Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 23 05 05 - Pipework

.2 Section 23 05 17 - Pipe Welding

.3 Section 23 05 23 - Valves

.4 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

.5 Section 23 31 13 - Metal Ducts

.6 Section 23 32 48 - Silencers

.7 Section 23 37 20 – Louvres

.8 Section 25 90 01 EMCS Site Requirements, Of Applications & Systems Sequences Operation

1.2 INTENT

.1 The intent of this Section is to provide guidelines to define the minimum acceptable standards for the field instrumentation and control devices installed in the Air Handling Unit (AHU). The programming and execution of the EMCS operating sequences will be performed by the Departmental Representative's Controls Contractor.

.2 All instruments and devices shall be subject to the Departmental Representative's approval.

.3 Provide all safety interlocks in AHU required to prevent AHU from operating in an unsafe condition (i.e. if bypass, return and exhaust air dampers are closed return air fans shall not operate).

1.3 QUALITY CONTROL

.1 ISO 9000

.2 CSA

1.4 SHOP DRAWINGS

.1 In accordance with Section 01 33 00 - Submittal Procedures and as specified herein.

.2 One-line diagram from sensor and control points to Field Interface device and/or Terminal Control Unit including all components and cables.

.3 All instruments, control devices, attachments and accessories, complete with specifications and calibration details.

1.5 GENERAL REQUIREMENTS

.1 Provide all remote sensing points and instrumentation as required for the complete Energy Monitoring and Control System. All sensors shall have the accuracy as stated hereinafter. Hysteresis, relaxation time, span, maximum/minimum limits, etc., shall also be accounted for in all application of sensors and controls.

.2 All instruments of a particular category shall be of the same type and manufacturer and shall be complete with all attachments and accessories suitable for the intended service.

.3 All external trim material shall be completely corrosion-resistant with all internal parts assembled in watertight, shockproof, vibration-proof, heat-resistant assembly.

.4 Use standard conduit box termination with slot screwdriver compression connector block unless otherwise specifically stated.

.5 Operating conditions -0° to 32°C with 10 – 90% RH (non-condensing) unless otherwise specifically stated.

.6 Provide manufacturer's installation instructions for all supplied equipment. All equipment shall be installed in accordance with Manufacturer's recommended methods and procedures.

.7 All controllers shall be BACNET MSTP or IP protocol approved and compatible.

.8 The following Control Description Logic (CDL) is a general description control logic and should not be construed as a detailed programming sequence or considered as a restriction to the vendor from including any additional features deemed as good engineering practice or normally included in the vendors' CDL. The controls vendor is solely responsible to ensure that all controlled components are operating in harmony and at optimum efficiency to achieve the design intent described hereunder.

.9 Any additional features, as mentioned above, shall be reported to the Departmental Representative.

.10 I/O schedule does not show pseudo points needed for all CDL features. Be responsible for the provision of all additional points necessary for a fully operational control system.

1.6 DESIGNATED CONTRACTOR

.1 Retain the services of Johnson Control Canada LP or its authorized representative to complete the work of all building automation system sections.

.2 Design, supply and installation of all controls including integration to BAS system and graphics shall be by Johnson Controls Canada LP and coordinated with Departmental Representative.

Part 2 Products

2.1 DESIGNATED MATERIALS

.1 There is an existing Johnson Controls Building Automation System presently installed in the building. All materials must be selected to ensure compatibility with the existing Johnson Controls Building Automation System.

2.2 TEMPERATURE TRANSDUCERS

.1 Temperature Sensors:

.1 Resistance type (RTD).

.2 The following shall apply to resistance temperature sensors as applicable:

.1 RTDs shall be 1000 ohm at 0°C (±0.12 ohms) platinum element with strain minimizing construction and three (3) integral anchored lead wires coefficient of resistivity of 0.00385 ohms/ohm/°C.

.2 Sensing element to be hermetically sealed.

.3 Stem and tip construction to be Copper or 304 Stainless Steel.

.4 Sensors to have a time constant response of less than three (3) seconds to a temperature change of 10°C.

.5 Immersion wells shall be of stainless-steel materials. Heat transfer compound to be compatible with sensor.

.2 Temperature Sensors Types:

.1 Temperature sensors shall be of the following types:

.1 General Purpose Duct Type: Suitable for insertion into air ducts at any angle, insertion length of 457 mm as noted on schedule or drawings.

.2 Spring-Loaded Thermowell Type: Spring-loaded construction with compression fitting for 21 mm NPT well mounting. Lengths of 100 mm to 150 mm as noted.

.3 Averaging Duct Type: Continuous filament with immersion length of 6000 mm minimum. Probe to be bent, at field installation time, to a minimum radius of 100 mm at any point along the probe length without degradation in performance.

.4 Outside Air Type: Complete with non-corroding shield designed to minimize solar and wind effects, threaded fitting for mating to 21 mm conduit, probe length of 100-50 mm.

.5 Strap-On: For strapping on pipe surface or other applications where high temperature is encountered.

.3 Temperature Transmitters:

.1 As applicable, RTD temperature transmitter to be provided having the following minimum specifications:

.1 Input circuit to accept 3-lead, 1000 ohm at 0°C, platinum resistance detectors as specified above.

.2 Output signal of 4-20 mA into maximum of 1000-ohm load.

