

1 General

1.1 DESCRIPTION OF THE WORK

- .1 The work included for control systems is generally described as follows:
 - .1 All control system detail design, control devices, actuators, relays, pre-wired panels/cabinets, control valves, and miscellaneous materials required for a fully operational control system for the sequences described, including all interconnecting conduit, wiring accessories and BACNet Interface as required.
 - .2 Mechanical systems for this project include those for plumbing, heating, ventilation and cooling systems.
 - .3 Detailed description of the work included is as follows:
- .2 Detailed control system design for the sequences as described using products of a standard of manufacture as specified herein. Detailed design shall include finalizing control product selections for material involved and production of detailed wiring diagrams and location drawings for all connections required. The diagrams and drawings shall indicate the number and size of conductors required, and location/termination details to the numbered/lettered terminal strips or color coded wire leads involved. All device representation on the diagrams and location drawings shall be marked to indicate the code numbers as shown on the contract drawings.
- .3 Supply of all control devices, actuators, relays, pre-wired control panels/cabinets and miscellaneous control materials delivered to the site.
- .4 Mounting of all pre-wired control panels/cabinets and duct and equipment mounted devices and devices such as those mounted on switchboxes/junction boxes.
- .5 Coordination of control requirements of related equipment. Coordinate with the suppliers of controlled equipment such as the condensers for control input/output signals required, and incorporate these into the work.
 - .1 Motor starters, manual and magnetic, and protection are to be provided by Division 22 or 23, unless noted otherwise. Some equipment will be supplied with proprietary or "vendor" controls as listed below Humidifiers will be supplied with duct mount flow switches and high level humidistats.
 - .2 It shall be the responsibility of this Contractor to install, wire, program, and make fully operational the controls for the vendor supplied equipment including ties to the DDC system and all BACNet interfaces.
- .6 Necessary control wiring shall be by this Contractor in accordance with the requirements of Division 26. Note that all wiring is to be run in conduit supplied and installed by this trade. Type and voltage ratings requirements of control wiring to be coordinated with Division 26. Spare 15A circuits in emergency distribution panels to be used for 120V feeds by this contractor to control devices. Coordinate with Division 26 for panel locations, wiring terminations and labelling of panel circuits.
- .7 The Contractor is to provide a desktop personal computer to be installed in the Penthouse Room 200, complete with a printer, a desk and a chair. The PC is to be incorporated in the DDC system to function as an Operator's Work Station, (OWS), for the operation and maintenance staff. The OWS is to be linked to the control

system and is to be programmed complete with graphics, input, output and alarm screens for all controls installed under this contract.

- .8 The control system shall also be accessible through a three tiered security protocol system provided by the service provider, coordinate with the Departmental Representative.
- .9 Programming of Control Systems: All initial application software shall be programmed by this Contractor. The Departmental Representative shall be provided with copies of the source program and all documentation necessary for the user to interpret it and make any changes necessary. Trend log programming shall be in system before start-up. All temperature measurements shall be logged so that a 21 day record is continuously available.
- .10 Commissioning
 - .1 As indicated in Article 3.2.
- .11 Shop Drawings and Product Data.
 - .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.
 - .2 Submit completed control diagrams and location drawings, indicating device positions, equipment device model numbers, set points and wiring layouts.
 - .3 Submit damper and valve actuator schedule indicating damper and valve manufacturer torque requirements compared to actuator torque provided.
 - .4 Submit technical literature on components, and samples as requested.
 - .5 Submit drawing of control panel layout and construction proposed.
 - .6 Submit proposed trend log arrangement and sample printout for review.
- .12 Operation and Maintenance Data and Service
 - .1 Provide complete operation and maintenance data and control diagrams for incorporation into manual specified in Section 01 10 01 – General Requirements.
 - .2 Provide a plasticized copy of the appropriate record control diagram at each control panel or cabinet location.
 - .3 In addition to warranty and training requirements specified elsewhere, provide a sequence and device performance check every four months during the first year of operation, from date of acceptance. Conduct such tests in the presence of the Departmental Representative's service staff and report in writing the results and any resettings made, for each system.

