© 2021 B2Q Associates

Data Overload?

5 Tools to Better Leverage Your Laboratory Building Automation System

Presented by B2Q Associates, Inc.

Sam Deptula, PE

Chris Schmidt, MSME

A Woman Business Enterprise (WBE)

University of Massachusetts, Amherst

© 2021 B2Q Associates

Learning Objectives

- Increase awareness of tools available through, and enabled by modern Building Automation Systems (BAS) to make sense of the vast amounts of data they generate and to analyze equipment performance, identify and diagnose issues, and stay ahead of future maintenance items.
- Understand the basic uses, benefits, and limitations of each tool
- Be able to select one or more strategies based on the situation, available resources, equipment type, and desired outcome
- Understand how the regular use of BAS analysis tools can positively impact building performance and laboratory environments
- Learn how utilizing these tools can help improve lab safety, occupant comfort, employee productivity, and more

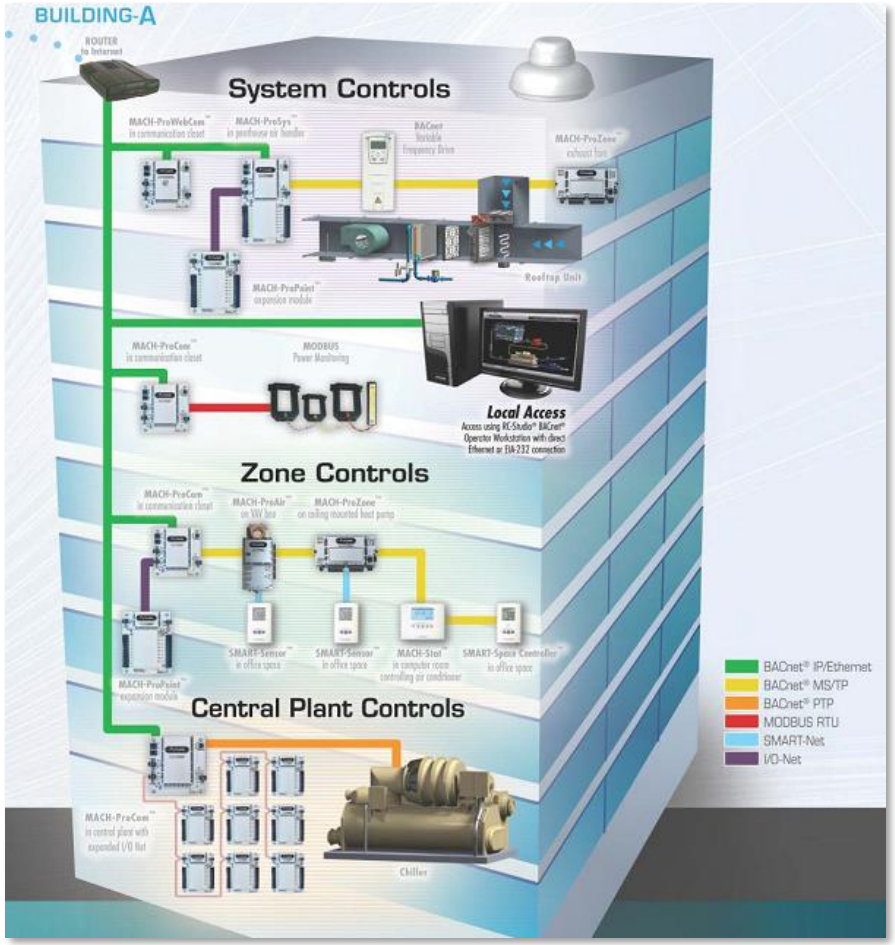
© 2021 B2Q Associates

Data Overload?

- Modern Direct Digital Control (DDC) Building Automation Systems can monitor and control several thousand points in a single building, which may translate to 10s or 100s of thousands of points across a campus or portfolio

- This is especially true in laboratory facilities that often have a high density of HVAC equipment along with lighting, access control, and other systems

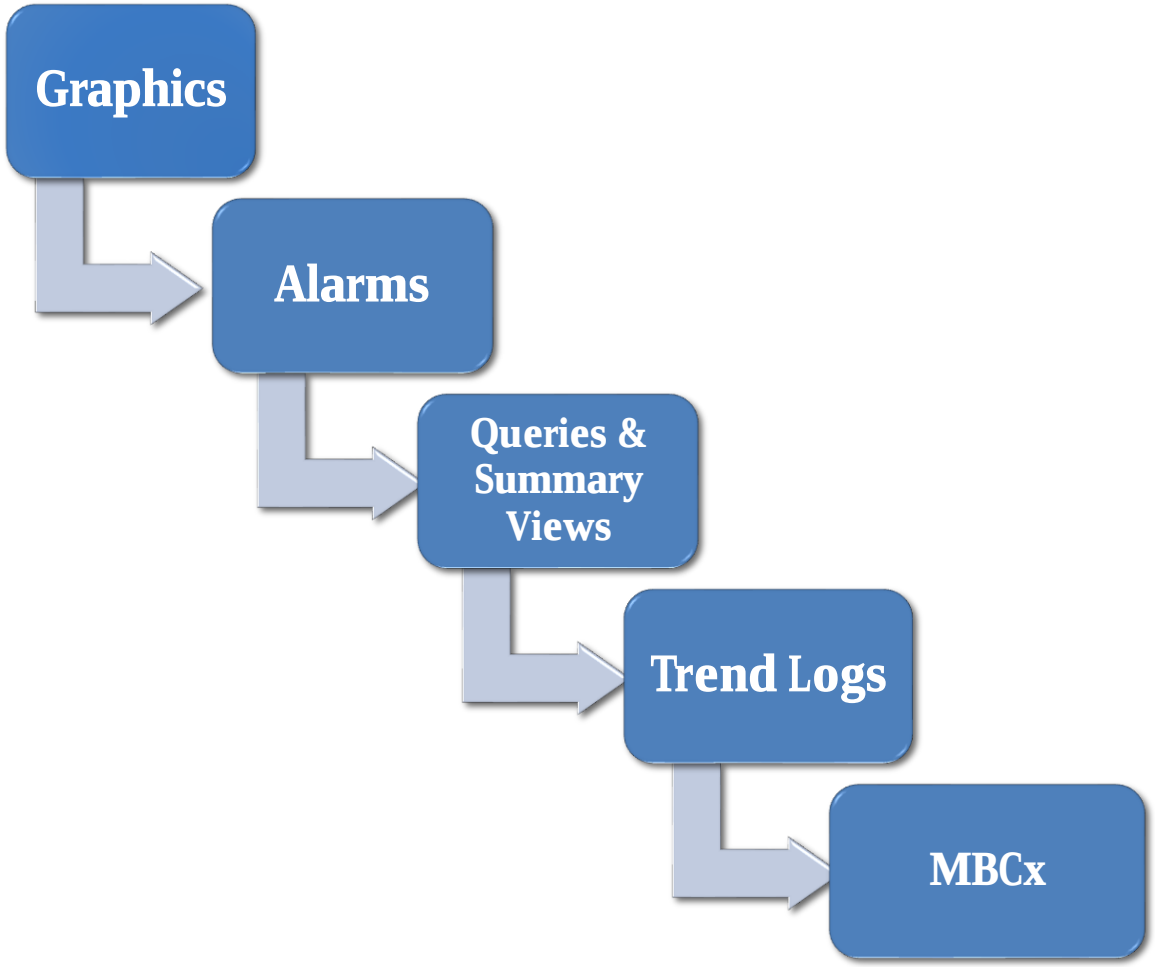
- The vast quantities of data can make the tasks of efficiently operating the building and assessing system performance more difficult and time consuming than ever for facilities staff and consultants.



© 2021 B2Q Associates

Leveraging Building Automation System Data

Five types of tools that facilities maintenance personnel and consultants have available to them to make sense of Building Automation System data



Why use any of these tools?

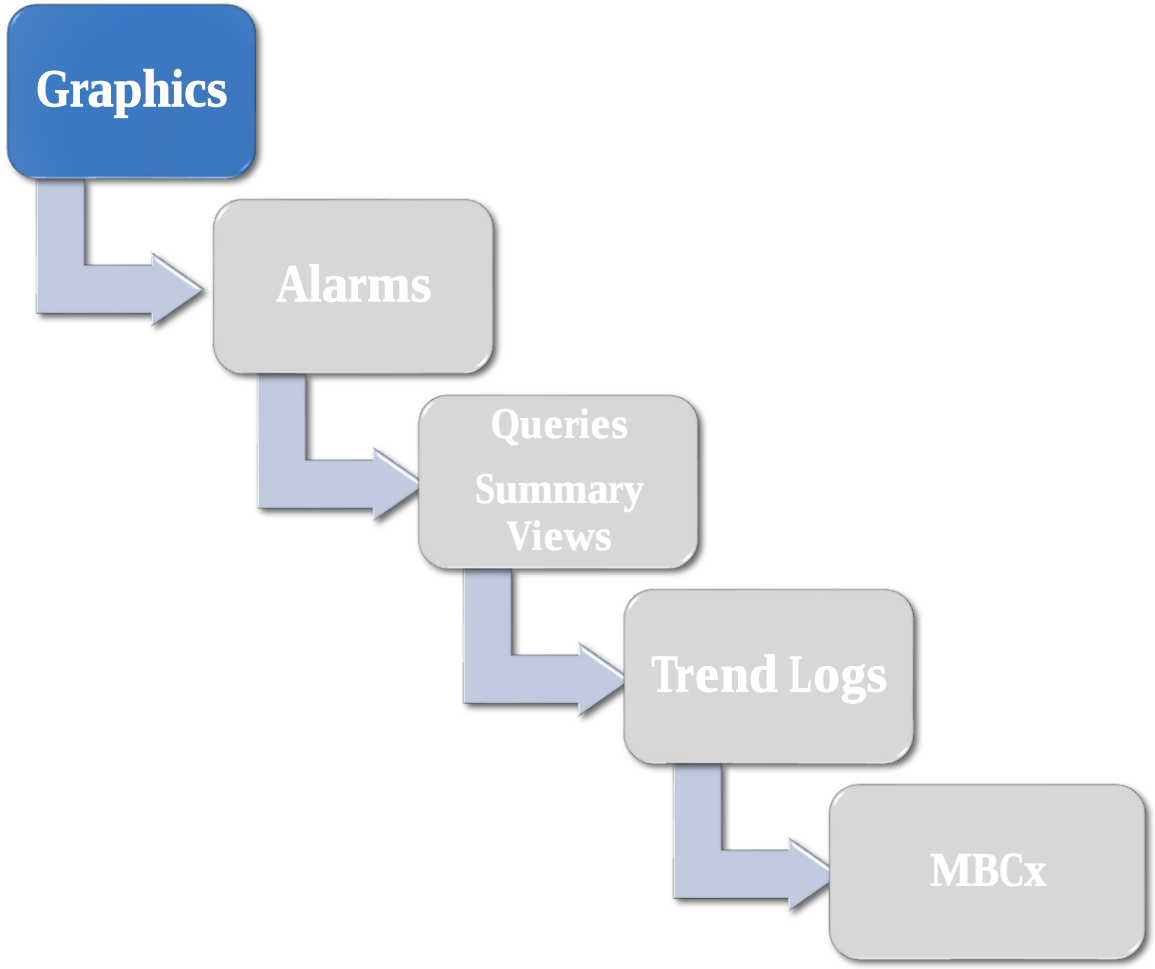
- Reduce response time to critical equipment failures
- Lower operating costs
- Improved understanding of systems
- Fewer comfort complaints and improved safety
- Savings justification for equipment upgrades or replacement

