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Mechanical Systems Energy Upgrade Specifications

Prepared for: Environment and Climate Change Canada
PACIFIC ENVIRONMENTAL SCIENCE CENTRE
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END OF SECTION

Discipline	Drawing Sheet	Title
Division 23 - Mechanical		
	M-1	Legend, Drawing List and Site Plan
	M-2	Block B Mechanical Plans
	M-3	Block B Penthouse Mechanical Room Demo Plan
	M-4	Block B Penthouse Mechanical Room New Plan
	M-5	Block C Mechanical Plans
	M-6	Block D Mechanical Plans
	M-7	Block E Mechanical Plans
	M-8	Heating and Domestic Water Schematics - Demo
	M-9	Heating and Domestic Water Schematics - New
	M-10	Mechanical Details
Division 26 - Electrical		
	E-1	Legend, Site Plan and Equipment Schedule
	E-2	Block B Mechanical Room Power Plan
	E-3	Block C Power Plan
	E-4	Block D Power Plan
	E-5	Block E Power Plan

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK COVERED BY CONTRACT DOCUMENTS

.1 General

.1 This Project Specification, including all appendices, shall be deemed to cover the complete installation ready for operation. Consequently, minor details not necessarily shown or specified but necessary for the proper functioning of the installation, including equipment serviceability, shall be included in the Work, the same as if shown on the drawings or in the Project Specification. Work shall be in accordance with the specifications and their intent, complete with all necessary components, including those not normally shown or specified, and shall be ready for operation before acceptance.

.2 The Mechanical Contractor shall be the Prime Contractor for the project and shall include all required sub trades including general contract trades, electrical, controls and any others as required to ensure a complete installation.

.3 The building HVAC systems shall remain in operation during renovations except for short periods during the switch over from the existing systems to the new systems.

.2 Intent

.1 Upgrade the boiler plant, domestic hot water heaters and HVAC equipment to provide more comfort and energy efficient operation

.3 Scope of Work - Mechanical Contractor

.1 Mechanical Systems:

.1 The new installation shall meet the current building standards in all aspects and shall meet all code requirements.

.2 Replace the three existing boilers and pumps and two water heaters and associated venting with units with higher efficiency.

.3 Provide a zone damper for isolation of air supply to administrative areas and lab in Block B, when the building is not occupied.

.4 Replace the reheats coils in 6 VAV boxes, (two each in Blocks C, D , and E) with higher capacity coils.

.5 Provide six high capacity ceiling fans, (two each in Blocks C, D , and E), in high bay areas for destratification.

.6 Provide a variable speed relief air fan and controls in Blocks D and E to recirculate air back to the air handling unit when the building is not occupied.

.7 Provide a domestic hot water heater and pump to provide temporary heat to heat exchangers for fish tanks, while the boiler plant is being upgraded. Retain the tank for future operation during the summer months when the boiler plant is off.

.4 Scope of Work – Controls Contractor

.1 Provide and install all additional hardware components necessary for a complete system installation, including network and communications devices; DDC controllers; field devices of all types, transformers, conduits, raceways, and wiring including power and network cabling to control the new equipment .

.2 The existing controllers as well as all devices including sensors, controllers, actuators, wiring, etc.that become redundant shall be reused if in good operating condition as required

.3 The existing conduits, wiring, relays, current transducers, electronic actuators can be re-used, providing they are suitable for the new system and are fully tested by the contractor.

.5 Scope of Work – Electrical Contractor

.1 Provide power, panels, starters, safety switches, conduit and wiring for the new HVAC equipment. Include for the removal and disposal of all the redundant panels, wire and conduit. Remove and dispose of all electrical conduit and wiring that are not re-used in this project.

1.2 CONTRACT METHOD

.1 Construct Work under stipulated price contract.

.2 Relations and responsibilities between Contractor and subcontractors are as defined in Conditions of Contract. Assigned Subcontractors must, in addition:

.1 Furnish to Contractor, bonds covering faithful performance of subcontracted work and payment of obligations there under when Contractor is required to furnish such bonds.

.2 Purchase and maintain liability insurance to protect Contractor from claims for not less than limits of liability which Contractor is required.

1.3 PROJECT SCHEDULE

.1 The following timetable outlines the anticipated schedule for the project. The timing may vary and shall ultimately be determined by the owner. The owner will not be responsible for any costs incurred by the Contractor related to changes in the estimated time-frames.

Event	**Anticipated Date**
Contract Award	1 week following tender close
Heating Plant Operational	12 weeks following Contract Award (Required)
Substantial Completion	20 weeks following Contract Award
Total Completion	4 weeks following substantial completion

1.4 WORK BY OTHERS

.1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Consultant.

.2 Co-ordinate work with other Contractors. If any part of work under this Contract depends on proper execution by or relies upon work of another Contractor, report immediately to the Consultant in writing, any situations which may interfere with proper execution of Work.

1.5 CONTRACTOR USE OF PREMISES

.1 Limit use of premises for Work, and for storage to allow:

.1 Owner occupancy during the construction period.

.2 Work by other contractors.

.2 Co-ordinate use of premises under direction of the Building Manager.

.3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

.4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.

.5 Repair or replace portions of existing work which have been altered during construction to match existing or adjoining work.

.6 At completion the work: ensure premises condition for the work area to be equal or better than that which existed before the work started.

1.6 OWNER OCCUPANCY

.1 Owner will occupy premises during entire construction period for execution of normal operations.

.2 Co-operate with the building manager in scheduling operations to minimize conflict and to facilitate occupancy.

1.7 WORK IN EXISTING BUILDINGS

.1 All work on site shall be co-ordinated with the Building Manager so as to minimize disruptions. Execute work with least possible interference or disturbance to building operations, occupants, and normal use of premises. Arrange with Building Manager to facilitate execution of work.

.2 Use only designated elevators, existing in building for moving workers and material.

.3 Obtain approval from the Owner's Representative prior to penetrating any structural surfaces including floor slabs. Obtain from the Building Manager approval of locations of all penetrations prior to commencing work. Contractor shall replace/repair any building services that are damaged due to this construction (example: drilling through concrete floors) at no extra cost.

.4 Carefully route new conduits and other new services so that they do not interfere with existing installation. Arrange and pay for any necessary relocation of existing conduit, cable tray, bus duct or any other services required for the proper installation of new Work.

.5 Removed equipment and material shall become the property of the Contractor and shall be removed from site unless otherwise requested by the Owner's Representative.

.6 All Contractors shall exercise due care and diligence in working in the occupied areas. Keep the job reasonably clear of waste material and rubbish at all times during progress of the work. Clean up and restoration of the work area shall occur after each day's installation to ensure that no disruption to the work area takes place.

.7 Protect all existing services and make good any damage occasioned by the work in this contract.

.8 The Owner reserves the right to complete and/or repair any work that is not in operating condition, beyond scheduled shut downs, in order to maintain the Owner's operation.

1.8 CONTINUITY OF EXISTING SERVICES

.1 Keep existing building in operation at all times with minimum length of shutdown periods.

.2 Co-operate with the Owner and other contractors on the job and provide necessary services so that existing building can be kept in operation at all time.

.3 Notify Building Manager of intended interruption of services and obtain required permission.

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

EQUIPMENT LIST

The following list is to be completed within one (1) week of contract award and prior to shop drawing submittals. Equipment shall be clearly identified by manufacturer's name, model number, serial or fabrication code and size where applicable.

Item	Manufacturer	Model/Size
Heating Boilers		
Domestic Hot Water Boilers		
Tanks		
Pumps		
Phase Change Material		
Variable Speed Drives (VSD)		
Destratification Fans		
Chemical Treatment		
Coils		

END OF SECTION

Part 1 General

1.1 Subcontractor Qualifications

.1 The following list is to be completed within one (1) week of contract award. Portions of the Work may be performed by Subcontractors. The Contractor shall indicate below any work that the is subcontracted along with the names of the Subcontractors intended to be used.

Subcontractor	**Scope of Work to be Performed**	**Union Affiliation**
Name:	Electrical	
Contact:		
Phone:		
Fax:		
Email:		
Name:	Sheet Metal	
Contact:		
Phone:		
Fax:		
Email:		
Name:	Controls	
Contact:		
Phone:		
Fax:		
Email:		

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Time is an essential part of this contract. Therefore the timely and successful completion of the work requires careful planning and scheduling of all activities inherent in the completion of the project.

.2 The contractor shall develop a Project Schedule to allow for a minimal amount of float in the construction schedule. This must be submitted to the consultant prior to the first progress payment review. All items including equipment lead times, shop drawings, installation, commissioning, balancing O&M manuals and owner demonstration must be accounted for in this summary.

.3 Acceptance of the project schedule and any subsequent submissions does not indicate approval of the methods of any change to the contract terms.

1.2 PROJECT PHASING REQUIREMENTS

.1 Include for all work relating to completing the project in a phased approach.

.2 Heating plant must remain operational throughout the construction period except for the scheduled shut down on nights, weekends and holidays to switch over the plant.

Part 2 Products - NOT USED

Part 3 Execution

3.1 DOMESTIC HOT WATER PHASING

.1 Phase 1:

- .1 Extend housekeeping pads and provide new for storage tanks
- .2 Remove one existing domestic heater
- .3 Install new heater and both storage tanks
- .4 Install expansion tank
- .5 Start-up new domestic heaters and tanks

.2 Phase 2:

- .1 Switch piping over existing piping to new water heater

.3 Phase 3:

- .1 Remove remaining existing water heater and install second water heater
- .2 Replace domestic hot water recirculation pump
- .3 Interconnect controls to DDC
- .4 Fully commission new domestic heaters and tanks

3.2 HEATING HOT WATER PLANT

.1 Phase 1:Pre Demolition

- .1 Install new electric hot water heater, piping, expansion tank associated with process heating
- .2 Chemically clean existing piping

.2 Phase 2: Demolition

- .1 Shut down heating system
- .2 Drain piping as required for Switchover
- .3 Remove boilers, pumps, and all other redundant equipment and piping

.3 Phase 3: Construction

- .1 Install new boilers, pumps, piping, valves and venting
- .2 Modify controls for system optimization
- .3 Make good all surfaces;
- .4 Commission system

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 78 00 – Closeout Submittals.

1.2 ADMINISTRATIVE

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

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

.3 Present shop drawings, product data 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 Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

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

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

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

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

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

.11 All major component shop drawings must be received within 1 week of contract award.

1.3 SHOP DRAWINGS AND PRODUCT DATA

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

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

.3 Allow 7 business days for Consultant's review of each submission.

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

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

.6 Accompany submissions with transmittal letter, containing:

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

.7 Submissions include:

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

.8 After Consultant's review, distribute copies.

.9 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.

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

.11 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Consultant.

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

.12 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Consultant.

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

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

.15 Delete information not applicable to project.

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

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

.18 Each shop drawing shall be **checked** and **stamped** as being correct, by trade purchasing item, and by the Contractor, before drawing is submitted to Consultant for review. If above requirements are not complied with, shop drawings will be rejected and returned forthwith.

.19 Do not have equipment delivered to site until a shop drawing for the item has been reviewed, stamped as accepted or modified by Consultant and returned to Contractor.

1.4 EQUIVALENCY

.1 Manufacturer products listed in these specifications are provided as materials or equipment already reviewed and accepted for inclusion in the Work. These listed materials or equipment demonstrate the minimum quality and performance of materials and equipment that manufacturers offerings and requests for equivalency must demonstrate in order to be considered for inclusion in the project.

.2 Unless stated ‘no equivalent’, manufacturers, their agents or representatives may and are invited to submit materials or equipment for consideration as equivalent to listed materials or equipment by submitting written request to the Consultant and providing information for submittals as detailed within these specifications.

.3 All requests for equivalency must be submitted no later than three days prior to the close of tender or request for pricing.

1.5 DETAIL DRAWINGS AND INSTRUCTIONS

.1 Submit notification of locations where installation of equipment would interfere with interior treatment and use of building. Detail drawings or instructions exactly locating these items will then be issued.

.2 Submit all the drawings respecting the work to the Consultant, upon request, for acceptance before using them. Contractor is responsible for performing the work properly notwithstanding such acceptance.

.3 Perform the work in accordance with drawings and instructions supplied by the Consultant but do not use such drawings for construction, manufacture or installation unless the Consultant has released them for such use.

.4 Inform the Consultant of any instructions given by any parties that would affect the equipment, quantities, locations, price, or any modification to the work as outlined in this Contract. Failure to comply may result in the rejection of the work or any associated costs.

1.6 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic copy of colour digital photography in fine resolution as directed by Consultant.

1.7 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Workers' Compensation Board status.

Part 2 Products - NOT USED

Part 3 Execution - NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Government of Canada

.1 Canada Labour Code, Part 2,

.2 Canada Occupational Safety and Health Regulations

.2 National Building Code of Canada (NBC):

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

.3 The Canadian Electric Code (as amended)

.4 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 CSA Z1006-10 Management of Work in Confined Spaces.

.5 CSA Z462- Workplace Electrical Safety Standard

.5 National Fire Code of Canada 2010 (as amended)

.1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.

.6 American National Standards Institute (ANSI):

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

.7 Province of British Columbia:

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

.8 Occupational Health and Safety Regulations

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

.1 Material Safety Data Sheets (MSDS).

1.2 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittal Procedures

1.3 SECTION INCLUDES

.1 Health and safety considerations required to ensure that PWGSC shows due diligence towards health and safety on construction sites, and meets the requirements laid out in PWGSC/RPB Departmental Policy DP 073 - Occupational Health and Safety - Construction.

1.4 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.

1.5 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.

1.6 SUBMITTALS

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

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

.3 Submit the following:

.1 Site Specific 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 current 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 Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 5 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.

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

.6 Submission of the Site-Specific 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.

1.7 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.

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

.4 Secure site at night time [or provide security guard] as deemed necessary to protect site against entry.

1.8 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with:

.1 Multi-employer work site.

.2 Federal employees and general public.

.3 Refer to attached "Preconstruction Assessment Form" (PAF) as an Appendix to this specification.

1.9 UTILITY CLEARANCES

.1 The Contractor is solely responsible for all utility detection and clearances prior to starting the work

.2 The Contractor will not rely solely upon the Reference Drawings or other information provided for utility locations.

1.10 REGULATORY REQUIREMENTS

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

.2 In event of conflict between any provision of 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.

1.11 WORK PERMITS

.1 Obtain speciality permits related to project before start of work.

1.12 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.

1.13 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 b work.

.4 Indicate Engineering and administrative control measures to b implemented at the site for managing identified risks an 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 Site Specific Health and Safety Plan by Public Service and Procurement Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Site Specific Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

1.14 EMERGENCY PROCEDURES

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

.1 Designated personnel from own company.

.2 Regulatory agencies applicable to work and as per legislated regulations.

.3 Local emergency resources.

.4 Departmental Representative site staff.

.2 Include the following provisions in the emergency procedures:

.1 Notify workers and the first-aid attendant, of the nature and location of the emergency.

.2 Evacuate all workers safely.

.3 Check and confirm the safe evacuation of all workers.

.4 Notify the fire department or other emergency responders.

.5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.

.6 Notify Departmental Representative site staff.

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

.1 Work at high angles.

.2 Work in confined spaces or where there is a risk of entrapment.

.3 Work with hazardous substances.

.4 Underground work.

.5 Work on, over, under and adjacent to water.

.6 Workplaces where there are persons who require physical assistance to be moved.

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

1.15 HAZARDOUS PRODUCTS

.1 Comply with requirements of Workplace Hazardous Materials

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

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

.1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per [Section 013300].

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

.3 Provide adequate means of ventilation in accordance with [Section 015100].

.4 The contractor shall ensure that the product is applied as per manufacturers recommendations.

.5 The contractor shall ensure that only pre-approved products are brought onto the work site in an adequate quantity to complete the work.

1.16 ASBESTOS HAZARD

.1 Carry out any activities involving asbestos in accordance with applicable Provincial / Federal Regulations.

.2 Removal and handling of asbestos will be in accordance with applicable Provincial / Federal Regulations.

1.17 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

1.18 MEETINGS

.1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.19 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.20 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.

1.21 COMPLIANCE REQUIREMENTS

.1 Comply with Workers Compensation Act, B.C. Reg.

.2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.22 PCB REMOVALS

.1 Mercury-containing fluorescent tubes and ballasts which contain polychorinated biphenyls (PCBs) are classified as hazardous waste.

.2 Remove, handle, transport and dispose of as indicated in Section [028400].

1.23 REMOVAL OF LEAD CONTAINING PAINTS

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

.2 Carry out demolition and/or remediation activities involving lea containing paints in accordance with applicable Provincial Territorial Regulations.

.3 Dry Scraping/Sanding of any materials containing lead is strictly prohibited.

.4 The use of Methylene Chloride based paint removal products is strictly prohibited.

1.24 ELECTRICAL SAFETY REQUIREMENTS

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

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

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

1.25 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.

1.26 OVERLOADING

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

1.27 FALSEWORK

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

1.28 SCAFFOLDING

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

1.29 CONFINED SPACES

.1 Carry out work in confined spaces in compliance with Provincial / Territorial Regulations

1.30 POWDER-ACTUATED DEVICES

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

1.31 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.

1.32 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.

1.33 FIRE PROTECTION AND ALARM SYSTEM

.1 Fire protection and alarm systems shall not be:

.1 Obstructed.

.2 Shut off.

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

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

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

1.34 UNFORSEEN 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.

1.35 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:

.1 Have site-related working experience specific to activities associated with mechanical and electrical systems installation.

.2 Have working knowledge of occupational safety and health regulations.

.3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.4 Be responsible for implementing, revising, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

.5 Be on site during execution of Work and report directly to and be under direction of site supervisor.

1.36 POSTING OF DOCUMENTS

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

.1 Site Specific Health and Safety Plan.

.2 Sequence of work.

.3 Emergency procedures.

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

.5 Notice of Project.

.6 Floor plans or site plans.

.7 Notice as to where a copy of the Workers' Compensation

.8 Act and Regulations are available on the work site for review by employees and workers.

.9 Workplace Hazardous Materials Information System (WHMIS) documents.

.10 Material Safety Data Sheets (MSDS). .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.

1.37 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

1.38 MEETINGS

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

1.39 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.

.2 Provide Departmental Representative with written report of action taken to correct non-compliance of 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".

Part 2 Products - NOT USED

Part 3 Execution - NOT USED

END OF SECTION

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PESC PRELIMINARY HAZARD ASSESSMENT FORM

Project Number:	PESC - 051
Location:	Pacific Environmental Science Centre, North Vancouver, B.C.
Date:	March 31

Site Specific Orientation Provided at Project Location ☐ Yes

Notice of Project Required ☐ Yes

NOTE:
PWGSC REQUIRES A Notice of Project FOR ALL CONSTRUCTION WORK RELATED ACTIVITIES

NOTE:
OHS law is made up of many municipal, provincial, and federal acts, regulations, bylaws and codes. There are also many other pieces of legislation in British Columbia that impose OHS obligations.

Important Notice: This hazard assessment has been prepared by PSPC for its own project planning process, and to inform the service provider of actual and potential hazards that may be encountered in performance of the work. PSPC does not warrant the completeness or adequacy of this hazard assessment for the project and the paramount responsibility for project hazard assessment rests with the service provider.

TYPES OF HAZARDS TO CONSIDER	Potential Risk for:				COMMENTS
Examples: Chemical, Biological, Natural, Physical, and Ergonomic Listed below are common construction related hazards. Your project may include pre-existing hazards that are not listed. Contact the Regional Construction Safety Coordinator for assistance should this issue arise.	PWGSC, OGD's, or tenants		General Public or other contractors		Note: When thinking about this pre-construction hazard assessment, remember a **hazard** is anything that may cause harm, such as chemicals, electricity, working from heights, etc; the **risk** is the chance, high or low, that somebody could be harmed by these and other hazards, together with an indication of how serious the harm could be.
	Yes	No	Yes	No	
Typical Construction Hazards					
Concealed/Buried Services (electrical, gas, water, sewer etc)		✓		✓	All work is exposed
Slip Hazards or Unsound Footing		✓	✓		Water spills
Working at Heights			✓		Installation of new ceiling Fans
Working Over or Around Water		✓		✓	
Heavy overhead lifting operations, mobile cranes etc.		✓	✓		Hoist of Boilers
Marine and/or Vehicular Traffic (site vehicles, public vehicles, etc.		✓		✓	
Fire and Explosion Hazards		✓	✓		Welding operation

Canada

High Noise Levels		✓	✓		Drilling, chipping floor
Excavations		✓		✓	
Blasting		✓		✓	
Construction Equipment		✓	✓		Work within Mechanical Rooms
Pedestrian Traffic (site personnel, tenants, visitors, public)		✓		✓	
Multiple Employer Worksite		✓		✓	Example: Contractor working in an occupied Federal Employee space.

Electrical Hazards					**Comments**
Contact With Overhead Wires		✓		✓	
Live Electrical Systems or Equipment		✓	✓		Electrical Work
Other:					
Physical Hazards					
Equipment Slippage Due To Slopes/Ground Conditions		✓		✓	
Earthquake		✓		✓	
Tsunami		✓		✓	
Avalanche		✓		✓	
Forest Fires		✓		✓	
Fire and Explosion Hazards		✓		✓	
Working in Isolation		✓		✓	
Working Alone		✓		✓	
Violence in the Workplace		✓		✓	
High Noise Levels		✓		✓	
Inclement weather		✓		✓	
High Pressure Systems		✓		✓	
Other:					
Hazardous Work Environments					
Confined Spaces / Restricted Spaces PSPC employees do not enter confined space.		✓		✓	If available, provide the contractor with the existing confined space assessment(s) for information only. Contractor must perform their own confined space assessment as per provincial regulations.
Suspended / Mobile Work Platforms		✓	✓		lift for fan installation
Other:					
Biological Hazards					
Mould Proliferations		✓		✓	
Accumulation of Bird or Bat Guano		✓		✓	
Bacteria / Legionella in Cooling Towers / Process Water		✓		✓	
Rodent / Insect Infestation		✓		✓	
Poisonous Plants		✓		✓	
Sharp or Potentially Infectious Objects in Wastes		✓		✓	
Wildlife		✓		✓	
Chemical Hazards					

Asbestos Materials on Site		✓		✓	If "yes" a pre-project asbestos survey report is required. Provide Contractor with ELF Form 16 "Contractor Notification and Acknowledgement"
Designated Substance Present		✓		✓	If "yes" a pre-project designated substance survey report is required.
Chemicals Used in work		✓		✓	
Lead in paint		✓		✓	If "yes" a pre-project lead survey report is required.
Mercury in Thermostats or Switches		✓		✓	If "yes" a pre-project mercury survey report is required.
Application of Chemicals or Pesticides		✓		✓	
PCB Liquids in Electrical Equipment		✓		✓	
Radioactive Materials in Equipment		✓		✓	
Other:		–		–	
Contaminated Sites Hazards					
Hazardous Waste		✓		✓	
Hydrocarbons		✓		✓	
Metals		✓		✓	
Other:		–		–	

Security Hazards					**Comments**
Risk of Assault					
Other:					
Other Hazards					

Other Compliance and Permit Requirements[1]	**YES**	**NO**	**Notes / Comments[2]**
Is a Building Permit required?		✓	
Is an Electrical permit required?	✓		
Is a Plumbing Permit required?	✓		
Is a Sewage Permit required?		✓	
Is a Dumping Permit required?	✓		
Is a Hot Work Permit required?	✓		
Is a Permit to Work required?	✓		Mandatory for ALL AFD managed work sites.
Is a Confined Space Entry Permit required?		✓	Mandatory N/R
Is a Confined Space Entry Log required		✓	Mandatory for all Confined Spaces N/R
Discharge Approval for treated water required	✓		

Notes:

(1) Does not relieve Service Provider from complying with all applicable federal, provincial, and municipal laws and regulations.

(2) TBD means To Be Determined by Service Provider.

Service Provider Acknowledgement: We confirm receipt and review of this Pre-Project Hazard Assessment and acknowledge our responsibility for conducting our own assessment of project hazards, and taking all necessary protective measures (which may exceed those cited herein) for performance of the work.			
Service Provider Name			
Signatory for Service Provider		**Date Signed**	
RETURN EXECUTED DOCUMENT TO PSPC DEPARTMENTAL REPRESENTATIVE PRIOR TO ANY WORK COMMENCING			

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 45 00 – Quality Control.

1.2 REFERENCES

.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC 2-2008 - Stipulated Price Contract.

.2 Within text of each specifications section, reference may be made to reference standards. List of standards reference writing organizations is contained in Section.

.3 Conform to these reference standards, in whole or in part as specifically requested in specifications.

.4 If there is question as to whether products or systems are in conformance with applicable standards, Owner's Representative reserves right to have such products or systems tested to prove or disprove conformance.

.5 Cost for such testing will be borne by Owner in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.3 QUALITY

.1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.

.3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.4 Should disputes arise as to quality or fitness of products, decision rests strictly with Owner's Representative based upon requirements of Contract Documents.

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

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

1.4 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Owner's Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.2 In event of failure to notify Owner's Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Owner's Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

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

.5 Remove and replace damaged products at own expense and to satisfaction of Owner's Representative.

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

1.6 TRANSPORTATION

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

.2 Transportation cost of products supplied by Owner will be paid for by Departmental Representative. Unload, handle and store such products.

1.7 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 Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant will establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.8 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative and Consultant 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 and Consultant reserves right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.9 CO-ORDINATION

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.10 CONCEALMENT

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

.2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

1.11 REMEDIAL WORK

.1 Refer to CCDC 2.

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

.3 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.12 LOCATION OF FIXTURES

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform Owner’s Representative of conflicting installation. Install as directed.

1.13 FASTENINGS

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

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.14 FASTENINGS - EQUIPMENT

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.15 PROTECTION OF WORK IN PROGRESS

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 01 33 00 – Submittal Procedure.

.3 Section 01 45 00 – Quality Control.

.4 Section 26 05 00 – Common Work Results – Electrical.

1.2 REFERENCES

.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC 2-2008 - Stipulated Price Contract.

1.3 PROJECT CLEANLINESS

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

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

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

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

.5 Provide and use marked separate bins for recycling.

.6 Clean interior areas daily at the end of each shift and prior to start of finishing 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.

1.4 FINAL CLEANING

.1 Refer to CCDC 2, GC 3.14.

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

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

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

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

.6 Remove waste materials from site at regularly scheduled times or dispose of as directed by Owner's Representative. Do not burn waste materials on site.

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

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

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

1.5 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 - NOT USED

Part 3 Execution - NOT USED

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Two weeks prior to Substantial Performance of the Work, submit to the Consultant, three final copies of operating and maintenance manuals in English and one electronic copy.

.3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

.4 Provide evidence, if requested, for type, source and quality of products supplied.

1.2 FORMAT

.1 Organize data as instructional manual.

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

.3 When multiple binders are used correlate data into related consistent groupings.

.1 Identify contents of each binder on spine.

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

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

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

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

.8 Electronic: manuals shall be submitted in .pdf format on a 32 GB (minimum) USB drive with the following:

.1 One compiled manual complete with table of contents and links to defined sections

.2 One folder containing all equipment cut sheets

.1 Cut sheets shall be organized in folders based on discipline

.2 Individual .pdf documents shall be named: "Equipment TAG – Description - Location.pdf" e.g. "EF-1 – General Exhaust – Administration Bldg Roof.pdf"

.3 A folder containing all project record drawings

.4 A folder containing all warrantees with independent

.9 Drawings: provide with reinforced punched binder tab.

.1 Bind in with text; fold larger drawings to size of text pages.

.10 Provide CAD files in .dwg and .pdf format on CD.

1.3 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

.1 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

.2 Record information concurrently with construction progress.

.1 Do not conceal Work until required information is recorded.

.3 Contract Drawings and shop drawings: mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

.4 Specifications: mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.5 Other Documents: maintain inspection certifications, field test records, required by individual specifications sections.

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

1.4 EQUIPMENT AND SYSTEMS

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

.1 Give function, normal operation characteristics and limiting conditions.

.2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.

.1 Include regulation, control, stopping, shut-down, and emergency instructions.

.2 Include summer, winter, and any special operating instructions.

.4 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.5 Provide servicing and lubrication schedule, and list of lubricants required.

.6 Include manufacturer's printed operation and maintenance instructions.

.7 Include sequence of operation by controls manufacturer.

.8 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.9 Provide installed control diagrams by controls manufacturer.

.10 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.11 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.12 Include test and balancing reports as specified in Section 01 91 13 - General Commissioning (Cx) Requirements.

.13 Additional requirements: as specified in individual specification sections.

1.5 MAINTENANCE MANUALS

.1 Submit three complete sets of manufacturer's operating and maintenance instructions, bound in three-ring, vinyl covered hard cover binder, 215.9 mm x 279.4 mm (8 ½" x 11") size at completion, and before final acceptance, of Work. Include for an electronic copy of the manuals. Indicate on cover and spine of binder "project title", date of project completion. Contents of books not to include hand-written data.

.2 Title sheet, in each book, to be labelled "Project Title – Energy Upgrade – Operations and Maintenance Manual" and to bear the following:

.1 Project Title;

.2 Building Names;

.3 Date of Project Completion;

.4 Table of Contents

.3 Each book to contain the following:

.1 Contact information including Contractor and Consultant company names, location address, telephone numbers, facsimile numbers, and email addresses;

.2 Manufacturer's literature, parts list, accepted shop drawing, and name and address of closest service organization and spare parts source, for each item of equipment;

.3 Voltage and ampere rating for each item of electrical equipment. Note: Suitably fold shop drawings larger than 215.9 mm x 279.4 mm (8 ½" x 11") and place in a manila envelope, 3-holepunched, for inclusion in book;

.4 Copy of electrical work acceptance by electrical safety inspector;

.5 Copy of plumbing work acceptance and reports by plumbing safety inspector;

.6 Copy of gas work acceptance and reports by gasSafety inspector;

.7 Extended equipment warranties;

.8 Balancing reports

.9 Letters of assurance for seismic restraints

.10 Pipe cleaning and chemical treatment reports

.11 Pressure testing reports

.12 Extended warrantees

.13 Completed reproducible record drawings in CAD and PDF formt;

.4 Review maintenance manual with Owner's operating staff or representatives to ensure a thorough understanding of each item of equipment and its operation.

.5 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

.1 Commission the installation and operation of the following upgraded hydronic and, plumbing systems including but not limited to the following systems:

- .1 Pumps, piping systems and storage tanks
- .2 Boilers and water heaters
- .3 Ceiling fans and exhaust fans
- .4 Reheat coils
- .5 Phase change material installation
- .6 Controls and Sequence of Operations

1.2 DEFINITIONS

.1 Commissioning: The process for achieving, verifying, and documenting that the facility and its systems are planned, designed, installed, and tested to ensure that they meet the original project requirements established by the Owner.

.2 Commissioning Team:

- .1 Client's Representative: Project Manager, as defined in the Agreement.
- .2 Consultant: as defined in the Agreement.
- .3 Commissioning Manager: Party engaged by the contractor to lead commissioning activities, and coordinate other team members.
- .4 Contractor Representatives: Representatives of the Contractor, including any sub-contractors whose scope of work includes items requiring commissioning.

.3 Commissioning Documents:

- .1 Commissioning Plan: A project-specific document which defines the scope and approach to commissioning of this facility.
- .2 Submittal: Contract submittal, as specified in Contract Documents.
- .3 Static check certificate: A document used to verify equipment data actually installed, prior to start-up or operation.
- .4 Operating check certificate. A document used to verify equipment operation, including performance statistics.
- .5 Startup Reports: Report prepared by equipment start-up personnel, including start-up sequence, and performance statistics.
- .6 Balancing Report: Report prepared by the balancing agency, indicating initial and final system performance.
- .7 Maintenance Manual: A document containing detailed descriptions and technical information about start-up, operation and maintenance of equipment.

1.3 METHODOLOGY

.1 The Commissioning Manager shall develop a Commissioning Plan, including as a minimum the management of commissioning meetings, and the management of project-specific commissioning documents.

.2 Commissioning Plan to include:

.1 Assembly of owner's requirements, including design criteria, performance goals, budgets, and schedules.

.2 Scheduling and chairing of commissioning meetings between team members.

.3 Development of static and operating check certificates for individual equipment.

.4 Assembly of commissioning reports, including testing and balancing reports, maintenance manuals, start-up reports, and testing reports.

.5 Verification of data by testing agency.

.6 Audit procedure, to be performed in the event of dispute or failure.

.3 Execute the commissioning plan.

1.4 REGULATORY REQUIREMENTS

.1 Arrange for regulatory authorities to witness those commissioning start up procedures which are also required by regulatory authorities.

.2 Obtain certificates of approval and for compliance with regulations from Authorities Having Jurisdiction; include copies of certificates with start up reports.

1.5 CONTRACT COMMISSIONING REQUIREMENTS

.1 Witnessing: Allow commissioning team members to witness starting, testing, adjusting, and balancing procedures.

.2 Allow Commissioning Manager free access to the site.

.3 Costs: Pay costs associated with starting, testing, adjusting, and relevant instruments and supplies required to perform those duties.

.4 Employ experienced personnel for equipment startup and commissioning, who are able to interpret results of readings and tests, and report the system status in a clear and concise manner.

.5 Provide all equipment required to perform testing, balancing, and commissioning of systems. Calibrate instruments used in start up as accurate; provide calibration certificates if requested by the Commissioning Manager.

.6 Utilize equipment check certificates and other commissioning documents required by the Commissioning Manager.

.7 Verify that equipment is installed in accordance with Contract Documents, and reviewed shop drawings. Sign and date static check certificates.

.8 Do not start up equipment unless static check sheets have been completed and submitted.

.9 Complete in detail, and sign operating check certificates.

Part 2 Products - NOT USED

Part 3 Execution

3.1 COMMISSION TESTING

.1 Allow for work, effort, and associated costs necessary to assist an Owner appointed and remunerated Commissioning Manager, for fulfilment of a commission testing process of the facility and Work.

.2 Coordinate, cooperate, and harmonize efforts with the Commissioning Manager.

.3 Commission testing will include a random testing and evaluation process as determined by the Consultant.

.4 System and device checks to be suitably logged, tabulated, signed, and incorporated into project Operating and Maintenance Manuals:

.1 Prior to start of testing, provide two (2) complete sets of up-to-date contract drawings and specifications including addenda to the Commissioning Manager.

.2 Provide one (1) copy of each approved notice of change and clarification.

.3 Coordinate site visits by the Commission Manager and the affected parties during warranty periods.

.5 The commissioning process will not:

.1 Preclude the duties and responsibilities described in the Contract Documents nor the requirements and obligations of the Contract.

.2 Circumvent any required warranties

.3 Relieve the Contractor from warranty requirements, responsibilities, or obligations.

.6 Prior to commission testing, perform the following and provide copies to the Commissioning Manager, of component and assembly Contract Document compliance:

.1 Static test certificates.

.2 Equipment operating certificates.

.3 Three (3) copies of valve tag list.

.4 Inspection certificates from authorities having jurisdiction.

.5 Required copies of shop drawings.

.6 Manufacturer’s operating and maintenance brochures of all major equipment.

.7 Ensure all systems have been started, adjusted to design criteria, and are functionally operational, ready for independent testing.

.8 Cooperate with the Commissioning Manager in advance of activating operating systems.

.9 Test results that illustrate failure to conform to the Contract Documents, will result in the Owner arranging and paying to correct the Work at the Owner's discretion, and recovering all associated costs from the Contractor.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA S350-M1980(R1998), Code of Practice for Safety in Demolition of Structures.

1.2 SUBMITTALS

.1 Prior to beginning of Work on site submit detailed Waste Reduction Workplan and indicate:

.1 Descriptions of and anticipated quantities of materials to be salvaged, reused, recycled and landfilled.

.2 Name and address of waste facilities.

1.3 SITE CONDITIONS

.1 Do not proceed until written instructions have been received from Consultant and approval to proceed is received from the Facility Manager.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 SCOPE OF DEMOLITION

.1 Removal of existing boilers, domestic hot water heaters, breeching, pumps, unused piping materials, reheat coils and other equipment that is to be upgraded as shown on the drawings and in the facility.

.2 Remove existing concrete bases for equipment in the boiler room.

.3 Remove redundant electrical equipment, conduit and wiring.

3.2 PREPARATION

.1 Inspect building with Facility Manager and verify extent and location of items designated for removal, disposal, and items to remain.

.2 Locate, close isolating valves, remove water, gas and drain piping, flue connections, electrical and control wiring connections to the boilers, water heaters and pumps.

.3 Locate, isolate and disconnect components of HVAC equipment to be upgraded.

.4 Remove and replace components while maintaining building heating systems and HVAC equipment in operation during occupied hours.

.5 Provide temporary enclosures, signage and barriers as directed by the Facility Manager.

.6 Comply with Work Safe BC regulations.

3.3 SITE REMOVALS

.1 Remove the boilers and install new boilers during the summer months when heating is not required in the building. The mechanical contractor shall provide an electric water heater and pump to supply hot water to the heat exchanger for the process load during the construction period for the boiler plant. The water heater shall be retained as a summer heating supply system so the new boiler plant can be shutoff during the summer months

.2 Remove HVAC equipment for disposal while retaining HVAC systems in operation.

.3 Remove packaging and pallets for new equipment to be installed.

.4 Redundant heating coils and piping shall be removed from the esite

3.4 DEMOLITION

.1 When the boilers and HVAC equipment have been removed, prepare surfaces for installation of new equipment.

.2 Make good any damages to the surfaces of wallsl, ceilings and floors.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International Inc..