1.2 Sustainable Design Submittals

- .1 Construction waste management plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Requiring Recycled Content".
 - .2 If products within this section are indicated on the "List of Products Requiring Recycled Content", only products with recycled content will be acceptable.

- .3 For products not identified on list, source products with highest recycled content available when practical.
- .4 Include following information with product data submission.
 - .1 Percentage of pre-consumer and post-consumer recycled content for each product.
- .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for “List of Products Required to be Locally Sourced”.
 - .2 If products within this section are indicated on the “List of Products Required to be Locally Sourced”, include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
- .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer’s certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California’s SCAQMD #1168.
- .5 Paints and Coatings.
 - .1 Provide low VOC Products as specified herein and complying with local regulations regarding toxic and hazardous materials.
 - .2 Ensure primers, paints and coatings used onsite and within building envelope meet or exceed requirements of following standards:
 - .1 Interior and Exterior Paints: GS-11
 - .2 Anti-Corrosive Paint: GS-11
 - .3 Clear Wood Finishes and other coating not covered in GS-11: SCAQMD #1113.
 - .3 Submit manufacturer’s certification indicating VOC limits of Products.
- .6 If requesting substitute product, ensure proposed substitution achieves above stated goals.

1.3 MAX. VOC CONTENT FOR SOLVENT CLEANING ACTIVITIES

- .1 Following are some of the Maximum allowed VOC Content for following activities, as per SCAQMD Rule 1171-9 (refer to SCAQMD manual for complete list and updates):
 - .1 Product cleaning during onsite surface preparation for coatings or adhesives application, and repair and maintenance cleaning:
 - .1 General maximum VOC 25g/L.
 - .2 Electrical apparatus components and electronic components.
 - .3 Cleaning of coatings or adhesives application equipment max. VOC 25g/L.
 - .2 Refer to SCAQMD for additional information and clarification and complete list of applications.

- 1.4 Any discrepancies are to be approved by Departmental Representative. Obtain written approval prior to use on site.
- 2 Products
 - 2.1 ACCEPTABLE MATERIAL
 - .1 Unless stated otherwise, numbers following refer to device series numbers as manufactured by Delta, Belimo, Danfoss, Siebe, Finder, and Greystone. Such identification does not preclude the use of equally comparable devices by Allerton or Automated Logic.
 - .2 Control system to be Native BACNet to the input/output level with master controller communication to the OWS located in Penthouse 200.
 - 2.2 LABELS
 - .1 Provide plastic laminated labels to identify all control components including room sensors. Labels to be in English and French. Where instrumentation is located above ceilings, place labels on room side of ceiling directly below device.
 - 2.3 STAND-ALONE CONTROLLERS
 - .1 For the purpose of providing direct digital control to the HVAC systems with full programming capabilities and features as required to perform sequences and operations indicated. Controller selection to allow for 10% spare input points and 10% spare output points or a minimum of 2 spare inputs and 2 spare outputs. Lap top access points to be provided for use by visiting maintenance personnel.
 - .2 Modular multi-tasking, multi-user 32 bit microprocessor based direct digital controller with 256 kilobytes SRAM memory, 1 MB DRAM memory and 1 MB Flash memory mounted in enclosure. Access protected user friendly English and French language with dual RS232 ports for communications interface with a field computer, printer or modem. Unit to be capable of interconnecting multiple zone controllers using an ethernet connection. Inputs and outputs to be accommodated up to a count of 145 through a plug in Base I/O board with I/O module and expansion cards as required. Complete P, PI, PID control, scheduling, alarm, trend logging and other control functions as required, including real time clock and battery back-up. Remote and local memory reloading capability is to be provided. Board must be expandable by use of plug-in field modules. All outputs on building controllers will come with built-in supervised hand-off-auto switches.
 - .3 Limits: Ambient temperature 0°C to 40°C.
 - .4 Unit to be provided complete with 120V to 24V power transformer and line filter.
 - .1 Acceptable Material: Delta DSC series system controllers with ethernet connection; Alerton BACtalk VLCP (w/EXP Modules); Automated Logic Corporation M-Line.
 - 2.4 OPERATOR'S WORK STATION (OWS) ROOM 200 AND ROOM 171
 - .1 Workstation shall be IBM-compatible Laptop with a minimum of:
 - .1 4th Generation Intel Core i5 Processor.

