1. GENERAL

1.1 Scope

.1 Complete and fully operational system of automatic controls, including all materials and labour.

.2 Work includes, but is not limited to, installation of all controls associated with the air handling units, including installation of remote control panel supplied by the air handling unit manufacturer.

.3 Demolition of obsolete controls as noted on Drawings.

.4 Submissions of technical system data.

.5 Demonstration of installed controls system**.**

1.2 Work by Other Trades

.1 Division 16 shall provide 120V power for Controls.

.2 Contractor shall install thermal wells, control valves and devices on piping, furnished by Controls Contractor.

.3 Unless noted otherwise in contract documents, control dampers integral with the air handling units are supplied by air handling unit supplier. Damper operators are supplied by Contractor and installed by the air handling unit manufacturer at the factory. All other control dampers are supplied by Contractor.

1.3 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.

1.4 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 Controls shop drawings shall be stamped by a professional Engineer registered in the Province of Manitoba.

1.5 Submittals

.1 Submit shop drawings in accordance with the front end.

.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 Submit approved shop drawings to mechanical contractor for inclusion in operations and maintenance manuals.

1.6 Instruction/Demonstration Sessions

.1 Formal instruction sessions shall be coordinated with the Commissioning Coordinator per Section 15020.

.2 Provide for instruction sessions according to Section 15020.

.3 Instruction sessions shall cover 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

.4 Contractor to provide three complete sets of training manuals to the City prior to commencing of the training session, plus one manual to the Contract Administrator.

1.7 Calibration Inspections/System Updates

.1 In addition to warranty call backs provide two (2) service and calibration inspections of a minimum 8 hours duration each. These calls will be initiated by the City

.2 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.

1.8 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 room thermostats 30 days prior to system acceptance.

1.9 Acceptance Testing

.1 A final operational acceptance test of seven consecutive days shall be conducted on the complete and total installed and operational control system to demonstrate that it is functioning properly in accordance with the Specifications.

.2 The correct operation of all monitored and controlled points shall be demonstrated as well as the operation and capabilities of all sequences, reports, specialised control programs and algorithms, diagnostics and all other software.

.3 In the event of the failure of function, during the test, of any of the hardware components or software application or routines, the test will recommence and run until seven (7) failure-free test days have occurred.

.4 After successful completion of the acceptance test, the Contract Administrator will issue written acceptance of the control system.

.5 Prior to acceptance of the work, submit hard copy and electronic copy on diskette of final data base listings.

1.10 Record Drawings

.1 Provide record drawings as per General Specification.

.2 Record all configuration and tuning parameters of the microprocessor based control systems for inclusion in the O&M manuals.

1.11 Technical Submittals

.1 The Contractor is to include sufficient technical data with the bid submission to detail the proposed system architecture, hardware and software components.

.2 The Controls Contractor shall guarantee compliance on an item by item basis list exceptions and alternate means for meeting specified requirements, within 15 calendar days of selection of contract.

1.12 Demonstrations

.1 The Controls Contractor shall arrange for a demonstration of an operating system that meets the technical submittal and specification requirements within 20 calendar days of the selection of contract.

.2 The demonstration shall include representative(s) from the Contract Administrator and representative(s) from the City.

.3 The Controls Contractor shall submit to the Contract Administrator a demonstration plan prior to conducting the demonstration.

.4 The Controls Contractor shall demonstrate to the Contract Administrator that the equipment, networks, installation programs and services as proposed for this contract meet the requirements of the Contract Documents.

.5 The Contractor shall complete all necessary documentation and testing forms prior to scheduling any tests, of the operating system being demonstrated.

.6 The Contract Administrator shall have the option of additional special testing to ensure the proper functioning of the control system at no extra cost to this Contract.

1.13 Costs

.1 All costs incurred in testing the controls system, including the City and Contract Administrator demonstration cost shall be included for under this Contract. No additional charges will be entertained by the City.

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

1.14 Award of Contract

.1 For award of contract to selected Controls Contractor will not occur until the evaluation of technical submissions and demonstration has been completed.

.2 The Contract Administrator reserves the right to reject the selected Controls Contractor based on the system evaluation.

1.15 Definitions

.1 "Fault Alarm" – a system failure has occurred that renders the unit inoperable.

.2 "Warning Alarm" – a system failure has occurred that does not render the unit inoperable but requires immediate attention.

