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Maximizing Your Building Automation System

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Presented by:

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Questions & Solutions Engineering, Inc.

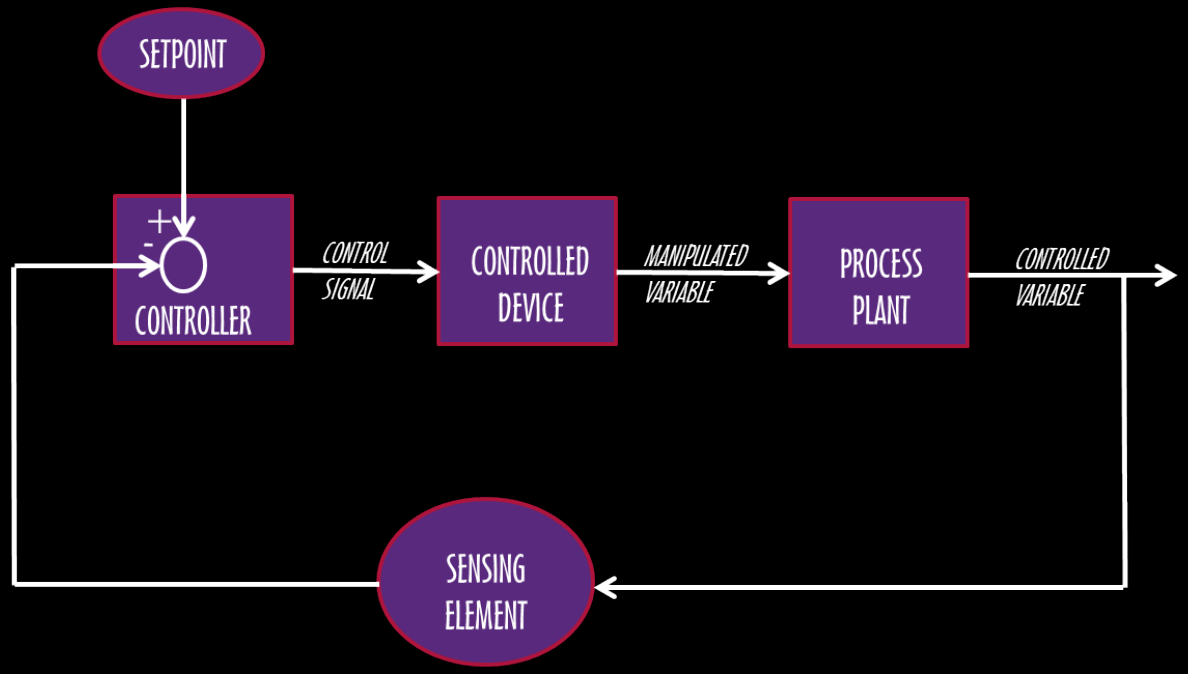
Better Performing

Outline

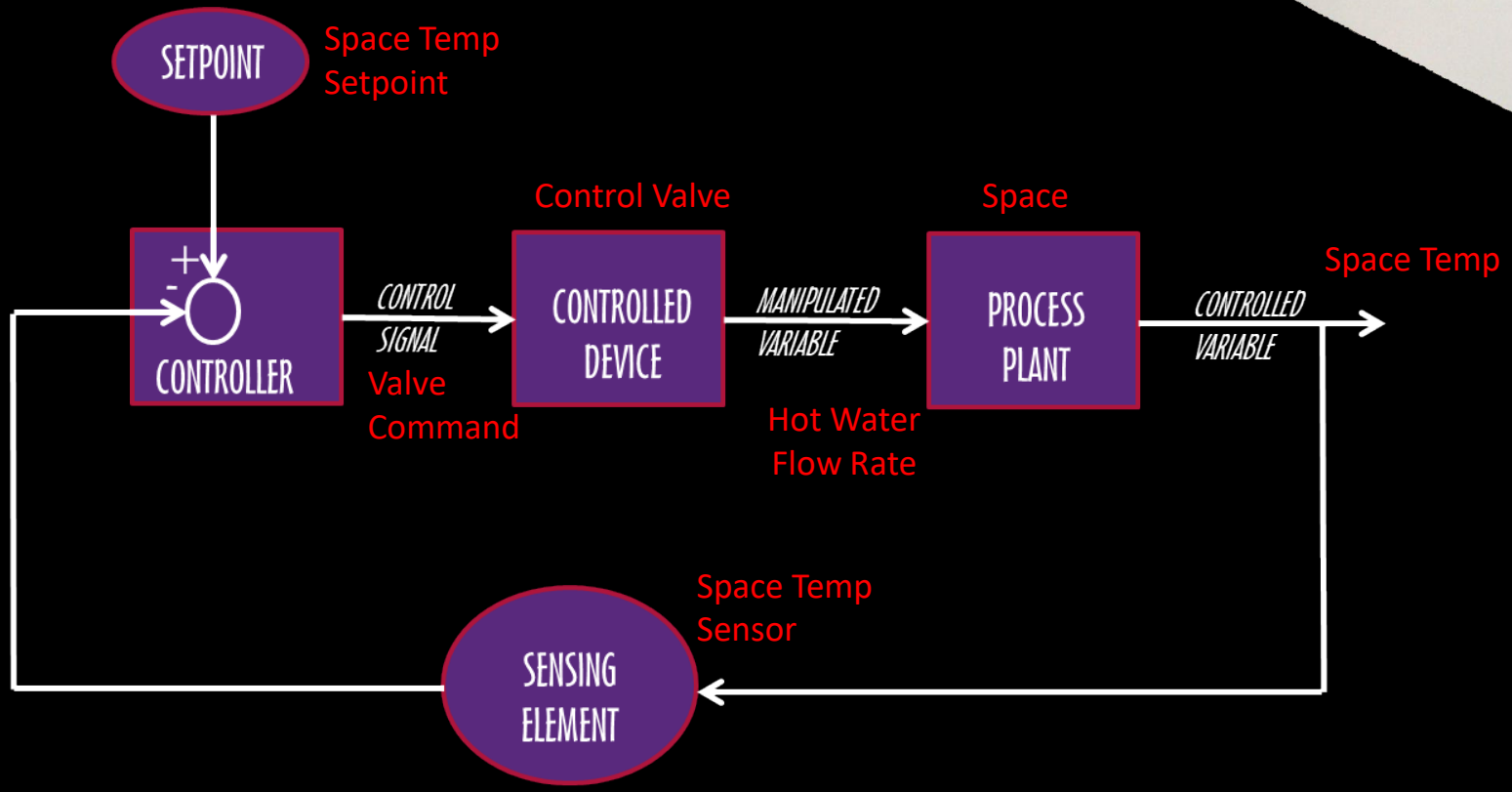
- **BAS introduction**
- **Sequences of operation**
- **Realtime troubleshooting**
  - **Hands-on troubleshooting exercises**
- **Trending**
  - **Troubleshooting After The Fact**
- **Alarming**