- .2 8 GB RAM.
 - .3 1 TB hard disk providing data at minimum 100 MB/sec.
 - .4 16x DVD-ROM drive.
 - .5 Serial, parallel, and network communication ports and cables required for proper system operation.
 - .6 High-Performance graphics adapter.
 - .7 Ethernet 10/100 network interface card.
 - .8 Microsoft Windows® (Windows 8.1 Professional), Red Hat Enterprise Linux (Version 6.5).
 - .9 21 inch Widescreen LCD Flat Panel Monitor.
- .2 It is the intention of this specification to provide a platform from which the building operator may interface with the control system. Systems which require the personal computer to remain “online” to direct communication between programmable control units will not be considered.
- .3 The Contractor shall be responsible to supply and install all software including graphics software, graphics for systems installed, and all required programming for a complete and operational system. Set-up software with protection to prevent deletion of the program.
- .4 When programming is completed, system shall have the ability to send remote alarms to emails and/or text message, coordinate with the Departmental Representative.
- .5 Room 171 OWS to be limited to temperature control of rooms 163, 165, 167, 168 and 170 only and HRV-5 high/low air flow.
- 2.5 OUTDOOR AIR TEMPERATURE SENSOR, OAT
- .1 For establishing outdoor air temperature from mounting position in outside air plenum or directly from outside under shroud on north facing wall.
 - .2 Solid state thermister element.
 - .3 Limits: -40°C to 43°C .
 - .4 Acceptable Material: Greystone Energy Systems Inc., TE-200F7.
- 2.6 SUPPLY, RETURN, EXHAUST AIR TEMPERATURE SENSOR, DTS
- .1 For establishing supply, return and exhaust air temperature from mounting position in air duct or plenum.
 - .2 Solid state thermister element for duct mounting.
 - .3 Limits: -40°C to 150°C.
 - .4 Acceptable material: Greystone Energy Systems Inc., TE-200FDB7B.
- 2.7 TWO POSITION DAMPER MOTOR, M
- .1 Suitable for damper actuator requirements for open/close dampers as specified and indicated on drawings.
 - .2 120V electric, direct-coupled, spring return actuator.

.3 Actuator torque rating to exceed maximum applied damper torque under any operating condition. Minimum torque rating per actuator 12.0 N-m.

.4 Acceptable material: Belimo AF24US.

2.8 MODULATING DAMPER MOTOR, M1

.1 Suitable for damper actuator requirements for modulated dampers as specified and indicated on drawings.

.2 24 V electronic positive positioning proportional control direct-coupled, spring return actuators.

.3 Actuator torque rating to exceed maximum applied damper torque under any operating condition. Minimum torque rating per actuator 15.0 N-m.

.4 Standard of Acceptance: AF24-MFT US, Honeywell.

2.9 AC CURRENT SENSOR, CS

.1 For AC current monitoring of motors.

.2 CSA approved, 3 AC current range availability, for AC current to proportional DC voltage, 0-5 VDC conversion for direct connection to microprocessor-based energy management systems.

.3 AC current ranges: 0-10 amps

.4 5-50 amps

.5 20-200 amps

.6 Acceptable material: Greystone Energy Systems Inc. CS-150.

2.10 CONTROL RELAYS, R

.1 Switching and isolating relays shall be provided by this Contractor wherever required for proper operation of the control devices for the sequences specified. They shall be panel mounted or wall mounted adjacent to the equipment served and shall be supplied with NEMA 1 enclosures.

.2 Electrical: Control voltage and switch contact rating to be as required for the application.

.3 Acceptable material: Finder, Sherley Controls, Omron.

2.11 ROOM TEMPERATURE SENSORS

.1 For establishing building air temperature for use with microprocessor-based energy management system.

.2 T1 - Temperature sensitive thermister element for switchbox mounting on interim room switchbox with stainless steel surface mount sensor

.3 T - Plastic surface mount sensor with digital display and push buttons for temperature overrides.