2. PRODUCTS

2.1 Control Panels

.1 Remote control panel for air handling units shall be according to mechanical drawings.

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

.3 Fabricate panels from 14 gauge rolled sheet metal steel with baked ASA 61 grey enamel finish, flush fitting, gasketted doors hung on piano type hinges and three point latches and

locking handles. Provide an interior 12 gauge steel mounting panel with baked white enamel finish. CSA approved for line voltage applications.

.4 Mount panels on vibration free wall or free standing angle iron supports. Provide engraved lamecoid nameplates for instruments and controls inside cabinet and on cabinet face.

.5 Provide pans and rails for mounting terminal blocks, PLC's, wiring and other necessary devices.

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

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

.8 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.

.9 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 ten spare terminals. Provide all necessary terminal block accessories such as manufacturer jumpers and marking tape. All terminal blocks to be Weidmuller W series.

.10 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.

.11 Provide "Push-to-Test" pilot lights.

.12 All new control panel assemblies, supplied by the Contractor, shall be supplied via a certified CSA panel shop.

.13 Provide a pocket internal to the panel for documentation and system data.

.14 Gland Connections: provide Myers hubs for threaded connection or CSA certified watertight fittings for Teck cable.

.15 Finish the interior of the enclosure with white baked enamel paint and provide a switched fluorescent light fixture and a 120VAC duplex convenience receptacle inside the enclosure.

.16 Standard of acceptance to be NEMA 4 rated as manufacturer by Hoffman or Hammond.

2.2 Wire

.1 All wiring shall be in accordance with Division 16.

.2 Control wiring for digital functions shall be 14 AWG, type TEW with 300 Volt insulation.

.3 Control wiring for analog functions shall be 16 AWG with 300 Volts insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.4 Sensor wiring shall be 16 AWG twisted and shielded, 2 or 3 wire to match analog function hardware.

.5 Single conductor solid wire will not be permitted. Two wires of different gauge size will not be permitted under one device terminal lug. No more than two wires of the same gauge will be terminated under any one device terminal lug. Wiring shall be routed in such a way to allow for this.

.6 Wiring connections will be installed exactly as shown on the shop drawings so that the drawings will truly reflect wiring routing. It is the intent of the Contract Administrator to review panel wiring shop drawings to achieve this intent. It shall be the responsibility of the Contractor to arrange the wiring and to illustrate same on the shop drawings to be reviewed by the Contract Administrator.

.7 All wiring shall be run in plastic snap cover wireway. The width and depth of the wireway shall be the minimum size necessary to accommodate all wiring and provide adequate space for future circuits (minimum of 25% spare capacity is required).

.8 Small trunk runs of wire, and free run wire shall be bundled with TY-Raps and secured to self-adhesive anchors at points of convenience. The wire shall be bundled in such a way as not to impede the ready removal of any component part. Small cross section wireway may be used at the discretion of the Contractor for this purpose.

.9 All stranded conductor wiring shall be tinned or equipped with crimp-on wire barrel ferrules prior to insertion into their respective terminal block termination.

.10 All devices shall be wired in such a manner that they will all be uniquely wired to terminal blocks, which will provide the point of common connection, rather than direct interconnection wiring between components. This method shall be strictly adhered to except as approved by the Contract Administrator.

.11 Connections to terminal blocks shall be representative of physical orientation, i.e., if panel wiring terminates on the right side of a terminal block, show on the right side of the shop wiring diagram and conversely for the left side. Terminal block arrangement on shop drawings shall be identical to the actual physical arrangement.

.12 All common jumper link bussed terminals shall be located adjacent to each other where possible. The Contractor shall ensure that all jumper connections provided for terminal blocks shall occur on the power supply side of the terminal block only. Any physical wiring performed by the Contractor, which does not conform to the wiring requirements noted herein, shall be repaired at the Contractor's expense.

.13 All blank terminal blocks shall be considered spare and will be complete with blank marker tags. A minimum of 20% spare terminals of each type shall be provided in each panel or junction box.

.14 The Contractor will provide quantities of universal rail mount fuse holder type terminal blocks for all power circuits (field I/O and panel supplies) requiring protection in accordance with shop drawings and manufacturer requirements. Supply complete with fuse as sized on the shop drawings. Provide ten (10) spare fuses of each type after completion of the Work.