BAS Introduction

- **Computerized Control Systems**
- **BAS / DDC / EMS / EMCS / BCS / BMS**



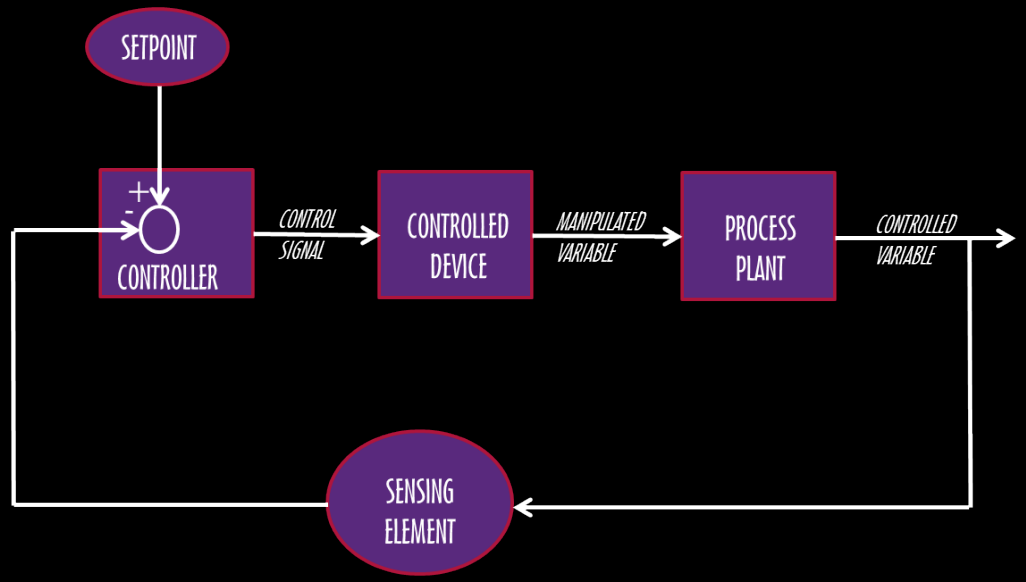
BAS Introduction



BAS Introduction

- **Inputs** (sensed temperatures, pressures, humidity, etc.)
- **Outputs** (commands to valves, dampers, fans, etc.)
- **Software Points** (setpoints, accumulated runtimes, etc.)
- **The presence of information in digital format is a very powerful thing!**