© 2021 B2Q Associates

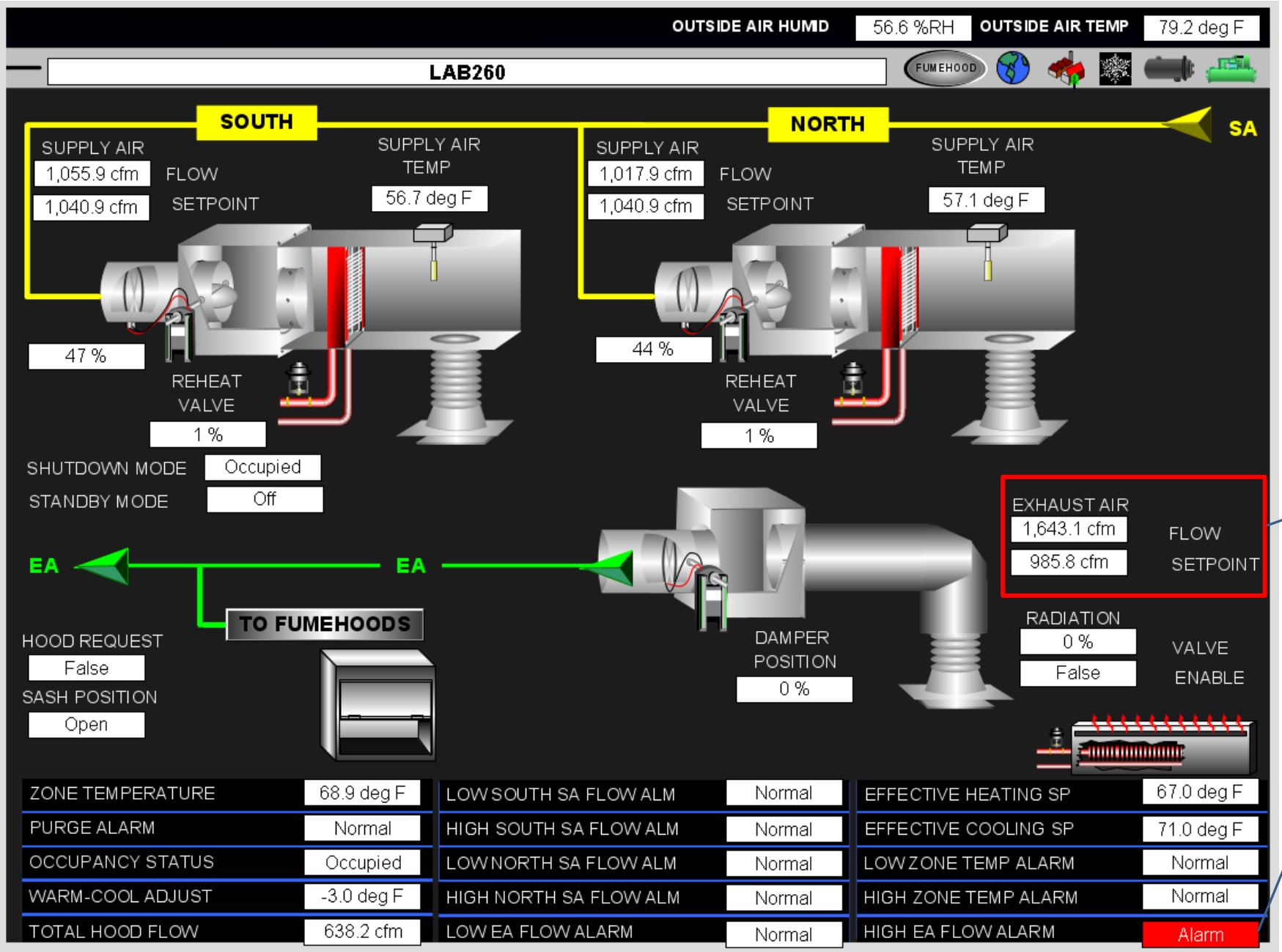
Leveraging Building Automation System Data

1. Equipment Graphics

Benefits	Limitations
Show sensor values, schedules, and set-points for equipment all on 1 or 2 screens	Display equipment parameters at a moment in time (no trend history)
Help provide context and visual organization to points and their values	Some key points may be omitted from the graphics
Can be one of the quickest ways to identify faults & opportunities for wide range of users from novice to expert	Accuracy of the graphics can vary and may be misleading (e.g. sensor placement, coil location, etc.)



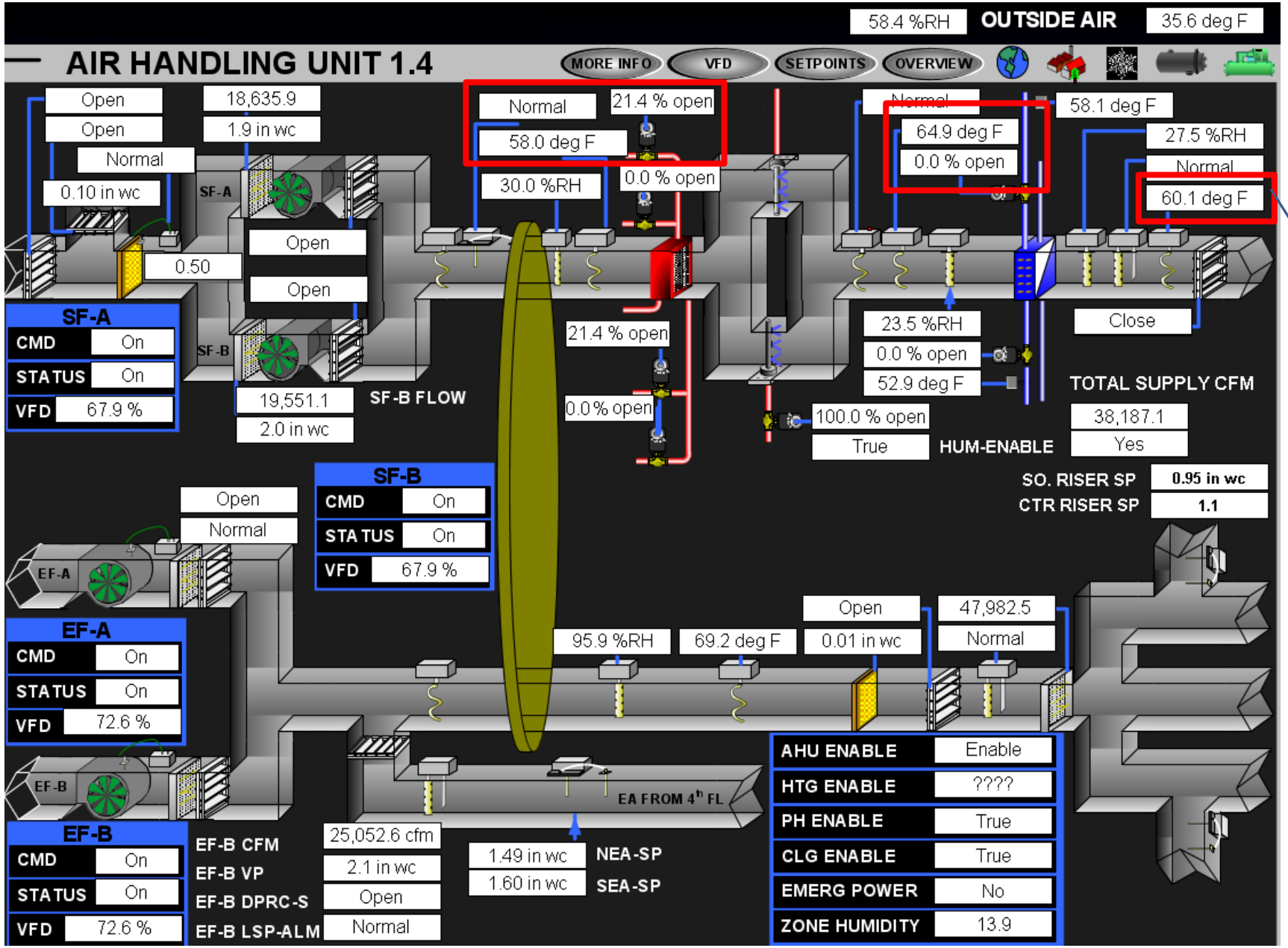
© 2021 B2Q Associates



General exhaust flow is significantly higher than set-point with damper commanded closed.

