REQUEST FOR PROPOSAL

PROPOSAL: **Water Treatment Plant Building Management System**

DATE: March 31, 2021

INITIATOR: Reg Bennett, Technical Services Manager

DATE PROPOSAL REQUIRED:

YEAR: **2021** MONTH: **April** DAY: **27** TIME: **2:00 PM Local Time**

Submit Proposal in a clearly marked and sealed envelope to the attention of:

Procurement Department:
Town of Drumheller
224 Centre Street
Drumheller, Alberta T0J0Y4

"RFP - Water Treatment Plant Building Management System"

This Request for Proposal document is comprised of:

1. RFP General Instructions
2. Schedule A – Evaluation Criteria
3. Schedule B – Mandatory Site Visit
4. Schedule C – Technical Specifications

If you do not have all of these components the RFP package is incomplete - please contact the Initiator. **NOTE:** A Mandatory Site Visit will be held on April 16, 2021 at 11:30 am local time at 2490 South Railway Avenue.

The Town of Drumheller will NOT accept electronic submissions.

Your firm is invited to submit a Proposal, pursuant to the general conditions for the scope of work as described. This Proposal shall not be considered authorization to proceed with work herein described. All Procurement processes must comply with Town of Drumheller Purchasing Policy C-09-20.

SECTION #1 - SCOPE OF WORK:

The Town of Drumheller invites Proposals for Water Treatment Plant Building Management System. The Town of Drumheller is looking upgrade and replace the current building controls system at its Water Treatment Plant. We have little control of the operations of our building equipment. Many of the exhaust fans in the space are interlocked with supply units that are currently turned off and cannot be accessed. Staff are currently unable to turn on some of the existing units in the space. Areas of this building that use these supply units as a primary source of heat are extremely cold in the winter months and are not a safe and healthy environment for occupants or equipment.

The supplier is required to complete all necessary sections of this Request for Proposal. Alternative methodologies or equipment will only be evaluated if submitted by the successful Proposer, no other work alternatives will be reviewed.

NOTE: A Mandatory Site Visit will be held on April 16, 2021 at 11:30 am local time at 2490 South Railway Avenue.

SECTION #2 - PROPOSAL AMOUNT:

All Proposals must be in Canadian Funds, excluding GST.

Total Cost $_____

Proposal submission price in effect for _____ days from date of acceptance from the Town of Drumheller.

SECTION #3 - SUBMISSION REQUIREMENTS:

The Town of Drumheller requires that all submissions shall include the following:

1. All pages of this Request for Proposal;
2. All issued Addendums;
3. Certificate of Recognition (COR) or Small Employer Certificate of Recognition (SECOR);
4. List of applicable Safe Work Procedures (SWP),
5. Table of Contents of the Corporate Safety Manual;
6. Workers Compensation Board (WCB) Coverage Letter;
7. Proof of Commercial Liability Insurance;
8. Town of Drumheller Business License;

SECTION #4 - INELIGIBILITY:

The Town of Drumheller shall deem a submission to be ineligible under the following situations:

1. Submissions that are unsigned, incomplete, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations or irregularities of any kind shall be considered ineligible.
2. Submissions that do not include the items listed in Section #3 Submission Requirements, and;
3. Submissions that are not received prior to the closing date and time, as determined by the time keeping of the Town of Drumheller computer system.

SECTION #5 - INSURANCE AND BONDING:

Insurance

The Town of Drumheller requires that all Proposals include proof of $5,000,000.00 Commercial Liability Insurance.

Bid Bond

1. Each submission must include a *Consent of Surety* and *Bid Bond* in the amount of 50% of the project cost, or in a form containing equivalent obligations on the part of the surety company and the submitter, executed under seal by a surety company satisfactory to *The Town* and authorized by the laws of Alberta to issue bonds in Alberta. In lieu of a *Consent of Surety* or *Bid Bond*, *The Town* may, in its sole discretion, accept from a financial institution acceptable to *The Town,* one of the following:
    1. a bank draft, certified cheque, irrevocable letter of credit, or guarantee, along with any additional documentation *The Town* may require; or
    2. a letter that a bank draft, certified cheque, irrevocable letter of credit, or guarantee, will be provided upon the request of *The Town.*

2. Failure to include in the submission the required documentation will result in *The Town*, in its sole discretion, electing to discontinue consideration of the submission.

Performance Security

1. No later than five *Days* following execution of the *Agreement*, the *Contractor* must deliver to *The Town Performance Security* as specified in the *Agreement*. The *Performance Security* must be in the form required by *The Town* or in a form that is acceptable to *The Town,* and must be enforceable in the Province of Alberta.

2. If the *Agreement* is amended or a *Change Order* is issued that increases the *Project Price*, the *Contractor* must also increase the *Performance Security* provided under the *Agreement* to an amount not less than 50% of the increased *Project Price* by obtaining and providing additional *Performance Security*, or a satisfactory rider or extension to the existing *Performance Security*, from the surety company. If the surety company declines consent or coverage for any amendment to the *Agreement* or for a *Change Order*, the *Contractor* must obtain and provide *The Town* with valid *Performance Security*, satisfactory to *The Town*, covering the *Work* specified in the amendment to the *Agreement* or in the *Change Order*. The *Contractor* will be compensated for the additional cost of such *Performance Security*.

3. If there is a *Labour and Material Payment Bond* required by *The Town*, the *Contractor* must ensure that all *Subcontractors* have notice of the *Labour and Material Payment Bond.* The *Contractor* must post and maintain in a conspicuous location or locations on the *Project Site*, a copy of the *Labour and Material Payment Bond*. The agenda for the meetings held by the *Contractor* will include notice of the *Labour and Material Payment Bond*.

SECTION #6 - EVALUATION CRITERIA:

The lowest, or any evaluated Proposal, may not necessarily be accepted. The Town of Drumheller reserves the right to reject any or all Proposals or to accept the Proposal evaluated to be in the best interest of the Town of Drumheller.

The Town's evaluator shall score each submission on the basis stated in Schedule A: Evaluation Criteria. The Town of Drumheller will have the sole and unfettered discretion to award up to the maximum number of points for each criterion listed in Schedule A: Evaluation Criteria.

By submitting a Proposal, you acknowledge and agree to waive any right to contest through legal proceedings. The decision to award points in respect to the criteria noted below will be at the sole discretion of the Town of Drumheller.

By submitting a Proposal, you acknowledge that you have reviewed the Ineligibility Criteria contained herein and you confirm that your Proposal meets all requirements of *the Town*.

SECTION #7 – REFERENCES:

Reference #1

Company Name: _____

Contact Name: _____

Contact Title: _____

Contact Phone Number: _____

Contact Email: _____

Reference #2

Company Name: _____

Contact Name: _____

Contact Title: _____

Contact Phone Number: _____

Contact Email: _____

Reference #3

Company Name: _____

Contact Name: _____

Contact Title: _____

Contact Phone Number: _____

Contact Email: _____

SECTION #8 - INTENT:

The undersigned contractor hereby provides a Proposal to supply the services as described herein in its entirety for the cost as described in Section 2.

COMPANY: _____

Print name of authorized personnel: _____

Signature: _____Corporate Seal:_____

Email Address: _____

Telephone number: _____

TOWN OF DRUMHELLER:

Print name of authorized personnel: _____

Signature: _____

DATE: YEAR 2021 MONTH _____ DAY _____

Upon completion of signatures above, this document will represent a contract agreement between the contractor and the Town of Drumheller.

SCHEDULE A – EVALUATION CRITERIA

Section A.1 – Evaluation Criteria Breakdown:

EVALUATION BASED ON:	100%
Cost	50%
References	10%
Safety	15%
Qualifications	15%
Specification	10%

Section A.2 – Evaluation Criteria Definitions:

Cost:
Full scoring for cost shall be given to the lowest Total Project Cost value submission. A score of zero (0) shall be given to the highest Total Project Cost value submission. All other submissions shall be awarded a pro-rated value between these two amounts.

References:
The scoring for references shall be based on number of references and quality of references. Scoring shall be assigned as follows:

- 0 references – 0% of score;
- 1 reference – 15% of the score;
- 2 references – 20% of the score, and;
- 3 or more references – 50% of the score.

The remaining 50% of the score shall be based on the quality of the reference as determined by the evaluator(s).

Safety:
Submissions including Certificate of Recognition (COR) or Small Employer Certificate of Recognition (SECOR) issued by Alberta Government shall receive the 50% of the score. Submissions that do not include either a COR or SECOR will be deemed ineligible as per Section #5 – Ineligibility. The evaluator shall award the remaining 50% of the score for this category based on review of the supplied list of applicable Safe Work Procedures, and Table of Contents of the Corporate Safety Manual.