.3 Output short circuit and open circuit protection.

.4 Input short circuit and open circuit protection.

.5 Output variation of less than 0.2% of full-scale output for supply voltage variations of ± 10%.

.6 Combined non-linearity, repeatability and hysteresis effects not to exceed ± 0.5% of full-scale output.

.7 Maximum current to a 1000-ohm RTD sensor not to exceed 5 mA.

.8 Integral, zero, and span adjustments.

.9 Temperature effect of ±1.0% full scale/50°C or less.

.10 Long-term output drift of equal to or less than 0.25% of full-scale output/6 months.

.11 Transmitters to be provided with ranges as follows:

.1 -50°C to +50°C, ± 0.5°C.

.2 0°C to +50°C, ± 0.25°C.

.3 0°C to 25°C, ± 0.1°C.

.4 0°C to 100°C, ± 0.5°C.

.5 10°C to 35°C, ± 0.25°C.

.12 The narrowest range is to be selected for each specific indication.

.13 Range of transmitters to be submitted with shop drawings.

.4 Differential Temperature Transmitters:

.1 Provide analog RTD temperature difference transmitter, using a matched pair of platinum resistance temperature detectors.

.2 RTDs to be matched to .025 ohm for 1000-ohm detectors.

.3 Temperature Effect: 55°C change ambient error 0.75% of space.

.4 Output signal of 4-20 MA.

.5 Power supply 575 ohm at 24 VDC. Power supply effect less than 0.01°C per volt change.

.6 Integral zero and span adjustment.

.7 Output linear with temperature. Linearity error of ±0.5% of full-scale output.

2.3 RELATIVE HUMIDITY TRANSDUCERS

.1 The RH series of Humidity/Temperature Transducer must be designed for use with automation, energy management, and process computer control/monitoring systems.

.2 Description:

.1 The RH transducers shall be intended specifically for use in energy monitoring and control systems (EMCS). Its design combines microprocessor-based linearization and temperature correction with a high-class resistance sensor. A field-interchangeable sensor combined with integral zero and span adjustments shall provide long-term reliability and accuracy for the most critical measurements.

.2 Excellent long-term stability and quick response time combined with temperature compensation.

.3 Sensors shall be available in different enclosures to permit wall or duct mounting or outdoor installation.

.3 Products:

.1 Sensor: Provide humidity sensors as directed with the following minimum specifications:

.1 Absolute accuracy of ± 2% RH for all sensors.

.2 Stainless steel sheath construction completes with integral shroud to enable specified operation in air streams of up to 10m/sec.

.3 Maintenance of sensor to be by a simple field method such as solvent or mild detergent solution washing, to remove anticipated airborne contaminants.

.4 Duct-mounted sensors shall be located such that the sensing element is between one third and two thirds the distance across the duct interior from any duct wall.

.5 Outdoor sensors to be located away from direct sunlight or rain.

.6 Sensors shall be unaffected by external transmitters such as walkie-talkies.

.7 Filter Type: 60-micron HDPE cover.

.8 Operating Humidity: 0-100% RH.

.9 Operating Temperature: -40° to 100°C.

.10 Inherent Accuracy: <3% RH.

.11 Response Time: 10 seconds (11-93% RH), 60 seconds (93-11% RH).

.12 Average Temp Coeff.: -0.3% RH/°C.

.13 Hysteresis: ±1% RH at 25°C.

.14 Calibration: NIST traceable.

.15 Sensor Construction: Polyelectrolyte polymer resistance type.

.16 Chemical Resistance: very high.

.17 Cyclic Aging (25°C): 100 cycles 0-100% RH, <1% shift @ 50% RH.

.18 Thermal Shock: 140°C (284°F) for six (6) hours <1% shift @ 50% RH.

.19 Saturation Condition: seven (7) weeks @ 100% RH.

.20 <2% shift @ 50% RH.

.21 Ammonia: 100% at 25°C.

.22 Long-Term Aging: <2% RH after 3+ years.

.2 Transmitters: As applicable, provide transmitters for all supplied relative humidity sensors, with the following minimum specifications:

.1 Output Signal Types (jumper selectable): 4-20 mA, 0-1 VDC, 0-5 VDC, 0-10 VDC (Note: all signals are scaled 0-100% RH.)

.2 Output Range Accuracy: <0.5% RH

.3 Output Resolution: <0.2% RH (9 bit)

.4 Hysteresis: <0.2% RH

.5 Temp. Correction Range: -31° to 84°C.

.6 Temp. Comp. Sensor: matched thermistor ± 0.2°C, 0° - 70°C

.7 Electronic Accuracy: <1% RH, including temperature compensation, hysteresis, non-linearity.

.8 Calibration Accuracy: <0.1% of span

.9 Operating Temperature: 0° - 70°C

.10 Operating Humidity: 5 – 95% RM (non-condensing).

.11 Power Supply: (loop powered) 12-35 VC at unit (3-wire) 24 VAC/dc nominal (±10%).

.12 Wiring Connections: screw terminals (14 to 22 AWG).

.13 Manufacturing Process: ISO 9002 Certified

.14 Optional Temp. Sensor: 1000 ohm. RTD or thermistors.