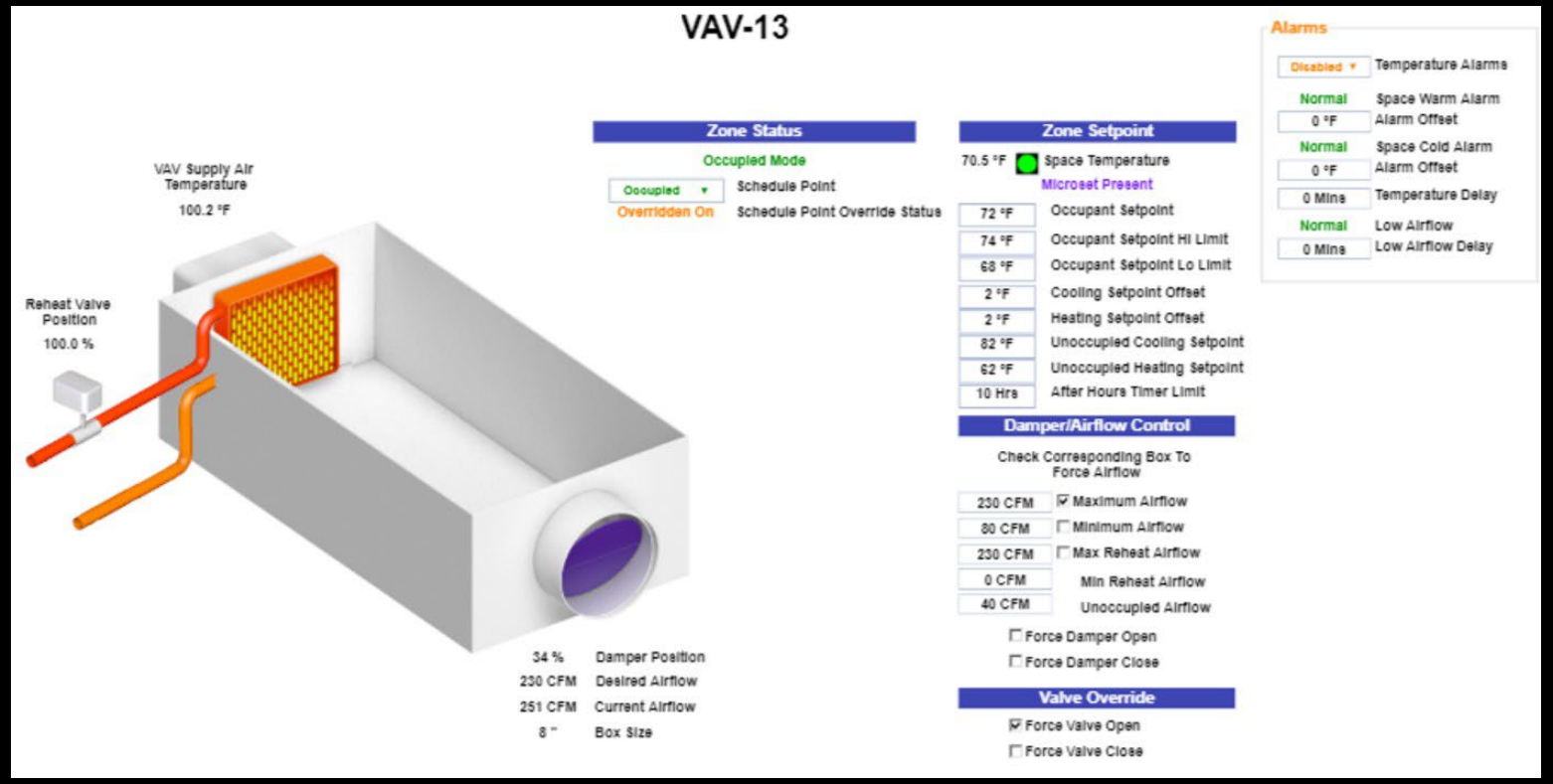
Information lives in digital format



BAS Introduction

- **What to do with all that information?**
  - **Information Sharing**
  - **Customized Programming**
    - **Increased performance**
    - **Reduced energy consumption**
  - **Graphics**
  - **Scheduling**
  - **Trending**
  - **Alarming**

BAS Introduction



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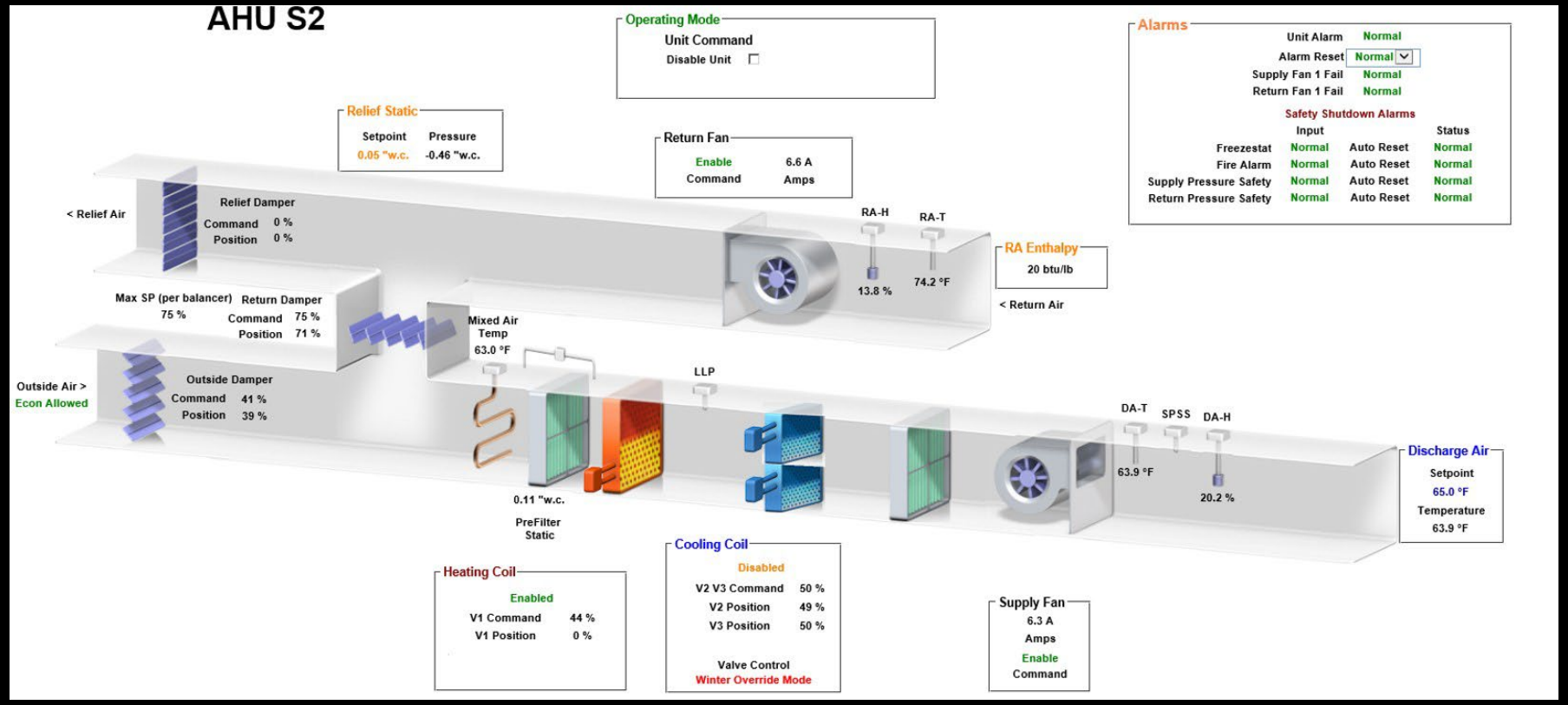