Qualifications:
The Town of Drumheller will evaluate submissions on the basis of proof to provide the work to expected industry standard levels of performance. The Town evaluator(s) shall review all submissions for qualification on the basis of:

1. Past work performance with the Town;
2. Proof of task and scope of work appropriate worker qualifications (tradespersons tickets, proof of certification from manufacturer, etc.), and;
3. Proof of work procedures and quality control and assurance programs.

Specifications:
The Town of Drumheller shall evaluate the submission to confirm that the Proposal represents a clear understanding of the performance and technical requirements.

SCHEDULE B – MANDATORY SITE VISIT

MANDATORY SITE TOUR ATTENDANCE

.1 A site tour will be held at the time and place specified on the cover of this RFP.

.2 Purpose is to provide Contractor's an opportunity to familiarize themselves with the required services under the Contract and with existing conditions. Town Representative's representative(s) will be present.

.3 Attendance at the time and place specified is a mandatory prequalification requirement.

.4 Each Contractor shall submit, with its prequalification submission, a copy of the attached Confirmation of Mandatory Site Tour Attendance. This form, when signed by the Town Representative's representative at the site tour, will attest to the attendance of the Contractor's representative. If this form is not submitted with the prequalification documents or is submitted improperly signed, and the Town Representative cannot otherwise verify a Contractor's attendance at the site visit, that Contractor will not be prequalified.

FROM: _____
(Name of Contractor)

_____
(Address)

TO: Reg Bennett
Technical Services Manager
Town of Drumheller
224 Centre Street
Drumheller, Alberta
T0J 0Y4

Telephone: 1-403-823-1348
e-mail: rbennett@drumheller.ca

RE: **Water Treatment Plant**
Request for Proposal (RFP)
Building Management System

It is understood that attendance at the site tour is a mandatory prequalification requirement. The undersigned hereby confirm that a representative of the above-named Contractor attended the site tour for the above name RFP, held on:

April 16, 2021

CONTRACTOR'S REPRESENTATIVE:

_____
(Signature)

_____
(Please Print Name of person signing)

SIGNATURE/STAMP OF TOWN REPRESENTATIVE

_____

SCHEDULE C – SPECIFICATIONS

The Town of Drumheller is looking upgrade and replace the current building controls system at its Water Treatment Plant. We have little control of the operations of our building equipment. Many of the exhaust fans in the space are interlocked with supply units that are currently turned off and cannot be accessed. Staff are currently unable to turn on some of the existing units in the space. Areas of this building that use these supply units as a primary source of heat are extremely cold in the winter months and are not a safe and healthy environment for occupants or equipment.

The specification are as follows:

1. General

1.1 RELATED WORK

.1 Section 20 00 13 – Mechanical General Requirements
.2 Section 20 01 06 – Documentation
.3 Section 20 03 10 – Testing
.4 Section 20 03 20 – Mechanical Systems Balancing
.5 Division 26 - Electrical

1.2 ABBREVIATIONS

.1 AHU - Air Handling Unit
.2 BMCS - Building Monitoring & Control System
.3 CSA – Canadian Standards Association
.4 DDC – Direct Digital Control
.5 FASS – Fire Alarm Security System
.6 MCU – Master Control Station
.7 OWS – Operators Work Station
.8 RCU – Remote Control Unit
.9 TCU – Terminal Control Unit
.10 ASC – Application Specific Controller

1.3 APPROVED SUPPLIERS

.1 The following is a list of approved manufacturers for building automation system:

.1 **Delta**
.2 **Reliable**
.3 Automated Logic
.4 Trane

1.4 SYSTEM DESCRIPTION

.1 Provide a complete and fully operational computerized Building Monitoring and Control System (BMCS) to meet the specified requirements and in accordance with applicable codes and regulations.

.2 It is the responsibility of the Control Subtrade to identify, prior to tender closure, 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 submittal shall be the Contractor's responsibility.

.4 BMCS communications will be a BACnet system. Provide all hardware and software to achieve full system integration with the above protocols.

.5 Major components of this building automation system:

.1 A network of "Smart Remote-Control Units" located as necessary to minimize the requirements for long cable and tubing runs. Maximum panel point count of 100 points.

.2 Open wiring method of T-bar space low voltage wiring.

.3 Instrumentation to satisfy the requirements of the input/output schedule and control sequences.

.4 Application software to satisfy requirements to monitor and control the system as required, including full graphical interface.

.5 All interconnections and interlocks required to operate equipment and systems.

.6 Space temperature sensors, controllers, damper motor operators, components and installation for space temperature control.

.7 Radiation and radiant zone valves spring return, reheat valves, non-spring return all valves to be floating or modulating control.

.8 Operator's station and system interface, including PC, keyboard, monitor, printer and 10/100/1000 network card.

.6 Contract documents for the BMCS system specify general installation instructions. Identify any error or omission to the Owner for clarification before proceeding with the work.

.7 Minimum ambient conditions for all equipment supplied under this contract unless otherwise noted:

.1 5 to 35 °C
.2 10 to 90% RH (non-condensing)
.3 120 VAC +10%, 60 Hz ±1%, single phase
.4 Division 16 will supply a minimum of 5 dedicated circuits in various locations in the building, Coordinate on site.

.8 Provide equipment that meets required specifications when subject to radio frequency interference (RFI) field levels of 5 volts/meter at a frequency range of 100 kHz to 500 MHz.

.9 Provide all on-site wiring of package control equipment in accordance to the supplier's wiring information.

.10 In addition to providing a computerized (BMCS), provide an upgrade of the existing control components as detailed in this specification or shown on the drawings.

.11 Clean-up and removal of redundant hardware, pneumatic tubing, wiring and other devices shall be the responsibility of the Contractor. The Contractor may not be required to remove redundant conduit, wiring or tubing from the ceiling spaces or other areas exempted by the Owner through written permission. Coordinate all removal work with the Owner. Turn over all redundant control devices and material to the Owner.

1.5 SYSTEM ACCURACY

.1 Maintain system end-to-end accuracy for one-year sensor to operator's console display for the applications specified.

.2 Refer to field devices and components for instrument end-to-end accuracies.

.3 If accuracy readings of any sensor is not within 2% or range, sensor calibration may be completed. If sensor varies again, replace sensor.

1.6 PRELIMINARY DEAIGN REVIEW

.1 Submit within ten (10) working days after award of the Contact and before the control contract is awarded, a preliminary design document for review by the Consultant that outlines the system architecture and defines the basic equipment, systems and overall scope of the control subtrade work.

1.7 SHOP DRAWINGS

.1 Shop drawings shall include: manufacturers literature, name, trade name catalogue model, nameplate data, size, layout dimension, capacity and all other information necessary to establish compliance with this specification; detailed system architecture showing all points; spare point capacity by number and type; complete valve schedule listing; damper sketches showing module assembly, interconnecting hardware, operator locations, spring range, pilot range, required torque, actual torque and stroke timing; flow measuring station information; shop drawing for each input/output point showing sensing element type and location, transmitter type and range, details of associated field wiring schematics, schedules and terminations, pneumatic schematics and schedules, point address, setpoints or curves or graphs and alarm limits and signal range; manufacturer's recommended installation instructions and procedures for each type of sensor and or transmitter; equipment wiring and layout, controller locations; single line drawings showing cable routings, conduit size and spare capacity between RCU's and major mechanical systems.

.2 As a minimum supply one (1) PDF copy to the Consultant for approval.

.3 Upon receipt of Shop Drawings and/or Submittals, the Consultant shall have 14

days for shop drawings and 72 hours for requests for information, excluding weekends and statutory holidays, for processing, coordinating and providing such information. The Consultant will not be held liable for delays within this time period.

1.8 SYSTEM DOCUMENTATION AND TRAINING

.1 Documentation:

.1 Provide documentation manuals and disks which cover the following areas:

.1 Design intent.
.2 Description of system and system architecture.
.3 System set-up.
.4 Operation of system.
.5 Standard system/equipment spec sheets.
.6 Maintenance.
.7 Provide four (4) copies of the manuals with each manual having a table of contents and index.

.2 Design Intent:

Explain, in this section, the design intent and give a system overview which outlines the relationships between the hardware, operating system, control software and other control components.

.3 Description of System:

Provide a detailed description of all the parts, components and software in the system as follows:

.1 Hardware Section – Describe all equipment provided including:

.1 General description and specifications.
.2 Electrical schematics and layout drawings.
.3 Field instrumentation and sensor characteristics.
.4 Valve and damper schedule.