.1 ASTM E96/E 96M-10 Water Vapor Transmission of Materials

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

.1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Manufacturer's Instructions:

.1 Include procedures to be used and installation standards to be achieved.

.3 Qualifications:

.1 Installer to be specialist in performing work of this section, and have at least 1 years successful experience in this size and type of project.

Part 2 Products

2.1 COMPONENTS

.1 The product, PCM phase change material, shall be certified as non-hazardous to health as per MSDS testing.

2.2 THERMAL STORAGE

.1 Minimum thermal storage capacity: 91btu/sqft

.2 Weight of material: 1 lb/ft^2

.3 PCM operation range 69℉ to 73℉ (4℉ Swings)

.4 Composition: Proprietary materials blend for thermal storage and phase change.

.5 Size of blankets: two feet by 4 feet.

2.3 THERMAL STORAGE INSTALLATION & SECUREMENTS

.1 PCM blankets to be lay on installation above T-bar ceiling with no overlap with other PCM blankets or heat generating equipment (lighting, service box etc); no fastener required during installation.

2.4 PERMEABILITY

.1 Phase change membrane shall have a permeance not greater than 60ng/(Pa*s8m2) measured in accordance with ASTM E96/E 96M, "Water Vapor Transmission of Materials" using the desiccant method (dry cup).

Part 3 Execution

3.1 EXISTING T-BAR CEILING IN OFFICE AREA OF BLOCK B

.1 Seismic Engineer engaged by the Mechanical Contractor shall examine the T-Bar structure and supports for the ceiling for capability to support the product and provide seismic engineering schedules at the end of the contract. Any changes that may be required to the supports for the ceiling will be carried as a Change Order to the contract.

3.2 APPLICATION

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

3.3 PRE- INSTALLATION REQUIREMENTS

.1 Surface preparation for PCM blanket placements includes verification and assurance that the ceiling material is solid, clean, dry and free from foreign materials.

3.4 INSTALLATION

.1 $50m^2$ of 24"x48" PCM blankets shall be placed over an area of $73m^2$. Placement of PCM blanket placement locations to prioritize glazing area and exterior walls.

.2 PCM blankets to be lay-on installation above T-bar ceiling with acoustical tile and gypsum board ceiling. Ensure no overlap with other PCM blankets or heat generating equipment (lighting, service box etc).

Note:

1.Typical PCM installation will have approximately 80% coverage.

2. No fasteners is required for the PCM blanket installation.

3.5 PHASE CHANGE MATERIAL SCHEDULES

.1 Provide $50m^2$ (24"x48") of BioPCM -Q23 M91rated as per Section 2.3 Thermal Storage

.2 Installation weight distribution of 1lb/sqft.

.3 Longevity / Environment Impact: 50 year plus / non-toxic & biodegradable.

.4 Considerations for supplier equivalency to match or exceed specifications. Provide breakdown of comparable installation cost to selection herein (3.4) for Prism Engineering review and assessment for equivalency determination.

3.6 QUALITY ASSURANCE

.1 Contractor to be adequately trained in the installation procedures. This will be done per manufacturers written recommendations published in their installation manual.

.2 Installer shall verify the structural integrity of load bearing assembly on which the Phase Change Blanket is installed with the project structural & seismic engineer prior to installing on any load bearing assembly.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Seismic restraint systems for new statically supported and vibration isolated equipment and systems; including boilers, pumps, speed drives, tanks, heating piping, fans.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA G40.20/G40.21-[04], General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

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

1.3 DEFINITIONS

.1 SRS: acronym for Seismic Restraint System.

1.4 SYSTEM DESCRIPTION

.1 SRS fully integrated into, and compatible with:

.1 Noise and vibration controls specified elsewhere.

.2 Structural, mechanical, electrical design of project.

.2 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.

.3 Designed by Professional Engineer specializing in design of SRS and registered in Province of British Columbia.

1.5 SUBMITTALS

.1 Submit Engineering Schedules at the end of the project signed and sealed by a structural engineer registered in the Province of BC for the seismic securement of mechanical equipment and piping installed in the upgrade.

.2 The seismic design, installation and certification shall be the responsibility of the Mechanical Contractor.

Part 2 Products

2.1 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 RC 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.

2.2 SRS FOR STATIC EQUIPMENT, SYSTEMS

.1 Floor-mounted equipment, systems:

.1 Anchor equipment to equipment supports.

.2 Anchor equipment supports to structure.

.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.

2.3 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.

.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.

2.4 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 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 Attachment points and fasteners:

.1 To withstand same maximum load that seismic restraint is to resist and in every direction.

.2 Slack Cable Systems (SCS):

.1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.

.2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.

.3 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.

.4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.

.5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.

.6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.

.7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.

.3 Install SRS at least 25 mm from equipment, systems, services.

.4 Miscellaneous equipment not vibration-isolated:

.1 Bolt through house-keeping pad to structure.

.5 Co-ordinate connections with other disciplines.

3.3 FIELD QUALITY CONTROL

.1 Inspection and Certification:

.1 SRS: inspected and certified by Seismic Engineer upon completion of installation.

.2 Provide written report to Consultant with certificate of compliance.

END OF SECTION

Part 1 General

1.1 ISOLATION AND RESTRAINT

.1 Provide vibration isolation on all motor driven equipment with motors of 0.37 kW (0.5 HP) and greater power output (as indicated on the motor nameplate) and on piping and ductwork, as specified herein. For equipment less than 0.37 kW, provide neoprene grommets at the support points. Where equipment is internally isolated by the manufacturer, it need not be externally isolated.

.2 Submit shop drawings including details of attachment to the structure. Attachment details to the structure to be approved by a BC Registered Professional Engineer.

.3 Space 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. In particular, chillers shall meet this requirement.

.4 For all electrical connections to isolated equipment, provide a minimum 90°bend of flexible conduit.

.5 Provide housekeeping pads at least 100 mm (4") high under all isolated equipment. Provide at least 175 mm (7") clearance between drilled inserts and edge of housekeeping pads and follow structural consultant's instructions for drilled inserts. All housekeeping pads shall be keyed to the structure to resist seismic displacement.

.6 Isolators and restraining devices which are factory supplied with equipment shall meet the requirements of this section.

.7 Bolt all equipment to the structure. Do not bridge isolation elements.

.8 Supply all isolators fully assembled and clearly labelled with full instructions for installation by the Contractor.

1.2 QUALIFICATIONS AND SUBMITTALS

.1 All equipment shall be tested in an independent testing laboratory, or certified by a registered professional engineer, to demonstrate that equipment meets the requirements of this section. If particular tests are carried out to represent an isolator type, the tests shall be valid for the full load range of the isolator. Submit such tests or certification on request.

.2 Obtain all relevant equipment information and provide shop and placement drawings for all vibration isolation elements and steel bases for review before materials are ordered. Provide attachment to both the equipment and the structure meeting the specified forces involved. Attachment details to the structure shall be approved by a BC Registered Professional Engineer.

.3 Submit samples of materials required to complete the work of this section for inspection and review if and when requested.

Part 2 Products

2.1 ISOLATORS

.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.

.2 All isolators shall be of the following types, supplied by the manufacturers named, or other acceptable manufacturers listed, or approved.

.3 Type 1 - Pad Isolator

.1 Neoprene/steel/neoprene pad isolators manufactured from "Bridge bearing quality neoprene", as defined by CSA Standard CAN3-S6-M78 Section 11.10. Select Type 1 pads for a 2.5 mm (0.1") static deflection or greater. Bolt down equipment mounted on neoprene pad isolators using neoprene grommets. Design is based on Vibron Vibropad VSV, Mason WMW or Super W.

.4 Type 2 - Rubber Floor Isolators

.1 Rubber/neoprene-in-shear isolators designed to meet specified seismic requirements. Select isolators for a 4 mm (0.15") minimum static deflection, and bolt to structure. In the case of rubber isolators, provide protection in the design of the isolator to avoid contact of the rubber element to oil in the mechanical room. Design is based on Trelleborg Type RAEM or Mason RAA, RBA, or RCA.

.5 Type 3 - Spring Floor Isolators:

.1 Spring mounts complete with levelling devices, and minimum 6 mm (0.25") thick ribbed neoprene sound pads with 1.3 mm (0.05") minimum deflection. Design isolators to meet specified seismic requirements. Bolt down using neoprene grommets. Design is based on Vibron VMR-2, Mason SSLFH, or approved.

.6 Type 4 – Hangers

.1 Spring hangers, c/w 6 mm (0.25") thick sound pads sized for 0.5 mm (0.02") minimum deflection, or neoprene hangers. Design is based on Vibron Series VH, approved equal - Mason HD, HS. A neoprene element alone, without a hanger box, is acceptable provided no short circuiting occurs.

2.2 FLEXIBLE PIPING CONNECTORS

.1 Furnish and install flexible piping connectors in all piping connectors to spring isolation mounted pumps.

.2 Flexible connectors shall be Mason Super-Flex twin sphere non-metallic connectors with nylon tire cord reinforced EPDM body, ductile iron reinforcing ring, and ductile iron connection flanges. Connectors shall be installed and hose lengths shall be pre-set in strict accordance with the manufacturer’s instructions. Where recommended by the manufacturer, connectors shall be fitted with control rods complete with isolated end fittings.

.3 Connectors size 20 mm (3/4") to 40 mm (1 1/2") pipe size shall be Mason Super Flex Model MFTU-DI with screwed connections. Connectors size 50 mm (2") and up shall be Mason Super-Flex Model MFTMC with flanged connections. Connectors shall be rated for continuous operation at 250 psi at 170°F and 165 psi at 250°F.

2.3 FLEXIBLE DUCT CONNECTIONS

.1 All fan connections to ducts or plenums shall be made with double coated neoprene flexible connections, Duro Dyne Grip-Lock Neoprene. Connections shall be 150 mm (6") long, installed as per the manufacturer's instructions.

Part 3 Execution

3.1 General

.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 Execute all work in accordance with the current editions of the S.M.A.C.N.A. - "Seismic Restraint Manual guidelines for Mechanical Systems", the C.A.L.S.M.A.C.N.A. and P.P.I.C. Manual "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems", and the "National Uniform Seismic Installation Guide".

.3 Isolate all floor or pier mounted equipment on Type 3 isolators, unless otherwise specified. Isolate pumps and axial fans rotating at more than 1170 RPM on Type 2 isolators. Use the lowest RPM scheduled for two speed equipment in determining isolator deflection. Spring deflections shall be as recommended by the isolator manufacturer for the particular equipment and location or shall be as specifically called for under the equipment specification.

.4 Before bolting isolators to the structure, start equipment and balance the systems so that the isolators can be adjusted to the correct operating position before installing (seismically rated) drilled inserts.

.5 For all equipment mounted on vibration isolators, provide a minimum clearance of 50 mm (2") to other structures, piping, equipment, etc.

.6 For equipment mounted on a slab on grade, in-line pumps, mount on Type 2 isolators, unless otherwise specified.

.7 Use Type I pads only where approved.

.8 Select Type 4 spring hangers for a minimum static deflection of 25 mm (1") for all ceiling hung fans and air handling units, boiler exhausts, emergency generator exhaust piping and silencers, steam PRVs and any other vibrating sources.

.9 Provide Type 4 resilient hangers on all piping, tanks, etc. connected to vibrating machinery, such as chillers, cooling towers, pumps 5 hp and larger, etc., if the piping is in excess of 40 mm (1.5") diameter. Provide the hangers for a distance of 6.5 m (20 ft.) for pipe size up to 50 mm (2") and 12.0 m (40 ft.) for pipe size 205 mm (10"). Isolate other pipe sizes for a proportionate distance. If neoprene hangers are proposed for non-critical

spaces, change to spring hangers at no additional cost in the event that the isolation proves inadequate.

.10 The supplier shall provide assistance to the contractor as necessary during the course of installation of isolation equipment. Prior to substantial completion, submit a report listing deficiencies to the specification.

3.2 FAN NOISE LEVELS

.1 Unless specifically noted otherwise in this specification, all fan equipment supplied shall not generate noise levels in excess of the levels calculated from the ASHRAE Guide (1987 Systems Edition, Chapter 52, Table 5) without specific approval.

.2 Submit sound power levels with shop drawings, measured to AMCA Standard 300 (latest edition) and calculated to AMCA Standard 301 (latest edition). Provide test data if required.

.3 All fan equipment shall be dynamically balanced, individually and after final assembly. All fan shafts shall have a critical speed of at least 1.5 times operational speed. Manufacturer shall guarantee that vibration displacement at full speed and load will not exceed 0.001 inch (0.025mm). All fan equipment shall have a maximum vibration velocity not exceeding 0.10 in/sec (2.54 mm/sec) as measured on the fan bearings.

3.3 EQUIPMENT

.1 All manufactured equipment, shall be complete with manufacturers' designed and rated seismic restraint anchor points and attachments so that they may be easily bolted down or restrained in the field. Equipment attachment anchor points shall be certified by the manufacturer. The equipment manufacturers of any mechanical equipment used on this project must design their equipment so that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the equipment itself to the supporting structure.

3.4 ISOLATION SCHEDULE

Isolated Equipment	**Base**		**Type of**	**Static**	
Description	**Type**	**Thickness**	**Isolation**	**Deflection**	**Remarks**
MUA Fans	-	-	Closed Spring	1.0"	By Manufacturer
Boilers, Heaters	Concrete	4"	-	-	-
Base-mounted & vertical in-line pumps	Concrete	4"	Victaulic Flex Connections	-	3 fittings downstream & upstream of pumps

3.5 VIBRATION ISOLATION STATIC DEFLECTION REQUIREMENTS

Description	Minimum static deflection (in.) for 4" to 6" thick solid concrete floors				
	Ground Supported Slab or Basement	20 ft. Floor Span	30 ft. Floor Span	40 ft. Floor Span	50 ft. Floor Span
Pumps - pipe mounted in line	-	-	-	-	-
Pumps - horizontal base mount					
up to 60 hp	-	0.75	1.5	1.5	1.5
75 hp and over	-	0.75	1.5	2.5	2.5
Pumps - vertical in line					
under 2 hp	-	-	0.12	0.25	0.50
2 hp to 15 hp	-	0.25	0.25	0.50	1.0
20 hp and over	-	0.25	0.35	0.75	1.5
Factory Assembled HVAC Units	From blower minimum deflection guide.				
Centrifugal Utility Sets	From blower minimum deflection guide.				
Tubular Centrifugal Fans	From blower minimum deflection guide.				
Tubular Axial Fans	From blower minimum deflection guide.				
Centrifugal Fans	From blower minimum deflection guide.				
Fan Heads	From blower minimum deflection guide.				

.1 NOTES:

.1 Minimum deflections called for in this specification are to be certifiable minimum's, not nominal rating.

.2 Steel spring isolators shall be used for all deflections 0.50" and over.

.3 Neoprene isolators shall be used for all deflections 0.35" and smaller.

.4 Limit deflections for utility sets 1/4 hp and smaller to 0.25".

.5 Refer also to major equipment specifications. Where isolator requirements are defined in two places, the most stringent requirement shall be provided.

.6 Where pumps are required to be vibration isolation mounted, they shall be mounted on reinforced concrete inertia bases, Mason Type K, and shall be fitted with flexible piping connections.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 SCOPE

.1 The Mechanical Contractor shall be the Prime Contractor for the Project and shall employ appropriate subcontractors as required for all aspects of the work to turn over complete operating system.

.2 This specification, together with the other Contract Documents, describes the requirements and quality of work for the design, supply and installation of new mechanical systems and Controls, equipment and modifications to the existing systems required to turn over complete operating systems as shown on the drawings and called for in these specifications.

.3 The Work shall include but not be limited to the supply of all labour, materials, equipment and supervision to complete the Work as shown on the Drawings and as required by the Contract Documents.

.4 Existing security, smoke control, fire alarms and monitoring shall be uninterrupted by the installation.

.5 Carefully examine any existing buildings, local conditions affecting the Work and building site, together with all other trades to make sure that Work under Specification and as shown on Drawings can be satisfactorily carried out without changes. Work of all trade Divisions shall be examined, before commencing Work, and any defect or interference affecting Work shall be reported at once.

.6 No allowance will be made for any expense incurred through failure to make these examinations or on account of any condition on site or item existing thereon which was visible or known to exist at the time Tender for Work was submitted.

.7 Drawings as provided, showing the Work, do not show every structural and architectural detail and are diagrammatic only. Take any information involving accurate measurements of the building. Refer to the Owner's Architect or Design Consultant's drawing for exact location of all existing equipment, piping, ductwork, wiring, sprinklers, lighting and other systems.

1.2 DEFINITIONS

.1 Where the works "indicated", "designated", "shown", "noted", "listed", or similar words or phrases are used in the Specification they shall be understood, unless the context otherwise provides, to mean that material or item referred to is "indicated", "designated", "shown", "listed" or "noted" in the Specifications or on the Drawings.

.2 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phases are used in the Specification they shall be understood, unless the context otherwise provides, to mean that material or item referred to shall be "approved by", "satisfactory to", "as directed by", "submitted to", "permitted by" or "inspected by" the Owners Representative.

.3 The term "provide" where used, shall be understood to include labour, materials and services necessary to supply and install the item or work referred to.

.4 In the Contract Documents the following definitions apply:

.1 "Work" includes the whole of the works, materials, matters and things required to be done, furnished and performed by the Contractor under the Contract Documents.

.2 "Substantial Performance" means the work is ready for use or is being used for the purpose intended and has passed the test procedure in accordance with the Project Specification and is so certified by the Owner's Representative.

.3 "Total Performance" shall mean that the entire work has been performed to the requirements of the Contract Documents and is so certified by the Owner's Representative.

1.3 EXAMINATION OF SITE

.1 Visit the site before tendering and examine all local and existing conditions on which the work is dependent.

.2 No consideration will be granted for any misunderstanding of work to be done resulting from failure to visit the site.

.3 When the contract documents do not contain sufficient information for the proper selection of equipment for bidding, notify the design authority during the tendering period. If clarification is not obtained, allow for the most expensive arrangement. Failure to do this shall not relieve the contractor of responsibility to supply the intended equipment.

.4 Check drawings of all trades and survey the site to verify space availability for the installation. Co-ordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent without written approval.

.5 The dimensions of existing work shown on the drawings are approximate and the Contractor must take actual measurements before ordering materials, equipment and the like. Failure to comply with this requirement will make the Contractor fully responsible for replacing such material or equipment at no extra cost to the contract.

1.4 LIABILITY

.1 Assume responsibility for laying out work and for damage caused by improper execution of work.

.2 Protect finished and unfinished work fillings and occupants furniture and equipment from damage.

.3 Take responsibility for condition of materials and equipment supplied and protect until work is completed and accepted.

.4 The Owner shall have recourse in tort for any negligent action by the contractor or his representatives.

.5 Contractor to make good all damage, painting, flooring, concrete anchors, etc.

1.5 INSURANCE

.1 Refer to Section 00 73 16 – Insurance Requirements

1.6 AWARD

.1 Upon written contract award the successful contractor shall provide but not limited to the following:

.1 Contractors appointed responsible supervisor;

.2 Submittal of one electrionic copy of shop drawings of equipment to the consultant for review within two weeks of contract award. Allowance shall be made in the contractors schedule for at least one week turnaround time of consultants review of the submittals;

.3 Construction schedule including after-hours work. The construction schedule shall also include testing, commissioning and operational demonstration of the works as specified.

1.7 DRAWINGS

.1 The drawings which accompany this specification shall be read in conjunction with all architectural, electrical, sprinkler and structural drawings. The Contractor will be required to make, without charge, any necessary modifications in the arrangement of piping, ductwork, or electrical service and wiring, to accommodate structural conditions or the work of the trades.

.2 The drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work. Do not scale the drawings. All services to be concealed unless otherwise noted.

.3 The Contractor, when estimating, shall visit the site and make himself familiar with all existing conditions and allow for same in his tender.

.4 The contract drawings shall not be used for the prefabrication of piping, ductwork, plenum work, etc. Where the Contractor prefabricates certain sections of the work, he shall be responsible for taking all required field measurements and surveys, to check out and make due allowance for the work of other trades, structure, and available space, and be fully responsible for his work.

.5 The Contractor shall be responsible for the detailed layout of all equipment, bases, ductwork and piping, etc. He shall take all required field measurements and surveys and lay out all equipment, bases, piping and duct runs accurately. Equipment locations and piping and duct runs shall generally conform to the contract drawings. Where required, he shall produce field shop drawings to show the positions of all equipment, bases and runs with detailed dimensions of equipment, bases, anchor bolts, etc.

1.8 PERMITS CODES AND APPROVALS

.1 The Contractor shall obtain all permits, pay fees therefore that are required by local municipal, provincial and federal authorities. Do Work in compliance with all laws, rules, ordinances and regulations having jurisdiction.

.2 Provide certificates, inspection reports for inclusion in the maintenance manuals, as evidence that the Work conforms with the laws and regulations of the authorities having jurisdiction.

.3 Engage and pay for the services of a structural seismic Engineer registered in the Province of BC to design seismic supports for all mechanical equipment, piping and ductwork and provide stamped Engineering Schedules at the end of the project to the Consultant.

1.9 CODES GOVERNING REGULATIONS

.1 The Work under this contract shall conform to but not be limited to the requirements of the following codes, regulations and standards:

.2 Bylaws

- .1 City of Vancouver Building Bylaw 8057 (2014).
- .2 City of Vancouver, Energy Bylaw.
- .3 Local Building Bylaws.

.3 Canadian Standards Association

- .1 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.
- .2 CSA Standard C22.1-1998, Canadian Electrical Code.
- .3 CSA Standard B51-97, Boiler, Pressure Vessel and Pressure Piping Code.

.4 National Fire Codes

.5 National Research Council of Canada

- .1 NRCC 23174 National Building Code of Canada - 2010.
- .2 NRCC 23175 National Fire Code of Canada - 2010.

.6 Province of British Columbia

- .1 B.C. Safety Authority Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation.
- .2 B.C. Building Code (2012) Parts 1 to 10 inclusive.
- .3 B.C. Amendment to Canadian Electrical Code.
- .4 B.C. Electrical Safety Branch Bulletins.
- .5 B.C. Code Amendments, Gas Safety Act & Regulations.
- .6 B.C. Industrial Health & Safety Regulations, Workers' Compensation Board of British Columbia.
- .7 B.C. Fire Code - 2012.

.7 SMACNA Publications

- .1 H.V.A.C. Duct Construction Standards, Third Edition 2005.
- .2 Guidelines for seismic restraints of mechanical systems.

.8 Where these specifications specifically indicate requirements more onerous than the aforementioned codes, these specifically indicated requirements shall be incorporated into the work.

1.10 ASHRAE 90.1

.1 All mechanical equipment shall comply with the minimum efficiency standards set out in ASHRAE 90.1 and the Model National Energy Code of Canada for Buildings. Submit all necessary information to substantiate conformance.

1.11 PROJECT MANAGER

.1 The Contractor shall identify a Project Manager who will be responsible for all aspects of the project (including co-ordination of subcontractors and suppliers, permits, installation, commissioning and contract administration). The Owner's Representative reserves the right to interview the prospective project manager to evaluate their understanding and ability to complete the project.

1.12 SITE CO-OPERATION

.1 Co-operate at all times with the Owner's Representative in all matters concerning scheduling of work, necessary interference with normal working routine, access to work areas, placing and removing of temporary barricades, and protection.

.2 All work in office space shall be undertaken outside of regular business hours unless otherwise approved in advance (minimum 24 hours) by the Owner's Representative.

.3 Electrical power shutdown to facilitate connection of equipment shall be done in co-operation with the Owner's Representative during off hours or during weekends.

.4 The Contractor shall at all times during performance of the Work keep the Site reasonably clean and presentable and for that purpose shall from time to time, remove from the Site all rubbish and debris accumulating from the Work, and upon completion of the Work shall leave the Site in a clean and presentable condition.

.5 Each trade shall protect its own and other trade's finished and unfinished work from damage, due to the carrying out of its work. Cover floors, office furnishings and other work with tarpaulins, if required, for this purpose. Each trade shall assume responsibility for repairing damage to floor and wall surfaces and office equipment resulting from its failure to provide such protection. Carry out such repairs in a satisfactory manner without expense to the Owner.

.6 Work of each trade shall be laid out so that it does not conflict with Work under other related contracts. Make good damage to the Owner's property or other trade's work, caused by improper locating or carrying out of Work. Co-ordinate related work with other contractors such that equipment downtime is minimal and only occurs between the hours of 6 PM to 6 AM on weekdays.

.7 Install services and equipment which are to be concealed, as close as possible to building structure for accessibility and so that necessary furring if required can be kept to minimum dimensions.

1.13 SIGNS AND PUBLICITY

.1 Neither the Contractor nor anyone directly or indirectly employed by them, shall post any site signs, nor release any publicity reports, photographs, sketches, plans or other information, orally or in writing, concerning the work performed or to be performed, without the prior written acceptance of the Owner's Representative.

1.14 RECORDS TO BE KEPT BY CONTRACTOR

.1 The Contractor shall, for a period of two years from the date of Total Performance, maintain and keep full records, vouchers, other writings and information in respect of his estimates and actual cost of the work, and shall make them available for copy, audit or inspection by the Owner's Representative.

1.15 MATERIALS

.1 All materials furnished and entering into the installation shall be new and of the best quality. Where two or more units of the same type of equipment are required, they shall be the product of the same manufacturer. All equipment and materials shall be installed in accordance with the manufacturer's recommendations.

.2 Preference shall be given to products from BC for all materials and supplies used in or on the construction of the building or site where price, quality and service are equal. Decision as to the equality of materials or supplies shall be made by the Owner, based on the recommendations of the Consultant.

1.16 SUBSTITUTION OF EQUIPMENT

.1 The Contractor shall base his tender on the goods specified or he may submit a tender using alternative material, provided such alternative material receives the written approval of the consultant prior to closing of tenders. Requests must be submitted at least five full working days prior to the closing of tenders for this trade.

.2 Where the Contractor proposes to use alternative material which requires any redesign, changes, or additions to the structure, piping, ductwork, wiring, etc., the cost of all such redesign, new drawings, changes, and additions required shall be borne by the Contractor.

1.17 FIRE STOPPING

.1 It shall be the responsibility of the Contractor to provide fire stopping at all duct, pipe, wiring and conduit penetrations of fire rated walls and floors where such penetrations are the result of the work of this Division. Use Dow Corning FS 2000 silicone and Dow Corning FS 2001 RTV Foam applied in accordance with the manufacturer's printed instructions. All materials must meet the smoke and flame spread requirements of the current edition of the BC Building Code and ULC approved for this application.

.2 Submit shop drawing for the products and the approved installation method for review prior to starting work.

1.18 MECHANICAL APPROVAL LIST

.1 Tenders for the mechanical work shall be based on equipment, materials, firms, etc., as specified or scheduled, or on those named as acceptable alternatives on the mechanical Approval List or in the specification.

.2 To receive approval for other alternate material or equipment, refer to clause "Substitution of Equipment". Substitute materials and equipment will be deemed as acceptable providing such material is of the same type, quality, capacity, performance rating, size, construction, and characteristics which, in the opinion of the Consultant, are equal to that specified.

.3 It is the responsibility of those suppliers who are not specified or scheduled, but who are named as acceptable alternatives in the mechanical Approval List or the specification to check and assure that their equipment meets all the requirements of the specifications and is of a size to fit into the allocated space without hindering access for operation and maintenance. Where the Contractor proposes to use alternative material or equipment which requires any redesign, changes, or additions to the structure, piping, ductwork, wiring, equipment layout, etc., the cost of all such redesign, new drawings, changes, and additions that are required shall be borne by the Contractor.

.4 Where, in the opinion of the Consultant, any alternative equipment or materials proposed do not meet the requirements of the specification, are of inadequate capacity, or are too large or are of a size unsuitable to the space allocated, such equipment and material will be rejected for use on this project.

.5 Suppliers shall not group or bulk different types of equipment or materials together and quote lump sum prices.

.6 Within 15 days of award of contract, the Contractor shall furnish to the Consultant for approval three (3) copies of a complete list of suppliers, equipment, materials, and sub-trades he intends to employ on the job. One name shall be submitted for each item listed on the mechanical Approval List. If any equipment or materials are not that specified or an approved alternative, or in the opinion of the Consultant are not suitable for the project, it shall be rejected, and the Contractor shall replace it with approved acceptable products.

.7 If the above list is not received by the Consultant within the stated time, the Contractor shall supply all equipment and materials exactly as specified or scheduled.

1.19 MECHANICAL EQUIPMENT SCHEDULES

.1 The equipment schedules are to be read in conjunction with the pertinent sections of the specification. The specification sections and the schedules are complimentary to one another.

.2 The equipment make and size shown in the schedules is that which the project design and drawings are based on and for which space in the building design has been allocated.

.3 Where alternative equipment makes have been shown in the specification equipment sections, the Mechanical Approval List, or are approved during the tender process, it shall be the Contractor's and equipment suppliers' responsibility to assure that the alternate equipment meets all the requirements of the specification, is of adequate size and capacity, has similar electrical characteristics, is suitable for the duty intended, and is of a physical size and shape to fit into the space which has been allocated in the system design. Where any alternate equipment fails to meet any of the criteria for the use of alternate equipment spelled out in this specification, it shall be rejected for use in the project.

1.20 PROJECT RECORD DRAWINGS

.1 Refer to Section 01 78 00 Closeout Submittals

.2 The Contractor shall maintain on-site, one complete set of white prints of the mechanical, plumbing, sprinkler and site service drawings. These drawings shall be maintained on-site, in good condition, to record all changes, revisions, addenda, etc. They shall not be used for any other purpose. This site record set of drawings shall be kept up to date and shall be available on-site at all times for review by the Consultant.

.3 The Contractor shall neatly record, on the site record set of drawings, all revisions, changes and addenda to the original contract drawings. All revisions shall be neatly drawn in red pencil. All changes in invert elevations shall be noted and recorded.

.4 The location and identification number of all concealed mechanical equipment controls, instruments, switches, transducers, etc., shall be recorded on the site record drawings.

.5 Maintain one contract drawing white print on site, solely for the purpose of recording, in red, any change and/or deviation from the contract drawing as it occurs.

.6 Submit a copy of as-installed drawings to the Consultant upon substantial completion of this contract.

.7 Mechanical Contractor shall submit Mechanical Record drawings in AutoCAD Version 2004 to Prism Engineering Ltd. c/w maintenance manuals. CAD drawings shall be completed by the contractor or by arrangement with the consultant, to transfer all changes to amend the CAD files. (Fee for this service will be approximately $100/drawing).

.8 Include all details and revisions reflecting As-Built conditions to the Mechanical System. Label each

.9 The piping colour code and identification schedule.

(a) Chemical cleaning and water treatment report. Instruction for the future care and water treatment of all systems.

(b) Provide list of equipment suppliers and contractors, including address and telephone number. Outline procedures for purchasing parts and equipment.

(c) Hydrostatic or air tests performed on piping systems, equipment alignment certificates, copy of balancing data for air and water systems, copy of valve tag identification and pipe colour code, inspection approval certificates for plumbing system, heating and ventilation systems and operational tests on gas-fired equipment.

(d) Provide materials received in compliance with clause “Shop Drawings”.

(e) The divider tabs shall be laminated mylar plastic and coloured according to Section. Plastic tabs with typewritten card insertions will not be accepted.

1.21 MAINTENANCE MANUALS

.1 The Contractor shall furnish and pay for three (3) complete sets of operating and maintenance manuals for the installation. The manuals shall be prepared by a specialized company or approved agency. The Contractor shall also provide a scanned copy of the O & M manual (soft copy) on a computer disk(s) or on a thumb drive memory stick. The Cost of the manuals shall be included in the contract price.

.2 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and transmit documentation for review to Engineer one (1) week prior to final inspection. The maintenance manuals shall be bound in 3 post binders. Each volume clearly titled Pacific Environmental Science Centre Mechanical Energy Upgrade Operating and Maintenance Manual.

.3 The manual shall be divided into indexed sections as follows:

(f) **Binder Cover and Binder Edge** - Building Name, address, project name, project number(GOC#), completed date.

(g) **Title Page** - O&M Manual for... Building name, address, date, general contractor information: name address, phone number. Consultant name address, phone number. Table of contents indicates each binder’s contents,

(h) **Index and Tabs:** Dividers with permanently marked tabs separate each section and sub section, Tab labels typed, not hand written Main tab for each specification section.

(i) **Tab A-** Signed letter of Warranty to include: dated, project name, project number (GOC#), location, warranty start date and end, to be from date of substantial, declared by Consultant, all warranties to be included from all contractors in this sections and extended warranties.

(j) **Tab B -** Contact information for all sub-contractors and suppliers. Contractor Information: Name, address, telephone number of manufacturer, installing contractor, 24-hour number for emergency service for all equipment in this section identified by equipment. Valve and equipment code list.

(k) **Tab C - All Reports -** Copies of all TAB reports, pre-functional tests, start up reports, completed performance verification forms(found in the Tender Documents), cabling verifications, ESA certification ,TSSA certification, fire alarm certifications, seismic certification, all permits i.e. electrical, building ,plumbing etc.

(l) **Tab D -** As Build Drawings-marked up by contractor, changes marked in red to also be given to Consultant

(m) **Tab E -** Sequence of Operation-outline how the systems installed were designed to work**.**

Accurate Sequence of Operation, with detailed instruction in proper sequence, for each mode of operation.
-Emergency Operation: Functions of equipment that can be operated while other functions disabled. Included only for alternate abnormal operations that can follow when there is a partial failure, malfunctioning of components, or other unusual condition.
-Shutdown Procedure: Instructions for stopping and securing the equipment after operation. If a particular sequence is required, step-by-step instructions given in that order.

(n) **Tab F - CMMS Data Sheets-**all equipment which is to be deleted, removed, added , or replaced is to have a CMMS inventory sheet completed and included in the O&M Manual. These documents are included at the end of this Section.

(o) Tab G - Shop Drawings-Copy of all reviewed "by the Consultant" shop drawings.

(p) Tab H - -Copy of specific service and maintenance manuals. Preventative and corrective maintenance, with service procedures and schedules.

-Schedule for preventive maintenance in a printed format and electronic format compatible with Owner's system.
- Recommended frequency of performance for each preventive maintenance task, cleaning, inspection and scheduled overhauls or reconditioning.
- Cleaning: Instructions and schedules for all routine cleaning and inspection recommended, including recommended cleaners and lubricants.
- Inspection: Periodic inspection of equipment required for operation, cleaning or other reasons, with items to be inspected indicated and inspection criteria given for motors, controls, filters, and any other maintenance items.
- Instructions for minor repairs or adjustments required for preventive maintenance routines.
- Listing of any special tools required to service or maintain the equipment.

(q) **Last Tab –** Misc. items i.e. – Special Requirements for equipment, not to be used for reports.

1.22 WARRANTY

.1 The Contractor shall guarantee that all apparatus shall develop the capacities and characteristics specified. The guarantee period shall be 12 months from the date of substantial completion of the general contract for the project as established by the owner.

.2 During this period, any defects in materials, workmanship, or performance shall, without cost to the owner, be remedied within a reasonable length of time of notice being received from the owner. The Contractor shall undertake all service or adjustment required to the equipment during this period as part of the guarantee.

.3 The warranty period shall not be shortened, or the terms altered, due to the use of the owner's equipment before substantial performance is accepted.

1.23 WORK IN EXISTING BUILDING

.1 Work includes changes to the existing occupied operational building and may include changes of old and new construction to suit as shown or as specified herein.

.2 Obtain approval from the Owner's Representative prior to penetrating any structural surfaces including roof and floor slabs. Obtain from the Owner's Representative approval of locations of all penetrations prior to commencing work. Contractor shall replace/repair any building services which are damaged due to this construction (example: drilling through concrete floors) at no extra cost.

.3 Carefully route new conduits and other new services so that they do not interfere with existing installation. Arrange and pay for any necessary relocation of existing conduit, cable tray, bus duct or any other services required for the proper installation of new Work, regardless of whether the conduit, tray or duct to be moved is the work of trade doing new Work.

.4 The removed equipment and material shall become the property of the Contractor and shall be removed from site unless otherwise requested by the Owner's Representative.

.5 After completion of work in ceiling space, arrange and pay for the repair of any damaged or dislodged fireproofing material.

.6 In area with solid ceilings, electrical and systems junction boxes along with associated wire and conduit shall be relocated to areas where ceiling access is possible, or access panels may be provided with the approval of the Owner's Representative.

.7 All contractors shall exercise due care and diligence in working in the occupied areas. Desks, equipment and furniture must be covered when the work is taking place. Clean-up and restoration of the work area shall occur after each day's installation to ensure that no disruption to the work area takes place.

.8 All work on site shall be co-ordinated with the Owner's Representative as to minimize disruptions. Installation of equipment must take place outside of regular business hours. Work taking place outside of the occupied areas that does not involve power interruptions may occur during the day with prior approval from the Owner's Representative.

.9 Obtain welding permit if required from the Owner prior to any welding. All welding operations must meet the Owner's standards and requirements. Include for ventilation of area and temporary disconnection of fire alarm if required.

.10 Provide and maintain temporary fire protection and fire extinguishers wherever welding, soldering or other open flame equipment is used. Provisions for temporary fire protection shall be co-ordinated with Contractor and with the Owner.

1.24 CONTINUITY OF EXISTING SERVICES

.1 Keep existing building in operation at all times with minimum length of shut-down periods.

