

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1      Sequence of operation:
  - .1      Air Handling Unit - AHU-1
  - .2      Energy Recovery Ventilator - ERV-1
  - .3      Variable Air Volume Terminal Unit with In-floor HTG and CLG - VAV-1, 2,
  - .4      In-floor Radiation
  - .5      Supply Fan Mechanical Room, F-1
  - .6      Crawlspace Supply & Exhaust Fan – F-2 & F-3
  - .7      Unit Heater UH-1
  - .8      Heating Primary Loop Pumps - P-1 & P-2
  - .9      Heating & Cooling Secondary Loop Pumps - P-3 & P-4
  - .10     Boiler Interface, B-1 and B-2
  - .11     Chiller Interface, CH-1
  - .12     Outside Air Conditions
  - .13     Blind Interface

**1.2                SYSTEM DESCRIPTION**

- .1      This section defines the manner and method by which controls function.
- .2      Requirements for each type of control system operation are specified.
- .3      Equipment, devices, and system components required for control systems are specified in other Sections.

**1.3                SUBMITTALS FOR REVIEW**

- .1      Section 21 05 00: Procedures for submittals.
- .2      Shop Drawings: Indicate mechanical system controlled and control system components.
  - .1      Label with settings, adjustable range of control and limits. Include written description of control sequence.
  - .2      Include flow diagrams for each control system, graphically depicting control logic.
  - .3      Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

**1.4                SUBMITTALS AT PROJECT CLOSEOUT**

- .1      Section 21 05 00: Submittals for project closeout.
- .2      Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

**Part 2            Products**

**2.1                Not Used**

- .1            Not Used

**Part 3            Execution**

**3.1                AIR HANDLING UNIT, AHU-1 - VARIABLE AIR VOLUME**

- .1            Run Conditions - Scheduled:
  - .1            The unit shall run based upon an operator adjustable schedule.
- .2            Emergency Shutdown:
  - .1            The unit shall shut down and generate an alarm upon receiving an emergency shutdown signal.
- .3            Freeze Protection:
  - .1            The unit shall shut down and generate an alarm upon receiving a freezestat status.
- .4            High Static Shutdown:
  - .1            The unit shall shut down and generate an alarm upon receiving a high static shutdown signal.
- .5            Supply Air Smoke Detection:
- .6            The unit shall shut down and generate an alarm upon receiving a supply air smoke detector status.
- .7            Supply Fan:
  - .1            The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.
  - .2            Alarms shall be provided as follows:
    - .1            Supply Fan Failure: Commanded on, but the status is off.
    - .2            Supply Fan in Hand: Commanded off, but the status is on.
    - .3            Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).
- .8            Supply Air Duct Static Pressure Control:
  - .1            The controller shall measure duct static pressure and modulate the supply fan VFD speed to maintain a duct static pressure setpoint. The speed shall not drop below 35% (adj.). The static pressure setpoint shall be reset based on zone cooling requirements.
    - .1            The initial duct static pressure setpoint shall be 100.0Pa (adj.).
  - .2            As cooling demand increases, the setpoint shall incrementally reset up to a maximum of 250 Pa (adj.).

