1.1 GENERAL

.1 The nature of this short form specification indicates that detailed execution and regulatory requirements may not be present in this section. It is expected that the contractor shall make allowance for exclusive arising from the use of this short form in bid price, and include all requirements that would be necessary if this had been a standard, three part format specification.

.2 Any clarification of scope, intent or specification information or otherwise required to complete the project shall be questioned during the tender process prior to the last addendum.

.3 Contract documents are diagrammatic only. They are to establish scope, material and quality. They are not detailed installation drawings. Minor details usually not shown or specified and any incidental accessories required for proper installation of the system are to be included in the work.

.4 Contractor is to ensure that all intended equipment will fit within given spaces. Make reference to the electrical, mechanical, architectural and structural drawings, when setting out work and before ordering equipment.

.5 The Contractor shall visit the site prior to tender and verify existing conditions. No claims for extras will be allowed for work or materials necessary for proper execution and completion of the Contract or for the Bidder's failure, error, or negligence in this regard.

.6 Coordinate activities with other sections and trades to minimize conflicts that may arise.

1.2 CODE COMPLIANCE

.1 All work shall conform to current editions of National, Provincial and Municipal Codes, Standards and Acts; and will meet the requirements of Authorities having jurisdiction.

1.3 LIABILITY

.1 Assume responsibility for layout of work; and for any damage caused to the Owner or others 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. Coordinate deliveries with the general contractor.

1.4 PERMITS, CERTIFICATES and FEES

.1 Permits and Compliance Monitoring:

.1 Arrange for the services of an agency authorized by Alberta Labour to issue permits and provide compliance monitoring in non-accredited municipalities.

.2 Agency shall not be affiliated with the Contractor in any fashion.

.3 Submit name of agency and other relevant information to the Consultant for review and acceptance.

.2 Compliance monitoring shall consist of a minimum of 3 site inspections: site services, rough-in, and final.

.3 Submit necessary drawings and specifications to the agency before commencement of the Work.

.4 Submit certificate of acceptance issued by the agency on completion of the Work.

.5 Pay associated fees with respect to obtaining permits and certificates.

1.5 CUTTING AND PATCHING

.1 All work shall be coordinated with other trades especially that related to cutting and patching of required openings; and locations and installation of sleeves, inserts, support, curbs, frames and access doors.

.2 Obtain approval from structural and electrical engineers before drilling and coring of existing structure.

.3 Provide X-ray of all required penetrations of the floor. X-ray use for locating in floor rebar and conduit to be done after normal working hours. Take necessary precautions to protect computer equipment when X-raying floors. Coordinate with Owner.

1.6 ALTERNATIVE MATERIALS AND EQUIPMENT

.1 Contract price shall be based on materials and equipment specified. Approval by Consultant of equipment submitted by the mechanical trade as equal to that specified does not relieve the mechanical trade of any responsibility.

.2 Revisions required to adapt accepted equals and alternatives shall be included in the contract price. No increase in the contract price will be considered to accommodate the use of equipment other than that specified.

.3 Certain items of equipment and items of work (such as balancing, water treatment) may not have an approved equal due to the need to have a consistent type or source of maintenance. Refer to specific clauses in this specification.

1.7 SUBMITTALS

.1 Shop drawings: Submit shop drawings in PDF format to Consultant for all equipment specified in the specification or drawings for review. Do not order equipment or materials until Consultant has reviewed shop drawings.

.2 Closeout documents:

.1 Record information using red pen on one (1) set of prints and specification manual dedicated for the use of Record Documents.

.2 Indicate all changes and variations from Contract Drawings concurrently with construction process; do not conceal any work until required information is recorded.

.3 Include sufficient information to accurately record actual construction including, but not limited to the following:

.1 Measured locations of equipment, ducting and piping concealed in construction to be referenced to visible and accessible features of construction.

.2 Field changes of dimension and detail or changes in construction materials or locations required by on-site conditions and to make components of the Work come together.

.3 Changes to equipment layout and services.

.4 Deviations in piping, duct runs, wiring, and utility connections.

.5 Actual locations of equipment referenced to fixed structural elements for items that are schematically indicated on the Drawing.

.6 Changes required by Addenda, Bid Revisions, Change Orders, Work Orders and Construction Communications.

.4 Make recordings immediately after the respective Work is completed and not less than once a week; date each recording.

.5 Changes to specification sections shall be legibly noted in the margins of the document or by stapling a sheet of white paper to the margin and referencing the affected article(s); use of adhesive tape or self-sticking removable notes will not be acceptable for this purpose.

1.8 WORKAMNSHIP AND MATERIALS

.1 Materials shall be new, carry CSA or ASTM labelling indicating approval.

.2 Only use new materials, except where specifically detailed or indicated that existing materials shall be re-used.

.3 Workmanship shall be performed in a neat and professional manner; as a minimum, the Consultant will expect that:

.1 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services to free space.

.2 Remove and replace improperly installed equipment as required to repair or rectify the deficiency at no extra cost.

.3 Damaged or incorrectly installed materials be removed and replaced.

.4 Damaged finishes are restored to match original finishes.

.5 Structural, Architectural or Electrical items are not damaged, altered, or interfered with by installation of materials by this Section, whether caused directly or indirectly because of their work.

.6 Site is left in clean and tidy at the end of each workday by removing tools, equipment, ladders, and empty cardboard boxes from site, and premises are left broom clean at the end of the week.

.4 Employ only tradesmen properly licensed to perform the specific work. The Consultant may perform spot checks for trade tickets and accreditation.

.5 Provide 1 year comprehensive warranty on all materials and workmanship.

1.9 SELECTIVE DEMOLITION

.1 Use new materials required for completion or repair matching materials damaged during performance of work of this Section demolition; new will meet assembly or system characteristics and carry CSA approval labels required by the Authority Having Jurisdiction.

.2 Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise as being retained and reconditioned for re-use in new construction.

.3 Demolished Materials: Demolished materials become the property of the Contractor.

.4 Salvaged Materials: Carefully remove materials designated for salvage and store in a manner to prevent damage or devaluation of materials.

.5 Hazardous Waste Materials: Carefully remove and store hazardous waste materials separately from other construction waste using storage barrels and procedures in accordance with the Authorities Having Jurisdiction.

.6 Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before submitting Bid; Owner will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit:

.1 Examine site and local conditions to determine any difficulties in carrying out work indicated and specified prior to submitting Bid.

.2 Examine site carefully and record exact condition of existing materials being removed or demolished.

.7 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations.

.8 Demolition, Removal:

.1 Disconnect and cap mechanical services in accordance with requirements of local authority having jurisdiction and with approval of the Owner.

.2 Do not disrupt active or energized utilities without prior approval of the Owner.

.3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes, to occupied building areas; remove partitions when complete.

.4 Demolish parts of existing building to accommodate new construction and remedial work as indicated.

.5 At end of each day's work, leave work in safe condition.

.6 Perform demolition work in a neat and workmanlike manner.

.1 Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.

.2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

.9 Prevent movement, settlement or damage of adjacent services and parts of existing buildings to remain. Provide bracing required.