.2 Obtain permission of the Owner before shutting down or disconnecting electrical and fire protection services. Co-operate with the Owner and other contractors on the job and provide necessary services so that existing building can be kept in operation at all time. Include in Tender Price for overtime that may be required to tie-in services at night or on weekends.

.3 The Owner reserves the right to complete and/or repair any work that is not in operating condition, beyond scheduled shut downs, in order to maintain the Owner's operation.

1.25 ACCESSIBILITY, ACCESS PANELS AND DOORS

.1 The Contractor shall install all equipment and systems so that they are readily accessible for adjustment, operation and maintenance. The Contractor shall provide access panels, and/or doors, where required, in building surfaces and equipment areas.

.2 The Contractor shall locate access panels in service areas, wherever possible, and shall not locate them in panelled or special finish walls without prior acceptance by the Owner's Representative.

.3 Access panels, accepted for and compatible with the structure in which they are mounted, shall be flush type of 14 gauge steel having mounting flange, concealed hinges and screwdriver cam locks. Access panels in fire separations and fire walls shall have a compatible fire rating and ULC label.

.4 Access doors shall be heavy duty steel construction complete with flush mounting frame, access door with continuous concealed hinge, and screwdriver operated cam lock. Access doors shall be furnished in prime coat finish unless specifically noted otherwise. Access doors and panels shall be Milcor, Acudor, Maxam, LeHage, or approved. Confirm all model numbers prior to ordering.

.5 Provide and install access panels as necessary to make all valves, dampers, equipment, etc., accessible for servicing or balancing. They shall be a minimum of 18" x 18".

.6 Access panels shall be installed at all drain valves, control valves, expansion joints, air vents, and where unions are installed in any main or branch main.

.7 Provide and install new access panels in new construction as required to provide access to existing valves, dampers, controls, equipment, etc., that may become covered up in new alterations.

.8 Access doors in plastered walls and ceilings shall be flush type made of 14 gauge steel with perforated anchor flange and plaster key and screwdriver cam locks.

.9 Access doors in tile, brick, or masonry finish walls shall be flush type made of 14 gauge steel having mounting flange, adjustable anchor straps, concealed hinges, and screwdriver cam locks.

.10 Access doors in fire rated walls and partitions shall be rated and ULC labelled for closure rating required.

1.26 STRUCTURAL FOUNDATIONS, PADS, BASES AND SPECIAL STRUCTURES

.1 The Contractor shall supply and erect all special structural work for installation of the mechanical equipment. All brackets shall be welded. Welds and edges shall then be

smoothed, cleaned and prime painted. Submit sketch and obtain approval from the Engineer for such structures.

.2 Existing and new structural systems shall be inspected and certified by a Structural Engineer where required and all costs for this work included in the Tender price. Copies of all Certificates of Compliance are to be forwarded to consultant before substantial completion.

.3 Where mechanical equipment is base mounted, suitable foundations shall be supplied and installed by others as per details on the structural drawings or as specified.

.4 In addition, a concrete pad (reinforced if necessary) shall be supplied and installed by the Contractor for this equipment and shall be 100 mm [4"] high or as otherwise noted, and 200 mm [8"] larger in length and width than mechanical equipment base dimensions. The Contractor shall ensure each base is keyed to structure to resist seismic forces.

.5 Base details shall be supplied by the Contractor who shall supply and install pipe sleeves for anchor bolts in pads or bases two sizes larger than anchor bolts.

.6 Where mechanical drawings call for concrete sumps, pits, catch basins, trenches, etc., all such enclosures shall be constructed so that it will be completely watertight. Provide and install waterproof membrane inside and outside of pit, complete with waterproof grout, flanges, inserts, gaskets, etc., as necessary.

.7 All modified and new pads shall be painted to match existing floor finish, beveled on the edge and abrasive caution hatch markings around perimeter of each pad.

1.27 INSERTS

.1 Supply and install all inserts, including sleeves and fastenings as required, to support piping, ducts, and miscellaneous equipment supplied under the Mechanical Contract.

.2 All inserts required to be encased in concrete and inserted in walls and floors shall be supplied in place in a manner so as not to be disturbed during construction and in no way to interfere with the structure.

.3 Supply all templates, special frame inserts, etc., as required to accommodate equipment supplied under this contract to other Divisions whose work is associated with its installation. It shall be the responsibility of the Mechanical Contractor to ensure the correct placement and mounting of these items.

.4 Extreme care must be taken when placing drilled-in type inserts. Ensure Structural Engineer's approval is obtained before proceeding. Use HKD drop-in anchors or Hilti Kwik-bolt stud anchors designed for a safety load factor of 4.

1.28 CUTTING AND PATCHING

.1 The Contractor shall be responsible for all cutting, patching and refinishing of the existing structure required for the work of this Contract.

.2 Care shall be exercised not to damage any existing electrical conduits running in roof joists or embedded in concrete or to weaken the reinforcement of concrete, steel, or wood construction when cutting holes.

.3 All cutting of concrete shall be done with a diamond drill. Particular care shall be taken to contain all water used and to minimize water damage. No structural members shall be cut without approval of the Engineer.

1.29 SCAFFOLDING, RIGGING AND HOISTING

.1 The Contractor shall furnish scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus removed or furnished.

.2 Remove same from premises when no longer required. Contractor to obtain the necessary permits and insurance for this work.

1.30 NAMEPLATES, LABELLING AND IDENTIFICATION

.1 All mechanical equipment, control equipment, instruments, control valves, main valves, pumps, fans, boilers, equipment, etc., shall be labelled, numbered, and indexed. Labels and tags shall be lamicoid plates, white writing on black background.

.2 The size and location of labels and tags and the size of lettering shall suit the area and installation and shall be as directed. Valve tags shall be minimum 1-1/2 inch diameter. Tags and labels shall be secured on or adjacent to equipment. Valve and instrument tags shall be secured to the equipment with brass chains.

.3 All piping systems shall be identified and colour coded. Arrows shall indicate the direction of flow. The colour code shall match existing. Colour coding shall be 2 inch wide bands of pressure sensitive colour code tape applied around the pipe with a 50% overlap. Identification legends and arrows shall be pressure sensitive tape and shall be secured with colour coded bands. Coding, identification, and arrows shall be applied to pipe at 20 foot intervals, at all access panels, and at all equipment. Colour coding tape, identification legends, and directional arrows shall be Brady, or approved.

1.31 MOTORS AND DRIVES

.1 All motors and accessories supplied shall comply with C.E.M.A. standards. Motors supplied for each similar group of equipment shall be the same make and type. Three phase motors shall be General Electric, or approved, Type K, totally enclosed fan cooled motors. One phase motors shall be General Electric, or approved, Type KC open drip proof motors, unless specifically noted to be TEFC. All belt connected motors shall be for 1800 rpm. Belt connected motors shall be mounted on heavy duty steel adjustable slide bases fitted with adjustment screws. All motors shall have grease lubricated ball bearings. Westinghouse motors of equal type are approved.

.2 All three phase motors size 746 watt (1 hp) and larger shall be AC induction type high efficiency motors. Efficiencies shall be as defined in CSA Standard C390 or IEEE Standard 112B. Motor make, model, type, and efficiencies shall be clearly stated on the shop drawings.

.3 The Contractor shall furnish all switches and do all power wiring unless specifically noted otherwise.

.4 All drive and driven sheaves and all shafts shall have cut keyways. Sheaves shall be secured on shafts with steel keys and set screws.

.5 Vee belt drives shall be Browning, or approved, properly selected for the rpm. and motor load. All drives size 375 watts (1/2 hp) and larger shall be fitted with at least two matched belts. Multiple belt drives shall be matched belt sets. All belt drives shall be sized to a rating of two times the connected motor nameplate load.

.6 All drives size 7460 Watt (10 hp) and smaller shall be adjustable pitch type. All drives 11200 Watt (15 hp) and larger shall be constant speed type.

.7 The Contractor shall include for replacement of pulleys and belts if necessary to obtain final rpm. after balancing.

.8 All exposed drives shall be fitted with belt guards, constructed of 25 mm square mesh galvanized screen rigidly supported by angle frames. Guards shall be easily removed to permit servicing of the drive and shall have provision for tachometer readings of shafts.

1.32 WIRING

.1 All control wiring shall be the responsibility of the Mechanical Contractor, regardless of voltage, unless specifically noted otherwise. All power wiring shall be by the Electrical Contractor. All wiring shall conform to the Canadian Electrical Code and all local codes. All circuits shall be protected regardless of voltage.

.2 All line voltage wiring shall be run in EMT conduit. Where the code requires wiring to be run in conduit, or where control wiring is run exposed or in mechanical rooms, it shall be run in EMT conduit.

.3 All electrical connections to isolated or moving equipment shall be made with approved flexible connections. Flexible connections shall be liquid tight flexible conduit and shall contain a minimum of one 90o angle bend in the connector.

.4 All conductors shall be coded and each wire and cable shall be identified at each termination point.

.5 All wiring shall be run concealed and shall be installed in a neat and workmanlike manner. All wiring shall be run parallel or perpendicular to building planes and shall be secured to building wall, roof or ceiling structure. Wiring shall not be run on suspended ceiling surfaces or be secured to piping, ductwork, pipe or duct hangers, or ceiling hangers. Wiring shall be secured to surfaces using wire clips or wire ties that have been positively secured to the building structure. Taping is not acceptable.

.6 All switches, relays, transformers and other interconnecting devices shall be supplied, installed and wired in place by the Contractor.

.7 The size of wiring conduit and the size and type of wire shall be the design responsibility of the controls contractor. Minimum low voltage wire size shall be 18 AWG.

1.33 SHOP DRAWINGS

.1 The Contractor shall email one set of shop drawings in PDF format to the Consultant for review prior to ordering.

.2 Note each shop drawing with the following information:

.3 Manufacturers and Suppliers name

.4 Catalogue Model Number

.5 Name and Trade supplying item

.6 Project Identification Number

.7 Number identifying item on Contract Drawing and/or in Specification

.8 Each shop drawing shall be checked and stamped as being correct by the trade purchasing the item and by the Contractor before the drawing is submitted. If the above requirements are not complied with, shop drawings will be rejected and returned forthwith.

.9 When drawings are accepted, the said acceptance does not in any way relieve the Contractor of his responsibility or the necessity of furnishing materials or performing work as required by the drawings and Project Specification.

.10 No factory or field fabrication shall commence nor shall any materials be delivered to the site before the drawings are accepted by the Owner's Representative.

1.34 CONNECTIONS TO OTHER EQUIPMENT

.1 The Contractor shall examine on site the details for connections to other equipment. The Contractor shall make all such connections as required by his trade complete with all materials etc., required for the proper operation of the equipment, and as required by codes and inspection having jurisdiction.

1.35 REDUNDANT EQUIPMENT REMOVAL

.1 The Contractor will remove all redundant equipment and dispose of or hand it over to the Owner's Representative as directed.

.2 Where existing equipment is removed, building roof, wall, ceiling and floor components and affected equipment are to be restored to match surrounding for structure, appearance, and function.

.3 Cover plates, with a suitable colour for the area, must be installed in locations where equipment is removed or where new equipment does not completely cover removed equipment in occupied areas.

.4 All existing accessible wiring that is no longer required in the new installation shall be disconnected and removed.

1.36 ASBESTOS

.1 All asbestos within the boiler room will have been remediated prior to the commencement of the work. Should material be suspected of containing asbestos, notify the owner and testing and subsequent abetment as required will be carried at the owner's expense.

1.37 TEMPORARY FIRE PROTECTION

.1 Provide and maintain temporary fire protection and fire extinguishers wherever welding, soldering or other open flame equipment is used. Provisions for temporary fire protection shall be co-ordinated with Contractor and with the Owner

1.38 CLEANING

.1 The Contractor shall be responsible to keep the building, site, and premises clean and tidy with respect to his work at all times.

.2 On completion, all dirt and rubbish for which the Contractor is responsible, shall be removed from the site and premises and the whole left clean and tidy. All soiling of finished walls, floors, ceilings, carpets, or other surfaces, caused by the Contractor shall be cleaned up or made good by the Contractor.

.3 All mechanical equipment, air handling apparatus, etc., shall be thoroughly cleaned of dust, dirt, and debris before start-up and hand-over.

1.39 PAINTING

.1 All new machinery shall be cleaned and touched up on completion by the Contractor.

.2 All non-coated steel surfaces, hangers, supports, stands, brackets, etc., shall be cleaned of all dirt, dust, grease, and mill scale, and then given one heavy coat of Rustoleum No. 796 damp-proof red primer.

.3 Equipment to be finish painted shall match existing unless otherwise directed.

1.40 PROVINCIAL CERTIFICATION OF UPGRADED BOILER PLANTS

.1 When installation is complete the contractor shall have the plant inspected by the Provincial Safety Inspection Authority.

.2 Complete any deficiencies noted by the safety inspector and submit approval document to Owner.

1.41 EQUIPMENT AND OPERATION

.1 All equipment operated by the Contractor prior to final acceptance of the building shall be maintained by the Contractor. All equipment shall be lubricated by the Contractor using correct lubricant at regular intervals.

.2 All lubricating positions on equipment shall be arranged or extended to accessible locations by the Contractor.

.3 All air filters shall be fitted with new filter media at the time the job is turned over to the Owner's Representative.

.4 Three sets of any keys, operators, special tools, etc., required for the operation and maintenance of the systems shall be turned over to the Owner's Representative.

.5 The Contractor shall employ the services of a qualified millwright to check and align the shafts, drives, and couplings on all base mounted split coupled motor driven machinery.

1.42 STARTING UP

.1 Provide services of a skilled mechanic as required to start in its proper sequence, and to thoroughly explain the operation and maintenance of each system provided to the full satisfaction of the Owner if so required. In addition, provide specialized instructions by the respective manufacturers as described under the appropriate clauses of this Specification. Arrange with the Owner the most suitable time for instructions to their operating and maintenance personnel. Keep a record of dates and duration of each instruction period together with the names of persons to whom the instructions were given. Submit one signed copy of such record.

.2 Where the Owner wishes to take over certain areas ahead of project completion date and these areas are intended to be fed from the new distribution systems, make temporary connections to such areas using services existing in these areas. Re-connect these areas to the permanent services, as shown, at a later date when new distribution systems are available in the areas concerned.

1.43 SUBSTANTIAL PERFORMANCE

.1 The Owner's Representative shall, within ten working days of receipt of a written application from the Contractor for a Substantial Performance, make an inspection and assessment of the work to verify the validity of the application according to the following details.

.2 Before Substantial Performance will be granted, an acceptance testing period of seven calendar days will begin. All features of the contracted system will be shown to be operational to the Owner's Representative.

.3 Documentation must be in place before Substantial Performance is granted.

.4 Once the basic requirements are met and all other features of the system are complete and acceptable, Substantial Performance shall be granted. A deficiency list shall be prepared and holdbacks applied. All deficiencies shall be corrected prior to Total Performance.

.5 The Owner's Representative shall, within seven days of its acceptance test, notify the Contractor of its approval or disapproval of the application. When the Owner's Representative finds the work to be substantially performed, a letter to that effect will be issued.

1.44 DEMONSTRATION

.1 The Contractor shall demonstrate the use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

1.45 TOTAL PERFORMANCE

.1 The Owner's Representative shall, within ten days of receipt of an application from the Contractor for certificate of Total Performance, make an inspection and assessment of work to verify the validity of the application. The Owner's Representative shall, within seven days of its inspection, notify the Contractor of its approval or disapproval of the application. When the Owner's Representative finds the work to be totally performed, it shall issue a letter of Total Performance and the date of this letter shall be the date of Total Performance of the Contract. Warranty shall start from the date of Total Performance of the work.

.2 Inspection certificates, as follows, shall be submitted before final acceptance will be issued:

- Electrical and Mechanical inspection reports
- Record Drawings
- Maintenance Manuals

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

.2 Closeout Submittals in accordance with Section 01-78-00 – Closeout Submittals.

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

.4 Maintenance Manuals to be submitted as per Section 01-78-00 Closeout Submittals. Contractor to include the following information as applicable:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.3 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.4 Equipment performance verification test results.

.5 Special performance data as specified.

.

1.2 SPARE PARTS AND SPECIAL TOOLS

.1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals.

.1 Products

1.3 MATERIALS

.1 Where two or more items of equipment and/or material of the same type, are required, they shall be the products of a single manufacturer.

.2 Material considered to satisfy the specification, but of a manufacturer other than those listed, may be submitted to the Consultant for consideration.

Part 2 Execution

2.1 CONCEALED SUPPLY PIPING

.1 Concealed water supply piping to plumbing fixtures, trim items, equipment, hose bibbs, etc., shall be installed using cast brass 90 degree drop ear elbow or drop ear tees as the piping design dictates.

.2 Blocking shall be provided within the concealed space and the elbows and tees shall be secured to the blocking using brass screws to provide a rigid installation.

2.2 CLEANING

.1 Clean interior and exterior of all systems including strainers.

2.3 VALVE INSTALLATION

.1 Disassemble solder end joint valves before soldering.

.2 Install shut-off or isolation valves whether shown on the drawings or not at the following locations:

.1 At the base of each building riser;

.2 At each main branch supply point; provide a valve on each outlet leg from the tee or cross;

.3 At each single plumbing fixture (i.e. normally this requirement is satisfied by the provision of the angle valve specified with the specific fixture);

.4 At each single piece of equipment;

.5 At all points as indicated on the drawings;

.6 At all points where the plumbing code requires same;

.3 Install balancing valves in hot water recirculation branch mains and branch connections to return mains whether indicated on drawings or not.

.4 Pressure reducing valve stations, as a minimum shall consist of the following:

.1 A high flow or main pressure reducing valve; which shall be one pipe size smaller than the incoming or out flowing building service, and shall be provided with a strainer, a reducer and a shut-off valve on the inlet side and a reducer and a shut-off valve on the outlet side.

.2 A low flow pressure reducing valve; which shall be 25 mm (1”) in size, and shall be provided with a strainer and a shut-off valve on the inlet side and a shut off valve on the outlet side.

.3 A bypass around both pressure reducing valves with normally closed globe valve; which shall be of the same pipe size as the incoming or out flowing building service, and a pressure gauge on each side of the globe valve

.4 Where a pressure reducing valve with integral low flow by pass is used the piping, fittings and accessories shall be arranged as described in 3.2.4.1 and 3.2.4.3 above.

.5 Pressure reducing valve stations on main shall be set to 415 kPa (60 psi) outlet pressure.

.6 Pressure reducing valve stations on small flow systems shall be set at 35 kPa (5 psi) higher outlet pressure than main pressure reducing valve.

.5 Vacuum breakers shall be installed:

.1 At each fixture or item of equipment where contamination of the domestic water system can occur.

.2 Atmospheric type vacuum breakers shall be installed at least 300mm (12”) above flood level rim of fixture.

.3 Drain pan shall be installed with water deflecting enclosure on concealed pressure type vacuum breaker with drain line piped to appropriate drain.

.4 Complete testing of all vacuum breakers shall be carried out under this section of the work prior to final acceptance of plumbing systems. A certificate shall be submitted duly signed and witnessed that testing was satisfactory.

.6 All cross connection control devices shall be installed, tested and maintained in accordance with the current BCBC and CAN/CSA-B64.10.01 requirements.

.7 All piping on the discharge side of a testable cross connection control device to be labelled to CAN/CGSB-24.3-92 Standard for Identification Piping Systems.

.8 Testable cross connection control device requires permanent lamacoid identification tag.

.9 Installation of an in line strainer shall be required where water may contain foreign material that could lodge on or erode the seating surfaces.

.10 All double detector check valves to be USC approved.

.11 Testable cross connection control device to have an isolation valve in the water supply.

.12 Pipe testable cross connection control device indirectly to drain.

.13 Install strainer blow-off connections. Connections shall be full drain connection size and shall include:

.1 Up to 50mm (2") – nipple and cap (hot services)

.2 65mm (2 ½") and larger – nipple, globe valve and nipple (hot services)

.3 All sizes (cold services) – plug the blow-off connection only

.14 Install unions or flanges on all connections to pumps, reducing valves, control valves, fixtures and equipment.

.15 Unless otherwise noted, union connections up to and including 50mm (2") size shall be all bronze union, 1035kPa (150psi) rating with ground seat.

.16 Union connections larger than 50mm (2") size shall be flanged.

.17 Install water hammer arrestor on all branch lines to flush valves, solenoid valves, self closing faucets, quick closing valves and on refrigeration, kitchen and laundry equipment incorporating solenoid valves.

.18 Install thermometer at each domestic hot water storage tank, inlet and outlet.

.19 Locate thermometers so that they can be easily read, and so that their sensing elements are directly in the flowing medium and immediately adjacent to the sensing element.

.20 Where a thermometer is installed to sense the temperature of a liquid in a pipe, install its sensing element in a non-ferrous, separable well filled with heat conducting liquid. Install the separable well so as to minimize the restriction to water flow and, if necessary, install in a section of oversized pipe.

.21 Install temperature and pressure relief valve at domestic hot water storage tank.

.22 Pipe temperature and pressure relief valve full outlet size to floor drain and arrange to prevent splash-over.

.23 Install dielectric type couplings where copper piping and accessories connect to plumbing equipment such as steel storage tanks or pressure reducing stations.

.24 Install air vent at all high points in domestic hot water recirculation system.

.25 Install air vent on tees and not on horizontal piping or radiused elbows.

.26 Install 12mm (1/2") minimum isolating gate valve ahead of each air vent.

.27 Pipe all air vent discharge connections separately to nearest building drain using 6mm (1/4") hard drawn copper.

.28 Provide trap seal primer valves for floor drain traps in public washrooms and other areas requiring priming according to plumbing code.

.29 Locate trap primer valves in locations that are readily accessible by the building maintenance staff c/w access panel where required.

2.4 PIPING INSTALLATION

.1 Install piping straight, parallel and close to walls and ceiling, with a fall of not less than 1:50 for gravity piping and with a slope to drain cocks, fixtures or equipment for all pressure piping unless otherwise indicated on drawings. Use standard fittings for direction changes. Provide drain cocks as required.

.2 Install groups of piping parallel to each other; spaced to permit application of insulation, identification, and service access, on trapeze hangers.

.3 Where pipe size differs from connection size to equipment, install reducing fitting close to equipment. Reducing bushing are not permitted.

.4 Brass and copper pipe and tubing shall be free from surface damage. Replace damaged pipe or tubing.

.5 Ream ends of pipe and tubes before installation.

.6 Lay copper pipe so that it is not in contact with dissimilar metal and will not be crimped or collapsed. All joints on cast or ductile iron pressure service piping shall be made electrically conductive.

.7 Install flanges or unions to permit removal of equipment without disturbing piping systems.

.8 Clean ends of pipes or tubing and recesses of fittings to be jointed. Assemble joints without binding.

.9 Install piping to connections at fixtures, equipment, outlets and all other appurtenances requiring service. Trap and vent waste connections to fixtures. Grade all vents to drain back to waste piping.

.10 Plug or cap pipe and fittings to keep out debris during construction.

.11 Jointing of pipe shall be compatible with type of pipe used.

.12 Non-corrosive lubricant or teflon tape shall be applied to the male thread of threaded joints.

.13 Flush and clean out piping systems after testing.

.14 Install drain valves at low points.

.15 Extend equipment drain piping to discharge indirectly to floor or hub drain.

.16 Install adequate support to piping to prevent any stress or strain.

.17 Install pressure piping with loops and offsets which will permit expansion and contraction to occur without damaging the pressure piping system.

2.5 CLEANOUTS

.1 Install cleanouts at the following locations:

.1 Changes of direction of more than 45 degrees in drainage piping.

.2 Nominally horizontal branch or building drain at intervals of not more than 15 metres (50') for 100mm (4") and smaller and 30 metres (100') for 150mm (6") and larger.

.3 Fixture drain of a sink, kitchen piping or grease waste piping at intervals not exceeding 7.5 metres (25') for pipe all sizes.

.4 Base of soil or waste stacks and rainwater leaders.

.5 As called for by the Province of British Columbia Plumbing Code.

.2 Cleanouts which are located low on walls shall be located 75mm (3") minimum above the top of the baseboard or minimum 200mm (8") above finished floor level where there is no baseboard.

.3 Cleanouts shall be co-ordinated with all millwork and with all other obstructions, shall be placed in readily accessible locations and shall have sufficient clearance for rodding and cleaning.

.4 Extend cleanouts to the finished floor or wall unless exposed in a basement room, pipe tunnel or accessible crawlspace.

.5 Cleanouts in wet floor areas shall extend above the floor in walls or be provided with gasketted waterproofed tops.

.6 Cleanouts passing through a waterproofed floor or a slab on grade shall possess a clamping collar which shall be clamped to the floor membrane or lead flashing.

.7 Cleanouts on outside drains shall be brought to grade and anchored in a concrete collar.

.8 Cleanouts in inside finished areas shall all be of the same shape either square or round.

HANGERS AND SUPPORTS

.9 On insulated piping larger than 25mm (1") diameter where the insulation possesses a continuous vapour barrier, install oversized hangers and insulation protection shields of gauge and length as recommended by the manufacturer. On insulated piping 25mm (1") diameter and less protect contact between pipe and hanger (Ref. 2.3.1.4.3) and fit insulation tightly around hanger and penetration through insulation.

.10 Maximum hanger spacing: (maximum spacing for cast iron is 1.5 meters [5']).

Pipe Size mm (in.)	Rod Diameter mm (in.)	Steel m (ft.)	Copper m (ft.)
to 18 (¾	9 (3/8)	1.5 (5)	1.5 (5)
25 - 30 (1 - 1‰)	9 (3/8)	2.1 (7)	1.8 (6)
40 - 50 (1‰- 2)	9 (3/8)	2.7 (9)	2.4 (8)
65 - 75 (2‰- 3)	12 (‰)	3.3 (11)	3.0 (10)
100 - 125 (4 - 5)	15 (5/8)	4.2 (14)	3.6 (12)
150 (6)	20 (¾	5.2 (17)	1.2 (4)
200 - 250 (8 1- 10)	22 (7/8)	5.8 (19)	1.2 (4)

.11 Do not support horizontal piping runs from the floor unless specifically indicated.

.12 Hangers and supports for natural gas piping shall be in accordance with the National Standard of Canada. CAN/CGA -B149.1-M86, Natural Gas Installation Code and the British Columbia Gas Safety Branch Bulletins.

2.6 PIPE SLEEVES AND ESCUTCHEONS

.1 Supply and installation of pipe sleeves is included in this section of the work. Install chrome plated escutcheon plates on exposed piping passing through walls, floors and ceilings in finished areas. Sleeves shall be through walls, floors and ceiling in finished areas. Sleeves shall be concentric with pipe and/ except at fire separations, shall be sized to allow for the continuity of insulation.

.2 Extend sleeves 50mm (2") above floor slabs in wet areas. Wet areas include equipment rooms, janitor's rooms, kitchen areas, utility rooms, bath areas and washrooms.

.3 Extend sleeves through outside walls to 25mm (1") beyond the exterior face and caulk with flexible caulking compound.

.4 Where removable plastic sleeves are used they shall be removed prior to pipe penetration and the resulting hole shall be then classified as the sleeve.

.5 Extra high vertical risers for cold water and hot water systems with many horizontal branch take offs passing through sleeves set in rigid structure adjacent to the main risers, sleeves shall be set to accommodate long term structural movement to avoid imposing stress on these systems.

2.7 CORE DRILLING AND CUTTING

.1 Arrange and pay for all core drilling and cutting for plumbing system in this section of the work.

.2 Verify the location of existing service runs and structural reinforcement within existing concrete floors and walls prior to core drilling and cutting. Coring and cutting of structural building components shall only take place upon the receipt of specific written approval of the structural engineer. Repairs to existing services damaged as a result of core drilling is included in this section of the work.

.3 Mechanical contractor to coordinate with the General Contractor coring of all penetrations and openings in the building structure.

2.8 MISCELLANEOUS METALS RELATING TO PLUMBING SYSTEMS

.1 All miscellaneous metal related to the plumbing systems including, all mild steel checker plate sumps covers and frames, all metal back up plates and supports or wall supported equipment or plumbing fixtures is part of this section.

.2 Frames which are out of level of cover plates which are warped are unacceptable.

.3 Prime coat after fabrication with two coats of red lead primer.

.4 See separate division of specification for finish painting requirements.

2.9 PIPING EXPANSION

.1 All piping systems, including all take-offs shall be so installed within the building that the piping and connected equipment will in no way be distorted by expansion, contraction or settling.

.2 If circumstances on the job require additional changes in direction from those shown on the drawings, the configuration shall be adjusted to suit at no extra cost.

.3 Anchors shall be installed where necessary to control expansion. Expansion joints or loops shall be installed on hot water piping where required.

2.10 SEISMIC RESTRAINT

.1 Supply and install sway-bracing hangers on the following systems:

.1 All plumbing services NPS 2‰ and larger.

.2 All piping NPS 1… and larger in Equipment Rooms

2.11 ACCESS DOOR REQUIREMENTS

.1 All access doors shall, in any event, be sized to satisfy minimum access requirements as required by plumbing code requirements but shall be increased in size wherever necessary to suit architectural block or other construction modules to provide a complete modular finished appearance.

.2 Install access doors at all concealed cleanouts, traps, unions, expansion joints, valves, control valves, air vents, water hammer arrestors, special equipment, trap primers, vacuum breakers and any other equipment for which subsequent periodic access will be required during the life of said equipment.

.3 Locate access doors so that all concealed items are readily accessible for adjustment, operation, maintenance and replacement.

.4 Do not locate access doors in feature walls or ceilings without the prior approval of the Consultant. Locate in service areas and storage rooms wherever possible.

.5 Plaster or wet wall construction: 14 gauge bonderized steel flush with wall or ceiling type with concealed flange.

.6 Masonry or drywall construction: 16 gauge for 400mm x 400mm and smaller, 14 gauge for 450mm x 450mm and larger. Bonderized steel face of wall type with exposed flange.

2.12 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Controland submit report as described in PART 1 - SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

2.13 TESTING AND INSPECTION

.1 Tests on the domestic water systems shall consist of hydraulic pressure testing of 1,400 kPa (200 psi) for 8 hours.

.2 Furnish all labour, materials, instruments, etc., necessary for all required tests. All work shall be subject to inspection by local plumbing inspector and design authority. At least forty-eight (48) hour's notice shall be given in advance of making the required tests.

.3 All leaks shall be corrected by remaking the joints. The systems shall be retested until no leaks are observed.

.4 No plumbing system or part thereof shall be covered until it has been inspected and approved by the Plumbing Inspector. If any plumbing system or part thereof is covered before being inspected or approved, it shall be uncovered upon the direction of the Plumbing Inspector or Consultant.

2.14 DEMONSTRATION

.1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

2.15 PROTECTION

.1 Protect equipment and system openings from dirt, dust, and other foreign materials with temporary sealing products appropriate to prevent the contamination of the system.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for plumbing pumps.

1.2 SUBMITTALS

.1 Shop Drawings.

.1 Submit shop drawings to indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.

.2 Wiring and schematic diagrams.

.3 Dimensions and recommended installation.

.4 Pump performance and efficiency curves.

.2 Instructions: submit manufacturer's installation instructions.

.3 Closeout submittals: submit maintenance and engineering data for incorporation into maintenance manuals, include:

.1 Manufacturers name, type, model year, capacity and serial number.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list with names and addresses.

.1 installation instructions and warranty requirements.

Part 2 Products

2.1 DOMESTIC HOT WATER CIRCULATING PUMPS

.1 Capacity: Refer to Section 23 06 00 Equipment Schedules for size and capacity.

.2 Construction: wet rotor, in-line centrifugal, all bronze or stainless steel body, 3 speed control.

.3 Furnish and install 6 mm (1/4") gauge tappings on the suction and discharge side of each pump. Each gauge tapping shall be fitted with a 1/4" needle valve, Winter DH-11, or equal, with nipple and cap. See Section - Gauges and Thermometers.

.4 Supports: provide as recommended by manufacturer.

2.2 DOMESTIC HOT WATER RECIRC. PUMP

.1 Capacity and size as noted in Section 23 06 00 Equipment Schedules

.2 Circulating pumps shall be wet rotor design with variable speed ECM motor and integral speed controller. The pump speed is electronically controlled to maintain a differential pressure over a permissible flow range or can accept a 0 to10 volt signal from the DDC system or be connected to the DDC system through an integral native BACnet interface.

.3 Body shall be stainless steel or bronze

.4 BACnet interface modules shall be BTL marked.

.5 Furnish and install 6 mm (1/4") gauge tappings on the suction and discharge side of each pump. Each gauge tapping shall be fitted with a 1/4" needle valve, Winter DH-11, or equal, with nipple and cap. See Section - Gauges and Thermometers.

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.

3.2 INSTALLATION

.1 Make piping and electrical connections to pump and motor assembly and controls as indicated.

.2 Ensure pump and motor assembly do not support piping.

.3 Install motor in a horizontal position.

3.3 START-UP

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements General Requirements, supplemented as specified herein.

.2 Procedures:

.1 Check power supply.

.2 Check starter O/L heater sizes.

.3 Start pumps, check impeller rotation.

.4 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.

.5 Test operation of hand-on-auto switch.

.6 Run-in pumps for 12 continuous hours.

.7 Adjust alignment of piping and conduit to ensure full flexibility.

.8 Eliminate causes of cavitation, air entrainment.

.9 Measure pressure drop across strainer when clean and with flow rates as finally set.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).

.1 ANSI/ASME B16.15-06, Cast Bronze Threaded Fittings, Classes 125 and 250.

.2 ANSI/ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22-01, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.24-01, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.

.2 ASTM International Inc.

.1 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.

.3 ASTM B88M-05, Standard Specification for Seamless Copper Water Tube (Metric).

.3 National Research Council (NRC)/Institute for Research in Construction

.1 NRCC 38728, National Plumbing Code of Canada (NPC) - 2010.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer’s printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 PIPING

.1 Domestic cold water systems within building:

.1 Copper tube, hard drawn, type L: to ASTM B88M.

.2 Domestic hot and recirculation systems, within building:

.1 Copper tube, hard drawn, type K: to ASTM B88M.

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.

.4 Cast iron: to AWWA C110.

.5 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.6 NPS 2 and larger: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.

.7 NPS 1 1/2 and smaller: wrought copper to ANSI/ASME B16.22 cast copper to ANSI/ASME B16.18; Suitable for operating pressure to 1400 kPa.

2.3 JOINTS

.1 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.2 Solder: Cast Copper Alloy: to ANSI B16.18 Lead Free

.3 Solder: Wrought Copper and Copper Alloy: to ANSI/ASME B16.22.Lead Free

.4 Teflon tape: for threaded joints.

.5 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 GATE VALVES

.1 NPS 2” and smaller, soldered:

.1 Bronze body, solid wedge disc, bronze or stainless steel trim, non-rising stem, 860 kPa (125 psi) rating.

.2 Acceptable products:

.1 Solder joint type: Crane 1320, Jenkins 300P, Kitz 41, Lunkenheimer 2133, Neuman-Hattersley A41Se, Red & White/Toyo 281A.

.2 Screwed joint type: Crane 428, Jenkins 810, Kitz 40, Lunkenheimer 2127, Neuman-Hattersely A40AT or 33X, Red & White/Toyo 280A.

.2 NPS 2” and smaller, screwed:

.1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.

2.5 GLOBE VALVES

.1 NPS 2" and smaller, soldered:

.1 50mm (2") and smaller, bronze body, bronze or stainless steel trim, 860 kPa (125 psi) rating.

.2 Acceptable products: i)

.1 Solder joint type with bronze bevel type disc: Crane 1320, Jenkins 300P, Kitz 12, Lunkenheimer 2125, Neuman-Hattersley A41SE, Red & White/Toyo 212.

.2 Screwed joint type with composition type disc: Crane 7, Jenkins 106A, Kitz 09, Lunkenheimer 2942, neuman-Hattersley 13, Red & White/Toyo 220.

.2 NPS 2" and smaller, screwed:

.1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc.

2.6 SWING CHECK VALVES

.1 NPS 2" and smaller, screwed:

.1 Screwed joint type, bronze body, bronze or stainless steel swing disc, 860 kPa (125 psi) rating.

.2 Acceptable products: i) Crane 37, Grinnell 3300, Jenkins 4092, Kitz 22, Lunkenheimer 2144, Neuman-Hattersley A60AT, Red & White/Toyo 236.

2.7 BALL VALVES

.1 NPS 2" and smaller, screwed:

.1 Brass two piece body, blow-out proof stem, PTFE seats, brass chrome plate ball, lever handle operator, 1035 kPa (150 spi) rating.

.2 Acceptable products:

.1 Solder joint type: Red & Whitre/Toyo 5049A, Apollo, Crane, Jenkins, Kitz, Lunkenheimer 746FS or 747FS, Neuman-hattersley 1969AT, Nippco, Watts, Worcester.

.2 Screwed joint type: Red & White/Toyo 5044A, Apollo-70 Series, Crane 93-TF, Grinnell 3700 full port, Jenkins-1101-T, Kitz 58, Lunkenheimer 746F or 747F, Neuman-Hattersley 1969AT, Nippco T-580-BR, Watts B-6000, Worcester 4211-RT.

.2 NPS 2" and smaller, soldered:

.1 To ANSI/ASME B16.18, Class 150.

.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors

2.8 STRAINERS

.1 Sized on a 4 to 1 ratio of basket open area to connecting pipe cross-sectional area, 'Y' pattern, 304 stainless steel screen.