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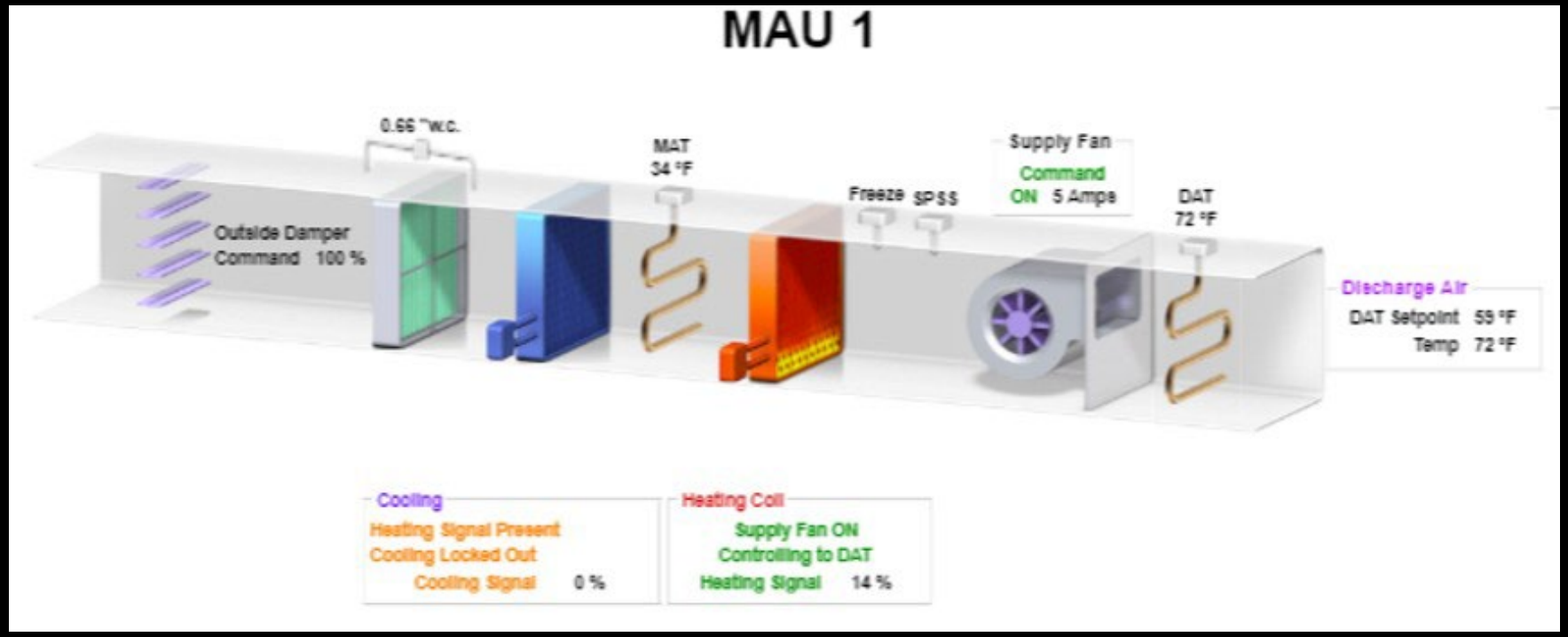
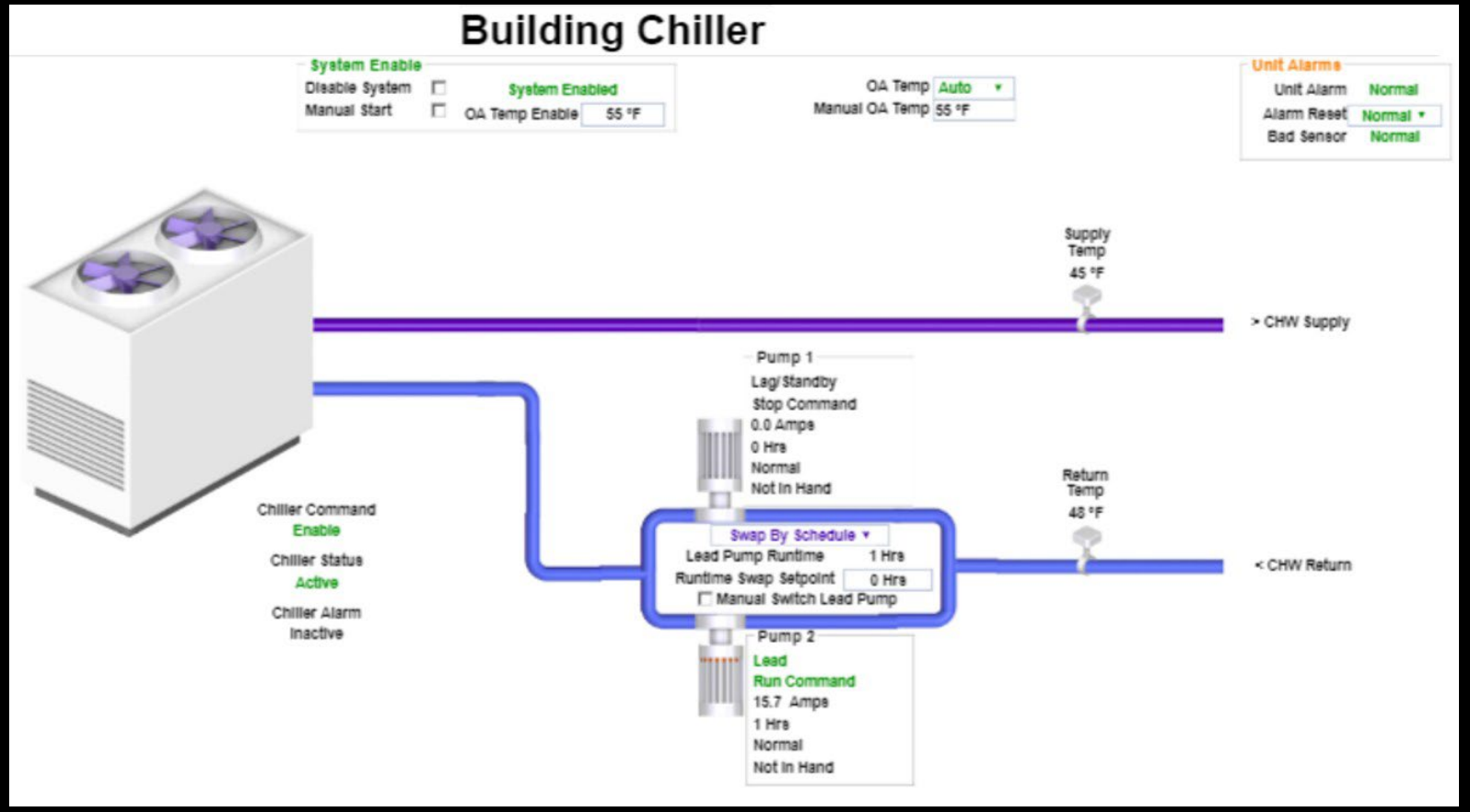