.10 Take precautions to support services and, if safety of buildings being demolished or of adjacent structures or services appears to be endangered, cease operations and notify the Consultant.

.11 Prevent debris from blocking drainage inlets. Protect mechanical and electrical systems that must remain in operation.

.12 Arrange demolition work so that interference with the use of the buildings by the Owner and users is minimized.

.13 Prevent debris from endangering the safe access to and egress from occupied buildings.

.14 Conform to the requirements of the referenced regulations as minimum.

1.10 RENOVATION

.1 Work associated with existing installation shall be carried out as follows:

.1 Schedule modifications and additions to existing mechanical systems so that interruptions to normal operations are kept to an absolute minimum, if at all.

.2 Schedule renovations so that areas adjoining the area of work are kept operational and include costs and equipment for temporary measures that become necessary to achieve this to maintain services.

.3 Schedule work to the satisfaction of the Consultant and for approval by the Owners, whose convenience will be of the foremost importance.

.2 Disconnect, remove, recondition and reinstall existing mechanical equipment identified for re-use in new locations as detailed on the Drawings, and as follows:

.1 Allow for removal and reinstallation of existing mechanical systems where necessary to accommodate the work of other trades, coordinate with architectural, electrical and structural drawings for full extent of work involved with this project.

.2 Completely remove existing mechanical installations, in areas identified for removal, where existing installations have been replaced by new installations and where these have not been specifically indicated for re-use, refer to Drawings.

.3 Examine existing materials specifically indicated for re-use before submission of Bid so that any work or materials necessary for cleaning and upgrading are included in the Bid; extras for items that could have been determined during a pre-bid examination will not be considered during construction phase of the work.

.4 Render the installations safe at locations where existing equipment has been removed.

.5 Remove and dispose of existing materials that are not scheduled for re-use, unless specifically indicated that materials are turned over to the Owner, then store materials in location directed by Owner.

.6 Restore any systems that may be disrupted by the removal of existing material or equipment, or because of renovation.

.3 Maintain existing mechanical systems outside of area being renovated, but passing through the area, in a functional and operational condition for the entire construction period:

.1 No interruptions will be allowed.

.2 Be responsible for identifying services that must be maintained.

.4 Not all existing equipment and devices may be shown on the drawings:

.1 Obtain clarification from the Consultant on unidentified equipment before submittal of bids.

.2 Be responsible for restoring connections to equipment in the area of renovation.

1.11 SUBSTANTIAL COMPLETION INSPECTION

.1 Advise Consultant five (5) days prior to the date inspection is desired. All systems to be fully operational and any deficiencies should be noted to the Consultant.

.2 All deficiencies shall be completed within two (2) weeks after substantial completion and letter submitted to Consultant within that time advising that the work is complete. Failure to complete work will result in work being done by the Owner and the costs deducted from final payment.

.3 The following shall be an outline checklist of the minimum requirements to be met by the contractor prior to the Consultants' Substantial Performance by the contractor.

Inspection:

- ☐ Vibration isolation supplier's inspection report
- ☐ Major equipment – suppliers start-up test sheets and letters certifying start up. (domestic water heater, exhaust fans, packaged equipment)
- ☐ Final As-Built Drawings ready for review
- ☐ Maintenance and operation manuals, ready for review

1.12 COORDINATION WITH OTHERS

.1 Contractor shall review all equipment requiring electrical hook-up with Electrical Contractor and electrical drawings prior to ordering equipment. Ensure proper electrical characteristics are determined for all affected and related work. This is part of the contractors shop drawing review and no extras will be considered for Div. 16/16 power mismatches.

.2 Coordinate with proper utilities for services such as water, sewer, natural gas, and assume all charges.

.3 Coordinate with the owner to shutdown, disconnect, reroute, or make connection to existing services. Provide written 24 hour notice for all service shutdowns.

1.13 OPERATION AND MAINTENANCE MANUALS

.1 Provide three (3) copies of manuals prepared by qualified and experienced personnel for use by Owner. Manuals form part of the contract and must be delivered to the Consultant before work will be considered complete. Each manual shall provide the following:

.2 Layman's description of all mechanical systems including operating maintenance and lubrication instructions,

.3 Certification of all equipment where required by local codes and authorities,

.4 Shop drawings and maintenance bulletins,

.5 List address and telephone numbers of all equipment suppliers and contractors.

.6 Performance details for all equipment including curves for fans and pumps with actual operating points noted.

.7 Provide this maintenance manual in electronic format documents, scanned drawings, autocad files, microsoft powerpoint etc.

1.14 TESTING AND BALANCING

.1 Testing and balancing shall be performed by an agency that specializes in this type of work. Balance, adjust and test work included in the specifications:

.1 Balance systems to ±10% of design values.

.2 Balance only new work and where existing is indicated to be balanced.

.2 Perform all necessary tests to confirm the correct operation of all systems affected by the renovations.

.3 Submit all test results in duplicate to the Consultant for approval.

1.15 COOPERATE WITH THE BALANCING AGENCY

.1 Make any corrections as required by Balancing Agency.

.2 Allow Balancing Agency free access to site during construction phase. Inform Balancing Agency of any major changes made to systems during construction and provide a complete set of record drawings and specifications for their use.

.3 Operate automatic control system and verify set points during balancing.

.4 Provide and install pulleys and sheaves for rotating equipment, as required to properly balance the systems to design flows, without additional cost to Owner.

.5 Allow in the contract price shaving of impellers as required to balance the pumps to design flow at operating condition.

1.16 PAINTING AND IDENTIFICATION

.1 Identify piping with labels and flow arrows. Provide identification at *15 m* maximum intervals, before and after pipes passing through walls, at all sides of tees, behind access doors. Use Brady B-500 vinyl cloth labels for non-insulated pipes and B-350 for insulated pipes.

.2 Provide *20 mm* diameter brass tags, secure to valve stems with key chain

.3 Identify electric starting switches, thermostats controlling motors and equipment supplied under this division with lamacoid plates having *6 mm* minimum letter size.

1.17 FIRE-STOPPING

.1 Fire-stop all pipe and duct penetrations through floors and walls, designated as fire and/or smoke separations.

.2 Fire-stopping materials to meet ULC CAN 2S115. Acceptable Materials: by "Tremco" or "National Firestopping" or approved alternate.

.3 Preparation of surfaces and installation of fire-stopping materials shall be carried out as per manufacturer's instructions.

1.18 METRIC CONVERSION

.1 All units in this division are expressed in metric units.

.2 When CSA approved IP Metric pipes are available and are provided, the contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings and equipment.

EQUIVALENT NOMINAL DIAMETERS OF PIPE

mm	Inches	mm	Inches	mm	Inches
3	1/8	65	2½	375	15
6	1/4	75	3	450	18
10	3/8	100	4	500	20
12	1/2	125	5	600	24
20	3/4	150	6	750	30
25	1	200	8		
30	1¼	250	10		
40	1½	300	12		
50	2				

.3 Metric Duct Sizes

.1 The metric duct sizes are expressed as1 inch=25 mm.

