BAS Tools

OPERATOR GUIDE

AHU-1

The sequence of operation in plain language, and how to run the unit from the Niagara graphic.

Equipment	VAV AHU, economizer, pumped preheat, 2-stage direct evap, CHW coil, supply and return fans on VFDs
Controller	Distech ECY-S1000 + 2x ECY-8UI6UO-HOA, ECY-16DI, ECY-8DOR
Program	29 control functions, 43 hardware points
Graphic	AHU-1.px (Niagara)

> Sample job. Built from the BAS Tools sample AHU-1 program and graphic. Values shown are the program defaults. Where this guide and the full sequence of operation differ, the sequence governs.

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01

About AHU-1

AHU-1 is a variable air volume air handler serving VAV terminal units. It mixes outside air and return air, filters the mix, heats it with a pumped hot water preheat coil, cools it with a two-stage direct evaporative section and a chilled water coil, and supplies it to the VAV boxes at a discharge temperature the zones need. A return fan tracks the supply airflow and holds building pressure, and an economizer uses outside air for free cooling.

The VAV boxes control each room. AHU-1 keeps duct static pressure and discharge air temperature where the boxes need them, using requests the VAV controllers send up through the BAS.

COMPONENT	WHAT IT DOES
Supply fan SF-1 (VFD-1)	Runs whenever the unit runs. Speed holds the duct static pressure setpoint, which is reset by the VAV boxes (trim & respond).
Return fan RF-1 (VFD-2)	Starts once the supply fan is proven. Speed tracks supply airflow minus an offset, or holds building static pressure, whichever needs more speed.
Outside, return and exhaust dampers (DA-1, DA-2, DA-3)	Modulating. Outside and exhaust air move together; the return damper does the opposite.
Pre-filter and final filter	Each has a differential pressure sensor (PT-3, PT-4) and a dirty filter alarm.
Preheat coil, valve VLV-1 and pump P-3	Hot water heating and freeze protection. The pump circulates the coil in cold weather and when the valve is open.
Direct evaporative section, pumps P-1 and P-2	Two stages of evaporative cooling over wetted media, fed from a sump.
Evaporative sump	Fill valve SOV-1, drain/bleed valve MV-1, low level switch LS-1, full switch LS-2 and conductivity sensor CE-1.
Chilled water coil, valve VLV-2 (PICV)	Final cooling stage, controlled on discharge air temperature.
Airflow stations AFMS-1, AFMS-2, AFMS-3	Outside, return and supply airflow.
Pressure sensors PT-1, PT-2	Supply duct static pressure and building static pressure.
Return air CO2 sensor CO2-1	Raises the minimum outside airflow when return air CO2 is high.
Safeties	Freeze low limit LLT-1, supply high static PS-1, return low static PS-2, supply and return smoke detectors SD-1/SD-2, fire alarm shutdown FAR-1.

Controller

Distech **ECY-S1000 + 2x ECY-8UI6UO-HOA, ECY-16DI, ECY-8DOR**. 43 hardware points; the full list is in Appendix A.

Operating schedule

- **Occupied / unoccupied** comes from the 7-day and holiday schedule in the BAS (Niagara). The controller reads it as the Occupancy point and the minutes to the next occupied period (Min to Occ).
- **Optimal start:** the unit can start up to **120 min** early (Opt Start Max) to warm up or cool down the building before occupancy.
- **Evaporative media dry-out:** a BAS schedule opens a daily 02:00–03:00 window (Section 4.11).
- **Weekly sump drain:** a BAS schedule picks the drain day; the drain happens during that day's dry-out window.

02

Reading the Graphic

The equipment schematic

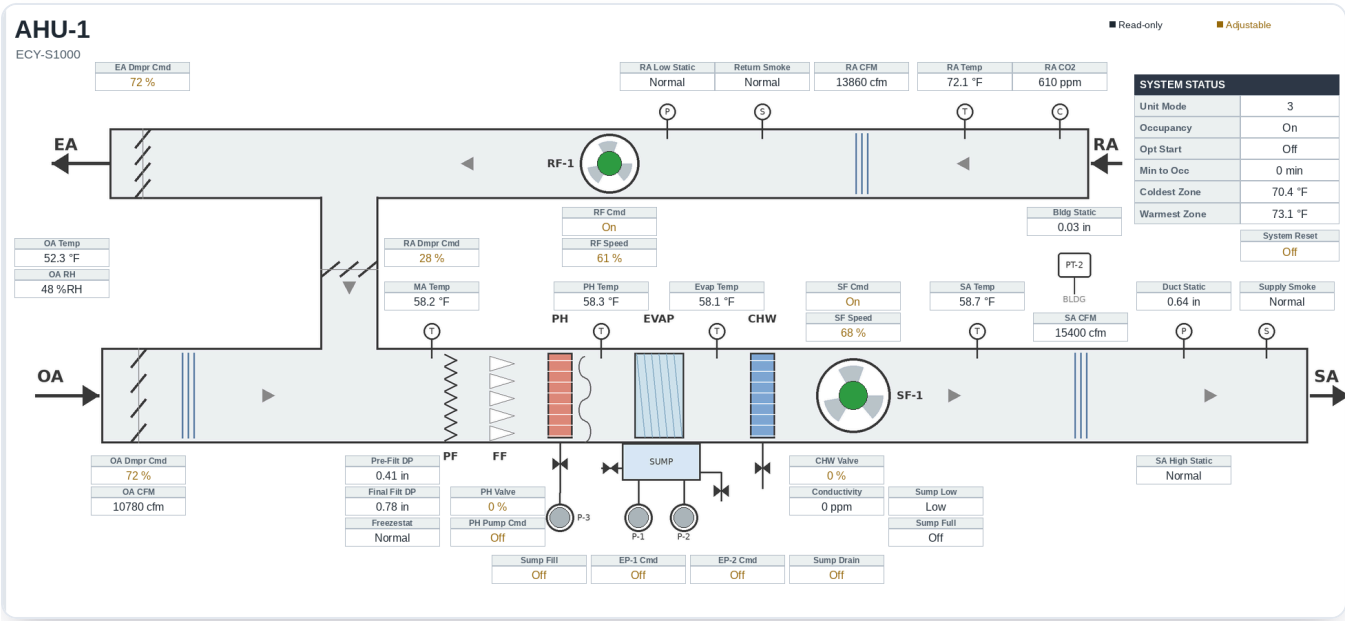


Figure 1. AHU-1 graphic (upper part of the page), in occupied mode with the economizer running.