.2 Software Section – Describe programming and testing including a detailed description of each software module. Describe calling requirements, data exchange requirements, data file requirements and other information necessary to enable proper integration, loading, testing and program execution. Also, specifically include:

.1 Plain language descriptive in hard copy outlining the logical step-by-step analysis of the program listing.
.2 Database structure and interface with running programs.
.3 Procedures for database construction.
.4 Procedures for user software writing and implementation.
.5 Description of implementation of the applications software including interfaces with calling and called programs.
.6 Description of the algorithms for the applications software.

.7 Program cross references.
.8 Sub-routine lists.
.9 Report generator data format, output format and content.
.10 Alarm messages and format.
.11 A complete printout of setpoints for all systems and components.

.4 System Set-up:

Provide listing of initial conditions for all system setpoints, alarm limits, control loop parameters and calibration information for sensors used.

.5 Operation of System:

Provide in addition to the programming and testing description in the software section, a complete description of the individual building control application system and software.

.6 Maintenance:

Provide description in this section of maintenance procedures for all equipment and systems as defined in this specification including a schedule for recommended planned and preventative maintenance work items and intervals.

Provide a list of resources to call upon in maintenance and servicing of equipment which includes name, address and phone numbers of supplier and service contact for each piece for equipment.

Include in this section all of the approved shop drawings and a complete set of as-built drawings.

.2 Training:

Provide for operator training according to the following schedule:

.1 A two (2) day seminar/workshop following acceptance test to cover all aspects of system use as follows:

.1 Operation of hardware components.
.2 System software configuration and setpoints.
.3 User/system interaction.
.4 Calibration of sensors and systems.
.5 Troubleshooting of system and components.
.6 Preventative maintenance

.2 A one (1) day review workshop at one month after system acceptance.

.3 A one (1) day review workshop after six months of operation for clarification of system operating techniques for building operators.

1.9 WARRANTY PERIOD

.1 Provide within the warranty period, which is one (1) year from the date of final acceptance, the following warranty provisions to be included in Contract:

.1 Hardware: material and labour to correct all failures within the warranty period.

.2 Software/firmware: materials and labour to upgrade/update the software/firmware to the latest issues within the above stated warranty period.

.3 Make provisions to monitor systems operations and assist the Owner with trouble calls throughout the warranty period.

2. Operators Work Station (OWS)

2.1 PROVISION FOR REMOTE COMMUNICATIONS

.1 Internet Access: Contractor to work with Owner's network administrator to be assigned a private IP address. To allow outside access a VPN or VNC must be set up using high speed access. This would be done by the Owner's representative.

2.2 OPERATING SYSTEM & UTILITIES

.1 Latest version of MS DOS and Windows operating system complete with all available commands and functions. Include disk image back-up software, e.g. Norton Ghost or similar. Include for Word and E-Mail software.

2.3 APPLICATION PROGRAM

.1 Provide software to interface between OWS and RCU network, which will allow the following functions:

.1 Complete saving to disk, of all volatile information in control systems, including database, user control programs, analog point loop information, operator access information, trends, and other setup information (Battery backed RAM is considered volatile for these purposes.)

.2 Complete loading of all information specified above.

.3 Saving or loading software shall be accomplished with one operation per RCU.

.4 Provide editing features which allow editing of database, passwords, user control language programs, trends and their set-ups, logs and their set-ups and analog point loop parameters.

.2 Provide the capability in the system of accepting database and user control

language programs created and edited via software running on IBM PC.

.3 At the end of the warranty period, provide latest versions of software or firmware for:

.1 Operating Systems/Utilities.
.2 Application Programs.

2.4 DYNAMIC COLOUR GRAPHICS SOFTWARE

.1 Provide dynamic colour graphics package which allows user to create, modify and delete graphics through use of a mouse and pull down windows or their equivalent.

.2 Graphics package shall provide:

.1 Owner creation of symbols which can be stored for future use.
.2 Control of symbol location of screen.
.3 Control of line drawing.
.4 Control of infill colour.
.5 Control of alpha numeric texts and information windows.

.3 Sixteen colour capability for dynamic graphic display.

.4 Mechanism for copying and editing graphics of similar layouts.

.5 Dynamic data display on each graphic which can accommodate any combination of dynamic (analog or digital) information, graphic symbols and text, displayed at any location on the entire screen.

.6 Automatic update or dynamic data and provide user-defined update intervals at an operator adjustable rate.

.7 Manual or automatic display of graphics. Automatic display to occur as a result of user-definable:

.1 Alarm occurrence.
.2 Change of state.
.3 Specific time, day or date.

.8 Provide graphics of all major systems; e.g. AHU, Boilers, Convertors, etc. Include all physical points, setpoints and alarms on corresponding graphic. Provide a hierarchically linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operation. The interface shall provide configurable pull-down menus and tool bars, standard tool bars, dialogue boxes, zoom, pan, scroll boxes, colouration and animation to facilitate operator understanding of the system. Multiple levels of graphic penetration shall be provided. Descriptors for graphics, points, alarms, etc. shall be modified through the operator station monitor. The operator shall select further penetration via a user input device, e.g. a keyboard entry or mouse click on an area.

2.5 REPORT PROGRAM

.1 Provide a report program to create, generate and format for graphic display, printing, temporary and permanent storage. It shall be possible to assign the points used in a particular report. If display output is requested, system to pause each time screen is filled and wait for operator's command to continue. Output to be sorted by Area, System.

.2 The software to provide for the following report types:

.1 Dynamic Reports: Provide software to allow operator to request a printout or display of any dynamic value which shall indicate the status at the time at the time the request was entered, when displayed, updated at scan frequency or an operator selectable time interval. Provide option also to specify report type, point name, scan rate, output device. Reports to be available on the following basis:

.1 All points in system.
.2 Area (all points in area)
.3 Area system (all points in system)
.4 Area system point (individual point)
.5 System (all points by system and point type)
.6 System point (all points by system and point type)
.7 Area point (all points by system and point type)
.8 Point (all points by point type)

.2 Summary Report:

Provide the software to permit the display or printing of any database valve selected by the operator which shall indicate the status at the time the request was entered. Reports to be available on same basis as Dynamic Reports. Options to be provided to Specify Report Type, Point Name, Output Device.

.3 Trend Reports:

Provide software to permit the trending of points selected by the operator including as a minimum digital input and output, analog input and output, setpoints and calculated values. A minimum of 40 selectable points per remote processing unit (RCU) to be concurrently trended at an operator selectable rate (2 seconds to 3600 seconds) individually selected for each point. Trend to be continuous and stored on a twenty-four (24) hour basis in temporary storage until the point is removed from the trend program by the operator. The operator may request the display or printout of any point individually or in selectable groups. Ability to be provided to specify Report, Type, Point Name, Output Device, Add Trend Point, Delete Trend Point, Scan Rate. The trend plots to be displayed on the OWS. Provide capability of plotting up to four (4) selectable points concurrently. For softcopy output the display shall automatically index to the left when the screen becomes full. All trend data shall be available in disk from for use in 3rd party personal computer applications.

.4 Historical Data Collection:

Provide software for the collection and recall of historical data. A minimum of forty (40) operator selectable points per remote processing unit (RCU) to be concurrently collected at an operator selectable rate (2 seconds to 120 minutes) individually selected for each point. A point to be a real point or calculated point. Data collection to be continuous and stored in temporary storage until point is removed from collection program by the operator. Provide software to automatically dump the temporary report storage to OWS on a periodic 24 twenty-four (24) hour basis minimum or when temporary storage is filled. The operator to be notified by printout when dump has occurred. The temporary storage to have a minimum capacity of seventy-two (72) hours.

2.6 EXECUTION

.1 Install the central PC to access RCU network, provide mass storage, and man-machine interface as required and specified.

.2 Perform following functions with central PC:

.1 Acquire information from process and transfer information to the RCU's, mass storage and system peripherals as required.

.2 Provide control system backup function by saving to mass storage, database, user control language programs and other required information.

3. Remote Control Units

3.1 MONITORING AND CONTROL SOFTWARE

.1 The remote-control software shall be capable of completely independent operation with no central host required.

.2 When the remote-control unit is used as a part of a lagar centralized system, all software databases and associated software programs shall be capable of communication in both directions to requirements of the building control.

.3 Panels supplied will be among two categories:

.1 Master Control Units (MCU): Fully programmable, smart panels for main equipment.

.2 Application Specific Controller (ASC): Application designed panels, limited program or canned program for zone control only.