- .4 ZT – Zone Thermostats (Supplied by VFR Terminal Unit Supplier and wired by this trade).
- .5 Limits: 4°C to 37°C.
- .6 Standard of Acceptance: Greystone Energy Systems Inc. TE200; Delta DNS-24

2.12 INFLOOR SLAB TEMPERATURE SENSOR

- .1 For establishing the perimeter concrete floor slab temperature
- .2 Temperature probe to be inserted inside 19mm EMT embedded in the slab as indicated on the drawings.
- .3 Minimum probe length to be 1500mm
- .4 Standard of Acceptance: Greystone Energy Systems Inc. TE200 with Flying Lead , 50mm SS Probe and FT-6 cable

2.13 ROOM AIR HUMIDITY SENSOR,

- .1 HRV-1 and HRV-2 Zones
 - .1 For establishing an average air humidity from a wall mounted position in 3 ventilated zones.
 - .2 Humidity range: 0-100%
 - .3 Accuracy: 2%
 - .4 Acceptable material: Greystone Energy Systems Inc., RH100B Series
- .2 HRV-6 (Room 171)
 - .1 For establishing air humidity from a wall mounted position.
 - .2 Humidity range: 0-100%
 - .3 Accuracy: 3%
 - .4 Acceptable material: Greystone Energy Systems Inc., RH100S Series

2.14 SOLID STATE RELAYS, SSR

- .1 For modulating control of duct mounted electric heating coils.
- .2 Electrical: Control voltage and switch contact rating to be as required for the application.
- .3 Standard of Acceptance: Cristal CCT Series.

2.15 SILICONE-CONTROLLED RECTIFIERS, SCR

- .1 For modulating control of electric preheat coils.
- .2 Electrical: Control voltage and switch contact rating to be as required for the application.
- .3 Standard of Acceptance: Cristal CCS Series.

2.16 DIFFERENTIAL PRESSURE SENSOR, DPS

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

- .1 Internal materials to be suitable for continuous contact with the process material measured.
 - .2 Output signal of 4-20 mA into maximum of 500 ohm load.
 - .3 Output variation of less than 0.2% full scale for supply voltage variations of $\pm 10\%$.
 - .4 Combined non-linearity repeatability and hysteresis effects not to exceed $\pm 0.5\%$ of full scale output over entire range.
 - .5 External exposed integral zero and span adjustment.
 - .6 Temperature effect of $\pm 1.5\%$ 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.
 - .2 Supply complete with optional local LCD readout. Filter status shall be provided by measuring the static pressure differential across final filter bank. Should differential pressure rise above initial setpoint of 250 Pa for longer than 30 minutes, initiate alarm.
 - .3 Standard of Acceptance: Greystone WP-D103LCD.
- 2.17 STATIC PRESSURE SENSOR, SPS
- .1 Compact low pressure transducer, 0-1000 Pa (0-4" w.c.) with $\pm 1\%$ FSO accuracy.
 - .2 Standard of Acceptance: Greystone LP3A00S.
- 2.18 PRESSURE SENSOR, PS
- .1 Compact gauge pressure transducer complete with 2 wire 4-20 mA output, $\frac{1}{4}$ " NPT connection, and a 1 meter cable for electrical connection. Pressure range of 0-690 kPa (0-100 psig). Operating temperature range of -40°C to 127° .
 - .2 Standard of Acceptance: Greystone PGS10012A1A.
- 2.19 VARIABLE FREQUENCY DRIVES
- .1 VFD: Wall mounted, normal duty, adjustable frequency AC drive with full graphic display control panel, 10% short term overload rating, UL NEMA-1 enclosure, minimum two analog outputs and two digital inputs, automatic reset, internal cooling fan and built-in lockable disconnect.
 - .2 Match power requirements as noted on drawings.
 - .3 HRV's requires VFD for both supply fans and exhaust fans for independent control through the BMS.
 - .1 Standard of Acceptance: ABB ACH550, Vacon.
- 2.20 CARBON MONOXIDE/NITROGEN DIOXIDE DETECTOR, CO/NO2
- .1 Single input network version Carbon monoxide or Nitrogen dioxide gas detector/transmitter complete with 10 step LED display, BACnet output for tie-in to the building DDC system and audible alarm. Supply with both Carbon monoxide or Nitric Oxide gas sensors.
 - .2 Carbon Monoxide Sensing Accuracy: $\pm 3\%$, 0-250 ppm.