.15 All wiring and terminal blocks in use shall be identified in accordance with the numbering system shown on shop drawings. All field wiring in the panel to be via terminal blocks. Label all terminal blocks sequentially and label all wiring such that the associated terminal block is identified. Label all spare conductors.

.16 Provide an AC safety ground bar within the control panel and connect to the main AC safety ground. G round all panel steel. Signal shields for analog signals to be grounded via dedicated terminal blocks in the panel.

2.3 Conduits and Cables

.1 All wiring shall be in rigid steel conduit or via Teck cable. Conform to Division 16.

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

.3 Run low level signal lines in separate conduit from high level signal and power transmission lines.

.4 Identify each cable/conduit at each point of termination as follows:

.1 P12 – power cables/conduit numbered sequentially from 01 to 99

.2 C12 – control cables/conduit (digital signal) numbered sequentially from 01 to 99

.3 S12 – instrumentation signal cables/conduit (analog) numbered sequentially from 01 to 99.

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

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

.7 Colour code all conductors and conduits by permanently applied colour bands on maximum 10 m interims. Colour code shall follow Division 16 requirements.

2.4 Related Accessories

.1 Provide and install all necessary transformers, transducers, interposing relays, interface devices, contractors and starters 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.

2.5 Freezestats

.1 Safety low limit protection thermostats (freezestats) 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 1500 mm above the floor).

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

2.6 Electronic Room Temperature Sensor (Thermostat)

.1 The sensor may be either RTD or thermistor type providing the following minimum performance requirements are met:

.1 Accuracy ±0.6°C

.2 Operating Range 2°C to 46°C

.3 Range 2°C to 30°C

.2 The setpoint adjustment dial shall allow for modification of the temperature by the occupant.

.3 The temperature indicator shall be a bi-metal or mercury thermometer and shall be visible without removing the sensor cover.

.4 Provide signal conversion equipment to convert all electrical signals to 4-20ma dc.

2.7 Dampers

.1 Automatic dampers shall be extruded aluminum multiple blade mounted in extruded aluminum flanged frame. Individual blades shall not exceed 150 mm in width or 1200 mm in length. Provide interlocking edges and compressible seals. Provide dual bearing system with additional thrust bearings for vertical blades. Damper configuration to be as shown on drawings. Use flanged to duct type dampers for all sizes under $0.4m^2$.

.2 Damper leakage requirements are to be as follows, based on leakage rate at 1,000 Pa, and pressure rate at 10 m/s for a 600 mm x 600 mm damper:

.1 Low Leakage: 35 l/s per m^2 leakage, 50 Pa pressure drop.

.2 Dampers shall be flanged-to-duct type unless noted otherwise.

.3 Approved Dampers: T.A. Morrison, Tamco 9000 for all applications.

2.8 Damper Operators

.1 Electronic Damper Operators

.1 Spring return, 24 VAC operating voltage unless noted otherwise on drawings, 0-10 Vdc input signal, 0-10 Vdc position output signal, 70 seconds max. running time for 90° opening and 30 seconds max. closing time.

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

2.9 Power Supply & Conditioning Equipment

.1 Provide all DC power supplies as required for all instrument circuits. Power supplies to be equal to Hammond, complete with an overvoltage protection module.

.2 Unless otherwise required, all DC power supplies to be rated 28 Vdc, adjustable plus or minus 5 percent, and set to provide 26.4 volts on the panel direct current bus. Minimum size is 2 amps with sufficient capacity for system requirements plus 25% spare.

.3 Provide transient 600 V and 120 V voltage surge protection devices as manufactured by Leviton or equal on all panel assembly and microprocessor power input lines, analog signal input lines that are of excessive length and susceptible to power surges, and on data communication circuits.

.4 All AC power supplies for control equipment (e.g. microprocessors, transmitter, 24 Vdc power supplies, discrete instrumentation, etc.) shall be provided with power conditioning equipment. The power conditioners shall assure a regulated voltage supply with isolation from both transverse and common mode noise input and suppression of transients with inherent overland protection. Standard of acceptance shall be Sola or Tycor.

.5 All external control and monitoring circuits supplied from the air handling unit shall be protected with individual fuses for each circuit.

2.10 Signal Conditioning Modules

.1 Where required, provide signal conditioning modules which comply with the following requirements, unless otherwise specified:

.1 Analog signal inputs: 4-20mA DC into 500 ohms

.2 Analog signal outputs: 4-20mA DC into 500 ohms

.3 Discrete output contacts: SPDT rated 5A

.4 Arrange electronic trips so that output contact opens in case of loss of signal or loss of power supply.