2.4 PRESSURE TRANSDUCERS

.1 Provide differential pressure transmitters having the following minimum specifications:

.1 Internal materials to be suitable for continuous contact with the process material measured including compressed air, water, or glycol.

.2 Output signal of 4-20 mA into maximum of 1000 ohm load.

.3 Output variation of less than 0.2% full scale for supply voltage variations of ±10%.

.4 Combined non-linearity repeatability and hysteresis effects not to exceed ±0.5% of full-scale output over entire range.

.5 External exposed integral zero and span adjustment.

.6 Temperature effect of ±1.5% full scale/50°C or less.

.7 Output short circuit and open circuit protection.

.8 Over-pressure input protection to a minimum of twice rated input.

.9 Differential pressure ranges as shown in point schedule.

.2 Static Pressure Transmitters:

.1 Fan system static pressure sensing unit to be a multipoint element with self-averaging manifold. Maximum pressure loss of 20 mm (.075 in wg) at 1000 M2 (2000 fpm): accuracy of 1% of actual duct static.

.2 Output of 4-20 mA linear into maximum of 1000 ohm load.

.3 Calibrated Span: not greater than 50% of static pressure at maximum flow.

.4 Accuracy: 0.4% of span.

.5 Repeatability: within 0.5% of output.

.6 Linearity: 1.5% of span.

.7 Dead band or Hysteresis: 0.1% of span.

.8 External exposed zero and span adjustment.

.9 Provide a Dwyer magnehelic gauge to indicate pressure.

.3 Velocity Pressure Transmitters:

.1 Fan system velocity pressure sensing unit to be a multipoint static and total pressure sensing element with self-averaging manifolds, complete with air equalizer and straightener section assembled as one unit for installation in air duct.

.2 Maximum pressure loss 3.8mm at 10m/s: accuracy of 1% of actual duct velocity.

.3 Output of 4-20 mA linear into maximum of 1000 ohm load.

.4 Calibrated Span: not greater than 25% of velocity pressure at maximum flow.

.5 Calibrated Accuracy: 0.4% of span.

.6 Repeatability: within 0.1% of output.

.7 Linearity: 0.5% of span.

.8 Dead band or Hysteresis: 0.1% of span.

.9 External exposed zero and span adjustment.

.10 Provide a Dwyer magnehelic gauge to indicate VP.

.4 Pressure Switches:

.1 Provide pressure or differential pressure switches for ranges as indicated on point schedule.

.2 Pressure sensing elements shall be bourdon tube, bellows or diaphragm type.

.3 Adjustable set-point and differential.

.4 Pressure switches shall be snap action type rated at 120 volts, 15 amps AC or 24 volts DC.

.5 Sensor assembly shall operate automatically and reset automatically when condition returns to normal.

.6 Sensor Ratings: sensors shall have following pressure and accuracy ratings:

.1 Hot chilled and condenser water sensors shall be rated at 150% of the system operating pressure.

.2 Pressure switches for fan operation shall have a range of 0 to 3000 Pa and adjustable differential from 10 to 300 Pa.

.3 All sensors shall have an isolation valve and snubber installed between the sensor and pressure source.

2.5 CURRENT TRANSDUCER

.1 Provide current transducers with range indicated on the point schedule and with the following minimum specifications:

.1 Current transducers shall measure line current and produce a proportional signal in one of the following ranges:

.1 4-20 mA dc,

.2 or 0-10 VDC,

.3 or 0-5 VDC

.2 Direct connection to PC’s and other measurement or display devices.

.3 Suitable to monitor motors, pumps, conveyors, machine tools, and any electrical load where an analog output is required over a wide range of currents.

.4 Suitable for energy management and monitoring.

.5 CSA NRTL/C approval (Canada/USA).

.6 Factory calibrated to <±2% FS and can also be easily field calibrated to custom ranges.

.7 Capable of monitoring up to 200 amps unless required otherwise.

.8 Operating humidity 0 – 95% RH non-condensing

.9 Operating temperature -30° to 70°C

2.6 CURRENT SENSING RELAY

.1 Provide current sensing relay having the following minimum capabilities:

.1 Relay to be complete with metering transformer ranged to match load being metered.

.2 Direct connection to PCs for general status monitoring.

.3 Directly controls AC or DC loads, such as relays and lamps, in response to the current of a monitored AC circuit.

.4 Suitable for use in safety and alarm circuits and monitors motors, heaters, etc.

.5 CSA NRTL/C approval (Canada/USA).

.6 Integral zero-leakage LED's to indicate sensor power and also switch status, which operates when the current level sensed by the integral current transformer exceeds the threshold value as set.

.7 Certified to CSA, NRTL/C standards.

.8 Operating temperature 0 – 70°C (32° to 158°F).

.9 Trip set-point: adjustable multi-turn pot over full detection range, GnG fixed at input one (1) minute.

.10 Hysteresis: <1% FS maximum.

.11 Operating humidity 0 – 95% RH non-condensing.

.12 Integral relay shall be provided with plug in base and shorting shunt (if required) to protect current transformer when relay is removed from socket. Current transformer shall be available for single or three-phase metering into single relay.

.13 Current relay shall have adjustable latch level, adjustable delay on latch and a minimum differential of 10% of latch setting between latch level and release level.