- **Top duct, return path (air flows right to left):** return air CO2, temperature and airflow (RA CO2, RA Temp, RA CFM), return smoke detector and low static switch, return fan RF-1 with its command and speed (RF Cmd, RF Speed), and the exhaust damper (EA Dmpr Cmd).
- **Mixing box:** outside air temperature and humidity (OA Temp, OA RH), outside airflow (OA CFM), outside and return damper commands, and mixed air temperature (MA Temp).
- **Bottom duct, supply path (air flows left to right):** pre-filter and final filter pressure drops, preheat coil (PH Temp, PH Valve, PH Pump Cmd), evaporative section (Evap Temp), chilled water coil (CHW Valve), supply fan SF-1 (SF Cmd, SF Speed), supply air temperature and airflow (SA Temp, SA CFM), duct static pressure, supply smoke detector and high static switch.
- **Sump (below the evaporative section):** sump fill and drain valves, evaporative pump commands (EP-1 Cmd, EP-2 Cmd), sump low and full switches, conductivity.
- **Building static (PT-2):** Bldg Static, the pressure in the building relative to outside.
- **System Status (top right):** the most important box on the page. See Section 3.2.

Colors: what they mean

The text color tells you whether you can change a value. The key in the top right corner of the graphic shows both.

TEXT COLOR	MEANING
Dark (ink)	Read only: a sensor reading, a status, an alarm or a calculated value. It cannot be changed from the graphic.
Amber	Adjustable: a setpoint or a command. Right-click it to change it (with the right access level).

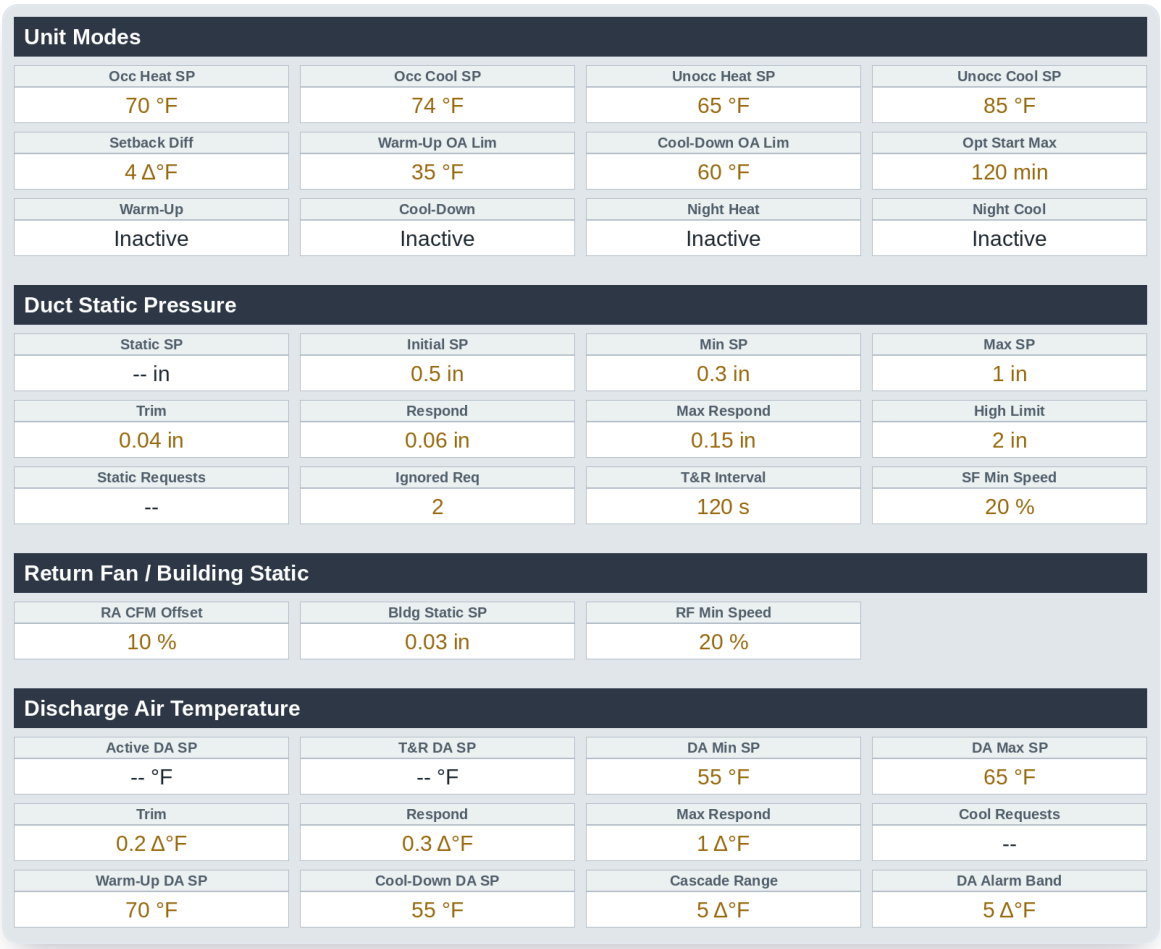
The box background shows the health of the point:

BACKGROUND	MEANING / WHAT TO DO
White	Normal.
Red	In alarm. See Section 5.
Orange	Fault, usually a failed sensor or a bad reading.
Yellow	Down. Communication to the controller is lost and values are not live.
Purple	Overridden. Someone has forced this point by hand, and it will not follow the sequence until it is released.
Tan	Stale. The value has not updated recently.
Light grey	Disabled point.

The circles on the fans and pumps are status lights: green when the device is proven running, grey when it is off.

Setpoint and status panels

The lower part of the graphic is two columns of panels grouped by system. The left column holds the unit modes and the air-side control settings; the right column holds the coils, evaporative cooling and alarms.



Unit Modes

Occ Heat SP	Occ Cool SP	Unocc Heat SP	Unocc Cool SP
70 °F	74 °F	65 °F	85 °F
Setback Diff	**Warm-Up OA Lim**	**Cool-Down OA Lim**	**Opt Start Max**
4 Δ°F	35 °F	60 °F	120 min
Warm-Up	**Cool-Down**	**Night Heat**	**Night Cool**
Inactive	Inactive	Inactive	Inactive

Duct Static Pressure

Static SP	Initial SP	Min SP	Max SP
-- in	0.5 in	0.3 in	1 in
Trim	**Respond**	**Max Respond**	**High Limit**
0.04 in	0.06 in	0.15 in	2 in
Static Requests	**Ignored Req**	**T&R Interval**	**SF Min Speed**
--	2	120 s	20 %

Return Fan / Building Static

RA CFM Offset	Bldg Static SP	RF Min Speed
10 %	0.03 in	20 %

Discharge Air Temperature

Active DA SP	T&R DA SP	DA Min SP	DA Max SP
-- °F	-- °F	55 °F	65 °F
Trim	**Respond**	**Max Respond**	**Cool Requests**
0.2 Δ°F	0.3 Δ°F	1 Δ°F	--
Warm-Up DA SP	**Cool-Down DA SP**	**Cascade Range**	**DA Alarm Band**
70 °F	55 °F	5 Δ°F	5 Δ°F

Figure 2. Left column. Rendered from the delivered AHU-1 .px with the program's default setpoints; live readings shown as --.



Figure 3. Right column: Preheat, Economizer / Minimum OA, Evaporative Cooling, Chilled Water and Alarms.