- .3 As cooling demand decreases, the setpoint shall incrementally reset down to a minimum of 60Pa (adj.) .
- .4 Alarms shall be provided as follows:
  - .1 High Supply Air Static Pressure: If the supply air static pressure is 25% (adj.) greater than setpoint.
  - .2 Low Supply Air Static Pressure: If the supply air static pressure is 25% (adj.) less than setpoint.
  - .3 Supply Fan VFD Fault.
- .9 Return Fan:
  - .1 The return fan shall run whenever the supply fan runs.
  - .2 Alarms shall be provided as follows:
    - .1 Return Fan Failure: Commanded on, but the status is off.
    - .2 Return Fan in Hand: Commanded off, but the status is on.
    - .3 Return Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).
    - .4 Return Fan VFD Fault.
- .10 Building Static Pressure Control:
  - .1 The controller shall measure building static pressure and modulate the return fan VFD speed to maintain a building static pressure setpoint of 5 Pa (adj.). The return fan VFD speed shall not drop below 20% (adj.).
  - .2 Alarms shall be provided as follows:
    - .1 High Building Static Pressure: If the building air static pressure is 25% (adj.) greater than setpoint.
    - .2 Low Building Static Pressure: If the building air static pressure is 25% (adj.) less than setpoint.
- .11 Supply Air Temperature Setpoint - Optimized:
  - .1 The controller shall monitor the supply air temperature and shall maintain a supply air temperature setpoint reset based on zone cooling and heating requirements
  - .2 The supply air temperature setpoint shall be reset for cooling based on zone cooling requirements as follows:
    - .1 The initial supply air temperature setpoint shall be 13°C (adj.).
    - .2 As cooling demand increases, the setpoint shall incrementally reset down to a minimum of 11.5°C (adj.).
    - .3 As cooling demand decreases, the setpoint shall incrementally reset up to a maximum of 22°C (adj.) .
- .12 Heating Modulation:
  - .1 The controller shall measure the supply air temperature and modulate the heating demand to maintain its Heating setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.
    - .1 The Heating shall be enabled whenever:
      - .1 Outside air temperature is less than 15.5°C (adj.).

- .2 AND the economizer (if present) is disabled or closed.
- .3 AND the supply fan status is on.
- .4 AND the cooling (if present) is not active.
- .2 Alarms shall be provided as follows:
  - .1 High Supply Air Temp: If the supply air temperature is 35°C (adj.) greater than setpoint.
- .13 Cooling Modulation:
  - .1 The controller shall measure the supply air temperature and modulate the cooling demand to maintain its cooling setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.
    - .1 The cooling shall be enabled whenever:
      - .2 Outside air temperature is greater than 15.5°C (adj.).
      - .3 AND the economizer (if present) is disabled or fully open.
      - .4 AND the supply fan status is on.
      - .5 AND the heating (if present) is not active.
  - .2 Alarms shall be provided as follows:
    - .1 High Supply Air Temp: If the supply air temperature is 3°C (adj.) greater than setpoint.
    - .2 Low Supply Air Temperature Alarm:
      - .1 The controller shall alarm if the supply air temperature is less than 8°C (adj.).
- .14 Economizer:
  - .1 The controller shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a setpoint 1°C (adj.) less than the supply air temperature setpoint. The outside air dampers shall maintain a minimum adjustable position open whenever occupied. Refer to schedule.
  - .2 The economizer shall be enabled whenever:
    - .1 Outside air temperature is less than 18°C (adj.).
    - .2 AND the outside air enthalpy is less than 34kJ/kg (adj.)
    - .3 AND the outside air temperature is less than the return air temperature.
    - .4 AND the outside air enthalpy is less than the return air enthalpy.
    - .5 AND the supply fan status is on.
  - .3 The economizer shall close whenever:
    - .1 Mixed air temperature drops from 4.5°C to 1.5°C (adj.)
    - .2 OR the freezestat (if present) is on.
    - .3 OR on loss of supply fan status.
    - .4 OR loss of outdoor air temperature or humidity sensor reading.**
  - .4 The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.
- .15 Final Filter Differential Pressure Monitor:

- .1 The controller shall monitor the differential pressure across the final filter.
- .2 Alarms shall be provided as follows:
  - .1 Final Filter Change Required: Final filter differential pressure exceeds a user definable limit (adj.).
- .16 Mixed Air Temperature:
  - .1 The controller shall monitor the mixed air temperature and use as required for economizer control (if present) or preheating control (if present).
  - .2 Alarms shall be provided as follows:
    - .1 High Mixed Air Temp: If the mixed air temperature is greater than 33°C (adj.).
    - .2 Low Mixed Air Temp: If the mixed air temperature is less than 8°C (adj.).
- .17 Return Air Humidity:
  - .1 The controller shall monitor the return air humidity and use as required for economizer control.
  - .2 Alarms shall be provided as follows:
    - .1 High Return Air Humidity: If the return air humidity is greater than 80% (adj.).
    - .2 Low Return Air Humidity: If the return air humidity is less than 25% (adj.).
  - .3 Return Air Temperature:
    - .1 The controller shall monitor the return air temperature and use as required for setpoint control or economizer control.
    - .2 Alarms shall be provided as follows:
      - .1 High Return Air Temp: If the return air temperature is greater than 33°C (adj.).
      - .2 Low Return Air Temp: If the return air temperature is less than 8°C (adj.).
- .18 Return Air Carbon Dioxide (CO2) Concentration Monitoring:
  - .1 The controller shall measure the return air CO2 levels.
    - .1 Alarms shall be provided as follows:
      - .1 High Return Air Carbon Dioxide Concentration: If the return air CO2 concentration is greater than 1000 ppm (adj.) when the unit is running.