An alarm has been generated for high exhaust airflow in this laboratory

© 2021 B2Q Associates



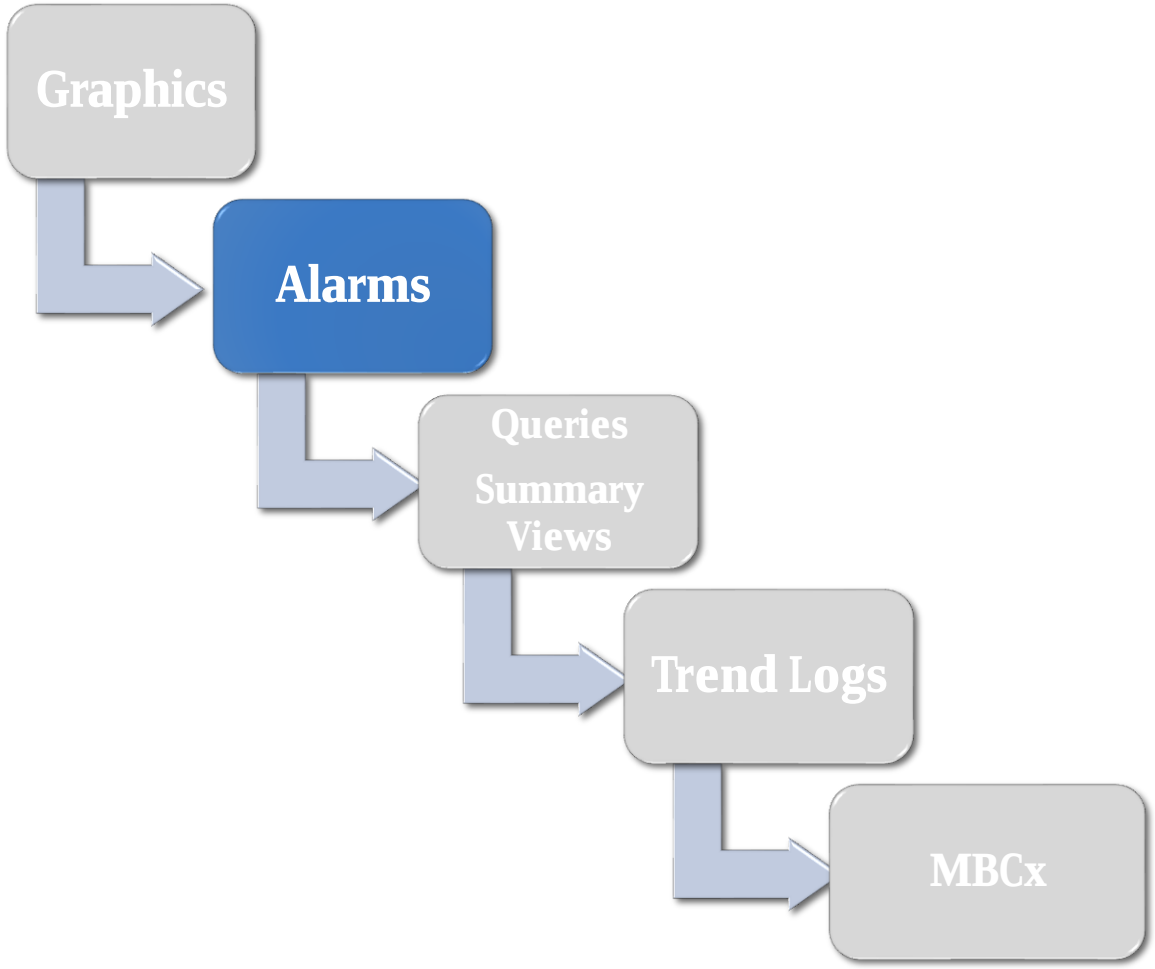
CHW coil leaving air temperature nearly 5°F less than entering air while CHW valve is commanded closed Preheat steam valve is opening further to compensate for leaking cooling valve

© 2021 B2Q Associates

Leveraging Building Automation System Data

2. Alarms and Events

Benefits	Limitations
Help staff react to urgent issues that may impact safety, comfort, or production	Volume of alarms can become overwhelming and/ or a nuisance; false alarms reinforce this
Can be programmed with multiple severity levels to assist with prioritization	Typically simple with minimal insight; Don't
Can be tied to pager, email, or text notifications for immediate action or tied to work order system	Reliance on alarms contributes to a reactive maintenance culture



© 2021 B2Q Associates

Event Viewer

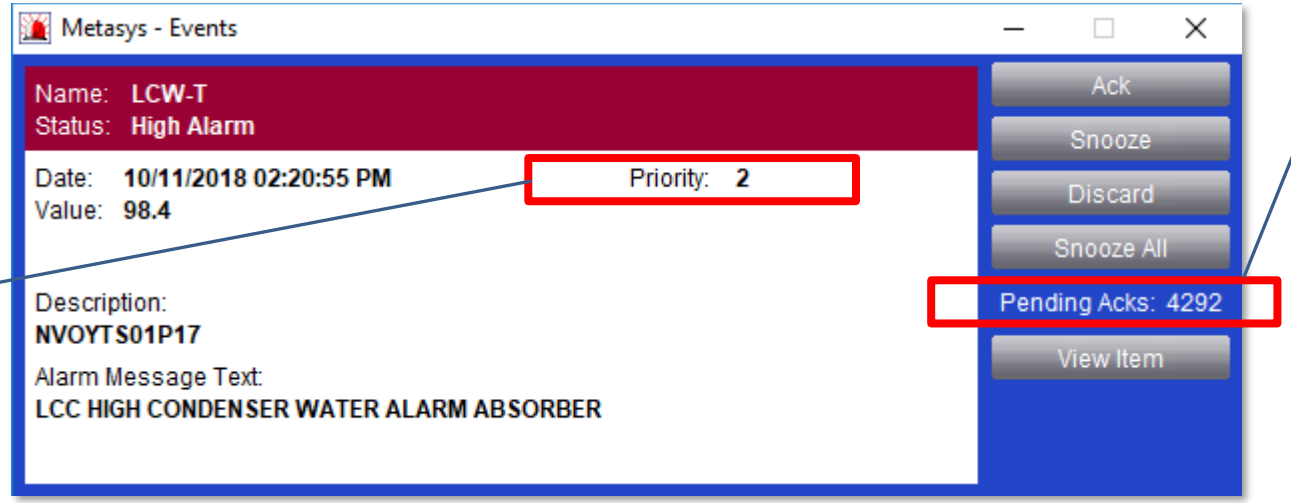
ADX01:NAE10 — Event Count: 1000

Type	Priority	When	Item	Value	Description	Alarm Message Text
Alarm	70	10/10/2018 02:31:58 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 02:27:41 PM EDT	HOOD-ALM	On	FUME HOOD ALARM	
Alarm	70	10/10/2018 02:25:48 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 02:24:34 PM EDT	HOOD-ALM	On	FUME HOOD ALARM	
Alarm	70	10/10/2018 02:23:14 PM EDT	HOOD-ALM	On	FUME HOOD ALARM	
Alarm	70	10/10/2018 02:20:07 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 02:18:45 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:59:12 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:57:05 PM EDT	HOOD-ALM	On	FUME HOOD ALARM	
Alarm	70	10/10/2018 01:55:37 PM EDT	FH0160A-002.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:54:01 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:48:59 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:44:01 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:40:16 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:38:48 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:32:05 PM EDT	FH0155A-002.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW FUME HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:30:49 PM EDT	HOOD-ALM	On	FUME HOOD ALARM	
Alarm	70	10/10/2018 01:29:58 PM EDT	HOOD-ALM	On	FUME HOOD ALARM	
Alarm	70	10/10/2018 01:28:16 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:26:47 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:25:18 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:21:08 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:17:09 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:15:35 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:13:57 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:07:55 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:04:43 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 01:02:51 PM EDT	HOOD-ALM	On	FUME HOOD ALARM	
Alarm	70	10/10/2018 01:01:33 PM EDT	HOOD-ALM	On	FUME HOOD ALARM	
Alarm	70	10/10/2018 12:58:54 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 12:58:52 PM EDT	HOOD-ALM	On	FUME HOOD ALARM	
Alarm	70	10/10/2018 12:52:40 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 12:51:13 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 12:45:18 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 12:40:28 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 12:38:13 PM EDT	FH0155E-003.OVR-ALM	Purge	EMERGENCY OVERRIDE ALARM	LOW FLOW HOOD OVERRIDE ALARM
Alarm	70	10/10/2018 12:36:51 PM EDT	HOOD-ALM	On	FUME HOOD ALARM	
Alarm	70	10/10/2018 12:36:47 PM EDT	FACEVEL-ALM	Alarm	FACE VELOCITY ALARM	
Alarm	70	10/10/2018 12:36:46 PM EDT	HOOD-ALM	On	FUME HOOD ALARM	

