Better Management of BAS Alarms

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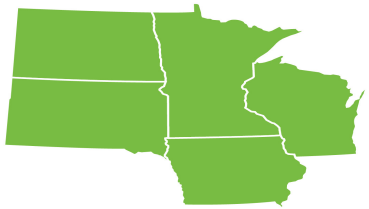

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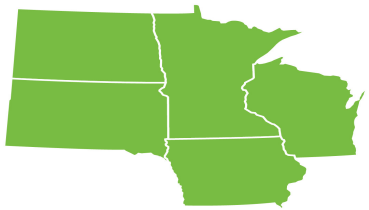

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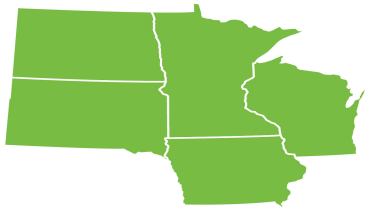
Overview

- Building Automation Systems
- BAS Alarming
- Alarm Saturation
- Reasons for Alarm Saturation
- Facilities Standard
- Effective Alarm Management for New Construction
- Effective Alarm Management for Existing Buildings



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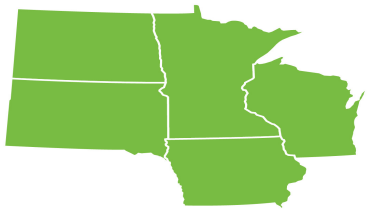
Building Automation Systems

- BAS – Building Automation System
  - Automates building systems operation
  - Monitors various parameters (sensors, controlled equipment)
  - Real time display of system operation



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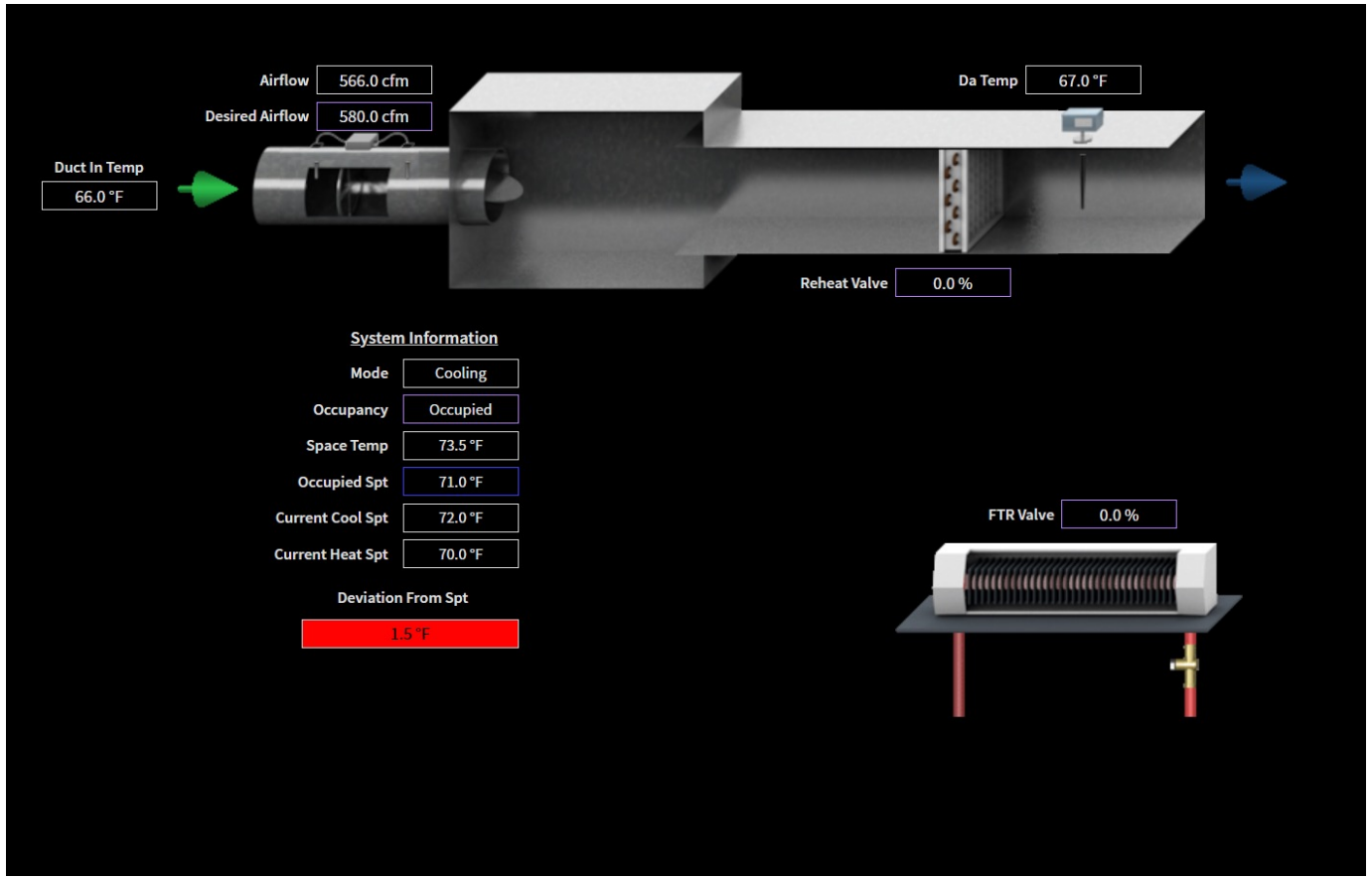
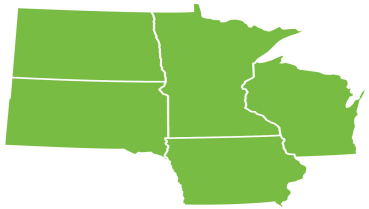
Building Automation Systems