**3.2 ENERGY RECOVERY VENTILATOR (ERV-1)**

- .1 Run Conditions - Scheduled:
  - .1 The unit shall run based upon an operator adjustable schedule.
- .2 Emergency Shutdown:
  - .1 The unit shall shut down and generate an alarm upon receiving an emergency shutdown signal.
- .3 Supply Fan:
  - .1 The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.
  - .2 Alarms shall be provided as follows:
    - .1 Supply Fan Failure: Commanded on, but the status is off.
    - .2 Supply Fan in Hand: Commanded off, but the status is on.
- .4 Exhaust Fan:
  - .1 The exhaust fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the Exhaust fan shall have a user definable (adj.) minimum runtime.
  - .2 Alarms shall be provided as follows:
    - .1 Exhaust Fan Failure: Commanded on, but the status is off.
    - .2 Exhaust Fan in Hand: Commanded off, but the status is on.
- .5 Heat Recovery Ventilator Air Filter Differential Pressure Monitor:
  - .1 The controller shall monitor the differential pressure across the filter.
  - .2 Alarms shall be provided as follows:
    - .1 Filter Change Required: Final filter differential pressure exceeds a user definable limit (adj.).
- .6 Supply Air Temperature:
  - .1 The controller shall monitor the supply air temperature.
  - .2 Alarms shall be provided as follows:
    - .3 Low Supply Air Temp: If the supply air temperature is less than -15°C (5 °F) (adj.).
- .7 Exhaust Air Temperature:
  - .1 The controller shall monitor the supply air temperature.
  - .2 Alarms shall be provided as follows:
    - .3 Low Supply Air Temp: If the supply air temperature is less than -15°C (5 °F) (adj.).
- .8 Exhaust Air Humidity:
  - .1 **The controller shall monitor the return air humidity.**

### **3.3 VARIABLE AIR VOLUME - TERMINAL UNIT (WITH INFLOOR HEAT)**

- .1 Run Conditions - Scheduled:
  - .1 The unit shall run according to a user definable time schedule in the following modes:
  - .2 Occupied Mode: The unit shall maintain
    - .1 A 23.5°C (adj.) cooling setpoint
    - .2 A 21°C (adj.) heating setpoint.
  - .3 Unoccupied Mode (night setback): The unit shall maintain
    - .1 A 29.5°C (adj.) cooling setpoint.
    - .2 A 13°C (adj.) heating setpoint.
  - .4 Alarms shall be provided as follows:
    - .1 High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
    - .2 Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).
- .2 Zone Setpoint Adjust:
  - .1 The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.
- .3 Zone Optimal Start:
  - .1 The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.
- .4 Zone Unoccupied Override:
  - .1 A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.
- .5 Reversing Variable Volume Terminal Unit - Flow Control:
  - .1 The unit shall maintain zone setpoints by controlling the airflow through one of the following:
- .6 Occupied:
  - .1 When zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum occupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
  - .2 When the zone temperature is between the cooling setpoint and the heating setpoint, the zone damper shall maintain the minimum required zone ventilation (adj.).
  - .3 When zone temperature is less than its heating setpoint, the controller shall enable heating to maintain the zone temperature at its heating setpoint. Additionally, if warm air is available from the AHU, the zone damper shall

modulate between the minimum occupied airflow (adj.) and the maximum heating airflow (adj.) until the zone is satisfied.