- .3 Nitrogen dioxide Sensing Accuracy: $\pm 3\%$, 0-10 ppm.
- .4 Range of Operation: 0 to 90% R.H., -20°C to 50°C (-4°F to 122°F).
- .5 One 4-20mA input signal and one 5Amp DPDT relay output.
- .6 120 VAC/60 HZ Input power complete with 120-24VAC step down transformer.
- .7 Supply complete with optional red wall mount strobe light for indoor/outdoor applications and 85 DbA audible alarm at 1 meter.
- .8 Standard of Acceptance: Honeywell E3 Point, CEA Instruments.
- .9 Standard of Acceptance for combination alarm-strobe: SWS 1200 UH-R

2.21 PIPE TEMPERATURE SENSOR, PTS

- .1 For establishing fluid temperature from mounting position in pipe mounted thermowell.
- .2 Solid state thermistor element for thermowell mounting.
- .3 Limits: 4°C to 116°.
- .4 Standard of Acceptance: WTS-420 with brass thermowell.

3 Execution

3.1 INSTALLATION

- .1 Install products using factory trained journeymen certified by the Province of New Brunswick. Provide all control devices located in control panels/cabinets mounted and pre-wired to a numbered terminal strip as a factory fabricated CSA approved and labelled assembly.
- .2 Install instrumentation where indicated. Where position is not shown, install in a position best suited for proper operation. See drawings 2301-2, 2301-3 and 2500-1 for equipment and instrumentation locations.
- .3 Submit to the Departmental Representative instrumentation installation details for all instruments prior to installation.

3.2 COMMISSIONING

- .1 All controls to be properly set up and calibrated for control sequences specified.
- .2 Put all controls through all specified sequences and verify correct operation on site. Make adjustments as required for proper operating condition. Allow minimum additional two days for a competent controls technician involved in the project to fully demonstrate the sequences specified to the Departmental Representative. Allow an additional two days to instruct the Departmental Representative's maintenance representative on the proper operation and minor adjustments/troubleshooting of the controls system.
- .3 After start-up, test, adjust and prove operation of all equipment and accessories to suit site conditions and 01 91 13 General Commissioning Requirements.

3.3 OPERATION SEQUENCES

- .1 Infloor Perimeter Heat
 - .1 Infloor perimeter electric heat shall modulate to maintain the floor slab at an adjustable zone low setpoint 22°C when the OAT drops below 5°C. As the OAT drops to 0°C, reset the zone temperature infloor setpoint linearly up to 25°C.
- .2 Rooms 128B and 130B Infloor Heat
 - .1 To modulate based on the room thermostat setpoint.
- .3 Building Heat Recovery Units (HRV-1 and HRV-2)
 - .1 HVR-1 and HRV-2 to run continuously during occupied mode from the Variable Refrigerant Flow system central controller. The unit will be scheduled to start one hour prior to occupancy and bring the temperature up or down to setpoint as required from unoccupied setpoints. Upon call for ventilation, fully open the exhaust and outdoor air dampers before energizing the HRV fans.
 - .2 HRV-1 Air Flows: 415 l/s exhaust , 470 l/s supply
 - .3 HRV-2 Air Flows: 320 l/s exhaust , 330 l/s supply
 - .4 HRV's to shut down upon signal from the fire alarm panel.
 - .5 HRV's shall have a tempering duct heater in the O/A to prevent the recovery core from freezing. Modulate the duct tempering heater to prevent the outdoor air from dropping below 2°C.
 - .6 The controls for the VRF system shall be proprietary to the VRF manufacturer with integration of controls signals to the BMS. This contractor shall be responsible for the installation of a complete operating system including , but not limited to, wiring, sensor devices and relays as well as VRF manufactured controls. See section 23 81 23 Split Air Conditioning Systems for the VRF sequence of operation.
 - .7 An isolation damper between the washrooms and general exhaust will close should the HRV be de-energized and open when the HRV is energized.
 - .8 Humidification
 - .1 Modulate H-1 and H-2 output in the HRV supply air to maintain zone air humidity setpoint at 30% as monitored by averaging 3 wall mounted zone humidity sensors in each wing. Lock out humidification above 10°C. Reset humidification setpoints as follows to prevent condensation formation on exterior windows:

OA Temperature	Humidity Setpoint
10°C	30% RH
0°C	24% RH
-10°C	20% RH
-20°C	17% RH
 - .2 Both humidifiers (H-1 and H-2) are to be enabled by wiring the humidifier control circuits in with the HRV supply fan starters and the duct high limit humidistat and duct flow switch provided with the humidifiers. Supply air duct humidistat to be set at 80%.
 - .9 On alarm from the fire alarm annunciator panel, all fans shall shutdown, outside air dampers and exhaust/relief air dampers shall close. Switches at the fire alarm system annunciator panel shall be wired to the DDC system by Division 26 for smoke management operation capability by firefighting staff. This mode of operation is a DDC override, as triggered by a digital input from the fire alarm

panel, for which no ventilation air cooling nor humidification is to be implemented; heating is to remain enabled.

.4 HRV- 3

- .1 HVR-3 to run continuously with two stages of air flow. Upon call to be energized, fully open the exhaust and outdoor air dampers before energizing the HRV fans.
- .2 A manual air flow control switch will be located on the hood EH-1 located in room 132 with status back to the BMS.
- .3 Air Flows: High – 1140 l/s exhaust , 1040 l/s supply and Low – 570 l/s exhaust , 520 l/s supply
- .4 HRV to shut down upon signal from the fire alarm panel.
- .5 HRV shall have two duct heaters, a tempering duct heater in the O/A to prevent the recovery core from freezing and a supply air duct heater to maintain the supply air setpoint. Modulate the O/A duct tempering heater to prevent the outdoor air from dropping below 2°C. The setpoint for the supply air shall be adjustable from the OWS only with a normal setting of 14°C.

.5 HRV - 4

- .1 HRV-4 to run continuously. Upon call to be energized, fully open the exhaust and outdoor air dampers before energizing the HRV fans.
- .2 Air Flows: 160 l/s exhaust , 140 l/s supply
- .3 HRV to shut down upon signal from the fire alarm panel.
- .4 HRV shall have two duct heaters, a tempering duct heater in the O/A to prevent the recovery core from freezing and a supply air duct heater to maintain the supply air setpoint. Modulate the O/A duct tempering heater to prevent the outdoor air from dropping below 2°C. The setpoint for the supply air shall be adjustable from the OWS only with a normal setting of 14°C.

.6 HRV- 5

- .1 HVR-5 to run continuously with two stages of air flow. Upon call to be energized, fully open the exhaust and outdoor air dampers before energizing the HRV fans.
- .2 Air Flows: High – 390 l/s exhaust , 350 l/s supply and Low – 180 l/s exhaust , 175 l/s supply
- .3 HRV to shut down upon signal from the fire alarm panel.
- .4 HRV shall have a tempering duct heater in the O/A to prevent the recovery core from freezing and individual supply air duct heater for each zone to maintain individual supply air setpoints. Modulate the O/A duct tempering heater to prevent the outdoor air from dropping below 2°C. The setpoint for the supply air temperature and flow shall be adjustable from the OWS and guard station only with a normal setting of 22°C and low flow.

.7 HRV- 6

- .1 HVR-6 to run continuously during a manual occupied mode. Upon call to be energized, fully open the exhaust and outdoor air dampers before energizing the HRV fans.
- .2 Air Flows: 450 l/s exhaust , 470 l/s supply
- .3 HRV to shut down upon signal from the fire alarm panel.
- .4 HRV-6 to operate in two modes.