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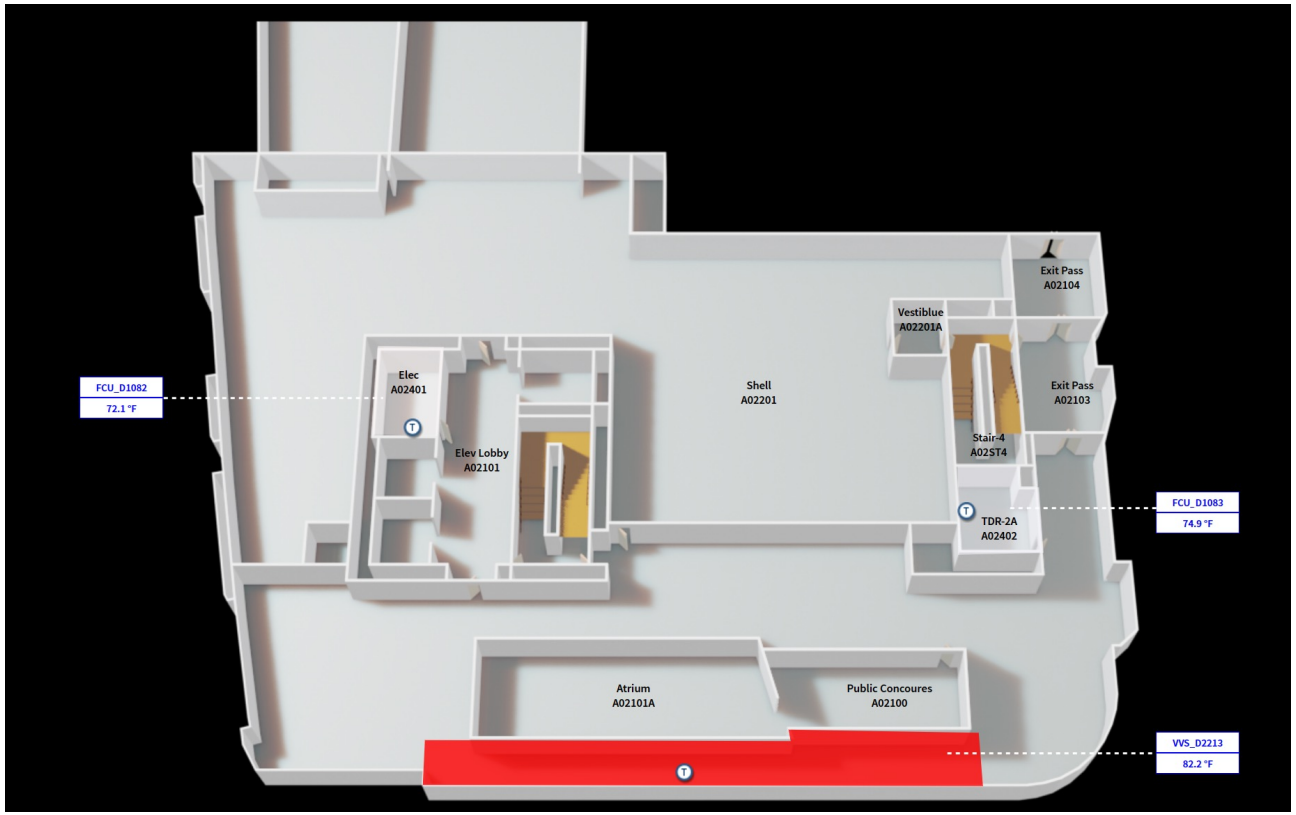
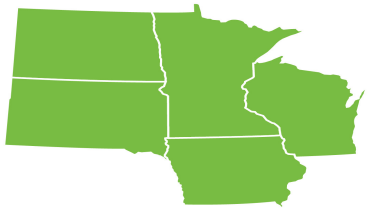
Building Automation Systems





