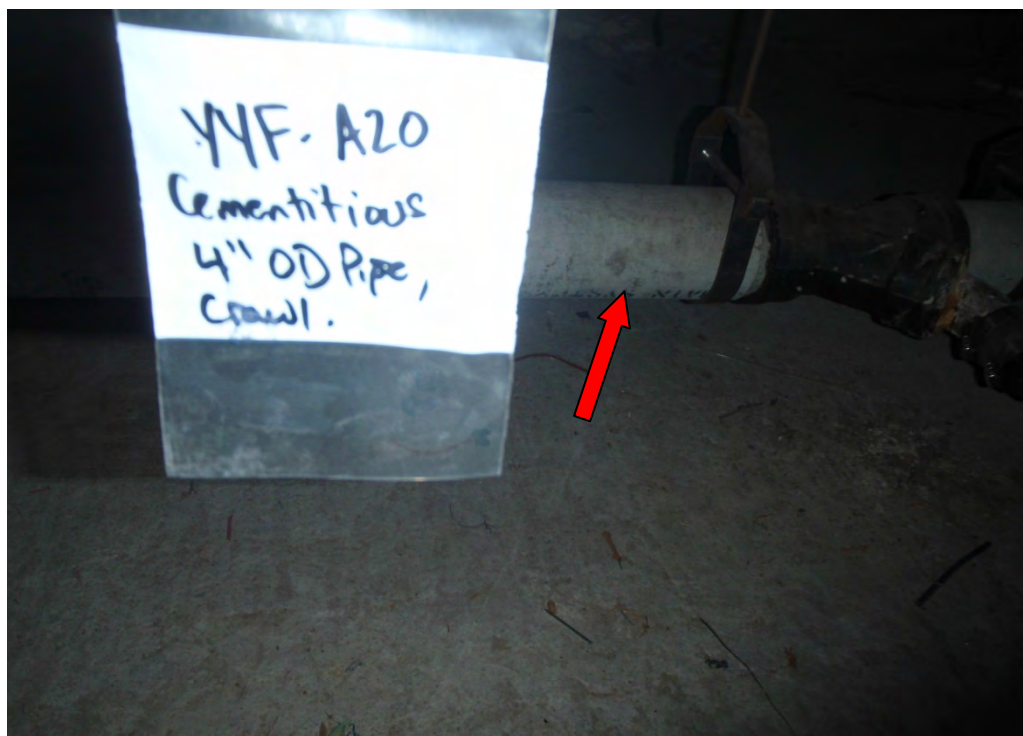
Photograph 29: Asbestos-containing light grey (off-white with grey streaks) vinyl floor tiles in Room 125 (Sample A4).



Photograph 30: Asbestos-containing drywall joint compound in Room 125 (Sample A5).



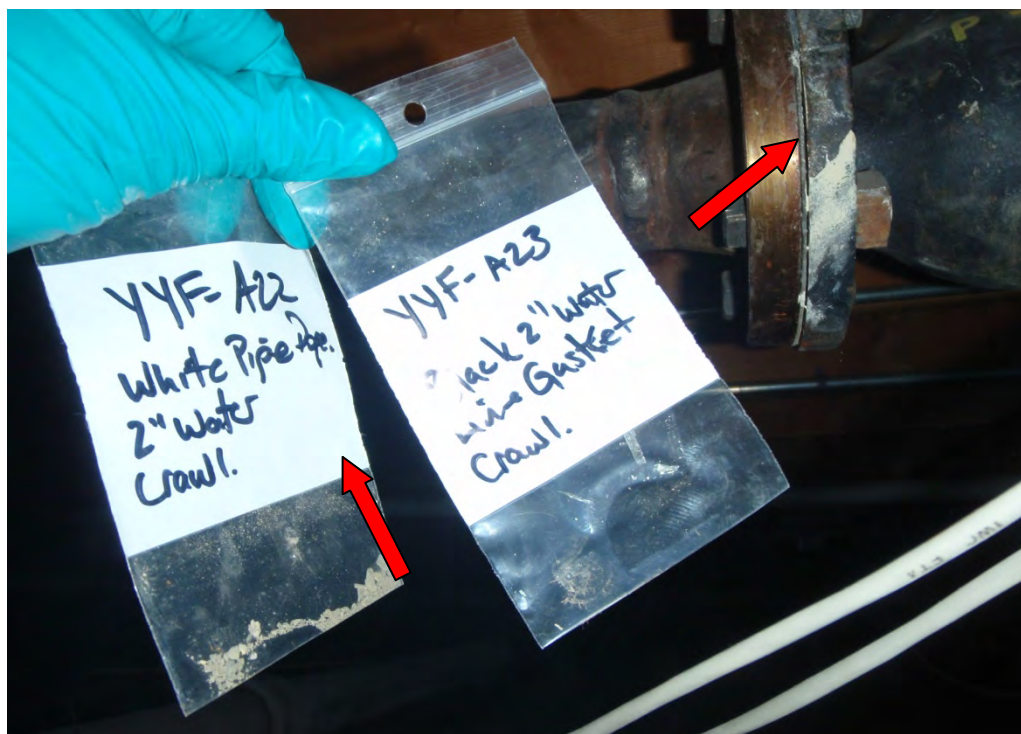
Photograph 31: Asbestos-containing green vinyl floor tiles (**Sample A15**).



Photograph 32: Asbestos-containing concrete pipe in crawlspace beneath Room 127 (**Sample A20**).



Photograph 33: Asbestos-containing bell and spigot joint filler (**Sample A21**).



Photograph 34: Asbestos-containing grey gasket in crawlspace beneath Room 127 (**Sample A23**) and non-asbestos containing white pipe sealant (**Sample A22**).



Photograph 35: Asbestos-containing drywall joint compound in Room 124 (**Sample A28**).



Photograph 36: Asbestos-containing pipe thread sealant on fire line in Room 124 (**Sample A29**).



Photograph 37: Asbestos-containing grey vinyl floor tile (**Sample A34**) and associated black mastic (**Sample A35**) over white floor leveling compound (**Sample A35 – Layer 2**) in Room 123.



Photograph 38: Asbestos-containing grey vinyl floor tile (**Sample A38**).



Photograph 39: Asbestos-containing drywall joint compound in Room 130 (**Sample A40**).



Photograph 40: Asbestos-containing drywall joint compound in ceiling space of Room 120 (**Sample A41**).



Photograph 41: Asbestos-containing grey window putty in Room 120 (Sample A43).



Photograph 42: Asbestos-containing grey vinyl floor tile debris located in the floor vent in Room 120 (Sample A45).



Photograph 43: Asbestos-containing drywall joint compound in Room 120 (**Sample A47**).



Photograph 44: Asbestos-containing grey window putty on upper window in Room 106A above Room 143. (**Sample 49**).



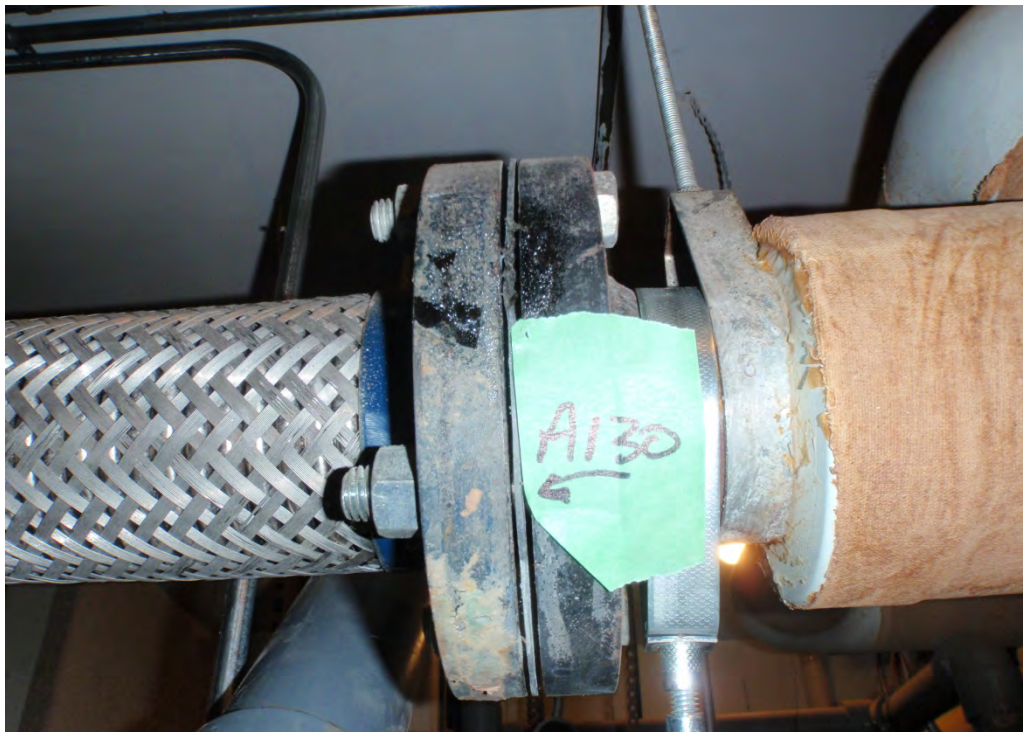
Photograph 45: Asbestos-containing drywall joint compound in Room 106A above Room 143 (**Sample A52**).



Photograph 46: Asbestos-containing exterior ceiling texture on south end of building (**Sample A108**).



Photograph 47: Asbestos-containing exterior wall texture on west side of building (**Sample A114** and **Sample A116**).



Photograph 48: Asbestos-containing grey pipe gasket in Room 137 (**Sample A130**).



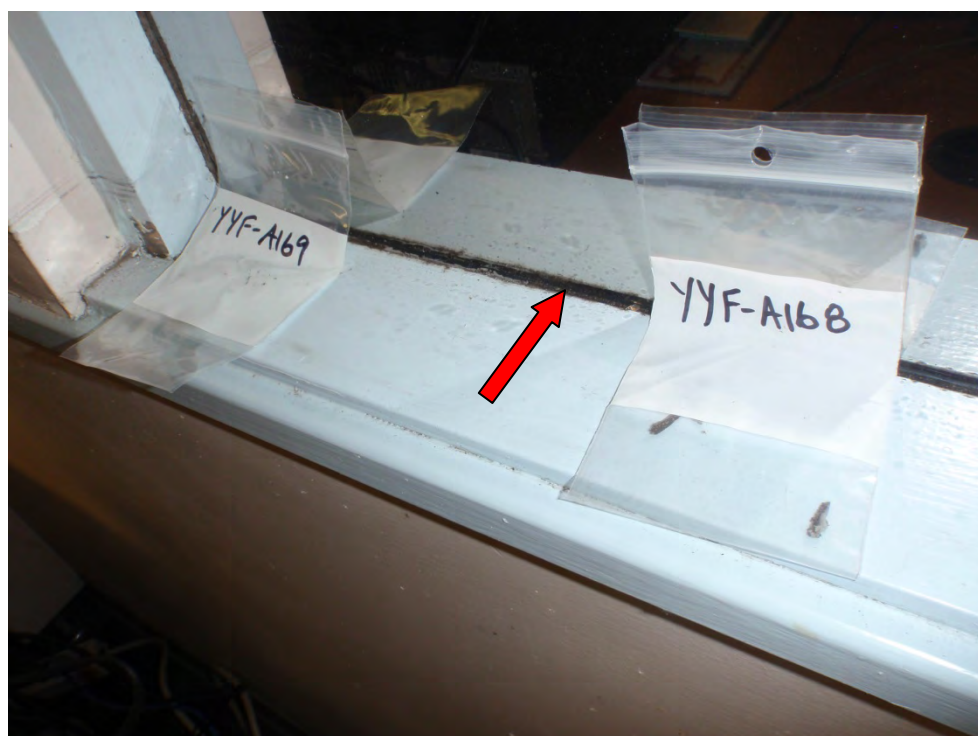
Photograph 49: Asbestos-containing off-white vinyl floor tile in Room 117 (**Sample A135**).