© 2021 B2Q Associates

Alarm Notification

Priority levels and color coding help provide some organization to alarms



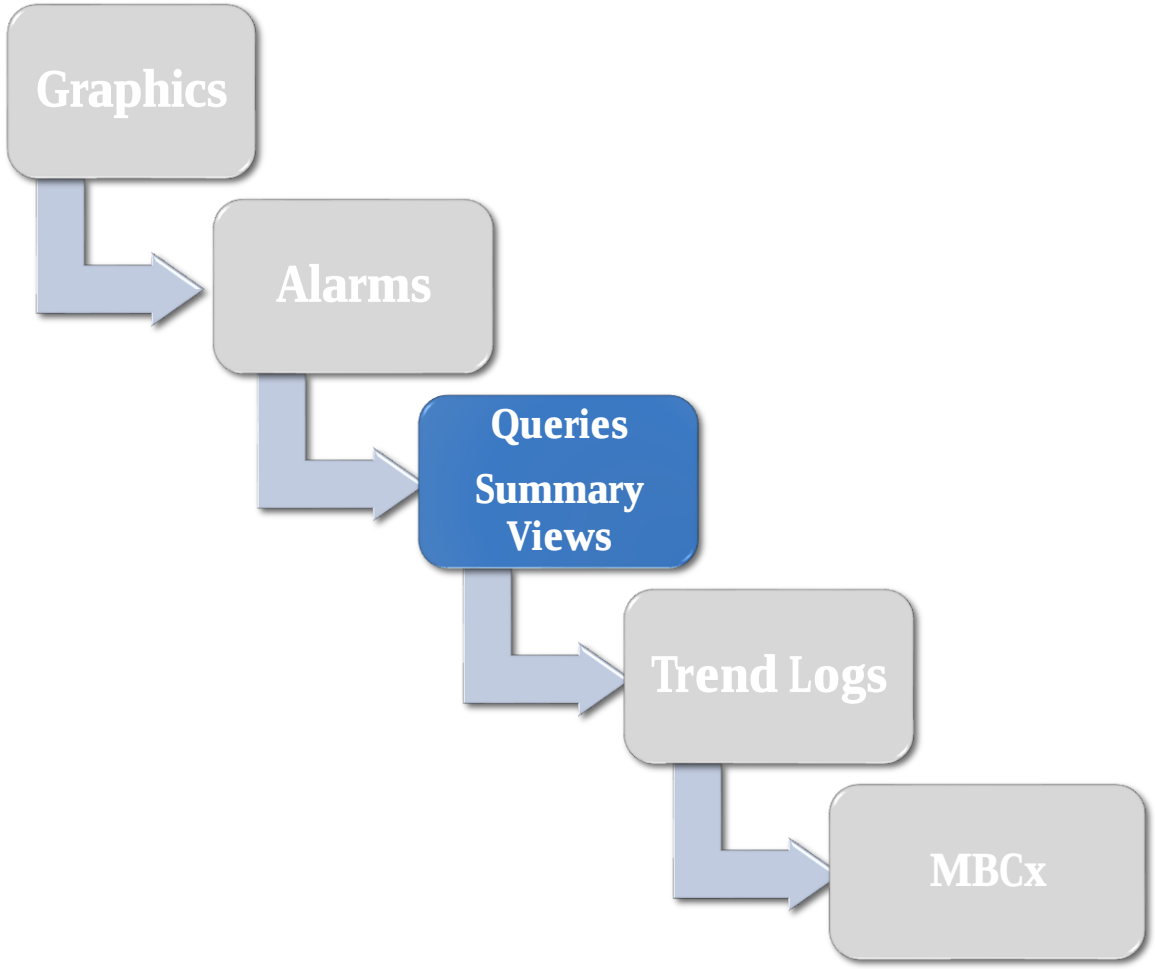
Thousands of "pending"alarms can accrue over time

© 2021 B2Q Associates

Leveraging Building Automation System Data

3. Queries & Summary Views

Benefits	Limitations
Display aggregate data across systems for “at a glance” comparison analysis	Display equipment parameters at a moment in time (no trend history)
Queries provide powerful searching and sorting capability for many different use cases	Users must know what they are looking for when using queries
Summary views can be tailored to the facility’s requirements or specific user needs	Summary views must be built by controls vendor or expert power user



© 2021 B2Q Associates

Global Search Viewer

To search, select the scope by clicking the Add button. Entering an Object Name is optional.

Search Locations

Add... Remove

Search Criteria

Object Name: OAT

Object Type: Field Points

☑ Include child objects

☑ Include search location objects

Search Stop Search

Search Results

		Sta...	Name/Label	Value	Units/States	Description	Location
			OAT	74.1 deg F	deg F	Athletics-Y Hockey Outside Air Temp(Map)	NAE-Athletics>N2 Trunk 1>DX-YHOCKEY>OAT
			OAT	72.6 deg F	deg F	Averill-HX Outside Air Temp	NCE-Johnson>N2 Trunk 2>AVRL-HX>OAT
			OAT	72.6 deg F	deg F	Averill-MUA Outside Air Temp	NCE-Johnson>N2 Trunk 2>AVRL-MUA>OAT
			OAT	74.1		Biomass-Outside Air Temp (Mapped)	NCE-Biomass>FCB>BIO-VAS>OAT
			OAT	77.6 deg F	deg F	Bixler-HV1 Outside Air Temp	NAE-Bixler>N2 Trunk 1>BIX-HV1>Inputs>OAT
			OAT	72.5 deg F	deg F	Bixler-HV2 Outside Air Temp	NAE-Bixler>N2 Trunk 1>BIX-HV2>Inputs>OAT
			OAT	77.7 deg F	deg F	Bixler-HV3 Outside Air Temp	NAE-Bixler>N2 Trunk 1>BIX-HV3>Setpoints>OAT
			OAT	77.7 deg F	deg F	Bixler-Lunder AHU1 Outside Air Temp	NAE-Bixler>N2 Trunk 1>LUN-DX1>Setpoints>OAT
			OAT	77.7 deg F	deg F	Bixler-Outside Air Temp	NAE-Bixler>N2 Trunk 1>BIX-HX2>Setpoints>OAT
			OAT	71.9 deg F	deg F	Bixler-Paint AH1 Outside Air Temp	NAE-Bixler>N2 Trunk 1>PAINT-AHU1>Inputs>OAT
			OAT	77.0 deg F	deg F	Bixler-Paint AH2 Outside Air Temp	NAE-Bixler>N2 Trunk 1>PAINT-AHU2>Inputs>OAT
			OAT	76.0 deg F	deg F	Bookstore-AHU1 Outside Air Temp	NAE-Cotter>N2 Trunk 1>BOOK-AHU1>Inputs>OAT
			OAT	70.4 deg F	deg F	Chapel-Outside Air Temp	NAE-Keyes>ALC BACnet>Chapel>OAT
×		Offline	OAT	??? 0.0 deg F	deg F	Chapel-Outside Air Temp (Mapped)	NCE-Hillside>N2 Trunk 2>CHAPEL-DX>OAT
			OAT	75.9 deg F	deg F	Coburn-HV1 Outside Air Temp	NAE-Marylow>N2 Trunk 1>COBN-HV1>Inputs>OAT
			OAT	77.9 deg F	deg F	Cotter-AC1 Outside Air Temp	NAE-Cotter>N2 Trunk 1>COT-AC1>Inputs>OAT
			OAT	77.9 deg F	deg F	Cotter-HX Outside Air Temp	NAE-Cotter>N2 Trunk 1>COT-HX>Setpoints>OAT
			OAT	111.9 deg F	deg F	Cotter-Pugh AHU Outside Air Temp Sec	NAE-Cotter>N2 Trunk 1>PUGH-AHU>Inputs>OAT
			OAT	77.9 deg F	deg F	Cotter-Radiant Outside Air Temp	NAE-Cotter>N2 Trunk 1>COT-RAD>Setpoints>OAT
			OAT	77.9 deg F	deg F	Cotter-RTU1 Outside Air Temp	NAE-Cotter>N2 Trunk 1>COT-RTU1>Setpoints>OAT
			OAT	69.8 deg F	deg F	Dana-HV1 Outside Air Temp	NCE-Dana>N2 Trunk 1>DANA-HV1>OAT
			OAT	69.8 deg F	deg F	Dana-HV2 Outside Air Temp	NCE-Dana>N2 Trunk 1>DANA-HV2>OAT
			OAT	69.8 deg F	deg F	Dana-HV3 Outside Air Temp	NCE-Dana>N2 Trunk 1>DANA-HV3>OAT
			OAT	69.8 deg F	deg F	Dana-HV4 Outside Air Temp	Colby>NCE-Dana>N2 Trunk 1>DANA-HV4>OAT