PANEL	WHAT YOU WILL FIND THERE
Unit Modes	Occupied and unoccupied heating and cooling setpoints, the night setback differential, the outside air limits for warm-up and cool-down, Opt Start Max, and the Warm-Up, Cool-Down, Night Heat and Night Cool modes.
Duct Static Pressure	The active Static SP, its initial, minimum and maximum, the trim and respond amounts, the high limit, the number of static pressure requests from the VAV boxes, Ignored Req, the trim & respond interval and SF Min Speed.
Return Fan / Building Static	RA CFM Offset, Bldg Static SP and RF Min Speed.
Discharge Air Temperature	Active DA SP (what the unit is controlling to), the T&R DA SP, its limits and trim/respond amounts, cooling requests from the VAV boxes, the warm-up and cool-down discharge setpoints, the cascade range and the discharge temperature alarm band.

PANEL	WHAT YOU WILL FIND THERE
Preheat	PH Disch SP, PH Offset, the preheat setpoint limits, the start-up ramp, and the freeze protection setpoint, outside air temperature and minimum valve position.
Economizer / Minimum OA	MA SP and its limits, Econ Deadband, Active Min OA, Min OA CFM, CO2 Max OA and RA CO2 Limit.
Evaporative Cooling	Cooling Call, Cooling SP, OA Dew Point, Max Zone RH, the evaporative enable limits, stage 2 offset and delay, the humidity limits, RH Lockout, Sump Ready, the bleed limits and Dry-Out.
Chilled Water	Cooling setpoint limits, CHW Ramp Limit and Freeze CHW Pos.
Alarms	Fan and pump failures, dirty filters, discharge temperature, sump low level, the three safety shutdowns, fire alarm, zone data fault and Alarm Reset.

03

Operating the Unit from the Display

Golden rule

The unit is designed to run itself. Make the smallest change that solves the problem, write down what you changed and why, and put everything back to Auto when you are done.

3.1 Changing a setpoint

1. Find the setpoint. Only amber values can be changed.
2. Right-click the box and choose **Set**.
3. Type the new value and click **OK**. Units are shown next to the entry field.
4. Confirm the box shows the new value. Give the unit time to respond: temperature loops can take 10 to 15 minutes, and the trim & respond resets step every 2 minutes.
5. Record the change.

Tip

Keep the occupied heating (70°F) and cooling (74°F) setpoints at least 2 to 3°F apart. They drive warm-up, cool-down and optimal start; if they overlap, the morning modes will fight each other.

Min OA CFM

The minimum outside airflow (4,000 CFM) sets the building's ventilation. It is an assumed value until the balancer confirms it (RFI-07). Do not lower it without the TAB report.

3.2 The System Status box

POINT	WHAT IT TELLS YOU
Unit Mode	The mode the unit is in right now, as a number. The highest active mode wins: **0** Unoccupied, **1** Warm-Up, **2** Cool-Down, **3** Occupied, **4** Night Heat, **5** Night Cool, **6** Smoke shutdown, **7** Safety shutdown (static or freeze).
Occupancy	The occupied/unoccupied state from the BAS schedule.
Opt Start	On while optimal start is bringing the building to setpoint before occupancy.
Min to Occ	Minutes until the next scheduled occupied period, from the BAS schedule.
Coldest Zone / Warmest Zone	The coldest and warmest VAV zone temperatures, sent to the controller by the BAS. They drive optimal start and the night modes.
System Reset	Clears a latched safety shutdown (smoke, static or freeze) once the device has been reset in the field. See Section 3.5.

3.3 Starting and stopping the unit

AHU-1 has no separate start/stop command. It runs whenever the schedule says occupied, during optimal start, warm-up, cool-down, night heat, night cool, or the evaporative media dry-out. To run it after hours, change the occupancy in the BAS schedule (or override the Occupancy point there), and put it back when you are done.

3.4 Manually positioning a valve, damper or fan

Fan speeds, valve and damper commands and the pump commands are driven by the program. When a device must be positioned by hand for testing or an emergency, a user with technician access can override the output point:

1. Right-click the command and choose the override action.
2. Enter the position or speed, and the override duration if offered.
3. The box turns purple while overridden.
4. When done, right-click and choose **Auto** to release it. A purple box means the sequence is not in control of that device.

> **Caution**
> Do not override the preheat valve or pump P-3 off in cold weather. Freeze protection depends on them.

3.5 Resetting after a safety trip

1. Find and fix the cause: frozen or plugged coil, closed damper, blocked filter, smoke condition cleared by the fire alarm system.
2. Reset the device at the unit. The freeze low limit (LLT-1) and the static pressure switches (PS-1, PS-2) are manual reset.
3. Confirm the device reads Normal on the graphic (Freezestat, SA High Static, RA Low Static, Supply Smoke, Return Smoke, Fire Alarm).
4. Press **System Reset**. Smoke Shutdown, Static Safety and Freeze Trip are latched by the program and only clear when System Reset is pressed with the device back to normal. The unit then restarts on its own if it is scheduled to run.

Equipment alarms (fan and pump failures, dirty filters, discharge temperature, sump low level) are also latched. Clear them with **Alarm Reset** in the Alarms panel once the condition has cleared.

04

How the Unit Runs

This section is the simplified sequence as it is programmed. Values are the program defaults; the live value on the graphic is the one in use. Where the sequence left a value or a decision open, the program uses an assumption that has been sent to the engineer as an RFI. Those are shown in yellow.

4.1 Occupancy and optimal start

The occupied/unoccupied state and the minutes to the next occupied period come from the BAS schedule. Before occupancy, a Distech **OptimumStart** block decides how early to start (up to 120 min) from the coldest and warmest zone temperatures, the occupied setpoints (70°F heating, 74°F cooling) and how fast the building has warmed or cooled on earlier mornings. It learns that rate each morning and adjusts the next start.

ON THE GRAPHIC Occupancy | Opt Start | Min to Occ | Opt Start Max | Coldest Zone | Warmest Zone

RFI-01: built on an assumption until the engineer answers

Optimal start: the sequence asks for Optimal Start-Stop but gives no limits. Confirm the BAS schedule is the source of occupancy and minutes-to-next-occupancy, and the maximum early start.

Assumed: Distech OptimumStart (adaptive, learns min/degF factors) with the BAS schedule as source; maximum early start 120 min; warm-up / cool-down limited to the OA conditions in D.2 / D.3.

4.2 Morning warm-up and cool-down

	WARM-UP	COOL-DOWN
Starts when	Optimal start calls for a warm-up (coldest zone below Occ Heat SP) and outside air is below 35°F	Optimal start calls for a pre-cool (warmest zone above Occ Cool SP) and outside air is above 60°F
Discharge setpoint	70°F (Warm-Up DA SP)	55°F (Cool-Down DA SP)
Outside air	Dampers closed (return air only)	Normal economizer and minimum outside air control
Cooling	Chilled water valve closed	Evaporative and chilled water cooling available
Ends when	Occupancy starts	Occupancy starts

Warm-up has priority if both are called.