BAS Introduction



Information is only useful if it is correct….Garbage in = Garbage out

Sequences of Operation

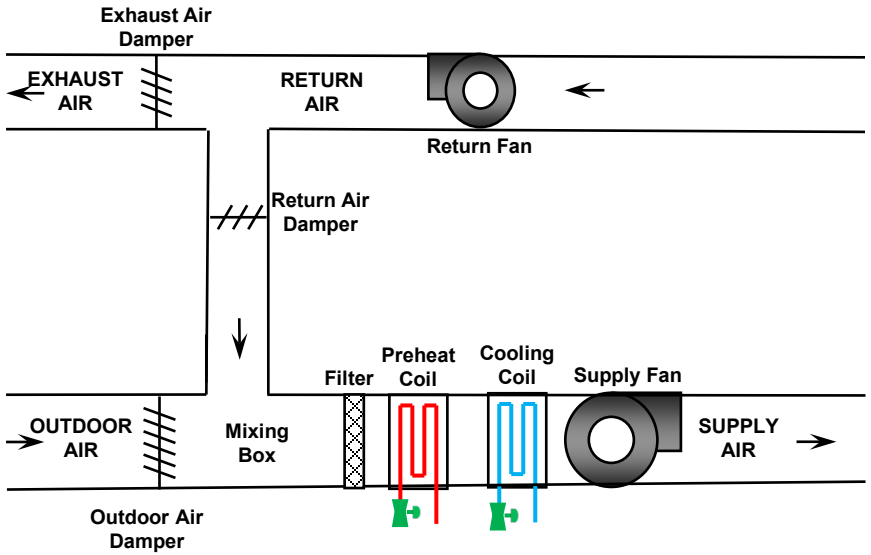
- **A narrative explanation how of the system is to operate**
- **Where to find them:**
  - **Design drawings/specifications**
  - **O&M documentation**

Radiation

1. Radiation valves will modulate to maintain room temperature.
   a. When the room temperature falls below the setpoint the heating valve will modulate open.
   b. When the room temperature rises above the setpoint the heating valve will modulate close.
      1) 65°F occupied setpoint
      2) 55°F unoccupied setpoint
2. Alarms
   a. When the room temperature falls below 50°F an alarm will be sent.

Understanding the Sequence of Operation is a prerequisite to troubleshooting a system!