1.19 PIPING

.1 General

.1 Install piping approximately as shown, with all lines being carried parallel to building walls as close to the structure as possible, or as detailed on the drawings.

.2 Align and support all piping properly. Under no circumstances may any piping load be transferred to the equipment or other piping. Make all equipment

connections so as to allow disassembly of the piping for equipment removal and maintenance.

.3 Install all piping to allow for expansion and contraction without unduly stressing pipe or connected equipment.

.2 Piping Material:

.1 Heating:

.1 Up to 50mm: banded malleable iron, screwedjoints.

.2 50mm and larger: Schedule 40 black steel, ASTM A53,Grade B; welded or grooved mechanical coupling with angle pattern bolt.

.3 Test to 1-1/2 times maximum working pressure or 1035 kPa, whichever is greater, water pressure measured at system low point.

.2 Natural gas: Steel, Schedule 40: ASTM A53/A53M, Grade B, welded.

.3 Domestic water above ground: Type "L" Hard Copper, ASTM B88, 95-5 solder.

.4 Equipment drains and overflow: cast brass, screwed.

1.20 PIPE HANGERS AND SUPPORTS

.1 All piping shall be firmly supported and securely braced. Provide copper plated hangers and supports for copper piping and galvanized hangers and supports for galvanized piping.

.2 Use of perforated straps is not permitted for pipe hangers.

.3 Provide ring type hangers for piping up to *40 mm* and clevis type hangers for piping over *40 mm*.

.4 Pipe Support Spacing

Pipe Size	Rod Diameter	Spacing
(in.) (mm)	**(in.)** (mm)	**(ft.)** (m)
1/2 (12)	**3/8 (**9)	**6 (**1.8)
3/4 to 1½ (20-40)	**3/8 (**9)	**8 (**2.4)
2 to 2½ (50-65)	**3/8 (**9)	**10 (**3.0)
3 to 4 (75-100)	**5/8 (**16)	**12 (**3.6)
6 to 12 (150-300)	**7/8 (**22)	**14 (**4.3)

.5 Expansion Compensation

.1 Provide expansion compensators, guide and anchors where required and where indicated.

1.21 VALVES

.1 Domestic Hot And Cold Water System Valves

.1 Ball valves up to *50 mm*; bronze body, chrome plated, bronze ball, threaded or solder ends, TFE seat and packing. *4134 kPa* non shock W.O.G. rating, Toyo/Red & White 5044A/5049A.

.2 Gate valves up to *50 mm* shall be bonze, solid wedge, rising spindle, *1378 kPa* W.O.G., threaded endsToyo/Red & White 293. Solder ends Fig. 299.

.3 Globe valves up to *50 mm* shall be bronze composition disc type fitted with No. 294-S disc for cold water; and No. 110 disc for hot water service. toyo/Red & White 221 for threaded ends; and Fig. 212 for solder ends.

.4 Inside hose bibbs shall be bronze body, globe valve, renewable disc, garden hose outlet, *2070 kPa* rating.

.2 Heating Valves:

.1 Ball Valves up to 50 mm: Brass body, chrome plated brass ball, threaded or solder ends, TFE seat and packing. 4134 kPa non-shock WOG rating. Threaded, Red-White Fig. 5044A. Solder joint, Red-White Fig. 5049A.

.2 Globe Valves up to 50 mm: Bronze body, screw over bonnet, threaded ends rating 1035 kPa steam, solder ends rating 2070 kPa water. Threaded, Red-White Fig. 221. Solder ends, Red-white Fig. 222.

.3 Globe Valves 65 mm and over: Cast iron body, flanged ends, O.S. and Y, renewable bronze seat ring, renewable composition disc. Rating 860 kPa steam. 1380 kPa water. Red-White Fig. 400.

.4 Gate Valves up to 50 mm: Bronze body, inside screw, travelling stem, solid wedge, screw-in bonnet, threaded ends rating 860 kPa steam, solder ends rating 1380 kPa water. Threaded, Red-White Fig. 293. Solder ends, Red-White Fig. 299.

.5 Gate Valves 65 mm and over: Cast iron body, bronze trim, O.S. and Y, rising stem, solid wedge, flanged ends, rating 860 kPa steam. Red-White Fig. 421.

.6 Swing Check Valves up to 50 mm: Bronze body, screw-in cap, replaceable disc, 860 kPa steam rating. Threaded, Red-White Fig. 236. Solder ends, Red-White Fig. 237.

.7 Swing Check Valves 65 mm and over: Cast iron body, regrind-renew swing check, bolted cover, flanged ends, bronze disc and seat ring, rating 860 kPa steam. Red-White Fig. 435.

.8 Silent Check Valves for Pump Discharge:

.1 Up to 50 mm: Bronze body, SS stem, 316 SS spring, teflon disc and seat ring, 430 SS seat screw, threaded ends. 1380 kPa water. Val Matic VM-S1400.

.2 65 mm and over: Wafer style, cast iron body, 316 SS seat, plug, spring and bushing. ANSI Class 125. Val Matic, Series 1400.

.9 Drain Valves up to 50 mm: Brass 2 piece body ball valve, blowout proof stem, teflon seats, forged brass chrome palted ball, hose end connection with cap and chain by male IP, 4200 kPa water, oil, gas rating, Red-White Fig. 5046.

.3 Installation:

.1 Install valves with stem upright or horizontal, not inverted.

.2 Install valves for shut-off and isolating service, to isolate all equipment, parts of systems, or vertical risers.

.3 Where butterfly valves are installed, provide threaded lug type valves on flanged systems. Victaulic connections where approved.

.4 Install globe or angle valves for throttling service and control device or meter by-pass.

.5 Provide drain valves at main shut-off valves, low points of piping and apparatus and terminal units.

.6 Provide valved drain and hose connection off the bottom of all strainers.

.7 Install strainers on the inlet to all pumps.

1.22 INSULATION

.1 Piping Insulation

.1 All cold piping to be insulated with fine fibrous glass insulation with factory applied vapour barrier jacket, moulded to conform to piping, "K" value at *24˚C* maximum *0.035 w/m ˚C*. Recover with ULC labelled thermocanvas.

.2 All hot piping to be insulated with fine fibrous glass insulation with factory applied general purpose jacket, moulded to conform to piping, "K" value at *24˚C* maximum *0.035 w/m˚C*. Recover with ULC labelled thermocanvas.

Piping to be Insulated	Pipe Size	Insulation Thickness *(mm)*
Domestic Cold Water	to *40 mm*	*15*
	50mm & Over	*25*
Domestic Hot and Recirc	to *40mm*	*25*
	50mm & Over	*40*

Heating	to 30mm	25
	40mm & over	50
Condensate drains from indoor air conditioning	All sizes	*12*

1.23 PLUMBING

.1 Plumbing General

.1 Install vacuum breakers, trap primers and backflow preventers on plumbing lines as required by code.

.2 Check invert elevations prior to sanitary and drainage connections.

.3 Grade drainage lines 2%, unless noted otherwise.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Provide or replace all materials and services as documented within these specifications and as required to furnish a complete and fully operational DDC Building Automation System to monitor and control the building systems referred to in this specification.