- .1 Winter Operation: HRV shall have a tempering duct heater in the O/A to prevent the recovery core from freezing and a supply air duct heater to maintain supply air setpoint. Modulate the O/A duct tempering heater to prevent the outdoor air from dropping below 2°C. The setpoint for occupancy and supply air temperature shall be adjustable from the OWS and guard station only with a normal setting of 22°C (±3°C) for winter operation.
- .2 Summer Operation: As the OAT rises from 15°C to 20°C, reset the SAT setpoint linear from 22°C to 15°C. A duct temperature sensor (DTS) located downstream of the cooling coil (AC-15) to energize CU-4 through the BMS based on the thermostat setpoint in room 171.
- .5 Humidification
 - .1 Modulate H-3 output in the HRV supply air to maintain zone air humidity setpoint at 30% as monitored by the wall mounted zone humidity sensor. Lock out humidification above 10°C. Reset humidification setpoints as follows to prevent condensation formation on exterior windows:

OA Temperature	Humidity Setpoint
10°C	30% RH
0°C	24% RH
-10°C	20% RH
-20°C	17% RH
 - .2 H-3 shall be enabled by wiring the humidifier control circuits in with the HRV supply fan starters and the duct high limit humidistat and duct flow switch provided with the humidifiers. Supply air duct humidistat to be set at 80%.
- .6 On alarm from the fire alarm annunciator panel, all fans shall shutdown, outside air dampers and exhaust/relief air dampers shall close. Switches at the fire alarm system annunciator panel shall be wired to the DDC system by Division 26 for smoke management operation capability by firefighting staff. This mode of operation is a DDC override, as triggered by a digital input from the fire alarm panel, for which no ventilation air cooling nor humidification is to be implemented; heating is to remain enabled.
- .8 DUCTLESS SPLIT COOLING SYSTEM, AC-14
 - .1 The ductless split AC-14 to operate off a Thermostat supplied by the ductless split manufacturer. Control wiring and installation is by this contractor.
- .9 CO/NOX EXHAUST FANS/ALARM-STROBE (EF-1 in Room 163)
 - .1 When CO or NOX sensor is activated (CO -25ppm, NOX-1ppm), open the associated fresh air and exhaust air dampers and energized the fans to the first stage of air flow (215 l/s). If the readings continue to rise (CO-50ppm, NOX-5ppm) energize the fan to the second stage of air flow (430 l/s) and turn on the alarm-strobe. As readings fall below 50ppm CO, 5ppm NOX reduce air flow to the first stage and turn off alarm/strobe and below 10 ppm CO, .05ppm NOX turn off the fan and close all associated dampers.
- .10 CO/NOX EXHAUST FANS/ALARM-STROBE (Room 164)

- .1 When CO or NOX sensor is activated (CO -25ppm, NOX-1ppm), turn on the alarm/strobe and turn HRV-5 on high. As readings fall below 25ppm CO,1ppm NOX turn off alarm/strobe and return HRV-5 to normal airflow.
- .11 ELECTRICAL ROOM 124 EXHAUST FAN (EF-2)
 - .1 Upon call for cooling, fully open the exhaust and outdoor air dampers before energizing the exhaust fan EF-2 until the setpoint has been reached.
- .12 EH-2 HOOD EXHAUST FAN (EF-3)
 - .1 The exhaust fan will be controlled by a switch located on the hood EH-2 located in room 144 and installed by division 26.
- .13 OUT BUILDING EXHAUST FAN (EF-4)
 - .1 The exhaust fan will be controlled by a switch located on the corridor wall in room 301 and installed by division 26. Open intake/exhaust dampers when fan is operating.
- .14 DHW CIRCULATING PUMP (C-DHWR)
 - 1. Pump to run on schedule supplied by users and controlled by the BMS.
 - 2. BMS to monitor through the current sensor.
- .15 EXTERIOR LIGHTING
 - .1 Enable exterior pole lighting, exterior sign, and exterior lantern at dusk. Disable exterior pole lighting, exterior sign, and exterior lantern at dawn. Exact schedule shall be coordinated with the Departmental Representative.
- .16 EMERGENCY POWER OPERATION
 - .1 Provide data from emergency generator indicating capacity available and amount being used as well as warnings when consumption exceeds 80% of capacity.
 - .2 HVAC
 - .1 During emergency power operation HRV-1, HRV-2, HRV-5, HRV-6, associated duct heaters, VRF compressors and humidifiers will not be operational.
 - .2 Maintain all operation to all exhaust fan EF-1, HRV-3 and HRV-4 and associated duct heaters at low flow rate.
 - .3 Provide an override switch on the BMS to activate each piece of ventilation equipment manually without duct heaters or humidification.
 - .4 All operable duct and space heaters will only work 100% on or off to prevent fluctuations to the power frequencies.
 - .5 Stage HRV's to start-up sequentially in 5 second intervals on return to normal power operation.
 - .3 PLUMBING
 - .1 Although all plumbing services and alarms will be maintained on emergency power, stage the domestic water heaters DHWT-1 & DHWT-2 in Room 125 will have a 10 minute window for each. Staging will be DHWT-1 only then DHWT-2, only, then DHWT-1 only Etc.....
- .17 Energy Meter
 - .1 Provide a signal from the meter in the main power service board to the BACnet operating program that will allow monitoring of power and trending of building power consumption.