.14 Three-phase application shall provide for discrimination between phases to allow detection of worst-case selection. Current relay shall be powered from control circuit of motor starter being metered and shall be suitable for mounting in the motor starter cabinet.

.15 Relay contacts shall be capable of handling five (5) amps at 240 Vac loads.

2.7 ELECTRIC RELAYS

.1 Provide double voltage DPDT relays for control and status indication of alarms and/or electrical starters and equipment where shown on point schedule.

.2 Relay coils shall be rated for 120 V or 24 V. Where other voltages occur provide transformer.

.3 Contacts rated at 5 amps at 120 V AC.

.4 Relays to be plug-in type with termination base.

2.8 DAMPER OPERATORS ELECTRONIC

.1 Provide push-pull type electronic proportional damper operators.

.2 Spring return for "fail-safe" in Normally Open or Normally Closed position as directed by Departmental Representative.

.3 Size operators to control dampers against maximum pressure or dynamic closing pressure whichever is greater.

.4 Power requirements are 5 VA maximum at 24 V AC.

.5 Operating range is 0-20 V DC.

.6 Operating speed and torque to match application and will be subject to Departmental Representative's approval.

2.9 CONTROL VALVES

.1 Control valves shall be external to unit.

.2 Control valves are existing three-way valve to reused for new AHU-7 and AHU-8.

2.10 WATER DETECTOR

.1 Acceptable Materials:

.1 The only acceptable materials are Greyston WD-10.

.2 Provide a water detector that allows for wiring to be opened or closed, powered by a set relay contacts and will determine leak detection, internal malfunction and power loss sensor.

.1 Specifications:

.1 Power Requirements: 12-32 VAC or VDC.

.2 Power Consumption at 12 VDC: 427 mW.

.3 Operating Temperature: 0°C to 70°C.

.4 Enclosure: gold-plated probes, adjustable legs, epoxy paint.

.5 Alarm output: Form C non-powered, rated at 120 VAC/2 amps.

.6 Supervisory Circuitry: Yes.

.7 Reverse Acting Contacts: Yes.

.8 Reverse Voltage Protection: Yes

.9 Internal Voltage Regulation: Yes

.10 RFI/EMI Noise Immunity: Yes

2.11 ANALOG TO PULSE (ATP) TRANSDUCERS

.1 Provide ATPs to convert an analog signal into a digital pulse output signal with user selectable eight standard analog input ranges to the ATP by changing jumper shunt positions. The ATP shall be provided with two timing modes, standard and custom selectable and shall meet the following minimum specifications:

.1 Supply Voltage: 24 VAC or VDC.

.2 Analog Input:

.1 Voltage/Impedance 0-15 VDC/1m.

.2 Supply Current 0-20 mA/250.

.3 Digital Output:

.1 Form "C" Relay 1 amp @ 24 volts

.2 Electrical Life 100,000 @ 1 amp

.3 Mechanical Life 10 million operations

.4 Environmental:

.1 Operating Temperature -28° to 65°C

.2 Operating Humidity 10 to 95% non-condensing

Part 3 Executions

3.1 GENERAL

.1 Provide all remote sensing points and instrumentation as indicated and/or required for the complete operational capability of the Energy Monitoring and Control System.

.2 All equipment shall be installed according to manufacturers' published instructions.

3.2 TEMPERATURE AND HUMIDITY SENSORS

.1 All sensors shall be stabilized to such a level as to permit on-the-job installations that will require minimum field adjustments or calibration.

.2 Sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.

.3 Sensors in ducts shall be mounted in locations to sense the correct temperature of the air only and shall not be located in dead air spaces. The location shall be within the vibration and velocity limits of the sensor. Where an extended surface element is required to properly sense the average temperature it shall be securely mounted within the duct to measure the best average temperatures. Elements shall be thermally isolated from brackets and supports to respond to air temperature only. Sensor element to be supported separately and not connected to coils or filter racks.

.4 Wells shall be installed for all piping installations. Where pipe diameter is less than the insertion length of the well, the well shall be installed at an elbow location to affect proper flow across the entire well area. The well, when installed, shall not restrict flow in piping by more than 30% (i.e., the well shall not represent more than 30% of the pipe as measured on a cross section by area).

.5 Room temperature and humidity sensors are existing to remain and to be reintegrated to new control system.

3.3 TRANSMITTERS

.1 Temperature transmitters, humidity transmitters, current to pneumatic transducers, solenoid air valves, controllers, and relays to be installed in NEMA 4X enclosures.

.2 Panels to be either free-standing or wall-mounted enamelled steel cabinets with hinged and key-locked front door. Arrange for conduit and tubing entry from top, bottom, or either side.

.3 Panels shall be modular multiple panels being used if required for capacity in any particular location. They shall handle all requirements with space to accommodate an additional 20% without adding further cabinets.

.4 All panels shall be lockable with the same key.

.5 All wiring and tubing within panels to be located in trays or individually clipped to back of panel, and clearly identified.

.6 Field-mounted transmitters and sensors to be properly supported on pipe stands or channel brackets, all wall-mounted devices to be mounted on plywood panel properly attached to the wall.

.7 All field devices to be properly identified.

.8 Flow measuring stations to be capped until ducts are cleaned.