3.2 MASTER CONTROL UNITS

.1 The term Master Control Unit shall refer to "smart" remote field programmable digital system controller, microprocessor based, capable of independent operation. Approval of equipment by CSA or ULC regulating bodies.

.2 To receive signals from remote building sensors, meters, transmitters or other pertinent equipment.

.3 The MCU shall be capable of scanning any analog input once every second. The slowest analog input scan rate acceptable for any one point is, at a minimum, once every second. The system shall have the capability of achieving an average analog input scan rate of less than ten seconds as well as offsetting each point.

.4 Scan rates for analog outputs shall be on-line selectable by the operator on an individual basis in the range of 1 second to every 60 seconds. It shall be possible to place all analog outputs on a maximum scan rate of 10 seconds if required. The required software shall be resident at the MCU's.

.5 To transmit output signals to controlled remote building end-devices or other pertinent equipment.

.6 To transmit to, to receive from and to check the integrity of data or other information received from the operator terminals or other system MCU's as applicable.

.7 To provide power fail safe/auto re-start facilities.

.8 Power supplies as required under this contract to ensure the functional operation of the MCU and associated field equipment.

.9 Manual override switches for all DDC outputs to allow manual control of mechanical equipment.

.10 Computer software to satisfy requirements to monitor and control the system as required, including all math and control loop routines as specified.

.11 Down line loading device to enable Owner to re-boot system as required.

.12 The MCU shall be equipped with non-volatile memory or sufficient firmware to allow for power failure or battery failure. Software loading from a disk or cassettes would be acceptable for this purpose. Minimum time for re-processing to be less than 4 minutes.

.13 The MCU shall be capable of down line loading from a remote device. Time for down line loading not to exceed 4 minutes.

.14 All normal monitoring, control and protection facilities shall be maintained at each MCU in the event of the failure or non-availability of the host or of one or more other system MCU's. The intent is that software programmable MCU's, capable of independent standalone operation, are called for under the specification for the MCU.

.15 Each MCU shall incorporate a functioning, software programmable, microprocessor or microcomputer based unit as required to ensure its normal, function operation. The microprocessor or microcomputer unit shall be, at minimum, of an 8-bit internal configuration. Memory expansion, in modular increments, shall be available to a minimum of 128 K bytes with no implied

equipment redundancy.

.16 MCU equipment shall be electricity isolated from the communications trunk such that MCU component failures will not affect the operation of the trunk to the system MCU's.

.17 All MCU's shall be master units and shall be identical to allow peer to peer communication.

.18 All cabinets shall have identical key and lock sets.

.19 Provide the MCU cabinets with nameplate or nameplate tag as follows:
- permanently attached to the component
- black and white lamicoid plastic with 6mm bold lettering.

.20 Provide and install plastic credit card size nameplates for all discrete items of equipment supplied at both termination and field ends including:
- sensors
- transmitters
- output devices
- status points

.21 Provide self-adhesive lamicoid labels, white letters on red background stating:

WARNING

This equipment operates under computer control and may start at any time. Phone for instructions before operating.

Attach these labels to operating equipment under computer control as directed by Owner.

Submit sample for approval by Owner.

.22 Analog Inputs (A-I)

.1 The A-I function shall monitor each analog input, perform A to D conversion and hold the digital value in a buffer for interrogation.

.2 The A-D conversions shall have a minimum resolution of 10 bits plus sign.

.3 Provide a signal conditioning for each analog input.

.4 Analog input signals shall be terminated on screw type terminals. Each analog input shall be 4-20mA, with the capability to accept 2 to 4 wire inputs.

.23 Digital Inputs (D-I)

.1 The D-I function shall accept on/off, open/close or other two state data indications.

.2 Provide optical isolation and protection against input voltage surges up to 180 VAC peak.

.3 Provide signal conditioning and separate excitation as required.

.24 Pulse Accumulators

.1 The pulse accumulator function shall have the same characteristics as the D-I except that in addition a buffer shall be required to totalize pulses between interrogations.

.2 the pulse accumulator shall accept rates up to 100 pulses per second.

.25 Digital Outputs (D-O)

.1 The D-O function shall provide contact closures for momentary and maintained operation of field devices.

.2 Closures shall have a minimum duration of 0.1 second.

.3 Provide electromagnetic interference suppression on all output lines to limit transients to non-damaging levels.

.4 Provide isolation and protection against voltage surges up to 180 VAC peak.

.5 Provide solid state relays for 5A/120 VAC.

.6 Provide signal conditioning and separate excitation as required.

.7 Install plug-in form C relays in interference cabinet.

.26 Analog Output

.1 The analog output function shall provide continuous individual output signals as necessary.

.2 The D/A converter shall have a minimum resolution of 10 bits.

.3 The following ranges will be available.
4 - 20 MA DC
0 - 10V
20 – 100 kPa

.4 Any associated conversion unit shall be mounted in adjacent cabinets for

installation and maintenance.

.5 In the event of MCU failure, the output shall fail to the failsafe condition.

.27 Software for MCU System

.1 Provide a real time operating system with the following capabilities:

.1 Execute programming control, timing and sequencing of all programs.

.2 Perform multiple tasks to run programs and concurrently to interface with I/O devices, compile, edit and debug programs while protecting system memory.

.3 Maintain and control time initiated commands, signals and printouts by means of a real time clock program routine.

.4 Provide orderly shutdown of system on power failure to units and an automatic restart of system when power restored.

.5 Provide saving of software programs and database onto magnetic storage device to facilitate system reloading.

.6 Provide diagnostic software to test RCU and data transmissions.

.2 System Control Software

.1 Provide system control software in the following six categories:
.1 Operator access to system
.2 Database creation and modification
.3 User control language
.4 Monitoring functions
.5 Analog point control loops
.6 Energy management control functions.

.2 Use interactive software written in higher language to structure each software category. Assign priority levels to each module and execute the modules as determined by the program controller in the real time operating system.

.3 Operator/System Communications

.1 Provide operator/system communication using full English language instructive prompting question and answers format. Use a mnemonic to identify each point in the system.

example: LC DD2 HDT
SUP Fan 1

Also provide system formatting that allows for software grouping of

points for monitoring and system control functions.

.2 Operator Access Control

Access Levels:

Provide multiple operator levels to the system through the use of user defined passwords. Allow each user to access the system by entering his unique name and password. Operator access levels are:

Level 0 - Normal operator functions such as log and display request, alarm acknowledgement.

Level 1 - All level 0 functions plus analog limit changes, time schedules, point lockout command functions and modifications or changes to point descriptors, user names.

Level 2 - All lower level functions plus access to add, modify or delete any and all user defined parameters, modification to calculations and access levels.

Allow the user to define the distinctions between the various access levels.

.3 Operator Access Reporting
Produce a hard copy report whenever:

.1 Operator signs on
.2 Invalid operator attempts to signs
.3 Operator signs off

.4 Input/Output Format

.1 System to respond to all terminal input commands.
.2 System control function to be initiated by operator level access at their appropriate terminal.
.3 Incorrect entries to activate error message.
example:
insufficient information
invalid command
analog limit outside range
point not commandable

.4 User Control Language

.1 Provide a general control language that permits free formatted equations, expressions and comments.

.2 The control language shall allow the user to develop and program custom

operational sequences, unique control algorithms, interactive point relationships, custom calculations and other relational and logical operators as listed.

.3 Provide the capability in the MCU to accept any of the system connected point values as valid real time inputs. Also provide the capability in the MCU to relate real time inputs to user programmed input values for time of day, day of week, date, constants and previous calculation results.

.4 As a result of software calculations by the processor, the MCU shall activate system changes such as:

- On/off commands
- Changing system setpoints
- Activating application programs
- Enabling alarm functions
- Defaulting analog control loops

.5 Provide the following types of operational sequences, control algorithms point relationship and custom calculations:

- Calculate and download mixed air temperature setpoints to mixed air damper control loop.
- At calculation result of X or alarm condition of Y close dampers, start circulating pump
- At a true result of a number of logical expressions, start motor one, wait three minutes, start pump two
- Calculate equipment output and energy consumption
- Calculate differential temperature and degree days
- Calculate metered energy costs

.5 Monitoring Functions

.1 System Initiated:

.1 Alarm Processing and Reporting: Provide user defined alarm processing and reporting features at any I/O communications device.

.2 Digital Alarms: Define which contact state is the alarm state. Provide automatic disabling time delay during start-up.

.3 Analog Limits: Provide for each analog point user definable high and low alarms limits which automatically adjust with change in setpoint. Provide automatic disabling of alarm at shut down and adjustable time delay during start-up.