Sequences of Operation



Economizer Operation

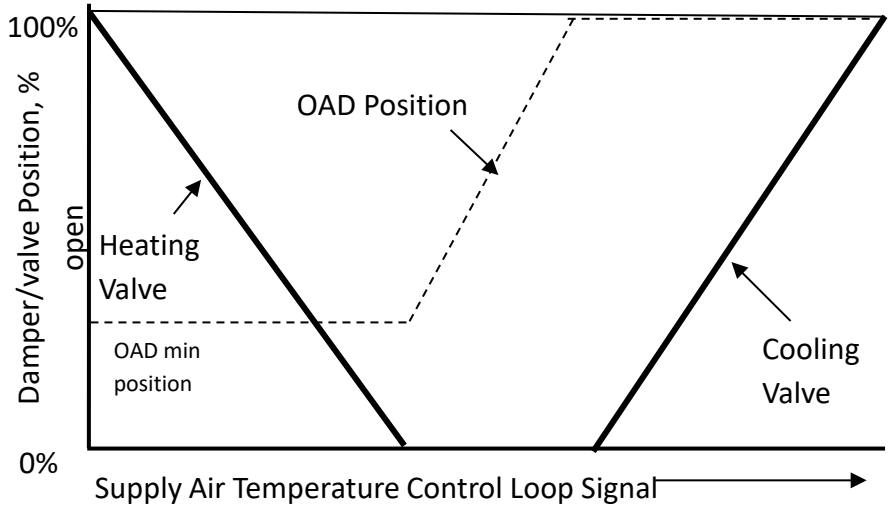
- If outside air temp rises above 68F, economizer is disabled
- If outside air temp drops below 66F, economizer is enabled

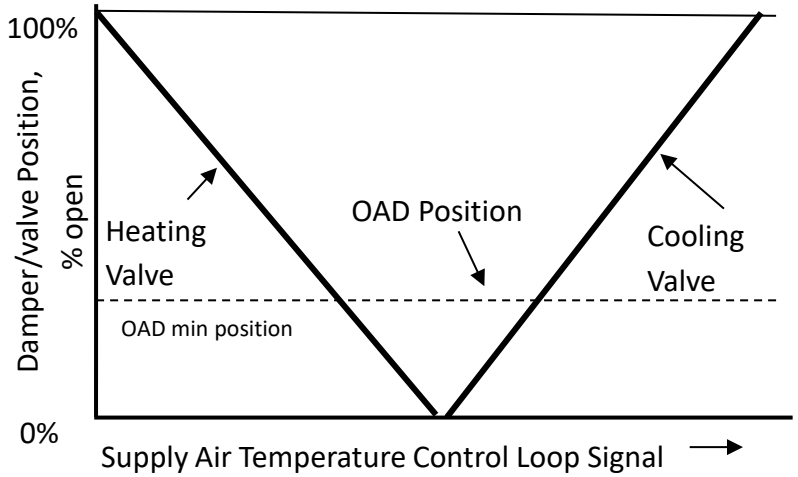
Damper Control

- Outdoor air damper modulated from minimum position (30%) to 100% open as the economizer control loop increases from 0-100%
- Return air damper will modulate inverse of outdoor air damper
- Exhaust air damper will modulate in unison with outdoor air damper

Supply Air Temperature Control

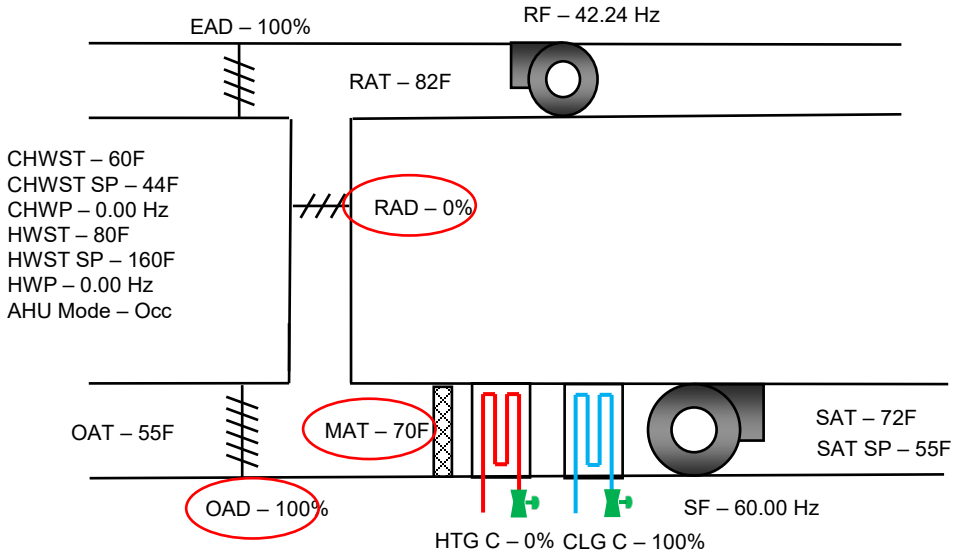
- If economizer is enabled, modulate heating valve, economizer and cooling valve in sequence to maintain supply air temperature at 55F (Adj). Outdoor air damper will never be allowed to go below minimum position.
- If economizer is disabled, modulate heating valve and cooling valve in sequence to maintain supply air temperature at 55F (Adj). Outdoor air damper to maintain minimum position.