ON THE GRAPHIC Warm-Up | Cool-Down | Warm-Up OA Lim | Cool-Down OA Lim | Active DA SP

4.3 Unoccupied: night heat and night cool

While unoccupied (and outside the optimal start window) the unit stays off unless the building drifts too far:

	NIGHT HEAT (TOO COLD)	NIGHT COOL (TOO WARM)
Starts when	Coldest zone below Unocc Heat SP (65°F) and outside air below 35°F	Warmest zone above Unocc Cool SP (85°F) and outside air above 60°F
Discharge setpoint	70°F, outside air dampers closed	55°F
Stops when	Coldest zone reaches Unocc Heat SP + Setback Diff (4°F), or occupancy starts	Warmest zone falls to Unocc Cool SP minus Setback Diff, or occupancy starts

ON THE GRAPHIC Night Heat · Night Cool · Unocc Heat SP · Unocc Cool SP · Setback Diff

Zone data from the BAS

Coldest Zone, Warmest Zone, Max Zone RH and the VAV request counts are written to the controller by the BAS. Each one is checked: if a value is missing or out of range (temperatures outside 40–100°F, humidity outside 0–100%), the controller uses a safe default instead (the occupied setpoints for temperature, 0% for humidity) and Zone Data Fault goes to Fault. A lost network value cannot start the night modes or lock out the evaporative cooling.

4.4 Supply and return fans

- **Supply fan SF-1** runs whenever the unit is called to run (occupied, optimal start, warm-up, cool-down, night heat, night cool or dry-out) and no safety shutdown is latched.
- **Return fan RF-1** starts only after SF-1 is commanded and proven running.
- **Supply fan speed** holds the duct static setpoint (Static SP). A second loop limits speed so duct static never exceeds the **High Limit** (2 in. w.c.); whichever loop asks for less speed wins. Minimum speed 20% while running, 0% when off.
- **Return fan speed:** one loop holds return airflow at supply airflow minus **RA CFM Offset** (10%); a second holds building static at **Bldg Static SP** (0.03 in. w.c.). Whichever asks for more speed wins. Minimum speed 20%.

ON THE GRAPHIC SF Cmd · SF Speed · RF Cmd · RF Speed · Duct Static · SA CFM · RA CFM · Bldg Static

RFI-02: built on an assumption until the engineer answers

Duct static high limit: "does not exceed 1.0 in. WC above scheduled total fan static / TAB value" - what absolute limit at PT-1 should be used?

Assumed: 2.0 in.wc at PT-1 (adjustable) until TAB sets it.

4.5 Duct static pressure reset (trim & respond)

The VAV boxes decide the duct static setpoint. Every **T&R Interval** (120 s) the controller counts the boxes that are at 90% or more of their airflow setpoint (Static Requests) and ignores the first **Ignored Req** (2):

- **More requests than ignored:** the setpoint goes up by 0.06 in. w.c. per request, at most 0.15 in. w.c. per interval.
- **Otherwise:** the setpoint trims down by 0.04 in. w.c..
- The setpoint stays between **Min SP** (0.3 in. w.c.) and **Max SP** (1 in. w.c.), and starts at **Initial SP** (0.5 in. w.c.) each time the fan starts.

ON THE GRAPHIC Static SP | Static Requests | Ignored Req | Trim | Respond | Max Respond | T&R Interval

RFI-03: built on an assumption until the engineer answers

Duct static trim & respond parameters (initial, minimum, trim, respond, max respond, interval) are not given.

Assumed: Initial 0.5, min 0.3, max 1.0 in.wc; trim 0.04, respond 0.06/request, max 0.15; 2 min interval; 2 ignored requests.

4.6 Discharge air temperature

The active discharge setpoint (**Active DA SP**) is reset the same way, from cooling requests (boxes at 90% or more of their cooling airflow setpoint). Every interval, requests above the ignored count lower it by 0.3°F each (at most 1°F); with no requests it rises by 0.2°F. It stays between **DA Min SP** (55°F) and **DA Max SP** (65°F) and holds at the maximum while the fan is off.

- **Warm-up and night heat** override it to 70°F; **cool-down and night cool** to 55°F.
- **One master loop, several stages.** A master loop compares supply air temperature with Active DA SP and trims the upstream setpoints up or down by up to **Cascade Range** (5°F). From that:

STAGE	ITS SETPOINT	LIMITS
Preheat (PH Disch SP)	Active DA SP + master trim – PH Offset (3°F) + start ramp. In heat modes, Active DA SP.	45°F to 60°F
Mixed air (MA SP)	Active DA SP + master trim	45°F to 65°F
Evaporative and chilled water (Cooling SP)	Active DA SP	52°F to 65°F

ON THE GRAPHIC Active DA SP | T&R DA SP | Cool Requests | Cascade Range | PH Disch SP | MA SP | Cooling SP | SA Temp

RFI-04: built on an assumption until the engineer answers

PDAT reset range and trim & respond amounts are not given.

Assumed: 55-65 F; trim +0.2 F, respond -0.3 F/request, max -1.0 F; starts at 65 F.

RFI-05: built on an assumption until the engineer answers

Preheat setpoint clamp limits and the start-up ramp (span and duration) are not given.

Assumed: Clamp 45-60 F; ramp starts 10 F high and steps down 1 F every 2 min (20 min) when OA < 40 F at start.

4.7 Preheat and freeze protection

- While the supply fan is proven (and the unit is not in cool-down or night cool), the preheat valve modulates to hold the preheat discharge temperature at **PH Disch SP**.
- **Cold start ramp:** if outside air is below 40°F when the fan is off, the preheat setpoint starts 10°F higher and steps down 1°F every interval after the fan proves, so the coil comes on gently (about 20 minutes).

- **Freeze protection:** when the unit is off or shut down by a safety and outside air is below **Freeze OA Temp** (35°F), or whenever the freeze low limit has tripped, the valve holds the coil at **Freeze PH SP** (70°F). With the unit off in that cold, the valve also keeps a minimum opening that rises from 0% at 35°F outside to **Freeze Min Pos** (30%) at 0°F.
- **Preheat pump P-3** starts when outside air is below 40°F or the valve is more than 10% open. It stops when outside air is above 45°F and the valve is below 5% for 5 min.

ON THE GRAPHIC PH Temp | PH Valve | PH Pump Cmd | PH Disch SP | Start Ramp | Freeze PH SP | Freeze OA Temp | Freeze Min Pos

> **RFI-06: built on an assumption until the engineer answers**
> "Minimum position vs. OA-T" for the preheat valve is not defined.
> **Assumed:** 0% at 35 F OA rising linearly to 30% at 0 F OA.