.2 The work includes the supply and installation of DDC controllers, instrumentation, control devices, conduit, wiring, tubing and other devices as necessary to provide a complete system of automatic controls, compliant with these specifications.

.3 Supply, install and configure all software, programming and databases; set up equipment operating schedules; and perform system activation functions as identified within these specifications, to provide a complete and fully operational BMS.

1.2 RELATED SECTIONS

.1	Electrical:	Division 26.
.2	Short Form Mechanical Provisions:	Section 20 00 15.
.3	Integrated Automation Local Control Units:	Section 25 14 00.
.4	Integrated Automation Input-Output Devices:	Section 25 30 10.
.5	Integrated Automation Control Sequences:	Section 25 90 00.

1.3 WORK BY OTHER TRADES

.1 Electrical contractor shall provide 120V power for Controls Panels, SCU's and Central Computer Equipment.

.2 Mechanical contractor shall install thermal wells, control valves and devices on piping, furnished by controls contractor.

.3 Unless noted otherwise in contract documents, damper operators are supplied and installed by controls contractor.

1.4 ABBREVIATIONS

.1 BMS Building Management System.

.2 OIU Operator Interface Units.

.3 SCU Standalone Control Unit.

.4 CCU Central Computer Unit.

1.5 CODES AND STANDARDS

.1 Install all components in accordance with the latest regulations of the Canadian Electrical Code, applicable Municipal and Provincial Codes and Regulations, and latest CSA Electrical Bulletins.

1.6 SUBMITTALS

.1 Submit shop drawings in accordance with Section 20 00 15.

.2 Provide shop drawings including complete operating data, system drawings, wiring diagrams and written detailed operational description of sequences and engineering data on each control system component. Include sizing and arrangements as requested.

.3 A detailed description of the Building Management System (BMS) and its components, both hardware and software. At a minimum the following is required:

.1 A block diagram of the BAS showing overall configuration and identifying all major components.

.2 A list, along with technical data of every hardware component to be provided, including standalone panels, interface devices, communications devices, sensors, relays, transducers, etc.

.3 A detailed description of the operating system and Operator Control Language (OCL) software, and a list of description of all alarm, reporting, and trending routines, and other application software to be supplied.

1.7 QUALITY ASSURANCE

.1 Install all components in accordance with the latest regulations of the Canadian Electrical Code, applicable Municipal and Provincial Codes and Regulations, and latest CSA Electrical Bulletins.

.2 The equipment manufacturer shall have trained service representatives resident in the Province where project is located.

.3 The following components shall be stocked locally:

.1 Replacement SCU and internal components.

.2 Replacement IP's.

.3 Replacement Sensors and Actuators.

1.8 OWNER ORIENTATION

.1 Contractor to provide three weeks written notice to the Engineer and building Owner prior to commencing formal training sessions.

.2 Formal training sessions shall commence only after "as-built" drawings have been completed, reviewed and approved by the Engineer.

.3 Provide for operator training according to the following schedule.

.1 At job completion a 1 day seminar/workshop for building operators covering all aspects of system use as follows:

.1 Operation of hardware components.

.2 System software configuration.

.3 User/system interaction.

.4 Calibration of sensors and system.

.5 Trouble shooting of system and components.

.6 Preventative maintenance.

.7 Full identification title of the project.

.8 Prime Consultant and Sub-Consultant - full identification.

.9 Prime Contractor - full identification.

.10 Mechanical Contractor - full identification.

.11 Controls Contractor - full identification.

.2 A one day review workshop one month after system acceptance.

.3 A half day seminar, six months after job acceptance, for clarification of system operating techniques for building operators.

.4 Allow for one additional, one day training seminar, in addition to the above seminars, within the first year of operation. This seminar is to be scheduled at contractor proposed time and approved by the owner.

.5 Controls contractor to provide three complete sets of training manuals to the Owner prior to commencing of the training session, plus one manual to the Engineer.

1.9 WARRANTY

.1 The warranty provisions shall commence for one year from the date of final acceptance and shall include, at no cost, all material and labour required to correct control system equipment failures that occur during the one year period.

.2 In addition to warranty call backs provide four service and calibration inspections of a minimum four hours duration each. These calls will be initiated by the contractor. Owner to provide representative contact information.

.3 The contractor shall supply and install at no cost all system software and hardware updates and upgrades occurring prior to the expiration of the warranty period.

1.10 SYSTEM ACTIVATION

.1 Submit control calibration check sheet prior to system acceptance. Check sheets to include unit identification, controller/transmitter tag numbers, device controlled, controller PID settings, interlock devices and wire tag numbers.

.2 Set damper linkages, static pressure/volume controls as required by the Balancing Trade.

.3 Adjust and calibrate all controls ten days prior to system acceptance.

Part 2 Products

2.1 COMMUNICATION PROTOCOL

.1 Native BACnet.

2.2 ACCEPTABLE MANUFACTURERS

.1 Reliable Controls.

.2 Honeywell Controls.

.3 Johnson Controls.

.4 Approved alternate et al

2.3 RELATED ACCESSORIES

.1 Provide and install all necessary transformers, transducers, interposing relays, interface devices, contactors, starters and EP's to perform control functions required.

.2 It is the responsibility of the Contractor to identify, at the time of tender submission, all additional items not specified that are required to meet the operational intent specified.

.3 Items required but not identified at the time of tender acceptance shall be the Contractor's responsibility.

2.4 FREEZESTATS

.1 Safety low limit protection thermostats shall be manual reset type with 6 m elements. Provide multiple thermostats for large duct cross-sectional areas. (Mount thermostats on the outside of the ductwork and no higher than 1,500 mm above the floor). Provide DPDT contacts for connection to SCU.

.2 Remote bulb elements shall be either averaging type of suitable length for air or rigid bulb type for liquids.

2.5 TERMINAL BMS CONTROLLER (TC)

.1 Each TC shall operate as a standalone controller, independent of other controllers in the network. Each TC shall be a microprocessor based, multi-tasking real-time digital control processor.

.2 Each TC shall be able to interface with the BMS.

.3 Features:

.1 PI control.

.2 Unique control algorithm for the application.

.3 Dignostics through portable operator's terminal at the room sensor, TRBC, or SCU.

.4 Return from power failure without operator intervention.

.5 No calibration requirements.

.6 No battery backup requirements to store setpoints and control parameters.

.4 The TC shall be powered from a 24 VAC source and shall function normally under an operating range of 18 to 28 VAC (-25% to +17%), allowing for power source fluctuations and voltage drops. The BAS contractor shall provide a dedicated power source and separate isolation transformer for each controller unable to function normally under the specified operating range. The controllers shall also function normally under ambient conditions of 0˚C to 50˚C and 10% to 95% RH (non-condensing). Install each controller in a hinged Nema 1 enclosure to protect the intelligence board assembly and to facilitate wire installation and terminations to controller. Label each enclosure with lamacoid label.

.5 The TC shall interface with a matching room temperature sensor. The controller shall function to maintain space temperature to within ±0.75˚C of setpoint at the room sensor location.