.2 6 mm (¼") to 50 mm (2"), screwed ends, bronze body, 1400 kPa (200 psi) rating. Acceptable products: Red & White/Toyo 380, Crane 988-‰, Armstrong, Muessco, Sarco (Canada), Kitz.

2.9 WATER HAMMER ARRESTORS

.1 Bellows or piston style with stainless steel casing and welded stainless steel nesting bellows if of the bellows style.

.2 Acceptable products:

.1 Zurn Z-1700 Series bellows style, R.T.S., Enpoco, Ancon, Amtrol, Watts; Precision Plumbing Products Inc. piston style.

2.10 PRESSURE GAUGES

.1 Design Basis:

.1 Pipe mounting type, plain case style, bottom connection.

.2 Wall or panel surface mounting type, flanged style.

.3 Flush panel mounting type, flush mount case style.

.2 Minimum Requirements:

.1 Seamless phosphor bronze Bourdon tube type, with minimum 115 mm (4½") diameter dial, unless otherwise indicated.

.2 Cast aluminium, black steel or stainless steel case, with stainless steel or chrome plated face ring.

.3 White background with pressure range in black.

.4 Accuracy - 2% of scale range.

.5 Scales to be calibrated in both psig and kilopascals.

.6 Scale range.

Operating Pressure		**Scale Range**	
kPa	(psig)	kPa	(psig)
-50 - 100	(-15"Hg - 15)	-100 - 100	(-30"Hg - 15)
0 - 150	(0 - 22)	0 - 200	(0 - 30)
150 - 310	(22 - 45)	0 - 400	(0 - 60)
310 - 520	(45 - 75)	0 - 700	(0 - 100)
520 - 690	(75 - 100)	0 - 1500	(0 - 200)
690 - 1035	(100 - 150)	0 - 2000	(0 - 300)
1035 - 1380	(150 - 200)	0 - 3000	(0 - 400)

.3 Install a needle valve ahead of each gauge.

.4 Acceptable products: Lunkenheimer, Moeller, Terice, Weiss, Weksler.

2.11 TEMPERATURE AND PRESSURE RELIEF VALVES

.1 Watts A.S.M.E. rated.

.2 Acceptable products: Cash Acme.

2.12 BACK FLOW PREVENTERS

.1 Preventers: to CSA-B64 Series, application as indicated, reduced pressure principle type, double check valve assembly back flow preventer with intermediate atmospheric vent and drain connection.

.2 All the piping on the discharge side of a testable cross connection control device to be labeled to CAN/CGSB-24.3-92 standard for identification piping systems.

.3 Testable cross connection control device require a permanent lamacoid identification tag.

.4 Installation of an in-line strainer shall be required where water contains foreign material that could lodge on or erode the seating surfaces.

.5 All the double detector check valves to be USC approved.

.6 The testable cross connection control devices to have an isolation valve in the water supply.

2.13 VACUUM BREAKERS

.1 Breakers: to CSA-B64 Series, vacuum breaker, atmospheric.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install in accordance with British Columbia Building Code (2012).

.2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.

.3 Assemble piping using fittings manufactured to standards as listed above.

.4 Install domestic cold water piping below and away from hot water piping so as to maintain temperature of cold water as low as possible.

.5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

3.3 VALVES

.1 Isolate equipment, fixtures and branches with gate or ball valves.

.2 Balance recirculation system using valves listed above. Mark settings and record on as-built drawings on completion.

3.4 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures.

.2 Install on branch lines downstream control valve.

3.5 BACK FLOW PREVENTORS

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.

.2 Pipe discharge to extend to nearest drain.

.3 All the piping on the discharge side of a testable cross connection control device to be labeled to CAN/CGSB-24.3-92 standard for identification piping systems.

.4 The testable cross connection control devices to have an isolation valve in the water supply.

3.6 PRESSURE TESTS

.1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.

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

3.7 STRAINERS

.1 Install with sufficient room to remove basket.

3.8 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw sample off longest run. Submit to testing laboratory to verify that system is clean to local potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

3.9 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.10 DISINFECTION

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of Consultant.

.2 Upon completion, provide laboratory test reports on water quality for Consultant approval.

3.11 START-UP

.1 Timing: start up after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.3 Bring HWS storage tank up to design temperature slowly.

.4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.

.5 Check control, limit, and safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

.5 Vacuum breakers, backflow preventers, backwater valves:

.1 Test tightness, accessibility for O&M of cover and of valve.

.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.

.3 Verify visibility of discharge from open ports.

.6 Water hammer arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

.7 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

.8 Hose bibbs, sediment faucets:

.1 Verify operation.

3.12 OPERATION REQUIREMENTS

.1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 05 - Installation of Pipework.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CAN/CSA-C309-M90 (R2009), Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for domestic water tank, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate: Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.5 WARRANTY

.1 For the Work of this Section 22 30 05 - Domestic Water Tanks, 12 months warranty period is extended to number of years specified for each product.

.2 Contractor hereby warrants domestic water tanks in accordance with CCDC2, but for number of years specified for each product.

Part 2 Products

2.1 STORAGE TANK

.1 Storage tank:

.1 Sizes, capacity: as indicated in Section 23 06 00 Equipment Schedules

.2 Shell: vertical steel to CSA B51, ANSI/ASME Unfired Pressure Vessel Code and Province of British Columbia standards, WWP/WSP 100 kPa. Provide certificates.

.3 Lining: double glass lined.

.4 Service Hole: 16”x20” ASME, with gasketted cover inspection and clean-out opening.

.5 Cathodic protection: magnesium anodes, number and size to provide for 20 years protection of tank material.

.6 Thermal insulation: R12.5 with Jacket.

.7 Extended warranty: 10 years. Provide certificate.

2.2 TRIM AND INSTRUMENTATION

.1 Drain valve: NPS 25mm (1”) with hose end.

.2 Thermometer: 100 mm dial type with red pointer and thermowell filled with conductive paste.

.3 Pressure gauge: 75 mm dial type with red pointer, syphon and shut-off cock.

.4 Thermowell filled with conductive paste for control valve temperature sensor.

.5 ASME rated temperature and pressure relief valve sized for full capacity of tank having discharge terminating over floor drain and visible to operators.

.6 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

2.3 ANCHOR BOLTS AND TEMPLATES

.1 Supply anchor bolts and templates for installation on concrete support pad.

.2 Size anchor bolts to withstand seismic zone 5 acceleration and velocity forces.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer’s Instructions: comply with manufacturer’s written recommendations, including product technical bulletins, installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install in accordance with manufacturer’s recommendations and authority having jurisdiction.

.2 Provide insulation between tank and supports.

.3 Seismically secure the tank on the concrete base.

.4 Pipe the tank to the heater with balanced piping for equal flow to both tanks.

.5 Install manufacturer supplied pressure relief valves and pipe to drain.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/Canadian Standards Association (ANSI/CSA)

.1 ANSI Z21.10.1-2009/CSA 4.1-2009, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.

.2 ANSI Z21.10.1a-2009/CSA 4.1a-2009, Addenda 1 to ANSI Z21.10.1-2009/CSA 4.1-2009, Gas Water Heaters Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.

.3 ANSI Z21.10.3-2011/CSA 4.3-2011, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.

.2 Canadian Standards Association (CSA International)

.1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CAN/CSA-B149.1-05, Natural Gas and Propane Installation Code.

.3 CAN/CSA-C309-M90 (R2009), Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for domestic water heaters, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide drawings stamped and signed by the Mechanical Contractor

.2 Indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.5 WARRANTY

.1 For the Work of this Section 22 30 06 - Domestic Water Heaters, 12 months warranty period is extended to number of years specified for each product.

.2 Contractor hereby warrants domestic water heaters in accordance for number of years specified for each product.

Part 2 Products

2.1 CONDENSING GAS FIRED HOT WATER HEATER

.1 Storage tank:

.1 Sizes, capacity: as indicated In Section 23 06 00 Equipment Schedules

.2 Reference product: A O Smith Cyclone MXI.

.3 Shell –steel; 1000kPa (150 PSI)ASME rated) glasslined, with powered annodes.

.4 Helical, internal, powered, top mounted, down firing, modulating premix burner, both sides glasslined, flue outlet at bottom of tank.

.5 Service Hole: inspection and clean-out opening.

.6 Thermal insulation: 58mm foamed in place foam or 50mm of fiberglass.

.7 Steel or plastic jacket over the insulation, top cover has rear cutaway to service parts.

.8 Extended warranty: 10 years. Provide certificate.

2.2 TRIM AND INSTRUMENTATION

.1 Drain valve: NPS 25mm (1”) with hose end.

.2 Temperature sensor to control burner.

.3 Electronic modulating controls adjust the firing rate to the specific demand, built in diagnostics, BACnet interface.

.4 ASME rated temperature and pressure relief valve sized for full capacity of heater having discharge terminating over floor drain and visible to operators.

.5 Vent opening at bottom of tank with Tee connection with drain connection.

.6 Refer to Section 23 51 00 Boiler and Water Heater Venting.

2.3 ELECTRIC HOT WATER HEATER (for process load)

.1 Sizes, capacity: as indicated In Section 23 06 00 Equipment Schedules

.2 Shell - steel 1000kPa (150 PSI) ASME rated) glasslined, with anodes ,

.3 Electric elements, gold plated,5 at 6 kW each, 600 V/ 3/60 complete with power circuit fusing, sequence controller and contactors for elements, thermostat control set for 160℉

.4 Pressure relief valve set for 100 psi

2.4 ANCHOR BOLTS AND TEMPLATES

.1 Supply anchor bolts and templates for installation in concrete support pad.

.2 Size anchor bolts to withstand seismic zone 4 acceleration and velocity forces.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.

.2 Install natural gas fired domestic water heaters in accordance with CAN/CSA-B149.1.

.3 Connect power, gas line, venting, acid neutralizer with plastic piping from vent connection and heaters to neutralizer and then to floor drain.

.4 Connect power to electric hot water heater.

.5 Pipe pressure relief valves on al water heaters to drain

.6 Seismical secured all water heaters to concrete bases.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's factory trained, certified technician to start up and commission DHW heating systems.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 Canadian Standards Association (CSA International)

.3 National Fire Code of Canada (NFCC 2005)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Store and handle in accordance with the manufacturer recommendations.

1.4 ASBESTOS ABATEMENT

.1 The Mechanical contractor shall indicate the extent of the insulation removal 2 weeks prior to commencement of work for the abatement of the asbestos associated with the modifications to the piping systems. Refer to section 02 81 01– Hazardous Materials.

Part 2 Products

2.1 MATERIAL

.1 Fire Stopping: in accordance with Fire Stopping requirements

.1 Contractor to provide shop drawings of the proposed fire stopping material and related approved data sheet for installation, for review.

.2 Refer to Section 07 84 00 - Fire Stopping.

2.2 PIPING

.1 All pipe used in, hot water heating, systems shall be standard weight Schedule 40 black steel pipe, ASTM Specification A53, Grade B.

.2 All piping size 50 mm (2") and smaller shall be screwed joints and all piping size 65 mm (2½") shall be welded or Victaulic couplings and fittings.

.3 All domestic cold water piping shall be certified and labelled type L hard copper tubing to ASTM B88, latest edition. Fittings shall be streamline wrought copper solder joint fittings to ANSI B16.22. All joints shall be made up using lead free solder.

.4 All threads shall be standard, clean cut, and tapered to ANSI B1.20.1. Threaded joints shall be made up using approved type thread lubricant applied to the male thread only. Thread lubricant shall be suitable for the service and temperature and shall be a type that does not set-up hard under service.

.5 Connections to heating elements and equipment shall be made using the correct tappings as recommended by the manufacturer or as detailed on the drawings.

.6 Where it is necessary to make solder joint connections to copper tubing, copper wall fin, or copper equipment connections, all joints shall be made up using lead free solder. Where it is necessary to use copper tubing in connections, all copper tubing used shall be certified and labelled type L hard copper tubing to ASTM B88, latest edition. Fitting shall be streamline wrought copper solder joint fittings to ANSI B16.22.

.7 When it is necessary to make new connections into existing piping it shall be the responsibility of the Contractor to trace the existing piping and correctly determine which of the existing lines is supply and which is return and to make all new connections accordingly.

.8 All piping drawings are schematic only. This Contractor shall co-ordinate his work with that of other trades and locate his piping runs and set his elevations with due regards to adjacent services, equipment, structure, and architectural intent. He shall take into consideration grading, draining, insulation, and thermal expansion and contraction. All piping shall be located to permit access and/or removal of all equipment and its internal elements.

.9 ll coils shall have the piping connections arranged to provide counterflow of air and water.

2.3 WELDING

.1 All welding shall be performed in accordance with the requirements of the B.C. Boiler Inspection Branch and ASME B31.1, Power Piping. Welding shall only be carried out by skilled pipe welders who have passed B.C. Boiler Inspection pipe welding test and who hold current welding certificates for the work being performed.

.2 Pipe size 65 mm (2½") and larger shall be electric arc welded. All welds shall be multiple pass. The ends of all pipe to be joined by welding shall be machine cut, properly and cleanly bevelled, and properly spaced to ensure the uniformity of the weld throughout the entire joint.

.3 Welding is approved in the following areas:

.1 Mechanical Rooms

2.4 GROOVED END PIPE AND FITTINGS

.1 The use of grooved end pipe, fittings, and couplings is acceptable for, and closed circuit heating piping, in sizes 65 mm and larger.

.2 Piping shall be standard weight Schedule 40 black steel pipe, ASTM Specification A53, Grade B, with machine cut or rolled grooves. Joints and couplings shall be Victaulic, or approved. Minimum working pressure for all joints, fittings, and couplings shall be 1034 kPa (150 psi).

.3 Couplings shall be full flow grooved steel type and shall comply with C.S.A. standard B242 (current edition), groove and shoulder type mechanical pipe couplings.

.4 All piping subject to expansion or contraction shall be set up using manufacturer's recommendations to maintain the pipe end separation at couplings necessary to contain transverse axial movement and misalignment.

.5 Use adaptor fittings where non-grooved connections are required or flange adaptor style 741 for flanged connections.

.6 All couplings shall be Victaulic style 77 or 71 for flexible joint. Couplox style 3400 and 3000 are also acceptable. All rigid connections to be Victaulic style 07 (zero-flex).

.7 Gaskets shall be EPDM Grade "E" for use on water systems - 35°C to 110°C (-30°F to +230°F). Gaskets shall have a green indicator marking.

.8 Where Victaulic jointing is used throughout a piping system, this manufacturer's complementary butterfly valves, check valves, strainers and suction diffusers may be used provided they meet the features and requirements of specified equipment.

2.5 DRAINS

.1 All piping drains, and all boiler room, fan room, and equipment room drains, etc., shall be fitted with 20 mm (¾") bronze screwed ball type drain valves complete with lever handle, hose outlet, hose cap and chain, Red-White No. 5046.

.2 All auxiliary drains in convectors, wall fin, unit heaters, booster coils, etc., shall be fitted with 20 mm (¾") bronze screwed hose bibs with wheel handle, hose outlet, and brass hose cap with chain, Emco. No. 10241.

.3 All hose bibs installed on cold water supply piping shall be fitted with a Watts No. 8 backflow preventer with tamper-proof set screw.

Part 3 Execution

3.1 APPLICATION

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

3.2 PIPING

.1 All piping runs shall be fabricated in a neat and workmanlike manner, all grades shall be true and even, and all vertical piping shall be plumb.

.2 Hot water heating piping systems, in general, shall pitch upwards in the direction of flow towards air vents with a uniform grade of 25 mm (1") in 6000 mm (20'-0"). Steam mains shall pitch downwards in the direction of flow towards drip points with a uniform grade of

25 mm (1") in 6000 mm (20'-0"). Condensate return lines shall pitch downwards in the direction of flow with a uniform grade of 25 mm (1:) in 4500 m (15'-0").

.3 All piping shall be installed so that all water or condensate can be completely drained.

.4 Runouts and branch lines to radiation, equipment, risers, stubs, etc., shall have a uniform grade of 25 mm (1") in 600 mm (24"). Water branches shall be taken off the top or bottom of the mains, as required, at an angle of 45° or 90°.

.5 Each runout or branch shall be made up with swing joints and shall contain at least three elbows for flexibility. The base of each riser or stub, and the top of each drop shall be made up with a two-elbow swing joint.

.6 All piping at pumps, coils, equipment, etc., shall be supported independent of the equipment and shall be anchored in close proximity to the equipment to prevent strain or shock being transmitted to the equipment.

3.3 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

.4 Install flushing bypasses to heat exchangers, sensitive pieces of equipment and as directed my manufacturers recommendations.

3.4 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer and as indicated without interrupting operation of other system, equipment, components.

3.5 DRAINS

.1 Install 20 mm (¾") hose drains at each low point in the system to permit complete drainage. Access panels shall be provided to all drain valves located concealed in walls or ceilings.

.2 Install 20 mm (¾") hose drains immediately down stream of each main zone or sub-zone isolating shutoff valves located in mains, sub-mains and branch mains to allow drainage of all isolated sections of piping.

.3 In the boiler room all drains, blow offs, and overflow lines shall be piped to floor drains.

.4 Install two 50 mm (2") valved drain at the low point in the return header in the boiler room for flushing the system 450mm upstream of the pump strainers. This shall be in addition to the required hose drain. It shall be fitted with an elbow and nipple and cap on the valve outlet to direct the flow of water.

.5 No drain or overflow shall discharge onto any floor or roof.

3.6 AIR VENTS

.1 Install auto air vents to CSA B139 at high points in piping systems. Recommended product standard Spirovent Spirotop.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible and next to the floor drain.

3.7 DIELECTRIC COUPLINGS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.8 VIBRATION INSULATION SLEEVES

.1 Use rubber made expansion joints for major pumps and chillers as shown.

.2 Reference product Danfoss Socla ZKB.

.3 Contractor to provide shop drawings for review.

3.9 PIPEWORK INSTALLATION

.1 Install pipework to CSA B139.

.2 Screwed fittings jointed with Teflon tape.

.3 Protect openings against entry of foreign material.

.4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.5 Assemble piping using fittings manufactured to ANSI standards.

.6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main. Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.10 Install, except where indicated, to permit separate thermal insulation of each pipe.

.11 Group piping wherever possible.

.12 Ream pipes, remove scale and other foreign material before assembly.

.13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.14 Provide for thermal expansion installed in the hot and chilled water pipes. Natural expansion on the L - bows is recommended strategy. Contractor to provide shop drawings of the thermal expansion.

.15 Install dirt pockets of at least 5 diameters of length on the bottom of risers. Install isolation valves to allow for cleaning without hindering operation. Allow the facilitation of attaching full bore flexible drain hoses, with clearance of the finished floor, typically 300mm.

.16 Valves:

- .1 Install in accessible locations.
- .2 Remove interior parts before soldering.
- .3 Install with stems above horizontal position unless indicated.
- .4 Valves accessible for maintenance without removing adjacent piping.
- .5 Use gate, ball valves at branch take-offs for isolating purposes except where specified.
- .6 Install butterfly valves on chilled water and related condenser water systems only.
- .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
- .8 Install future loop valve arrangements for prove potential branch flow at design pressure drop during TAB procedure.

.17 Check Valves:

- .1 Install silent check valves on discharge of pumps and in vertical pipes with upward flow and as indicated.
- .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.10 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere:

.1 Provide space for firestopping.

.2 Maintain fire rating integrity.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.11 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws.

.1 Chrome or nickel plated brass or type 302 stainless steel..

.3 Sizes: outside diameter to cover opening or sleeve.

.1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.12 PREPARATION FOR FIRE STOPPING

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation.

.2 Uninsulated unheated pipes not subject to movement: no special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.13 EXISTING AND NEW SYSTEM CLEANING

.1 Prior to the installation of the new boilers into the hydronic system, the existing piping system with the existing boilers and pumps, shall be chemically cleaned and flushed.

.2 Cleaning shall be carried out to the recommendation of and under the direction of the chemical cleaning and treatment agency that services the facility.

.3 On completion of the system cleaning, all systems shall be flushed out with clean water until all traces of the cleaning chemical have been removed. All strainer baskets shall be removed, cleaned, and replaced.

.4 Flushing shall be done by opening a drain valve and allowing the makeup water system for the heating plant to supply makeup water until the effluent from the drain valve is clean. This will prevent air pockets occurring in the piping system during the cleaning process.

.5 When the installation of the new boilers, piping and pumps in the boiler room has been completed, the boiler piping systems shall be isolated from the distribution piping systems and the new piping and boilers and pumps shall be cleaned and flushed. Provide temporary piping connections, valves as required. When the cleaning and flushing is complete. remove the temporary isolation.

.6 For both system fire on of the boiler to het the circulating water to 70° C.

3.14 PIPING SYSTEM CHEMICAL TREATMENT

.1 After cleaning and flushing, the chemical cleaning agency shall treat the system water with a closed system inhibitor in the recommended quantities.

.2 All water treatment chemicals used in the system shall be as recommended by the chemical treatment agency and previously used in the building. Standard of Acceptance: CorrShield OR4407 Non-Nitrite/Non-Molybdate Inhibitor.

.3 A letter signed by a principal of the cleaning agency, certifying the cleaning of the system and the final chemical treatment shall be filed with the engineer for approval. This shall include a chemical analysis of the final system water condition.

3.15 CHEMICAL POT FEEDER AND SIDE STREAM FILTER

.1 Provide a new chemical pot feeder and side stream filter complete with flow indicator. Provide a box of 12 filter cartridges for the existing filter housing.

3.16 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Consultant 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work. All new section of piping and all installations in the mechanical rooms shall be pressure tested.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Consultant.

.6 Pay costs for repairs or replacement, retesting, and making good. Consultant to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Consultant.

3.17 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Consultant.

.2 Request written approval by Consultant 10 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

3.18 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Electrical motors, drives and guards for mechanical equipment and systems.

.2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 25.

.4 Refer to Division 26 for quality of materials and workmanship.

1.2 REFERENCES

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

.1 ASHRAE 90.1-[01], Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

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

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

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

.2 Product Data:

.1 Shop Drawings: submit drawings stamped and signed the Mechanical Contractor

.3 Closeout Submittals

.1 Provide maintenance data for motors, drives and equipment for incorporation into the maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

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

Part 2 Products

2.1 GENERAL

.1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1, 2012.

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 73 W, 1/2 HP : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W, 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 208 or 600 V, unless otherwise indicated.

2.3 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 7.5 kW, 10 HP : standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW, 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer’s design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed.

2.4 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
- .3 38 mm dia holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.-

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

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 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.3 Section 23 05 53.01 - Mechanical Identification.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B40.100-01, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-01, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

.2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.4 SUBMITTALS

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

.2 Submit shop drawings and product data.

.3 Submit manufacturer's product data for following items:

.1 Thermometers.

.2 Pressure gauges.

.3 Stop cocks.

.4 Syphons.

.5 Wells.

Part 2 Products

2.1 GENERAL

.1 Design point to be at mid point of scale or range.

.2 Ranges: as indicated.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB14.4 ASME B40.200.

2.3 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.4 THERMOMETERS

.1 Industrial, variable angle type, aluminum case, glass front, 1% midscale accuracy, liquid filled, 125 mm scale length: to CAN/CGSB14.4 black letters with white background, dual temperature scale.

2.5 PRESSURE GAUGES

.1 Industrial, oil filled, 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:

.1 Snubber for pulsating operation.

.2 Diaphragm assembly for corrosive service.

.3 Gasketted pressure relief back with solid front.

.4 Bronze stop cock.

.5 Oil filled for high vibration applications including: pumps & chillers

Part 3 Execution

3.1 GENERAL

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 DIRECT READING THERMOMETERS

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

.2 Install in locations as indicated and on inlet and outlet of:

.1 Boilers

.2 DHW tanks.

.3 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in following locations:

- .1 Suction and discharge of pumps and across associated strainer.
- .2 Upstream and downstream of PRV's.
- .3 Upstream and downstream of control valves.
- .4 Inlet and outlet of coils..
- .5 Inlet and Outlet of boilers.
- .6 In other locations as indicated.

.2 Install pressure gauge test cocks and single pressure gauge for each equipment differential piped to test cocks.

.3 Install gauge cocks for balancing purposes, elsewhere as indicated.

.4 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME B1.20.1-[1983(R2006)], Pipe Threads, General Purpose (Inch).

.2 ANSI/ASME B16.18-[2001], Cast Copper Alloy Solder Joint Pressure Fittings.

.2 ASTM International

.1 ASTM A276-[08], Standard Specification for Stainless Steel Bars and Shapes.

.2 ASTM B62-[02], Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 ASTM B283-[08a], Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.4 ASTM B505/B505M-[08a], Standard Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

.1 MSS-SP-25-[1998], Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS-SP-80-[2008], Bronze Gate Globe, Angle and Check Valves.

.3 MSS-SP-110-[1996], Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 MATERIALS

.1 Valves:

.1 Except for specialty valves, to be single manufacturer.

.2 Products to have CRN registration numbers.

.2 End Connections:

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.

.2 Copper tube systems: solder ends to ANSI/ASME B16.18.

.3 Gate Valves:

.1 Requirements common to gate valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Packing: non-asbestos.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125

.1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 Operator: Handwheel.

.3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:

.1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 Operator: handwheel.

.4 NPS 2 and under, rising stem, split wedge disc, Class 125:

.1 Body: with long disc guides, screwed bonnet.

.2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.

.3 Operator: handwheel.

.5 NPS 2 and under, rising stem, solid wedge disc, Class 125:

.1 Body: with long disc guides, screwed bonnet.

.2 Operator: handwheel.

.6 NPS 2 and under, rising stem, solid wedge disc, Class 150:

.1 Body: with long disc guides, screwed union bonnet.

.2 Operator: handwheel.

.4 Globe Valves:

.1 Requirements common to globe valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, composition disc, Class 125:

.1 Body and bonnet: screwed bonnet.

.2 Disc and seat: renewable rotating PTFE disccomposition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.3 Operator: handwheel.

.4 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.5 Operator: handwheel.

.3 NPS 2 and under, plug disc, Class 150, screwed ends:

.1 Body and bonnet: union bonnet.

.2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem.

.3 Operator: [handwheel].

.4 Angle valve, NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 Operator: handwheel.

.5 Check Valves:

.1 Requirements common to check valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Connections: screwed with hexagonal shoulders.

.2 NPS 2 and under, swing type, bronze disc, Class 125:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.3 NPS 2 and under, swing type, bronze disc:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.6 Silent Check Valves:

.1 NPS 2 and under:

.1 Body: cast high tensile bronze to ASTM B62 with integral seat.

.2 Pressure rating: Class 125.

.3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.

.4 Disc and seat: renewable rotating disc.

.5 Stainless steel spring, heavy duty for downflow application.

.6 Seat: regrindable.

.7 Ball Valves:

.1 NPS 2 and under:

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: Class125.

.3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders, solder ends to ANSI.

.4 Stem: tamperproof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: replaceable ,[stainless steel, solid ball and Teflon seats.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

.8 Butterfly Valves:

.1 NPS 2 1/2 through NPS 6, ,[2068 kPa,] with grooved ends.

.1 Body: cast bronze, with copper-tube dimensioned grooved ends.

.2 Disc: elastomer coated ductile iron with integrally cast stem.

.3 Operator: lever.

Part 3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Remove internal parts before soldering.

.3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.1-[05], Cast Iron Pipe Flanges and Flanged Fittings.

.2 ASTM International Inc.

.1 ASTM A49-01(2006), Standard Specification for Heat-Treated Carbon Steel Joint Bars.

.2 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.3 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.

.4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 ASTM B85/B85M-08, Standard Specification for Aluminum-Alloy Die Castings.

.7 ASTM B209-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

.1 MSS SP-61-[03], Pressure Testing of Steel Valves.

.2 MSS SP-70-[06], Grey Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS SP-71-[05], Grey Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS SP-82-[1992], Valve Pressure Testing Methods.

.5 MSS SP-85-[2002], Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide drawings stamped and signed by the mechanical contractor.

Part 2 Products

2.1 MATERIAL

.1 Valves:

.1 Except for specialty valves, to be of single manufacturer.

.2 Standard specifications:

.1 Gate valves: MSS SP-70.
.2 Globe valves: MSS SP-85.
.3 Check valves: MSS SP-71.

.3 Requirements common to valves, unless specified otherwise:

.1 Body, bonnet: cast iron to ASTM B209 Class B
.2 Connections: flanged ends plain face, grooved ends to ANSI B16.1.
.3 Inspection and pressure testing: to MSS SP-82.
.4 Bonnet gasket: non-asbestos.
.5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
.6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
.7 Gland packing: non-asbestos.
.8 Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
.9 Identification tag: with catalogue number, size, other pertinent data.

.4 All products to have CRN registration numbers.

2.2 GATE VALVES

.1 NPS 2 1/2 - 8, non rising stem, inside screw, [bronze] [iron] trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: with [bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
.2 Disc: solid offset taper wedge, bronze to ASTM B62.
.3 Seat rings: renewable bronze to ASTM B62, screwed into body.
.4 Stem: bronze to ASTM B62.

2.3 VALVE OPERATORS

.1 Install valve operators as follows:

.1 Handwheel: on valves except as specified.

2.4 CHECK VALVES

.1 Swing check valves, Class 125:

.1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.

.1 Up to NPS 16: [cast iron to ASTM A126 Class B] [ductile iron ASTM A536 Grade 65-45-12].

.2 NPS 18 and over: cast iron to ASTM A126 Class C.

.2 Ratings:

.1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.

.2 NPS 14 - 16: 860 kPa steam; 1.03 MPa CWP.

.3 NPS 18 and over: 1.03 MPa CWP.

.3 Disc: rotating for extended life.

.1 Up to NPS 6: bronze to ASTM B62 or stainless steel type 316.

.2 NPS 8 and over: bronze-faced cast iron.

.4 Seat rings: renewable bronze to ASTM B62 screwed into body.

.5 Hinge pin, bushings: renewable bronze to ASTM B62 or stainless steel.

2.5 SILENT CHECK VALVES

.1 Construction:

.1 Body: [malleable] [or] [ductile iron] with integral seat.

.2 Pressure rating: Class 125, WP = 860 kPa.

.3 Connections: grooved ends.

.4 Disc: [bronze] [or] [stainless steel] renewable rotating disc.

.5 Seat: renewable, EPDM.

.6 Stainless steel spring, heavy duty for down flow application.

Part 3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

3.2 CLEANING

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

.2 Clean installed products in accordance to manufacturer’s recommendation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1-07, Power Piping.

.2 ASTM International

.1 ASTM A125-1996 (2007), Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC)

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under 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.

2.2 GENERAL

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

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

2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.

.2 Ensure steel hangers in contact with copper piping are copper plated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 9 mm UL listed13 mm FM approved.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP58 and MSS-SP69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved.

.4 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed [FM approved to MSS SP69.

.5 Shop and field-fabricated assemblies:

.1 Trapeze hanger assemblies:

.2 Steel brackets: Sway braces for seismic restraint systems:

.6 Hanger rods: threaded rod material to MSS SP58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.3 Do not use 22 mm rod.

.7 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: carbon steel black.....

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP69 UL listed FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: black.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.4 INSULATION PROTECTION SHIELDS

.1 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.5 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 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.

2.7 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.9 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 150 mm larger than equipment; chamfer pad edges.

.2 Paint new pad to match existing floor color with similar paint, outline with yellow along edges of pad.

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, cooling towers, 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 approved constant support type hangers where:

.1 Vertical movement of pipework is 13 mm or more,

.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.

.2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

.1 Plumbing piping: to BC Plumbing Code authority having jurisdiction.

.1 Horizontal:

.1 up to NPS 15mm (½"): every 2.0 m (6')

.2 20mm to 25 mm (¾ to 1"): every 2.5m (8')

.3 32mm to 65 mm (1-1/4" to 2 ½"): every 3.0 m (10')

.4 75mm to 100mm (3" to 4"): every 5.0 m (15')

.5 125mm to 200mm (5" to 8"): every 6.0 m (20').

.2 Vertical:

.1 Every floor but not less than 125% of horizontal spacing

.2 Copper piping: up to NPS 1/2: every 1.5 m.

.3 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.4 Within 300 mm of each elbow.

.5 Per the following table:

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

3.7 HOUSE-KEEPING PADS

.1 Housekeeping pads to be dowelled to floor slab to resit seismic forces.

.2 Mechanicla contractor's seismic engineer shll provid number ans sizes iof doll to secure the pad.

.3 Contractor shall X-ray slab before drilling hles for dowels.

.4 Dowels shall be secured in the slab with epoxy glue.

.5 Submit seismic schedules for the bases at the completion of the project.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and requirements for the identification of **new** piping systems, duct work, valves, boilers, pumps, fans and controllers, including the installation and location of identification systems.

1.2 REFERENCES

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 Lamacoid labels, 3 mm thick laminated plastic or white anodized aluminum, 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 All Mechanical Equipment throughout: use size # 9.

.5 Identification for Preventive Maintenance Support System (PMSS):

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 Equipment in Mechanical Room:

.1 Main identifier: size #9.

.2 Source and Destination identifiers: size #6.

.3 Terminal cabinets, control panels: size #5.

.3 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Consultant.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1 and authority having jurisdiction.

Or

.2 Natural Gas: Painted yellow with labeling per CSA/CGA B149.1 and authority having jurisdiction.

.3 ANSI A.31

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 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.3 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.

.4 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.5 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.

.6 Colours and Legends:

.1 Where not listed, obtain direction from Consultant.

.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
** Add design temperature		
++ Add design temperature and pressure		
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Safety valve vent	Yellow	STEAM VENT
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
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: back, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped 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 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC or CSA registration plates as required by respective agency.

3.3 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 At beginning and end points of each run and at each piece of equipment in run.

.7 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.

.8 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.

3.5 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. 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 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.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 Reference Sections

.1 Section 25 90 01 - EMCS Sequences of Operation

1.3 SCOPE OF WORK

.1 Conduct the following system measurement and balancing as indicated on the drawings across the following systems:

.1 Air Balancing

.1 Air intake to six reheat coils in Blocks C, D, E, that are being replaced.

.2 Two new exhaust fans and VAV boxes, RF-D1, VAV-D1 Block D; RFE-1, VAV-E1 Block E.

.3 Zone Isolation damper Block B, CD-1. Verify flow rates and set point for speed control to maintain relative space pressurization and non-isolated flow rates.

.4 Space pressurization verification as outlined in Section 25 90 01

.2 Water Balancing

.1 Heating Pumps (P-1, P-2; P-3 P-4)

.2 Boilers (B-1, B-2, B-3)Water flow with 1, 2, and three boiler operating

.3 Water heaters DHWB-1, BHWB-2and pumps DHWP-2, DHWP-2

.4 Electric water heater and pump for process load Block E.

1.4 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Consultant within 30 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

.3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:

.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 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.

1.5 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.

1.6 EXCEPTIONS

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

1.7 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.

1.8 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Consultant adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Consultant 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.

1.9 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.10 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Consultant for verification of TAB reports.

1.11 START OF TAB

.1 Notify Consultant 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

.7 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 Air systems: reheat coils and fan powered VAV box

.1 Filters in associated AHU in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Access doors, installed, closed.

.7 Outlets installed, volume control dampers open.

.3 Heating piping 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.

1.12 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 All HVAC systems: plus 5%, minus 5%.

.2 Hydronic systems: plus or minus 10%.

1.13 ACCURACY TOLERANCES

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

1.14 INSTRUMENTS

.1 Prior to TAB, submit to Consultant 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 Consultant.

1.15 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.16 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Consultant, 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.

1.17 TAB REPORT

.1 Format in accordance with referenced standard.

.2 TAB report to show results in SI & IP units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit 6 copies of TAB Report to Consultant for verification and approval, in English in D-ring binders, complete with index tabs.

1.18 VERIFICATION

.1 Reported results subject to verification by Consultant.

.2 Pay costs to repeat TAB as required to satisfaction of Consultant.

1.19 SETTINGS

.1 After TAB is completed to satisfaction of Consultant, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.20 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Consultant.

1.21 AIR SYSTEMS

.1 Standard: TAB to most stringent of this section or TAB standards of AABC. TAB current member in good standing of AABC qualified to standards of AABC.

.2 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC.

.3 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.4 Locations of equipment measurements: to include as appropriate:

.1 Inlet and outlet of dampers, filter, coil, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.5 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.22 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

.2 Air Handling units and Exhaust systems

.1 Contractor to include for balancing the HVAC systems served by both existing and new units.

.2 Contractor to include for preliminary air flow measurements and verification of the AHU air flow and static pressure.

.3 Water systems balancing

.4 For the new hot water pumps, boilers, and bypass valves.

.5 Balancing of the distribution systems shall be conducted with all motorized valves in 100% open position.

.6 Include for review and inspection of the valves prior to TAB.

.7 Utilize flow control valves and pump curves to calculate pump flows

.8 Contractor to include for preliminary air flow measurements and review of the results with the Consultant.

.9 Final balancing instruction will be provided by the Consultant after preliminary balancing report review.

.10 Contractor to balance water systems accordingly.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 GENERAL

.1 The following equipment schedules are to be read in conjunction with the pertinent sections of the specification. The specification sections and the schedules are complimentary to one another.

.2 The equipment make and size shown in the schedules is that which the project design and drawings are based on and for which space in the building design has been allocated.

.3 Where alternative equipment makes have been shown in the specification equipment sections, the Mechanical Approval List, or are approved during the tender process, it shall be the contractors and equipment suppliers responsibility to assure that the alternate equipment meets all the requirements of the specification, is of adequate size and capacity, has similar electrical characteristics, is suitable for the duty intended, and is of a physical size and shape to fit into the space which has been allocated in the system design. Where any alternate equipment fails to meet any of the criteria for the use of alternate equipment spelled out in this specification, it shall be rejected for use in the project.

