PART 4: SEQUENCE OF OPERATIONS

FOR HVAC CONTROLS

Section Includes

1. **Single or Multi Zone Unit Constant Volume (Steam PreHeat with Steam Heat)**
2. **Exhaust Fan - On/Off**
3. **Steam Unit Heater**
4. **Single or Multi Zone Unit Constant Volume (Steam PreHeat with Steam Heat)**

Run Conditions - Scheduled:
The unit shall run according to a user definable time schedule in the following modes:

* + Occupied Mode: The unit shall maintain
		- A 74°F (adj.) cooling setpoint (for units with modulating osa – no mech cooling)
		- A 70°F (adj.) heating setpoint.
	+ Unoccupied Mode (night setback): The unit shall maintain
		- A 85°F (adj.) cooling setpoint. setpoint (for units with modulating osa – no mech cooling)
		- A 55°F (adj.) heating setpoint.

Alarms shall be provided as follows:

* + High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
	+ Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Optimal Start:
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.

Return Air Smoke Detection:
The unit shall shut down and generate an alarm upon receiving a return air smoke detector status. (only units with return air)

Supply Fan:
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.

Alarms shall be provided as follows:

* + Supply Fan Failure: Commanded on, but the status is off.
	+ Supply Fan in Hand: Commanded off, but the status is on.
	+ Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Steam Pre Heating (Modulated):
The controller shall measure the preheat coil discharge temp temperature and modulate the heating to maintain its heating setpoint. Where coils have multiple valves, Modulate 1/3 valve from 0 to 100% then modulate 2/3 valve from 0 to 100%

* Set point to be 55F whenever any zone calls for cooling
* Set point to be 65F whenever no zones call for cooling
* Set point to be modulated upwards 80F whenever all zones call for heating.

The heating shall be enabled whenever:

* + Outside air temperature is less than 65°F (adj.).
	+ AND the zone temperature(s) is/are below heating setpoint.
	+ AND the supply fan status is on.
	+ AND the cooling/economizer is not active.

Steam Heating (Modulated):
The controller shall measure the zone temperature and modulate the heating to maintain its heating setpoint. Where coils have multiple valves, Modulate 1/3 valve from 0 to 100% then modulate 2/3 valve from 0 to 100%

The heating shall be enabled whenever:

* + Outside air temperature is less than 65°F (adj.).
	+ AND the zone temperature is below heating setpoint.
	+ AND the supply fan status is on.

Economizer:
The controller shall measure the zone temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the zone cooling setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied (or as % of OSA shown on original drawings).

The economizer shall be enabled whenever:

* + Outside air temperature is less than 65°F (adj.).
	+ AND the outside air temperature is less than the return air temperature.
	+ AND the supply fan status is on.

The economizer shall close whenever:

* + Mixed air temperature drops from 45°F to 40°F (adj.).
	+ OR on loss of supply fan status.
	+ OR the freezestat (if present) is on.

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.

Mixed Air Temperature:
The controller shall monitor the mixed air temperature and use as required for economizer control (if present) or preheating control (if present).

Alarms shall be provided as follows:

* + High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
	+ Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

Return Air Temperature:
The controller shall monitor the return air temperature and use as required for economizer control (if present).

Alarms shall be provided as follows:

* + High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
	+ Low Return Air Temp: If the return air temperature is less than 45°F (adj.).
1. **Exhaust Fan - On/Off (see drawings for quantities)**

Run Conditions - Interlocked:
The fan(s) EF --- shall be interlocked to run whenever Air Handling Unit ---- runs unless shutdown on safeties. Exh temp on units shown – to be used for zone heating coil/space temp.

Fan:
The fan shall have a user definable (adj.) minimum runtime.

Fan Status:
The controller shall monitor the fan status.

Alarms shall be provided as follows:

* + Fan Failure: Commanded on, but the status is off.
	+ Fan in Hand: Commanded off, but the status is on.
	+ Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).
1. **Steam Unit Heater (see Drawings for Quantities)**

Run Conditions - Scheduled:
The unit shall run according to a user definable time schedule in the following modes:

* + Occupied Mode: The unit shall maintain
		- A 70°F (adj.) heating setpoint.
	+ Unoccupied Mode (night setback): The unit shall maintain
		- A 55°F (adj.) heating setpoint.

Alarms shall be provided as follows:

* + Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Fan:
The fan shall run anytime the unit is commanded to run, unless shutdown on safeties.

Steam Heating (Modulated):
The controller shall measure the zone temperature and modulate the steam heating valve(s) to maintain its heating setpoint. To prevent short cycling, the unit shall have a user definable (adj.) minimum runtime.

The heating shall be enabled whenever:

* + Outside air temperature is less than 65°F (adj.).
	+ AND the zone temperature is below heating setpoint.
	+ AND the fan is on.

Discharge Air Temperature:
The controller shall monitor the discharge air temperature.

Alarms shall be provided as follows:

* + High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.).
	+ Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.).

Fan Status:
The controller shall monitor the fan status.

Alarms shall be provided as follows:

* + Fan Failure: Commanded on, but the status is off.
	+ Fan in Hand: Commanded off, but the status is on.
	+ Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).