Select All Clear List Remove From List Add New... Copy

Search Completed

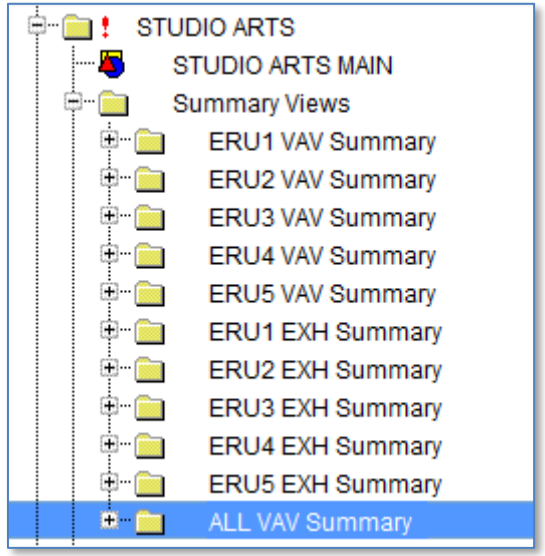
Objects Found: 138

Outdoor air temperatures ranging from 69.8°F to 111.9°F

© 2021 B2Q Associates

Summarize by equipment type and model tree selections

Current values for key equipment points, sortable



ALL VAV Summary

Tailored Summary | Summary

Available Tailored Summaries: VAV

Key Data

Item	Value
ERU-1.OA-T	81.8 deg F

	Zone Temp	Discharge Air Temp	Damper	Airflow	Airflow Setpoint	Reheat Valve
142VAV11	67.0 deg F	63.1 deg F	100.0 %	4,389.6 cfm	4,600.0 cfm	22.7 %
299EVAV7	70.3 deg F	57.1 deg F	100 %	1,743.3 cfm	1,950.0 cfm	0 %
199KVAV9	72.9 deg F	52.9 deg F	100.0 %	1,815.5 cfm	1,800.0 cfm	0.0 %
110VAV2	69.6 deg F	55.5 deg F	100.0 %	1,571.7 cfm	1,900.0 cfm	0.0 %
212VAV2	71.2 deg F	56.8 deg F	100 %	949.1 cfm	950.0 cfm	0.0 %
016VAV7	67.9 deg F	60.6 deg F	100 %	1,025.4 cfm	1,500.0 cfm	21 %
228VAV1	71.7 deg F	57.5 deg F	100 %	984.9 cfm	1,200.7 cfm	0 %
155VAV22	69.8 deg F	61.6 deg F	98.8 %	649.1 cfm	600.0 cfm	0.0 %
015VAV6	66.5 deg F	57.7 deg F	100 %	390.5 cfm	500.0 cfm	0 %
148DVAV14	74.3 deg F	84.3 deg F	51.1 %	159.9 cfm	150.0 cfm	99.8 %
157VAV23	68.5 deg F	61.5 deg F	73.9 %	1,262.6 cfm	1,200.0 cfm	0.0 %
099EVAV4	68.4 deg F	107.3 deg F	80 %	783.9 cfm	800.0 cfm	100 %
014VAV5	70.6 deg F	75.7 deg F	81 %	288.0 cfm	300.0 cfm	22 %
142AVAV10	71.1 deg F	55.5 deg F	0.0 %	0.0 cfm	0.0 cfm	0.0 %
253VAV6	69.4 deg F	66.0 deg F	68.9 %	834.8 cfm	880.0 cfm	0.0 %
156VAV20	71.3 deg F	61.4 deg F	71.2 %	2,020.9 cfm	1,850.0 cfm	7.7 %
250VAV11	69.8 deg F	57.0 deg F	71.6 %	863.7 cfm	880.0 cfm	0.0 %
128VAV6	74.6 deg F	56.7 deg F	67.0 %	1,075.0 cfm	976.2 cfm	0.0 %
001VAV1	67.9 deg F	58.2 deg F	59 %	586.6 cfm	600.0 cfm	1 %
199EVAV7	71.6 deg F	75.9 deg F	62.1 %	1,026.5 cfm	900.0 cfm	21.9 %
201WVAV8	70.1 deg F	58.2 deg F	57 %	1,164.4 cfm	1,050.0 cfm	0 %
150VAV15	73.6 deg F	92.7 deg F	53.6 %	610.6 cfm	550.0 cfm	34.3 %
142CVAV12	72.1 deg F	73.9 deg F	41.9 %	999.7 cfm	1,000.0 cfm	27.3 %
125VAV5	68.2 deg F	56.4 deg F	54.5 %	620.4 cfm	660.0 cfm	1.1 %
259EVAV12	68.2 deg F	56.6 deg F	46.8 %	1,254.3 cfm	1,250.0 cfm	0.0 %
299KVAV5	71.8 deg F	57.9 deg F	46.1 %	739.6 cfm	700.0 cfm	0.0 %
017VAV9	66.5 deg F	57.9 deg F	43 %	212.6 cfm	220.0 cfm	0 %

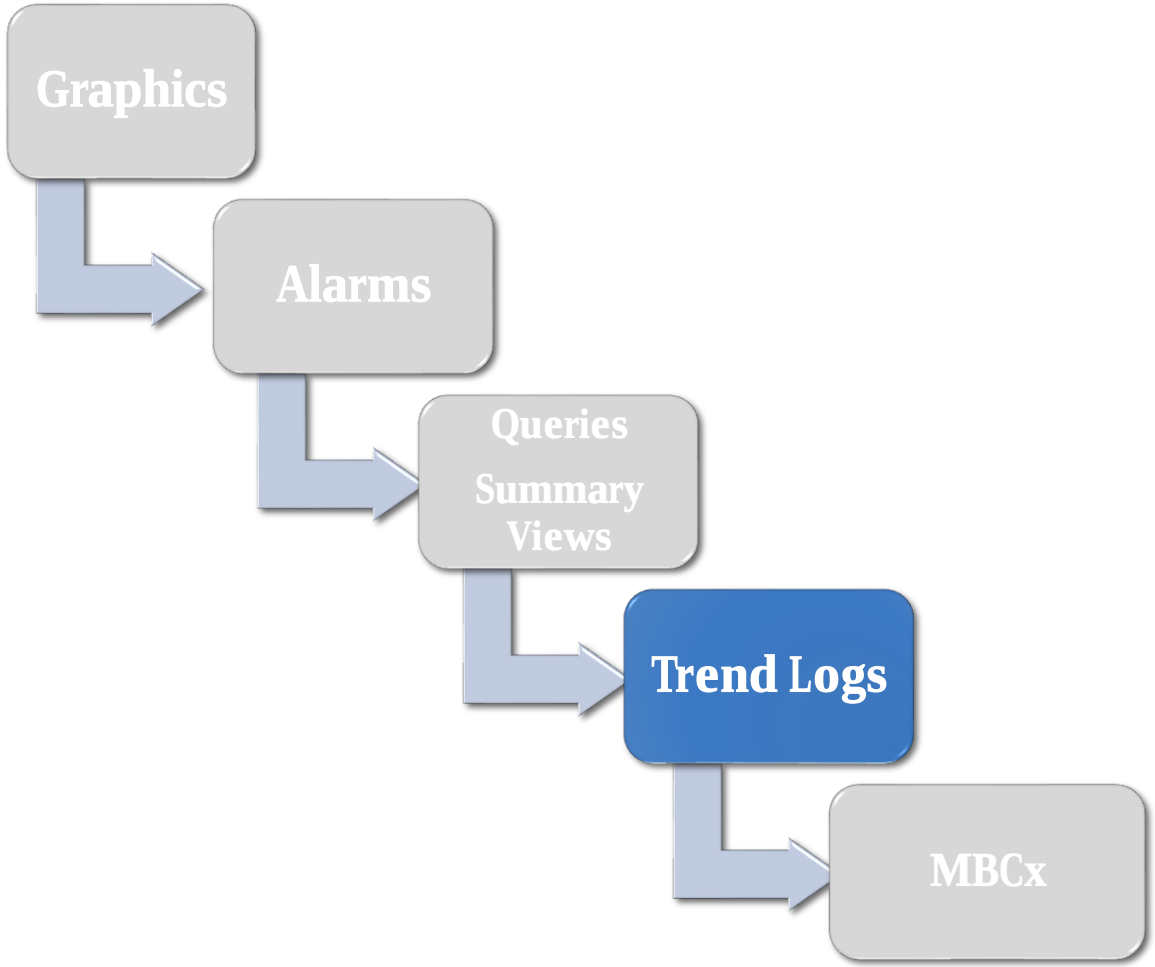
Total Row Count: 48

© 2021 B2Q Associates

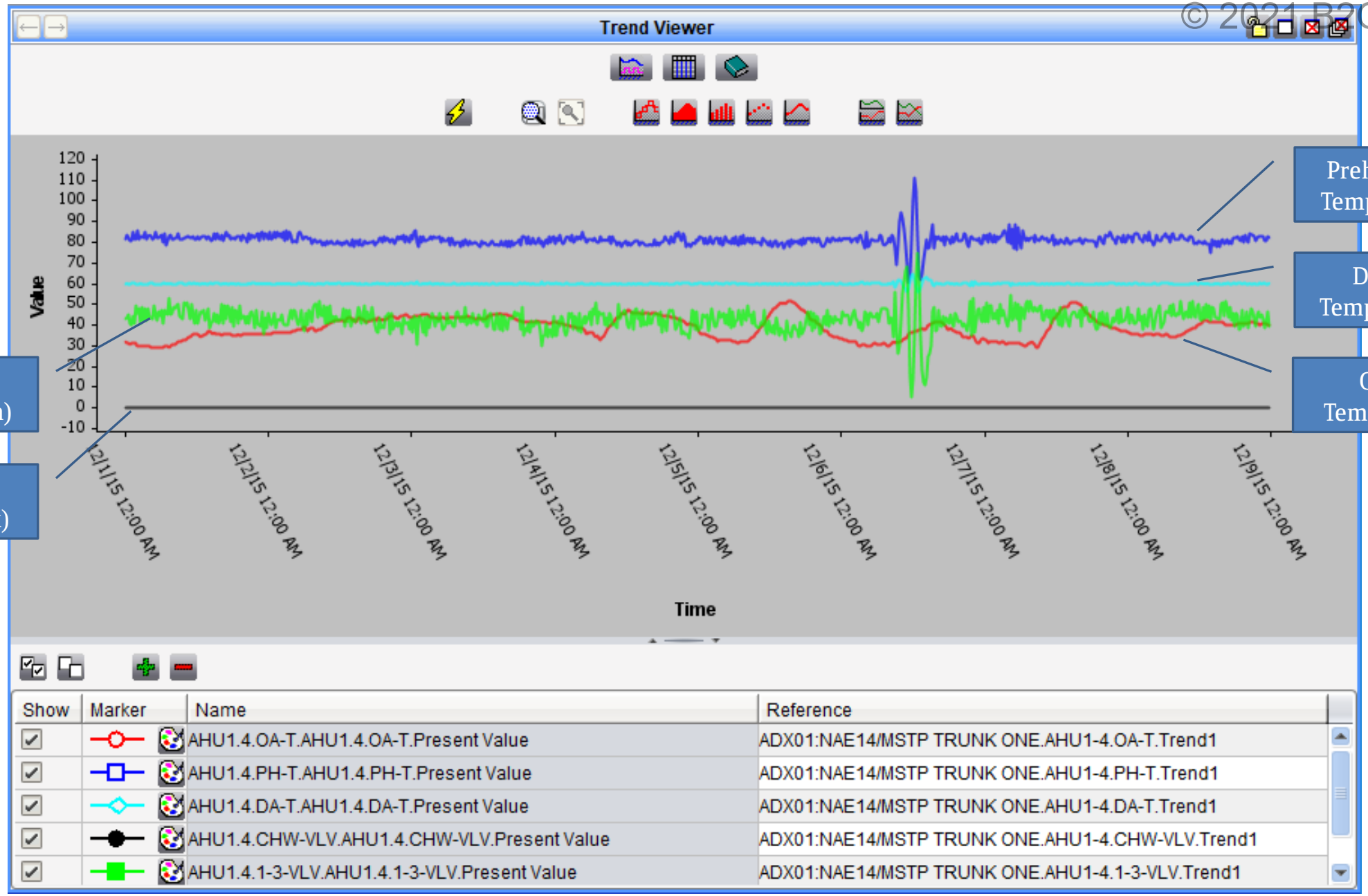
Leveraging Building Automation System Data