.5 Modules to be rated for continuous operation in an ambient temperature of 0 to 80°C. Ambient temperature effect not to exceed plus or minus 0.01 percent per °C within that range.

.6 Span and zero adjustments to be made by front accessible multi-turn potentiometers.

.7 Provide electronic trip modules with LED indicators for relay status.

.8 Modules to withstand 30 volts per meter radio frequency radiation between 200 and 500 MHz with not more than 0.25 percent calibration effect. Provide modules with traps on the terminals to shunt conducted radio frequency interference to ground.

.9 Galvanically isolate signal and power supply terminals from the case.

.10 All modules specified in this section to be the product of a single manufacturer.

2.11 Air Handling Unit Controls

.1 General

.1 Each air handling unit shall be supplied with a separate stand alone control system located in a local panel.

.2 The air handling unit shall be supplied for mounting, with a remote control panel in the Control Room.

.3 The control system shall provide the functionality described in the Control Sequences section.

.4 Panel construction shall comply with or exceed the minimum standards described in Divisions 15, 16, and 17.

.5 Provide all programming software tools and accessories for the development and modification of application programs.

.6 Configuration will be such that operation will automatically resume normal operation when subjected to short term power interruptions.

.7 Provide dry contacts for connection to the SCADA system to indicate:

.1 AHU-1 Run

.2 AHU-1 Alarm/Warning

.3 AHU-1 Fail

.4 AHU-2 Run

.5 AHU-2 Alarm/Warning

.6 AHU-2 Fail

.2 Local AHU Control Panel

.1 The local control panel shall feature:

.1 Microprocessor based control system.

.2 System shall be mounted in Nema 4 enclosure located in AHU service corridor.

.3 Local Human Machine Interface (HMI) – the HMI shall be a solid state electronic device with LCD display, and keypad. The HMI shall provide access to the following data and setpoints:

.1 Warning alarms, which shall include but not be limited to, dirty filters, high supply air temperature, high space temperature, high compressor head, etc.

.2 Fault alarms, which shall include but not be limited to, no air flow, compressor failure, etc.

.3 Status of unit components.

.4 O/A, S/A, M/A, and R/A temperatures.

.5 Stages of cooling.

.6 Ability to adjust free cooling setpoint.

.7 Ability to reset "latching" alarms.

.3 Remote Control Panel

.1 The remote control panel shall feature indication and controls as described in Specification and Drawings.

.2 The remote control panel shall feature "push-to-test" pilot lights.

.3 The remote control panel shall include a HMI for each air handling unit and shall duplicate the functionality of the HMI in the local control panel.

.4 Software Documentation

.1 The foremost consideration in program documentation is that it is meaningful to maintenance staff.

.2 Provide program documentation in such detail that maintenance staff experienced in microprocessor controls are to be able to troubleshoot maintenance calls without extensive training. Provide all documentation in the English language and Metric Units.

.3 The standards in this guideline give minimum levels of documentation and are not meant to limit the documentation supplied.

.4 Provide a symbol and address comment for all word and bit addresses.

.5 Follow a uniform standard format throughout. Include tag names in accordance with the format noted herein.

.6 When address comments are inappropriate, use instruction comments to improve clarity and understanding.

.7 Document all unused inputs or outputs as “SPARE” in the address comments.

.8 Name program files as related to content in that file.

3. EXECUTION

3.1 Installation

.1 Verify location of thermostats and other exposed control sensors with drawings before installation. Locate thermostats 1400 mm above floor.

.2 Install damper motors on outside of ducts. Do not locate in air stream, except for roof mounted equipment.

.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 operators level.

.6 Install pressure gauges on branch lines, at each controller, transmitter, and actuator excepting individual room thermostats.

.7 Provide hardware in accordance with the foregoing requirements in sufficient quantity to satisfy the performance requirements defined in this and other Divisions of this Specification.

.8 Provide all necessary documentation to define the configuration of the control system including I/O lists, wiring requirements for I/O, communication system, power supply, and conditioning equipment details.

.9 Develop application software in accordance with these specifications.

.10 Commission and start-up the system as defined herein.

.11 Provide all documentation and training as defined herein.

END OF SECTION