2.6 DUCT STATIC & FLOW MEASURING GRIDS - EXISTING

Part 3 Execution

3.1 INSTALLATION

.1 Verify location of thermostats, sensors, pushbuttons and other exposed control sensors with drawings before installation. Locate thermostats, space sensors and remote pushbuttons 1,500mm above finished floor.

.2 Install damper motors on outside of ducts. Do not locate in air stream.

.3 Wire "hand/off/auto" selector switches such that automatic operating controls and not safety controls and electrical over current protection shall be overridden when switch is in the "hand" position.

.4 Unless specified otherwise, install all outdoor air sensors on the north exposure of the building.

.5 Install all safety limits at the operator's level.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for building automation controllers including:

.1 Master Control Unit (MCU).

.2 Local Control Unit (LCU).

.3 Equipment Control Unit (ECU).

.4 Terminal Control Unit (TCU).

1.2 RELATED SECTIONS

.1	Common Work Results for Integrated Automation:	Section 25 05 00.
.2	Integrated Automation Input-Output Devices:	Section 25 30 10.
.3	Integrated Automation Control Sequences:	Section 25 90 00.

1.3 SYSTEM DESCRIPTION

.1 General: Network of controllers comprising of MCU(s), LCU(s), ECU(s) or TCU(s) to be provided to support building systems and associated sequences of operations as detailed in these specifications.

.1 Provide sufficient controllers to meet intents and requirements of this section.

.2 Controller quantity, and point contents to be approved by Engineer at time of preliminary design review.

.2 Controllers: stand-alone intelligent Control Units.

.1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.

.2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.

.3 Capable of interfacing with operator interface device.

.4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controllers.

.1 Secondary input used for reset such as outdoor air temperature may be located in other Controllers.

1.4 DESIGN REQUIREMENTS

.1 To include:

.1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.

.2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.

.3 Perform Analogue control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.

.4 Control of systems as described in sequence of operations.

.5 Execution of optimization routines as listed in this section.

.2 Field Termination and Interface Devices:

.1 Electronically interface sensors and control devices to processor unit.

.2 Include, but not be limited to, following:

.1 Programmed firmware or logic circuits to meet functional and technical requirements.

.2 Power supplies for operation of logics devices and associated field equipment.

.3 Lockable wall cabinet.

.4 Required communications equipment and wiring (if remote units).

.5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.

.6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.

.7 Wiring terminations: use conveniently located screw type or spade lug terminals.

.3 AI interface equipment to:

.1 Convert analogue signals to digital format with 10 bit analogue-to-digital resolution.

.2 Provide for following input signal types and ranges:

.1 4 - 20 mA;

.2 0 - 10 V DC;

.3 100/1000 ohm RTD input;

.3 Have common mode signal rejection greater than 60 dB to 60 Hz.

.4 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.

.4 AO interface equipment:

.1 Convert digital data from controller processor to acceptable analogue output signals using 8 bit digital-to-analogue resolution.

.2 Provide for following output signal types and ranges:

.1 4 - 20 mA.

.2 0 - 10 V DC.

.5 DI interface equipment:

.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.

.2 Accept pulsed inputs up to 2 kHz.

.6 DO interface equipment:

.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.

.2 Switch up to 5 amps at 220 V AC using optional interface relay.

.3 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.

.4 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.

.1 Provide for conduit entrance from top, bottom or sides of panel.

.2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.

.5 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.6 Provide surge and low voltage protection for interconnecting wiring connections.

Part 2 Products

2.1 MASTER CONTROL UNIT (MCU)

.1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.

.2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.

.1 MCU must support BACnet.

.3 Central Processing Unit (CPU).

.1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.

.2 CPU idle time to be more than 30% when system configured to maximum input and output with worst case program use.

.3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:

.1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.

.2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, set points, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.

.4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.

.4 Local Operator Terminal (OT)

.1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Engineer.

.2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.

.3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English.

.4 Functions to include, but not be limited to, following:

.1 Start and stop points.

.2 Modify set points.

.3 Modify PID loop parameters.

.4 Override PID control.

.5 Change time/date.

.6 Add/modify/start/stop weekly scheduling.

.7 Add/modify setpoint weekly scheduling.

.8 Enter temporary override schedules.

.9 Define holiday schedules.

.10 View analogue limits.

.11 Enter/modify analogue warning limits.

.12 Enter/modify analogue alarm limits.

.13 Enter/modify analogue differentials.

.5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.

.6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.

.7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.

.8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

2.2 LOCAL CONTROL UNIT (LCU)

.1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.

.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.3 Points integral to one Building System to be resident on only one controller.

.4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:

.1 Include minimum 2 interface ports for connection of local computer terminal.

.2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.

.3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.

.4 Include power supplies for operation of LCU and associated field equipment.

.5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.

.6 Provide conveniently located screw type or spade lug terminals for field wiring.

2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.

.2 Controller to communicate directly with integrated automation system through LAN and provide access from OWS for setting occupied and unoccupied space temperature set points, flow set points, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to OWS.

.3 VAV Terminal Controller.

.1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs.

.2 Controller to support point definition; in accordance with Section 250500 - Common Work Results for Integrated Automation.

.3 Controller to operate independent of network in case of communication failure.

.4 Controller to include damper actuator and terminations for input and output sensors and devices.

2.4 SOFTWARE

.1 General.

.1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDLs.

.2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.

.3 Include initial programming of Controllers, for entire system.

.2 Program and data storage.

.1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.

.2 Maintain CDL and operating data including set points, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.

.3 Programming languages.

.1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.

.2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required.

.4 Operator Terminal interface.

.1 Operating and control functions include:

.1 Multi-level password access protection to allow user/manager to limit workstation control.

.2 Alarm management: processing and messages.

.3 Operator commands.

.4 Reports.

.5 Displays.

.6 Point identification.

.5 Pseudo or calculated points.

.1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.

.2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).

.6 Control Description Logic (CDL):

.1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.

.2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. set points) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.

.3 Perform changes to CDL on-line.

.4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.

.5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.

.6 MCU to be able to perform following pre-tested control algorithms:

.1 Two position control.

.2 Proportional Integral and Derivative (PID) control.

.7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.

.8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

.9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

.7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.

.8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.

.1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:

.1 Time of day scheduling.

.2 Calendar based scheduling.

.3 Holiday scheduling.

.4 Temporary schedule overrides.

.5 Optimal start stop.

.6 Night setback control.

.7 Economizer switchover.

.8 Peak demand limiting.

.9 Temperature compensated load rolling.

.10 Hot water reset.

.2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.

.3 Apply programs to equipment and systems as specified.

.9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.

.1 MCUs to accumulate and store automatically run-time for binary input and output points.

.2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analogue or binary pulse input-type points.

.3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.

.4 Totalization routine to have sampling resolution of 1 min or less for analogue inputs.

.5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (e.g. kWH, litres, tonnes, etc.).

.6 Store event totalization records with minimum of 9,999,999 events before reset.

.7 User to be able to define warning limit and generate user-specified messages when limit reached.

Part 3 Execution

3.1 INSTALLATION

.1 Provide necessary power from local 120 V branch circuit panel for equipment.