4. Trend Logs

Benefits	Limitations
Provide a historical view of equipment operation and allow for deeper analysis of equipment performance	Must be configured in the BAS; investment required varies by system
Raw trend data can be used to derive more useful performance and benchmarking indicators	The complexity of exporting trend data and output format vary by system
Can be used as inputs for calculations and models to estimate energy savings associated with equipment upgrades or retrofits	Generally used by "power users" and consultants, although most modern systems offer built-in graphing tools that are user-friendly



© 2021 B2Q Associates



Preheat Discharge Temperature (blue)

Discharge Air Temperature (cyan)

Outdoor Air Temperature (Red)

Preheat Valve Position (green)

CHW Valve Position (black)

© 2021 B2Q Associates

Trend Viewer

Copy To Clipboard

Copy and paste to spreadsheet or .CSV file to export

Time	...4.OA-T.Present Value ()	....PH-T.Present Value ()	....DA-T.Present Value ()	...-VLV.Present Value ()	AHU1.4.1-3-VLV.AHU1.4.1-3-
12/1/15 12:00:00 AM EST	31.88153	81.21633	59.94654	0.0273876	42.87174
12/1/15 12:15:00 AM EST	31.24522	83.81867	60.34039	0.0273876	43.40443
[illegible]0 AM EST	31.04624	82.13627	59.93921	0.0273876	44.93771
[illegible]0 AM EST	30.83609	80.99645	59.94233	0.0273876	40.98442
[illegible] AM EST	31.47577	80.7244	60.17138	0.0273876	40.24744
[illegible] AM EST	31.47577	84.91632	60.18726	0.0273876	44.10744
[illegible] AM EST	31.47577	81.45192	60.18726	0.0273876	40.67403
[illegible] AM EST	31.47577	83.41769	59.58245	0.0273876	49.5581
12/1/15 2:00:00 AM EST	30.85988	81.62247	59.82013	0.0273876	45.32304
12/1/15 2:15:00 AM EST	29.90033	85.65041	60.01933	0.0273876	47.35115
12/1/15 2:30:00 AM EST	29.68864	81.31583	59.61038	0.0273876	47.76678
12/1/15 2:45:00 AM EST	29.68864	83.21442	60.23124	0.0273876	40.51989
12/1/15 3:00:00 AM EST	29.68864	82.94069	59.62853	0.0273876	49.15364
12/1/15 3:15:00 AM EST	29.68864	81.87849	60.04384	0.0273876	41.93989
12/1/15 3:30:00 AM EST	29.68864	85.07857	60.03738	0.0273876	47.98196
12/1/15 3:45:00 AM EST	29.68864	81.37	60.05386	0.0273876	41.97569
12/1/15 4:00:00 AM EST	29.68864	82.83546	59.85052	0.0273876	47.94459
12/1/15 4:15:00 AM EST	29.68864	83.90586	60.26155	0.0273876	43.37113
12/1/15 4:30:00 AM EST	29.24545	82.81875	60.05984	0.0273876	43.67163
12/1/15 4:45:00 AM EST	29.24545	81.54387	60.05984	0.0273876	42.81567
12/1/15 5:00:00 AM EST	29.24545	82.42703	59.84932	0.0273876	49.57391
12/1/15 5:15:00 AM EST	29.04115	84.74358	60.05601	0.0273876	44.89812
12/1/15 5:30:00 AM EST	29.44517	82.00231	60.05601	0.0273876	42.44894
12/1/15 5:45:00 AM EST	29.44517	82.21174	59.85342	0.0273876	46.50152
12/1/15 6:00:00 AM EST	29.44517	82.61513	60.0528	0.0273876	44.64411
12/1/15 6:15:00 AM EST	29.44517	83.37413	60.05217	0.0273876	47.50482
12/1/15 6:30:00 AM EST	29.4884	80.26589	60.25803	0.0273876	40.70667
12/1/15 6:45:00 AM EST	29.70065	84.124	60.27451	0.0273876	47.56404
12/1/15 7:00:00 AM EST	30.11264	78.89254	59.64729	0.0273876	46.12097

© 2021 B2Q Associates

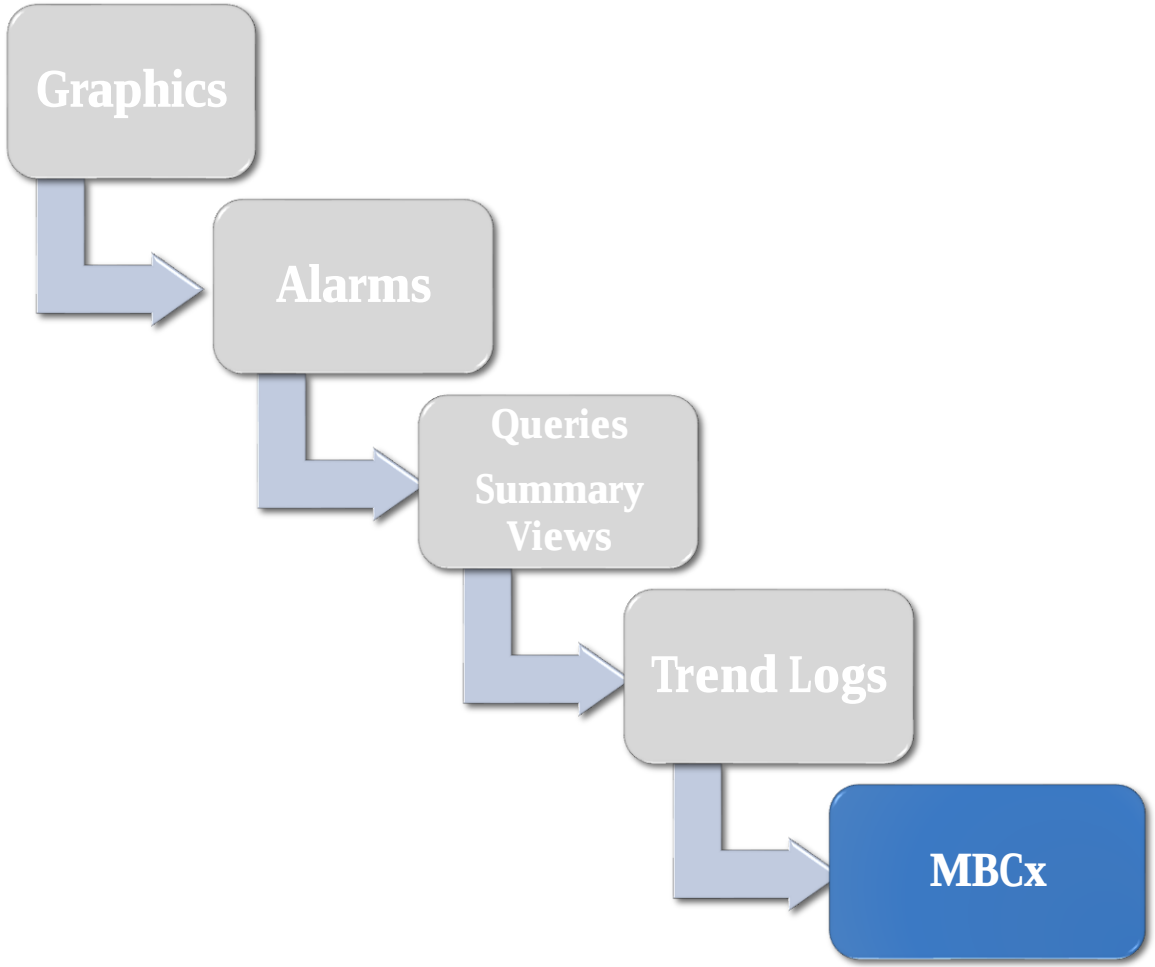
BAS Trend Data							Existing		Proposed		Savings			
Date/Time	OA-T	PH-T	DA-T	CHW-VLV	PRHT-VLV	SF-SPD	CHW Coil Delta T	PRHT Coil Delta T	CHW Coil Delta T	PRHT Coil Delta T	CHW Savings		Steam Savings	
MM/DD/YYYY HH:MM:SS	°F	°F	°F	%	%	%	°F	°F	°F	°F	tons	$	lbs/hr	$
12/1/15 12:00:00 AM EST	31.9	81.2	59.9	0.0	42.9	53.6	21.3	49.3	0	28.1	69.2	$7.75	685	$13.71
12/1/15 12:15:00 AM EST	31.2	83.8	60.3	0.0	43.4	56.5	23.5	52.6	0	29.1	80.6	$9.03	766	$15.32
12/1/15 12:30:00 AM EST	31.0	82.1	59.9	0.0	44.9	57.0	22.2	51.1	0	28.9	76.9	$8.62	750	$14.99
12/1/15 12:45:00 AM EST	30.8	81.0	59.9	0.0	41.0	53.6	21.1	50.2	0	29.1	68.5	$7.68	649	$12.97
12/1/15 1:00:00 AM EST	31.5	80.7	60.2	0.0	40.2	53.0	20.6	49.2	0	28.7	66.2	$7.41	622	$12.43
12/1/15 1:15:00 AM EST	31.5	84.9	60.2	0.0	44.1	53.0	24.7	53.4	0	28.7	79.6	$8.92	820	$16.39
12/1/15 1:30:00 AM EST	31.5	81.5	60.2	0.0	40.7	53.7	21.3	50.0	0	28.7	69.4	$7.78	650	$13.00
12/1/15 1:45:00 AM EST	31.5	83.4	59.6	0.0	49.6	54.3	23.8	51.9	0	28.1	78.6	$8.80	888	$17.75
12/1/15 2:00:00 AM EST	30.9	81.6	59.8	0.0	45.3	54.3	21.8	50.8	0	29.0	71.9	$8.05	743	$14.85
12/1/15 2:15:00 AM EST	29.9	85.7	60.0	0.0	47.4	52.7	25.6	55.8	0	30.1	82.0	$9.19	912	$18.24
12/1/15 2:30:00 AM EST	29.7	81.3	59.6	0.0	47.8	54.2	21.7	51.6	0	29.9	71.5	$8.01	779	$15.58
12/1/15 2:45:00 AM EST	29.7	83.2	60.2	0.0	40.5	54.2	23.0	53.5	0	30.5	75.7	$8.48	700	$14.00
12/1/15 3:00:00 AM EST	29.7	82.9	59.6	0.0	49.2	54.2	23.3	53.3	0	29.9	76.8	$8.60	861	$17.22
12/1/15 3:15:00 AM EST	29.7	81.9	60.0	0.0	41.9	52.5	21.8	52.2	0	30.4	69.6	$7.79	688	$13.76
12/1/15 3:30:00 AM EST	29.7	85.1	60.0	0.0	48.0	52.7	25.0	55.4	0	30.3	80.1	$8.97	903	$18.06
12/1/15 3:45:00 AM EST	29.7	81.4	60.1	0.0	42.0	52.7	21.3	51.7	0	30.4	68.2	$7.64	672	$13.45
12/1/15 4:00:00 AM EST	29.7	82.8	59.9	0.0	47.9	52.9	23.0	53.1	0	30.2	73.8	$8.27	828	$16.56
12/1/15 4:15:00 AM EST	29.7	83.9	60.3	0.0	43.4	52.9	23.6	54.2	0	30.6	76.0	$8.51	771	$15.41
			60.1	0.0	43.7	52.9	22.8	53.6	0	30.8	73.1	$8.19	747	$14.94
			60.1	0.0	42.8	54.0	21.5	52.3	0	30.8	70.4	$7.89	691	$13.83
			59.8	0.0	49.6	55.0	22.6	53.2	0	30.6	75.5	$8.45	841	$16.82
			60.1	0.0	44.9	54.0	24.7	55.7	0	31.0	81.0	$9.08	833	$16.66
			60.1	0.0	42.4	53.7	21.9	52.6	0	30.6	71.5	$8.01	700	$14.00
			59.9	0.0	46.5	53.9	22.4	52.8	0	30.4	73.2	$8.20	781	$15.63
			60.1	0.0	44.6	54.1	22.6	53.2	0	30.6	74.1	$8.30	757	$15.14
			60.1	0.0	47.5	56.8	23.3	53.9	0	30.6	80.5	$9.02	833	$16.65
			60.3	0.0	40.7	56.8	20.0	50.8	0	30.8	69.1	$7.74	612	$12.24
			60.3	0.0	47.6	56.8	23.8	54.4	0	30.6	82.3	$9.22	853	$17.05