.4 Critical vs. Non-Critical: Provide the capability for the user to differentiate between critical and non-critical alarms. Critical alarms shall be acknowledged by operator.

.5 Alarms Reporting: Whenever the system senses an alarm condition, provide a logged report with the following information:

- Current time, date initials of on duty operator
- User name assigned to point
- Current value or status including appropriate engineering units

- Nature of the alarm, high or low, on or off, open or closed
- Differentiate between critical and non- critical alarms, including operator acknowledgement

.2 Operators Initiated:

.1 Reports and Logs: Provide, in English language format, manual or automatic (i.e. time or event initiated) reports and logs on any system point or user defined group of points, which can be directed to any system I/O communication device. Provide the following report categories:

.2 Summaries – Current values as applicable of:

- All enabled points
- All disabled points
- Building, system or custom group of points
- Motor status
- Points in alarm condition
- Alarm limits and differentials
- Analog setpoints
- Alarm messages associated with points

.3 Trend Logs – Provide trend logging capability for each point which allows the user to set sampling time and define start and stop time for trending. Automatic hard copy dump by point to clear allocated RAM when full.

.4 Profile Report – Provide broiler and chiller reports which report over a day, week, or month's time, the following:

- Energy in user defined units
- Output in Kw
- Efficiency
- Hours of operation
- Energy cost

.5 Totalization Report - Provide system with operator assigned totalization capability on all points. Totalize analog values in their appropriate engineering units and digital points in accumulated hours or minutes, run time or contact status.

.6 Access Reports:

- Level Assignments – Includes operator's name, password, access level assignment and on duty initials.
- System Entry-Reports when an operator signs on or off the system, includes operator's name, time and date, console number and elapsed time of operator access.

.7 Database Report: Printout of the current database.

.8 System Diagnostic Report: Includes system hardware and software errors.

.9 Energy Management Reports: Includes application programs associated with energy management functions.

.6 Algorithmic Control Sequences

.1 Provide software permitting the creation and execution of algorithmic control sequences for automatic control of equipment based on operational parameters including those defined in the database. Provide protection for currently running sequences from authorized modifications and deletions. All mathematics package functions specified shall be available for use in creating the algorithmic control sequences.

.2 Provisions shall exist for DDC setpoints as stored in MCU software, to be derived from:

.1 Manual input from the remote keyboard /CRT or the integral MCU keyboard.

.2 As a bias plus some other system value held within the same MCU.

.3 From the input, setpoint or output of some other DDC loop within the same MCU.

.4 By defined calculated means. The logic required for the calculation shall exist at the MCU.

.3 Provide three term (proportional-integral-derivative) software digital control algorithmics within the MCU software. Make provision for on-line modification by the operator.

.4 Make provision in the DDC algorithms to prevent the occurrence of integral wind-up.

.5 Make provision in the DDC algorithms for output range limiting in a flexible manner on a per loop basis.

.6 Make provision for bumpless transfer between manual and automatic DDC control modes.

.7 Make provision for the on-site development and commissioning of control strategies between individual controlled loops including, though not necessarily limited to:

- ratio control
- output bias control
- cascade control (master sub-master)
- lead/lag compensation
- feed forward
- logic control

.8 The logic control shall include at minimum the following:

- cascade control
- master sub-master
- time delay de-energize
- sequencing
- time delay de-energize
- relay routing
- low/high select routine

- status routine
- constant routine
- invert routine
- and routine
- or routine.

.7 Energy Management Control Functions

.1 Provide standard energy management software as follows.

.2 Time of Day Scheduling:

.1 Provide a minimum of 20 automatic start and stop schedules for designated points or groups of points, according to the following operator defined information:

- Time, day, date (including weekend and holiday skip feature).
- Commands such as on, off, auto, etc.
- Time delay between successive commands (for groups of points).

.2 Provide for operator override of the schedule for each point.

.3 Provide a report of all time schedules and their associated electrical loads.

3.3 APPLICATION SPECIFIC CONTROLLER

.1 Regulatory Requirements

.1 Provide equipment with CSA approval.

.2 Provide a digital logic solid state standalone controller to operate all terminal equipment specified.

.3 All points associated with each terminal equipment must be terminated in its respective controller.

.4 Application specific controllers (ASC) can only be used for room control applications unless otherwise noted herein.

.2 System Description

.1 Provide application specific devices for new pieces of equipment as specified. The DDC system shall support specific controllers for the following types of equipment as a minimum:

.1 Room reheat coils with or without baseboard radiation or radiant panel heating.

.2 Baseboard radiation or radiant panel heating only.

.3 Provide terminal equipment controller capable of operating independent of the MCU, with return from power failure without operator intervention.

- .4 Provide each controller performing space

temperature control with a matching room temperature sensor. The sensor may be either RTD or thermistor type providing the following minimum performance requirements are met:

.1 Accuracy: ± 0.3 °C
.2 Operating range: 5 to 25°C
.3 Setpoint adjustment range: 15 to 30°C
.4 Setpoint Modes: independent heating, cooling, night setback heating, night setback cooling
.5 Calibration Adjustments: none required
.6 Installation: up to 30 m from controller

.5 Include a terminal jack integral to the sensor assembly with each room temperature sensor, to be used to connect a portable laptop or similar operator's terminal to control and monitor all hardware and software points associated with the controller.

.6 Include the following auxiliary devices on each room temperature sensor:

.1 Setpoint adjustment devices
.2 Temperature indicators
.3 Override switch

.7 The setpoint adjustment device shall allow for modification of the temperature by the occupant. Setpoint adjustment may be locked out, overridden by an authorized operator at the central work station, MCU or via the portable programming tool.

.8 Provide an LCD readout on the temperature indicator visible without removing the sensor cover.

.9 The override switch shall initiate override of the night setback mode to normal (day) operation when activated by the occupant. The override function may be locked out, overridden or limited as to the time through software by an authorized operator at the central workstation, MCU or via the portable programming tool.

.3 Communication

.1 Each controller shall perform its primary control function independent of other MCU network communication, or if network communication is interrupted. Reversion to a failsafe mode of operation during network interruption is not acceptable. Should the controller reside on a MCU network, the controller shall receive its real time data from the MCU clock to ensure network continuity. Each controller shall include algorithms incorporating proportional, integral and derivative PI control of space

conditions and shall facilitate optimal occupant comfort and energy savings. Controllers that incorporate proportional and integral control algorithms only shall not be acceptable.

.4 Database

.1 Provide each application specific device with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, or minimum of 100 hour battery backup shall be provided. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration. Provide uninterruptible power supplies (UPSs) of sufficient capacities for all ASC controllers that do not meet this power protection requirement. Operating programs shall be field selectable for specific applications. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.

.5 Operator Interface

.1 Provide each controller with a connection port for a portable terminal (POT), at both the controller and at the matching room temperature sensor as previously specified. The terminal may be used for readout of system variables, override control, adjustment of control parameters, servicing and troubleshooting. The terminal shall provide the user with the following functionality as a minimum:

.1 Display system status (heating, cooling, etc.)
.2 Display all point values and setpoints
.3 Set and change all setpoints
.4 Set and change heating/cooling dead bands
.5 Set and Change PID loop gains
.6 Set and change system mode (occupied/unoccupied)
.7 Set and change system mode times
.8 Override all setpoints
.9 Override all digital and analog outputs
.10 Command all digital and analog outputs
.11 Select application mode
.12 Assign controller address

.2 Display POT in full English language with accompanying SI (international system of units) engineering units.

.3 In addition to local interface capabilities, all functionally as specified above may be performed both from the central operator's workstation and from MCU on the

communications network via the same portable terminal. From a terminal connected to any MCU it shall be possible to issue global commands to groups of controllers. Provide the following global commanding capabilities for all controllers. Provide the following global commanding capabilities for all controllers as a minimum:

.1 Heating/cooling setpoint changes

.2 Modulate open/closed all valves in percent open notation

.3 Day/night setpoint changes

.4 Provide additional terminals at each MCU and workstation, if required, to perform the specified functionality without the following limitations:

.1 Disconnect communication bus for any communication between the terminals and the controllers

.2 Identify the specific network bus, MCU or application specific device prior to initiating any communication.

.6 Input/Output Devices

.1 Power the control valve controllers from a 24 VAC source to function normally under an operating range of 18 to 28 VAC (-20% to +15%), allowing for power source fluctuations and voltage drops. The controls Contractor shall provide a dedicated power source and separate isolation transformers for each controller unable to function normally under the specified operating range.