.2 Install tamper locks on breakers of circuit breaker panel.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This section is a module that specifies the Field Instrumentation, Piping, Tubing, Wiring, Thermostats, Aquastats, Control Valves, Operators, Dampers, Control Panels, Sensing Devices and Actuators.

1.2 RELATED SECTIONS

.1	Common Work Results for Integrated Automation:	Section 25 05 00.
.2	Integrated Automation Local Control Units:	Section 25 14 00.
.3	Integrated Automation Control Sequences:	Section 25 90 00.

1.3 SUBMITTALS

.1 Submit shop drawings for review for all components in accordance with Division 1.

.2 Provide shop drawings including complete operating data, system drawings, wiring diagrams and written detailed operational description of sequences and control data on each control system component. Include sizing and arrangements as requested. Include calculations for control valve selections.

.3 Record drawing: Before the certification of substantial performance will be issued the contractor must provide the Consultant with complete record drawings. Refer to Section 20 05 00 and Division 1.

1.4 WARRANTY

.1 Provide a 2-year warranty on all items provided under this contract including all equipment and wiring. The warranty period shall commence on the date of final acceptance.

Part 2 Products

2.1 GENERAL

.1 Provide field instrumentation and sensing devices analog or digital as applicable which measure temperature, humidity, pressure, flow, current, voltage, equipment states, etc., and which input signals to the SCU terminal strip that conform to the input requirements.

.2 Provide output devices and actuators which convert the digital or analog output signal from the SCU to activate relays or open and close valves, dampers, etc.

.3 The end to end accuracy called for in Subsection 2.2 includes the combined effect of sensitivity, hysterisis, linearity and repeatability between the measured variable and the input to the analog-to-digital converter in the SCU or between the SCU input to the digital-to-analog converter and the controlled variable for the full sensing range.

2.2 CONTROL PANELS – REPLACE WITH NEW

.1 Provide control panel of unitized cabinet type construction. Mount relays, switches and controllers with control point adjustment in cabinet and pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

.2 Fabricate panels from 3 mm rolled sheet metal sheet with baked enamel finish, flush fitting, gasketted doors hung on piano type hinges and three point latches and locking handles. CSA approved for line voltage applications.

.3 Mount panels on vibration free walls or free standing angle iron supports. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

.4 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

.5 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 volt supply.

.6 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.7 Identify all wiring by means of stamped markings on heat shrinkable tubing. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, where practical, contained in plastic wiring channels with covers. Maximum 25 conductors to each wire bundle.

.8 Provide terminal blocks, tabular clamp, 300 V, complete with track. Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20% spare unit terminals, with a minimum of two spare terminals. Provide all necessary terminal block accessories such as manufacturer jumpers and marking tape.

.9 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are not overridden when selector switch is in the "Hand" position. "Hand-Off-Auto" selector switches shall be provided for all ventilation fans and sump pumps.

.10 Control Power for control panel shall be 120 Volts A.C. from panel circuits provided by Division 16.

.11 Install bonding conductor between main control and auxiliary panels complete with grounding lugs, in addition to CSA grounding requirements.

2.3 WIRING – REPLACE WITH NEW

.1 Control wiring for digital functions shall be 18 AWG minimum with 300 Volt insulation.

.2 Control wiring for analog functions shall be 18 AWG minimum with 300 Volts insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.3 Sensor wiring shall be 18 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware or 16 AWG as required by code.

.4 Transformer current wiring shall be 16 AWG minimum.

2.4 CONDUITS AND CABLES – REPLACE WITH NEW

.1 All wiring in exposed areas, mechanical rooms and electrical rooms shall be in conduit or trays. Conform to Division 26 requirements for conduit and tray specifications.

.2 Wiring in accessible ceiling areas may be installed using FT4 rated plenum wire not in conduit or raceway where wire is not subject to physical damage. Wire must be strapped to building structure at intervals not exceeding 2 metres, wire must be installed perpendicular or parallel to building lines.

.3 For wall sensors install CSA approved junction box recessed in wall, mount sensor to junction box. Install conduit from wall sensor box to accessible ceiling area.

.4 Seal conduit where such conduit leaves heated areas and enters unheated area.

.5 In the field panel, run low level signal lines in separate conduit from high level signal and power transmission lines.

.6 Identify each cable and wire at every termination point.

.7 Where applicable, mount field interface equipment (i.e. relays, transducers, etc.) in local device cabinets adjacent to field interface panels.

.8 Provide instrumentation complete with standard electrical conduit box for termination unless otherwise noted.

.9 Separate conduits shall be provided for pneumatic tubing and electrical wiring runs.

.10 Color code all conductors and conduits by permanently applied color bands. Color code shall follow base building schedule.

2.5 THERMOSTATS – REPLACE WITH NEW

.1 Provide **new** room thermostats with Celsius scale, gradual-acting, adjustable sensitivity, temperature deadband. Automatic change over from line pressure with manual override at each thermostat.

.2 Provide concealed aspirating thermostats in all public areas, gymnasiums, atriums, washrooms.

.3 All thermostats shall have covers with adjustable set point.

.4 Provide tamper proof guards for the following areas: Entrances, public areas, corridors, gym areas. Guards: Acceptable material: Powers Model 001-217 or Acceptable Alternative.

.5 Safety low limit protection thermostats shall be remote reset type with 6 m elements. Provide multiple thermostats for large duct cross-sectional areas. Mount thermostats on the outside of the ductwork and no higher than 1500 mm above the floor. Provide DPDT contacts for connection to SCU.

.6 Remote bulb elements shall be either averaging type of suitable length for air or rigid bulb type for liquids.

.7 Thermostats shall not contain mercury. Provide electronic type or sealed contact magnetic u shaped bimetal snap switch type.

2.6 THERMOWELLS – RELACE WITH NEW

.1 Provide **new** stainless steel wells for domestic water, pool water and corrosive liquid applications.

.2 Provide brass wells for chilled and heating water applications.

2.7 DAMPERS – EXISTING TO REMAIN

2.8 DAMPER OPERATORS – REPLACE WITH NEW

.1 Piston or gear drive type damper operators with spring return to "fail-safe" in normally open or normally closed position.

.2 Provide pilot positioners on all dampers that are to be sequenced with other operators or actuators.

.3 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one damper operator per damper section.

.4 Provide control air to inlet vane operators provided by others at sufficient pressure and volume to achieve unrestricted movement.

2.9 CONTROL VALVES – REPLACE WITH NEW

.1 Two-way for liquids: Two-way valves shall have equal percentage characteristics and three-way valves shall have linear characteristics. Size two-way valve operators to close against maximum pump shut-off head.

.2 Size control valves as per following criteria:

.1 Select two-way control valves for coils, heat exchangers, terminal units, etc., with a nominal pressure drop of 20 kPa.

.2 Select three-way control valves for coils, heat exchangers, terminal units etc., for pressure drop equal to three times the equipment pressure drop up to maximum 20 kPa

.3 Provide pilot positioners on all valves that are to be sequenced (on all steam valves).

.4 Valves shall "fail-safe", spring return to normal position.