Part 2 Equipment

2.1 ACID NEUTRALIZERS TANKS

Tag	**Units**	**AN-1**	**AN-2**
Service	-	Three boilers	Two DHW heaters
Location	-	Mechanical Room	Mechanical Room
Type		Rectangular tank with dividers, inlet & outlet connections and neutralizing media	Rectangular tank with dividers, inlet & outlet connections and neutralizing media
Capacity	*L (US gal)*	Accommodate condensation from 6500MBH gas consumption	Accommodate condensation from 1000MBH gas consumption
Size		Tank size and media to accommodate above consumption	Tank size and media to accommodate above consumption
Manufacturer		Axiom	AO Smith
Accessories		1	1
Remarks			

.1 Accessories:

.1 1 set of spare media

2.2 AIR TERMINALS

Notation	**R-1**
Manufacturer	E.H. Price
Type	Return Air Grille
Model No.	24”x18”/530/F/L/A/B12
Border	Surface Mount Standard
Blade Orient	Long dimension
Nom Size	24”x18”
Volume Damper	No
Fastening	Screw
Finish	B12-White Powder Coat
Options	Surface Mount SM

2.3 BOILERS – HYDRONIC HEATING

Boilers					
Tag		**Units**	**B-1**	**B-2**	**B-3**
Service		-	Radiant Panel and AHU/Reheat Loop	Radiant Panel and AHU/Reheat Loop	Radiant Panel and AHU/Reheat Loop
Location		-	Block B Boiler Room	Block B Boiler Room	Block B Boiler Room
Type		-	Natural Gas	Natural Gas	Natural Gas
Combustion Category		-	IV	IV	IV
Operating Weight		*kg (lbs)*	1053 (2322)	1053 (2322)	1053 (2322)
Capacity	Input	*kW (MBH)*	633 (2160)	633 (2160)	633 (2160)
	Output	*kW (MBH)*	614 (2094)	614 (2094)	614 (2094)
Water Volume		*l (US gal)*	570 (150.6)	570 (150.6)	570 (150.6)
Vent Connection		*mm (in)*	251 (10)	251 (10)	251 (10)
Vent size		*mm (in)*	251 (10)	251 (10)	251 (10)
Boiler Connection		*mm (in)*	100 (4)	100 (4)	100 (4)
Burner					
Turndown Ratio		-	5:1	5:1	5:1
Burner Manufacturer			Weishaupt	Weishaupt	Weishaupt
Model			WM-G 10/3	WM-G 10/3	WM-G 10/3
Electrical		*V/PH/Hz* -	120/1/60	120/1/60	120/1/60
	Current	*Amps*	17.5	17.5	17.5
Boiler Manufacturer		-	Viessmann	Viessmann	Viessmann
Model Number		-	Vitocrossal 300-CT3-57	Vitocrossal 300-CT3-57	Vitocrossal 300-CT3-57
Accessories			1, 2, 3,4	1, 2, 3,4	1, 2, 3,4
Remarks			1, 2	1, 2	1, 2

.1 Accessories:

.1 BACNet Interface
.2 Manufacturer supplied seismic anchorage kit
.3 Weishaupt linkageless burner
.4 Manufacturer supplied cascade controller

.2 Remarks

.1 Venting – AL-29-4 SS venting required
.2 Venting size to be confirmed by boiler manufacturer

2.4 CONTROL DAMPERS (Round)

Tag	Units	CD-1
Service		Block B General Lab Exhaust
Location		Block B, lab Room #B111 (Exhaust Duct)
Quantity		1
Type		Round
Diameter	*mm (in)*	550 (22)
Manufacturer		Ruskin
Model		CDRS 25
Actuator		Belimo
Model		FB 24 - SR
Accessories		1.2
Remarks		-

.1 Accessories:

.1 Flange Connections

.2 Actuators shall be modulating, spring return, high torque

.2 Remarks

.1 -

2.5 CONTROL VALVES

Control Valves	**Units**	**CV-B1 CV-B2 CV-B3**	**CV-1**	**CV-2**	**CV-3**
Service		Boiler Isolation	Radiant Panels	AHU & Reheat Coils	Low Temp Diverting
Location		Boiler Room	Boiler Room	Boiler Room	Boiler Room
Type		Butterfly, two position	Mixing, modulating Spring Return	Mixing, modulating, Spring Return	Diverting, modulating
Number of Ports		2	3	3	3
Flow Rate	*l/s (USgpm)*	13.8 (220)	5.05 (80)	22.5 (356)	5.05 (80)
Port Size	*mm (in)*	100	50	100	50
Cv		-	36	200	36
Manufacturer		Belimo	Belimo	Belimo	Belimo
Supplied		Div 23	Div 25	Div 25	Div 25
Installed		Div 23	Div 23	Div 23	Div 23
Controls		Div 23	Div 25	Div 25	Div 25
Accessories					
Remarks			1	1	2

.1 Accessories:

.1 -

.2 Remarks

.1 Fail to heat

.2 Fail to divert 15% of flow

2.6 COILS - HEATING

UNIT	Units	HC-1&2	HC-3 & 4	HC-5 & 6
Service	-	C-Block	D-Block	E-Block
Location	-	In VAV boxes in high bay area	In VAV boxes in high bay area	In VAV boxes in high bay area
Capacity	*kW (MBH)*	11.7 (40)	11.7 (40)	11.7 (40)
Coil Type	-	Reheat for installation downstream of VAV boxes 2	Reheat for installation downstream of VAV boxes 2	Reheat for installation downstream of VAV boxes 2
Air Flow	*l/s (cfm)*	400 (830)	400 (830)	400 (830)
Coil Entering Temp	*℃ (℉)*	15.8(60)	15.8(60)	15.8(60)
Air Pressure Drop	*H_2O (pa)*	-	-	-
Waterflow Rate	*l/s (gpm)*	0.25 (4)	0.25 (4)	0.25 (4)
Water Entering Temp	*℃ (℉)*	71 (160)	71 (160)	71 (160)
Water Leaving Temp	*℃ (℉)*	60 (140)	60 (140)	60 (140)
Water Pressure Drop	*kPa (ft H2O)*	10 (3.3)	10 (3.3)	10 (3.3)
Dimensions LxH x D	*mm x mm (in x in x in)*	350 X312 (14 X 12.5)	350 X312 (14 X 12.5)	350 X312 (14 X 12.5)
Rows	-	2 row high capacity	2 row high capacity	2 row high capacity
Remarks	-	1,2	1,2	1,2

.1 Remarks

.1 Remove and reinstall all piping, accessories, valves, insulation

.2 Measure exact dimensions prior to shop drawing review

2.7 FANS

UNIT NO.	Units	xEF-18	RFD-1	RFE-1
Service	-	B-Block General Exhaust	D-Block Mezz r Return Duct	E-Block Mezz Return Duct
Location	-	B Block Penthouse	D-Block Mezz Return Duct	E-Block Mezz Return Duct
Fan Type	-	Backward Inclined Flat Blade	Inline Duct Blower	Inline Duct Blower
Air Flow	*l/s (cfm)*	2833 (6000)	850 (1800)	850 (1800)
Fan S.P.	*Pa (in)*	205 (0.82)	62 (0.25)	62 (0.25)
Fan Speed	*RPM*	1225	532	532
Drive Type	-	Belt	Belt	Belt
Fan Motor HP	-	New Motor 3HP	0.33	0.33
Volts/Phase/Hz	-	600/3	120/1/60	120/1/60
Manufacturer	-	Loren Cook CO.	Delhi	Delhi
Model No.	-	210CPV	212	212
Accessories		1,2 ,3	3	3
Remarks		1,2		

.1 Accessories:

.1 Shaft grounding ring M39B-1

.2 New motor Baldor EM3611T-5

.3 Variable Speed Drive

.2 Remarks

.1 Existing fan to remain. Replace motor with new VFD rated motor.

.2 Replace existing fan bearings, belts, pulley

2.8 FANS – CEILING

UNIT NO.	Units	HVLS-C1	HVLS-C2	HVLS-D1
Service	-	Block C, Lab Office Areas	Block C, Lab Office Areas	Block D, Lab Office Areas
Location	-	Block C, Lab Office Ceiling	Block C, Lab Office Ceiling	Block D, Lab Office Ceiling
Fan Type	-	High Volume Ceiling fan	High Volume Ceiling fan	High Volume Ceiling fan
Air Flow	*l/s (cfm)*	Approx. 7550 (16,000)	Approx. 7550 (16,000)	Approx. 7550 (16,000)
Fan S.P.	*Pa (in)*	-	-	-
Fan Draw (BHP)	*BHP*	-	-	-
Fan Speed	*RPM (min/max)*	44/141	44/141	44/141
Drive Type	-	EC Motor With Digital Inverter Drive	EC Motor With Digital Inverter Drive	EC Motor With Digital Inverter Drive
Fan Motor HP	*HP (min/max)*	0.0059/0.085	0.0059/0.085	0.0059/0.085
Volts/Phase/Hz	-	120/1/60	120/1/60	120/1/60
Manufacturer	-	Big Ass	Big Ass	Big Ass
Model No.	-	Haiku 84	Haiku 84	Haiku 84
Colour		White	White	White
Accessories		1,2	1,2	1,2
Remarks		1	1	1

UNIT NO.	Units	HVLS-D2	HVLS-E1	HVLS-E2
Service	-	Block D, Lab Office Areas	Block E, Lab Office Areas	Block E, Lab Office Areas
Location	-	Block D, Lab Office Ceiling	Block E, Lab Office Ceiling	Block E, Lab Office Ceiling
Fan Type	-	High Volume Ceiling fan	High Volume Ceiling fan	High Volume Ceiling fan
Air Flow	*l/s (cfm)*	Approx. 7550 (16,000)	Approx. 7550 (16,000)	Approx. 7550 (16,000)
Fan S.P.	*Pa (in)*	-	-	-
Fan Draw (BHP)	*BHP*	-	-	-
Fan Speed	*RPM (min/max)*	44/141	44/141	44/141
Drive Type	-	EC Motor With Digital Inverter Drive	EC Motor With Digital Inverter Drive	EC Motor With Digital Inverter Drive
Fan Motor HP	*HP (min/max)*	0.0059/0.085	0.0059/0.085	0.0059/0.085
Volts/Phase/Hz	-	120/1/60	120/1/60	120/1/60
Manufacturer	-	Big Ass	Big Ass	Big Ass
Model No.	-	Haiku 84	Haiku 84	Haiku 84
Colour		White	White	White
Accessories		1,2,3	1,2,3	1,2,3
Remarks		1	1	1

.1 Accessories:

.1 Mounting hardware & secondary independent cable ties to structure

.2 64” drop tube extension. Provide additional hardware for drop fan to existing fan height

.3 0-10VDC control module

.2 Remarks

.1 Confirm exact location on site with structure and surrounding fixtures. Maintain 2’ clearance from all obstructions

2.9 SINGLE DUCT TERMINAL UNIT

NOTATION	Units	VAV-D1	VAV-E1
Manufacturer		E.H. Price	E.H. Price
Type		Variable volume Terminal Box	Variable volume Terminal Box
Location		Block D High Bay Area	Block E High Bay Area
Air Flow Maximum	*cfm*	1350	1350
Air Flow Minimum	*cfm*	300	300
Air Pressure Drop	*inwg*	0.25	0.25
Accessories		1	1
Remarks		1	1

.1 Accessories:

.1 Flow sensor

.2 Remarks

.1 Boxes supplied without controls. Controls field installed by Division 25

2.8 PUMPS

Tag		**Units**	**P-1**	**P-1**	**P-3**	**P-4**
Service		-	Reheat Coil and AHU	Reheat Coil and AHU	Reheat Coil and AHU	Reheat Coil and AHU
Location		-	Mechanical Room	Mechanical Room	Mechanical Room	Mechanical Room
Type			Vertical Inline	Vertical Inline	Vertical Inline	Vertical Inline
Size	Flow Rate	*l/s (USgpm)*	22.5 (356)	22.5 (356)	5.05 (80)	5.05 (80)
	Head	*m.w.g (ft H2O)*	14.6 (48)	14.6 (48)	20.1 (66)	20.1 (66)
	Suction	*mm (in)*	100 (4)	100 (4)	50 (2)	50 (2)
	Discharge	*mm (in)*	100 (4)	100 (4)	50 (2)	50 (2)
Dimensions	Impeller	*mm (in)*	192 (8)	192 (8)	217 (8.56)	217 (8.56)
	Flange	*mm (in)*				
Motor		*KW (HP)*	5.5(7.5)	5.5(7.5)	3.8(5)	3.8(5)
Electrical	V/PH/Hz		600/3/60	600/3/60	600/3/60	600/3/60
Manufacturer			Grundfos	Grundfos	Grundfos	Grundfos
Model Number			40957 VL	40957 VL	20955 VL	20955 VL
Accessories			1,2	1,2	1,2	1,2
Remarks			1	1	1	1

.1 Accessories:

.1 Differential pressure transmitter

.2 Frequency converter for pump control

.2 Remark

.1 c/w geni module BACNet interface module for external DDC controls

Tag		**Units**	**DHWP-1**	**DHWP-2**	**DHRP-1**
Service		-	DHW Heating	DHW Heating	DHW Recirc.
Location		-	Mechanical Room	Mechanical Room	Mechanical Room
Type			Inline variable speed	Inline variable speed	Inline variable speed
Size	Flow Rate	*l/s (USgpm)*	1.25 (20)	1.25 (20)	0.63(10)
	Head	*kPa (ft H2O)*	46 (16)	46 (16)	46 (16)
	Suction	*mm (in)*	32 (1.25)	32 (1.25)	32 (1.25)
	Discharge	*mm (in)*	32 (1.25	32 (1.25	32 (1.25
Dimensions	Impeller	*mm (in)*			
	Flange	*mm (in)*	32 (1.25)	32 (1.25)	32 (1.25)
Motor		*A*	2.5	2.5	2.5
Electrical	V/PH/Hz		120/1/60	120/1/60	120/1/60
Manufacturer			Grundfos	Grundfos	Grundfos
Model Number			Magna 3 32-60	Magna 3 32-60	Magna 3 32-60
Accessories			1,2,3	1,2,3	1,2,3
Remarks			1	1	1

.1 Accessories:

.1 Differential pressure transmitter

.2 Frequency converter for pump control

.3 Stainless steel body

.2 Remark

.1 c/w geni module, BACNet interface module for external DDC controls

2.10 DOMESTIC HOT WATER HEATER – GAS FIRED

Tag	Units	DHWB-1	DHWB-2
Service	-	Domestic Water	Domestic Water
Location	-	Mechanical Room	Mechanical Room
Type	-	Commercial Gas Water Heater	Commercial Gas Water Heater
Tank Size	*l (gal)*	451 (119)	451 (119)
Input	*kW (MBH)*	146 (500)	146 (500)
Burner Type		Condensing 95% Efficient	Condensing 95% Efficient
Electrical	*V/PH/Hz*	120/1/60	120/1/60
Current	*A*	5	5
Recovery Capacity	*Lph(Gal/hour)*	2179 (576)	2179 (576)
Manufacturer		AO Smith	AO Smith
Model Number		Cyclone MX1	Cyclone MX1
Accessories		1	1
Remarks		1	1

.1 Accessories:

.1 Extended 10 year warranty

.2 Remarks

.1 Venting polypropylene or AL-429-C

2.11 TANKS – HYDRONIC STORAGE

Tag		Units	DHWT-1	DHWT-2
Service		-	Domestic Hot Water Storage	Domestic Hot Water Storage
Location		-	Mechanical Room	Mechanical Room
Type			Vertical Storage	Vertical Storage
Capacity		*L (US gal)*	950 (250)	950 (250)
Size	Diameter	*mm (in)*	915 (36)	915 (36)
	Height	*mm (in)*	2362 (93)	2362 (93)
Quantity and size of Ports		*mm (in)*	Refer to Dwgs for number and size	Refer to Dwgs for number and size
Manufacturer			AO Smith	AO Smith
Model Number			TJV-250	TJV-250
Pressure Rating		*kPa (psi)*	150 (120)	150 (120)
Maximum Temperature		*℃ (℉)*	92 (198)	92 (198)
Supply Temperature		*℃ (℉)*	60 (140)	60 (140)
Accessories			1,2	1,2
Remarks			1,2,3	1,2,3

.1 Accessories:

.1 Cathodic Protection

.2 Extended 10 year warranty

.2 Remarks

.1 ASME Rated

.2 ASHRAE 90.1 – 2013 Rated insulation (R 12.5) and Jacket

.3 2 Temperature Sensing Ports

2.12 TANKS – EXPANSION DHW SYSTEM

Tag		Units	ET-1	ET-2	ET-3
Service		-	Heating Hot Water	Domestic Water System	Standby Process Heating system
Location		-	Boiler Room	Block B Mechanical Room	Block C at Water Heater EH-C1
Type		-		Bladder	Diaphragm
Capacity		*l (US gal)*		490 (130)	166 (44)
Operating Weight		*Kg (Lbs)*		148 (325)	227 (500)
Size	Diameter	*mm (in)*		750 (30)	400 (16)
	Height	*mm (in)*		1346 (53)	1400 (55)
Manufacturer		-		Wessels	Armstrong
Model Number		-		NLAP_560	AX80V
Accessories		-		1,2	1, 2
Remarks		-	1		2

.1 Accessories:

.1 Seismic Kit

.2 Precharged

.2 Remarks

.1 Existing to remain

.2 Acceptance Volume 22 gal.

…

2.13 ELECTRIC WATER HEATER (Process Heating Load)

Tag		**Units**	**EH-C1**
Service		-	Process Heating Load
Location		-	Block B Penthouse
Type		-	Electric Water Heater
Input		*kW*	30
Tank Size		*Litre (US gal)*	300 (80)
Number of Elements		-	6
Electrical		*V/PH/Hz*	600/3/60
	FLA	*Amps*	30
Manufacturer			AO Smith
Model Number			Gold DRE
Approx. Weight		*kG(lb)*	136 (300)
Accessories			1,2
Remarks			1,2,3

.1 Accessories:

.1 Anodes

.2 Insulated with metal jacket

.2 Remarks

.1 Glass Lined tank,

.2 Gold plated elements

.3 Power circuit fusing, contactors, sequence control of elements by thermostat

END OF SECTION

Part 1 General

1.1 REQUIREMENTS

.1 The following listed manufacturers are acceptable for their ability to meet the general design intent, quality and performance characteristics of the specified product. The list does not endorse the acceptability of all products available from the listed manufacturers/suppliers.

.2 It remains the responsibility of the contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.

.3 The contractor shall be fully responsible for any additional work or materials, to accommodate the use of equipment from the acceptable manufacturers and suppliers list.

.4 Submit within 14 days of contract award a copy of the list underlining the name of the manufacturer whose price was carried in the tender. If no manufacturers' names are submitted, it will be assumed that the price carried in the tender was that of the specified manufacturer or where the specified product is generic, the first acceptable manufacturer listed for each item and equipment.

.5 Submit shop drawings on all items marked with an asterisk (*) within 30 days of award of contract.

Part 2 Products

2.1 EQUIPMENT & ACCESSORIES

EQUIPMENT/ACCESSORIES	SUPPLIERS / MANUFACTURERS (APPROVED EQUALS)
ACCESS DOORS / PANELS	
Building Surfaces	Acudor, Cendrex, E.H. Price, Maxam, Milcor, Mifab, Steel Brothers
Ducts	Nailor, Ventlok
AIR TERMINAL UNITS	
Air Valves	E.H. Price, Nailor, Tempmaster, Titus, Trane,
BACKDRAFT DAMPERS	
Light Duty	E.H. Price CBD, Ruskin B02/A1, Nailor
Medium Duty	Airolite 625, Penn CBD-6, Ruskin CBD-4, Nailor

EQUIPMENT/ACCESSORIES	SUPPLIERS / MANUFACTURERS (APPROVED EQUALS)
Heavy Duty	Ruskin CBS7
BOILERS	
High Efficiency, Condensing	Viessmann
CHIMNEYS	
Boilers (Positive Pressure)	Ampco, Cleaver Brooks, Metalbestos PS, IPS, Van-Packer DW, Metal-Fab PIC
COILS	
DX, Liquid, Steam	Aerofin, Colmac, Eng. Air, E. H. Price, McQuay, Trane, York
CONDENSATE TANK	Axiom
CONTROL DAMPERS	
Round	Ruskin DCRS-25, Nailor 1090
DUCT CONNECTORS FLEXIBLE	Duro Dyne "Durolon", Ventfabrics - "Ventlon", Dynair Hypalon
FIRE STOPPING	Hilti Canada Ph. 1-800-363-4458 Nexlevel Construction Solutions, Jim Smiley Ph. 1-647-288-1326 JV Firestop Inc. Ph. 1-416-356-7102 Fire Stop Systems Ph. 1-647-288-1326
DUCTWORK - SPIRAL	United Sheet Metal, B.C. Ventilating, Spiro-Lok
EXPANSION JOINTS	Flexonics, Hyspan, Uniroyal, Keflex, Mason, Goodall, Victaulic
FANS	
Cabinet	Acme, Airdex,Carnes, Airtex, Loren Cook, Delhi, Greenheck, Penn, Twin City
FIRE DAMPERS	
Folding Shutter Type	Controlled Air, Nailor, NCA, Ruskin

EQUIPMENT/ACCESSORIES	SUPPLIERS / MANUFACTURERS (APPROVED EQUALS)
GAS APPLIANCE VENTS	Ampco, Ecco, Selkirk Metalbestos
GAUGES – AIR PRESSURE	Dwyer 2000
GROOVED JOINT COUPLINGS & FITTINGS	Not Permitted, welding only
INSULATION - DUCT	Fiberglas, Knauf, Johns-Manville, Atlas, PPG, Manson, Certainteed
INSULATION - PIPING	Fiberglas, Knauf, Johns-Manville, Manson, Atlas, PPG, Certainteed
LOUVRES	Airolite, Alumavent, Ruskin, Westvent
LOUVRED PENTHOUSE	Airolite, Greenheck, Jenn Air, Penn
PIPE CONNECTORS (FLEXIBLE)	Mason Victaulic(flexible couplings)
PRESSURE RELIEF VALVES	
Water (Bypass)	Braukmann, Fulflo, Lonergan
Water	Watts
PUMPS	
Base Mounted	Aurora, Armstrong, Bell & Gossett, Darling, Leitch, Paco, Taco
Pipe Mounted In-Line	Armstrong, Bell & Gossett, Grundfos, Taco
Vertical In-Line	Aurora, Armstrong, Bell & Gossett, Grundfos, Leitch, Paco, Taco
PUMP SUCTION GUIDES	Armstrong, Bell & Gossett, Taco, Grundfos
PUMP TRIPLE DUTY DISCHARGE VALVES	Armstrong, Bell & Gossett, Taco, Grundfos
SEISMIC ISOLATORS	Mason, USS Snubbers
TANKS	

EQUIPMENT/ACCESSORIES	SUPPLIERS / MANUFACTURERS (APPROVED EQUALS)
Expansion (Air Cushion)	Clemmer, Enermax, Westeel, Wheatley
Expansion (Diaphragm)	Amtrol, Extrol, Expanflex, ITT, Taco, Wheatley
VALVES	
Valves - Butterfly	Jenkins, Keystone, DeZurik, Centreline, Monotight, Dresser, Lunkenheimer, Crane, Bray, Toyo, Grinnell,
Valves - Circuit Balancing	Armstrong, B & G, Wheatley, Tour & Anderson
Valves – Control (all sizes)	Delta, Burkert, Honeywell, Johnson Controls
Valves – Control (terminal two-port, 1 NPS & smaller)	Delta, Burkert, Honeywell, Johnson Controls, Belimo
Valves - Gate, Globe, Swing, Check, Ball	Jenkins, Toyo, Crane, Kitz, Milwaukee,
Valves - Silent Check	Val-matic, APCO, StreamFlo
Valves -Water Pressure Reducing	Watts, Clayton, Singer, Zurn. Wilkins, BCA, Cash Acme, Braukman
VARIABLE SPEED MOTOR DRIVE CONTROLLER (VSD)	Eaton, ABB, Baldor, Hitachi
VIBRATION ISOLATORS	Mason, Korfund

Part 3 Execution

3.1 NOT USED

END OF SECTION

BALANCING:	K.D. ENGINEERING CO.
	WESTERN MECHANICAL SERVICES
CHEMICAL WATER TREATMENT:	PACE CHEMICALS
COMMISSIONING:	K.D. ENGINEERING CO.
	WESTERN MECHANICAL SERVICES
	ZENITH COMMISSIONING CONSULTING
CONTROLS:	JOHNSON CONTROLS
OPERATING & MAINTENANCE MANUALS:	K.D. ENGINEERING
	WESTERN MECHANICAL SERVICES

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 REFERENCES

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

.1 ASHRAE Standard 90.1-10, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

.2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547-2003, Mineral Fiber Pipe Insulation.

.7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

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

.1 Material Safety Data Sheets (MSDS).

.5 Manufacturer’s Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.6 Underwriters’ Laboratories of Canada (ULC)

.1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 SUBMITTALS

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

.2 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.

1.5 QUALITY ASSURANCE

.1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards or a member of TIAC.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with WBC requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer’s written instructions and Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer’s written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer’s name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

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.

.2 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

2.3 HOT WATER HEATING PIPING

.1 All hot water heating piping shall be insulated with 2.5 kg/m^3 (5-1/2 lb.) density molded preformed fiberglass pipe insulation with integral all-service jacket.

2.4 HEATING EQUIPMENT

.1 Equipment shall be insulated with 2.5 kg/m^3 (5-1/2 lb.) density mineral fibre blanket faced with factory applied all service jacket.

2.5 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, plain or reinforced, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.6 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting or air drying on mineral wool, to ASTM C449/C449M.

2.7 VAPOUR RETARDER LAP ADHESIVE

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

2.8 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.9 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.10 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: to match adjacent finish paint or by Consultant.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness: 0.75mm.

.7 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.2 ABS Plastic:

.1 One-piece moulded type and sheet with pre-formed shapes as required.

.2 Colours: to match adjacent finish paint or by Consultant.

.3 Minimum service temperatures: -40 degrees C.

.4 Maximum service temperature: 82 degrees C.

.5 Moisture vapour transmission: 0.012 perm.

.6 Thickness: 0.75mm.

.7 Fastenings:

.1 Solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.8 Locations:

.1 For outdoor use ONLY.

.3 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.4 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, 0.5mm thick at 300mm spacing.

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 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and this specification.

.3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, primary flow measuring elements, air separator and equipment.

.2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: aluminum, SS, PVC, ABS, high temperature fabric.

3.5 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: SS wire bands

.2 Tape at 300 mm on centre.

.3 Seals: lap seal adhesive, lagging adhesive.

.4 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: SS wire bands

.2 Tape at 300 mm on centre.

.3 Seals: VR lap seal adhesive, VR lagging adhesive.

.4 Installation: TIAC Code: 1501-C.

.4 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 degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 to <1 ‰	1 ‰ to < 4	4 to < 8	8 & over
Hot Water Heating	60 - 94	[A-1]	25	38	38	38	38	38
Hot Water Heating	up to 59	[A-1]	25	25	25	38	38	38
Domestic HWS		[A-1]	25	25	25	38	38	38
Domestic CWS with vapour retarder		[C-2]	25	25	25	25	25	25

.5 Finishes:

.1 Exposed indoors: canvas or PVC jacket.

.2 Exposed in mechanical rooms: canvas or PVC jacket.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 On TIAC code A-3 insulation, use vapour retarder jacket compatible with insulation.

.5 Outdoors: water-proof aluminum jacket, silicone seal all joints.

.6 Finish attachments: SS bands, at 300 mm on centre. Seals: closed.

.7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Procedures and cleaning solutions for cleaning new and existing heating piping systems and equipment.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

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

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures, Include product characteristics, performance criteria, and limitations.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 CLEANING SOLUTIONS

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

Part 2 Execution

2.1 MANUFACTURER'S INSTRUCTIONS

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

2.2 CLEANING HYDRONIC SYSTEMS

.1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain the water treatment contractor currently used by the facility to perform system cleaning and flushing.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment contractor.

.4 Cleaning procedures:

.1 Contractor to provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Isolation of new equipment and piping systems for cleaning and flushing.

.7 Complete analysis of water used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:

.1 Systems: free from construction debris, dirt and other foreign material.

.2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers: clean prior to initial fill.

.4 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning:

.1 When cleaning of existing piping systems is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 New Hydronic Systems including piping, boilers,:

.1 Provide temporary bypasses in the piping as required.

.2 Fill system with water, ensure air is vented from system.

.3 Use water metre to record volume of water in system to +/- 0.5%.

.4 Add chemicals under direct supervision of chemical treatment contractor.

.5 Closed loop systems: circulate system cleaner as directed by the cleaning contractor. Drain as quickly as possible.

.6 Refill with water and inhibitors to protect piping and equipment.

.8 Existing and new domestic water piping and equipment systems.

.1 As above but with an additional flush and then disinfection in compliance with BC plumbing code.

.9 Reports:

.1 Provide individual reports on material used, procedures followed and test results, for the systems in the Arena and Community Centre.

2.3 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.

.5 Clean out strainers repeatedly until system is clean.

.6 Check pressurization to ensure proper operation and to prevent water hammer, and cavitation.

.7 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.8 Adjust pipe supports, hangers, springs as necessary.

.9 Check operation of drain valves.

.10 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

2.4 CLEANING

.1 Proceed in accordance with Clause 2.2 above.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

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

.2 Scope of Work: Remove gas piping to existing boilers. Install new gas piping to new boilers and domestic hot water heaters.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.18- 01, Cast Copper Alloy Solder Joint Pressure Fittings.

.2 ASME B16.22- 01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A53/A53M- 04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.2 ASTM B75M- 99, Standard Specification for Seamless Copper Tube Metric .

.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)

.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)

.1 CAN/CSA B149.1HB- 00, Natural Gas and Propane Installation Code Handbook.

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer’s printed product literature, specifications and datasheet for piping, fittings and equipment.

.2 Indicate on manufacturer’s catalogue literature following: valves.

.3 Instructions: submit manufacturer’s installation instructions.

.4 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 All works related to the gas systems installations shall be conducted by professional gas fitter.

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 NPS2 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: nonmetallic flat.

.4 Brazing: to ASTM B837.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:

.1 Malleable iron: screwed, banded, Class 150.

.2 Steel pipe flanges and flanged fittings: to ASME B16.5.

.3 Welding: butt-welding fittings.

.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.

.5 Bolts and nuts: to ASME B18.2.1.

.6 Nipples: schedule 40, to ASTM A53/A53M.

.2 Copper pipe fittings, screwed, flanged or soldered:

.1 Cast copper fittings: to ASME B16.18.

.2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

.1 Provincial Code approved, lubricated plug type.

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 in accordance with Section 23 05 01 - Installation of Pipework, applicable Provincial/Territorial Codes, CAN/CSA B149.1, CAN/CSA B149.2, supplemented as specified.

.2 Provide gas piping for the new heating boilers and domestic hot water heaters as per manufacturer's recommendation and up to the latest version of the BC Gas Code.

.3 Install drip points:

.1 At low points in piping system.

.2 At connections to equipment.

.4 Contractor to obtain all necessary approvals for the upgraded gas installation. Provide to Consultant for review.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

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

3.5 ADJUSTING

.1 Purging: purge after pressure test in accordance with CAN/CSA B149.1 CAN/CSA B149.2.

.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.

3.6 CLEANING

.1 Perform cleaning operations in accordance with manufacturer's recommendations.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

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

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.

.2 ASME B16.3-98, Malleable Iron Threaded Fittings.

.3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.

.4 ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.2 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International).

.1 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Couplings.

.4 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).

.1 MSS-SP-67-025, Butterfly Valves.

.2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.

.4 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

.1 To NPS6:

.2 NPS2 and under: screwed fittings with PTFE tape or lead-free pipe dope.

.3 NPS2-1/2 and over:

.1 Welding fittings and flanges: to CAN/CSA W48

.2 Roll grooved: Rigid coupling to CSA B242.

.4 Flanges: plain or raised face, slip-on weld neck to AWWA C111.

.5 Orifice flanges: slip-on raised face, 2100 kPa.

.6 Flange gaskets: to AWWA C111.

.7 Pipe thread: taper.

.8 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.9 Roll grooved coupling gaskets: Not Permitted

2.2 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150

.2 Pipe flanges and flanged fittings:

.1 Cast iron: to ASME B16.1, Class 125

.2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3

.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M ductile iron to ASTM A536.

2.3 VALVES

.1 Connections:

.1 NPS2 and smaller: screwed ends.

.2 NPS2.1/2 and larger: Flanged or grooved ends.

.2 Gate valves: to MSS-SP-70 to MSS-SP-80. Application: Isolating equipment, control valves, pipelines.

.1 NPS2 and under:

.1 Mechanical Rooms and elsewhere: Class 125, rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS2 1/2 and over:

.1 Mechanical Rooms and elsewhere: rising stem, solid wedge disc, bronze] trim, as specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

.3 Butterfly valves: to MSS-SP-67 Application: Isolating cells or section of multiple component equipment (eg. multi-section coils, multi-cell cooling towers):

.1 NPS21/2 and over: Lug type or Grooved ends: as specified Section 23 05 05 Installation of Pipework.

.4 Globe valves: to MSS-SP-80 85 Application: Throttling, flow control, emergency bypass:

.1 NPS2 and under:

.1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 Elsewhere: Globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS21/2 and over:

.1 With bronze disc and trim, as specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

.5 Balancing, for TAB:

.1 Sizes: Circuit Balancing valves, as specified this section.

.2 NPS2 and under:

.1 Mechanical Rooms and elsewhere: bronze body, globe style, with bronze flow control plug and stem with handwheel and turn indicator and sampling ports to measure flow.

.3 NPS2.5 and over

.1 Mechanical Rooms and elsewhere: ductile iron body with grooved ends, globe style, with flow control plug and stem with handwheel and turn indicator and sampling ports to measure flow.

.6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze

.7 Swing check valves: to MSS-SP-71.

.1 NPS2 and under:

.1 Class 125swing, with compositiondisc, as specified Section 23 05 23.01 - Valves - Bronze

.2 NPS21/2 and over:

.1 Flanged Grooved ends: as specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

.8 Silent check valves:

.1 NPS2 and under:

.1 As specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS21/2 and over:

.1 Flanged Grooved ends: as specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check

.9 Ball valves:

.1 NPS2 and under: as specified Section 23 05 23.01 - Valves - Bronze

Part 3 Execution

3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work

3.2 CIRCUIT BALANCING VALVES

.1 Install flow balancing valves where indicated.

.2 Remove handwheel after installation and when TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.3 CLEANING, FLUSHING AND START-UP

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

3.4 BALANCING

.1 Balance water systems to within plus or minus 5 % of design output.

.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME-04(2007), Boiler and Pressure Vessel Code.

.2 ASTM International Inc.

.1 ASTM A536-84(2004), Standard Specification for Ductile Iron Castings.

.2 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International)

.1 CSA B51-03(R2003), Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CSA B51-03(R2005), Boiler, Pressure Vessel, and Pressure Piping Code, Supplement #1.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit one PDF copy of shop drawings for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 AUTOMATIC AIR VENT

.1 All high points in the piping system, heating coils, cooling coils, unit heaters, etc., shall be fitted with automatic air vents. Automatic air vents shall be SpiroTop VTP-1, or approved, for systems with working pressures up to and including 1034 Kpa . Install a 20 mm ball valve on the system side of each air vent and run a 6 mm copper drain line away from each vent to drain.

.2 Access panels shall be provided for all air vents located concealed in walls, ceilings, shafts, etc.

.3 Drain lines from automatic air vents shall be 6 mm hard drawn copper tubing run in a neat and workmanlike manner properly secured in place. A maximum of 2 air vent drains may be piped in a common drain line. Drains shall be run to the nearest suitable drain as directed on the site. All drain lines shall terminate in a visible location. Drain lines shall be located, run, and terminated such that they will not be subject to accidental damage or vandalism.

2.2 PIPE LINE STRAINER (less than 2.5 IPS)

.1 Strainers size 50 mm and smaller screwed, suitable for 860 kPa W.S.P.

.2 Strainer baskets shall be stainless steel or monel with perforations sized for the service to be performed.

.3 Screwed strainers shall be fitted with a blow-off tapping fitted with a plug.

2.3 PIPE LINE STRAINER 2.5IPS & LARGER

.1 Strainers size 65 mm and larger shall have cast iron body with flanged connections, suitable for 860 kPa W.S.P.

.2 Strainers shall be Metraflex LPD Y low pressure drop strainers with larger stainless steel screen with 0.045" perforations and removable cover.

.3 Provide pipe nipple, ball valve and cap in opening in cover.

2.4 PRESSURE RELIEF VALVES

.1 Pressure Relief Valves shall be Watts Series 174A or equivalent. Outlets shall be piped to the drain. Drain piping is not shown on the drawings for clarity.

.2 Pressure Relief Valves Schedule

TAG	Valve Type	Service	Comments
PRV-B1, B-2, B-3	Factory installed on Boilers B-1, B-2, B-3	B-1, B-2, B-3 boilers	Supplied with boilers by the boiler supplier – 30 PSI
PRV DHWB-1, DHWB-2, DHWT-1. -2	Factory Installed on DHW boilers and storage tanks	DHW system	Total 4 valves installed on 2 DHW boilers and DHW tanks. Valves factory sized and supplied.