.7 Operator Interface

.1 Operator shall be able to view or modify setpoints and control strategies as follows:

.1 With portable operators terminal at the room sensor, terminal controller or MCU

.2 At the central operators station

.8 Interface with MCU

.1 ASC shall be capable of accepting global commands from the MCU.

.2 Connect the ASC's to MCU network with a single twisted pair.

.3 MCU shall store ASC database for download capabilities.

3.4 EXECUTION

.1 Install all equipment, accessories, conduit, interconnecting wiring and

pneumatic piping in a neat manner using the latest standards of the industry.

.2 Perform installation with personnel having the relevant skills and experience.

.3 Install equipment stable and fixed to wall or floor. Provide anti-vibration mounts for the proper isolation of the equipment. Install panels with 25 mm offset from the wall.

.4 Install equipment to allow for easy maintenance access such that it does not interfere with access to adjacent equipment and personnel traffic in the surrounding space.

4. FIELD DEVICES AND COMPONETS

4.1 DESCRIPTION

.1 Design and mount items to expedite field repair or maintenance with minimal disruption

.2 All assemblies shall be of modular design.

.3 Maintenance of an individual unit shall not affect the operation of other system components.

.4 All modules, test jack and terminations shall be easily accessible.

.5 Provide control damper shop drawings which include location, arrangement, velocities and static pressure drops on each system.

.6 Provide schedule of control valve pressure drops and valve schedule with shop drawing submission of control valves.

.7 Submit data to Mechanical Contractor for inclusion in Operating and Maintenance Manuals.

.8 Label components on drawings and identify function.

4.2 SENSING DEVICES, ACTUATORS AND COMPONETS

.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 RCU terminal strip that conform to the input requirements specified in Section 1.5.

.2 Provide output devices and actuators which convert the digital or analog output signal from the RCU to activate relays or open and close valves, dampers, etc., that conform to the output requirements specified this Section.

.3 The end to end accuracy called for in “Analog Sensor Input Schedule” includes the combined effect of sensitivity, hysteresis, linearity and repeatability between the measured variable and the output at the operator interface device or between the RCU input the digital-to-analog convertor and controlled variable.

.4 The letter under the “Type” column in the following device list are the same used in the points list and also on the drawings.

.1 Analog Input Sensors – Temperature: Supply operating range to suit application.
Maintain accuracy level ±5°C

Application	Type	Remarks
Duct mounted probe	Td	Probe
Pipe well mounted	Tw	c/w stainless or bronze wells
Duct mounted averaging temperature	Ta	Length to suit duct size
Outside air	To	c/w solar shield
Space temperature	Ts	
Miscellaneous temperature	T	Various temperatures

.2 Analog Input Sensors – Relative Humidity

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Duct mounted	Hd	5-90% RH 0°C - 60°C	±3%	
Space humidity	Hr	4 – 90% RH	±5%	c/w tamperproof cover
Outside air	Ho	10°C - 30°C 5 – 90% RH		c/w solar shield

.3 Analog Input Sensors – Pressure

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Static water, steam	Ps	0 – 120 kPa 0 – 350 kPa 0 – 700 kPa 0 – 2000 kPa	±3%	
Static air	Sp	0 – 500 Pa 0 – 1250 Pa 0 – 2500 Pa	±2%	
Instrument air	La	0 – 120 kPa	±2%	transducer

.4 Analog Input Sensors – Velocity Pressure

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Velocity pressure Monitoring station (air)	VP	0 – 62.5 Pa	±1.0%	-multipurpose static & total pressure sensing element -air equalizer & straightener -maximum pressure loss 36 Pa @ 10 m/sec -lowest sensitivity
Velocity pressure Monitoring station (water, steam)	Pv	As required	±1.0% full	1% of range annubar or orifice plate
Wind velocity and direction	Wv	As required		

.5 Analog Input Sensors – Electrical

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Watt meters	KW	110/203 V 347 V 600 V	±0.25% Full scale	As applicable
Current transformers	Ct	As required	±0.25% Full scale	As applicable

.6 Analog Input Sensors – Gas Detection

.1 All gas detection sensor devices must not be sensitive to ambient air temperature or relative humidity. Allow proper amount of sensors based on the effective area of coverage for each sensor.

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Carbon monoxide	CO	0 – 500 ppm	±5% Full range	CO sensors to be Electrochemical devices only
Carbon dioxide	CO_2	0 – 2000 ppm	±5% Full range	CO_2 detectors to be Comag 1R or equal model Smart Scan 4022H

				with duct housing (204-444-7000)
Nitrogen dioxide	NO_2	0 – 10 ppm	±5% Full range	

.7 Analog Output Devices

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Damper motors	Dm	20 – 104 kPa 0 – 10 V OC 4 – 20 mA	±2% Full range	I/P transducer electronic
Valve actuators	Vm	20 – 104 kPa 0 – 10 V DC 4 – 20 mA	±1% Full scale	I/P transducer electronic
Fan speed	Ei	4 – 20 mA 0 – 10 V DC	±2% Full range	Speed drive control signal

.8 Digit Input Devices

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Dry contact	Dc	N/A	N/A	Utilize existing device
End switch	Es	N/A	N/A	Adjustable position
Level switch	Ls	N/A	N/A	Adjustable setpoint and Differential. Pressure rating Suitable to application
Humidity switch	Hs	5 – 95% RH	N/A	Adjustable setpoint
Pressure switch	Ps	As required	±1.5% Full scale	Adjustable setpoint and differential.
Temperature switch	Tsw	As required	±1%°C	Adjustable setpoint and differential. Manual reset for freeze protection.
Current switch relay	Cr	As required	N/A	Adjustable trip setpoint and operating range
P/E relay	Pe	0 – 120 kPa	N/A	Adjustable setpoint and

				differential
CO controller	Gd	0 – 500 ppm		Low trip 50 ppm; high trip 100 ppm; electrochem only; no solid state devices
NO_2 controller	Gd	0 – 10 ppm		Low trip 1 ppm; high trip 3 ppm
CO_2 controller	Gd	0 – 2000 ppm		Trip 800 ppm adjustable

.9 Digit Output Devices

Application	**Type**	**Operating Range**	**End-to-End Accuracy**	**Remarks**
Relays	Ry	On/Off	N/A	Relay – Configuration and contacts rated to suit application
Humidity enable	Hy	On/Off		Humidity output
E/P relays	Ep	On/Off	N/A	Various voltages as required
Damper motors	Dm	On/Off		Various voltages as required

.5 Local Devices Panel

.1 Provide CEMA-1 panels with locking doors and filtered ventilation to mount field components requiring protection.

.2 Supply cabinets with double sided screw terminal strips for entering and leaving wiring and separate raceways for high and low level signal. Terminal strips shall have individual terminal identification numbers.

.3 At minimum, mount and connect within cabinets, components such as E-P, I-P and related components of system. Mount pneumatic devices in lower part of panel clear of electrical devices.

.4 position and mount panels in locations as required protected from vibration, heat and dirt while readily accessible for maintenance. Provide and connect one 110 VAC, 60 Hz duplex outlet inside or adjacent to each panel. Confirm locations with Consultant for installation.

.5 Connect to nearest available utility source.

.6 Install a weatherproof canopy or NEMA 4 WP rating on cabinets where subject to fluid leakage.

.6 Thermostats

.1 Thermostats to be electronic/electric as per sequence.

.2 Provide covers with adjustable setpoint with thermometer for all thermostats unless noted otherwise.

.3 Provide covers with adjustable setpoint with thermometer for all thermostats unless noted otherwise.

.4 Safety low limit protection thermostats shall be manual rest 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.

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

.6 Electric room thermostats shall be low profile type with heavy duty metal covers.

.7 Gymnasium thermostats to have metal covers with rounded edges.

.7 Control Valves

.1 Valves shall “fail-safe”, spring return to normal position for radiation or radiant panel. Valves can be floating or modulating non spring return or reheat coils.

.2 Modulating two-way and three way valves for liquids. Either equal percentage or linear characteristics. Size two-way valve operators to close against maximum pump shut-off head. Size for nominal 21 kPa drop. Characterized ball valves will be acceptable.

.8 Dampers

.1 Dampers for Outside Air Flows:

.2 Tamco Series 9000 BF (or equal) thermally broken extruded aluminum frame insulated with polystyrene; extruded aluminum frame insulated with polystyrene; extruded silicone frame seals, designed to operate in temperatures that range from -40°C to 100°C.

.3 150 mm wide extrude aluminum blades, internally insulated with

expanded polyurethane foam; extruded silicone blade seals.

.4 Celcon inner bearing fixed to 11.11 mm aluminum hexagon blade pin, rotating within polycarbonate outer bearing inserted in the frame (no metal to metal or metal to plastic contact).