Photograph 50: Asbestos-containing red mastic on HVAC ducting in crawlspace beneath Room 136 (**Sample A146**).



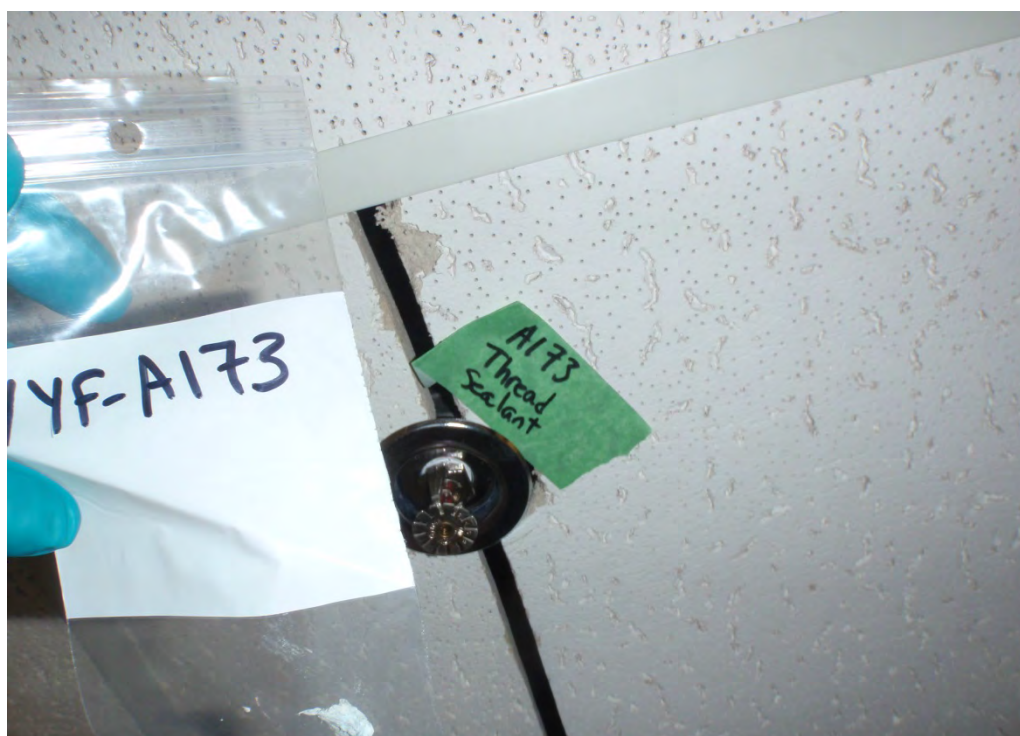
Photograph 51: Asbestos-containing off-white vinyl floor tile in Room 117 (**Sample A165**).



Photograph 52: Asbestos-containing grey window putty in Room 117 (**Sample A168**).



Photograph 53: Asbestos-containing tan vinyl floor tile in Room 119 (**Sample A170**).



Photograph 54: Asbestos-containing pipe thread sealant on fire line in Room 143 (**Sample A173**).



Photograph 55: Asbestos-containing grey vinyl floor tile located inside wall compartment in Room 106B (Sample A180).



Photograph 56: Asbestos-containing white vinyl floor tile in Room 112 (Sample A196).



Photograph 57: Asbestos-containing tar on floor adjacent door step in Room 110 (**Sample A202**).



Photograph 58: Typical fire door to Room 137 (not sampled - inaccessible).



Photograph 59: Lead-based light brown/blue paint on double doors in Room 125 (**Sample P1**).



Photograph 60: Lead-based brown paint on door and window frames in Room 125 (**Sample P2**).



Photograph 61: Lead-based white paint on walls in Room 125 (**Sample P3**).



Photograph 62: Lead-based green paint on door frame in Room 127 (**Sample P4**).



Photograph 63: Lead-based grey paint on a wall panel in Room 127 (**Sample P5**).



Photograph 64: Lead-based light brown / blue paint on door to Room 130 (**Sample P9**).



Photograph 65: Lead-based beige wall trim in Room 120 (**Sample P10**).



Photograph 66: Lead-based off-white trim paint in Room 106A above Room 143 (**Sample P12**).



Photograph 67: Lead-based white paint in Room 106A above Room 143 (**Sample P13**).



Photograph 68: Lead-based light blue/white paint on small door frame in Room 109 (**Sample P14**).



Photograph 69: Lead-based yellow paint on steel pipe on roof (**Sample P17**).



Photograph 70: Lead-based grey paint on wall of raised portion of roof (**Sample P18**) and lead-based white paint on soffit of raised portion of roof (**Sample P19**).



Photograph 71: Lead-based black paint on ladder to raised portion of roof (**Sample P20**).



Photograph 72: Lead-based dark brown paint on window trim on east side of raised portion of roof (**Sample P21**).



Photograph 73: Lead-based white paint on tar of foundation exterior (**Sample P22**).



Photograph 74: Lead-based blue paint on exterior of building (**Sample P24**).



Photograph 75: Lead-based dark brown paint on exterior door frame to Room 125 (**Sample P25**).



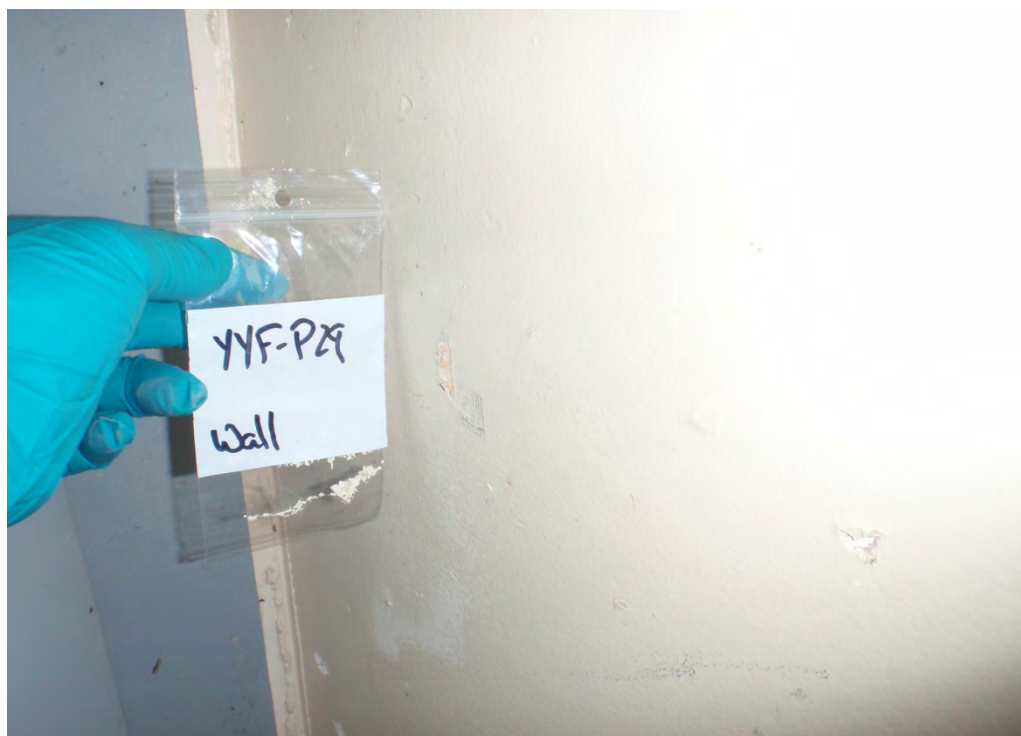
Photograph 76: Lead-based exterior light grey / white paint on concrete foundation (**Sample P26**).



Photograph 77: Lead-based pink wall and ceiling paint in Room 128B (**Sample P27**).



Photograph 78: Lead-based grey floor paint on concrete in Room 138 (**Sample P28**).



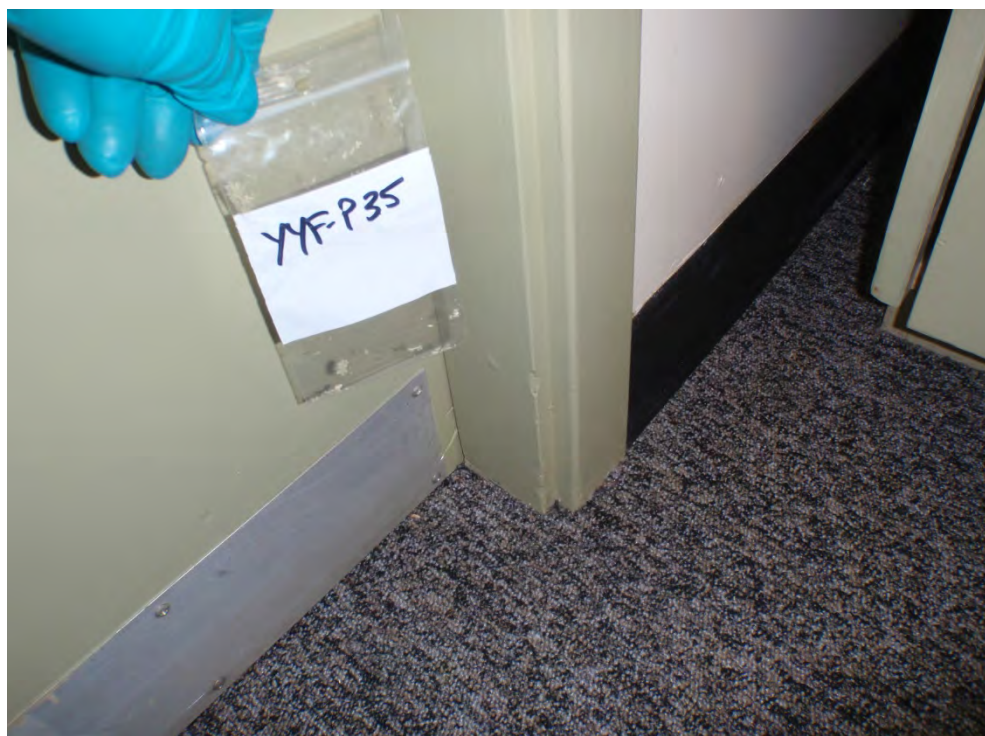
Photograph 79: Lead-based beige paint on walls of Room 138 (**Sample P29**).



Photograph 80: Lead-based beige paint on walls of Room 137 (**Sample P33**).



Photograph 81: Lead-based grey primer paint on wall in ceiling space of Room 142 (**Sample P34**).