.7 Unoccupied:

- .1 When the zone is unoccupied the zone damper shall control to its minimum unoccupied airflow (adj.).
- .2 When the zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum unoccupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
- .3 When zone temperature is less than its unoccupied heating setpoint, the controller shall enable heating to maintain the zone temperature at the setpoint. Additionally, if warm air is available from the AHU, the zone damper shall modulate between the minimum unoccupied airflow (adj.) and the auxiliary heating airflow (adj.) until the zone is satisfied.

.8 Discharge Air Temperature:

- .1 The controller shall monitor the discharge air temperature.
- .2 Alarms shall be provided as follows:
  - .1 High Discharge Air Temp: If the discharge air temperature is greater than 49°C (adj.).
  - .2 Low Discharge Air Temp: If the discharge air temperature is less than 4.5°C (adj.).

.9 Infloor Coil Valve:

- .1 The controller shall measure the zone temperature and modulate the in floor valve open to maintain its heating or cooling setpoint.
- .2 In floor – Slab temperature
  - .1 The controller shall measure the slab temperature and adjust the infloor heating from 72°F to 80°F in heating (adj.).
  - .2 The controller shall measure the slab temperature and adjust the infloor heating from 74°F to 64°F in cooling (adj.).
  - .3
- .3 Slab Temperature:
  - .1 The controller shall monitor the slab temperature.
  - .2 Alarms shall be provided as follows:
    - .1 High slab Temp: If the slab temperature is greater than 85°F (adj.).
    - .3 Low slab Temp: If the slab temperature is less than 60°F (adj.).



### 3.4 IN FLOOR RADIATION

- .1 Run Conditions - Scheduled:
  - .1 The unit shall run according to a user definable time schedule in the following modes:
  - .2 Occupied Mode: The unit shall maintain
    - .1 A 74°F (adj.) cooling setpoint
    - .2 A 70°F (adj.) heating setpoint.
  - .3 Unoccupied Mode (night setback): The unit shall maintain
    - .1 A 78°F (adj.) cooling setpoint.
    - .2 A 62°F (adj.) heating setpoint.
  - .4 Alarms shall be provided as follows:
    - .1 High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
    - .2 Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).
- .2 In-floor Coil Valve(s):
  - .1 The controller shall measure the zone temperature and modulate the in floor valve open to maintain its heating or cooling setpoint.
  - .2 In floor – Slab temperature
    - .1 The controller shall measure the slab temperature and adjust the infloor heating from 72°F to 80°F in heating (adj.).
    - .2 The controller shall measure the slab temperature and adjust the infloor heating from 74°F to 64°F in cooling (adj.).
  - .3 Slab Temperature:
    - .1 The controller shall monitor the slab temperature.
    - .2 Alarms shall be provided as follows:
      - .1 High slab Temp: If the slab temperature is greater than 85°F (adj.).
      - .3 Low slab Temp: If the slab temperature is less than 60°F (adj.).
- .3 Air handling unit – AHU-1
  - .1 Additional heat to maintain the space temperature when space is unoccupied.
    - .1 AHU-1 shall stage on @ 50% supply flow and provide supplemental heating to maintain unoccupied heating setpoint.

### 3.5 FAN MECHANICAL ROOM, F-1

- .1 Run Conditions - Scheduled:
  - .1 The fan shall run according to space temperature.
  - .2 The unit shall maintain a **cooling** setpoint of 23°C (adj.).
- .2 Fan:
  - .1 The fan shall have a user definable (adj.) minimum runtime.
- .3 Outside Air Damper:
  - .1 The outside air damper shall open anytime the unit runs and shall close anytime the unit stops. The Relief air damper shall close 30 sec (adj.) after the fan stops.
  - .2 Alarms shall be provided as follows:
    - .1 Damper Failure: Commanded open, but the status is closed.
    - .2 Damper in Hand: Commanded closed, but the status is open.
- .4 Damper Status:
  - .1 The fan shall be enabled after the damper status has proven.
    - .1 Alarms shall be provided as follows:
      - .1 Damper Failure: Commanded open, but the status is closed.
      - .2 Damper in Hand: Commanded closed, but the status is open.
- .5 Fan Status:
  - .1 The controller shall monitor the fan status.
  - .2 Alarms shall be provided as follows:
    - .1 Fan Failure: Commanded on, but the status is off.
    - .2 Fan in Hand: Commanded off, but the status is on.
    - .3 Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).