.5 Maximum leakage rate not to exceed 25L/s/m^2 at 1 kPa pressure differential at – 40°C.

.6 Dampers for Mixed Air, or dampers that form part of a ventilation system that are not defined in item .1:

.1 Tamco Series 1000 (or equal) extruded aluminum airfoil damper.
.2 150 mm wide, 12 gauge extruded aluminum blades with extruded EPDM blade gaskets.
.3 100 mm deep extruded aluminum channel frames with extruded TPE edge seals.
.4 11.11 mm hexagon extruded aluminum pivot rods interlocking into the blade section. Double sealed type bearings with a Celcon inner bearing on rod within a Celcon inner bearing on rod within a polycarbonate outer bearing inserted into the frame (no metal to metal to plastic contact).
.5 Maximum leakage rate a 52 L/s/m^2 with a 1.0 kPa pressure differential.

.7 Mixing dampers of opposed blade construction arranged to mix streams. Provide pilot positioners on mixed air damper motors where dampers are not mechanically linked.

.8 Provide separate minimum fresh air damper with separate damper motor.

.9 Electric Actuators

.1 Provide electronic direct coupled actuation on intake/exhaust/motorized dampers, terminal box dampers, valves and other mechanical devices.

.2 The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage.

.3 Provide electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator.

.4 Build an internal mechanical spring return mechanism into the actuator housing for power failure safety applications.

.5 Analog Variable Output: Provide proportional actuators to accept a

0 to 20 mA control input and provide a 4 to 20 mA or 0-10 VDC operation ranges. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. All actuators shall provide a 2 to VDC position feedback signal.

.6 Digital 2 Position Output: Provide two position actuators voltage as required.

4.3 EXECUTION

.1 Install systems components and accessories in accordance with manufacturer's instructions.

.2 Provide necessary interconnections, services and adjustments required for a complete operable system.

.3 Input Hardware:

- .1 (Td) Duct Temperature Sensor
- .2 (Ta) Averaging Temperature Sensor
- .3 (T0) Outside Air Temperature Sensor
- .4 (Ts) Space Temperature Sensor
- .5 (Tw) Liquid Temperature Sensor
- .6 (Fv) Flow Transducer
- .7 (Hd) Duct Relative Humidity Sensor
- .8 (Hs) Duct Humidity Switch
- .9 (Ho) Outside Air Relative Humidity Sensor
- .10 (Hr) Space Relative Humidity Sensor
- .11 (IA) Instrument Air
- .12 (Ps) Differential Pressure, Liquid (Analog)
- .13 (Sp) Differential Pressure, Air (Analog)
- .14 (Pd) Pressure Switch
- .15 (Ls) Level Switch
- .16 (Dc) Auxiliary Contract
- .17 (Ct) Current Transmitter (Analog)
- .18 (Fz) Low Temperature Protection
- .19 (Es) End Switch
- .20 (Cr) Current Switch Relay (Digital)
- .21 (Vp) Air Volume Sensor
- .22 (Wv) Wind velocity + Direction Package
- .23 (CO) Carbon Monoxide Sensor (Analog)
- .24 (NO_2) Nitrogen Dioxide Sensor (Analog)
- .25 (CO_2) Carbon Dioxide Sensor (Analog)
- .26 (Gd) Gas Detection Panel (Digital)

.4 Output Hardware

- .1 (Ip) Current to Pressure Transducer
- .2 (Ry) Compact Relay
- .3 (Ep) Three-way Electric/Pneumatic Solenoid Value
- .4 (Dm) Pneumatic or Electronic Damper Actuator (Analog or

Digital)

.5 (Vm) Pneumatic or Electronic Valve Actuator (Analog or Digital)
.6 (I) 4-20 MA Output
.7 (Ei) 0-10V?4-20mA for VFD speed control

.5 Verification location of thermostats with Consultant before installation.

.6 Locate thermostats 1500 mm above floor.

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

.8 Coordinate this work with work of other trades.

.9 Wiring:

.1 Wiring: to CSA C22.2 No. 75-M1983, copper conductor, 600V RW90 X-link insulation. 300V insulation allowed for conductors not entering enclosures containing line voltage.

.2 120 VAC control wiring: minimum #14 AWG.

.3 Low voltage field wiring:
.1 Minimum #22 AWG,
.2 Twisted pairs,
.3 Stranded, except #18 AWG and larger may be solid.
.4 Shielded with drain wire, except for digital input/output wiring carrying less than 24 mA and not installed in tray.
.5 Multi-conductor wiring must have individually twisted and shielded pairs with a drain wire for each pair. Cable mush have overall shield. Maximum 6 pairs.

.4 Plenum rated cable:
.1 FT4 rated/FT6 multi-conductor cables.
.2 Refer to the CED for other designations meeting FT4 criteria.

.5 Where network is BACNET or LON Works, supply and install only manufacturer approved cable designed for that network.

.10 Conduits and Cables:

.1 Use EMT conduit; conform to Division 16 Requirements for conduit:
.1 For all high speed communications trunk wiring between RCU's.
.2 For wiring that would be exposed to mechanical damage.
.3 For wiring in inaccessible areas.
.4 Where indicated on drawings or otherwise required by CEC.
.5 In mechanical rooms.

.2 Use grid metal conduit for all wiring in areas designated as

hazardous.

.3 Install conduit junction boxes free from dents and in such a manner as to not interfere with access to equipment or components. Plug ends to prevent entrance of dirt or moisture.

.4 Clean out conduit prior to installation of conductors.

.5 Install flexible conduit connections from junction boxes to equipment to avoid transmission of vibration.

.6 Install conduit where in areas that are accessible.

.7 Seal conduit where such conduit heated area and enters unheated area.

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

.9 Install conduit parallel or at right angles to building lines; minimize crossovers and conserve space and headroom.

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

.11 Leave pull wire in conduit for future use. Wire fill shall not exceed 75%.

.12 Provide instrumentation complete with a standard electrical box for termination.

.13 Mount field interface equipment (i.e. relays, transducers, etc.) In local device cabinets adjacent to field interface panels.

.14 Low voltage wiring for terminal control units shall be in accordance with the Electrical Code.

.15 BMCS identification tags consisting luggage style tags, containing physical point identification information imprinted on the tag, will be attached to all field devices. Tags must be typed, not handwritten.

.16 All BMCS point identification tags shall include the following minimum information:

.1 Logical Point Mnemonic (refer to Section 15941)

.2 Point Hardware Address (RCU/ASC and connection terminal identifiers)

.3 Associated system Identification

.4 Point Description, including device part number.

.17 Plastic nameplates consisting of self-adhesive composite laminated plastic nameplates with one smooth white surface and core of black plastic to leave black lettering on a white background will be provided for all BMCS, MCU's, TCU's and equipment cabinets (20 mm size).

.18 BMCS Wiring Directories: for each MCU and ASD device, provide a laminated sheet with a cross-reference listing of logical point mnemonic, descriptor, wiring label and hardware address for each wire terminated on cabinet. Order and placing of information shall mimic patter of wiring terminations.

.19 BMCS Equipment Cabinet Directories: for each BMCS equipment cabinet, provide a laminated sheet graphically showing location of each transducer, relay or other device in cabinet. Each device outlet to be labeled and function of device indicated. Provide logical

mnemonic , descriptor, wiring label and hardware address for field wiring terminating at transducers and relays within cabinet.

5. BMCS START-UP, TESTING AND COMMISSIONING

5.1 WORK INCLUDED

.1 This testing should not be confused with testing and commissioning subsequent to contract compliance. The Control Sub-trade shall confirm that the system meets all the requirements of the Contract Document before calling for final inspection.

.2 The Control Contractor shall demonstrate to the Owner that equipment, networks, installation programs and services as installed under this contract meet the requirements of the Contract Documents

.3 The Contractor shall complete all necessary documentation and testing forms prior to scheduling any test.

.4 The Owner shall have the option of additional special testing to ensure the proper functioning of the BMCS at no cost to this contractor.

.5 All equipment, software, consumable items, personnel and facilities as required to reasonably execute the BMCS factory or site acceptance tests, including any signal simulation equipment shall be made available under terms of this contract at no cost to the Owner.

.6 On equipment designated to be controlled from the BMCS, assist the Contractor in coordinating the complete interface.

.7 Where interface is required to equipment provided under the electrical sections, assist the Contractor in co-coordinating all such tie-in with electrical work on-site.