.3 Outlet line from PRV's shall be same size as the valve outlet, hard drawn copper tubing run in a neat and workmanlike manner properly secured in place. One pipe per PRV. Outlet pipes shall be run to the nearest suitable drain as directed on the site by the Consultant. All lines shall terminate in a visible location.

2.5 CIRCUIT BALANCING VALVES

.1 Balancing valves shall be like Tour and Anderson STAD series for DN 50 and smaller; STAF for DN 65 and up.

.2 All new balancing valves shall be equipped with factory supplied plugs for water flow measurements (Pete Plugs)

.3 For GPM flows refer to equipment served in Section 23 06 00 Equipment Schedules.

2.6 DIRT SEPARATOR

.1 Dirt separators shall be fabricated from steel to create a low velocity and low turbulence dirt separation chamber.

.2 Pipe opening at the bottom of the separator body shall be provided with a pipe nipple, ball valve and cap for removal of sediment.

.3 Acceptable manufacturer: Spirotherm.

2.7 AIR SEPARATOR

.1 Provide a coalescing air separator to replace the existing unit. The separator shall be complete with an air vent at the top and a pipe nipple, ball valve and cap at the bottom of the assembly.

.2 The internal coalescing medium breaks up entrained air and suspended solids.

.3 The entrained air rises to the top of the unit and is discharged through an automatic air vent.

.4 Suspended solids fall to the bottom of the chamber where they can be discharged.

.5 Size as noted on the drawings.

.6 Acceptable manufacturer: Spirovent or B&G-CRS.

2.8 SIDE STREAM FILTER

.1 Provide a side stream filter complete with flow indicator, (ball with window), isolating valve andmanual balancing valve, across piping for pumps, P-3 & P-4.

.2 Provide 1 box of filters to the Owner at the end of the contract.

.3 Filter vessel sized for 250 mm, 5 micron filter and ¾IPS ball valve on bottom of cylinder . Filter constructed with a brass head with O ring and stainless steel housing.

Part 3 Execution

3.1 APPLICATION

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

3.2 GENERAL

.1 Run drain lines and blow off connections to terminate above nearest drain.

.2 Maintain adequate clearance to permit service and maintenance.

.3 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.

.4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.3 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.

3.4 AIR VENTS

.1 Install at high points of systems.

.2 Replace all of the existing air vents in the heating piping system in both the boiler room and throughout the building.

.3 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.5 PRESSURE RELIEF VALVES

.1 Run discharge piping from the factory installed valves to nearest floor drain.

3.6 CIRCUIT BALANCING VALVES

.1 Install where shown on the drawings. Balance the flows to match the flows of the equipment listed in Section 23 06 00 Equipment Schedules

3.7 DIRT SEPARATOR

.1 Install in the supply piping from the boiler in the mechanical room with isolating calves.

.2 Provide supports and seismic restraints.

3.8 AIR SEPARATOR

.1 Disconnect and remove the existing unit and install the new coalescing air separator.

.2 Provide isolating and valves and revise the piping as required to install and pipe up the unit.

.3 Provide supports and seismic restraints.

.4 Install an air vent at the top of the unit and pipe to nearest drain.

3.9 SIDE STREAM FILTER

.1 Provide 3/4 IPS piping with isolating ball and manual balancing valves and flow indicator, connected across heating piping for Pumps P-3 & P-4.

.2 Install a new cartridge in the filter housing and commission filter operation. Install a new filter at the Inspection for Substantial Completion and turn over one box of filters to Owner.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Electrical Equipment Manufacturers Advisory Council (EEMAC).

1.2 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 21 05 01 – Mechanical General Requirements.

Part 2 Products

2.1 VERTICAL IN-LINE PUMPS

.1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.

.2 Impeller: brass or bronze.

.3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: single inside type mechanical seal with flush line from pump discharge. Seal suitable for service to 135 ℃.

.5 Split Coupled arrangement with adaptor between motor and pump so seal can be replaced without removing motor. Coupling to be rigid self-aligning.

.6 Motor: rigidly mounted, squirrel cage induction motor drip proof, ball bearing, 1750 r/min.

.7 Provide shutoff valve, strainer and suction guide with cast iron body, outlet guide vanes on pump inlet.

.8 Provide combination shut off, check and flow throttling valve for installation on pump outlet.

.9 Capacity: as indicated in Section 23 06 00 Equipment Schedules.

2.2 IN-LINE CIRCULATORS

.1 Volute: cast iron radially split, with screwed or flanged design suction and discharge connections.

.2 Impeller: cast bronze.

.3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical for service to 135 ℃.

.5 Coupling: flexible self-aligning.

.6 Motor: resilient mounted, drip proof, sleeve bearing, 1750 r/min.

.7 Capacity: as indicated in Section 23 06 00 Equipment Schedules.

2.3 COMMERCIAL HIGH EFFICIENCY CIRCULATORS

.1 System circulating pumps shall be Wilo, or Grundfos, size, type and capacity as scheduled.

.2 Circulating pumps shall be wet rotor design with variable speed ECM motor and integral speed controller. The pump speed is electronically controlled to maintain a differential pressure over a permissible flow range or can accept a 0 to10 volt signal from the DDC system or be connected to the DDC system through an integral native BACnet interface.

.3 BACnet interface modules shall be BTL marked.

.4 Furnish and install 6 mm (1/4") gauge tappings on the suction and discharge side of each pump. Each gauge tapping shall be fitted with a 1/4" needle valve, Winter DH-11, or equal, with nipple and cap. See Section - Gauges and Thermometers.

.5 Capacity: as indicated in Section 23 06 00 Equipment Schedules.

Part 3 Execution

3.1 INSTALLATION

.1 Vertical type: Bolt suction diffuser and Flotrek balancing valve to pump and support assembly installed on concrete pad. Connect piping.

.2 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.

.3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer’s installation instructions for details.

.4 Pipe drain tapping to drain.

.5 Install volute venting pet cock in accessible location.

.6 Check rotation prior to start-up.

.7 Install pressure gauge test cocks.

3.2 START-UP

.1 General

.1 In accordance with Section 01 91 31 – Commissioning (Cx) Plan; supplemented as specified herein.

.2 In accordance with manufacturer’s recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system, over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.10 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.11 Eliminate cavitation, flashing and air entrainment.

.12 Adjust pump shaft seals, stuffing boxes, glands.

.13 Measure pressure drop across strainer when clean and with flow rates as finally set.

.14 Replace seals if pump used to degrease system or if pump used for temporary heat.

.15 Verify lubricating oil levels.

.16 Clean strainers.

3.3 PERFORMANCE VERIFICATION (PV)

.1 General

.1 In accordance with Section 01 91 00 – Commissioning , supplemented as specified herein.

.2 In accordance with manufacturer's recommendations.

.2 Exclusions:

.1 This paragraph does not apply to small in-line circulators.

.3 Assumptions: These PV procedures assume that:

.1 Manufacturer's performance curves are accurate.

.2 Valves on pump suction and discharge provide tight shut-off.

.4 Multiple Pump Installations - Parallel:

.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.6 Commissioning Reports: In accordance with Section 01 91 00 – Commissioning, reports supplemented as specified herein. Reports to include:

.1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

.2 Pump performance curves (family of curves).

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

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

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.

.3 ASTM A653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 National Fire Protection Association (NFPA).

.1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.

.3 IAQ Guideline for Occupied Buildings Under Construction 1995 1st Edition.

.4 .

1.3 SUBMITTALS

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

Part 2 Products

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

.3 Class C: transverse joints and connections made air tight with sealant. Longitudinal seams unsealed.

.4 Unsealed seams and joints.

2.2 SEALANT

.1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.4 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows.

.1 Rectangular: Centreline radius: 1.5 times width of duct.

.2 Round: smooth radius or five pieces. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 With double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct45 degrees entry on branch.

.2 Tapered fitting for round ducts.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 Full radiused elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

2.5 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to ASHRAE SMACNA.

.3 Joints: to ASHRAE SMACNA proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.6 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to ASHRAE and SMACNA.

.3 Hangers: black steel angle with galvanized steel rods to ASHRAE and SMACNA as per the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp steel plate washer.

.3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 GENERAL

.1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Support risers in accordance with ASHRAE, SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

.3 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

Part 2 Products

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

.1 Frame: galvanized sheet metal frame 2 mm thick with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m^2.

2.3 ACCESS DOORS IN DUCTS

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks [complete with safety chain.

.2 301 to 450 mm: four sash locks [complete with safety chain.

.3 451 to 1000 mm: piano hinge and minimum two sash locks.

.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.

.5 Hold open devices.

.6 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

.1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA.

2.5 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

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 data sheet.

3.2 INSTALLATION

.1 Flexible Connections:

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans.

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:

.1 Size:

.1 600 x 1200 mm for person size entry.

.2 600 x 600 mm for servicing entry.

.3 300x 300 mm for viewing.

.4 As indicated for kitchen exhaust duct.

.2 Locations:

.1 Fire and smoke dampers.

.2 Control dampers.

.3 Devices and ducts requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.3 Instrument Test Ports:

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by Consultant

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.4 Turning vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

.1 Perform cleaning operations in accordance with manufacturer's recommendations.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Fans, motors, accessories and hardware for commercial use.

1.2 REFERENCES

.1 Air Conditioning and Mechanical Contractors (AMCA)

.1 AMCA Publication 99-[2003], Standards Handbook.

.2 AMCA 300-[1996], Reverberant Room Method for Sound Testing of Fans.

.3 AMCA 301-[1990], Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/AMCA 210-[1999], Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181-[99], Ready-Mixed Organic Zinc-Rich Coating.

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

.1 Material Safety Data Sheets (MSDS).

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, static pressure, bhp, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

.4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.4 SUBMITTALS

.1 Shop Drawings:

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

.1 Shop Drawings: submit drawings stamped and signed Mechanical Contractor

.2 Provide :

.1 Fan performance curves showing point of operation, BHP, kW and efficiency.

.2 Sound rating data at point of operation.

.3 Indicate:

.1 Motors, sheaves, bearings, shaft details .

.2 Minimum performance achievable with variable speed controllers.

.4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.5 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 FANS GENERAL

.1 Motors:

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 For use with variable speed controllers.

.3 Sizes as specified.

.2 Factory primed before assembly in colour standard to manufacturer.

.3 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.4 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.2 INLINE CABINET FAN

.1 Fan characteristics and construction: as centrifugal fans.

.2 [Cabinet hung double wheel with DWDI centrifugal fan in factory fabricated casing complete with vibration isolators and seismic control measures, motor, direct drive.

.3 Fabricate casing of zinc coated or phosphate treated steel of thickness as indicated reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to CAN/CGSB 1.181. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet with 25 mm thick rigid acoustic insulation, pinned and cemented, with metal nosings on exposed edges.

.4 Refer to Section 23 06 00 Equipment Schedules for dimensions and capacities.

2.3 UTILITY FAN (Existing Fan EF-18 Rebuild)

.1 Rebuild the existing fan components with the following:

.2 Replace the existing motor with a new larger motor supplied by Division 26. Include new motor pulley and belts.

.3 Provide new bearings for the fan.

2.4 CEILING FANS

.1 Supply and install six new eighty-four inch diameter Haiku 84 ceiling fans.

.2 Refer to Section 23 06 00 Equipment Schedules for size and capacities.

.3 Fans shall be certified and built in accordance with UL standard 507 and CSA standard 22.2 No. 1113. Fans shall be ENERGY STAR qualified.

.4 Fans shall be designed for low operational noise and field balancing of air foils shall not be necessary.

.5 Fan shall be white with 64 " long extension on the motor housing.

.6 Airfoil system: The fan shall be equipped with three airfoils connected to the hub with screws.

.7 The fan shall have an electronically commutated motor rated for 120- 240V/1/60 power supply and designed for continuous operation.

.8 Controls: The digital inverter electronic fan controller is incorporated into the fan assembly. The fan shall be equipped with a 7speed remote control for operating the fan speed, Reverse, Timer, Sleep and Whoosh modes with infrared control signals to activate electronics in the motor housing.

.9 Mounting system shall be designed for quick secure installation.

.10 Safety Cable: The fan shall be equipped with a safety cable securing the fan motor base to the structure.

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 CABINET FAN

.1 Suspend fan from ceiling structure and seismically secure.

.2 Provide flexible connections and duct transitions to ductwork and VAV box.

.3 Electrical connections by Section 26.

.4 Commission fan and measure air flow with VAV box at full volume.

3.3 EXHAUST FAN EF-18 REBUILD

.1 Remove existing motor and install new 3HP 575/3/60 motor supplied by Division 26. Provide new motor, pulley and belts.

.2 Supply and install new bearings on the fan.

.3 Measure the air flow of the fan at full speed when the variable speed drive and control changes have been completed. Submit report to the Consultant.

3.4 CEILING FANS

.1 Secure the fan extension shaft to the steel joists in accordance with the instructions in the installation manual for the ceiling fans.

.2 Both the fan installation and safety cable shall be seismically secured to the structure.

3.5 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Variable volume boxes, constant volume bypass, dual duct boxes and fan powered and electronic variable air volume boxes.

.2 Related Sections:

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

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI/AMCA 210-[1999], Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.2 ANSI/NFPA 90A-[2002], Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Underwriter's Laboratories (UL)

.1 UL 181-[2003], Factory-Made Air Ducts and Air Connectors.

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Test data: to ANSI/AMCA 210.

.1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.

.2 Sound power level with minimum inlet pressure of [0.25] [0.5] [1] [1.5] kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency.

.3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

.2 Shop Drawings:

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

.1 Shop Drawings: submit drawings stamped and signed by the Mechanical Contractor

.2 Indicate the following:

.1 Capacity.

.2 Pressure drop.

.3 Size and dimensions

.4 Noise rating.

.5 Leakage.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

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

1.6 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 MANUFACTURED UNITS

.1 Terminal units of the same type to be product of one manufacturer.

2.2 COILS FOR VARIABLE VOLUME BOXES

.1 Provide replacement 2 row high capacity reheat coils for existing VAV boxes in Blocks C, D, E.

.2 Sizes, capacities, accessories as indicated in Section 23 06 00 Equipment Schedules.

2.3 VARIABLE VOLUME BOXES

.1 Provide variable volume boxes for return air relief to return air ducts on air handing units AHU-2 and AHU-3 in Blocks E and D respectively.

.2 Sizes, capacities, accessories as indicated in Section 23 06 00 Equipment Schedules.

.3 Complete with:

.1 Damper, cross flow air sensor.

.2 Supplied without damper operator and controls.

.4 Controls and damper operator supplied under Section 25 30 02 EMCS – Field Control Devices.

.5 Air flow sensor to have multiple sensing ports for total and static pressure sensing.

.6 Casing: constructed of 0.76 mm thick galvanized steel, internally lined with 12 mm, 0.7 kg density fibrous glass, to UL181 and ANSI/NFPA 90A. Mount control components inside protective metal shroud.

.7 Damper: blade constructed of 2 layers of heavy gauge galvanized steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

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 manufacturers recommendations.

.2 Seismic support independently of ductwork in accordance with Section 23 05 49 - Seismic Restraints.

.3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.

.4 Locate controls, dampers and access panels for easy access.

3.3 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Return grilles in Blocks D and E

1.2 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Indicate following:

.1 Capacity.

.2 Neck velocity.

.3 Border.

.4 Noise criteria.

.5 Pressure drop.

.6 Instructions: submit manufacturer's installation instructions.

.3 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, noise level, neck velocity as indicated in the Equipment Schedules.

2.2 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.3 RETURN GRILLES AND REGISTERS

.1 Type RA Aluminium, 19 mm border, single 45 degrees deflection, horizontal face bars. Finish: off white.

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 manufacturer’s instructions.

.2 Install with flat head screws in countersunk holes where fastenings are visible. Screw colour shall match grille colour.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials, accessories and installation for venting gas fired equipment.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.2 Underwriters' Laboratories of Canada (ULC)

1.3 SUBMITTALS

.1 Shop Drawings:

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

.1 Submit drawings stamped and signed by th Mechanical Contractor.

.2 Indicate following:

.1 Methods of sealing sections.

.2 Methods of expansion.

.3 Details of connections.

.4 Supports.

.2 Closeout Submittals

.1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with CEAA and applicable Provincial regulations.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

Part 2 Products

2.1 BOILER VENTING

.1 Boiler venting shall be Class AL29-4C SS stainless steel single or double wall construction. Provide new rain-cap and new stainless steel flashing for the vent at the roof opening as detailed. Sizing shall be as indicated on the drawings.

.2 Venting installation shall comply with BC Safety Regulations.

.3 A new double wall flue shall be vertically extended from the boiler outlet up to 7 feet above the floor, then single wall flues shall be installed up and through the existing boiler venting to three feet above the roof. Provide counter flashing between the existing vents and the new vents.

.4 For all boilers, provide tees at the base of the flues. Extend plastic drain lines from the venting tee for the boilers and the boiler condensate drains, with traps to an acid neutralizer at the floor drain adjacent to the boilers.

.5 Provide one neutralizer sized to accommodate the condensate for all three boilers. Pipe the acid neutralizer to the floor drain.

.6 Slope the venting back to the boilers so condensate can run down to tee at connection to the boiler.

.7 Boiler venting materials shall be supplied by the boiler supplier.

2.2 DHW HEATER VENTING

.1 CPVC 4” diameter vent system from each heater up through the existing Class B vents for the removed water heaters to three feet above the roof. Provide counter flashing between the existing vents and the new vents.

.2 Venting installation shall comply with BC Safety Regulations.

.3 For all heaters, provide tees at the base of the flues. Extend plastic drain lines from the venting tee for the water heaters and the heater condensate drains, with traps to an acid neutralizer at the floor drain adjacent to the water heaters.

.4 Provide one neutralizer sized to accommodate the condensate for all two water heaters. Pipe the acid neutralizer to the floor drain.

.5 Slope the venting back to the water heaters so condensate can run down to tee at connection to the water heaters.

.6 Venting materials shall be supplied by the water heater supplier

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 - GENERAL

.1 Follow manufacturer's installation recommendations forvent installation.

.2 Support and suspend the venting as directed by the manufacturer.

END OF SECTION

Part 1 General

1.1 SUBSTITUTION OF EQUIPMENT

.1 The Contractor shall base his tender on the specified boilers or he may submit a tender using alternative boilers, provided the alternative boilers receive the written approval of the consultant prior to closing of tenders. Requests must be submitted at least five full working days prior to the closing of tenders for this trade.

.2 Where the Contractor proposes to use alternative material which requires any redesign, changes, or additions to the structure, piping, ductwork, wiring, etc., the cost of all such redesign, new drawings, changes, and additions required shall be borne by the Contractor.

1.2 REFERENCES

.1 American Boiler Manufacturer's Association (ABMA)

.2 American National Standards Institute (ANSI)

.1 ANSI Z21.13-2004/CSA 4.9-2004, Gas-Fired Low-Pressure Steam and Hot Water Boilers.

.3 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 2004.

.4 Canadian Gas Association (CGA)

.1 CAN1-3.1-77(R2001), Industrial and Commercial Gas-Fired Package Boilers.

.2 CAN/CSA-B149.1-05, Natural Gas and Propane Installation Code.

.5 Canadian Standards Association (CSA International)

.1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

.6 Electrical and Electronic Manufacturer's Association of Canada (EEMAC).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in including product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

.1 Submit one PDF copy of shop drawings to the Consultant for the boiler including the following:

.1 General arrangement showing terminal points, instrumentation test connections.

.2 Clearances for operation, maintenance, servicing, cleaning, .

.3 Foundations with loadings, anchor bolt arrangements.

.4 Piping and vent connections.

.5 Equipment electrical drawings.

.6 Burners and controls.

.7 CRN number.

.8 All miscellaneous equipment.

.9 Flame safety control system.

.10 Breeching and stack configuration.

.2 Engineering data to include:

.1 Boiler efficiency at 25%, 50%, 75%, 100%, of design capacity.

.2 Radiant heat loss at 100% design capacity.

.3 manufacturer's installation instructions.

.4 Dimmensions and heating capacity

.3 Closeout Submittals:

.1 Submit operation and maintenance data for incorporation into maintenance manuals by the Mechanical Contractor.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with applicable Provincial regulations.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Include for shipping the boiler to the site.

.2 The Mechanical contractor for the project shall be responsible for the timely delivery of the equipment to the jobsite, unloading and installation the boilers in the existing boiler room.

.3 Equipment shall be unloaded, handled, and stored in accordance with the manufacturer's handling and storage instruction.

Part 2 Products

2.1 GENERAL

.1 Performance: Refer to Section 23 06 00 Equipment Schedules

.2 Packaged boiler:

.1 Complete with removable burner and necessary accessories and controls.

.2 Factory tested at rated capacity to, and bearing seal or nameplate certifying compliance with, CSA.

.3 Ready for attachment to piping, electrical power, controls, flue gas vents.

.4 Designed and constructed to ASME Section IV Code.

.5 CRN (Canadian Registration Number), to CSA B51.

.6 Boiler/burner package to bear ULC, CGA label.

.7 Stainless steel boiler body and water wall surrounding the combustion chamber, down firing heat exchanger with corrugations for more efficient heat transfer, high efficiency, condensing type with dual return piping connections.

.8 Constructed with .9 m^2 heating surface per 0.75 kW input.

.9 Pressure vessel constructed with stainless steel enclosure.

.10 Low and high temperature dual return.

.3 Electrical:

.1 Refer to Section 23 06 00 – Equipment Schedule, Boiler Schedule for information.

.4 Controls: factory wired. Enclosed in EEMAC 1 steel cabinet.

.5 Thermal insulation: 50 mm thick mineral fibre. Seal insulation at handholes, manholes, mudholes, piping connections with insulating cement.

.6 Casing: heavy gauge metal, powder coat paint finish, easily removable.

.7 Mounting structural steel base, lifting lugs.

.8 Start-up, instruction, on-site performance tests: allow for two site visits.

2.2 AUXILIARIES

.1 Provide auxiliaries for each boiler and to meet ANSI/ASME requirements.

.2 Hot water boilers:

.1 Relief valves: ANSI/ASME rated, set at 700 kPa.

.2 Pressure gauge: 90 mm diameter complete with shut-off cock.

.3 Stack thermometer: 75 mm diameter

.4 Water side thermometer: 90 mm diameter range 10 to 150° C.

.5 Low water cut-off to shut off burner on low water condition.

.6 Drain valve: FPT 1”.

.7 Condensate treatment package – tank, lid, trap, sized for 3 boilers.

2.3 GAS BURNERS

.1 General:

.1 Forced draft with:

.2 Unitized venture with modulating gas valve, variable speed blower and metal burner head design.

.3 Capable of modulation down to 5:1 from high fire

.2 Gas pilot:

.1 To building code and provincial regulations including solenoid gas valve, pressure regulator, pressure gauge, manual shut-off valve.

.3 Main gas train:

.1 To building code and provincial regulations including main shut-off valve, pressure regulator, motorized electric shut-off valve, downstream block-test valve with test connection and pressure gauge.

.4 Controls:

.1 Electronic combustion control relay with ultra-violet flame detector for combustion control and flame supervision.

.2 Control to shut off fuel within 5 seconds upon pilot flame or main flame failure or upon signal of safety interlock or emergency shut off valve and to ensure, when restarted, in sequence:

.1 Pre-purge.

.2 Pilot ignition and supervision.

.3 Main gas valve opening.

.4 Pilot cut-off. Pilot-proving period not to exceed 10 seconds.

.5 Burner operation.

.6 Post-purge burner shut-down.

.3 Fuel-air mixture: control through:

.1 Electronically controlled modulating motor on burner fan and modulating gas valve, down to 20 % of rated capacity.

.4 Immersion controllers:

.1 Modulating: to modulate burner output.

.2 High limit: manual reset, set at 100° C.

.5 Visual and audible alarms: to indicate burner shutdown due to flame failure, low water level, high and low gas pressure, high temperature.

.6 Selector switch: to permit manual and automatic firing at any rate between low and high fire.

.7 Pilot lights: to indicate normal burner operation.

.8 Burner to start up in low fire position.

.9 Burner Lead-Lag system integration control provided to stage the three new boilers.

.10 BACnet communications gateway for remote HWST reset control, boiler enable, boiler firing rate and boiler general alarm.

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 The manufacturer's approved technician shall inspect the boiler installation and if in accordance with the manufacturer's recommendation and the local building and safety codes, shall supervise the start-up of the boilers.

.2 Boiler shall be seismically secured to boiler base.

.3 Provide the following connections to the boilers:

.1 Pipe relief valves to floor drain,

.2 Install low water cut-off device in boiler supply pipe wired to shut off boiler on low water level condition,

.3 Extend existing natural gas piping to connect to the gas trains on the boiler burners. Provide gas pressure regulators vented to outside if required,

.4 Install combination pressure and temperature gauge in supply pipe at boiler,

.5 Wire hi-limit controller to shut off burner,

.6 Division 25 to connect to BACnet controller in burner control panel,

.7 Division 26 to provide power wiring to burner panel,

.8 Provide drain valve and cap on boiler drain connection,

.9 Provide reduced pressure back flow preventer on domestic cold water makeup water supply to boilers.

3.3 FIELD QUALITY CONTROL

.1 Commissioning:

.1 Certify installation of the boiler.

.2 Start up and commission installation.

.3 Carry out on-site performance verification tests.

.4 Demonstrate operation and maintenance.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 05 02 – EMCS Summary of Work

.2 Section 01 33 00 - Submittal Procedures

.3 Section 01 78 00 - Closeout Submittals

1.2 GENERAL

.1 This Project Specification, including all appendices, shall be deemed to cover the complete installation ready for operation. Consequently, minor details not necessarily shown or specified but necessary for the proper functioning of the installation, including equipment serviceability, shall be included in the Work, the same as if shown in the Project Specification.

.2 The Work shall include but not be limited to the supply of all labour, materials, equipment and supervision to complete the Work as required by the Contract Documents.

.3 Existing security, smoke control, fire alarms and monitoring shall be uninterrupted by the installation.

.4 Carefully examine the existing building, local conditions affecting the Work and building site, together with all other trades to make sure that Work under this Specification can be satisfactorily carried out without changes. Work of all trade Divisions shall be examined, before commencing Work, and any defect or interference affecting Work shall be reported at once.

.5 The Contractor, when estimating, shall visit the site and make himself familiar with all existing conditions and allow for same in his tender.

1.3 INTENT

.1 Work shall be in accordance with the specifications and their intent, complete with all necessary components, including those not normally shown or called for, and shall be ready for operation before acceptance.

.2 Any reference to the “engineer” or "consultant" shall mean Prism Engineering Ltd.

.3 The work "provide" shall mean "supply and install" unless otherwise indicated.

.4 The new installation shall meet the existing building standards in all aspects.

1.4 INTEROPERABILITY REQUIREMENTS

.1 All DDC equipment shall be BACnet compatible and operate seamlessly with the existing Johnson Controls DDC systems hardware, software and firmware.

1.5 CONTROLS CONTRACTOR REQUIREMENTS

.1 The Control System to be installed shall be Johnson Controls.

.2 The Controls Contractor shall have an established working relationship with the Control System Manufacturer of not less than three years.

.3 The Controls Contractor shall provide 24-hour response in the event of a customer call.

1.6 CODES, STANDARDS AND PERMITS

.1 Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section. All equipment shall be installed in accordance with the latest requirements of the following:

.1 The local Building Code

.2 The B.C. Building Code

.3 The Workers' Compensation Act

.4 The Canadian Electrical Code

.5 The Canadian Standards Association

.6 National Fire Protection Association

.2 Electric equipment shall bear CSA labels and, where applicable, ULC label certifying compliance with test standards of these agencies.

.3 Obtain all required permits and pay all fees therefore and comply with all provincial, municipal and other legal regulations, codes and by-laws applicable to the work.

.4 General contractor and all sub-contractors shall obtain security clearance as per Justice Institute requirements before perform any work inside the building.

1.7 LIABILITY

.1 Assume responsibility for laying out work and for damage caused by improper execution of work.

.2 Protect finished and unfinished work from damage.

.3 Take responsibility for condition of materials and equipment supplied and protect until work is completed and accepted.

.4 The owner shall have recourse in tort for any negligent action by the contractor or his representatives.

1.8 INSURANCE

.1 The Contractor shall provide and show proof of, at his expense, insurance in accordance with Justice Institute requirements.

.2 The Contractor shall carry full employee's liability insurance for the whole of the work in accordance with the Workers' Compensation Act.

1.9 SIGNS AND PUBLICITY

.1 Neither the Contractor nor anyone directly or indirectly employed by them, shall post any site signs, nor release any publicity reports, photographs, sketches, plans or other information, orally or in writing, concerning the work performed or to be performed, without the prior written acceptance of the Owner's Representative.

1.10 PROJECT MANAGER

.1 The Contractor shall identify a Project Manager who will be responsible for all aspects of the project (including co-ordination of subcontractors and suppliers, permits, installation, commissioning and contract administration).

.2 The Owner's Representative reserves the right to interview the prospective project manager to evaluate their understanding and ability to complete the project.

1.11 EXAMINATION OF SITE

.1 A site visit is recommended for all the contractors before tendering the project. Examine all local and existing conditions on which the work is dependent.

.2 No consideration will be granted for any misunderstanding of work to be done resulting from failure to visit the site.

.3 When the contract documents do not contain sufficient information for the proper selection of equipment for bidding, notify the design authority 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 supply the intended equipment.

.4 Check drawings of all trades and survey the site to verify space availability for the installation. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent without written approval.

.5 Wall locations, ceiling layout, heights, and equipment locations shall be verified on site. Failure to do this shall not relieve the contractor of the responsibility for correct location of mechanical systems and equipment.

1.12 WORKMANSHIP

.1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by design authorities and the trade.

.2 Employ only tradesmen holding valid provincial trade qualification certificates. Tradesmen shall perform only work that their certificate permits.

1.13 NEW PRODUCTS ONLY

.1 All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 1 year. This installation shall not be used as a test site for any new products unless explicitly approved by the Engineer in writing prior to bid date. Spare parts shall be available for at least 5 years after completion of this contract.

1.14 SHOP DRAWINGS

.1 Shop Drawings shall be submitted as per Section 01 33 00 – Submittal Procedures

1.15 AS-BUILT DRAWINGS

.1 As-Built drawings shall be submitted as per Section 01 78 00 – Closeout Submittal

1.16 OPERATING AND MAINTENANCE MANUALS

.1 Existing Operating and Maintenance Manuals shall updated as per the changes in this specification.

1.17 COMMISSIONING

.1 The control system must be commissioned and tested at the end of the work to be completely operational including the following:

.1 every new point shall be end to end checked to ensure accuracy and integrity of systems. Provide check-out data sheet signed off by the DDC Contractor.

.2 DDC Program Code shall successfully control the systems.

.3 time schedules shall be built and in control of time-controlled equipment.

.4 graphic displays must be installed and each graphic screen shall be fully operational.

.5 all specified trends covering a Seventy-Two (72) hour continuous period to confirm system operation must be created and operational.

.6 Runtime totalizer shall be set on all digital outputs.

.7 all features of system shall have been exercised.

.8 operator shall have been briefed on operation of system.

.9 all alarms shall be operational.

.10 all sensors shall have been calibrated.

.2 Results of all tests shall be documented by the Contractor and a hard copy of the commissioning sheets and trends covering a continuous period shall be submitted to Prism for review.

1.18 DEMONSTRATION

.1 The contractor shall dedicate a minimum of 2 x 4 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements.

.2 The demonstration constitutes a joint acceptance inspection, and acceptance of the delivered system for on-line operation.

1.19 WARRANTY

.1 At the end of the final start-up/testing and commissioning, if equipment and systems are operating satisfactorily to the Owner and Owner's Representative, the Owner shall sign certificates certifying that the control system's operation has been tested andaccepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.

.2 Labour & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner.

.3 The warranty shall provide all material, parts and labour, including labour provided on an emergency response basis outside of normal working hours. Labour shall include any related travel time and other related costs associated with providing the warranty service.

1.20 ACCEPTANCE

.1 The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner.

.2 Any tests that cannot be performed due to circumstances beyond the control of the Controls Contractor may be exempt from the Completion requirements if stated as such in writing by the Engineer's representative. A deficiency amount will be held at Substantial Completion for such tests. Deficiency amounts will be released after tests are performed and documented to the satisfaction of the Engineer.

.3 Warranty shall start from the date of all deficiencies are corrected and tests are performed and documented to the satisfaction of the Engineer.

1.21 SUBSTANTIAL PERFORMANCE

.1 Once the above basic requirements are met and all other features of the system are complete and acceptable, Substantial Performance shall be granted. A deficiency list shall be prepared and holdbacks applied. All deficiencies shall be corrected prior to Total Performance. Warranty shall start from the date of Substantial Performance of the work.

Part 2 Products - NOT USED

Part 3 Execution - NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 78 00 - Closeout Submittals

.3 Section 25 05 01 – EMCS General Requirements

1.2 GENERAL

.1 The objective of the project is to implement the DDC measures associated with the mechanical system energy upgrade at the Pacific Environmental Science Centre.

.2 Three new condensing boilers with BACnet boards are to be provided and installed by the mechanical contractor. Boilers shall be controlled by a boiler plant integral controller provided by the boiler manufacturer.

The DDC system shall enable the boiler plant and reset the supply water temperature setpoint. DDC contractor shall re-wire existing boiler control points to the new boiler plant control panel, provide and install five new immersion temperature sensors as indicated in the mechanical drawings, and extend the BACnet network to the boiler BACnet communication board. New temperature sensors shall be wired to a new expansion module for the existing boiler DDC controller.

.3 New four heating water circulating pumps with variable frequency drives (VFD) with BACnet cards will be provided and installed by the mechanical contractor. The DDC contractor shall wire control points to the pump VFD's using available I/O points in the existing controller and extend the BACnet network to the VFD. Differential pressure sensors shall be installed in the Block D mechanical room for controlling the pump speeds.

.4 The existing domestic hot water heaters are to be replaced with two new hot water heaters including dedicated circulating pumps. DDC contractor shall re-wire existing points to the new heaters and provide start/stop and status points for the new circulating and recirculating pumps. New temperature sensors (8 in total) shall be provided for each boiler supply water temperature, common supply water temperature, common return water temperature, DHW supply, DHW return, and each tank water temperature as indicated in the mechanical drawings. New points shall be wired to the new expansion board in the boiler controller.

.5 Demand based operation shall be implemented for the bench exhaust fan FEF-34 located in room E106. DDC contractor shall provide and install an override switch inside the room and revise the existing program code to modulate the associated VAV boxes.

.6 Zone isolation damper and a VFD with BACnet card for block B exhaust fan EF-18 shall be provided and installed by the mechanical contractor as indicated in the mechanical drawings. DDC contractor shall provide, install, and connect the damper actuator; re-wire the exhaust fan command and status points to the new VFD; and extend the BACnet network to the fan VFD.

.7 Return air duct provided with a variable speed fan and VAV box shall be installed by mechanical contractor for the air handling units serving Blocks D and E to allow recirculation air from office areas. An air valve shall be installed in the general exhaust fan system for maintain space pressurization during unoccupied periods. DDC contractor shall provide DDC controllers for the return and exhaust VAV boxes and integrate to the DDC system.

.8 Existing ceiling fans currently installed in Block C, D, and E lab areas are to be replaced by the mechanical contractor with six variable flow de-stratification fans. DDC contractor shall interface the fans with the DDC system for operating schedule and temperature/speed reset control.

.9 DDC contractor shall revise the existing program code controlling the air handling units and VAV boxes in Block C, D, and E for implementing unoccupied temperature control and (warm up) optimal start.

.10 DDC contractor shall provide and install duct temperature sensors in the supply air of all VAV boxes with re-heat coils. Existing shop drawings indicate the following quantity: Block A (6); Block B (20); Block C (5); Block D (14); Block E (19). Temperature sensors shall be wired to available inputs on the VAV box controller. Existing shop drawings indicate that the available input on 31 controllers is used for fumehood status. In these cases a network temperature sensor should be used.

.11 Program codes, graphic screens, and trend logs for boiler plant, air handling units, and all applicable equipment shall be modified as per sequences of operation in this specification.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

.1 Provide and install all hardware components necessary for a complete system installation, including network and communications devices; DDC controllers; field devices of all types, transformers, conduits, raceways, and wiring including power and network cabling;

.2 DDC contractor shall interface/network the BACnet boards provided with the boiler and pump VFDs to the DDC network and map all the applicable points. Graphic screens with available BACnet points provided for the boiler plant and VFD points such as pump status/speed; amps; frequency; alarms; etc shall be created and linked to the boiler/pump graphic screens;

.3 Existing program code for boiler plant, pumps, and applicable air handling units shall be modified as per sequences of operation in this specification;

.4 Provide trend logs as required to reflect the changes in the system operation as per this specification and to allow the building operator analysis and troubleshooting;

.5 Existing graphic screens shall be revised as per changes in the piping layout, and to include additional points such as temperature sensors, new VAV and control dampers as applicable.

.6 Provide all required labour and supervision for the installation, calibration, adjustments, checkouts, commissioning of all components and devices provided.

.7 All re-used control devices such as temperature sensors, current sensors and control relays shall be verified, tested, and calibrated as required;

.8 The new points and changes in the DDC system including new BACnet interface shall be fully tested and commissioned to prove point functionality and communication after installation.

.9 Update existing documentation including as built drawings, O&M manuals, commissioning reports, etc. with complete information of the installed system;

.10 Provide a complete training and demonstration of the control system capabilities as per this specification;

.11 Provide one year Warranty as per this specification.