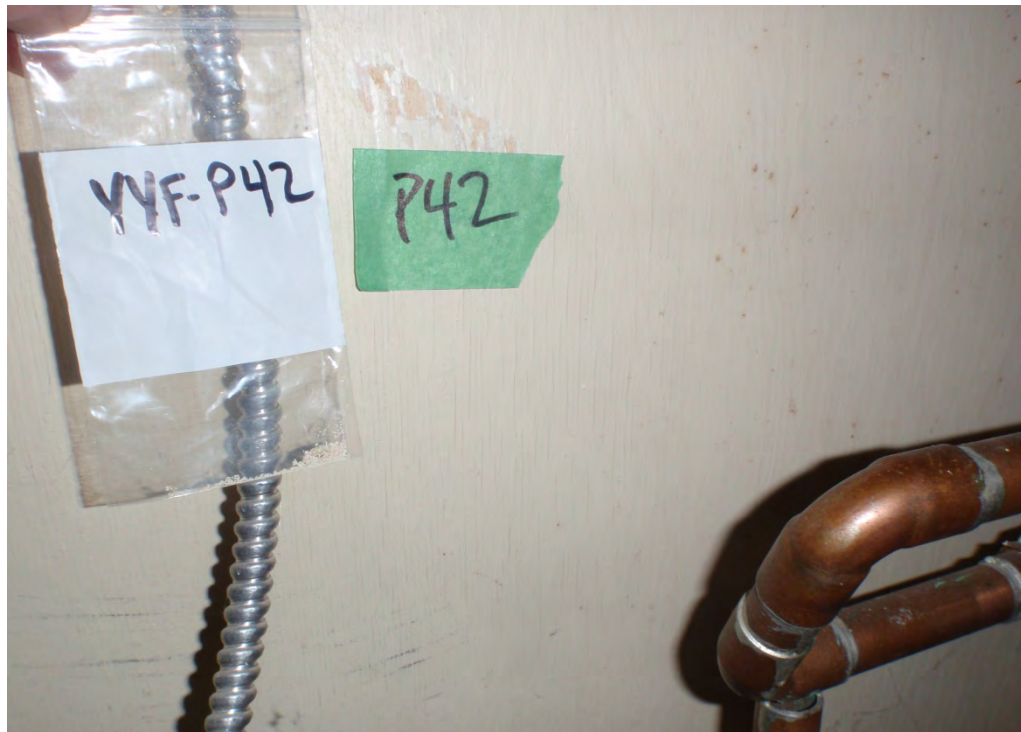
Photograph 82: Lead-based green paint on door frame of Room 135 (**Sample P35**).



Photograph 83: Lead-based red paint on window trim along the west wall of Room 106B (**Sample P40**).



Photograph 84: Lead-based brown paint on door to Room 143 (**Sample P41**).



Photograph 85: Lead-based yellow paint in wall cabinet on south end of Room 106B (**Sample P42**).



Photograph 86: Lead-based yellow paint on door frame of Room 112 (**Sample P44**).



Photograph 87: Lead-based beige paint on steel pipe near ceiling of Room 107 (**Sample P46**).

APPENDIX III

Laboratory Analytical Report (IATL)



9000 Commerce Parkway Suite B
Mt. Laurel, NJ 08054
Telephone: (856) 231-9449
Email: customerservice@iatl.com

Cover Letter

Apr 07, 2016

SNC - Lavalin, Inc.

Thank you for choosing iATL for your analytical needs. The Report herein along with the chain of custody contains details of (1) the transmittal of the samples from you to our laboratory, (2) the acceptance and analysis of the samples, (3) the supporting documentation tied to this project, (4) any QA notifications or communications, and (5) our invoice for this project. In addition:

- Please carefully look over these report deliverables and make sure that it meets your needs. Depending upon regulator and accrediting body limitations, you may have some choices for the formatting and data presentation beyond what follows. Please contact our customer service department for information on any options.
- You may intend for all, or select, samples in this submittal to move forward in the laboratory for other testing procedures. The batch sheet in this Report may list that authorization to proceed. Please login to our secure client portal and check this status or to confirm any additional analyses.
- If there are other offices, individuals, or customers who you think should receive this report – please send us that information and we will happily forward the report.

iATL is always seeking to improve our services and the customer experience. Any feedback that you can supply would benefit our commitment to quality. Please consider emailing any of the contacts on the next page of this report.

Finally, I wanted to take this opportunity to express our appreciation in your choice of iATL. We value our customers and seek to earn your business... one sample at a time.

Regards,

A handwritten signature in black ink, appearing to read "Eric Snyder", followed by a long horizontal line.

Eric Snyder
President, iATL

A handwritten signature in black ink, appearing to read "Frank Ehrenfeld", followed by a long horizontal line.

Frank Ehrenfeld
Laboratory
Director, iATL

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896891
Client No.: YYF-A1

Description: Grey Cementitious
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5896892
Client No.: YYF-A2

Description: Black Cove Base
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896893
Client No.: YYF-A3

Description: Off-White Joint Compound
Facility:

Location:

Percent Asbestos:
PC 1.1 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
98.9

Lab No.: 5896893(L2)
Client No.: YYF-A3

Description: Tan Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896894
Client No.: YYF-A4

Description: Light Grey Floor Tile
Facility:

Location:

Percent Asbestos:
PC 0.75 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
99.25

Lab No.: 5896894(L2)
Client No.: YYF-A4

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

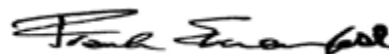
Date Received: 4/5/2016

Date Analyzed: 4/6/2016 6:14:59 AM

Signature:

Analyst: Tom Barkley

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896894(L3)
Client No.: YYF-A4

Description: Tan Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896895
Client No.: YYF-A5

Description: Tan Joint Compound
Facility:

Location:

Percent Asbestos:
PC 1.3 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
98.7

Lab No.: 5896896
Client No.: YYF-A6

Description: Grey Putty
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896897
Client No.: YYF-A7

Description: White Grey Ceiling Tile
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
50 Cellulose
10 Fibrous Glass

Percent Non-Fibrous Material:
40

Lab No.: 5896898
Client No.: YYF-A8

Description: Brown Tar Paper
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
75 Cellulose

Percent Non-Fibrous Material:
25

Lab No.: 5896898(L2)
Client No.: YYF-A8

Description: Tan Insulation
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
100 Fibrous Glass

Percent Non-Fibrous Material:
None Detected

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

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Signature:

Analyst: Tom Barkley

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6


Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|---|---|
| Lab No.: 5896899 Client No.: YYF-A9 | Description: Silver Insulation Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 15 Cellulose 15 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 70 |
| Lab No.: 5896899(L2) Client No.: YYF-A9 | Description: Black Tar Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896900 Client No.: YYF-A10 | Description: White Cementitious Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896901 Client No.: YYF-A11 | Description: Silver Insulation Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 15 Cellulose 15 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 70 |
| Lab No.: 5896901(L2) Client No.: YYF-A11 | Description: Black Tar Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896902 Client No.: YYF-A12 | Description: Grey Mortar Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 6:14:59 AM
Signature: 
Analyst: Tom Barkley

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|---|--|
| Lab No.: 5896903 Client No.: YYF-A13 | Description: White Grey Ceiling Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 50 Cellulose 20 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 30 |
| Lab No.: 5896904 Client No.: YYF-A14 | Description: Grey Putty Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 2 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 98 |
| Lab No.: 5896905 Client No.: YYF-A15 | Description: Green Floor Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>10 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 90 |
| Lab No.: 5896905(L2) Client No.: YYF-A15 | Description: Black Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 2.5 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 97.5 |
| Lab No.: 5896906 Client No.: YYF-A16 | Description: Black Cove Base Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896906(L2) Client No.: YYF-A16 | Description: Brown Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

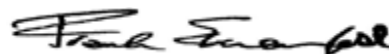
Date Received: 4/5/2016

Date Analyzed: 4/6/2016 6:14:59 AM

Signature:

Analyst: Tom Barkley

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

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8648 Commerce Court
Burnaby BC V5A 4N6


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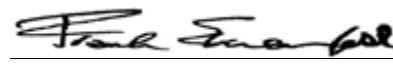
Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|--|---|--|
| Lab No.: 5896907 Client No.: YYF-A17 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: Black Cove Base Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896907(L2) Client No.: YYF-A17 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: White Mastic Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896908 Client No.: YYF-A18 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: Red Caulk Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896909 Client No.: YYF-A19 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: White Caulk Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896910 Client No.: YYF-A20 <u>Percent Asbestos:</u> <i>15 Chrysotile</i> <i>10 Crocidolite</i> | Description: Grey Transite Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 75 |
| Lab No.: 5896911 Client No.: YYF-A21 <u>Percent Asbestos:</u> <i>PC 5.1 Amosite</i> | Description: Tan Insulation Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 94.9 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 6:14:59 AM
Signature: 
Analyst: Tom Barkley

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6


Report Date: 4/7/2016
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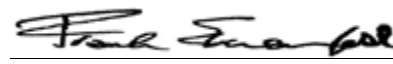
Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|--|---|
| Lab No.: 5896912 Client No.: YYF-A22 | Description: Grey Cementitious Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896913 Client No.: YYF-A23 | Description: Grey Gasket Facility: | Location: |
| <u>Percent Asbestos:</u> <i>40 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 60 |
| Lab No.: 5896914 Client No.: YYF-A24 | Description: Black Tar Paper Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 75 Cellulose | <u>Percent Non-Fibrous Material:</u> 25 |
| Lab No.: 5896915 Client No.: YYF-A25 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896916 Client No.: YYF-A26 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896917 Client No.: YYF-A27 | Description: White Tan Ceiling Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 95 Cellulose | <u>Percent Non-Fibrous Material:</u> 5 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 6:14:59 AM
Signature: 
Analyst: Tom Barkley

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
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Burnaby BC V5A 4N6


Report Date: 4/7/2016
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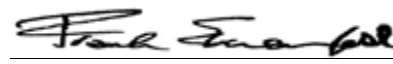
Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|---|--|
| Lab No.: 5896918 Client No.: YYF-A28 | Description: Black Cove Base Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896918(L2) Client No.: YYF-A28 | Description: Off-White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 1.1 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 98.9 |
| Lab No.: 5896918(L3) Client No.: YYF-A28 | Description: White Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896919 Client No.: YYF-A29 | Description: Grey Sealant Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 0.5 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 5 Synthetic | <u>Percent Non-Fibrous Material:</u> 94.5 |
| Lab No.: 5896920 Client No.: YYF-A30 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896921 Client No.: YYF-A31 | Description: White Grey Ceiling Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 25 Cellulose 25 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 50 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 6:14:59 AM
Signature: 
Analyst: Tom Barkley

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6


Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|--|--|
| Lab No.: 5896922 Client No.: YYF-A32 | Description: White Brown Ceiling Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 90 Cellulose | <u>Percent Non-Fibrous Material:</u> 10 |
| Lab No.: 5896923 Client No.: YYF-A33 | Description: Tan Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896924 Client No.: YYF-A34 | Description: Grey Floor Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 8.7 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 91.3 |
| Lab No.: 5896924(L2) Client No.: YYF-A34 | Description: Black Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 0.5 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 99.5 |
| Lab No.: 5896925 Client No.: YYF-A35 | Description: Black Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 0.5 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 99.5 |
| Lab No.: 5896925(L2) Client No.: YYF-A35 | Description: White Leveling Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 1.3 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 98.7 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|---|--|
| Lab No.: 5896926 Client No.: YYF-A36 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: White Caulk Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896927 Client No.: YYF-A37 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: White Brown Ceiling Tile Facility: <u>Percent Non-Asbestos Fibrous Material:</u> 50 Fibrous Glass 20 Cellulose | Location: <u>Percent Non-Fibrous Material:</u> 30 |
| Lab No.: 5896928 Client No.: YYF-A38 <u>Percent Asbestos:</u> <i>PC 6.0 Chrysotile</i> | Description: Brown Floor Tile Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 94 |
| Lab No.: 5896929 Client No.: YYF-A39 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: Grey Woven Material Facility: <u>Percent Non-Asbestos Fibrous Material:</u> 40 Cellulose | Location: <u>Percent Non-Fibrous Material:</u> 60 |
| Lab No.: 5896930 Client No.: YYF-A40 <u>Percent Asbestos:</u> <i>PC 1.2 Chrysotile</i> | Description: Off-White Joint Compound Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 98.8 |
| Lab No.: 5896931 Client No.: YYF-A41 <u>Percent Asbestos:</u> <i>PC 1.2 Chrysotile</i> | Description: Off-White Joint Compound Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 98.8 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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Project No.: 636476