.5 Provide valves complete with electronic operators for valves 38 mm and under. Valves over 38 mm shall be provided with pneumatic operators.

.6 All control valve selections are to be included in shop drawing submission to the Consultant.

2.10 ANALOGUE INPUT SENSORS

.1 Temperature

Application	Type	Operating Range	End to End Accuracy	Remarks
Duct Mounted	Tp	0˚C to 60˚C	±0.3˚C	
Pipe Well Mounted	Tw	0˚C to 50˚C 0˚C to 100˚C 50˚C to 150˚C	±0.2˚C ±0.5˚C ±0.5˚C	c/w thermal wells
Averaging	Ta	-30˚C to 60˚C	±0.5˚C	Length to suit duct size
Space Temp.	Tr	2˚C to 46˚C	±0.6˚C	c/w tamper-proof cover
Outside Air	To	-50˚C to 50˚C	±0.5˚C	c/w solar-shield
Surface Temp.	Ts	0˚C to 50˚C	±0.3˚C	

.2 Pressure

Application	Type	Operating Range	End to End Accuracy	Remarks
Static-Water	Ps	0 to 104 kPa 0 to 208 kPa 0 to 689 kPa 0 to 2,000 kPa	±3% ±3% ±3% ±3%	
Static-Air	Sp	0 to 500 Pa 0 to 1,250 Pa 0 to 2,500 Pa	±2% ±2% ±2%	
Instrument	Ia	0 to 120 kPa	±2%	

Application	Type	Operating Range	End to End Accuracy	Remarks
Velocity Pressure monitoring station (air)	Vp	0-62.5 Pa 0-125 Pa 0-250 Pa	±1.0%	- multi-point static & total pressure sending element manifold - self-averaging manifold - air equalizer & straightener - max, pressure loss 36 Pa @ 10 m/s - lowest sensitivity 1% of range
Velocity Pressure monitoring station (water, steam)	Pv	As required	±2.0% full scale	- annubar or orifice plate

.3 Electrical

Application	Type	Operating Range	End to End Accuracy	Remarks
Current Transformers	Ct	As required	±0.25% full scale	

2.11 ANALOGUE OUTPUT DEVICES

Application	Type	Operating Range	End to End Accuracy	Remarks
To Damper Motors	Dm	0-10 VDC 4-20 MA 20-104 kPa	±2% full scale	
To Valve Actuators	Vm	0-10 VDC 4-20 MA 20-104 kPa	±1% full scale	

2.12 DIGITAL INPUT DEVICES

Application	Type	Operating Range	End to End Accuracy	Remarks
Pressure Switches	Pd	As required	±1.5%	- Adjustable set-point and differential - Automatic reset
Temperature	Td	As required	±1˚C	- Adjustable set-point and differential - Automatic reset - Normal reset for freeze protection
Current Sensing Relays	Ri	As required	N/A	- Adjustable trip c/w LED Status Indication
Motor Status Relays	St	As required	N/A	- Auxiliary contacts

Application	Type	Operating Range	End to End Accuracy	Remarks
Level	Ls	N/A	N/A	- Pressure range suitable to application - Adjustable set-point and differential
Motion	Md			- Passive infrared Sentrol Series 6147

2.13 DIGITAL OUTPUT DEVICES

Application	Type	Operating Range	End to End Accuracy	Remarks
Relays	Ry	N/A	N/A	- Double voltage DPDT plug-in type with terminal base contacts rated at 5 Amp 120 VAC

2.14 SIGNAL TRANSMISSION

.1 Provide a digital transmission network to communicate between all SCU's as required.

.2 Digital transmission at 9,600 baud minimum.

Part 3 Execution

3.1 INSTALLATION

.1 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.2 Verify location of thermostats and other exposed control sensors with drawings before installation. Locate thermostats 1524 mm above floor.

.3 Install damper motors on outside of ducts. Do not locate in outside air stream.

.4 Unless specified otherwise, install all outdoor air sensors on the north exposure of the building.

.5 Install all safety limits at the operator's level.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.

.2 The point schedule contains a general list and description of the points to be connected. The Contractor shall examine the point schedule and ensure that all points required to make the described control sequences work are provided whether included in the point schedule or not.

.3 The relationships between the points, systems, and building are described in the control sequences.

.4 Consult with the Engineer during the shop drawing stage to finalize the control sequences and points for each system.

1.2 RELATED SECTIONS

.1	Common Work Results for Integrated Automation:	Section 25 05 00.
.2	Integrated Automation Local Control Units:	Section 25 14 00.
.3	Integrated Automation Input-Output Devices:	Section 25 30 10.

1.3 SUBMITTALS

.1 Submit shop drawings for review.

Part 2 Products

2.1 NOT APPLICABLE

Part 3 Execution

3.1 GENERAL

.1 Provide data base for all hardware points listed for system operation to meet specification operation sequences.

.2 All air handling units will have integrated controls provided by Engineered Air, BMS will have the capability to monitor and adjust the set-points.

3.2 AIR HANDLING UNIT AH-1

.1 General:

.1 The unit is a constant air volume double deck air system, consisting of a supply fan, cold deck with DX cooling coil, hot deck with heating coil, air filter, mixing section. There are four (4) thermal zones. Each zone will be served through a mixing damper.

.2 System Start/Stop:

.1 AH-1 will be energized via the building automation system and operate on a scheduled day/night (occupied/unoccupied) basis. The unit will be cycled on to maintain the space temperature at full return air during night (unoccupied) mode.

.2 When a start command is received the outside air motorized damper and exhaust air motorized damper shall open and when status is proven the supply fan and return fan shall be energized and ramp to their minimum speed.

.3 When the supply and return fans stop, the outside and exhaust air motorized dampers shall close.

.3 Low Temperature Thermostat:

.1 Upon sensing a low supply air temperature, the supply fan and return fan shall stop. All outside and exhaust air motorize dampers shall close. The low temperature thermostat must be reset manually.

.4 Temperature Control:

.1 The supply air temperature shall be monitored and reset through the building automation system.

.2 Hot deck: the gas-fired burner and heat exchangers shall be controlled to maintain the supply air temperature set-point of 35 ˚C (adjustable).

.3 Cold deck: The DX cooling system shall be controlled to maintain the supply air temperature set-point of 12.7 ˚C (adjustable).

.5 Filter Monitoring

.1 Differential pressure switches monitor the filters on the unit. When pressure drop exceeds the filter specification, a maintenance alarm is to be generated on the building automation system.

.6 Alarms

.1 The building automation system shall provide alarms for fan failure, temperature beyond the alarm limits and filter loading.

3.3 HEATING SYSTEMS

.1 Primary Heating Water Loop

.1 The primary heating water loop consists of three (2) high efficiency modulating gas-fired boilers (B-1 ~ B-2) each complete with integral control system by boiler manufacturer. Provide tie-in points to BMS system as indicated in the point schedule.

.2 Each boiler is provided with one boiler pump P-1~P-2.

.3 Boiler low water cutoff switch, flow switch and temperature limit switched to be supplied by the boiler supplier.

.4 Provide all safety or operational interlocks to boiler panels as required.