EEM-1: Repair Cooling Leakby on AHU-1.4		
Electric Savings	195,908	kWh
CHW Savings	195,908	kWh
Electric Cost Savings	$19,591	$
Steam Savings	6,692	MLbs
Steam Cost Savings	$133,831	$
Total Cost Savings	$153,422	$
Project Cost Estimate	$7,700	$
Potential Utility Incentive	$17,632	$

© 2021 B2Q Associates

Leveraging Building Automation System Data

5. **Monitoring-based Commissioning (MBCx)**



© 2021 B2Q Associates

What Is Monitoring-Based Commissioning?

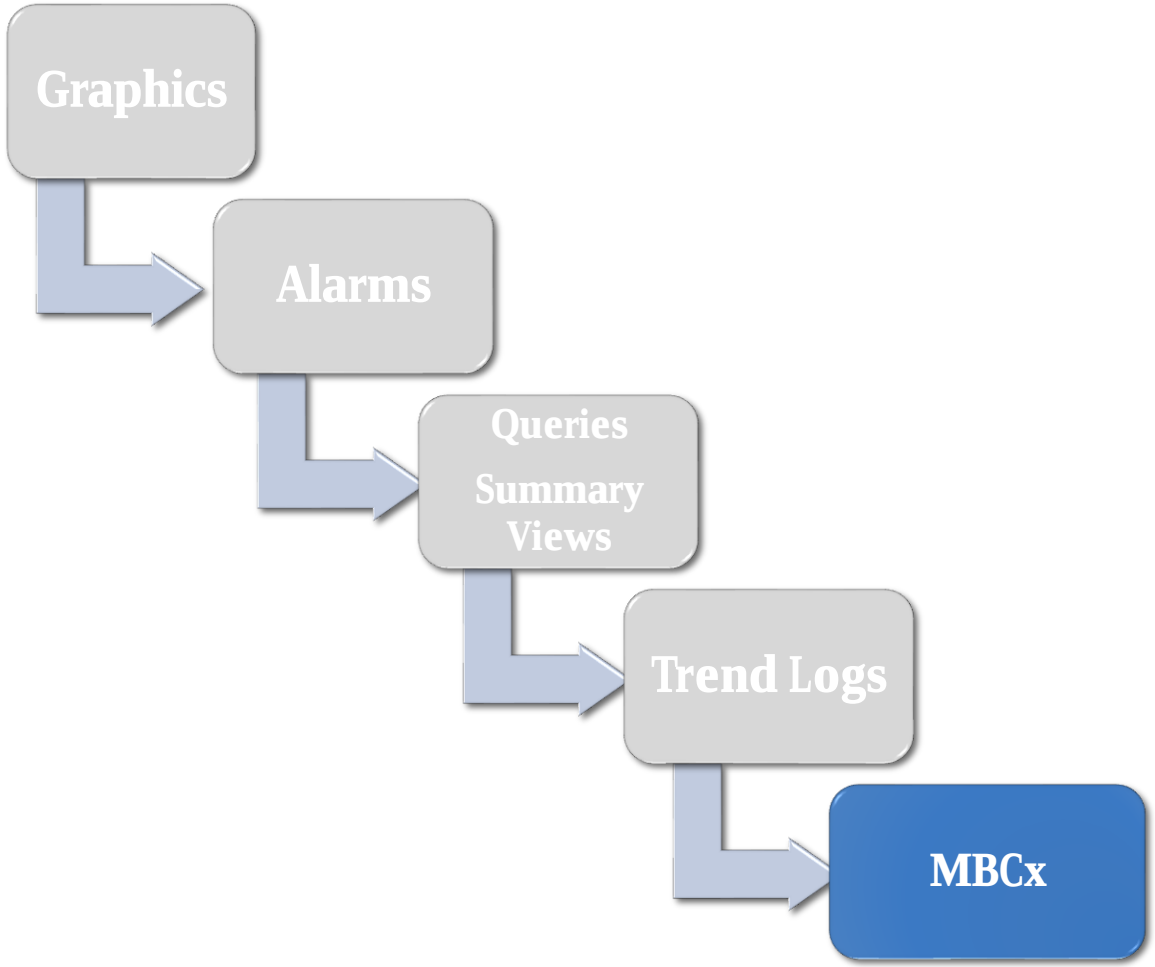
- MBCx also known as Continuous Commissioning (CCx) or Real-time Energy Management (RTEM)
- Comprehensive approach to commissioning of new or existing buildings incorporating:
  - Aggregation of data from multiple sources (BMS, Metering, Weather, etc.)
  - Continuous fault detection and diagnostics
  - Multi-dimensional prioritization of faults and recommendations
  - Energy management tools for initial benchmarking and tracking
  - Software platform to visualize data and results, anytime, anywhere

© 2021 B2Q Associates

Leveraging Building Automation System Data

5. Monitoring-based Commissioning (MBCx)

Benefits	Limitations
Leverage existing BAS controls investments to monitor and improve building performance	Initial investment to configure software and tailor analytics to specific equipment sequences
Automatically mines BAS data for opportunities; provides prioritization and cost estimates estimate	Most systems do not make changes on their own – need staff to act on recommendations
Acts as a 24/7 commissioning agent to reduce building energy costs, increase safety and comfort	Not all MBCx systems are created equal; some may not feature analytics tailored for complex lab HVAC systems



© 2021 B2Q Associates

Dashboard summarizing raw data and valuable derived information from MBCx analytics

© 2021 B2Q Associates

Integrated Science
UMass Amherst > Integrated Science

My Voice | Public | *Fleet View | Options

FDD LAB General Exhaust Box, FDD VAV Box, FDD LAB Fume Hood, FDD Lab Zone, FDD A... | Data Points 4 | Samples 0 | 2018-07-01 12:00:00 AM | Custom | 2018-07-31 11:59:59 PM | Get Data

RESTORE | DATA 1 of 1

Analytics: Historical Severity Distribution By Asset

Asset	Savings Opportunity	Historical Severity Distribution
260 Lab - Biochemistry (5)	$4,062.52	
355B Lab Support - Chemistry (5)	$2,157.07	
160D Lab - Chemistry (5)	$1,469.42	
299U Circulation - General Building (4)	$724.02	
363 Lab Support - Chemistry (5)	$270.77	
460 Lab - Veterinary (5)	$126.98	
355C Lab - Chemistry (5)	$118.10	
455 Lab - Veterinary (5)	$108.93	
058C Lab - Animal Care (5)	$78.33	
470 Lab - Veterinary (5)	$63.24	
375 Lab Support - Chemistry (5)	$33.01	
268 Lab - Biochemistry (5)	$31.92	
368 Lab - Biology (5)	$26.48	
066 Lab Support - Veterinary (5)	$13.38	
061 Utility - General Building (4)	$12.00	
355A Lab - Chemistry (5)	$4.88	
355E Lab - Chemistry (5)	$2.48	
364 Lab - Biology (5)	$2.21	
269 Lab Support - Chemistry (5)	$1.53	
060 Lab Support - Veterinary (4)	$0.68	
363A Lab Support - Chemistry (5)	$0.37	
155A Lab - Chemistry (5)	$0.36	
160C Lab - Chemistry (5)	$0.34	
263A Lab Support - Chemistry (4)	$0.22	

"Heat Map" of analytic findings, priotized by duration, frequency, cost savings, and equipment type