4.8 Economizer and minimum outside air

- **Economizer** is allowed while the supply fan is proven and outside air is cooler than return air minus **Econ Deadband** (2°F). The dampers then modulate to hold mixed air at **MA SP**.
- **Minimum outside air:** a second loop holds outside airflow (OA CFM) at **Active Min OA**. Whichever loop opens the outside air damper further wins.
- **CO2 reset:** when return air CO2 rises above **RA CO2 Limit** (1,000 ppm), Active Min OA rises from **Min OA CFM** (4,000 CFM) toward **CO2 Max OA** (8,000 CFM). Ventilation for each room is handled by its VAV box.
- **Evaporative cooling running:** the outside air damper goes to 100%.
- **Warm-up and night heat:** outside air and exhaust dampers closed.
- **Fan not proven or a safety shutdown:** outside and exhaust dampers closed, return damper open.
- The exhaust damper always follows the outside air damper, and the return damper does the opposite.

ON THE GRAPHIC OA Dmpr Cmd | RA Dmpr Cmd | EA Dmpr Cmd | MA Temp | MA SP | OA CFM | Active Min OA | RA CO2

> **RFI-07: built on an assumption until the engineer answers**
> Minimum OA airflow, CO2 maximum setpoint and the CO2-reset maximum airflow are not given.
> **Assumed:** Min OA 4,000 CFM; RA-CO2 limit 1,000 ppm; CO2 reset up to 8,000 CFM.

4.9 Evaporative cooling

Call for cooling: when mixed air is more than 2°F above Cooling SP; it ends when mixed air falls back to Cooling SP or the fan stops. The controller calculates the outside air dew point from outside temperature and humidity (OA Dew Point).

	STAGE 1 (PUMP P-1)	STAGE 2 (PUMP P-2)
Runs when	Call for cooling, fan proven, outside air above **Evap OA Enable** (55°F), OA dew point below **OA Dew Pt Limit** (50°F), sump not low, Sump Ready, no humidity lockout, not drying out, no safety shutdown	Stage 1 conditions, and evaporative discharge temperature more than **Stage 2 Offset** (3°F) above Cooling SP for **Stage 2 Delay** (10 min)
Stops when	Any stage 1 condition is lost	Evap discharge falls 1°F below Cooling SP, stage 1 stops, or Max Zone RH is above **Stg 2 RH Limit** (50% RH)
Minimum times	5 min on / 5 min off	5 min on / 5 min off

High humidity: if the highest zone humidity rises above **Stg 1 RH Limit** (54% RH), evaporative cooling is locked out (RH Lockout). Once humidity is back down, the chilled water valve is ramped closed 10% per interval; when it is nearly closed the lockout clears and evaporative cooling can run again.

ON THE GRAPHIC Cooling Call · Cooling SP · OA Dew Point · Max Zone RH · EP-1 Cmd · EP-2 Cmd · Evap Temp · RH Lockout

Hardware interlock
The sump low level switch LS-1 is also wired into the evaporative pump starters, so the pumps cannot run dry even if the controller is overridden.

RFI-08: built on an assumption until the engineer answers
Evap "call for cooling" and the stage 2 off condition are not defined; minimum on/off times are not given.
Assumed: Call when MA-T > cooling setpoint + 2 F (off at setpoint); stage 2 off when EV-T < setpoint - 1 F; pumps 5 min on / 5 min off.

4.10 Sump fill, drain and bleed

- **Fill (SOV-1):** opens only when outside air has been above 55°F for 30 min, there is a call for cooling, and no drain is in progress. **Sump Ready** goes on 15 min after the sump is full; the pumps wait for it.
- **Cold weather drain (MV-1):** opens when outside air has been below 40°F for 30 min.
- **Conductivity bleed (MV-1):** opens at **Bleed Open** (1,200 ppm) and closes at **Bleed Close** (900 ppm). Bleed Active shows when it is bleeding.
- **Weekly drain:** MV-1 opens during the dry-out window on the weekly drain day.

ON THE GRAPHIC Sump Fill · Sump Drain · Sump Full · Sump Low · Sump Ready · Conductivity · Bleed Active

4.11 Media dry-out

Each night the BAS opens a 02:00–03:00 window. If stage 1 ran for at least 60 min in a row in the past 24 hours, the unit runs its fan through the window with the evaporative pumps off to dry the media. Dry-Out shows on the graphic while it runs.

RFI-09: built on an assumption until the engineer answers

Dry-out: confirm "ran >= 1 hr" may be one continuous hour, and what runs during dry-out (assumed fan on with OA at minimum, pumps off). Weekly drain day?

Assumed: One continuous hour of stage 1 in the last 24 h; fan on, pumps off, MV-1 open on the weekly drain day from the BAS schedule.

4.12 Chilled water

- The chilled water valve modulates to hold supply air temperature at **Cooling SP** while the fan is proven, the unit is not in warm-up or night heat, and no safety shutdown is latched.
- After a high humidity lockout, **CHW Ramp Limit** caps the valve while it ramps closed (Section 4.9).
- **Freeze low limit trip:** the valve opens to **Freeze CHW Pos** (10%) to keep water moving.

ON THE GRAPHIC CHW Valve | Cooling SP | SA Temp | CHW Ramp Limit | Freeze CHW Pos

4.13 Safety shutdowns

SHUTDOWN	CAUSED BY	WHAT HAPPENS
Smoke Shutdown (Unit Mode 6)	Supply or return smoke detector, or fire alarm shutdown	Fans stop; outside and exhaust dampers close. Latched until the devices are reset and System Reset is pressed.
Static Safety (Unit Mode 7)	Supply high static (PS-1) or return low static (PS-2), manual reset	Fans stop. Latched until the switch is reset at the unit and System Reset is pressed.
Freeze Trip (Unit Mode 7)	Freeze low limit LLT-1, manual reset	Fans stop, preheat holds the coil at 70°F, chilled water valve opens to 10%. Latched until LLT-1 is reset and System Reset is pressed.

These devices are also hardwired into the VFD safety circuits, so the fans stop even in Hand.

RFI-10: built on an assumption until the engineer answers

Smoke detector auxiliary contact action (opens or closes on alarm) is not stated.

Assumed: Closes on alarm (no reverse action on SA-SMK / RA-SMK).

05

Alarms: What They Mean and What to Do

Equipment alarms stay in alarm until **Alarm Reset**; safety shutdowns stay latched until **System Reset**. Delays are the programmed defaults.