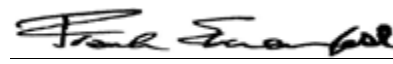
Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|--|--|
| Lab No.: 5896932 Client No.: YYF-A42 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896933 Client No.: YYF-A43 | Description: Grey Putty Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 3.5 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 96.5 |
| Lab No.: 5896934 Client No.: YYF-A44 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896935 Client No.: YYF-A45 | Description: Grey Floor Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 7.2 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 92.8 |
| Lab No.: 5896935(L2) Client No.: YYF-A45 | Description: Black Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC Trace Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896936 Client No.: YYF-A46 | Description: Grey Cementitious Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

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Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896937
Client No.: YYF-A47
Percent Asbestos:
PC 0.75 Chrysotile

Description: Off-White Joint Compound
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected


Location:
Percent Non-Fibrous Material:
99.25

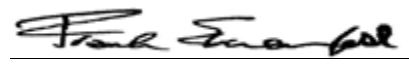
Lab No.: 5896938
Client No.: YYF-A48
Percent Asbestos:
None Detected

Description: Grey Grout
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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Signature: 
Analyst: Tom Barkley

Approved By: 
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Laboratory Director

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Burnaby BC V5A 4N6

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Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896939
Client No.: YYF-A49
Percent Asbestos:
PC 4.1 Chrysotile

Description: Grey Putty
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
95.9

Lab No.: 5896940
Client No.: YYF-A50
Percent Asbestos:
None Detected

Description: White Wrap
Facility:
Percent Non-Asbestos Fibrous Material:
60 Cellulose
30 Mineral Wool

Location:
Percent Non-Fibrous Material:
10

Lab No.: 5896941
Client No.: YYF-A51
Percent Asbestos:
None Detected

Description: White/Grey Ceiling Tile
Facility:
Percent Non-Asbestos Fibrous Material:
40 Cellulose
30 Mineral Wool

Location:
Percent Non-Fibrous Material:
30

Lab No.: 5896942
Client No.: YYF-A52
Percent Asbestos:
PC 2.4 Chrysotile

Description: Grey Joint Compound
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
97.6

Lab No.: 5896943
Client No.: YYF-A53
Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected


Location:
Percent Non-Fibrous Material:
100


Lab No.: 5896944
Client No.: YYF-A54
Percent Asbestos:
None Detected

Description: Grey Grout
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:
Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
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Analyst: Vane Smith

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
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Report Date: 4/7/2016
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Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|--|---|
| Lab No.: 5896945 Client No.: YYF-A55 | Description: Brown Rubber Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896946 Client No.: YYF-A56 | Description: Brown Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896946(L2) Client No.: YYF-A56 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896947 Client No.: YYF-A57 | Description: Off-White Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896948 Client No.: YYF-A58 | Description: Tan Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896949 Client No.: YYF-A59 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
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Signature: 
Analyst: Vane Smith

Approved By: 
Frank E. Ehrenfeld, III
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8648 Commerce Court
Burnaby BC V5A 4N6


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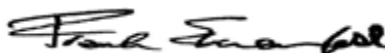
Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|--|---|
| Lab No.: 5896950 Client No.: YYF-A60 | Description: Brown Wallpaper Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 30 Cellulose | <u>Percent Non-Fibrous Material:</u> 70 |
| Lab No.: 5896951 Client No.: YYF-A61 | Description: Grey Rubber Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896952 Client No.: YYF-A62 | Description: Yellow Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896953 Client No.: YYF-A63 | Description: Black Grout Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896954 Client No.: YYF-A64 | Description: Off-White Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896955 Client No.: YYF-A65 | Description: White Non-Fibrous Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|--|---|
| Lab No.: 5896956 Client No.: YYF-A66 | Description: Grey Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896957 Client No.: YYF-A67 | Description: Grey Caulk Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896958 Client No.: YYF-A68 | Description: Brown Ceiling Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 98 Cellulose | <u>Percent Non-Fibrous Material:</u> 2 |
| Lab No.: 5896959 Client No.: YYF-A69 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896960 Client No.: YYF-A70 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896961 Client No.: YYF-A71 | Description: White Texture/Plaster Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|--|---|
| Lab No.: 5896962 Client No.: YYF-A72 | Description: White/Grey Ceiling Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 60 Cellulose 10 Mineral Wool | <u>Percent Non-Fibrous Material:</u> 30 |
| Lab No.: 5896963 Client No.: YYF-A73 | Description: White/Grey Ceiling Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 40 Cellulose 30 Mineral Wool | <u>Percent Non-Fibrous Material:</u> 30 |
| Lab No.: 5896964 Client No.: YYF-A74 | Description: White/Grey Ceiling Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 40 Cellulose 20 Mineral Wool | <u>Percent Non-Fibrous Material:</u> 40 |
| Lab No.: 5896965 Client No.: YYF-A75 | Description: Orange Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896966 Client No.: YYF-A76 | Description: Tan Rubber Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896967 Client No.: YYF-A77 | Description: White Texture Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|--|---|
| Lab No.: 5896968 Client No.: YYF-A78 | Description: White Texture Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896969 Client No.: YYF-A79 | Description: White Texture Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896969(L2) Client No.: YYF-A79 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896970 Client No.: YYF-A80 | Description: White Texture Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896971 Client No.: YYF-A81 | Description: White Texture Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896972 Client No.: YYF-A82 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896973
Client No.: YYF-A83

Percent Asbestos:
None Detected

Description: White/Black Shingle
Facility:

Percent Non-Asbestos Fibrous Material:
15 Synthetic

Location:

Percent Non-Fibrous Material:
85

Lab No.: 5896974
Client No.: YYF-A84

Percent Asbestos:
None Detected

Description: White/Blace Shingle
Facility:

Percent Non-Asbestos Fibrous Material:
15 Synthetic

Location:

Percent Non-Fibrous Material:
85

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Vane Smith

Approved By:



Frank E. Ehrenfeld, III

Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896975
Client No.: YYF-A85

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5896976
Client No.: YYF-A86

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5896977
Client No.: YYF-A87

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5896978
Client No.: YYF-A88

Description: Black/White Shingle
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
15 Synthetic

Percent Non-Fibrous Material:
85

Lab No.: 5896978(L2)
Client No.: YYF-A88

Description: Black Roof Material
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
25 Cellulose
Trace Fibrous Glass

Percent Non-Fibrous Material:
75

Lab No.: 5896979
Client No.: YYF-A89

Description: Grey Caulk
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

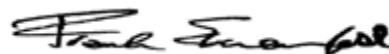
Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Rachel McQuiggan

Approved By:



Frank E. Ehrenfeld, III

Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

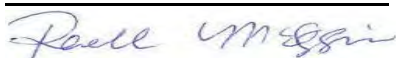
Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|--|---|
| Lab No.: 5896980 Client No.: YYF-A90 | Description: Black Shingle Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 20 Synthetic | <u>Percent Non-Fibrous Material:</u> 80 |
| Lab No.: 5896981 Client No.: YYF-A91 | Description: Black/Grey Caulk Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 5 Cellulose | <u>Percent Non-Fibrous Material:</u> 95 |
| Lab No.: 5896982 Client No.: YYF-A92 | Description: Black Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> Trace Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896983 Client No.: YYF-A93 | Description: Grey Cementitious Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896984 Client No.: YYF-A94 | Description: Black Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> Trace Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896985 Client No.: YYF-A95 | Description: Grey Caulk Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
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Signature: 
Analyst: Rachel McQuiggan

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

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8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
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Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896985(L2)
Client No.: YYF-A95

Description: Clear Caulk
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896986
Client No.: YYF-A96

Description: Black/Grey Caulk
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5896987
Client No.: YYF-A97

Description: Dk.Brown Caulk
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896988
Client No.: YYF-A98

Description: White Caulk
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896989
Client No.: YYF-A99

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5896990
Client No.: YYF-A100

Description: Brown Paper
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
95 Cellulose

Percent Non-Fibrous Material:
5

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Rachel McQuiggan

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

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Client: SNC - Lavalin, Inc.
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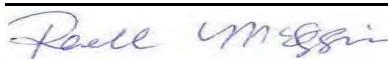
Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|--|--|---|
| Lab No.: 5896991 Client No.: YYF-A101 | Description: Tan Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5896992 Client No.: YYF-A102 | Description: Grey Caulk Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 5 Cellulose | <u>Percent Non-Fibrous Material:</u> 95 |
| Lab No.: 5896993 Client No.: YYF-A103 | Description: Black Tar Paper Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 70 Cellulose | <u>Percent Non-Fibrous Material:</u> 30 |
| Lab No.: 5896994 Client No.: YYF-A104 | Description: Black/Grey Shingle Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 15 Synthetic | <u>Percent Non-Fibrous Material:</u> 85 |
| Lab No.: 5896994(L2) Client No.: YYF-A104 | Description: Black Roof Material Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 20 Cellulose 5 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 75 |
| Lab No.: 5896994(L3) Client No.: YYF-A104 | Description: Black Tar Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
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Signature: 
Analyst: Rachel McQuiggan

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Frank E. Ehrenfeld, III
Laboratory Director

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Client: SNC - Lavalin, Inc.
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Burnaby BC V5A 4N6

Report Date: 4/7/2016
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Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896994(L4)
Client No.: YYF-A104

Description: Brown Fibrous
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
90 Cellulose

Percent Non-Fibrous Material:
10

Lab No.: 5896995
Client No.: YYF-A105

Description: Grey Caulk
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5896996
Client No.: YYF-A106

Description: Brown Tar Paper
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
90 Cellulose

Percent Non-Fibrous Material:
10

Lab No.: 5896997
Client No.: YYF-A107

Description: Black Tar
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5896998
Client No.: YYF-A108

Description: White Texture
Facility:

Location:

Percent Asbestos:
PC 4.1 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
95.9

Lab No.: 5896999
Client No.: YYF-A109

Description: White Texture
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
99 Fibrous Glass

Percent Non-Fibrous Material:
1

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Rachel McQuiggan

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5896999(L2)
Client No.: YYF-A109

Description: Black Tar
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897000
Client No.: YYF-A110

Description: White Texture
Facility:

Location:

Percent Asbestos:
PC 4.7 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
95.3

Lab No.: 5897001
Client No.: YYF-A111

Description: Grey/White Paint
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897002
Client No.: YYF-A112

Description: Grey Paper
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
90 Cellulose

Percent Non-Fibrous Material:
10

Lab No.: 5897003
Client No.: YYF-A113

Description: White Putty
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897004
Client No.: YYF-A114

Description: White Texture
Facility:

Location:

Percent Asbestos:
PC 5.0 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
95

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Rachel McQuiggan

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

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Client: SNC - Lavalin, Inc.
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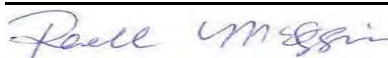
Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|--|--|--|
| Lab No.: 5897005 Client No.: YYF-A115 | Description: White Texture Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 3 Other | <u>Percent Non-Fibrous Material:</u> 97 |
| Lab No.: 5897006 Client No.: YYF-A116 | Description: White Texture Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 4.8 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 95.2 |
| Lab No.: 5897007 Client No.: YYF-A117 | Description: Grey Cove Base Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897008 Client No.: YYF-A118 | Description: Yellow Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897009 Client No.: YYF-A119 | Description: Brown Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897010 Client No.: YYF-A120 | Description: Grey/Black Cove Base Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Rachel McQuiggan

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
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Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897010(L2)
Client No.: YYF-A120