.5 The boilers shall operate on a lead/lag basis. The boiler control system shall control the firing rate and energy input of each individual boiler throughout its full modulating range to maximum the condensing capability and thermal efficiency output of the entire heating plant.

.6 The setpoint of boilers shall be provided by the BAS system to the individual boilers, and each boiler shall have feedback to the BAS indicating loading of the boiler. Boiler loop supply temperature setpoint is to be reset based on outside air temperature according to the following schedule:

O/A Temp.	HWS Temp.
-20˚C or less	88˚C (adjustable)
10˚C or higher	60˚C (adjustable)

.7 A heating system pressure sensor will monitor the heating water system pressure. Provide alarms if the pressure increases above 235 kPa (adjustable) or decreases below 35 kPa (adjustable). Provide alarms for boiler ignition failure, low heating water temperature and pump failure. Disable heating alarms when outside air temperature is above the heating system shutdown set-point.

.8 The heating water pumps P-3/P-4 shall be operated on a lead lag basis and the speed shall be modulated to maintain a constant system differential pressure. Provide minimum run times to prevent short cycling.

3.4 AIR SYSTEM THERMAL ZONES (4 IN TOTAL)

.1 A space temperature sensor shall provide the signal to modulate the cold deck and hot deck motorized dampers to maintain the desired temperature.

.2 The space temperature sensor will send readings to BMS.

3.5 RADIANT PANEL AND RADIATION

.1 A space temperature sensor shall provide the signal to modulate the 2-way control valve to maintain the desired temperature.

.2 The space temperature sensor will send readings to BMS.

.3 Day/night mode selection is through BAS. In the night mode setpoint is reset to 18˚C.

3.6 OUTSIDE AIR TEMPERATURE

.1 An outside air temperature calculated value will be used for all control references. The calculated value will be determined form the two (2) outside air temperature sensors located at north face of the building.

3.7 CONTROL POINT LIST

.1 Air Handling Unit AH-1

Point Description	Digital			Analog			Remarks
	Output	Input	Alarm	Output	Input	Alarm Limits	
Supply Fan enable/stop	X	--	--	--	--	--	
Return Fan Status	--	X	X	--	--	--	
Mixed Air Temp	--	--	--	--	X	X	
Outdoor air damper	--	--	--	X	--	--	
Return air damper	--	--	--	X	--	--	
Exhaust air damper	--	--	--	X	--	--	
Compressor #1 enable	X	--	--	--	--	--	
Compressor #1 status	--	X	X	--	--	--	
Compressor #1 alarm	--	--	X	--	--	--	
Compressor #2 enable	X	--	--	--	--	--	
Compressor #2 status	--	X	X	--	--	--	
Compressor #2 alarm	--	--	X	--	--	--	
Heating Valve	--	--	--	X	--	--	
Supply Air Temp-cold deck	--	--	--	--	X	X	
Supply Air Temp-hot deck	--	--	--	--	X	X	
Filter Status	--	X	X	--	--	X	
Low Temp Alarm	--	X	X	--	--	--	
Minimum O/A Flow	--	--	--	--	X	--	
Cold deck damper	--	X	--	--	--	--	
Hot deck damper	--	X	--	--	--	--	
Space Temp	--	--	--	--	X	X	

Point Description	Digital			Analog			Remarks
	Output	Input	Alarm	Output	Input	Alarm Limits	
Space static pressure	--	--	--	--	X	X	
Zone 1							
Supply Air Temp setpoint	--	--	--	--	X	X	
Cold deck damper	--	--	--	X	--	--	
Hot deck damper	--	--	--	X	--	--	
Space Temp	--	--	--	--	X	X	
Zone 2							
Supply Air Temp setpoint	--	--	--	--	X	X	
Cold deck damper	--	--	--	X	--	--	
Hot deck damper	--	--	--	X	--	--	
Space Temp	--	--	--	--	X	X	
Zone 3							
Supply Air Temp setpoint	--	--	--	--	X	X	
Cold deck damper	--	--	--	X	--	--	
Hot deck damper	--	--	--	X	--	--	
Space Temp	--	--	--	--	X	X	
Zone 4							
Supply Air Temp setpoint	--	--	--	--	X	X	
Cold deck damper	--	X	--	--	--	--	
Hot deck damper	--	X	--	--	--	--	

Point Description	Digital			Analog			Remarks
	Output	Input	Alarm	Output	Input	Alarm Limits	
Space Temp	--	--	--	--	X	X	

.2 Heating System

Point Description	Digital			Analog			Remarks
	Output	Input	Alarm	Output	Input	Alarm	
Primary Loop							
Boiler B-1 Enable	X	--	--	--	--	--	
Boiler B-1 Status	--	X	X	--	--	--	
B-1 Supply Water Temp.	--	--	--	--	X	X	
B-1 Setpt Reset	--	--	--	X	--	--	
Pump P-1Enable	X	--	--	--	--	--	
P-1 Alarm	--	X	--	--	--	--	
P-1 Status	--	--	--	X	--	--	
Boiler B-2 Enable	X	--	--	--	--	--	
Boiler B-2 Status	--	X	X	--	--	--	
B-2 Supply Water Temp.	--	--	--	--	X	X	
B-2 Setpt Reset	--	--	--	X	--	--	
Pump P-2 Enable	X	--	--	--	--	--	
P-2 Alarm	--	X	--	--	--	--	
P-2 Status	--	--	--	X	--	--	
System supply water temp.	--	--	--	--	X	X	
System return water temp.	--	--	--	--	X	X	
Pump P-3 Enable	X	--	--	--	--	--	

Point Description	Digital			Analog			Remarks
	Output	Input	Alarm	Output	Input	Alarm	
P-3 Alarm	--	X	--	--	--	--	
P-3 Status	--	--	--	X	--	--	
Pump P-4 Enable	X	--	--	--	--	--	
P-4 Alarm	--	X	--	--	--	--	
P-4 Status	--	--	--	X	--	--	
Office Zone 3-way valve	--	--	--	X	--	--	
Detention Zone 3-way valve	--	--	--	X	--	--	
Zone 3-way valve	--	--	--	X	--	--	
System Pressure	--	--	--	--	X	X	
System Diff Pressure	--	--	--	--	X	X	
System Supply Temp	--	--	--	--	X	X	
System Return Temp	--	--	--	--	X	X	

.3 Radiant Panel and Radiation

Point Description	Digital			Analog			Remarks
	Output	Input	Alarm	Output	Input	Alarm	
Radiant Panel (Admin Area, 7 zones)							
Space Temperature setpoint	--	--	--	--	X	--	
Space temperature	--	--	--	--	X	X	
Radiant Panel 2-way Control Valve	--	--	--	X	--	--	
Radiation (2 zones)							
Space Temperature	--	--	--	--	X	X	
Radiation 2-way control Valve	--	--	--	X	--	--	

.4 Miscellaneous

Point Description	Digital			Analog			Remarks
	Output	Input	Alarm	Output	Input	Alarm Limits	
O/A Temperature Sensor	--	--	--	--	X	--	
Communications Link							

END OF SECTION