© 2021 B2Q Associates

Integrated Science
UMass Amherst > Integrated Science

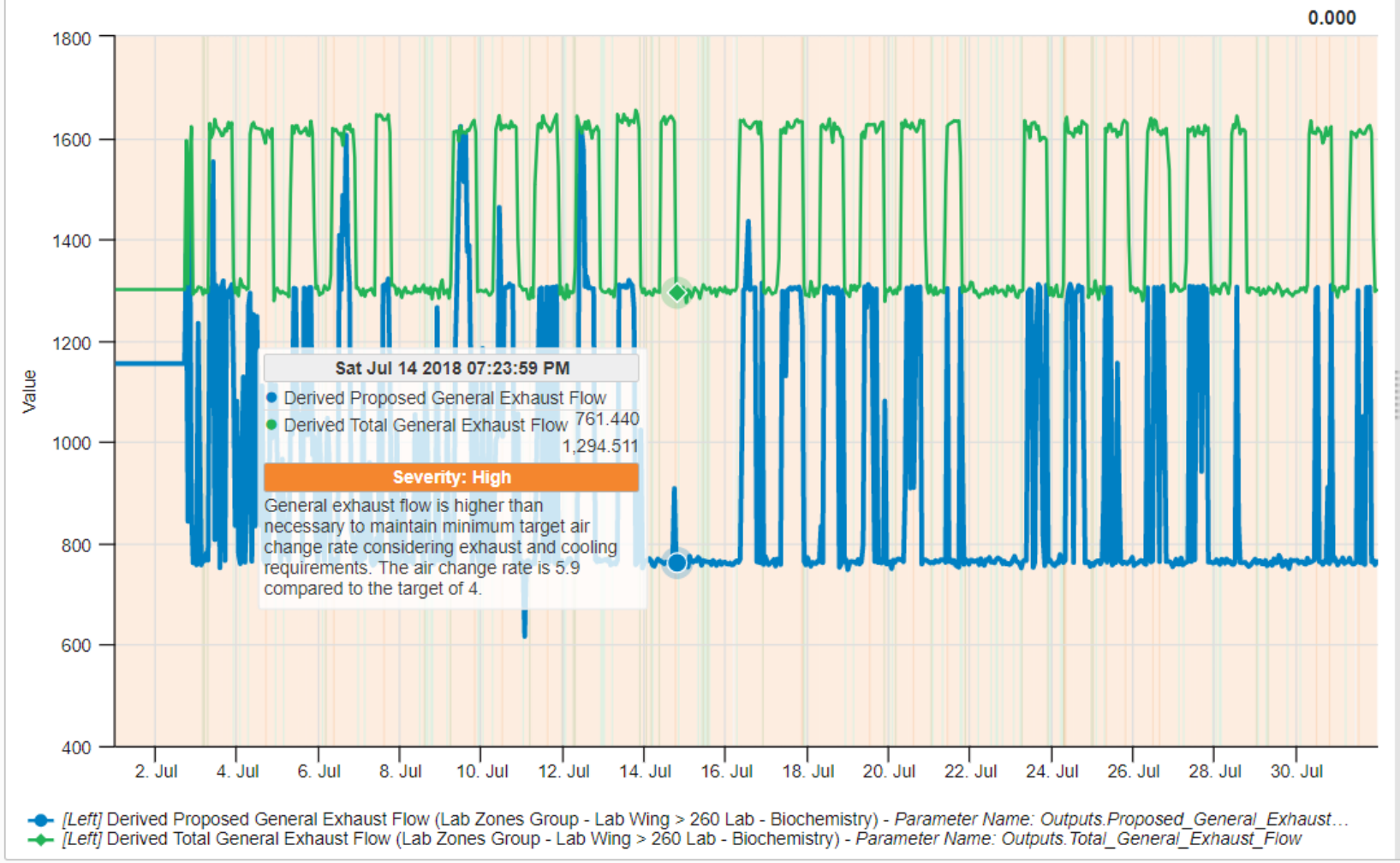
My Voice | Public | *Fleet View | Options

FDD LAB General Exhaust Box, FDD VAV Box, FDD LAB Fume Hood, FDD Lab Zone, FDD A... | Data Points 8 | Samples 1442 | 2018-07-01 12:00:00 AM | Custom | 2018-07-31 11:59:59 PM | Get Data

CLOSE | DATA 2 of 2 | Save KPIs | Remove

R_LAB006A - Laboratory airflow analysis

UMass Amherst > Integrated Science > Lab Zones Group - Lab Wing > 260 Lab - Biochemistry



Analytic Results

Severity: High

From: Thu Aug 02 2018 4:35:00 PM
To: Thu Aug 02 2018 8:20:00 PM

Finding: General exhaust flow is higher than necessary to maintain minimum target air change rate considering exhaust and cooling requirements. The air change rate is 7.1 compared to the target of 6.

Probable Causes

Likelihood / Description

75% General exhaust minimum flow set-points are too high for the zone to meet the target air change rate

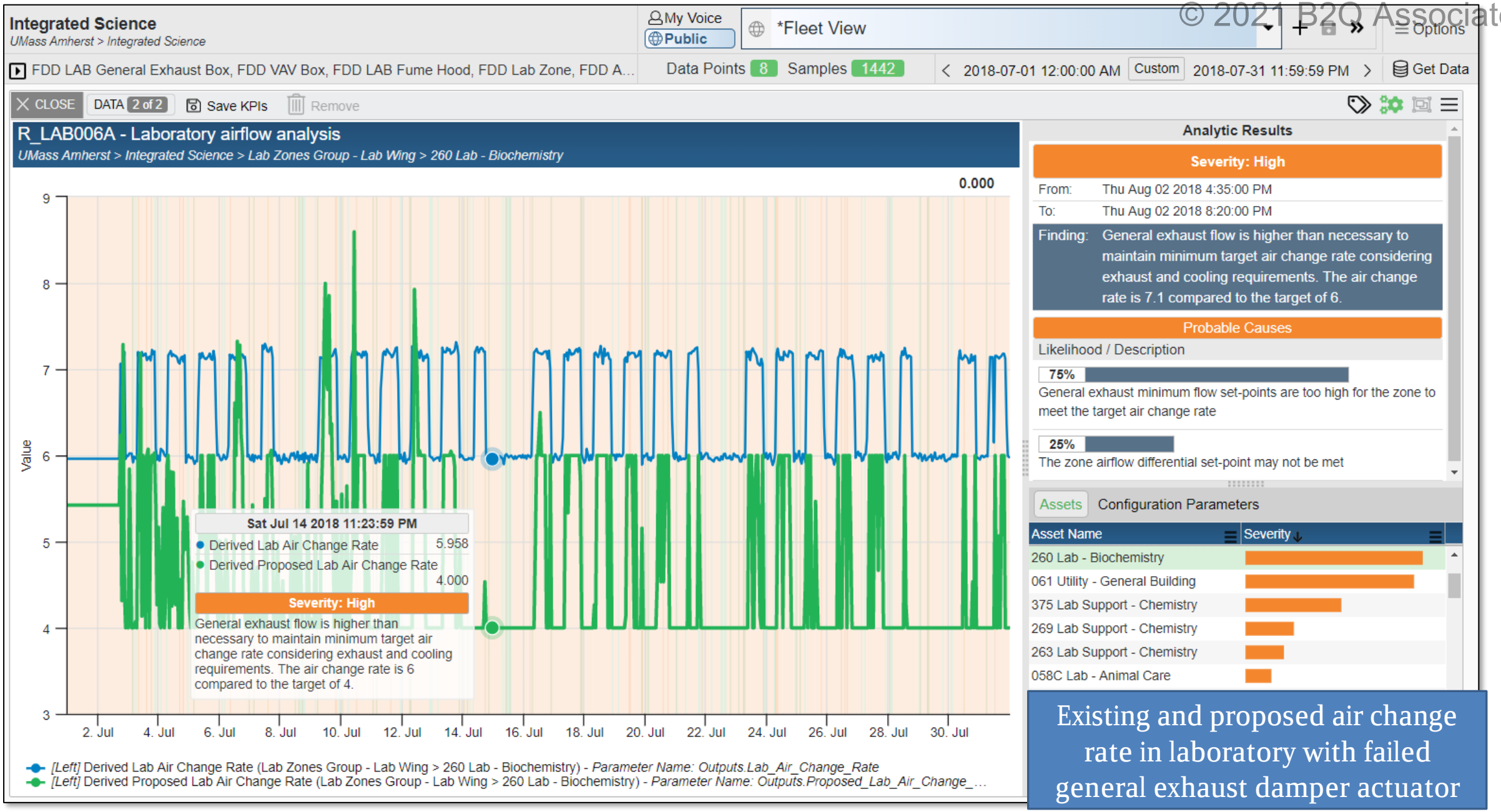
25% The zone airflow differential set-point may not be met

Assets | Configuration Parameters

Asset Name	Severity
260 Lab - Biochemistry	
061 Utility - General Building	
375 Lab Support - Chemistry	
269 Lab Support - Chemistry	
263 Lab Support - Chemistry	
058C Lab - Animal Care	

Detail View of analytic results with key points related to the finding and potential causes for the issue

© 2021 B2Q Associates



Existing and proposed air change rate in laboratory with failed general exhaust damper actuator

© 2021 B2Q Associates

Benefits of MBCx in a Lab Facility

Facilities Staff

- Informs on equipment and controls performance, at the equipment and lab level
- Identifies & prioritizes worst offenders with analytics specifically tailored to lab control sequences
- Quantifies potential savings for issues found, considering interactive nature of equipment within each lab
- Identifies likely causes and recommends corrective actions

Environmental Health & Safety

- Monitor air change rates, lab pressurization, and fume hood flows in real time, for any lab
- Notification of issues
- New tools for reporting lab HVAC and fume hood performance

Research Staff & PIs

- Improved transparency for safety
- High performing lab systems may attract research candidates

© 2021 B2Q Associates

B2Q Associates, Inc.
100 Burtt Rd. Ste. 212
Andover, MA 01810

Chris Schmidt—Vice President
cschmidt@b2qassociates.com
(603) 247-1575 (Mobile)

Questions?