Description: Tan/Grey Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

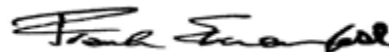
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Signature:

Analyst: Rachel McQuiggan

Approved By:



Frank E. Ehrenfeld, III

Laboratory Director

CERTIFICATE OF ANALYSIS

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Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897011
Client No.: YYF-A121

Description: Tan Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Percent Non-Fibrous Material:
95

Lab No.: 5897012
Client No.: YYF-A122

Description: Orange Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897013
Client No.: YYF-A123

Description: Orange Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897013(L2)
Client No.: YYF-A123

Description: Off-White Foam
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897014
Client No.: YYF-A124

Description: Yellow Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897015
Client No.: YYF-A125

Description: White Joint Compound
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

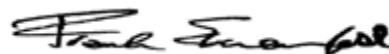
Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Rodney Redman

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

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Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|--|---|---|
| Lab No.: 5897016 Client No.: YYF-A126 | Description: Grey Cementitious Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 5 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 95 |
| Lab No.: 5897017 Client No.: YYF-A127 | Description: Yellow/Grey Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897018 Client No.: YYF-A128 | Description: Orange Non-Fibrous Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897019 Client No.: YYF-A129 | Description: Tan/Silver Wrap Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 10 Fibrous Glass 60 Cellulose | <u>Percent Non-Fibrous Material:</u> 40 |
| Lab No.: 5897020 Client No.: YYF-A130 | Description: Grey Gasket Facility: | Location: |
| <u>Percent Asbestos:</u> <i>15 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 15 Cellulose | <u>Percent Non-Fibrous Material:</u> 70 |
| Lab No.: 5897021 Client No.: YYF-A131 | Description: White/Silver/Tan Wrap Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 10 Fibrous Glass 60 Cellulose | <u>Percent Non-Fibrous Material:</u> 40 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

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Analyst: Rodney Redman

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PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|--|--|--|
| Lab No.: 5897022 Client No.: YYF-A132 | Description: Black Non-Fibrous Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897023 Client No.: YYF-A133 | Description: Black Gasket Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 10 Cellulose | <u>Percent Non-Fibrous Material:</u> 90 |
| Lab No.: 5897024 Client No.: YYF-A134 | Description: Off-White Wrap Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 20 Mineral Wool 60 Cellulose | <u>Percent Non-Fibrous Material:</u> 20 |
| Lab No.: 5897025 Client No.: YYF-A135 | Description: Off-White Floor Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 4.8 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 95.2 |
| Lab No.: 5897025(L2) Client No.: YYF-A135 | Description: Black Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897026 Client No.: YYF-A136 | Description: Grey Caulk Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Rodney Redman

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

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Client: SNC - Lavalin, Inc.
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Client: SNC483

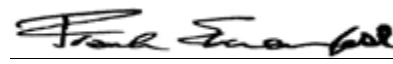
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PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|--|--|---|
| Lab No.: 5897027 Client No.: YYF-A137 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: Brown Rubber Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897027(L2) Client No.: YYF-A137 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: Clear Mastic Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897028 Client No.: YYF-A138 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: White/Tan Ceiling Tile Facility: <u>Percent Non-Asbestos Fibrous Material:</u> Cellulose 90 | Location: <u>Percent Non-Fibrous Material:</u> 10 |
| Lab No.: 5897029 Client No.: YYF-A139 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: White/Tan Ceiling Tile Facility: <u>Percent Non-Asbestos Fibrous Material:</u> Cellulose 90 | Location: <u>Percent Non-Fibrous Material:</u> 10 |
| Lab No.: 5897030 Client No.: YYF-A140 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: Grey Cementitious Facility: <u>Percent Non-Asbestos Fibrous Material:</u> Fibrous Glass 10 | Location: <u>Percent Non-Fibrous Material:</u> 90 |
| Lab No.: 5897031 Client No.: YYF-A141 <u>Percent Asbestos:</u> <i>None Detected</i> | Description: Black Floor Tile Facility: <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | Location: <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Rodney Redman

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897031(L2)
Client No.: YYF-A141

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897032
Client No.: YYF-A142

Percent Asbestos:
None Detected

Description: Blue Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897032(L2)
Client No.: YYF-A142

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Location:

Percent Non-Fibrous Material:
95

Lab No.: 5897033
Client No.: YYF-A143

Percent Asbestos:
None Detected

Description: Tan/Blue/Pink Wrap
Facility:

Percent Non-Asbestos Fibrous Material:
10 Mineral Wool
50 Cellulose

Location:

Percent Non-Fibrous Material:
40

Lab No.: 5897034
Client No.: YYF-A144

Percent Asbestos:
None Detected

Description: Black Wrap
Facility:

Percent Non-Asbestos Fibrous Material:
15 Fibrous Glass

Location:

Percent Non-Fibrous Material:
85

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Rodney Redman

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897035
Client No.: YYF-A145

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
1 Cellulose

Location:

Percent Non-Fibrous Material:
99

Lab No.: 5897035(L2)
Client No.: YYF-A145

Percent Asbestos:
None Detected

Description: Tan/Yellow Insulation
Facility:

Percent Non-Asbestos Fibrous Material:
10 Fibrous Glass
85 Cellulose

Location:

Percent Non-Fibrous Material:
5

Lab No.: 5897036
Client No.: YYF-A146

Percent Asbestos:
PC 1.2 Chrysotile

Description: Red Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
98.8

Lab No.: 5897037
Client No.: YYF-A147

Percent Asbestos:
None Detected

Description: Grey Cove Base
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897038
Client No.: YYF-A148

Percent Asbestos:
None Detected

Description: Lt.Tan Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897039
Client No.: YYF-A149

Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Ellen Smith

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|---|---|--|
| Lab No.: 5897040 | Description: Tan Ceiling Tile | Location: |
| Client No.: YYF-A150 | Facility: | |
| <u>Percent Asbestos:</u> None Detected | <u>Percent Non-Asbestos Fibrous Material:</u> 35 Cellulose 20 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 45 |

| | | |
|---|---|--|
| Lab No.: 5897041 | Description: Tan Ceiling Tile | Location: |
| Client No.: YYF-A151 | Facility: | |
| <u>Percent Asbestos:</u> None Detected | <u>Percent Non-Asbestos Fibrous Material:</u> 35 Cellulose 20 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 45 |


| | | |
|---|--|---|
| Lab No.: 5897042 | Description: Green Floor Tile | Location: |
| Client No.: YYF-A152 | Facility: | |
| <u>Percent Asbestos:</u> None Detected | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |


| | | |
|---|--|---|
| Lab No.: 5897042(L2) | Description: Tan Mastic | Location: |
| Client No.: YYF-A152 | Facility: | |
| <u>Percent Asbestos:</u> None Detected | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

| | | |
|---|--|---|
| Lab No.: 5897043 | Description: Off-White Floor Tile | Location: |
| Client No.: YYF-A153 | Facility: | |
| <u>Percent Asbestos:</u> None Detected | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

| | | |
|---|--|---|
| Lab No.: 5897043(L2) | Description: Tan Mastic | Location: |
| Client No.: YYF-A153 | Facility: | |
| <u>Percent Asbestos:</u> None Detected | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Ellen Smith

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897044
Client No.: YYF-A154

Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897045
Client No.: YYF-A155

Percent Asbestos:
None Detected

Description: Lt.Blue Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897045(L2)
Client No.: YYF-A155

Percent Asbestos:
None Detected

Description: Tan Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897046
Client No.: YYF-A156

Percent Asbestos:
None Detected

Description: White Joint Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Ellen Smith

Approved By:



Frank E. Ehrenfeld, III

Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897047
Client No.: YYF-A157

Percent Asbestos:
None Detected

Description: Off-White Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897047(L2)
Client No.: YYF-A157

Percent Asbestos:
None Detected

Description: Black/Brown Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897048
Client No.: YYF-A158

Percent Asbestos:
None Detected

Description: Off-White Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897048(L2)
Client No.: YYF-A158

Percent Asbestos:
None Detected

Description: Grey Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897049
Client No.: YYF-A159

Percent Asbestos:
None Detected

Description: Blue Cove Base
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897050
Client No.: YYF-A160

Percent Asbestos:
None Detected

Description: Yellow Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

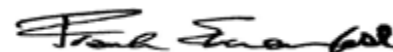
Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Shane Cone

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6


Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|--|---|--|
| Lab No.: 5897051 Client No.: YYF-A161 | Description: Black Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897052 Client No.: YYF-A162 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897053 Client No.: YYF-A163 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897054 Client No.: YYF-A164 | Description: Off-White Vinyl Sheet Flooring Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 20 Cellulose 10 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 70 |
| Lab No.: 5897054(L2) Client No.: YYF-A164 | Description: Tan Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897055 Client No.: YYF-A165 | Description: Off-White Floor Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 1.5 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 98.5 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Shane Cone

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897055(L2)
Client No.: YYF-A165

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897055(L3)
Client No.: YYF-A165

Percent Asbestos:
None Detected

Description: Grey Cementitious
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897056
Client No.: YYF-A166

Percent Asbestos:
None Detected

Description: Blue Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897056(L2)
Client No.: YYF-A166

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897056(L3)
Client No.: YYF-A166

Percent Asbestos:
None Detected

Description: Clear Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897057
Client No.: YYF-A167

Percent Asbestos:
None Detected

Description: White Wrap
Facility:

Percent Non-Asbestos Fibrous Material:
90 Cellulose

Location:

Percent Non-Fibrous Material:
10

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Shane Cone

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897058
Client No.: YYF-A168

Description: Grey Caulk
Facility:

Location:

Percent Asbestos:
10 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
90

Lab No.: 5897059
Client No.: YYF-A169

Description: Black/White Non-Fibrous
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897060
Client No.: YYF-A170

Description: Tan Floor Tile
Facility:

Location:

Percent Asbestos:
PC 1.4 Chrysotile

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
98.6

Lab No.: 5897060(L2)
Client No.: YYF-A170

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897060(L3)
Client No.: YYF-A170

Description: Tan Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897061
Client No.: YYF-A171

Description: White Joint Compound
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

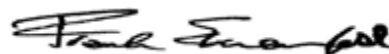
Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Shane Cone

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6


Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476


Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|--|---|--|
| Lab No.: 5897062 Client No.: YYF-A172 | Description: Off-White Ceiling Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 50 Cellulose 20 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 30 |
| Lab No.: 5897063 Client No.: YYF-A173 | Description: Off-White Caulk Facility: | Location: |
| <u>Percent Asbestos:</u> <i>PC 1.4 Chrysotile</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 98.6 |
| Lab No.: 5897064 Client No.: YYF-A174 | Description: Grey Cementitious Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897065 Client No.: YYF-A175 | Description: White Caulk Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897066 Client No.: YYF-A176 | Description: Tan Insulation Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 90 Fibrous Glass | <u>Percent Non-Fibrous Material:</u> 10 |
| Lab No.: 5897067 Client No.: YYF-A177 | Description: Black Rubber Tile Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Shane Cone

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
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Burnaby BC V5A 4N6

Report Date: 4/7/2016
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Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897068
Client No.: YYF-A178

Percent Asbestos:
None Detected

Description: Tan Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897069
Client No.: YYF-A179

Percent Asbestos:
None Detected

Description: Grey Cementitious
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897070
Client No.: YYF-A180

Percent Asbestos:
PC 1.2 Chrysotile

Description: Off-White Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
98.8

Lab No.: 5897070(L2)
Client No.: YYF-A180

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

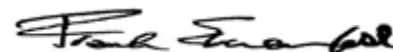
Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Shane Cone

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897071
Client No.: YYF-A181

Description: White Joint Compound
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897072
Client No.: YYF-A182

Description: White Mortar
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897073
Client No.: YYF-A183

Description: Grey Grout
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897074
Client No.: YYF-A184

Description: Grey Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897075
Client No.: YYF-A185

Description: White Joint Compound
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897076
Client No.: YYF-A186

Description: White Joint Compound
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

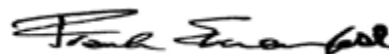
Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Randy Caran

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6


Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

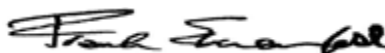
Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

| | | |
|--|---|---|
| Lab No.: 5897077 Client No.: YYF-A187 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897078 Client No.: YYF-A188 | Description: White Joint Compound Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897079 Client No.: YYF-A189 | Description: Grey Cove Base Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897079(L2) Client No.: YYF-A189 | Description: White Mastic Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |
| Lab No.: 5897080 Client No.: YYF-A190 | Description: Grey Vinyl Sheet Flooring Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> 10 Synthetic | <u>Percent Non-Fibrous Material:</u> 90 |
| Lab No.: 5897081 Client No.: YYF-A191 | Description: Grey Grout Facility: | Location: |
| <u>Percent Asbestos:</u> <i>None Detected</i> | <u>Percent Non-Asbestos Fibrous Material:</u> None Detected | <u>Percent Non-Fibrous Material:</u> 100 |

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.