**3.6 CRAWLSPACE SUPPLY & EXHAUST FAN – F-2 & F-3**

- .1 Run Conditions:
- .2 The unit shall be continuously enabled to maintain a zone temperature of less than 26°C (79°F) and humidity set points less than 50% RH (adj.).
- .3 If the crawlspace temperature is less than 15°C (60°F). (adj.) Fans shall be disabled.
- .4 Alarms shall be provided as follows:
  - .1 Low ambient Temperature: If the crawlspace temperature is less than 13°C 55°F. (adj.).
- .5 Run Conditions:
  - .1 Fan shall be controlled by thermostat and dehumidistat located in the crawlspace. Fans shall be enabled to run when temperatures or humidity exceed set points.
- .6 Modulating Air Damper:
  - .1 The air damper shall open anytime the unit runs and shall close anytime the unit stops. The exhaust air damper shall close 30 sec (adj.) after the fan stops.
  - .2 Damper Status:
  - .3 The fan shall be enabled after the damper status has proven.

**3.7 UNIT HEATER UH-1**

.1 Run Conditions – Temperature:

.1 The unit shall run according to a user definable temperature:

.2 The unit shall maintain

.1 The unit shall maintain a heating setpoint of 18°C (adj.).

.2 Zone Setpoint Adjust:

.1 The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

.3 Fan:

.1 The fan shall run anytime the zone temperature drops below heating setpoint, unless shutdown on safeties.

**.4 Heating Coil Valve:**

**.1 The heating coil valve shall open anytime the boilers are activated and closed during any other operation.**

.5 Alarms shall be provided as follows:

.1 Low ambient Temperature: If the temperature is less than 15°C 60°F. (adj.). Alarm shall be audible in the mechanical room.

.2 High ambient Temperature: If the temperature is less than 26°C 79°F. (adj.). Alarm shall be audible in the mechanical room.

### 3.8 HEATING & COOLING PRIMARY LOOP PUMPS - P-1 & P-2

- .1 Water Pump Run Conditions:
  - .1 The water pumps shall be enabled whenever:
    - .1 There is a call for heating.
  - .2 The pumps shall run for freeze protection anytime outside air temperature is less than 5°C (adj.).
  - .3 To prevent short cycling, the pump shall run for a minimum time and be off for a minimum time (both user adjustable).
- .2 Heating Operation
  - .1 Water Pump Lead/Standby Operation:
    - .2 The two water pumps shall operate in a lead/standby fashion.
      - .1 The lead pump shall run first.
      - .2 On failure of the lead pump, the standby pump shall run and the lead pump shall turn off.
  - .3 The Lead pump shall stage on to meet the minimum flow of the boiler and modulate flow to maintain the air handler's discharge air temperature setpoint.
  - .4 The designated lead pump shall rotate upon one of the following conditions (user selectable):
    - .1 manually through a software switch
    - .2 if pump runtime (adj.) is exceeded
      - .1 daily
      - .2 weekly
      - .3 monthly
- .5 Cooling Operation
  - .1 Water Pump Parallel Operation:
    - .1 The two water pumps shall operate in a parallel fashion to maintain a constant flow.
- .6 Alarms shall be provided as follows:
  - .1 Water Pump 1
    - .1 Failure: Commanded on, but the status is off.
    - .2 Running in Hand: Commanded off, but the status is on.
    - .3 Runtime Exceeded: Status runtime exceeds a user definable limit.
    - .4 Fault.
  - .2 Water Pump 2
    - .1 Failure: Commanded on, but the status is off.
    - .2 Running in Hand: Commanded off, but the status is on.
    - .3 Runtime Exceeded: Status runtime exceeds a user definable limit.

- .4 Fault.
- .7 Water Temperature Monitoring:
  - .1 The following temperatures shall be monitored:
    - .1 Water supply.
    - .2 Water return.
  - .2 Alarms shall be provided as follows:
    - .1 High Water Supply Temp: If the water supply temperature is greater than 90°C (adj.).
    - .2 Low Water Supply Temp: If the water supply temperature is less than 38°C (adj.).