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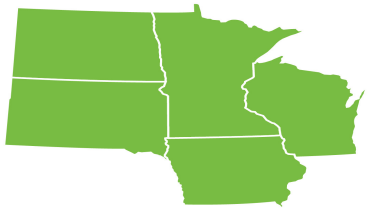
  - Trended information for display of previous system operation
    - Documentation to show compliance with CMS requirements



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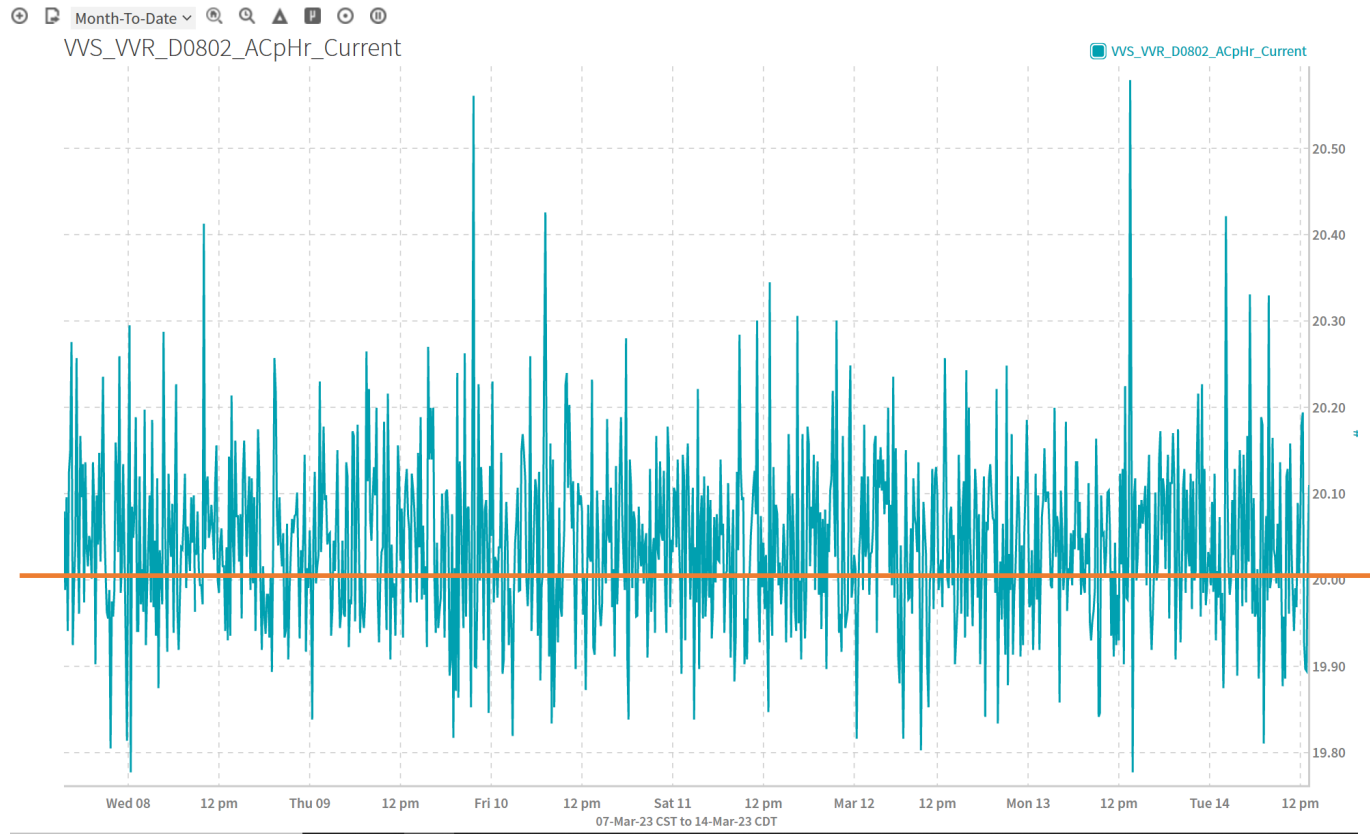
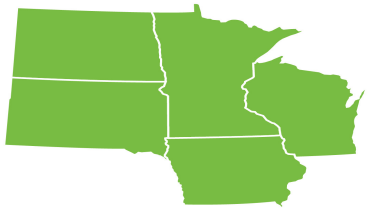
Building Automation Systems