Date Received: 4/5/2016
Date Analyzed: 4/6/2016 12:00:00 AM
Signature: 
Analyst: Randy Caran

Approved By: 
Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897082
Client No.: YYF-A192

Description: White Grout
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897083
Client No.: YYF-A193

Description: Grey Vinyl Sheet Flooring
Facility:
Percent Non-Asbestos Fibrous Material:
10 Cellulose
10 Synthetic

Location:

Percent Asbestos:
None Detected

Percent Non-Fibrous Material:
80

Lab No.: 5897084
Client No.: YYF-A194

Description: White Joint Compound
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Asbestos:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897085
Client No.: YYF-A195

Description: Grey Mastic
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Asbestos:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897086
Client No.: YYF-A196

Description: Grey Floor Tile
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Asbestos:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897086(L2)
Client No.: YYF-A196

Description: Yellow Mastic
Facility:
Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Asbestos:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Randy Caran

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897086(L3)
Client No.: YYF-A196

Percent Asbestos:
PC 3.6 Chrysotile

Description: White Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
96.4

Lab No.: 5897086(L4)
Client No.: YYF-A196

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897086(L5)
Client No.: YYF-A196

Percent Asbestos:
None Detected

Description: White Leveling Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897087
Client No.: YYF-A197

Percent Asbestos:
None Detected

Description: Off-White Vinyl Sheet Flooring
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897088
Client No.: YYF-A198

Percent Asbestos:
None Detected

Description: Off-White Vinyl Sheet Flooring
Facility:

Percent Non-Asbestos Fibrous Material:
5 Cellulose

Location:

Percent Non-Fibrous Material:
95

Lab No.: 5897088(L2)
Client No.: YYF-A198

Percent Asbestos:
None Detected

Description: Grey Floor Tile
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Randy Caran

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897088(L3)
Client No.: YYF-A198

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897089
Client No.: YYF-A199

Description: White/Brown Ceiling Tile
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
98 Cellulose

Percent Non-Fibrous Material:
2

Lab No.: 5897090
Client No.: YYF-A200

Description: Tan Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897090(L2)
Client No.: YYF-A200

Description: Grey Floor Tile
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897090(L3)
Client No.: YYF-A200

Description: Black Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897091
Client No.: YYF-A201

Description: White/Brown Ceiling Tile
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
100 Cellulose

Percent Non-Fibrous Material:
Trace

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Randy Caran

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897092
Client No.: YYF-A202

Percent Asbestos:
None Detected

Description: Black Mastic
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897092(L2)
Client No.: YYF-A202

Percent Asbestos:
PC 2.4 Chrysotile

Description: Black/Grey Leveling Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
97.6

Lab No.: 5897093
Client No.: YYF-A203

Percent Asbestos:
None Detected

Description: White Leveling Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897094
Client No.: YYF-A204

Percent Asbestos:
None Detected

Description: Tan Putty
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897095
Client No.: YYF-A205

Percent Asbestos:
None Detected

Description: Grey Leveling Compound
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Lab No.: 5897096
Client No.: YYF-A206

Percent Asbestos:
None Detected

Description: Grey Cove Base
Facility:

Percent Non-Asbestos Fibrous Material:
None Detected

Location:

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Randy Caran

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Client: SNC483

PLM BULK SAMPLE ANALYSIS SUMMARY

Lab No.: 5897097
Client No.: YYF-A207

Description: Tan Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897098
Client No.: YYF-A208

Description: White Joint Compound
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897099
Client No.: YYF-A209

Description: Red Mastic
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Lab No.: 5897100
Client No.: YYF-A210

Description: White Joint Compound
Facility:

Location:

Percent Asbestos:
None Detected

Percent Non-Asbestos Fibrous Material:
None Detected

Percent Non-Fibrous Material:
100

Analytical Method -US EPA 600, R93-116. Please refer to the Appendix of this report for further information regarding your analysis.


Date Received: 4/5/2016

Date Analyzed: 4/6/2016 12:00:00 AM

Signature:

Analyst: Randy Caran

Approved By:



Frank E. Ehrenfeld, III
Laboratory Director

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Client: SNC483

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Appendix to Analytical Report

Customer Contact: Tony Kavelares

Analysis: US EPA 600, R93-116

This appendix seeks to promote greater understanding of any observations, exceptions, special instructions, or circumstances that the laboratory needs to communicate to the client concerning the above samples. The information below is used to help promote your ability to make the most informed decisions for you and your customers. Please note the following points of contact for any questions you may have.

iATL Customer Service: customerservice@iatl.com

iATL Office Manager: cdavis@iatl.com

iATL Account Representative: Shirley Clark

Sample Login Notes: See Batch Sheet Attached

Sample Matrix: Bulk Building Materials

Exceptions Noted: See Following Pages

General Terms, Warrants, Limits, Qualifiers:

General information about iATL capabilities and client/laboratory relationships and responsibilities are spelled out in iATL policies that are listed at www.iATL.com and in our Quality Assurance Manual per ISO 17025 standard requirements. The information therein is a representation of iATL definitions and policies for turnaround times, sample submittal, collection media, blank definitions, quantification issues and limit of detection, analytical methods and procedures, sub-contracting policies, results reporting options, fees, terms, and discounts, confidentiality, sample archival and disposal, and data interpretation.

iATL warrants the test results to be of a precision normal for the type and methodology employed for each sample submitted. iATL disclaims any other warrants, expressed or implied, including warranty of fitness for a particular purpose and warranty of merchantability. iATL accepts no legal responsibility for the purpose for which the client uses test results. Any analytical work performed must be governed by our Standard Terms and Conditions. Prices, methods and detection limits may be changed without notification. Please contact your Customer Service Representative for the most current information.

This confidential report relates only to those item(s) tested and does not represent an endorsement by NIST-NVLAP, AIHA LAP LLC, or any agency of local, state or province governments nor of any agency of the U.S. government.

This report shall not be reproduced except in full, without written approval of the laboratory.

Information Pertinent to this Report:

Analysis by US EPA 600 93-116: Determination of Asbestos in Bulk Building Materials by Polarized Light Microscopy (PLM).

Certification:

- NIST-NVLAP No. 101165-0
- NY-DOH No. 11021
- AIHA-LAP, LLC No. 100188

Quantification at <0.25% by volume is possible with this method. (PC) Indicates Stratified Point Count Method performed. (PC-Trace) means that asbestos was detected but is not quantifiable under the Point Counting regimen. Analysis includes all distinct separable layers in accordance with EPA 600 Method. If not reported or otherwise noted, layer is either not present or the client has specifically requested that it not be analyzed (ex. analyze until positive instructions). Small asbestos fibers may be missed by PLM due to resolution limitations of the optical microscope. Therefore, PLM is not consistently reliable in detecting asbestos in non-friable organically bound (NOB) materials. Quantitative transmission electron microscopy (TEM) is currently the only method that can pronounce materials as non-asbestos containing.

Analytical Methodology Alternatives: Your initial request for analysis may not have accounted for recent advances in regulatory requirements or advances in technology that are routinely used in similar situations for other qualified projects. You may have the option to explore additional analysis for further information. Below are a few options, listed as the matrix followed by the appropriate methodology. Also included are links to more information on our website.

Bulk Building Materials that are Non-Friable Organically Bound (NOB) by Gravimetric Reduction techniques employing PLM and TEM: ELAP 198.6 (PLM-NOB), ELAP 198.4 (TEM-NOB)

Loose Fill Vermiculite Insulation, Attic Insulation, Zonolite (copyright), etc.: US EPA 600 R-4/004 (multi-tiered analytical process)
Sprayed On Insulation/Fireproofing with Vermiculite (SOF-V): ELAP 198.8 (PLM-SOF-V)

Soil, sludge, sediment, aggregate, and like materials analyzed for asbestos or other elongated mineral particles (ex. erionite, etc.): ASTM D7521, CARB 435, and other options available

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Client: SNC483

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

Asbestos in Surface Dust according to one of ASTM's Methods (very dependent on sampling collection technique – by TEM): ASTM D 5755, D5756, or D6480

Various other asbestos matrices (air, water, etc.) and analytical methods are available.

Disclaimers / Qualifiers:

There may be some samples in this project that have a "NOTE:" associated with a sample result. We use added disclaimers or qualifiers to inform the client about something that requires further explanation. Here is a list with highlighted disclaimers that may be pertinent to this project. For a full explanation of these and other disclaimers, please inquire at customerservice@iatl.com.

- 1) Note: No mastic provided for analysis.
- 2) Note: Insufficient mastic provided for analysis.
- 3) Note: Insufficient material provided for analysis.
- 4) Note: Insufficient sample provided for QC reanalysis.
- 5) Note: Different material than indicated on Sample Log / Description.
- 6) Note: Sample not submitted.
- 7) Note: Attached to asbestos containing material.
- 8) Note: Received wet.
- 9) Note: Possible surface contamination.
- 10) Note: Not building material. 1% threshold may not apply.
- 11) Note: Recommend TEM-NOB analysis as per EPA recommendations.
- 12) Note: Asbestos detected but not quantifiable.
- 13) Note: Multiple identical samples submitted, only one analyzed.
- 14) Note: Analyzed by EPA 600/R-93/116. Point Counting detection limit at 0.080%.
- 15) Note: Analyzed by EPA 600/R-93/116. Point Counting detection limit at 0.125%.

Recommendations for Vermiculite Analysis:

Several analytical protocols exist for the analysis of asbestos in vermiculite. These analytical approaches vary depending upon the nature of the vermiculite mineral being tested (e.g. un-processed gange, homogeneous exfoliated books of mica, or mixed mineral composites). Please contact your client representative for pricing and turnaround time options available.

iATL recommends initial testing using the EPA 600/R-93/116 method. This method is specifically designed for the analysis of asbestos in bulk building materials. It provides an acceptable starting point for primary screening of vermiculite for possible asbestos.

Results from this testing may be inconclusive. EPA suggests proceeding to a multi-tiered analysis involving wet separation techniques in conjunction with PLM and TEM gravimetric analysis (EPA 600/R-04/004).

Further information on this method and other vermiculite and asbestos issues can be found at the following: Agency for Toxic Substances and Disease Registry (ATSDR) www.atsdr.cdc.gov, United States Geological Survey (USGS) www.minerals.usgs.gov/minerals/, US EPA www.epa.gov/asbestos. The USEPA also has an informative brochure "Current Best Practices for Vermiculite Attic Insulation" EPA 747F03001 May 2003, that may assist the health and remediation professional.