### **3.9 HEATING & COOLING SECONDARY LOOP PUMPS - P-3 & P-4**

- .1 Water Pump Run Conditions:
  - .1 The water pumps shall be enabled whenever:
    - .1 The in floor radiant system needs heating or cooling.
  - .2 The pumps shall run for freeze protection anytime outside air temperature is less than -10°C (adj.).
  - .3 To prevent short cycling, the pump shall run for a minimum time and be off for a minimum time (both user adjustable).
- .4 Water Pump Lead/Standby Operation:
  - .1 The two water pumps shall operate in a lead/standby fashion.
    - .1 The lead pump shall run first.
    - .2 On failure of the lead pump, the standby pump shall run and the lead pump shall turn off.
- .5 The designated lead pump shall rotate upon one of the following conditions (user selectable):
  - .1 manually through a software switch
  - .2 if pump runtime (adj.) is exceeded
    - .1 daily
    - .2 weekly
    - .3 monthly
- .6 Alarms shall be provided as follows:
  - .1 Water Pump 1
    - .1 Failure: Commanded on, but the status is off.
    - .2 Running in Hand: Commanded off, but the status is on.
    - .3 Runtime Exceeded: Status runtime exceeds a user definable limit.
    - .4 Fault.
  - .2 Water Pump 2
    - .1 Failure: Commanded on, but the status is off.
    - .2 Running in Hand: Commanded off, but the status is on.
    - .3 Runtime Exceeded: Status runtime exceeds a user definable limit.
    - .4 Fault.
- .7 Hot Water Differential Pressure Control:
  - .1 The controller shall measure the water differential pressure and modulate the pump in sequence to maintain its water differential pressure setpoint.
  - .2 The following setpoints are recommended values. All setpoints shall be field adjusted during the commissioning period to meet the requirements of actual field conditions.
    - .1 The controller shall modulate water pump speeds to maintain a water differential pressure of 83kPa (adj.).

- .2 On dropping water differential pressure, the pumps shall stage on and run to maintain setpoint as follows:
  - .1 The controller shall modulate the lead pump to maintain setpoint.
- .3 On rising water differential pressure,
  - .1 The controller shall modulate the lead pump to maintain setpoint.
- .3 Alarms shall be provided as follows:
  - .1 High Water Differential Pressure: If 25% (adj.) greater than setpoint.
  - .2 Low Water Differential Pressure: If 25% (adj.) less than setpoint.
- .8 Water Temperature Monitoring:
  - .1 The following temperatures shall be monitored:
    - .1 Water supply.
    - .2 Water return.
  - .2 Alarms shall be provided as follows:
    - .1 High Water Supply Temp: If the water supply temperature is greater than 50°C (adj.).
    - .2 Low Water Supply Temp: If the water supply temperature is less than 13°C (adj.).



**3.10 BOILER INTERFACE MONITOR:**

- .1 Current boiler status and operating conditions will be monitored through its communications interface port. The interface will monitor and trend all points from the from the boiler controller.
- .2 Boiler System Run Conditions:
  - .1 The boiler system shall be enabled to run whenever:
  - .2 A definable number of hot water coils need heating.
  - .3 AND outside air temperature is less than 15°C (adj.).**
  - .4 To prevent short cycling, the boiler system shall run for and be off for minimum adjustable times (both user definable), unless shutdown on safeties or outside air conditions.
- .3 The boiler shall run subject to its own internal safeties and controls.
- .4 Boiler Water Isolation Valve:
  - .1 The valve shall open anytime the boiler is called to run. The valve shall also open whenever the water pump runs for freeze protection.
  - .2 The valve shall open prior to the boiler being enabled and shall close only after the boiler is disabled. The valve shall therefore have:
    - .1 A user adjustable delay on start.
    - .2 AND a user adjustable delay on stop.
    - .3 The delay times shall be set appropriately to allow for orderly boiler water system start-up, shutdown and sequencing.
    - .4 Alarms shall be provided as follows:
      - .1 Failure: Valve commanded open but the status indicates closed.
      - .2 Open in Hand: Valve commanded closed but the status indicates open.
- .5 Supply water Reset:
  - .1 The Controller shall reset the supply water temperature based on outside air temperature
- .6 Primary Hot Water Temperature Monitoring:
  - .1 The following temperatures shall be monitored:
    - .1 Primary hot water supply.
    - .2 Primary hot water return.
  - .2 Alarms shall be provided as follows:
    - .1 High Primary Hot Water Supply Temp: If greater than 94°C (adj.).
    - .2 Low Primary Hot Water Supply Temp: If less than 38°C (adj.).
- .7 Boiler valve end switches shall be monitored to enable the pump from either P-1 or P-2.
  - .1 Boiler 1 End Switch