3.4 TESTING

.1 All devices shall be properly calibrated and tested for performance and accuracy. A report detailing test performed and results to be submitted to the Departmental Representative for approval. The Departmental Representative will verify results at random. Provide all testing equipment necessary. Provide manpower necessary to assist in verification.

.2 Submit samples at random from equipment shipped, before installation, as requested by the Departmental Representative for testing by the Departmental Representative or an independent agency. Devices not meeting performance and accuracy specified shall be replaced by proper equipment at the Contractor's expense.

.3 Refer to Section 01 73 00 – Execution Requirements, for detailed testing requirements of static and velocity transmitters.

3.5 SEQUENCE OF OPERATION:

3.6 GENERAL

.1 AHU-7 & AHU-8 are designed to serve Bay 3 cleanroom.

.2 For the purpose of this project AHU-7 and AHU-8 are intended to have local controllers and controls, supplied and installed under this contract and integrated to the building EMCS/BAS system.

.3 AHU-7 & AHU-8 are intended to be fully redundant units but to have the options of running both at the same time under limited fan capacity. When both units are in operation the fan capacity of both units shall be soft limited by interlock between each unit and modulate to maintain the main supply header, ductwork static pressure setpoint. Soft limits for both unit operation shall be set during TAB. During normal mode the runtime on AHU-7 and AHU-8 shall be equal based on a weekly schedule.

.4 AHU-7 & AHU-8 shall never be started at the same time. Startup of each unit shall be performed in a sequential start even when both units are to operate and shall be soft started.

3.7 LOCAL CONTROLS

.1 Local controls are to be provided to permit the programming, setting of set points, sequencing, and full operation (including scheduling) of each unit without the requirement for connection to the BAS system. If BAS system fails units shall operate with last setpoints and sequence of operation.

3.8 BUILDING AUTOMATION SYSTEM INTERFACE

.1 The Building Automation System (BAS) shall be able to read/write and read only points to be able to adjust unit operation and setpoints from operator workstation and to trouble shoot unit through BAS graphics.

.2 If a BAS is not present, or communication is lost with the BAS the local controller shall operate using last setpoints.

.3 BAS shall sequence each AHU on/off depending on space occupancy status and if one unit has failed the back up AHU shall be started.

3.9 OCCUPIED

.1 During occupied periods, the supply and return fan shall run continuously and the outside air damper shall open to maintain minimum ventilation requirements. The chilled water and hot water valves shall modulate to maintain the discharge air temperature setpoint. If economizing is enabled the outside air damper shall also modulate to maintain the discharge air temperature setpoint. If the discharge air temperature sensor fails, the chilled water and hot water valves shall close, and an alarm shall be annunciated at the BAS.

3.10 UNOCCUPIED

.1 When the space temperature is below the unoccupied heating setpoint of 18.0ºC (adj.) the supply and return fan shall start, the outside air damper shall remain closed and the hot water valve shall open. When the space temperature rises above the unoccupied heating setpoint of 18.0ºC (adj.) plus the unoccupied differential of 2.0ºC (adj.) the supply and return fan shall stop and the hot water valve shall close. When the space temperature is above the unoccupied cooling setpoint of 27.0 ºC (adj.) the supply and return fan shall start, the outside air damper shall open if economizing is enabled and remain closed if economizing is disabled and the chilled water valve shall open. When the space temperature falls below the unoccupied cooling setpoint of 27.0ºC (adj.) minus the unoccupied differential of 2.0ºC (adj.) the supply and return fan shall stop, the chilled water valve shall close and the outside air damper shall close.

3.11 OPTIMAL START

.1 The BAS shall monitor the scheduled occupied time, occupied space setpoints and space temperature to calculate when the optimal start occurs.

.2 BAS shall sequence start up time of units with other units on system to reduce incoming current.

3.12 MORNING WARM-UP MODE

.1 During optimal start, if the average space temperature is below the occupied heating setpoint a morning warm-up mode shall be activated. When morning warm-up is initiated the unit shall enable the heating and supply fan. The outside air damper shall remain closed. When the space temperature reaches the occupied heating setpoint (adj.), the unit shall transition to the occupied mode.

3.13 PRE-COOL MODE

.1 During optimal start, if the average space temperature is above the occupied cooling setpoint, pre-cool mode shall be activated. When pre-cool is initiated the unit shall enable the fan and cooling or economizer. The outside air damper shall remain closed, unless economizing. When the space temperature reaches occupied cooling setpoint (adj.), the unit shall transition to the occupied mode.

3.14 OPTIMAL STOP

.1 The BAS shall monitor the scheduled unoccupied time, occupied setpoints and space temperature to calculate when the optimal stop occurs. When the optimal stop mode is active the unit controller shall maintain the space temperature to the space temperature offset setpoint. Outside air damper shall remain enabled to provide minimum ventilation.

3.15 OCCUPIED BYPASS

.1 The BAS shall monitor the status of the “on” and “cancel” buttons of the space temperature sensors. When an occupied bypass request is received from a space sensor, the unit shall transition from its current occupancy mode to occupied bypass mode and the unit shall maintain the space temperature to the occupied setpoints (adj.).