The following is a summary of the analytical process outlines in the EPA 600/R-04/004 Method:

- 1) **Analytical Step/Method:** Initial Screening by PLM, EPA 600R-93/116
Requirements/Comments: Minimum of 0.1 g of sample. ~0.25% LOQ for most samples.
- 2) **Analytical Step/Method:** Wet Separation by PLM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Sinks" only.
- 3) **Analytical Step/Method:** Wet Separation by PLM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Floats" only.
- 4) **Analytical Step/Method:** Wet Separation by TEM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Sinks" only.
- 5) **Analytical Step/Method:** Wet Separation by TEM Gravimetric Technique, EPA R-04/004
Requirements/Comments: Minimum 50g** of dry sample. Analysis of "Suspension" only.

LOQ, Limit of Quantitation estimates for mass and volume analyses.

*With advance notice and confirmation by the laboratory.

**Approximately 1 Liter of sample in double-bagged container (~9x6 inch bag of sample).

CERTIFICATE OF ANALYSIS

Client: SNC - Lavalin, Inc.
8648 Commerce Court
Burnaby BC V5A 4N6

Client: SNC483

Report Date: 4/7/2016
Report No.: 506746 - PLM
Project: Penticton Airport-PWGSC
Project No.: 636476

APPENDIX IV

Laboratory Analytical Report (Maxxam)

Your P.O. #: 636476
Your Project #: PENTICTON AIRPORT
Site Location: PENTICTON, BC

Attention: Tim Drozda

SNC-LAVALIN INC.
BURNABY, ENVIRONMENT DIVISION
8648 COMMERCE COURT
BURNABY, BC
CANADA V5A 4N6

Your C.O.C. #: G052566, G052567, G052568, G052569, G052570

Report Date: 2016/04/01
Report #: R2151555
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B623801

Received: 2016/03/31, 16:05

Sample Matrix: Paint
Samples Received: 49

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Analytical Method |
|--|----------|-------------------|------------------|-------------------|-------------------|
| Elements by ICP-AES (acid extr. solid) | 49 | 2016/04/01 | 2016/04/01 | BBY7SOP-00018 | EPA 6010c R3 m |

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key



Graham Rudkin
Project Manager, Environmental
01 Apr 2016 17:05:00 -07:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Graham Rudkin, Project Manager, Environmental

Email: GRudkin@maxxam.ca

Phone# (604)638-5926 Ext:5926

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B623801
Report Date: 2016/04/01

SNC-LAVALIN INC.
Client Project #: PENTICTON AIRPORT
Site Location: PENTICTON, BC
Your P.O. #: 636476
Sampler Initials: MAH

LEAD IN PAINT CHIPS (PAINT)

| Maxxam ID | | OJ3770 | OJ3771 | OJ3772 | OJ3773 | OJ3774 | OJ3775 | | OJ3776 | | |
|---------------|-------|------------|------------|------------|------------|------------|------------|-----|------------|-----|----------|
| Sampling Date | | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | | 2016/03/28 | | |
| COC Number | | G052566 | G052566 | G052566 | G052566 | G052566 | G052566 | | G052566 | | |
| | UNITS | YYF-P1 | YYF-P2 | YYF-P3 | YYF-P4 | YYF-P5 | YYF-P6 | RDL | YYF-P7 | RDL | QC Batch |

| Total Metals by ICP | | | | | | | | | | | |
|---------------------|-------|------|------|-----|------|-----|------|-----|---------|----|---------|
| Total Lead (Pb) | mg/kg | 5700 | 8350 | 788 | 8480 | 990 | <3.0 | 3.0 | <15 (1) | 15 | 8230578 |

RDL = Reportable Detection Limit

(1) Detection limits raised due to insufficient sample volume.

| Maxxam ID | | OJ3777 | OJ3778 | OJ3779 | OJ3780 | OJ3781 | OJ3784 | OJ3785 | | |
|---------------|-------|------------|------------|------------|------------|------------|------------|------------|-----|----------|
| Sampling Date | | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | | |
| COC Number | | G052566 | G052566 | G052566 | G052566 | G052566 | G052567 | G052567 | | |
| | UNITS | YYF-P8 | YYF-P9 | YYF-P10 | YYF-P11 | YYF-P12 | YYF-P13 | YYF-P14 | RDL | QC Batch |

| Total Metals by ICP | | | | | | | | | | |
|---------------------|-------|------|------|-----|------|------|------|-----|-----|---------|
| Total Lead (Pb) | mg/kg | <3.0 | 1780 | 187 | <3.0 | 1570 | 1350 | 461 | 3.0 | 8230578 |

RDL = Reportable Detection Limit

| Maxxam ID | | OJ3786 | | OJ3787 | OJ3788 | OJ3789 | OJ3790 | OJ3791 | | |
|---------------|-------|------------|----------|------------|------------|------------|------------|------------|-----|----------|
| Sampling Date | | 2016/03/28 | | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | | |
| COC Number | | G052567 | | G052567 | G052567 | G052567 | G052567 | G052567 | | |
| | UNITS | YYF-P15 | QC Batch | YYF-P16 | YYF-P17 | YYF-P18 | YYF-P19 | YYF-P20 | RDL | QC Batch |

| Total Metals by ICP | | | | | | | | | | |
|---------------------|-------|------|---------|------|-------|-----|-------|-----|-----|---------|
| Total Lead (Pb) | mg/kg | <3.0 | 8230578 | 50.4 | 18800 | 732 | 34500 | 337 | 3.0 | 8230676 |

RDL = Reportable Detection Limit

| Maxxam ID | | OJ3792 | OJ3793 | | OJ3794 | | OJ3795 | OJ3796 | OJ3797 | | |
|---------------|-------|------------|------------|-----|------------|-----|------------|------------|------------|-----|----------|
| Sampling Date | | 2016/03/28 | 2016/03/28 | | 2016/03/28 | | 2016/03/28 | 2016/03/28 | 2016/03/28 | | |
| COC Number | | G052567 | G052567 | | G052567 | | G052567 | G052568 | G052568 | | |
| | UNITS | YYF-P21 | YYF-P22 | RDL | YYF-P23 | RDL | YYF-P24 | YYF-P25 | YYF-P26 | RDL | QC Batch |

| Total Metals by ICP | | | | | | | | | | | |
|---------------------|-------|------|------|-----|---------|----|-----|------|------|-----|---------|
| Total Lead (Pb) | mg/kg | 3430 | 4220 | 3.0 | <15 (1) | 15 | 173 | 4080 | 2500 | 3.0 | 8230676 |

RDL = Reportable Detection Limit

(1) Detection limits raised due to insufficient sample volume.

| Maxxam ID | | OJ3798 | OJ3799 | OJ3800 | OJ3801 | OJ3802 | | OJ3803 | | |
|---------------|-------|------------|------------|------------|------------|------------|-----|------------|-----|----------|
| Sampling Date | | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | | 2016/03/28 | | |
| COC Number | | G052568 | G052568 | G052568 | G052568 | G052568 | | G052568 | | |
| | UNITS | YYF-P27 | YYF-P28 | YYF-P29 | YYF-P30 | YYF-P31 | RDL | YYF-P32 | RDL | QC Batch |

| Total Metals by ICP | | | | | | | | | | |
|---------------------|-------|-----|------|-----|------|------|-----|---------|----|---------|
| Total Lead (Pb) | mg/kg | 370 | 2110 | 745 | 19.5 | <3.0 | 3.0 | <24 (1) | 24 | 8230676 |

RDL = Reportable Detection Limit

(1) Detection limits raised due to insufficient sample volume.

Maxxam Job #: B623801
Report Date: 2016/04/01

SNC-LAVALIN INC.
Client Project #: PENTICTON AIRPORT
Site Location: PENTICTON, BC
Your P.O. #: 636476
Sampler Initials: MAH

LEAD IN PAINT CHIPS (PAINT)

| | | | | | | | | | | |
|----------------------|--------------|----------------|-----------------|----------------|----------------|----------------|----------------|----------------|------------|-----------------|
| Maxxam ID | | OJ3804 | | OJ3805 | OJ3806 | OJ3807 | OJ3808 | OJ3809 | | |
| Sampling Date | | 2016/03/28 | | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | | |
| COC Number | | G052568 | | G052568 | G052568 | G052568 | G052569 | G052569 | | |
| | UNITS | YYF-P33 | QC Batch | YYF-P34 | YYF-P35 | YYF-P36 | YYF-P37 | YYF-P38 | RDL | QC Batch |

| | | | | | | | | | | |
|----------------------------------|-------|-----|---------|-----|------|------|------|------|-----|---------|
| Total Metals by ICP | | | | | | | | | | |
| Total Lead (Pb) | mg/kg | 524 | 8230676 | 130 | 1170 | 4810 | <3.0 | <3.0 | 3.0 | 8230730 |
| RDL = Reportable Detection Limit | | | | | | | | | | |

| | | | | | | | | | | |
|----------------------|--------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|------------|-----------------|
| Maxxam ID | | OJ3810 | OJ3811 | OJ3812 | OJ3813 | OJ3814 | OJ3815 | OJ3816 | | |
| Sampling Date | | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | 2016/03/28 | | |
| COC Number | | G052569 | G052569 | G052569 | G052569 | G052569 | G052569 | G052569 | | |
| | UNITS | YYF-P39 | YYF-P40 | YYF-P41 | YYF-P42 | YYF-P43 | YYF-P44 | YYF-P45 | RDL | QC Batch |

| | | | | | | | | | | |
|----------------------------------|-------|------|-----|-----|------|------|-----|------|-----|---------|
| Total Metals by ICP | | | | | | | | | | |
| Total Lead (Pb) | mg/kg | <3.0 | 705 | 952 | 5780 | 21.5 | 396 | 40.1 | 3.0 | 8230730 |
| RDL = Reportable Detection Limit | | | | | | | | | | |

| | | | | | | | | | |
|----------------------|--------------|----------------|----------------|------------|----------------|------------|----------------|------------|-----------------|
| Maxxam ID | | OJ3817 | OJ3818 | | OJ3819 | | OJ3820 | | |
| Sampling Date | | 2016/03/28 | 2016/03/28 | | 2016/03/28 | | 2016/03/28 | | |
| COC Number | | G052569 | G052569 | | G052569 | | G052570 | | |
| | UNITS | YYF-P46 | YYF-P47 | RDL | YYF-P48 | RDL | YYF-P49 | RDL | QC Batch |

| | | | | | | | | | |
|--|-------|-----|------|-----|----------|-----|---------|----|---------|
| Total Metals by ICP | | | | | | | | | |
| Total Lead (Pb) | mg/kg | 667 | <3.0 | 3.0 | <9.0 (1) | 9.0 | <18 (1) | 18 | 8230730 |
| RDL = Reportable Detection Limit | | | | | | | | | |
| (1) Detection limits raised due to insufficient sample volume. | | | | | | | | | |

Maxxam Job #: B623801
Report Date: 2016/04/01

SNC-LAVALIN INC.
Client Project #: PENTICTON AIRPORT
Site Location: PENTICTON, BC
Your P.O. #: 636476
Sampler Initials: MAH

GENERAL COMMENTS

Results relate only to the items tested.