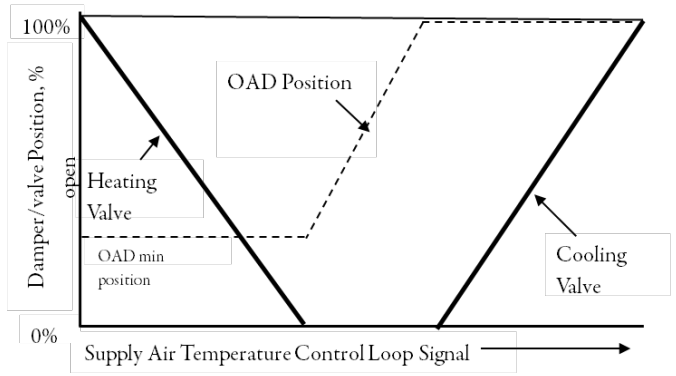




Troubleshooting Exercise #1

Situation: Springtime; chiller is still disabled from the winter
Issue: Spaces are too hot





Damper positions are not where they are commanded to be

TAKE AWAY: Use temperatures to determine if dampers/valves are stuck

Trending

- *Trending* is the historical log of information
  - Interval Trends
    - E.g., Log an entry every 10 minutes
  - Change of Value (COV) Trends
    - E.g., Every time a variable changes state

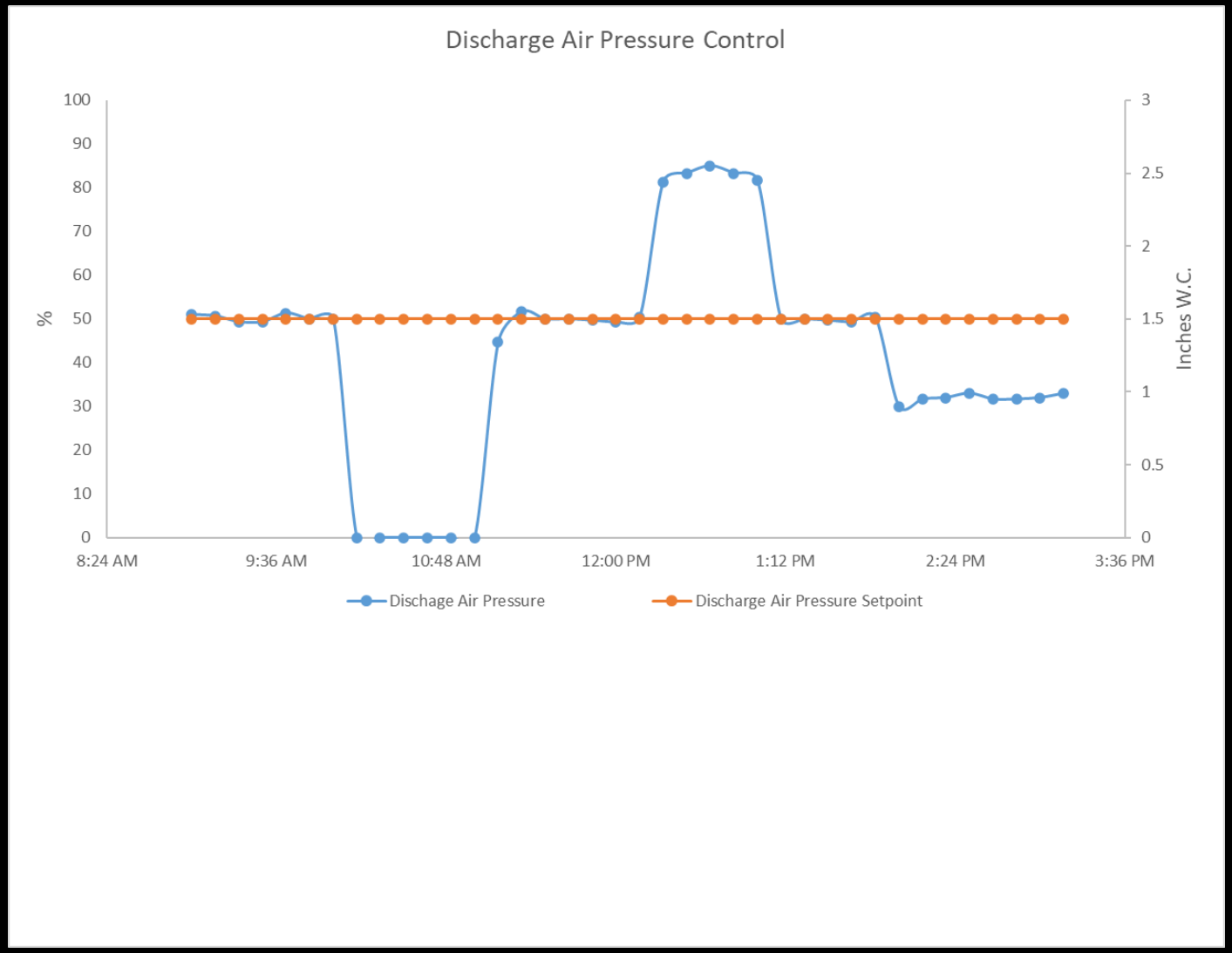
Point Type	Example	Interval Trend	COV Trend
Analog input	AHU Discharge Air Temp	X	
Analog output	Modulating Fan Speed Command	X	
Binary input	Fan status		X
Binary output	Start/Stop Command to Chiller		X
Software Point	Hot water supply temperature setpoint	X (If setpoint reset automatically)	X (If setpoint is fixed)