ALARM ON GRAPHIC	WHAT IT MEANS	WHAT TO CHECK / DO
Smoke Shutdown	A smoke detector or the fire alarm shut the unit down. Latched.	Follow fire alarm procedures. Reset at the fire alarm panel, then System Reset.
Static Safety	High or low static switch tripped. Fans locked out. Manual reset + latched.	Look for closed dampers (including fire/smoke dampers) and blocked filters. Reset the switch at the unit, then System Reset.
Freeze Trip	Freeze low limit tripped. Fans off, preheat and chilled water valves to their freeze positions. Manual reset + latched.	Check hot water supply, preheat valve and pump P-3, and the outside air damper. Reset LLT-1, then System Reset.
SF Fail / RF Fail	Fan command and status disagree for 60 s (also catches a fan running in Hand).	Check the VFD, power, belts and the safety circuit. Alarm Reset once fixed.
PH Pump Fail / EP-1 Fail / EP-2 Fail	Pump command and status disagree for 60 s.	Check the pump, starter, breaker and (for the evaporative pumps) the sump level. Alarm Reset once fixed.
Pre-Filt Dirty / Final Filt Dirty	Filter pressure drop above 0.75 in. w.c. (pre) or 1.25 in. w.c. (final) for 5 min with the fan running.	Schedule a filter change, then Alarm Reset.
DA Temp Alarm	Supply air more than **DA Alarm Band** (5°F) away from Active DA SP for 10 min with the fan running.	Compare valve commands with what the coils are doing; check hot water and chilled water supply, the evaporative section and the dampers. Alarm Reset once fixed.
Sump Low Alarm	Sump low level while evaporative cooling is called and the sump should be ready, for 60 s.	Check the fill valve, water supply and the drain/bleed valve.
Fire Alarm	Fire alarm shutdown input (FAR-1) is active.	Follow fire alarm procedures.
Zone Data Fault	A zone value from the BAS is missing or out of range; safe defaults are in use.	Check the BAS links from the VAV controllers to AHU-1 (Coldest Zone, Warmest Zone, Max Zone RH).

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Adjustable Setpoints: Quick Reference

Programmed defaults. The live value on the graphic is the one in use.

SETPOINT (GRAPHIC NAME)	PANEL	DEFAULT	WHAT IT DOES
Occ Heat SP	Unit Modes	70°F	Occupied zone heating setpoint
Occ Cool SP	Unit Modes	74°F	Occupied zone cooling setpoint
Unocc Heat SP	Unit Modes	65°F	Unoccupied heating setpoint
Unocc Cool SP	Unit Modes	85°F	Unoccupied cooling setpoint
Setback Diff	Unit Modes	4°F	Night heat/cool differential
Warm-Up OA Lim	Unit Modes	35°F	Warm-up / night heat allowed below this OA temp
Cool-Down OA Lim	Unit Modes	60°F	Cool-down / night cool allowed above this OA temp
Opt Start Max	Unit Modes	120 min	Optimal start maximum lead time
Initial SP	Duct Static Pressure	0.5 in. w.c.	Duct static setpoint at fan start
Min SP	Duct Static Pressure	0.3 in. w.c.	Duct static reset minimum
Max SP	Duct Static Pressure	1 in. w.c.	Duct static reset maximum
Trim	Duct Static Pressure	0.04 in. w.c.	Duct static trim per interval
Respond	Duct Static Pressure	0.06 in. w.c.	Duct static respond per request
Max Respond	Duct Static Pressure	0.15 in. w.c.	Duct static maximum respond per interval
High Limit	Duct Static Pressure	2 in. w.c.	Duct static high limit
Ignored Req	Duct Static Pressure	2	Requests ignored in trim & respond
T&R Interval	Duct Static Pressure	120 s	Trim & respond update interval
SF Min Speed	Duct Static Pressure	20%	Supply fan minimum speed
RA CFM Offset	Return Fan / Building Static	10%	Return airflow offset from supply airflow
Bldg Static SP	Return Fan / Building Static	0.03 in. w.c.	Building static setpoint
RF Min Speed	Return Fan / Building Static	20%	Return fan minimum speed
DA Min SP	Discharge Air Temperature	55°F	Discharge setpoint reset minimum
DA Max SP	Discharge Air Temperature	65°F	Discharge setpoint reset maximum
Trim	Discharge Air Temperature	0.2°F	Discharge setpoint trim
Respond	Discharge Air Temperature	0.3°F	Discharge setpoint respond
Max Respond	Discharge Air Temperature	1°F	Discharge setpoint maximum respond per interval
Warm-Up DA SP	Discharge Air Temperature	70°F	Warm-up / night heat discharge setpoint
Cool-Down DA SP	Discharge Air Temperature	55°F	Cool-down / night cool discharge setpoint
Cascade Range	Discharge Air Temperature	5°F	Master loop trim range applied to upstream setpoints
DA Alarm Band	Discharge Air Temperature	5°F	Discharge temp alarm band

SETPOINT (GRAPHIC NAME)	PANEL	DEFAULT	WHAT IT DOES
PH Offset	Preheat	3°F	Preheat setpoint = Discharge setpoint
PH Low SP	Preheat	45°F	Preheat setpoint clamp low
PH High SP	Preheat	60°F	Preheat setpoint clamp high
Freeze PH SP	Preheat	70°F	Preheat hold setpoint during freeze protection
Freeze OA Temp	Preheat	35°F	Freeze protection active below this OA temp
Freeze Min Pos	Preheat	30%	Preheat valve minimum at 0 degF OA during freeze protection
MA Low SP	Economizer / Minimum OA	45°F	Mixed air setpoint clamp low
MA High SP	Economizer / Minimum OA	65°F	Mixed air setpoint clamp high
Econ Deadband	Economizer / Minimum OA	2°F	Economizer disabled when OA-T > RA-T
Min OA CFM	Economizer / Minimum OA	4,000 CFM	Minimum outside airflow
CO2 Max OA	Economizer / Minimum OA	8,000 CFM	Outside airflow limit when CO2 raises minimum OA
RA CO2 Limit	Economizer / Minimum OA	1,000 ppm	Return air CO2 maximum
Evap OA Enable	Evaporative Cooling	55°F	Evap enabled above this OA temp
OA Dew Pt Limit	Evaporative Cooling	50°F	Evap enabled below this OA dew point
Stage 2 Offset	Evaporative Cooling	3°F	Evap stage 2 on when EV-T above setpoint by this
Stage 2 Delay	Evaporative Cooling	10 min	Evap stage 2 on delay
Stg 1 RH Limit	Evaporative Cooling	54% RH	Evap stage 1 off above this zone RH
Stg 2 RH Limit	Evaporative Cooling	50% RH	Evap stage 2 off above this zone RH
Bleed Open	Evaporative Cooling	1,200 ppm	Bleed
Bleed Close	Evaporative Cooling	900 ppm	Bleed
Cooling Low SP	Chilled Water	52°F	Evap / cooling coil discharge setpoint clamp low
Cooling High SP	Chilled Water	65°F	Evap / cooling coil discharge setpoint clamp high
Freeze CHW Pos	Chilled Water	10%	CHW valve position on freezestat trip

Adjustable in the controller, not on the graphic

These are set in the controller and can be changed from the Niagara point list by the controls contractor.