Maxxam Job #: B623801
Report Date: 2016/04/01

QUALITY ASSURANCE REPORT

SNC-LAVALIN INC.
Client Project #: PENTICTON AIRPORT
Site Location: PENTICTON, BC
Your P.O. #: 636476
Sampler Initials: MAH

| QC Batch | Parameter | Date | Method Blank | | RPD | | QC Standard | |
|----------|-----------------|------------|--------------|-------|-----------|-----------|-------------|-----------|
| | | | Value | UNITS | Value (%) | QC Limits | % Recovery | QC Limits |
| 8230578 | Total Lead (Pb) | 2016/04/01 | <3.0 | mg/kg | NC | 35 | 95 | 80 - 120 |
| 8230676 | Total Lead (Pb) | 2016/04/01 | <3.0 | mg/kg | NC | 35 | 92 | 80 - 120 |
| 8230730 | Total Lead (Pb) | 2016/04/01 | <3.0 | mg/kg | 16 | 35 | 94 | 80 - 120 |

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

CHAIN OF CUSTODY RECORD

Page: 2 of 5

G052567

Maxxam Job#:

Invoice To: Require Report? Yes ☒ No ☐

Company Name: SNC-Lavalin Inc.

Contact Name: Tim Drozda / Asantall

Address: 8640 Commerce Court

Burnaby BC PC: V5A4N6

Phone / Fax#: Ph: 44-515-5151 Fax: 604-815-9151

E-mail: tim.ardzda@snc-lan.liu.se

Company Name: As At LGFT

Contact Name: _____

Address: _____

PC:

Phone / Fax#: Ph: Fax:

E-mail: roger.hall@svtlandia.se

PO #: _____

Quotation # St. Chavala's Fraternity

Project # : 636476

Proj. Name: Enticdon Airport

Location: Penticton, BC

Sampled By: MAH/TDD

REGULATORY REQUIREMENTS SERVICE REQUESTED:

☐ CSR 1900 ☐ Regular Turn Around Time (TAT)

CCME 290 ppm (5 days for most tests)

☐ BC Water Quality ☒ RUSH (Please contact the lab)☐ Other ☒ 1 Day ☐ 2 Day ☐ 3 Day

DRINKING WATER. Date Required:

Special Instructions:

Return Cooler ☐ Ship Sample Bottles (please specify) ☐

ANALYSIS REQUESTED

| | Sample Identification | Lab Identification | Sample Type | Date/Time Sampled | BTEX/VPH | VOC/VPH | EPH | PAH | COME-PHC (Fractions 1-4 Plus BTEX) | COME-PHC (Fractions 2-4) | COME-BTEX (Fraction 1 Plus BTEX) | PCB | Phenols by 4AAP | TOG | Dissolved Metals | Total Metals Field Analysis | Nitrate | Chloride | Total Suspended Solids-TSS | pH | BOD | COD | Culturm, Total & E.coli | Absorbance | HOLD |
|----|-----------------------|--------------------|-------------|-------------------|----------|---------|-----|-----|------------------------------------|--------------------------|----------------------------------|-----|-----------------|-----|------------------|-----------------------------|---------|----------|----------------------------|----|-----|-----|-------------------------|------------|------|
| 1 | YYF-P13 | | Paint | March 28-30 | | | | | | | | | | | | | | | | | | | X | | |
| 2 | YYF-P14 | | | | | | | | | | | | | | | | | | | | | | X | | |
| 3 | YYF-P15 | | | | | | | | | | | | | | | | | | | | | | X | | |
| 4 | YYF-P16 | | | | | | | | | | | | | | | | | | | | | | X | | |
| 5 | YYF-P17 | | | | | | | | | | | | | | | | | | | | | | X | | |
| 6 | YYF-P18 | | | | | | | | | | | | | | | | | | | | | | X | | |
| 7 | YYF-P19 | | | | | | | | | | | | | | | | | | | | | | X | | |
| 8 | YYF-P20 | | | | | | | | | | | | | | | | | | | | | | X | | |
| 9 | YYF-P21 | | | | | | | | | | | | | | | | | | | | | | X | | |
| 10 | YYF-P22 | | | | | | | | | | | | | | | | | | | | | | X | | |
| 11 | YYF-P23 | | | | | | | | | | | | | | | | | | | | | | X | | |
| 12 | YYF-P24 | | | | | | | | | | | | | | | | | | | | | | X | | |

Samples are from a Drinking Water Source?

Samples are from a Drinking Water Source?

Laboratory Use Only

| | | | | | | | | |
|--|------------------|-------|--------------------|------------------|-------|--------------------------|-----------------------------|---|
| *Relinquished By: | Date (YY/MM/DD): | Time: | *Received by: | Date (YY/MM/DD): | Time: | Time Sensitive: | Temperature on Receipt (C): | Custody Seal Intact on Cooler? |
| <i>[Signature]</i> | 16/03/31 | 16:05 | <i>[Signature]</i> | 2016/03/31 | 16:05 | <input type="checkbox"/> | NA | Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> |
| <small>IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL YAT DELAYS.</small> | | | | | | | | |
| <small>White: Maxam Yellow: Client</small> | | | | | | | | |

IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maximum Yellow: Client

COD-1028 (05/10)

Maxxim International Corporation c/o Maxxim Analytics



Page: 4 of 5

Maxxam Job#:

Invoice To: Require Report? Yes ☒ No ☐

Company Name: AS AT LEFT

Contact Name: _____

Address: _____

PC:

| | | |
|---------------|-----|------|
| Phone / Fax#: | Ph: | Fax: |
|---------------|-----|------|

E-mail gagan.will@cs.columbia.edu

Report To:

AS AT LEFT

PC:

Ph: _____ Fax: _____

www.bbc.com/health

Quotation #: SNC Lavalin P10001

Project #: 636476

Proj. Name: Penticton Airport

Location: Pentzton, BC

Sampled By: MAH/TDD

☐ CSR *< 90 ppm* ☐ Regular Turn Around Time (TAT)
☐ CCME (5 days for most tests)
☐ BC Water Quality ☒ RUSH (Please contact the lab)
☐ Other ☒ 1 Day ☐ 2 Day ☐ 3 Day
 DRINKING WATER Date Required: _____

Return Cooler ☐ Ship Sample Bottles (please specify) ☐

| ANALYSIS REQUESTED | | | | | | | | | |
|-------------------------------------|--------------------------|------------------|---|--|--|--|--|--|--|
| BTEX/VPH | <input type="checkbox"/> | MTBE | <input type="checkbox"/> | | | | | | |
| VOC/VPH | <input type="checkbox"/> | | | | | | | | |
| EPH | <input type="checkbox"/> | TEH | <input type="checkbox"/> | | | | | | |
| PAH | <input type="checkbox"/> | LEP/HNEPH | <input type="checkbox"/> | | | | | | |
| COMET-PHC (Fractions 1-4 Plus BTEX) | | | | | | | | | |
| COMET-PHC (Fractions 2-4) | | | | | | | | | |
| COMET BTEX (Fraction 1 Plus BTEX) | | | | | | | | | |
| PCB | <input type="checkbox"/> | | | | | | | | |
| Phenols by AAPP | <input type="checkbox"/> | Phenols by GC/MS | <input type="checkbox"/> | | | | | | |
| TOG | <input type="checkbox"/> | MOG | <input type="checkbox"/> | | | | | | |
| | | SWOG | <input type="checkbox"/> | | | | | | |
| Dissolved Metals | <input type="checkbox"/> | Fast Filtrate? | Y <input type="checkbox"/> N <input type="checkbox"/> | | | | | | |
| | | Fast Acid/base? | Y <input type="checkbox"/> N <input type="checkbox"/> | | | | | | |
| Total Metals Field Analysis? | <input type="checkbox"/> | | Y <input type="checkbox"/> N <input type="checkbox"/> | | | | | | |
| Nitrate | <input type="checkbox"/> | Nitrite | <input type="checkbox"/> | | | | | | |
| | | Ammonia | <input type="checkbox"/> | | | | | | |
| Chloride | <input type="checkbox"/> | Fluoride | <input type="checkbox"/> | | | | | | |
| | | Sulphate | <input type="checkbox"/> | | | | | | |
| Total Suspended Solids-TSS | <input type="checkbox"/> | TDS | <input type="checkbox"/> | | | | | | |
| pH | <input type="checkbox"/> | Conductivity | <input type="checkbox"/> | | | | | | |
| | | Alkalinity | <input type="checkbox"/> | | | | | | |
| BOD | <input type="checkbox"/> | | | | | | | | |
| COD | <input type="checkbox"/> | | | | | | | | |
| Cultivate, Total & E. coli | <input type="checkbox"/> | Fecal | <input type="checkbox"/> | | | | | | |
| Asbestos | <input type="checkbox"/> | | | | | | | | |
| Lead in Paint | <input type="checkbox"/> | | | | | | | | |
| HCLUT | <input type="checkbox"/> | | | | | | | | |

Samples are from a Drinking Water Source?
Does source supply multiple households?

| | | | | | | | | |
|--------------------|------------------|-------|--------------------|------------------|-------|--------------------------|-----------------------------|--------------------------------|
| Relinquished by: | Date (YY/MM/DD): | Time: | Received by: | Date (YY/MM/DD): | Time: | Time Sensitive | Temperature on Receipt (°C) | Custody Seal Intact on Cooler? |
| <i>[Signature]</i> | 16/03/31 | 1605 | <i>[Signature]</i> | 2016/03/31 | 16:05 | <input type="checkbox"/> | NA | Yes <i>NA</i> No |

IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL DELAYS.

Write: Maxxam Yellow: Client

COC-1020 (05/10)

Maxcam International Corporation c/o Maxcam Analytics

Write: Maxxam Yellow; Client



Page: 5 of 5

Maxxam Job#:

Invoice To: Require Report? Yes ☒ No ☐

Report To:

Company Name: SN-Lavalin Inc.

Company Name: AS RT LEFT

Contact Name: Vin Doozda/ Aaron Hall

Contact Name: _____

Address: Ab48 Commerce Court

Address: _____

Phone / Fax#: Phone: 604-955-9551 Fax: 604-955-9550 Phone / Fax#:

PH: _____ Fax: _____

E-mail tim.drozda@srk.com E-mail

PH: _____ Fax: _____

seron.hall@Snehalati.com

PO #:
Quotation #: SR Leachin Pricing
Project #: 636476
Proj. Name: Penticton Airport
Location: Penticton, BC
Sampled By: Matt TDD

REGULATORY REQUIREMENTS SERVICE REQUESTED:

CSR *290ppm* ☐ Regular Turn Around Time (TAT)
CCME (5 days for most tests)
BC Water Quality ☒ RUSH (Please contact the lab)
Other ☒ 1 Day ☐ 2 Day ☐ 3 Day
DRINKING WATER Date Required: _____

Special Instructions:

Return Cooler ☐ Ship Sample Bottles (please specify) ☐

ANALYSIS REQUESTED

[illegible]

Samples are from a Drinking Water Source?
Does source supply multiple households?

| | | | | | | | | | |
|--|------------------|-------|--------------------|------------------|-------|--------------------------|-----------------------------|---|--|
| Laboratory Use Only | | | | | | | | | |
| *Relinquished by: | Date (YY/MM/DD): | Time: | Received by: | Date (YY/MM/DD): | Time: | Time Sensitive | Temperature on Receipt (°C) | Custody Seal Intact on Cooler? | |
| <i>[Signature]</i> | 16/03/31 | 1605 | <i>[Signature]</i> | 21/6/03/31 | 16:05 | <input type="checkbox"/> | NA | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | |
| <small>IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL DELAYS.</small> | | | | | | | | | |
| <small>White: Maxam Yellow: Client</small> | | | | | | | | | |

IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS

White: Maxxam Yellow: Client

CDC-1020 (05/10)

Maxxim International Corporation o/a Maxxim Analytics



SNC • LAVALIN

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Canada V5A 4N6
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www.snclavalin.com