3.4 GRAPHICS AND ALARMS

- .1 The OWS is to be programmed by the Contractor with user-friendly interface graphics depicting the controlled systems. Graphics are to be continuously updated and setpoint adjustments, override/enable/disable and alarm acknowledgement operation shall be performed from the graphic screen. Graphics to indicate location of all systems under control and are to indicate systems schematically with dynamic reporting of all inputs/outputs for equipment status, temperature values, pressure values, etc. discussed in sequences of operation. Graphics are to be set up with loading software for remote operation.
- .2 Connect electrical service entrance board digital power meter to DDC system through BacNet communication module. DDC system to graphically display and trend the following information: voltage, current, power factor, kW and kWh. BacNet wiring, interface and graphics by Division 25. Digital power meter by Division 26. All work to be coordinated between Division 25 and 26
- .3 Supply air duct temperature sensors shall be programmed to trigger a freeze stat alarm and de-energize a given air system when SA temperature drops to 4°C.
- .4 Alarms to be triggered via DDC system monitoring for the following:
 - .1 Space temperature low, S.P. = 13°C.
 - .2 All filter status alarms.
 - .3 HRV-1 supply fan trip or "out of range" amperage.
 - .4 HRV-1 exhaust fan trip or "out of range" amperage.
 - .5 HRV-2 supply fan trip or "out of range" amperage.
 - .6 HRV-2 exhaust fan trip or "out of range" amperage.
 - .7 HRV-3 supply fan trip or "out of range" amperage.
 - .8 HRV-3 exhaust fan trip or "out of range" amperage.
 - .9 HRV-4 supply fan trip or "out of range" amperage.
 - .10 HRV-4 exhaust fan trip or "out of range" amperage.
 - .11 HRV-5 supply fan trip or "out of range" amperage.
 - .12 HRV-5 exhaust fan trip or "out of range" amperage.
 - .13 HRV-6 supply fan trip or "out of range" amperage.
 - .14 HRV-6 exhaust fan trip or "out of range" amperage.
 - .15 CU-1 system trouble alarm.
 - .16 CU-1 compressor trip or "out of range" amperage.
 - .17 CU-2 system trouble alarm.
 - .18 CU-2 compressor trip or "out of range" amperage.
 - .19 CU-3 system trouble alarm.
 - .20 CU-3 compressor trip or "out of range" amperage.
 - .21 CU-4 system trouble alarm.
 - .22 CU-4 compressor trip or "out of range" amperage.
 - .23 AC-1 system trouble alarm.
 - .24 AC-2 system trouble alarm.
 - .25 AC-3 system trouble alarm.
 - .26 AC-4 system trouble alarm.
 - .27 AC-5 system trouble alarm.
 - .28 AC-6 system trouble alarm.
 - .29 AC-7 system trouble alarm.

- .30 AC-8 system trouble alarm.
- .31 AC-9 system trouble alarm.
- .32 AC-10 system trouble alarm.
- .33 AC-11 system trouble alarm.
- .34 AC-12 system trouble alarm.
- .35 AC-13 system trouble alarm.
- .36 AC-14 "High Room Temperature" alarm
- .37 AC-15 "High Duct Temperature" alarm
- .38 C-DHWR pump trip or "out of range" amperage.
- .39 Fire alarm annunciator panel trouble alarm.
- .40 Emergency power active on manual transfer switch.
- .41 Emergency generator "Consumption exceeding 80% of Capacity"
- .42 EF-1 trip or "out of range" amperage.
- .43 EF-2 trip or "out of range" amperage.
- .44 EF-3 trip or "out of range" amperage.

END OF SECTION