1.4 WORK BY OTHERS

.1 Co-operate and co-ordinate with other Contractors in carrying out their respective works and carry-out instructions from Engineer.

.2 If any part of work under this Contract depends on proper execution by or relies upon work of another Contractor, report immediately to the Engineer, in writing, any situations which may interfere with proper execution of Work.

1.5 WORK IN EXISTING BUILDINGS

.1 All work on site shall be co-ordinated with the Owner's Representative so as to minimize disruptions. Execute work with least possible interference or disturbance to building operations, occupants, and normal use of premises.

.2 Work taking place outside of the occupied areas that does not involve power or comfort systems interruptions may occur during the day with prior approval from the Owner's Representative. Work in mechanical rooms can be performed during occupied periods between 8:00AM and 4:00PM and anytime if required to complete the work. Coordinate with the Maintenance Team Leader, in advance the areas and intended working hours.

.3 Installation of equipment in occupied areas must take place outside of regular business hours. Desks, equipment and furniture must be covered when the work is taking place. Work taking place outside of the occupied areas that does not involve power interruptions may occur during the day with prior approval from the Owner's Representative.

.4 Include in Price any overtime that may be required to tie-in services at night or on weekends.

.5 Obtain approval from the Owner's Representative prior to penetrating any structural surfaces including floor slabs. Obtain from the Owner's Representative approval of locations of all penetrations prior to commencing work. Contractor shall replace/repair any building services that are damaged due to this construction (example: drilling through concrete floors) at no extra cost.

.6 Carefully route new conduits and other services so they do not interfere with existing installation.

.7 Removed equipment and material shall become the property of the Contractor and shall be removed from site unless otherwise requested by the Owner's Representative.

.8 After completion of work in ceiling space, arrange and pay for the repair of any damaged or dislodged fireproofing or other building materials.

.9 In area with solid ceilings, electrical and systems junction boxes along with associated wire and conduit shall be relocated to areas where ceiling access is possible, or access panels may be provided with the approval of the Owner's Representative.

.10 All Contractors shall exercise due care and diligence in working in the occupied areas. Keep the job reasonably clear of waste material and rubbish at all times during progress of the work. Clean up and restoration of the work area shall occur after each day's installation to ensure that no disruption to the work area takes place.

.11 Protect all existing services and make good any damage occasioned by the work in this contract.

.12 The Owner reserves the right to complete and/or repair any work that is not in operating condition, beyond scheduled shut downs, in order to maintain the Owner's operation.

1.6 CONTINUITY OF EXISTING SERVICES

.1 Keep existing building in operation at all times with minimum length of shutdown periods.

.2 Obtain permission of the Owner before shutting down or disconnecting electrical and fire protection services. Shutdowns of systems are to be co-ordinated with the PESC Facilities Manager.

.3 Co-operate with the Owner and other contractors on the job and provide necessary services so that existing building can be kept in operation at all time.

.4 Allow for afterhours work for services to be done inside occupied areas during office hours.

.5 Where Work involves breaking into or connecting to existing services, give Owner's Representative 48 hours notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to tenant operations.

.6 Submit schedule to and obtain approval from Owner's Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

.7 Where unknown services are encountered, immediately advise Engineer and confirm findings in writing.

1.7 CLEANING

.1 The Contractor shall be responsible to keep the building, site, and premises clean and tidy with respect to his work at all times.

.2 On completion, all dirt and rubbish for which the Contractor is responsible shall be removed from the site and premises and the whole left clean and tidy. All soiling of finished walls, floors, ceilings, carpets, or other surfaces, caused by the Contractor shall be cleaned up or made good by the Contractor.

.3 All control panels, etc., shall be thoroughly cleaned of dust, dirt, and debris before start-up and hand-over.

Part 2 **Products - NOT USED**

Part 3 **Execution - NOT USED**

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 Summary of Work

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 25 05 01 – ECMS General Requirements

Part 2 Products

2.1 NOT USED

Part 3 Installation

3.1 INSTALLATION STANDARDS

.1 The intention of this clause is to guide the Contractor as to the required quality of installation.

.2 All installations shall be performed by skilled certified technicians and trades people and meet the existing building standards in all aspects.

.3 Contractor shall continually monitor the installation for code compliance and quality of workmanship.

.4 Contractor shall arrange for field inspections by local and/or Provincial authorities having jurisdiction over the Work.

.5 Equipment shall be installed to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.6 All points associated with a single zone or an individual system shall be connected to the same stand alone panel, and associated terminal unit controller.

.7 Patch and touch up paint to match existing or a provide cover plate where sensors were removed or replaced by new DDC sensors.

3.2 ELECTRICAL WORK BY THE CONTROLS CONTRACTOR

.1 All wiring required for devices supplied under this Specification, regardless of the voltage, shall be the responsibility of the Controls Contractor.

.2 Provision of control panels, pilot lights, selectors, relays, etc., required for the proper operation of the control systems.

.3 Conduit and wiring from the starter control circuits to the mechanical system control panels including 110 V wiring.

.4 Conduit and wiring required for the interlocking of mechanical system motor starters as required for the proper operation of the control system.

.5 Wiring from pilot devices, relays, contactors, or other control interface devices required for the proper operation of the control system.

.6 Wiring from spare 15 amp circuit breakers in power panels for line voltage power sources where required by control system. Circuit breakers shall be locking type.

.7 Power wiring and control wiring to stand alone panels and terminal unit controllers.

.8 Controls Contractor shall confirm all new wiring connections between controllers and field devices and provide a copy of the End-to-End Checkout Sheet for every control panel.

.9 Controls Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with termination identified at the job site.

.10 Wiring of mechanical component controls, i.e., boilers, chillers, etc.

3.3 CONTROL AND INTERLOCK WIRING

.1 All control and interlock wiring shall comply with the national and local electrical codes as well as the following clauses.

.2 All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.

.3 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with local codes.

.4 Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.

.5 Adhere to Division 26 requirements for installation in raceways.

.6 Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3’ in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

.7 Use coded conductors throughout with different coloured conductors for each phase and white wire for neutral.

.8 All wiring in mechanical rooms and service rooms shall be in conduit or raceway. Provide 600 mm, B-X flexible connection to input and output devices where required for servicing or to accommodate vibration.

.9 Identify each wire and cable at every termination point. Identify all conduits with “neat” colour bands at no more than 7.5 m intervals and on both sides of walls and floors.

.10 Junction and Pull boxes shall be adequate tagged to indicate its use for DDC system. Self sticker labels with controls company logo could be used for that purpose.

3.4 COMMUNICATION WIRING

.1 Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run inside conduit and separately from other wiring.

.2 All communication wiring between main Building Controller and the Operator Interface shall be installed in conduit.

.3 All BACnet MS/TP networks shall communicate error free at a baud rate of 76,800 bps.

.4 Low capacitance cable with less than 15 Pico farads per foot shall be provided for MS/TP networks to for stable and less network communication errors.

.5 All exposed connection for external communication device as modem, laptop, etc. shall terminate with a utility box with a faceplate with CAT5 connector.

3.5 CLASS 1 WIRING

.1 120 V circuits shall be, at a minimum, of #12 AWG RW-90 copper. For runs over 50 m in length, use #10 AWG RW-90 copper.

.2 All 120 V interlock wiring and power supplies for panels to be installed in conduit.

.3 Provide 120 V power supplies to all main DDC panels, separately circuited from all other loads.

.4 Several Application Specific Controllers may be supplied from one 120 V power supply through a 120/24V transformer in accordance with the manufacturer's design. Only Application Specific Controllers connected to the same Building Controller may be connected to a common power supply.

3.6 CLASS 2 WIRING

.1 24 VAC power to controllers shall be separated from field devices transformer.

.2 Size and type of low voltage control signal wiring shall be suitable for the service for which it will be put to use and be the responsibility of this Contractor; minimum of #18 AWG RW-90 stranded copper conductors.

.3 Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:

.1 Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

.2 All cables shall be UL listed for application, i.e. cables used in ceiling plenums shall be UL listed specifically for that purpose.

.4 Any existing wiring considered for re-use (i.e. thermostat wiring re-use for temperature sensor) must be fully tested and verified prior to connection to new system. Any wiring deemed to not meet the project requirements must be replaced at the cost of the contractor.

.5 Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

.6 Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.

.7 All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block.

.8 All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

3.7 INSTALLATION OF SENSORS

.1 Install sensors in accordance with the manufacturer's recommendations.

.2 Mount sensors rigidly and adequate for the environment within which the sensor operates.

.3 Immersion temperature sensors shall be installed in such a manner to allow the sensing element to be truly indicative of the medium temperature. Sensors shall be installed in wells with heat conducting compound and fastened into the well with fittings designed for the purpose.

.4 Supply approved thermal wells of the appropriate size and type for sensing water temperatures, as required in the Points List, to the mechanical contractor for installation.

.5 Duct static pressure sensing tip shall be located so as to properly sense the static pressure in the duct without being adversely affected by changes in flow from duct fittings. Locate sensing tip a minimum straight duct length of 6 duct diameters upstream and 4 duct diameters downstream from any duct takeoff or elbow fittings.

.6 All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.

.7 Install labels on the inside covers of all room sensors identifying the point name using peel and stick labels such as the Brother labelling system.

3.8 INSTALLATION OF PRESSURE TRANSDUCERS

.1 Install transducers in accordance with the manufacturer's recommendations.

.2 Mount transducers rigidly on a wall or on a vertical surface with the pressure ports and cable entrance on the bottom. Avoid locations with severe vibrations or excessive moisture. Ensure there is enough space around the unit to make the pressure and electrical connections.

.3 Water pressure transducers shall be provided complete with 3-way manifold valves provided by the manufacturer.

.4 Pressure probes shall be installed perpendicular to the piping. Probes installed in horizontal pipes shall not be installed at the top or the bottom of the pipe to avoid air or dirt contamination going to the sensor. Allow minimum 6 pipe diameter upstream and downstream of the probe for the location.

.5 Line/tubing connection to the transducer shall be in copper tubing and not plastic.

.6 Purge to eliminate any trapped air when connecting the tubing to the transducer connections.

.7 Install labels on the inside covers of all sensors identifying the point name using peel and stick labels such as the Brother labelling system.

3.9 INSTALLATION OF RELAYS

.1 Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.

.2 All relays to be tagged indicating DDC controller, point and function. All plug-in relays shall be labeled such that removal of the component does not remove the label.

3.10 IDENTIFICATION OF HARDWARE AND WIRING

.1 All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information. Cable identifier shall be shown on and match record documents.

.2 Permanently label or code each point of field terminal strips to show the instrument or item served.

.3 Identify control panels with minimum 1 cm letters on laminated plastic nameplates.

.4 Identify all other control components including control relays with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

.5 Where new points are added or where controllers are replaced, all cabling, wiring, and device tags shall be updated, as required and as built drawings shall be issued.

3.11 CONCEALED DEVICES IDENTIFICATION

.1 Identification shall be used to indicate the location of VAV boxes and concealed devices.

.2 Identification shall be accordingly to existing code

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 25 05 01 – ECMS General Requirements

1.2 COMMUNICATIONS

.1 The data communication protocol for the project shall comprise a BACnet inter-network. The PC Workstation and Building Controller components shall meet ASHRAE / ANSI Standard 135-2008, BACnet - A Data Communication Protocol for Building Automation and Control Networks

.2 Each BACnet device shall operate on the BACnet physical/data link protocols specified for that device as defined earlier in Section 25 30 01.

.3 The communication between the Building Controllers (B-BC), and Advanced Application Controllers (B-AAC) / Application Specific Controllers (B-ASC) shall be via BACnet MS/TP networks. Arcnet, Lon or other protocols are not acceptable.

.4 All BACnet MS/TP networks shall communicate error free at a baud rate of 76,800 bps.

.5 Low capacitance cable with less than 15 Pico farads per foot shall be provided for MS/TP networks to for stable and less network communication errors.

.6 The Controls Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the inter-network.

.7 Communications services over the inter-network shall result in operator interface and value passing that is transparent to the inter-network architecture as follows:

.1 Connection of an operator interface device to any one controller on the inter-network will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the inter-network.

.2 All database values (i.e., points, software variable, custom program variables) of any one controller shall be readable by any other controller on the inter-network. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform inter-network value passing.

.3 The time clocks in all controllers shall be automatically synchronized daily.

.4 The Ethernet network shall be extended to all supervisory controllers, operator workstation and data server.

.5 Networks connecting zone level controllers such as VAV boxes, re-heat systems, etc. shall be directly connected to the DDC controller controlling the associated air handling unit.

1.3 INFORMATION ACCESS PROTOCOL

.1 The Operator Workstation shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.9, respectively, of ASHRAE Standard 135-2008, to communicate with BACnet objects in the internetwork.

1.4 INPUT/OUTPUT INTERFACE

.1 Hardwired inputs and outputs may tie into the system through Building, Custom, Application Specific Controllers or Lighting Controllers.

.2 All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

.3 Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices.

.4 Analog inputs shall allow the monitoring of low voltage (0-10 VDC), current (4-20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

.5 Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Binary outputs on Custom and Building Controllers shall have 3-position (on/off/auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.

.6 Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device. Analog outputs on building or custom programmable controllers shall have status lights and a 2-position (auto/manual) switch and manually adjustable potentiometer for manual override.

1.5 SYSTEM GRAPHICS

.1 Graphic screens:

.1 Existing graphic screens shall be updated and new ones created for each new system schematic or equipment as applicable.

.2 Building Network Diagram graphic screen shall be provided showing each controller and network panel complete with tag, address, controller make and model and installed location.

.2 Graphic screens shall be submitted to Prism for review prior to installation on the workstation. Final graphic screens shall be reviewed and accepted by the JIBC Facility Manager.

1.6 PROGRAMMING

.1 Provide programming for the system as per specifications and adhere to the control sequences provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

.2 All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.

.3 Create and name all points indicated in the points lists. Software points (variable) shall have the same characteristics on the graphic screens as the real or hardware points. A few additional points may be required to comply with the intent of the generic logic, depending on the vendors system.

.4 Provide a description for each analog and binary variable created. The description property shall include application and scope of the variable.

.5 All variables specified as adjustable or configurable shall be configured as BACnet Analog Value objects. Adjustable shall signify that the object present value is displayed and can be modified on graphic screens whereas configurable signifies that the object present value can only be modified from within the object properties definition. All variables specified as fixed shall be imbedded in control programs and shall not be configured as BACnet objects

1.7 ALARMS AND ALARM REPORTING

.1 Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.

.2 The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages graphics.

.3 Each binary object shall be set to alarm based on the operator specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.

.4 Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.

.5 Adequate range, time delay and interlocks shall be provided to avoid nuisance alarms caused by changes of state or normal temperature recovery period.

.6 The alarm message shall be clear and provide enough information for the operator to determine the action to be taken in the event of an alarm. It shall include the name of the calling location, the device that generated the alarm, and the alarm message itself.

1.8 TREND LOGS

.1 The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, type of collection (polling or COV), start-time, and stop-time. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk.

.2 Trend data shall be able to be viewed and printed from the operator interface software. They shall also be storable in a tab delimited ASCII format and able to be exported for use by other industry standard word processing and spreadsheet packages.

.3 Trend axis shall be labeled with applicable units. Variable shall be assigned to an axis based on expected range and/or units.

.4 Trends logs shall be configured as per section 25 90 01 – EMCS Systems Sequences of Operation for each I/O point for 300 samples at 15-minute intervals.

1.9 OVERRIDDEN POINTS REPORT

.1 Overridden Points Report shall be created and available for the operator use

1.10 POINT NAMING CONVENTION

.1 System names as points, variables, trends, schedule, calendar and other names shall be modular in design, allowing easy operator interface without the use of a written point index.

.2 Control points shall be named in as per existing convention.

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 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 25 05 02 – ECMS Summary of Work.

.4 Section 25 05 01 – ECMS General Requirements

Part 2 Products

2.1 CONTROL VALVES

.1 Control valves for plant equipment shall be two-way or three-way type for two-position or modulating service as scheduled or shown. Control valves for zone control may have modulating or floating point control.

.2 Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.

.3 Where CV is specified in the points list or on a valve schedule, ensure the control valve has a similar CV to that specified.

.4 Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:

.5 Water Valves:

.1 two-way: 150% of total system (pump) head;

.2 three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

.6 Sizing Criteria:

.1 two-position service / diverting application: Line size;

.2 2-way Modulating Service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 5 psi maximum;

.3 valves 1/2" through 2" shall be bronze body or cast brass ANSI Class 250, spring loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball;

.4 2-1/2" valves and larger shall be cast iron ANSI Class 125.

.5 Belimo ball valve with characteristic disc is accepted for the bypass application. Butterfly valve is accepted for the diverting application.

.6 Schedule: Refer to section 23 06 00 Equipment Schedules

.7 Valve Actuators:

.1 The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.

.2 Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.

.3 Proportional actuators shall accept a 0-10 VDC or 0-20 mA control signal.

.4 All non-spring return actuators shall have an external manual gear release to allow manual positioning when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.

.5 Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

.6 Actuators shall be Underwriters Laboratories Standard 873 listed.

.7 Actuators shall allow smooth operation throughout entire operating range and assure tight shut-off against system pressure.

.8 Actuators shall remain stationary until the applied signal changes.

2.2 TEMPERATURE SENSORS

.1 Provide one of the following temperature sensor types throughout:

.1 10,000 Ohm at 25℃ thermister

.2 1000 Ohm at 0℃ (–0.2 ohm) thin film platinum with coefficient of resistivity of 0.000385 ohms/ohm/℃

.3 100 Ohm at 0℃ (–0.2 ohm) pla tinum with coefficient of resistivity of 0.00385 ohms/ohm/℃

.2 Sensors shall have an accuracy of –0.3 C or better.

.3 All temperature sensors provided shall be constructed in a strain minimizing construction with integral anchored lead wires

2.3 IMMERSION TEMPERATURE SENSORS (TSP1)

.1 Provide, spring-loaded, thermowell mount sensors as follows:

.1 stainless steel sheath;

.2 spring loaded construction complete with compression fitting for 20 mm or 12 mm NPT well mounting as applicable;

.3 length as suitable for the application;

.4 standard conduit box termination, complete with screw terminal connector block.

.2 Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well to be consistent with the system pressure in which it is to be installed.

2.4 DIFFERENTIAL PRESSURE TRANSMITTERS – Air Service (DPT/x)

.1 Provide differential pressure transmitters as follows:

.1 Solid-state design, operating on capacitance principle

.2 Range selected to suit application

.3 Internal materials of the transducer suitable for the application

.4 Integral filters at each air connection port

.5 Integral, accessible non-interactive zero and span adjustment

.6 Minimum operating range of 0℃ to 50℃ with 20% to 90% RH (non -condensing)

.7 Accuracy of –1% range including non-linearity and hysteresis

.8 Over pressure input protection as necessary for the application

.9 Shock and vibration protection as necessary

2.5 CONTROL RELAYS (CR1, 2, 3, crs)

.1 Provide control relays as follows:

.1 Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.

.2 Electro mechanical relays shall have integral override switch to allow local override in event of DDC Control failure.

.3 Motor rated relays shall be provided in DDC Enable application for small motors (pumps, fans, etc.) with manual starters.

.4 Provide NEMA 1 Type enclosure when not installed in local control panel.

2.6 CURRENT TRANSDUCERS (CS1)

.1 Provide current transducers as follows:

.1 range selected to match the current of the application;

.2 output to match the requirements of the DDC System;

.3 accuracy of – 2% full scale or better;

.4 repeatability of –2% full scale or better;

.5 over-current and over-voltage protection as applicable;

.6 shock and vibration protection as necessary.

2.7 TRANSFORMERS AND POWER SUPPLIES

.1 Provide control relays as follows:

.1 Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.

.2 Unit shall operate between 0℃ and 50℃.

.3 Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Unit shall have built-in over-voltage protection.

.4 A single transformer limited to a Class 2 (100VA) transformer could be used to power several VAV box controllers. Transformers shall be located inside the air handling unit mechanical room.

2.8 FIELD DEVICE TYPES

.1 Field devices, specifications shall be based on the following device types as noted in points lists and/or drawings.

Table 1: Control Device Types

Device Type	Description	Technical Performance	Standard of Acceptance
CR1	Control relay (Dry contact electro-mechanical relay)	240V, 10 amps rated capacity. SPST function. Normally open (or normally closed) as required by points list or application	IDEC - RH Series Carlo Gavazzi - RCP8 Functional Devices RIB Series
CS1	Current Transducer		Greystone CS-450. Enercorp Sentry 100
CV8	Control valve (2 - 3 way, modulating actuator)	Ball valve with equal percentage flow characteristic, threaded connections. Material suitable for chilled water or hot water up to 125℃, Body pressure rating of 875 kPa (300 psi). Close off pressure rating to meet system pressure. 24VAC modulating actuator	Belimo B2 Series Belimo B3 Series Submittal Data - Submittal data shall include the proposed CV rating for each control valve.
DPTL	Differential Pressure Transmitter - liquids	+/- 1% FS Accuracy Pressure Range to suit application. Proof pressure min 2X of maximum full scale Burst pressure 5X of maximum full scale 3-valve manifold.	Setra Model 231 c/w 3-valve manifold Greystone WP-D-xxx-LCD-VB
TSP1	Temperature Sensor, immersion type.		Greystone TE-200-C. Enercorp TS-P

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 25 05 02 – EMCS Summary of Work.

.4 Section 25 05 01 – ECMS General Requirements

Part 2 Products

1.2 NOT USED

Part 3 Execution

1.3 GENERAL

.1 Variables

.1 Adjustable shall signify that the object present value is displayed and can be modified on graphic screens whereas configurable signifies that the object present value can only be modified from within the object properties definition. All variables specified as fixed shall be imbedded in control programs.

1.4 CONTROL SEQUENCES

.1 Existing program and control sequences shall be retained except for the following changes:

1.5 DEMAND BASED OPERATION OF BLOCK E BENCH EXHAUST SYSTEM

.1 General

.1 Currently, the exhaust for the lab bench extractor system (FEF-34) located in Room E 106 (Block E) operates continuously, drawing 2,640 cfm from the space. The lab bench is seldom used for its intended purpose, and can remain off for much of the year.

.2 The proposed modification would install a manual switch with a pilot light on the lab entrance as indicated in the mechanical drawings to enable the system when required. When the bench is enabled, the existing supply VAV boxes would modulate to compensate for the additional flow requirements required to maintain pressurization.

.3 DDC contractor shall revise sequencing of VAV-711 and VAV-713 from constant volume operation to an operation based on switch enable signal from the bench extractor. A minimum volume rate of 142 l/s (adjustable) shall be maintained to the room from VAV-711. New control switch shall be wired to an available input in the existing DDC controller for the exhaust fan in the Block E mechanical room.

.2 Operation

.1 The exhaust fan FEF-34 shall be off, the VAV-711 damper shall be closed and VAV-713 damper modulating to maintain the minimum flow setpoint of 142 l/s (adjustable).

.2 When the override switch is pressed, the exhaust fan shall start. A pilot light in the switch shall light up to confirm the fan operation. The VAV711 and VAV-713 dampers shall open and modulate to the current setpoint of 778 l/s and 825 l/s. If the exhaust fan status is not proved the VAV shall move to the unoccupied position, the pilot light shall flash, and an alarm generated at the workstation.

.3 System Graphics

.1 Graphic screens shall be created/revised to indicate the exhaust fan and VAV boxes. Link on the floor plan graphic screen shall direct to the exhaust/VAV graphic screen.

.4 Trends

.1 Provide 300 sample multiple point trends at 15-minute intervals for the following points/variables:

Point	Trend Type
FEF-34 Command	Polling
FEF-34 Amps (status)	Polling
VAV-711 Air Volume	Polling
VAV-711 Damper Position	Polling
VAV-713 Air Volume	Polling
VAV-713 Damper Position	Polling

1.6 ZONE DAMPER ISOLATION – BLOCK B

.1 General

.1 Some areas in Block B are unoccupied at night. It is proposed to install zone isolation dampers, controlled by the DDC system, allowing the supply and exhaust airflow to be shut off to unoccupied areas.

.2 The proposed spaces for zone isolation in Block B are the following: Office: B102, B103, B104, B105 and B124; General Lab: B106, and B111.

.3 It is understood that these offices or general lab space ventilation systems can be shut off during building unoccupied periods. Isolation of these systems will reduce the overall scheduled space conditioning by 70%.

.1 A zone isolation motorized damper shall be installed by the mechanical contractor in the general exhaust duct branch from lab B106 and a VFD shall be installed in the general exhaust fan EF-18 for speed/flow control.

.2 DDC contractor shall rewire the existing EF-18 DDC points as well as new BACnet network cabling to the new VFD.

.3 Existing program code shall be modified for scheduling operation of the rooms.

.4 Balancer shall confirm pressurization and flow rates in adjacent labs during system isolation.

.2 Operation

.1 During scheduled occupied periods the isolation exhaust damper shall be open and VAV boxes modulating as per existing program code. The exhaust fan shall be at 100% speed or as per setpoint speed set by the balancing contractor.

.2 During scheduled unoccupied periods the exhaust isolation damper shall be closed and the exhaust fan speed reduced to the unoccupied speed setpoint as set by the balancing contractor. The VAV box dampers serving the offices and general lab B-106/111 shall be fully closed.

Room	VAV
B102	VAV-603
B103/104/105	VAV-601, 602
B124	VAV-605
B106/111	VAV-604, 606, 607

.3 System Graphics

.1 Existing graphic screens shall be revised to indicate the isolation damper position and new VFD for EF-18. Existing VAV graphic screen shall be revised to include mode for the applicable VAV boxes.

.2 New graphic screen shall be created for display fan BACnet information such as amperage, amperage, voltage, and others to be determined.

.3 Links shall be created to direct to the fan information and trends.

.4 Trends

.1 Provide 300 sample multiple point trends at 15-minute intervals for each zone for the following points/variables:

Point	**Trend Type**
AHU-5 Supply Air Pressure	Polling
AHU-5 Supply Air Pressure Setpoint	Polling
AHU-5 Supply Fan Speed	Polling
Occupancy Schedule	Polling
Isolation Damper Command	Polling
Exhaust Fan EF-18 Speed	Polling

1.7 ADD RETURN AIR FAN AND VAV BOXES – BLOCK D AND E

.1 General

.1 Mechanical contractor is installing a return air duct from the office areas in Blocks D and E to the associated air handling unit. Return will be provided with a VAV box and a booster fan to achieve energy savings without compromising the air quality to the space.

.2 An air valve will be installed on the general lab exhaust duct to allow the office areas to be shut down when unoccupied, while maintaining the required relative space and building pressurization.

.3 DDC contractor shall provide new DDC controllers for the general exhaust and for the return air VAV boxes. Start/stop and status points for the new return air fan shall be wired to the new return air VAV controller or to available inputs/outputs in the associate air handling unit controller.

.2 Operation

.1 During occupied periods the return air fan shall be on and the VAV box damper modulating to maintain the return air volume setpoint. The return air volume shall be calculated based on the supply air provided by the VAV boxes serving the office areas and as determined by the balancing contractor to maintain a positive pressure in the office areas. The general exhaust air volume setpoint shall be as determined by the balancing contractor.

.2 During unoccupied periods the return fan shall be off. The dampers on the return air VAV and the supply air VAV box serving the offices shall be fully closed. The general exhaust fan VAV box should modulate to compensate for the reduced supply air volume and to maintain a relative positive pressure between the office and the laboratory areas. The unoccupied VAV exhaust air volume setpoint shall be determined by the balancing contractor.

.3 Applicable VAV boxes

Block	VAV Tag	Min/Max Flow
Block D	VAV-122	200 / 401 l/s
	VAV-123	200 / 401 l/s
Block E	VAV-727	200 / 401 l/s
	VAV-728	200 / 401 l/s

1.8 IMPLEMENT DE-STRATIFICATION FANS CONTROL – BLOCK C, D, AND E

.1 General

.1 New high volume low speed (HVLS) ceiling fans (total of six) shall be installed in the lab office areas in Blocks C, D and E replacing old ceiling fans. The new fans shall be interfaced with the DDC system to ensure the fans are being enabled when optimal and operate at acceptable speeds to serve the function of their design.

.2 A temperature sensor shall be installed at the ceiling level above the fans for temperature control. Room temperature is provided by existing VAV temperature sensor. A start/stop (BO) and 0-10VDC (AO) speed commands shall be provided for both fans. DDC points shall be connected to available inputs and outputs in existing Block C and D controllers. An expansion to existing controller shall be provided for block E.

.3 The DDC systems shall operate the fans to maintain optimum flow rate for summer and winter conditions.

.4 Detailed sequences of operation and wiring schematics will be provided after approval of the HVLS mechanical shop drawings by the consultant.

1.9 IMPLEMENT UNOCCUPIED TEMPERATURE CONTROL FOR BLOCKS C, D AND E

.1 General

.1 Currently there is no unoccupied (night setback) temperature control for Blocks C, D and E. The air handling units operate continuously to maintain the occupied temperature setpoint. Energy savings can be achieved by allowing the VAV boxes to modulate during unoccupied periods to maintain an unoccupied temperature setpoint.

.2 The DDC contractor shall revise the existing VAV program code for implementing unoccupied operation as per a weekly schedule set for the block. The occupied operation shall remain as per existing program code.

.2 Operation

.1 During occupied periods the VAV boxes shall operate as per existing program code.

.2 During unoccupied periods the VAV boxes shall modulate to maintain the unoccupied temperature setpoint. The owner shall be able to adjust the unoccupied temperature setpoint in each of the zones.

.3 System Graphics

.1 Existing VAV graphic screen tables shall be revised to indicate the unoccupied temperature setpoint.

1.10 IMPLEMENT OPTIMAL START (WARM-UP) ROUTINE – BLOCKS A TO E

.1 General

.1 There is no optimal start routine implemented currently implemented for Blocks A and B and the warm-up period is set by adjusting the weekly schedule to an earlier time.

.2 Optimal start (warm-up) routine shall be implemented to all Blocks including C to E allowing the temperatures to be at the occupied temperature setpoint in the beginning of the scheduled occupied period.

.2 Operation

.1 The existing program code shall be revised to implement the following changes:

.2 The air handling units serving Blocks A to E operate continuously. Heating optimal start routine shall be implemented to the systems to reset the temperature setpoint at an adequate start time to have the spaces at the occupied temperature setpoint at the beginning of the scheduled occupancy.

.3 The optimal start time shall be calculated based on current and past outdoor air temperatures, space temperatures, and rate of temperature increase in the spaces. The earlier start time shall be limited to 120 minutes.

1.11 ADD SUPPLY AIR TEMPERATURE TO VAV BOXES – BLOCKS A TO E

.1 General

.1 There is no supply air temperature sensors currently installed in the VAV boxes with re-heat coil. Installing a supply air temperature sensor will allow the operator to troubleshooting the VAV box/re-heat coil operation and provide and alarm if the re-heat coil valve is passing.

.2 DDC contractor shall provide and install duct temperature sensors in the VAV supply air duct after the re-heat coils. Existing shop drawings indicate the following quantity: Block A (6); Block B (20); Block C (5); Block D (14); Block E (19).

.3 Temperature sensors shall be wired to available inputs on the VAV box controller. Existing shop drawings indicate that the existing input on 31 controllers is used for fumehood status. In these cases a network temperature sensor shall be used.

.4 Program code and graphic screens shall be revised to implementing passing valve alarm.

.2 Alarms

.1 Provide the additional following alarm:

Alarm	Alarm Source	High Limit	Low Limit
Heating Valve Leak	SAT Sensor	(1)	

Heating Valve Leak Alarm shall be generated if the heating valve is commanded closed for more than 10 minutes and the box supply air temperature is +5°C higher than the primary air (AHU supply) temperature.

.3 System Graphics

.1 Applicable graphic screens (system schematics, tables, etc.) shall be updated to indicate the supply air temperature sensor readings and alarm.

.2 Associated AHU's supply air temperatures and setpoints shall be added to each existing VAV tables.

.4 Trends

Provide 300 sample trends, at 15-minute intervals, for the following points/variables:

Point	Trend Type
VAV Re-heat Valve Position	Polling
VAV Supply Air Temperature	Polling
AHU Supply Air Temperature	Polling

1.12 BOILERS CONTROL

.1 General

.1 The existing boilers are being replaced with three new condensing boilers with BACnet boards for DDC interface. The existing boiler pumps will be removed and motorized isolating valves installed on the boilers leaving hot water piping.

.2 The boilers shall be controlled by their integral boiler controller for staging and controlling the isolating valves.

.1 The DDC system shall enable and reset the boilers to maintain the supply water temperature at setpoint. DDC points controlling the existing boilers shall be re-wired to the new boiler plant controller. Redundant points such as boiler B-2 and B-3 command, status and alarm shall be deleted and wiring removed from the DDC controller.

.2 New immersion temperature sensors shall be provided and installed in each boiler supply water piping and in each of the dual return water piping to the boilers. Existing common supply water temperature sensor shall be relocated if required.

The new temperature sensors shall be wired to an expansion module for the existing boiler DDC controller.

.3 An insertion type flow meter shall be provided by the DDC contractor to measure the return water flow to the low temperature return to the boilers. Flow meter shall be Badger model 220B or approved similar.

.4 Immersion wells, control valves, and flow meter shall be installed by mechanical contractor.

.5 The existing program code shall be revised as per following sequences of operation. The proposed sequences could be modified during the implementation to achieve better operation results.

.2 Start-up:

.1 The heating water plant shall be enabled as per existing sequences of operation.

.3 Operation

.1 When the heating water system is enabled, the lead pumps for the radiant and for the heating coil loops shall start and operate as required. Pumps shall operate in duty/standby fashion. Upon failure of the lead pump, the standby pump shall operate. The lead pump shall alternate on a weekly basis.

.2 The boilers shall be controlled by the boiler integral controller. Once enabled by the DDC system, the boiler controller shall open the isolation valve first. The boiler shall start and operate upon proof of water circulation by the boiler water flow switch. When the boiler is disabled, the associated boiler isolation valve shall stay open for a delay as determined by the boiler manufacturer.

.3 The DDC system shall reset the boilers to maintain the heating water supply water temperature setpoint. A single control loop shall provide a setpoint reset signal on the deviation of the primary loop water temperature from setpoint.

.4 The hot water supply temperature setpoint shall be reset according to outdoor air temperature as follows:

OAT	Boiler Water Temp
-10℃ (14℉)	90℃ (194℉)
18℃ (64℉)	60℃ (140℉)

.5 The lead boiler shall be alternated on a weekly basis.

.4 Morning Warm-up Mode / Cold Weather Mode:

.1 The boilers shall be enabled at maximum reset in warm-up boost mode when the OAT<5”C (adjustable).

.5 Minimum Low Temperature Return Water Flow Control:

.1 The DDC system shall monitor the return water flow on the low temperature return piping to the boilers. A 3-way diverting valve shall modulate as required to maintain the minimum return flow setpoint to the boilers as determined by the balancing contractor and boiler manufacturer.

.6 Alarms

.1 Provide the following alarms:

Alarm	**Alarm Source**	**High Limit**	**Low Limit**
High Boiler SWT (3)	Boiler SWT Sensor	> 105°C	-
Boiler Alarms (3)	Boiler BACnet	-	-
Low Return Wtr Flow	Flow Meter	-	TBD

.7 System Graphics

.1 System graphic screens shall indicate all related inputs, outputs, and setpoints including boiler alarms, overrides. All setpoints shall be adjustable at graphic screen.

.2 Add a virtual point on the proposed point list/DDC graphics called “Condensing Mode”, based on RWT’s back to boiler (125°F ave or lower).

.8 Trends

.1 Provide 300 sample trends, at 15-minute intervals as applicable, for the following points/variables:

Point	Trend Type
Boiler B-1 Supply Water Temperature	Polling
Boiler B-2 Supply Water Temperature	Polling
Boiler B-3 Supply Water Temperature	Polling
Supply Water Temperature Setpoint	Polling
Boiler Reset Command	Polling
High Return Water Temperature	Polling
Low Return Water Temperature	Polling
Diverting Valve Position	Polling

1.13 RADIANT HEATING PUMPS CONTROL

.1 General

.1 Existing radiant heating pump P-3 will be replaced with two new pumps (P-3 and P-4) equipped with variable speed drives provided with BACnet boards. DDC contractor shall re-wire existing pumps start/stop and status (current sensor) points to the new pumps/VFDs and extended BACnet network to the pump VFDs.

.2 Existing bypass valve and differential pressure sensor shall be retained and use for pressure control when the variable speed drive fails and the VFD is in bypass operation (full speed).

.3 A new differential pressure sensor for controlling the pump speed shall be installed in the radiant heating loop piping in block B mechanical room. New sensor shall be wired to available input in the AHU-3 DDC controller/expansion.

.4 The existing program code shall be revised as per following sequences of operation. The proposed sequences could be modified during the implementation to achieve better operation results.

.2 Start-up:

.1 The radiant heating pumps serve radiant panels in perimeter zones. The radiant system shall be enabled when the outdoor air temperature is below the OAT_RAD lockout setpoint initially set at 15”C (adjustable).

.3 Operation

.1 Pumps shall operate in duty/standby fashion. Upon failure of the lead pump, the standby pump shall operate. The lead pump shall alternate on a weekly basis.

.2 When the radiant heating system is enabled, the lead pump shall start at minimum speed setpoint initially set at 50% (adjustable) and ramp gradually to the speed setpoint.