.2 Boiler 2 End Switch.

### 3.11 AIR COOLED CHILLER

- .1 Chiller - Run Conditions:
  - .1 The chiller shall be enabled to run whenever it is commanded to be enabled by the chiller manager program. The chiller shall run subject to its own internal safeties and controls.
- .2 **Chiller System Run Conditions:**
  - .1 **The chiller system shall be enabled to run whenever:**
  - .2 **The AHU-1 is calling for cooling.**
  - .3 **And heating is disabled.**
  - .4 **And economizer is not active.**
  - .5 **To prevent short cycling, the chiller system shall run for and be off for minimum adjustable times (both user definable), unless shutdown on safeties or outside air conditions.**
- .3 Chilled Water Isolation Valve:
  - .1 The valve shall open anytime the chiller is called to run.
  - .2 The valve shall open prior to the chiller being enabled and shall close only after the chiller is disabled. The valve shall therefore have:
    - .1 A user adjustable delay on start.
    - .2 AND a user adjustable delay on stop.
  - .3 The delay times shall be set appropriately to allow for orderly chilled water system start-up, shutdown and sequencing.
  - .4 Alarms shall be provided as follows:
    - .1 Failure: Valve commanded open but the status indicates closed.
    - .2 Open in Hand: Valve commanded closed but the status indicates open.
- .4 Chiller:
  - .1 The chiller shall be enabled a user adjustable time after pump statuses are proven on. The chiller shall therefore have a user adjustable delay on start.
    - .1 The delay time shall be set appropriately to allow for orderly chilled water system start-up, shutdown and sequencing.
  - .2 The chiller shall run subject to its own internal safeties and controls.
    - .1 Alarms shall be provided as follows:
      - .1 Chiller Failure: Commanded on, but the status is off.
      - .2 Chiller Running in Hand: Commanded off, but the status is on.
      - .3 Chiller Runtime Exceeded: Status runtime exceeds a user definable limit.
  - .3 Chilled Water Temperature Monitoring:
    - .1 The following temperatures shall be monitored:
      - .1 Chilled water supply.
      - .2 Chilled water return.
  - .4 Alarms shall be provided as follows:

- .1 High Chilled Water Supply Temp: If the chilled water supply temperature is greater than 13°C (adj.).
- .2 Low Chilled Water Supply Temp: If the chilled water supply temperature is less than 4°C (adj.)

### **3.12 OUTSIDE AIR CONDITIONS**

- .1 The controller shall monitor the outside air temperature and humidity and calculate the outside air enthalpy on a continual basis. These values shall be made available to the system at all times.
- .2 Alarm shall be generated as follows:
  - .1 Sensor Failure: Sensor reading indicates shorted or disconnected sensor. In the event of a sensor failure, an alternate outside air conditions sensor shall be made available to the system without interruption in sensor readings.
- .3 If an OA Temp Sensor cannot be read, a default value of 18.5°C will be used.
- .4 If an OA Humidity Sensor cannot be read, a default value of 50 % will be used.
- .5 Outside Air Temperature History:
  - .1 The controller shall monitor and record the high and low temperature readings for the outside air. These readings shall be recorded on a daily, month-to-date, and year-to-date basis.

### **3.13 BLIND INTERFACE**

- .1 The controller shall be connected to the blind controller. System shall monitor blind status and alarms.
  - .1 The Blinds shall run subject to its own internal controls and safeties.
- .2 Alarm shall be generated as follows:
  - .1 Sensor Failure, motor failure, any other alarm point generation.

**END OF SECTION**