Trending

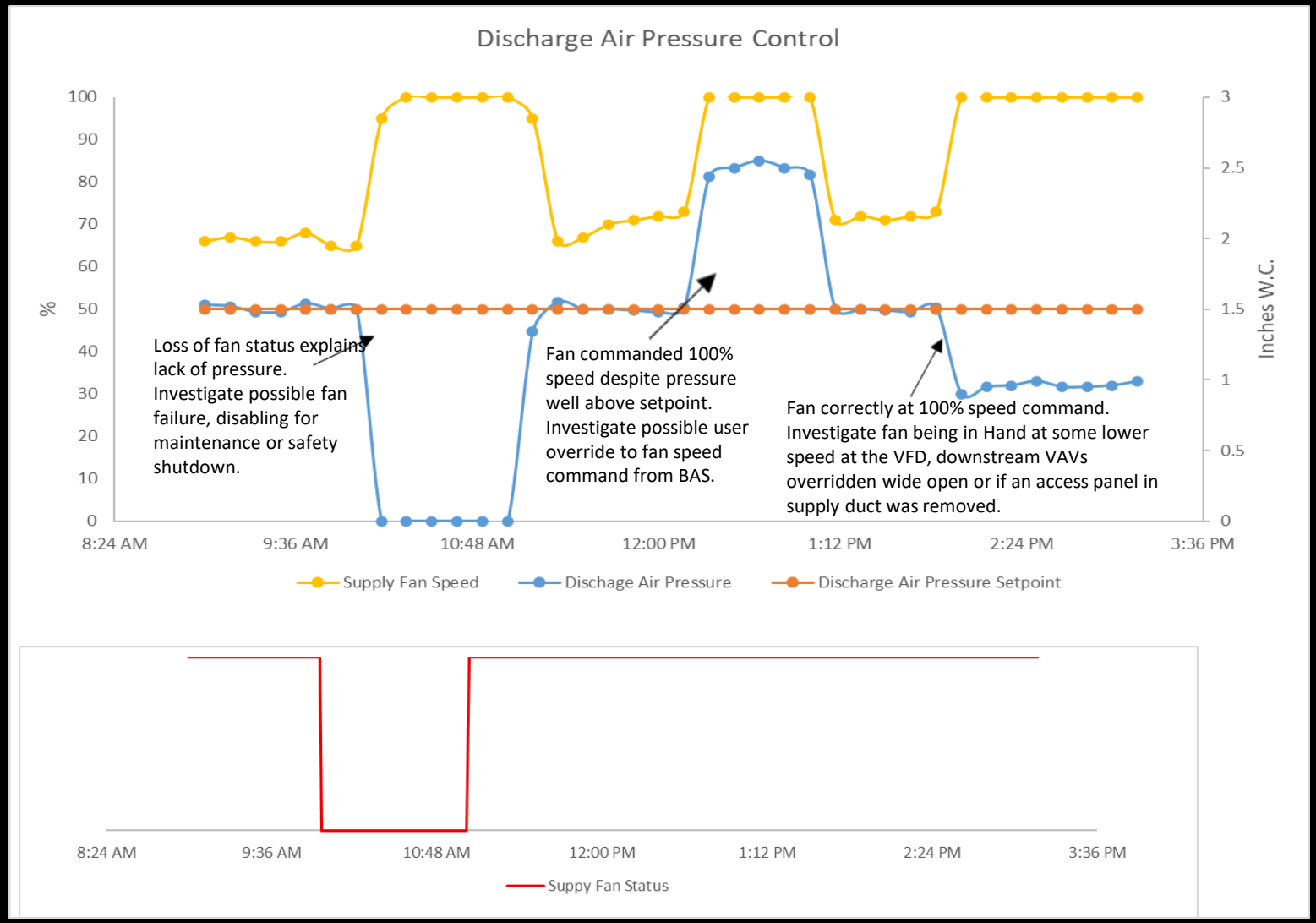
Applications

- Verifying system performance
- Troubleshooting issues after the fact
- Capacity verification for future rightsizing

Troubleshooting After The Fact



Troubleshooting After The Fact



Alarming

- Purpose: Identify when system parameters are out of tolerance or equipment is malfunctioning, and alerts building operators where attention is needed
  - Example: Space temperature too low
  - Example: Exhaust fan is commanded on, but is failing to run
  - Example: A freezestat on an Air Handling Unit (AHU) has triggered
- Notification can be on graphics screen, alarm log, email, text or page

Alarming

- Alarm Saturation - A state when building operators are overwhelmed by the quantity of alarms!
- Results:
  - Alarms may be ignored
  - Critical alarms not identified
  - Decision paralysis
  - Degrading faith in the BAS

The alarms become a liability instead of an asset, and their intended purpose is lost.

Alarming

Reasons for Alarm Saturation

- Unnecessary alarms
- Inappropriate alarm thresholds and delays
- Unconfigured alarm priority levels
- Lack of alarm suppression
- Inappropriate latching of alarms
- Programming issues
- Equipment failures

Nuisance Alarms

Let Alarms Be Your Guide

- Review of alarms on reoccurring basis
- “Override report” generated at set intervals
- Address suspected nuisance alarms first (low hanging fruit)
  - Identify root cause of alarm
  - Value of interest?
  - Inappropriate threshold?
  - Inappropriate delay?
  - Lack of suppression?
- Remove alarm or adjust alarm parameters as necessary
- Test alarm modifications meet expectations
- Replicate solutions to all other systems

Let Alarms Be Your Guide

- Address remaining alarms as they are generated, in order of descending priority
  - Identify root cause of alarm
  - Document and track required solution
  - Prioritize solutions which require investment
  - Train staff on outstanding issues with system and any interim actions required
- Update Facility Standard with Lessons Learned

Questions?

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