POINT	DEFAULT	WHAT IT DOES
`coolingCallDb`	2°F	Call for cooling: MA-T above cooling setpoint by this
`preheatRampOaTemp`	40°F	Preheat start-up ramp armed below this OA temp
`preheatRampSpan`	10°F	Preheat start-up ramp: added to setpoint at fan start
`preheatRampStep`	1°F	Preheat start-up ramp: removed each trim & respond interval
`phPumpOnOaTemp`	40°F	Preheat pump on below this OA temp
`phPumpOffOaTemp`	45°F	Preheat pump off above this OA temp

POINT	DEFAULT	WHAT IT DOES
`phPumpOnValvePos`	10%	Preheat pump on above this valve position
`phPumpOffValvePos`	5%	Preheat pump off below this valve position
`phPumpOffDelay`	5 min	Preheat pump off delay
`evapStage2OffOffset`	1°F	Evap stage 2 off when EV-T below setpoint by this
`evapMinOnTime`	5 min	Evap pump minimum on time
`evapMinOffTime`	5 min	Evap pump minimum off time
`chwRampStepPct`	10%	CHW valve ramp-closed step per interval after high humidity
`sumpDrainOaTemp`	40°F	Sump drained below this OA temp
`sumpDrainDelay`	30 min	Sump drain delay
`sumpFillOaTemp`	55°F	Sump fill allowed above this OA temp
`sumpFillEnableDelay`	30 min	Sump fill OA temp delay
`sumpFillToPumpDelay`	15 min	Delay from sump fill/full to pump enable
`dryOutEvapRunTime`	60 min	Dry-out only if evap ran this long
`dryOutLookbackTime`	1,440 min	Dry-out look-back window
`preFilterAlarmPress`	0.75 in. w.c.	Pre-filter dirty alarm
`finalFilterAlarmPress`	1.25 in. w.c.	Final filter dirty alarm

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Quick Troubleshooting

SYMPTOM	CHECK ON THE GRAPHIC
Unit not running when it should	System Status: Occupancy, Unit Mode (6 or 7 means a safety shutdown; reset the device, then System Reset). Alarms panel: Fire Alarm, Freeze Trip, Static Safety. SF Fail.
Zones too warm	Active DA SP and Cool Requests. Cooling Call, EP-1/EP-2 Cmd (RH Lockout? Sump Ready? OA Dew Point above its limit?). CHW Valve and CHW Ramp Limit. Economizer: MA Temp vs MA SP. Any purple (overridden) boxes?
Zones too cold	Active DA SP (warm-up or night heat?), PH Temp vs PH Disch SP, PH Valve, PH Pump Cmd. Outside air damper position vs Active Min OA.
Zones short of air	Duct Static vs Static SP, Static Requests, SF Speed (at High Limit?), filter pressure drops.
Doors hard to open / whistling	Bldg Static vs Bldg Static SP, RA CFM vs SA CFM, RF Speed, EA Dmpr Cmd.
Evaporative cooling not running	Cooling Call, OA Temp vs Evap OA Enable, OA Dew Point vs OA Dew Pt Limit, Sump Ready, Sump Low, RH Lockout, Dry-Out.
High CO2 in return air	RA CO2 vs RA CO2 Limit, Active Min OA, OA CFM, OA Dmpr Cmd.
Values not updating / yellow boxes	Controller communication is down. Contact the controls contractor.

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Appendix A: Hardware Points

TAG	POINT	TYPE	MODULE	TERMINAL	DESCRIPTION
AHU1-OA-T	`outdoorAirTemp`	AI	M1 ECY-8UI6UO-HOA	UI1	Outside Air Temperature (HT-1, 10K T3)
AHU1-OA-RH	`outdoorAirHumidity`	AI	M1 ECY-8UI6UO-HOA	UI2	Outside Air Humidity (HT-1, 4-20mA 0-100%RH)
AHU1-RA-T	`returnAirTemp`	AI	M1 ECY-8UI6UO-HOA	UI3	Return Air Temperature (TS-2, 10K T3)
AHU1-RA-CO2	`returnAirCO2`	AI	M1 ECY-8UI6UO-HOA	UI4	Return Air CO2 (CO2-1, 0-10V 0-2000ppm)
AHU1-MA-T	`mixedAirTemp`	AI	M1 ECY-8UI6UO-HOA	UI5	Mixed Air Temperature (TS-3 averaging, 10K T3)
AHU1-PH-T	`preheatDischTemp`	AI	M1 ECY-8UI6UO-HOA	UI6	Preheat Coil Discharge Temp (TS-4 averaging, 10K T3)
AHU1-EV-T	`evapDischTemp`	AI	M1 ECY-8UI6UO-HOA	UI7	Evap Section Discharge Temp (TS-5 averaging, 10K T3)

TAG	POINT	TYPE	MODULE	TERMINAL	DESCRIPTION
AHU1-SA-T	`dischargeAirTemp`	AI	M1 ECY-8UI6UO-HOA	UI8	Supply (Discharge) Air Temperature (TS-6, 10K T3)
AHU1-SF-SPD	`supplyFanSpeedCmd`	AO	M1 ECY-8UI6UO-HOA	UO1	Supply Fan Speed Command (VFD-1, 0-10V)
AHU1-RF-SPD	`returnFanSpeedCmd`	AO	M1 ECY-8UI6UO-HOA	UO2	Return Fan Speed Command (VFD-2, 0-10V)
AHU1-OAD-CMD	`outdoorAirDamperCmd`	AO	M1 ECY-8UI6UO-HOA	UO3	Outside Air Damper Command (DA-1, 2-10V, NC)
AHU1-RAD-CMD	`returnAirDamperCmd`	AO	M1 ECY-8UI6UO-HOA	UO4	Return Air Damper Command (DA-2, 2-10V, NO)
AHU1-EAD-CMD	`exhaustAirDamperCmd`	AO	M1 ECY-8UI6UO-HOA	UO5	Exhaust Air Damper Command (DA-3, 2-10V, NC)
AHU1-PHV-CMD	`preheatValveCmd`	AO	M1 ECY-8UI6UO-HOA	UO6	Preheat Valve Command (VLV-1, 2-10V, NO to coil)
AHU1-SA-SP	`ductStaticPress`	AI	M2 ECY-8UI6UO-HOA	UI1	Supply Duct Static Pressure (PT-1, 4-20mA 0-5 in.wc)
AHU1-BLDG-SP	`buildingStaticPress`	AI	M2 ECY-8UI6UO-HOA	UI2	Building Static Pressure (PT-2, 4-20mA +/-0.25 in.wc)
AHU1-OA-CFM	`outdoorAirflow`	AI	M2 ECY-8UI6UO-HOA	UI3	Outside Airflow (AFMS-1, 4-20mA 0-20000 CFM)
AHU1-RA-CFM	`returnAirflow`	AI	M2 ECY-8UI6UO-HOA	UI4	Return Airflow (AFMS-2, 4-20mA 0-30000 CFM)
AHU1-SA-CFM	`dischargeAirflow`	AI	M2 ECY-8UI6UO-HOA	UI5	Supply Airflow (AFMS-3, 4-20mA 0-30000 CFM)
AHU1-PF-DP	`preFilterDiffPress`	AI	M2 ECY-8UI6UO-HOA	UI6	Pre-Filter Differential Pressure (PT-3, 4-20mA 0-1 in.wc)
AHU1-FF-DP	`finalFilterDiffPress`	AI	M2 ECY-8UI6UO-HOA	UI7	Final Filter Differential Pressure (PT-4, 4-20mA 0-2 in.wc)
AHU1-SUMPCOND	`sumpConductivity`	AI	M2 ECY-8UI6UO-HOA	UI8	Evap Sump Conductivity (CE-1, 4-20mA 0-2000ppm)
AHU1-CHWV-CMD	`chilledWaterValveCmd`	AO	M2 ECY-8UI6UO-HOA	UO1	Chilled Water Valve Command (VLV-2 PICV, 2-10V, NC)
AHU1-SF-STS	`supplyFanStatus`	DI	M3 ECY-16DI	DI1	Supply Fan Status (CS-1)
AHU1-RF-STS	`returnFanStatus`	DI	M3 ECY-16DI	DI2	Return Fan Status (CS-2)
AHU1-PHP-STS	`preheatPumpStatus`	DI	M3 ECY-16DI	DI3	Preheat Pump Status (CS-3)
AHU1-EP1-STS	`evapPump1Status`	DI	M3 ECY-16DI	DI4	Evap Pump 1 Status (CS-4)
AHU1-EP2-STS	`evapPump2Status`	DI	M3 ECY-16DI	DI5	Evap Pump 2 Status (CS-5)
AHU1-SUMP-LO	`sumpLowLevelAlarm`	DI	M3 ECY-16DI	DI6	Evap Sump Low Level (LS-1, opens on low - reverse acting)
AHU1-SUMP-FULL	`sumpFull`	DI	M3 ECY-16DI	DI7	Evap Sump Full (LS-2, closes on full)