3.16 ECONOMIZER

.1 The discharge air temperature sensor shall measure the dry bulb temperature of the air leaving the cooling coil while economizing. When economizing is enabled and the unit is operating in the cooling mode, the economizer damper shall be modulated between its minimum position and 100% to maintain the discharge air temperature setpoint. The economizer damper shall modulate toward minimum position in the event the mixed air temperature falls below the low temperature limit setting. Reference Enthalpy: Outside air (OA) enthalpy shall compare with the reference enthalpy control setpoint. The economizer shall enable when OA enthalpy is 4.7 kJ/kg less than enthalpy control setpoint. The economizer shall disable when OA enthalpy is greater than enthalpy control setpoint.

3.17 SUPPLY FAN

.1 The fan shall be off in the unoccupied mode. When the unit controller is in the occupied mode, the supply fan shall operate continuously and its VFD speed shall be modulated to maintain the duct static pressure setpoint or 200 Pa (adj.) to be set during TAB.

.2 If the supply fan fails to prove status for 30 seconds (adj.), the fan shall be commanded off, the outside air damper shall close, all valves shall close, and an alarm will be annunciated at the BAS. A manual reset shall be required to restart the fan. A hardwired, high static pressure cut-off switch shall be electrically interlocked with the variable speed drive. If the high static pressure cut-off switch is tripped the fan shall stop, the outside air damper shall close, all valves shall close, and an alarm will be annunciated at the BAS. A manual reset of the high static pressure cut-off switch shall be required to restart the fan.

.3 Fan inlet probes shall provide supply fan airflow.

3.18 RETURN FAN

.1 The return fan shall be off in the unoccupied mode. When the controller is in the occupied mode, the return fan shall operate continuously and modulate the VFD to maintain the return plenum static pressure setpoint of 200 Pa (adj.), to be set during TAB.

.2 If the return fan fails to prove status for 30 seconds (adj.), the fan shall be commanded off, the outside air damper shall close, all valves shall close, and an alarm shall be annunciated at the BAS. A manual reset is required to restart the fan. A hardwired, high static pressure cut-off switch is electrically interlocked with the variable speed drive. If the high static pressure cut-off switch is tripped, the fan shall stop, the outside air damper shall close, and all valves shall close, and an alarm shall be annunciated at the BAS. A manual reset of the high static pressure cut-off switch shall be required to restart the fan. Supply and return fans are interlocked via software, a failure of either shall disable both.

3.19 BUILDING PRESSURE CONTROL

.1 A differential pressure transducer shall actively monitor the difference in pressure between the building bay 3 (indoors) and outdoors. If the building pressure increases above the desired setpoint of 10 Pa (adj.), the AHU controller shall modulate the relief air damper and mixed air damper to control building pressure at setpoint. If the building pressure decreases below the desired setpoint and relief air damper is closed, then controller shall modulate the outdoor air damper open to maintain setpoint.

3.20 MIXED AIR LOW LIMIT

.1 The initial damper opening rate shall be limited to 2% per minute (adj.) until the damper has reached its minimum ventilation position. The outside air damper shall modulate to a position less than the minimum damper position if the mixed air temperature drops below 10.0ºC (adj.). If the mixed air temperature sensor fails an alarm shall be annunciated at the BAS and the outside air damper shall return to the minimum position.

3.21 FREEZE PROTECTION

.1 A hardwired, low limit temperature switch shall be electrically interlocked with the variable speed drive. If the low limit temperature switch is tripped 4ºC (adj.), the outside air damper shall close, hot water heating valves shall open to 100% (adjust per climate) and an alarm shall be annunciated at the BAS. Chilled water valves shall modulate closed. All unit dampers shall modulate closed, except the mixed air damper that shall be open. A manual reset of the low limit temperature switch shall be required to restart the fan.

3.22 FILTER STATUS

.1 A differential pressure switch shall monitor the differential pressure across the different filter banks, pre-filter separates then final and separate than HEPA filters when the fan is running. If the switch closes during normal operation a dirty filter alarm shall be annunciated at the BAS.

3.23 DEHUMIDIFICATION

.1 When the chilled water system is in operation and the outdoor air enthalpy is higher than return air enthalpy (economizer sequence) and when average zone humidity is 1% above

set point and zone temperature is at set point. Chilled water valve shall be fully enabled to the coil and coil bypass damper (MD-1) shall modulate from closed position to bypass air around cooling coil to maintain humidity setpoint. If room humidity set point is not achieved with a predetermined time frame (45 minutes) close the F/A damper fully. If humidity set point is not still achieved (15 minutes later), abort the dehumidification sequence and resume normal operation, provide an alarm at the BAS. If space thermal conditions are still within specification, the dehumidification function may continue for a longer period of time.

.2 When chilled water systems are shutdown, or the outside air enthalpy is lower than return air enthalpy (economizer sequence) and when average zone humidity is 1% above set point and zone temperature is at set point. Modulate the economizer dampers from current position to maintain humidity setpoint. If room humidity set point is not achieved with a predetermined time frame (45 minutes) reset/release humidity economizer sequence and revert back to original. If humidity set point is not still achieved (15 minutes later), abort the dehumidification sequence and resume normal operation, provide an alarm at the BAS. If space thermal conditions are still within specification, the dehumidification function may continue for a longer period of time.

3.24 FIRE ALARM/SMOKE CONTAINMENT MODE (2ND STAGE SIGNAL)

.1 BAS is connected to fire alarm system for signal only. Fire Alarm sequence of operation listed below is to be programmed and activated by the local controller.