.8 Where there is a possibility of voiding the warranty on equipment supplied by others but requiring the tie-in to the building automation system, assist the Contractor in coordinating that tie-in with the supplier of the related equipment at no cost to the Owner.

.9 Advise the Owner, in writing, at least three weeks in advance of testing.

.10 Have installation, engineering, software, system and sub-contractor personnel, as applicable, be available on site during the course of these tests.

.11 Any deficiencies or defect noted shall be corrected and a new time for re-test shall be schedules.

.12 Provide the necessary manpower and test equipment to demonstrate the operation of the BMCS at all levels from individual end devices through to total system operation.

.13 On-site testing shall be performed as soon as reasonably possible after each major part of the Building System is mechanically and electrically completed and the appropriate software modules are functioning as specified.

.14 At the discretion of the Owner, final BMCS acceptance testing may be carried out at the following defined levels:
- .1 Per point basis 100% of the total point count
- .2 Per system basis 100% of the air supply systems
- .3 Function basis 100% of total room controls

.15 Final acceptance testing shall include provision for demonstration of function of all software facilities including those as related to future expansion and equipment features. Provisions must be made to provide for testing of features which may not be fully supported by commissioned field devices and/or hardware.

.16 Submit for acceptance by the Owner, a total demonstration test plan before commencement of each test. All hardware and software system components shall be fully tested during the course of the demonstration.

.17 System test procedures shall include those specifically oriented to demonstrating the satisfactory operation of all aspects of the BMCS operator interfaces.

.18 Perform a complete and detailed calibration and operational check for each individual point and for each individual function as contained within the supplied system. These checks shall ensure that all equipment, software, network elements, modules and circuits, as provided under the terms of this test, shall be carried out with the use of point/function log sheets.

.19 The Contractor shall provide the Owner with final record documentation prior to commencement of substantial performance testing in order to assist in the execution of the substantial performance testing.

5.2 EXECUTION

.1 System Documentation

Provide following documentation prior to start of testing:
- .1 System manuals including hardware, software, maintenance and operations.
- .2 Interlock and control diagrams for all systems controlled.
- .3 shop drawings and calibration procedures.
- .4 Written description of control strategy for each system.
- .5 Table of operating setpoints and alarm limits for each system.
- .6 Listing of actual data file for each point and for control strategies.
- .7 Certification of operation and list calibration of all hardware components.

.2 Hardware Start Up:

.1 Ensure hardware component is properly installed as per manufactures recommendations and functioning properly.

.2 Hardware Starting:

.1 This testing must be completed and verified before any software logic and control is added to the system:

Calibrate the following components as per manufacturer's recommendations:

- Thermostats
- Damper motor operators and positioners
- Valves and operators and positioned
- Transmitters
- Humidistat's
- Air compressors, dryers
- Pressure reducing/relief valves
- Clocks
- Gauges, thermometers, etc.
- Pressure/electronic switches
- Static sensors and transmitters
- Flow switches
- Carbon monoxide sensors and alarm points
- Alarm settings
- Fire and security system and alarm points
- Interposing relays
- Current sensitive relays

.3 Pressure test all pneumatic air tubing as per Section 15900

.4 Gauge all wiring used to ensure conformance to CSA and specifications. Ensure all circuits are complete and all terminal wiring connections are tight.

.5 Adjust control dampers. Ensure uniform mixing. Ensure tight shut-off closure and measure leakage. Fail-safe operation.

.6 Put all electronic hardware into operation in accordance with manufacture's recommendations. Replace all defective components. Prove proper operation with software starting and print out.

.7 Test and ensure all interface with Division 16 is complete. Test and ensure all interface with other "package control" is complete.

.8 Ensure point identification is completed and all wiring labeling is completed. As minimum standard, the point tag should contain the following information:

Logical Point Name Point Multiplayer Address

Associated System Identification

Point Description, including device part number.

.9 For dynamic graphics, ensure the proper operation of:
- .1 Dynamic values displayed on screen.
- .2 Update period
- .3 Color change or status change
- .4 Proper identification of system and points on screen
- .5 Reaction to alarms.

.10 Check out each point through the terminal device end to end. This checkout to include tests for range, reliability, repeatability.

.11 Calibrate all control valves.
- .1 Ensure no overlap of control ranges
- .2 No leakage when valves are closed particularly steam.
- .3 Failsafe operation.

.12 Check all interface cabinetry to ensure compliance with the specifications and all applicable codes.

Software Starting

.1 Ensure all hardware is completely installed and started and fully operational before software start-up.

.2 Compare shop drawings and specifications to final software and check:
- .1 Flow charts
- .2 Hardcopy printouts
- .3 Control flow logic diagrams

.3 Enter software and operating setpoints and schedules into terminal device.

.4 Check out each system through the terminal by:
- .1 Simulations of system start/stop functions.
- .2 Simulation of systems operation including:
  - Optimization
  - Limit functions
  - Safety features (override values)
  - Operation sequences specified
- .3 Verification of system component hardwired interlocks.

.5 Verify operation of specific routines such as:
- .1 Optimization
- .2 Demand limiting
- .3 Peak shaving
- .4 Night setback, morning warm up
- .5 Building dynamic control

.6 Variable volume air systems supply/return fan tracking control
.7 Power fail recovery

.6 Simulate alarm conditions and verify alarm printouts.

.7 Check out reports generation.

.8 Check out communication network, input and output.

.9 Check operation of system under failure modes.
.1 Component failure
.2 Smart remote failure
.3 Communication failure
.4 Host failure
.5 Outside air sensor failure

.4 Operation Acceptance Tests

.1 Conduct the operational acceptance test for 7 consecutive days, 24 hours per day, on the complete and total installed and operational DDC system to demonstrate that it functions in accordance with all requirements.

.2 Demonstrate the correct operation of all monitor and control points, as well as operational and capability of all software. The equipment shall operate continuously for a 7 consecutive calendar day period with no unexplained shutdowns.

.3 Outages to mean whenever the DDC system is unable to fulfill all required functions due to any malfunction of hardware or software. Outrages of the system resulting from the following causes will not be considered failures:

.1 An outage of building power in excess of the capability of any back-up power source provided that the automatic shutdown and re-start of the DDC system fulfills the requirements.

.2 Failure resulting from any sensor or controller failure provided the system has recorded the fault and no more than one percent of the sensors and controllers are of out of service at any time.

.3 A system hardware failure provided that the initiation of the DDC system functional requirements for back-up provisions are accomplished and hardware is restored to services within 24 hours.

Software: Upon successful completion of the operational acceptance test, provided both source and object modules of all accepted software on a rigid disk. Provide a duplicate copy of each media containing the source and object modules of the software in a magnetically shielded case. Provide two (2) set of media usable with the bulk loader with the duplicated copy in magnetically shielded case.

.5 Room Controls

.1 Terminal heating units shall be checked for proper zoning and operation.

.2 Calibrate room temperature controllers.

6. POINT SCHEDULES AND CONTROL SEQUENCES

6.1 GENERAL

.1 A physical point is a specific software address which is resident in the WTP and which is identified with a particular field sensor, instrument or sensor.

.2 The point schedule contains a list and description of the points to be connected.

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

.4 Consult with the Owners representative during the shop drawing stage to finalize the physical terminal address of each point within the WTP.

.5 Provide any necessary points in addition to those listed on the Point Schedule as required to complete the control sequence defined.

6.2 CONTROL SEQUENCES

.1 MUA's with interlocking fans

.1 Provide all field wiring for MUA's as required.

.2 Unit fan to run continuous. Exhaust fans to run continuous. Units to cycle to maintain WTP pressurization relative to the outside.

.3 Cycle heat to maintain room temperature. Utilize new building standard thermostats.

.4 All points can be seen and adjusted from graphics.

Control Sequences and Points Database

- 7-MUA units c/w exhaust fan interlocks
  - Enable
  - Status
  - Supply Air Temp
  - Room Temp

- Emergency Generator
  - Mixed Air Damper
  - Room Temp
  - Generator Status Point
  - Unit Heater Enable
  - Unit Heater Status
- 2-Furnace
  - Supply Fan Enable
  - Status
  - Heating Enable
  - DX Enable
  - Supply Air Temp
  - Mixed Air Temp
  - Room Temp
  - Mixed Air Dampers
- Misc. Exhaust Fans
  - EF-5 – Enable, Status & Damper
  - EF-13 – Enable, Status & Damper
  - EF-8 – Enable, Status & Damper
  - EF-9 – Enable & Status
  - EF-11 – Enable & Status
  - EF-12 – Enable & Status
- Space
  - Room Isolation Dampers control & room temp
  - Space Relative Pressure
  - Outside Pressure