TAG	POINT	TYPE	MODULE	TERMINAL	DESCRIPTION
AHU1-FRZ	`freezeStatAlarm`	DI	M3 ECY-16DI	DI8	Freeze Low Limit (LLT-1 38F manual reset, opens on trip - reverse acting)
AHU1-SA-HSP	`supplyHighStaticAlarm`	DI	M3 ECY-16DI	DI9	Supply High Static Safety (PS-1, opens on trip - reverse acting)
AHU1-RA-LSP	`returnLowStaticAlarm`	DI	M3 ECY-16DI	DI10	Return Low Static Safety (PS-2, opens on trip - reverse acting)
AHU1-SA-SMK	`supplySmokeAlarm`	DI	M3 ECY-16DI	DI11	Supply Smoke Detector (SD-1 aux contact, closes on alarm - see RFI)
AHU1-RA-SMK	`returnSmokeAlarm`	DI	M3 ECY-16DI	DI12	Return Smoke Detector (SD-2 aux contact, closes on alarm - see RFI)
AHU1-FA-SD	`fireAlarmShutdown`	DI	M3 ECY-16DI	DI13	Fire Alarm Shutdown (FAR-1, opens on alarm - reverse acting)
AHU1-SF-SS	`supplyFanCmd`	DO	M4 ECY-8DOR	DO1	Supply Fan Start/Stop (VFD-1 run enable)
AHU1-RF-SS	`returnFanCmd`	DO	M4 ECY-8DOR	DO2	Return Fan Start/Stop (VFD-2 run enable)
AHU1-PHP-SS	`preheatPumpCmd`	DO	M4 ECY-8DOR	DO3	Preheat Pump Start/Stop (P-3 via RIB)
AHU1-EP1-SS	`evapPump1Cmd`	DO	M4 ECY-8DOR	DO4	Evap Pump 1 Start/Stop (P-1 via RIB, thru LS-1)
AHU1-EP2-SS	`evapPump2Cmd`	DO	M4 ECY-8DOR	DO5	Evap Pump 2 Start/Stop (P-2 via RIB, thru LS-1)
AHU1-SUMP-FILL	`sumpFillValveCmd`	DO	M4 ECY-8DOR	DO6	Sump Fill Valve (SOV-1)
AHU1-SUMP-DRN	`sumpDrainValveCmd`	DO	M4 ECY-8DOR	DO7	Sump Drain/Bleed Valve (MV-1)

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Appendix B: Open Questions for the Engineer (RFI)

The program was built before these were answered. Each one runs on the stated assumption until the engineer of record responds; the setpoints involved are adjustable.

RFI	REFERENCE	QUESTION	BUILT ON
RFI-01	Sequence A.2	Optimal start: the sequence asks for Optimal Start-Stop but gives no limits. Confirm the BAS schedule is the source of occupancy and minutes-to-next-occupancy, and the maximum early start.	Distech OptimumStart (adaptive, learns min/degF factors) with the BAS schedule as source; maximum early start 120 min; warm-up / cool-down limited to the OA conditions in D.2 / D.3.
RFI-02	Sequence B.2	Duct static high limit: "does not exceed 1.0 in. WC above scheduled total fan static / TAB value" - what absolute limit at PT-1 should be used?	2.0 in.wc at PT-1 (adjustable) until TAB sets it.

RFI	REFERENCE	QUESTION	BUILT ON
RFI-03	Sequence B.2	Duct static trim & respond parameters (initial, minimum, trim, respond, max respond, interval) are not given.	Initial 0.5, min 0.3, max 1.0 in.wc; trim 0.04, respond 0.06/request, max 0.15; 2 min interval; 2 ignored requests.
RFI-04	Sequence B.5	PDAT reset range and trim & respond amounts are not given.	55-65 F; trim +0.2 F, respond -0.3 F/request, max -1.0 F; starts at 65 F.
RFI-05	Sequence B.7	Preheat setpoint clamp limits and the start-up ramp (span and duration) are not given.	Clamp 45-60 F; ramp starts 10 F high and steps down 1 F every 2 min (20 min) when OA < 40 F at start.
RFI-06	Sequence C.2, D.1	"Minimum position vs. OA-T" for the preheat valve is not defined.	0% at 35 F OA rising linearly to 30% at 0 F OA.
RFI-07	Sequence B.8, B.9	Minimum OA airflow, CO2 maximum setpoint and the CO2-reset maximum airflow are not given.	Min OA 4,000 CFM; RA-CO2 limit 1,000 ppm; CO2 reset up to 8,000 CFM.
RFI-08	Sequence B.10	Evap "call for cooling" and the stage 2 off condition are not defined; minimum on/off times are not given.	Call when MA-T > cooling setpoint + 2 F (off at setpoint); stage 2 off when EV-T < setpoint - 1 F; pumps 5 min on / 5 min off.
RFI-09	Sequence B.11, B.12	Dry-out: confirm "ran >= 1 hr" may be one continuous hour, and what runs during dry-out (assumed fan on with OA at minimum, pumps off). Weekly drain day?	One continuous hour of stage 1 in the last 24 h; fan on, pumps off, MV-1 open on the weekly drain day from the BAS schedule.
RFI-10	Points list	Smoke detector auxiliary contact action (opens or closes on alarm) is not stated.	Closes on alarm (no reverse action on SA-SMK / RA-SMK).