.2 AHU goes to Fire Alarm/Smoke Containment Mode to create a negative pressure in the alarmed zone, relative to adjacent zones.

.3 AHU-7 and AHU-8 to be off. All dampers on AHU-7 and AHU-8 to fully close.

.4 R/F ON at 25% of max capacity (adj.).

.5 Activate smoke exhaust fans in Bay 3.

3.25 SMOKE EVACUATION MODE – CHANGES FROM OCCUPIED MODE

.1 BAS is connected to fire alarm system for signal only. Fire Alarm sequence of operation listed below is to be programmed and activated by the local controller.

.2 Upon activation of the local zone key switch, unit will operate in the Smoke Evacuation Mode.

.3 R/A damper (MD-1) and B/A damper (MD-4) fully closed.

.4 F/A damper (MD-2) fully open.

.5 E/A damper (MD-3) open, outside air volume to be 2360 L/s.

.6 S/F and R/F ON.

.7 Heating coil controlled for 13°C make-up air temperature.

.8 Upon deactivation of the local zone key switch, normal scheduled occupied or unoccupied mode will resume.

.9 Activate smoke exhaust fans in Bay 3.

3.26 FIRE ALARM INTERFACE

.1 EMCS shall be interlocked with fire alarm panel through a digital input signal.

.2 The AHU serves a designated fire/smoke zone. The two-stage fire alarm panel shall issue a second stage alarm signal to the zone under fire/smoke condition and a first stage signal to the remaining zones.

.3 A zone in second stage fire must have the AHU to go into Fire Alarm/Smoke Containment Mode to maintain negative zone pressurization relative to adjacent zones. All adjacent zones in first stage fire alarm shall continue to operate normally until receiving a second stage alarm.

.4 Wire and provide keyed exhaust fan switch in Bay 3 next to Gridline 12/F at ground level next to existing switch.

.5 When the fire alarm panel has been reset (i.e. the fire extinguished), a manual override keyed switch located in the space shall permit the fire authority to put the designated zone HVAC equipment in a Smoke Evacuation Mode to permit smoke evacuation. When the keyed switch is returned back to the OFF position (of after 30 minutes), the AHU shall resume normal operation.

.6 Contractor will provide the signal and necessary contacts in the vicinity of the air handling equipment. Co-ordinate work as necessary for proper operation the keyed switch is returned back to the OFF position (of after 30 minutes), the AHU shall resume normal operation.

3.27 AUTOMATIC RESTART SEQUENCE

.1 EMCS shall automatically restart AHU-5 in sequence with existing air handlers (1-minute lag between starting of each unit), during initial start-up, scheduled start-up, fire alarm reset, or power failure restart.

.2 Alarms shall be suppressed during systems start-up, until systems operation has stabilized.

3.28 EMERGENCY POWER SYSTEMS OPERATION

.1 When emergency power system is activated, EMCS shall automatically restart all systems, connected to emergency power, in sequence. If the generator fails or upon a power glitch, when normal power is resumed start AHUs in sequence according to their designation number with a delay to avoid power demand penalty.

3.29 HUMIDIFICATION

.1 When average zone humidity is 1% below set point and zone temperature is at set point. Controller shall energize associated humidifier and open control valve associated to operating AHU. Modulate humidifier output to maintain space humidity setpoint.

.2 Monitor humidifier and report any alarms.

3.30 CO2 DEMAND CONTROLLED VENTILATION

.1 AHU-7 and AHU-8 shall not modulate outdoor air damper based on CO2.

.2 Controller shall monitor CO2 on return air duct for BAS graphics and alarm should CO2 levels be above 800 ppm (adj.)

3.31 UNOCCUPIED MIXED AIR PLENUM TEMPERAURE

When AHU-7 or AHU-8 are off, BAS shall modulate the heating control valve to maintain a mixed air plenum temperature of 18ºC (adj.).