.3 The pump speed shall modulate as required to maintain a differential pressure setpoint based on a differential pressure sensor installed in the block D radiant heating loop. Pressure setpoint shall be set initially at 5 psig (adjustable).

.4 The 3-way radiant heating valve shall modulate to maintain the supply water temperature setpoint reset according to outdoor air temperature as follows:

OAT	Radiant Loop Temp
-10℃ (14℉)	90℃ (194℉)
15℃ (60℉)	60℃ (140℉)

.5 The outdoor air temperature and radiant loop temperature limits shall be adjusted on a graphic screen.

.4 System Graphics

.1 System graphic screens shall indicate all related inputs, outputs, setpoints, alarms, and overrides. All setpoints shall be adjustable at graphic screen. A graphic screen shall be created to display relevant VFD BACnet points such as voltage, amperage, frequency, speed, alarms, etc.

.5 Trends

.1 Provide 300 sample trends, at 15-minute intervals as applicable, for the following points/variables:

Point	**Trend Type**
Outdoor Air Temperature	Polling
Radiant Supply Water Temperature	Polling
Radiant Supply Water Temperature Setpoint	Polling
Radiant 3-Way Valve Position	Polling
Radiant Return Water Temperature	Polling
Water Differential Pressure	Polling
Radiant Pump P-3 Speed Command	Polling
Radiant Pump P-4 Speed Command	Polling

1.14 HEATING PUMPS CONTROL

.1 General

.1 Existing heating coil pump P-4 will be replaced with two new pumps (P-1 and P-2) equipped with variable speed drives provided with BACnet boards. DDC contractor shall re-wire existing pumps start/stop and status (current sensor) points to the new pumps/VFDs and extended BACnet network to the pump VFDs.

.2 A new differential pressure sensor for controlling the pump speed shall be installed in the radiant heating loop piping in block B mechanical room. New sensor shall be wired to available input in the AHU-3 DDC controller/expansion.

.3 The existing program code shall be revised as per following sequences of operation. The proposed sequences could be modified during the implementation to achieve better operation results.

.2 Start-up:

.1 The heating system shall be enabled when the outdoor air temperature is below the OAT_HTG lockout setpoint initially set at 18”C (adjustable) and the heating request is above the heating request setpoint.

.3 Operation

.1 Pumps shall operate in duty/standby fashion. Upon failure of the lead pump, the standby pump shall operate. The lead pump shall alternate on a weekly basis.

.2 When the heating system is enabled, the lead pump shall start at minimum speed setpoint initially set at 50% (adjustable) and ramp gradually to the speed setpoint.

.3 The pump speed shall modulate as required to maintain a differential pressure setpoint based on a differential pressure sensor installed in the block D mechanical room heating loop. Pressure setpoint shall be set initially at 5 psig (adjustable).

.4 The 3-way mixing heating valve shall modulate to maintain the supply water temperature setpoint shall be reset from 40”C to 90”C based on heating request from the VAV re-heat coil valves and AHU heating coil valves.

.5 A trim and respond algorithm shall be applied to adjust the supply temperature setpoint as follows:

.6 Each heating valve shall set a temperature reset request when heating water is available and the valve has been fully open for 5 minutes continuous otherwise the request shall be set to zero. The VAV re-heat coil valve importance multipliers shall initially be set to a value of 1. The AHU heating coil valves importance multipliers shall initially be set to a value of 5 (adjustable by AHU).

.7 When the heating pump is enabled, the initial supply water temperature setpoint shall as reset from the outdoor air temperature same as the radiant heating pumps.

.8 The DDC system shall monitor the heating request and if the heating request is greater than the heating request setpoint initially set at 5 (adjustable), the supply water temperature setpoint shall increase by 2”C (adjustable). If the heating request is less than the heating request setpoint, the supply water temperature setpoint shall decrease by 1”C.

.4 System Graphics

.1 System graphic screens shall indicate all related inputs, outputs, setpoints, alarms, and overrides. All setpoints shall be adjustable at graphic screen. A graphic screen linked to the pump graphic screen shall be created indicating the heating coil valve positions.

.2 A graphic screen shall be created to display relevant VFD BACnet points such as voltage, amperage, frequency, speed, alarms, etc.

.5 Trends

.1 Provide 300 sample trends, at 15-minute intervals as applicable, for the following points/variables:

Point	Trend Type
Heating Supply Water Temperature	Polling
Heating Supply Water Temperature Setpoint	Polling
Heating 3-Way Valve Position	Polling
Heating Return Water Temperature	Polling
Water Differential Pressure	Polling
Heating Pump P-1 Speed Command	Polling
Heating Pump P-2 Speed Command	Polling

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

.2 CSA C22.2

.3 CAN/CSA-C22.3 No. 1-01(current version), Overhead Systems.

.4 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.3 Institute of Electrical and Electronics Engineers (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 DEFINITIONS

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

1.3 REGULATORY REQUIREMENTS

.1 Execution of all Work shall be performed to comply with and conform to requirements of the 2012 Canadian Electrical Code C22.1-12 (or current version), 2012 BC Building Code (or current version), 2010 National Building Code (or current version), 2010 National Fire Code (or current version) and all applicable provincial, city, municipal and / or district bylaws and to the satisfaction of authorities having jurisdiction of the place of Work.

.2 Where requirements detailed in these specifications exceed code requirements or are more stringent than code requirements, the specification requirements shall take precedence and shall be adhered to.

.3 In the event of a conflict between code requirements and those detailed in these specifications, the former shall prevail. Note that requirements within the specification that are more stringent requirements than codes do not constitute a conflict.

1.4 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

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

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

1.5 SUBMITTALS

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

.2 Shop drawings:

.1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.4 If changes are required, notify Owner’s Representative of these changes before they are made.

.3 Record Drawings

.1 After completion of the work, provide the building owner with a set of Record Drawings (“As-Builts”) on a set of clean blackline prints as updated with AutoCAD 2012 or later version, or by contracting with the Engineer ($500). Drawing must indicate all changes to equipment layout, final device circuiting, and conduit routing.

1.6 QUALITY ASSURANCE

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold a valid Master Electrical Contractor license or are employed by such an entity. Apprentices may conduct Work under the supervision of a journeyman electrician in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 – Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Owner's Representative with a material delivery schedule.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

1.8 SYSTEM STARTUP

.1 Instruct Owner's Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

Part 2 Products

2.1 STANDARD OF MATERIALS

.1 Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.

.2 Materials required for performance of work to be new and the best of their respective kinds and of uniform pattern throughout work.

.3 Materials to be of Canadian manufacture where obtainable. Materials of foreign manufacture, unless specified are to be approved before being ordered. Products are to be purchased through manufacturer's Canadian Distributors or Wholesalers, or directly from the manufacturer, when obtainable.

.4 Equipment items are to be standard products of approved manufacture. Identical units of equipment are to be of same manufacture. In any unit of equipment, identical component parts to be of same manufacture, but the various component parts comprising the unit need not be of one manufacture.

.5 Chemical and physical properties of materials and design performance characteristics and methods of construction and installation of items of equipment, specified herein, to be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.

.6 Materials to bear approval labels as required by Code and / or Local Inspection Authorities and be eligible for sale and installation in Canada. All equipment to be approved by a certification agency listed in BC Electrical Bulletin 0-7-0. Where it is stated within this specification that equipment "must be CSA approved", or similar wording, it is to be taken that equipment bearing an appropriate certification label from any certification organizations listed in federal, provincial or territorial bulletins is acceptable.

.7 Install materials in strict accordance with manufacturer's recommendations.

.8 Include items of material and equipment not specifically noted on drawings, provided on informational bills of material, or mentioned in specifications but which are necessary to make a complete and operating installation.

.9 Confirm capacity or ratings of equipment being provided, when based on ratings of equipment being provided under other trade Section, before such items are purchased.

.10 Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.

.11 Where requirements of this Specification exceed those of applicable standards, this Specification governs.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls.

2.3 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction.

.2 Decal signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

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

.2 Apply anti-oxidization compounds as required for connections made between dissimilar metals.

2.5 EQUIPMENT IDENTIFICATION

.1 Labels for feeder conduits, cables and bus ducts to indicate their content are to comprise pressure sensitive tape. Print labels on plastic coated tape, 50.8 mm x 152.4 mm (2" x 6") size with black printing on yellow background indicating applicable voltage, i.e. 600 volts.

.2 Provide name plates on each piece of electrical equipment, namely power panels, distribution panels, lighting panels, transformers, disconnect switches, contactors, telephone panels, miscellaneous systems panels, double throw switches and automatic transfer switches.

.3 Indicate equipment being controlled and voltage on nameplates for disconnects and contactors.

.4 Nameplates are to be black-white-black lamicoid with bevelled edges and white engraved letters. Fasten or cement nameplates to equipment in a conspicuous location. Locate nameplate on flush mounted panels on front of panel behind hinged door.

.5 Identify equipment not listed above, such as incoming service cables, contactor motors, in a similar manner showing name and number of the equipment, voltage and load information.

.6 Identify feeder pull boxes and junction boxes with lettering stamped on brass or aluminium tags showing feeder or system concerned, voltage involved and data for both termination points whether equipment or panel. Tag to be held to boxes under lid screws using steel wire.

.7 Identify control conductors for motors and equipment by pressure sensitive tape markers at each main terminal point and wherever they are introduced into ducts or equipment. Schedule and chart marker numbers with corresponding machine numbers and locations and include with Record Drawings.

.8 Label feeder conduits, cables.

.9 Locate labels as follows:

.1 At every end of every conduit, duct or cable run, adjacent to item of equipment serviced.

.2 On each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall, partition or floor).

.3 At every access point on concealed conduit duct or cable.

.10 Labels are to be visible from 5'-0" (1524 mm) above adjacent floor or platform.

2.6 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.7 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.8 SLEEVES AND CURBS

.1 Maintain the integrity of the fire rating of the floors and walls around electrical raceways and/or cables passing through such floors and/or walls.

.2 Materials used to maintain rating to have a minimum 2 hour ULC listed rating.

.3 Provide sleeves of galvanized steel for conduit and cable runs passing through concrete walls, beams, slabs and floor. Sleeves for bus ducts, wireways and cable trays to be minimum 3.18 mm (1/8") galvanized steel.

.4 Provide concrete curbs, minimum 101.6 mm (4") high above finished floor, keyed to floor for mounting of transformer as indicated.

.5 Install fire stop or sealant material between opening or sleeve and raceway or cable in accordance with the recommendations of the manufacture to achieve a minimum 2 hour rating, unless otherwise noted.

2.9 SAFETY SWITCHES

.1 Provide engraved nameplates on each switch.

.2 Fused or unfused disconnect or safety switches to be Type "A", quick-make, quick-break construction with provision for padlocking switches in either "ON" or "OFF" position.

.3 Fused switches to have fuse clips designed for NEMA Class "J" HRC fuses and designed to reject standard N.E.C. fuses.

.4 Switches throughout job are to be of same manufacture and to match base building standards.

.5 Provide fused or unfused safety or disconnect switches as shown and as required.

2.10 FUSES

.1 Fuses to conform to CSA Standard C22.2 No. 106-1953 or CSA Standard C22.2 No. 106-M1985.

.2 Fuse interrupting rating to be 200,000 A RMS symmetrical.

.3 Fuses are to be sized as shown.

.4 Fuses rated to 600 A are to be CSA certified HRCI-J/Class J time delay.

.5 Fuses rated 601 A and larger to be CSA certified HRC-L/Class L.

.6 Provide a complete set of fuses in each fusible device supplied under this Division.

.7 Provide a spare set of three fuses of each size and type supplied and hand over to Owner at completion of work.

2.11 PANELBOARD BREAKERS

.1 All new breakers to match existing panelboard type and specifications

Part 3 Execution

3.1 INSTALLATION

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

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

.3 Provide new breakers sized for new equipment in existing panelboards.

.4 Relocate any lighting as required that is obstructing new equipment installations so to avoid the new equipment and provide even illumination of the area.

3.2 NAMEPLATES AND LABELS

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

3.3 MOUNTING HEIGHTS

.1 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.4 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.5 TEMPORARY POWER SERVICES

.1 Provide temporary power supplies with receptacles and extension cords from existing building services, for construction equipment, e.g.: drills, saws, etc. Locate, relocate and remove services as necessary.

.2 Maintain the temporary facilities in good repair and in safe working condition throughout the duration of the construction project.

.3 Remove, at the end of project, the above noted temporary systems.

3.6 FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.2 Conduct following tests:

.1 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.4 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.7 CLEANING

.1 Refer to 01 74 11 - CLEANING

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 26 05 00 – Common Work Results for Electrical.

1.2 PRODUCT DATA

.1 Provide product data in accordance with Section 01 33 00 – Submittal Procedures.

.2 CSA C22.2 No. 0.3-09 Test Methods for Electrical Wires and Cables.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Packaging Waste Management: remove for reuse and recycle.

Part 2 Products

2.1 CONDUCTORS, WIRES AND CABLES

.1 All conductors are to be copper conductors. All AWG sizes given in this specification refer to the copper AWG size.

.2 Wiring installed in conduit, unless otherwise noted, to be 600 volt RW-90 X-Link.

.3 Use copper wiring, minimum No. 12 gauge for lighting and power wiring. Size wires for 2% maximum voltage drop to farthest outlet on a loaded circuit.

2.2 TECK 90 CABLE

.1 Cable: in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Conductors:

- .1 Grounding conductor: copper as indicated.
- .2 Circuit conductors: copper as indicated, size as indicated.

.3 Insulation:

- .1 Ethylene propylene rubberEP.
- .2 Cross-linked polyethylene XLPE.
- .3 Rating: 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: aluminum.

.6 Overall covering: compliant to applicable Building Code classification for this project.

.7 Fastenings:

.1 One hole straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 1200 mm centers.

.3 Threaded rods: 6 mm diameter to support suspended channels.

.8 Connectors:

.1 Watertight, approved for TECK cable.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90.

.3 Armour: interlocking type fabricated from galvanized steel strip.

.4 Type: PVC jacket over armour and compliant to applicable Building Code classification for this project.

.5 Connectors: anti short connectors.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Perform tests using method appropriate to site conditions and to approval of Owner's Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 WIRING METHODS

.1 Install wiring in conduit unless otherwise specified.

.2 Use thin wall conduit for branch circuit and signal wiring in ceilings, and furred spaces. Use rigid galvanized steel conduit for wiring in poured concrete, or where conduit could be exposed to mechanical injury.

.3 Conduit is to be of sufficient size to permit easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced. Do not bend conduit over sharp objects. Improperly formed bends and running threads will not be accepted. Do not use bends and fittings together.

.4 Run conduits and cables in finished areas concealed, above finished ceilings, under floors, in walls and in partitions. Run conduit and cables in unfinished areas, such as fan rooms and penthouses, exposed and install at right angles or parallel to building lines, accurate in line and level.

.5 Runs of conduit and cables, where shown are indicated only by general location and routing. Install conduits and cables to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass. Install as close to building structure as possible, so that, where concealed, necessary furring can be kept to a minimum. Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.

.6 Wiring and conduit for wall devices etc., to be routed in ceiling space of floor they are serving.

.7 Install conduit and cables to avoid proximity to water and heating pipes. They are not be run within 152.4 mm (6") of such pipes except where crossings are unavoidable, in which case they are to be kept at least 25 mm (1") from covering of pipe crossed.

.8 Provide expansion joint sleeves with ground jumpers in conduit runs where they cross building expansion joints.

.9 Provide new wires in conduit for all new equipment shown on drawings.

3.3 GROUNDING

.1 Ground electrical equipment and wiring in accordance with Canadian Electrical Code and Local Inspection Authority's Rules and Regulations.

.2 Condition or existence of grounding of existing luminaries must be reviewed and proper grounding confirmed. Inform Consultant if ungrounded luminaries or service feeder to luminaires are identified.

3.4 CONDUCTORS, WIRES AND CABLES

.1 Colour code all conductors. Conductors No. 2 gauge and smaller to have colour impregnated into insulation at time of manufacture. Conductors size larger than No. 2 gauge may be colour coded with adhesive colour coding tape but only black insulated conductors are to be employed in this case, except for neutrals which are to be white whenever possible. Conductors of No. 8 gauge and larger must be stranded.

.2 Colour code as follows:

Phase "A"	Red	Ground	Green
Phase "B"	Black	Neutral	White
Phase "C"	Blue	Control	Orange

.3 Neutral conductors may be identified by a coloured insulation with three or more extruded longitudinal white stripes along the insulation, and will be deemed to have a white or natural covering. All neutral conductors used in the Work must match building standard.

.4 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

.5 Splice wire, up to and including No. 6 gauge, with twist-on style connections rated minimum 600 volts. Connection body to be moulded of thermoplastic. Spring insert to have an expandable square-edge. Splice large conductors using split-bolt or compression type connections wrapped with PVC tape.

.6 Where colour coding tape is utilized, it is to be applied for a minimum of 50.8 mm (2") at terminations, junction and pull boxes and condulet fittings. Do not paint conductors under any circumstances. Colour coding also applies to bussing in panels.

3.5 EQUIPMENT AND WIRING TESTING

.1 Make tests of equipment and wiring at time requested.

.2 Tests are to include measured insulation values, voltage and current readings to determine balance of panels and feeders under full load, and operation of each piece of equipment for correct operation.

.3 Supply meters, materials and personnel as required, to carry out these tests.

.4 Test electrical work to standards and function of Specification and applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

.5 Where specialized equipment or controls systems requiring commissioning are installed as part of Work, arrange and pay for services of manufacturer's factory service engineer / technician to supervise initial start-up or calibration of such equipment or controls. Engineer / technician shall check systems installation and verify operation is correct or shall adjust, balance and calibrate components, or direct installer to perform these tasks, including installation related wiring and operation of controls, to the satisfaction of the engineer / technician and the Consultant.

.6 Instruct Owner's operating personnel in the operation of the installations. Provide these services for such periods, and for as many visits as may be necessary to put applicable portion of installation in complete working order, and to ensure that Owner's operating personnel are fully conversant with every aspect of the operation, care and maintenance thereof.

3.6 GENERAL CABLE INSTALLATION

.1 Cable Colour Coding: to Section 26 05 00 – Common Work Results for Electrical.

.2 Conductor length for parallel feeders to be identical.

.3 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.4 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.5 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.

3.7 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

3.8 INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable concealed, securely supported by straps or hangers.

3.9 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible on channels.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical.

Part 2 Products

2.1 HANGERS

.1 Ensure that hangers used for electrical conduit are galvanized after fabrication.

.2 Do not use perforated strapping (grabbler bars) to hang conduit.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to poured concrete with expandable inserts.

.2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.4 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.5 Suspended support systems.

- .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.6 For surface mounting of two or more conduits use channels at 1200 mm on centre spacing.

.7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.9 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.

.11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer’s installation recommendations.

3.2 SUPPORTS AND BASES

.1 Supply and erect special structural and concrete work required for the installation of electrical equipment. Provide anchor bolts and other fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.

.2 Switches or other electrical equipment are to be complete with suitable bases or mounting brackets. Install angle or channel iron supports to bear the equipment where it is shown on or in structural tile walls, or walls are inadequate to bear the equipment.

.3 Provide channel iron or other metal supports where necessary, to adequately support lighting luminaires. Do not use wood unless wood forms part of the building structure.

.4 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members, required between beams for supporting conduits, cables and bus ducts. Use coach screw rods or lag screws in any wood construction.

.5 Provide any additional supports required from existing concrete construction for any piping or equipment, by drilling same and installing expansion bolt cinch anchors.

.6 Do not use explosive drive pins in any section of Work without obtaining prior approval from Owner's Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-09, Canadian Electrical Code, Part 1, 21st Edition.

1.2 SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

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

.2 Waste Management and Disposal:

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

Part 2 Products

2.1 OUTLET BOXES

.1 Conform to CSA Standard C22.2 No. 18.

.2 Ceiling boxes are to be 101.6 mm (4") octagon or square, complete with fittings, where required to support luminaires.

.3 Switch and receptacles boxes to be:

.1 No. 1104, where flush mounted in wood or drywall, with stud fasteners as required.

.2 Boxes for 347 volt switches are to be similar but sized as per Code with barriers between switches.

.4 Where boxes are surface mounted in unfinished areas, they are to be FS condulets.

.5 Standard outlet boxes are to be manufactured from code gauge galvanized steel.

.6 Ensure outlet boxes installed outside building and/or in damp locations are FS weatherproof type. If in direct contact with the ground, they are to be made of cast iron.

.7 Provide a suitable outlet box for each luminaire, switch, receptacle or other outlet, approved for the particular area in which it is to be installed.

2.2 CONDUIT BOXES

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

2.3 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Support outlet boxes independently of conduit and cable.

.2 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.

.3 Offset outlet boxes, shown back to back in partitions, horizontally to minimize noise transmission between adjacent rooms.

.4 Use gang boxes at locations where more than one device is to be mounted. Use combination boxes with suitable barriers where outlets for more than one system are shown.

.5 Flush mount boxes, panels, cabinets and electrical devices, which are installed in finished areas, and fit with suitable flush trims and doors or covers, unless specifically noted otherwise.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No. 1-04(R2009), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.

.2 CSA C22.2 No. 45-M1981(R2007), Rigid Metal Conduit.

.3 CSA C22.2 No. 56-04(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.4 CSA C22.2 No. 83-M1985(R2008), Electrical Metallic Tubing.

1.2 SUBMITTALS

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

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.

.2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.3 Flexible metal conduit: to CSA C22.2 No. 56, steel.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller.

.1 Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for NPS 1 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT.

.1 Set-screws are not acceptable.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

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

.2 Use rigid galvanized steel threaded conduit except where specified otherwise.

.3 Use electrical metallic tubing (EMT) except in cast concrete or susceptible to mechanical injury.

.4 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.5 Mechanically bend steel conduit over 19 mm diameter.

.6 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.7 Install fish cord in empty conduits.

.8 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.9 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Do not pass conduits through structural members except as indicated.

.5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 74 21 – Construction/Demolition Waste Management And Disposal.

.3 Section 26 05 00 – Common Work Results – Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2No.29-M1989(R2000), Panelboards and enclosed Panelboards.

1.3 SHOP DRAWINGS

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

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

Part 2 Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 250 and 600V panelboards: bus and breakers rated for 10,000A (symmetrical) interrupting capacity or as indicated.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Two keys for each panelboard and key panelboards alike.

.6 Copper bus with neutral of same ampere rating as mains.

.7 Mains: suitable for bolt-on breakers.

.8 Trim with concealed front bolts and hinges.

.9 Trim and door finish: air dried grey enamel.

2.2 LIGHTING AND RECEPTACLE TYPE PANELS

.1 Provide engraved nameplates, after completion of wiring, in accordance with details specified in Article "Equipment Identification".

.2 Panels to be constructed and finished in accordance with details specified in Article "Panel Trim".

.3 After completion of wiring, type directory showing a clear description of each circuit being controlled from panel and place in metal frame inside door.

.4 In panelboards where changes to circuiting have occurred, replace the existing directory with new typed directory updated to reflect changes that have occurred.

.5 Panels to be constructed and finished in accordance with details specified in Article "Panel Trim".

.6 Panels to be dead front type in code gauge steel enclosures.

.7 Each panel is to be dead front type in code gauge steel enclosures.

.8 Panels are to have mains of voltage and capacity, and main and branch breakers and contractors, as shown on the "Lighting and Receptacle Panel Schedule". Spaces to include necessary bus work such that the Owner, at a later date, need buy only the breakers.

.9 Contactors in panel mains to be electrically operated, mechanically held and rated to loads as shown. Contactors to be mounted within panel and to be open type. Contactors to be complete with fuse and fuse adapter mounted and connected to line side of contactor and to be connected to supply power to operating coil. Coil clearing contacts shall be included in contactor where a contactor is controlled by a time switch, photo switch or similar device.

.10 Contactors to be as manufactured by:

.1 Ascoelectric Ltd. – Bulletin 920 Series

.2 Or Accepted Equivalent.

.11 Where panels exceed 42 circuits, use multi-section panel with main cross-over solid bus bars. Main bus capacity of each section to be full size to match cross-over bus.

.12 Provide isolated grounding bar in all new and existing panelboards mounted on insulators for connection from isolated ground type receptacles.

.13 Connect ground bar in each panel with minimum #1/0 green insulated ground conductors to ground bar on existing bus duct riser.

.14 Breakers to have bolted type connections. Two and three pole breakers to be common trip type with a single handle, suitable for voltage applied and of same manufacture as single pole breakers.

.15 Breakers servicing bedrooms shall be Arc-Fault type.

.16 Panels for 120/208 volt, 3 phase, 4 wire systems to be complete with full size breakers with a symmetrical interrupting capacity of 10,000 A.

.17 Panels for 347/600 volt, 3 phase, 4 wire systems, to be complete with breakers having a symmetrical interrupting rating of 14,000 A.

.18 Panels to be factory assembled of the same manufacture as existing building panelboards.

.19 Panels to be factory assembled, of the same manufacture and shall be as manufactured by one of the following:

.1 Federal Pioneer Ltd.

.2 Siemens Canada Ltd.

.3 Square “D” Company (Canada) Ltd.

.4 Westinghouse Canada Ltd.

.5 Or Accepted Equivalent.

.20 Provide locking bars on non-switched circuits where panels are used for switching lighting circuits.

2.3 POWER PANELS

.1 Provide engraved nameplates, after completion of wiring, in accordance with details specified in Article “Equipment Identification”.

.2 Panels are to be constructed and finished in accordance with details specified in Article “Panel Trim”.

.3 Power panels to be surface or flush-mounting type as shown.

.4 Connections between main buses are to be made with solid bus bars to match when a panelboard comprises two or more sections Buswork in panel is to be copper throughout.

.5 Panels are to be complete with branch breakers, spares and spaces as shown. “Spares” are to be complete breakers. “Spaces” are to be understood to include necessary bus work such that the Owner, at a later date, need buy only breakers.

.6 Sectionalize panels so that flush panels do not exceed 1850mm (72”) and surface panels do not exceed 2300mm (90”) in height, unless noted otherwise.

.7 Power panels to be of same manufacture as lighting and receptacle type panels.

.8 Breakers to be of quick-make, quick-break, bolted connection moulded case type with thermal magnetic trips and interrupting capacity shown on Power Panel Schedule.

.9 Panelboards to be factory assembled type CDP, unless otherwise specified.

.10 Provide power panels, surface or flush mounting type as shown.

2.4 BREAKERS

.1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for 10% of 15 to 30A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.

Part 3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00 – Common Work Results – Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.2 PANEL TRIM

.1 Panels to be given a rust-resistant treatment to both tub and trim.

.2 Flush panels to have concealed hinges and flush type combination lock latch. Locks to be chrome plated. Doors are to open minimum 235 degrees. Trims to have fasteners concealed and shall be prime coated to receive room finish paint.

.3 Surface mounted panels to:

.1 Have manufacturer’s standard trim complete with lock and latch.

.2 Be finished with two coats of grey ASA No. 61.

.4 Surface mounted panels to be finished as follows, based on Bapco colours:

.1 Normal power - Pale Blue

.2 Emergency power - 28031 (International Orange)

.5 Panel locks to be common to one key throughout project

.6 Locks are to match those used in most recent renovation or addition to project.

.7 Recessed panels to have standard flush trims.

.8 Co-ordinate panel finish with Room finish Schedule.

.9 Deliver two (2) duplicate keys for panel locks to Owner.

3.3 PANEL MOUNTING HEIGHT

.1 Mount electrical panels, where possible, with top of trim at uniform height of 1900 mm (6'-6") or to match door heads or to suit tile layout.

.2 Provide three 25 mm (1") empty conduits from top and from bottom.

.3 Provide three 50 mm (2") empty conduits from top and from bottom, of power panels.

.4 Cap ends of conduits in accessible locations in ceiling spaces above and below panels, to allow for future wiring.

.5 Cap ends of conduits for panels located in areas with raised floors, in raised floor area to allow for future wiring.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 01 33 00 - Submittal Procedures.

.2 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.2 SUBMITTALS

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

.2 Product Data:

.1 Provide fuse performance data characteristics for each fuse type and size above 60A. Performance data to include: average melting time-current characteristics.

.3 Shop Drawings:

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

.2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in switchboard.

.3 Store fuses in original containers in storage cabinet.

.4 Waste Management and Disposal:

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

1.4 MAINTENANCE MATERIALS

.1 Three (3) spare fuses of each type and size installed above 60A.

Part 2 Products

2.1 FUSES - GENERAL

.1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

.2 Fuses: product of one manufacturer.

2.2 FUSE TYPES

.1 Class L fuses.

.1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type L2, fast acting.

.2 Class J fuses.

.1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type J2, fast acting.

.3 Class R -R fuses.

.1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.

.2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

.4 Class C fuses.

Part 3 Execution

3.1 INSTALLATION

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices.

.1 Install rejection clips for Class R fuses.

.3 Ensure correct fuses fitted to assigned electrical circuit.

.4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

.5 Install spare fuses in fuse storage cabinet.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5-[02], Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.4 SUBMITTALS

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

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers: to CSA C22.2 No. 5

.1 Electronic trip molded case standard function 80% rated circuit breakers

.2 All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup Ground Fault Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.

.3 Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated drawing.

.4 Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

.2 Common-trip breakers: with single handle for multi-pole applications.

.3 Circuit breakers shall have a minimum interrupting capacity of 50,000 AIC at 120/208V and 600V.

.4 Moulded-case circuit breakers shall be Schneider LSI series or approved equivalent.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers in accordance with manufacturer's instructions.

.2 Provide new doors and panels as required.

.3 Test, Commission and place into working order.

.4 Provide all Lamacoid Name Plates and permanently fix to the Distribution Board.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for fused and non-fused disconnect switches.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 29.06 - Health and Safety Requirements.

.3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.4 Section 26 05 00 - Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4-[M89 (R2000)], Enclosed Switches.

.2 CSA C22.2 No.39-[M89 (R2003)], Fuseholder Assemblies.

1.4 SUBMITTALS

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

1.5 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for recycling and place in designated containers in accordance with Waste Management Plan.

.5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible and non-fusible, disconnect switch in CSA Enclosure to CAN/CSA C22.2 No.4, size as indicated on drawings.

.2 Provision for padlocking in on-off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.

.5 Fuseholders: to CSA C22.2 No.39 suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 78 00 – Closeout Submittals.

.3 Section 26 05 00 – Common Work Results – Electrical.

1.2 REFERENCES

.1 International Electrotechnical Commission (IEC)

.1 IEC 947-4-1, Part 4: Electromechanical contactors and motor-starters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide shop drawings: in accordance with Section 01 33 00 – Submittal Procedures.

.1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.

.2 Provide shop drawings for each type of starter to indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout and components.

.4 Enclosure types.

.5 Wiring diagram.

.6 Interconnection diagrams.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.

.2 Submit operation and maintenance data for each type and style of motorstarter for incorporation into maintenance manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 MATERIALS

.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 MOTOR STARTERS

.1 Motor starters to be electromechanical type with coil control and overload integrated into a single or dual microcontroller.

.2 Install motor starters in accordance with manufacturer's instruction, connect all control wiring.

.3 Temperature operating range for motor starters to be within a range of -40 to 65 degrees C and shall meet or exceed the following Standards and Certifications: UL, CSA, NEMA ICS1, ICS2, ICS5, IEC 60947-4-1, CE, and KEMA where applicable.

.4 Motor starters are to:

.1 Have one torroidal current sensor, accurate to 2%, per phase to provide input to analog circuitry and software that yields a time-current curve paralleling actual motor heating. Motor FLA is to be set via a potentiometer for 1.0 or greater Service Factor settings.

.2 Provide phase loss and current unbalance protection; such that an unbalance of any phase greater than or less than approximately 50% of the average will cause device to trip. This feature shall be field adjustable to be enabled / disabled.

.3 Accommodate auxiliary contacts of various combinations of single and dual auxiliaries. Mechanical interlock on contactors are to prevent closing of one contactor when the other is closed.

.4 Provide Manual, Remote Reset, or Auto Reset capability.

.5 Be equipped with fuseless overcurrent protection, two (2) 24V DC LED type indicating lights (Run and Stop), HOA switch, an NO OL trip contact, an NC auto contact, and two (2) NO contacts, unless otherwise noted.

.5 Overload trips to be selectable with Trip Class of 10, 20 and 30 on overload relay. Trip Class to be field adjustable using the Test button and FLA dial. Provide each motor starter with a lockable cover that prevents unwanted tampering of FLA dial settings once installed.

.6 Motor starters shall have replaceable fixed and movable contacts, and shall have no laminations, shading coils, or magnet noise.

.7 Motor starters to match base building standards.

2.3 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 – Common Work Results – Electrical.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results – Electrical.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses installed.

.4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results – Electrical and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING

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

.2 Waste Management: separate waste materials for reuse and recycling.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results

.2 Section 26 05 21 – Wires and Cables

1.2 SECTION INCLUDES

.1 Variable speed drives for fans, EF-18, RFD-1, RFE-1.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.

.2 CAN/CSA-C22.3 No. 1-01(Update March 2005), Overhead Systems.

.3 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

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

.1 Provide shop drawings for each type of variable speed drive to indicate:

.1 Mounting method and dimensions.

.2 Variable Speed Drive size and type.

.3 Layout and components.

.4 Enclosure types.

.5 Wiring diagram.

.6 Interconnection diagrams.

1.5 CLOSEOUT SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Submit operation and maintenance data for each type and style of variable speed drive for incorporation into maintenance manual.

Part 2 Products

2.1 VARIABLE SPEED DRIVES

.1 Variable Speed Drive shall be as manufactured by:

.1 ABB or manufacturer to match existing.

.2 To be mounted in a NEMA 3R metal enclosure with hinged door;

.3 Drives shall be CSA and ULC certified;

.4 Drives shall carry a minimum 2-year on-site parts and labour warranty;

.5 Rating: As shown on Schedules on E-1 VSD to be rated for Pump.

2.2 GENERAL FEATURES:

.1 Suitable to be capable of continuous operation at a minimum of 115% of rated motor full load current.

.2 Door interlocked, padlock able circuit breaker that will disconnect all input power from the drive and all internally mounted options;

.3 Door mounted keypad with complete programmability of display, including Hand-Off-Auto, Run, Digital Speed Control on hand mode, and Help key;

.4 Real time clock including date and time stamp on all fault conditions;

.5 Unit shall be mounted in a NEMA 12 enclosure with temperature controlled cooling fans as per manufacturers recommendation;

.6 Drive efficiency of 97% or greater at full load;

.7 Over voltage and under voltage protection;

.8 Built in PID controller;

.9 Programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include voltage (0 to 10 V DC, 2 to 10 V DC) and current (0 to 20 mA, 4 to 20 mA) input;

.10 Programmable 0 to 20 mA analog outputs shall be provided for indication of VSD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24 V DC status indication;

.11 Network communication with DDC system with BACnet protocol;

.12 USB port or RS232 for PC programming access;

.13 Drives shall fail to OFF in the event of a Variable speed drive or control system failure.

.14 Factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection shall be provided in both drive and bypass modes. Operation shall switch to bypass mode automatically upon failure of VSD.

.15 Provide on cover or adjacent to each VSD an operations, laminated tips sheet. Each sheet shall include steps for general operation and methods for general operation including steps for switching to bypass. Include emergency contact information for support.

2.3 PRIMARY PROTECTION BETWEEN VSD AND POWER SUPPLY (LINE REACTOR)

.1 EMI/RFI filters to attenuate radio frequency interference conducted to the AC line.

.2 The VSD shall have a 5% impedance inductive line reactor, DC Link Choke, upstream of each VSD to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors.

2.4 SECONDARY PROTECTION BETWEEN VSD AND MOTOR (LOAD REACTOR)

.1 Secondary protection between drive and motor shall include a 5% load reactor.

2.5 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.6 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Supply nameplates for VSD identification. Nameplates shall indicate equipment being controlled and voltage. Fasten or cement nameplates to equipment in a conspicuous location.

Part 3 Execution

3.1 INSTALLATION

.1 Install variable speed drives and control devices in accordance with manufacturer's instructions.

.2 Confirm fan nameplate and adjust overload device to suit.

.3 Provide wiring and any additional devices required to integrate the new drives to existing DDC system and alarm system. Reroute or extend all control wiring to suit.

.4 Add a lamicoid warning label to existing safety switch. Label to read as follows, "Emergency Use Only. Do not operate unless VSD has first been turned off."

.5 Where required, construct a structural mounting stand, seismically secured to floor, for the mounting of the VSD's.

3.2 WIRING

.1 Include for the VSD wiring and conduit installation.

.2 Use separate conduit installation for each of the following: motor wiring, fire alarm wiring, power wiring, and control wiring. Install all wiring in conduit. Flexible liquid tight flexible conduit to be used for connection to motor.

.3 Provide all required relays, contactors and equipment for interfacing any specified equipment with fire alarm system and provide verifications of system as required.

.4 Once transfer of existing power and control wiring to new VSD is complete, remove all redundant or obsolete wiring from the existing starter.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Sections 26 05 00 - Common Work Results for Electrical, 01 91 13 – Testing and Commissioning and manufacturer's instructions.

.2 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

.3 An approved representative of the drive manufacturer shall set-up, start and commission the drive and fan combinations on site.

.4 A complete report with all VSD parameters and readings, which includes but not limited to VSD and accessories technical information, model and serial number, installation check-out, voltages and amperages on normal and bypass mode, motor information data, ambient and inside enclosure temperatures, measurements of the harmonics and voltage peaks at the motor, and all setup parameters, shall be submitted to the Consultant.

END OF SECTION