AHU - 7 & 8 UC600 - 1 FLOW - SYSTEM POINTS LIST

CONTROLLER: UC600		POINT TYPE								ALARMS							
TAG	SYSTEM POINT DESCRIPTION	GRAPHICS	HARDWARE INPUT	HARDWARE OUTPUT	SOFTWARE POINT	HARDWARE INTERLOCK	WIRELESS	NETWORK	DEFAULT VALUE	HIGH ANALOG LIMIT	LOWANALOG LIMIT	BINARY	LATCH DIAGMOSTIC	SENSOR FAIL	COMMUNICATIO N FAIL	DIAGNOSTIC	NOTES
1	FRESH AIR DAMPER	X	AI	AO													
2	COOLING COIL LEAVING TEMPERATURE	X	AI							X	X			X		SENSOR FAILURE	
3	DISCHARGE AIR TEMPERATURE	X	AI							X	X			X		SENSOR FAILURE	
4	DUCT STATIC PRESSURE	X	AI											X		SENSOR FAILURE	
5	MIXED AIR TEMPERATURE	X	AI							X	X			X		SENSOR FAILURE	
6	OUTDOOR AIR RELATIVE HUMIDITY	X	AI														
7	OUTDOOR AIR TEMPERATURE	X	AI														
8	HEATING COIL LEAVING TEMPERATURE	X	AI							X	X			X		SENSOR FAILURE	
9	RETURN AIR C02	X	AI							X			X			CO2 SENSOR FAILURE	
10	RETURN AIR TEMPERATURE	X	AI							X	X			X		SENSOR FAILURE	
11	RETURN FAN AIR FLOW	X	AI														
12	SPACE STATIC PRESSURE	X	AI							X	X			X		SENSOR FAILURE	
13	SUPPLY FAN AIR FLOW	X	AI														
14	RETURN PLENUM STATIC	X	AI														
15	RETURN HIGH/LOW STATIC ALARM	X	BI			X						X	X			DUCT STATIC PRESSURE HIGH/LOW	NOTE 1
16	LOW LIMIT TEMPERATURE CUTOUT	X	BI			X						X	X			LOW TEMP DETECT	NOTE 1
17	RETURN FAN STATIC ALARM	X	BI			X						X	X			DUCT STATIC PRESSURE HIGH/LOW	NOTE 1
18	RETURN FAN STATUS	X	BI									X				FAN FAILURE	
19	SUPPLY FAN STATUS	X	BI									X				FAN FAILURE	
20	CHILLED WATER COILVALVE COMMAND OUTPUT	X	AI	AO													
21	EXHAUST AIR DAMPER COMMAND	X	AI	AO													
22	HEATING COMMAND OUTPUT	X	AI	AO													
23	MIXED AIR DAMPER	X	AI	AO													
24	RETURN FAN VEIL/ SPEED COMMAND	X	AI	AO													
25	SUPPLY FAN VFD SPEED COMMAND	X	AI	AO													
26	RETURN FAN VFD START STOP COMMAND	X		BO													
27	SUPPLY FAN VFD START STOP COMMAND	X		BO													
28	COOLING COIL BYPASS DAMPER	X	AI	BO													
29	OCCUPIED COOLING SETPOI NT	X			X				23.3 ºc								
30	OCCUPIED HEATING SETPOINT	X			X				21.1ºC								
31	OCCUPIED STANDBY COOLING SETPOINT	X			X				26.7 ºC								
32	OCCUPIED STANDBY HEATING SETPOI NT	X			X				18.3 ºC								
33	UNOCCUPIED COOLING SETPOI NT	X			X				29.4 ºC								
34	UNOCCUPIED HEATING SETPOINT	X			X				15.6 ºC								
35	OCCUPIED BYPASS TIM ER	X			X				2.0 hrs								
36	DISCHARGE AIR TEMPERING SETPOINT	X			X				12.8 ºC	X	X			X			
37	DISCHARGE AIR TEMPERATURE CONTROL POINTS	X			X												
38	PASCOMMUNICATION STATE	X			X										X		NOTE 2
39	MAINTENACE REQUIRED	X			X				600 hrs								
40	DISCHARGE AIR HIMIDITY	X	AI														
41	HUMIDIFIER SELECTOR VALVE	X	AI	AO												TWO POSITION ON/OFF W/ END SWITCH	
42	SUPPLY HIGH/LOW STATIC ALARM	X	BI			X						X	X			DUCT STATIC PRESSURE HIGH/LOW	NOTE 1
43	RETURN FAN VFD FEEDBACK	X	AI							X	X			X			
44	SUPPLU FAN VFD FEEDBACK	X	AI							X	X			X			
45	RETURN AIR HUMIDITY	X	AI														
46	COOLING COIL DISCHARGEAIR TEMPERATURE	X	AI														
47	PRE-FILTER DIFFERENTIAL PRESSURE AND ALARM	X	AI							X	X			X			
48	BAG FILTER DIFFERENTIAL PRESSURE AND ALARM	X	AI							X	X			X			
49	HEPA PRE-FILTER DIFFERENTIAL PRESSURE AND ALARM	X	AI							X	X			X			
50	HEPA FILTER DIFFERENTIAL PRESSURE AND ALARM	X	AI							X	X			X			
51	ROOM TEMPERATURE SENSOR	X	AI														
52	ROOM TEMPERATURE SENSOR	X	AI														
53	ROOM TEMPERATURE SENSOR	X	AI														
54	ROOM TEMPERATURE SENSOR	X	AI														
55	ROOM HUMIDITY SENSOR	X	AI														
56	ROOM HUMIDITY SENSOR	X	AI														
57	ROOM HUMIDITY SENSOR	X	AI														
58	ROOM HUMIDITY SENSOR	X	AI														
59	HUMIDIFIER START/STOP	X		BO								X					
60	HUMIDIFIER STATUS	X	BI									X					
61	HUMIDIFIER OUTPUT	X		AO													
62	HUMIDIFIER ALARM	X	BI									X					
CONTROLLER SPARE HARDWARE POINTS																	
	UNIVERSAL INPUT(S)		6														
	ANALOG OUTPUT(S)			5													
	BINARY OUTPUT(S)			2													

GENERAL NOTES

1.DEVICE IS HARDWARE INTERLOCKED, MANUAL RESET MAY BE REQUIRED.
2.DISPLAYED AT THE BAS USER INTERFACE IF PRESENT.
3.ALLANALOG SETPOINTS SHALL BE ADJUSTABLE AT USER INTERFACE.

AHU-7 and AHU-8 Controls Schematic