20.5 ACH

Setpoint = 20 ACH

19.8 ACH



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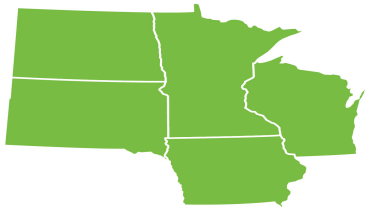
    - Documentation to show compliance with CMS requirements
  - Alarming/notification to building operators when system errors are occurring



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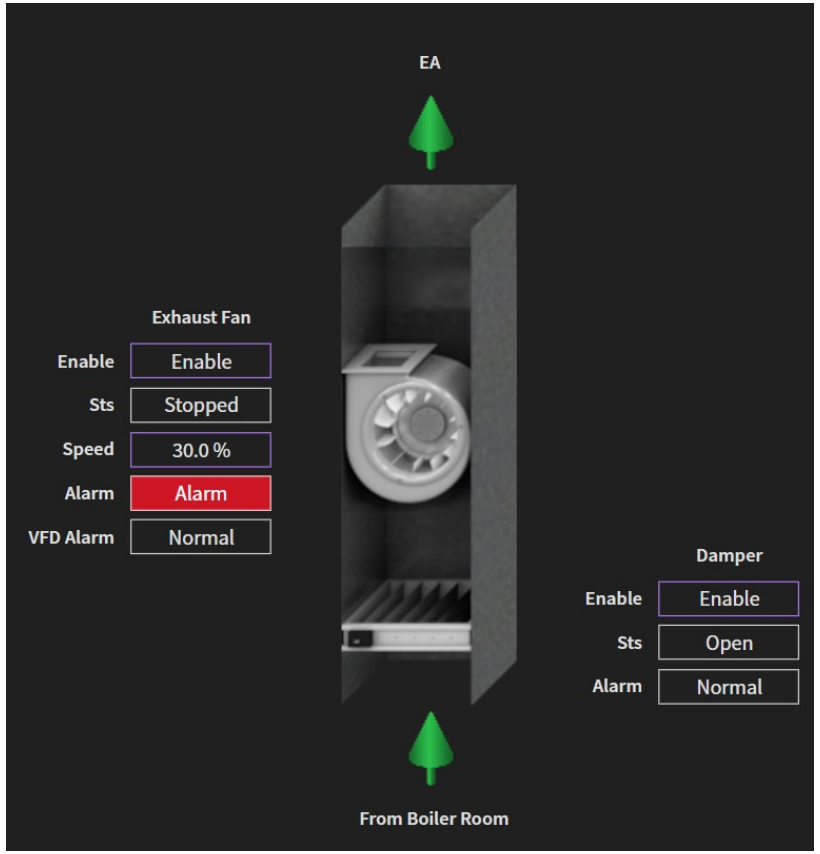
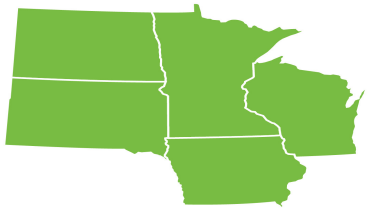
BAS Alarming





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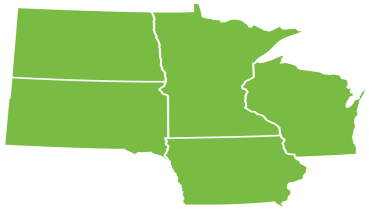
BAS Alarming

	Info	Timestamp	Source	Message Text	Source State	Priority	Ack State	Alarm Class
☐		14-Mar-23 1:04:40 PM CDT	AHU_D1007_Water_Detector_2	Alarm	Offnormal	255	0 Acked / 1 Unacked	Default Alarm Class
☐		14-Mar-23 12:18:03 PM CDT	TF_D1001_TF_VFD_Fault	Alarm	Offnormal	255	0 Acked / 3 Unacked	Default Alarm Class
☐		14-Mar-23 11:52:19 AM CDT	FCU_D1091_Space_Temp_High_Alarm		Offnormal	255	1 Acked / 0 Unacked	EHVN_Critical
☐		14-Mar-23 8:41:30 AM CDT	HUM_D1003_AirflowProvingSwitch	Alarm	Offnormal	255	0 Acked / 1 Unacked	Default Alarm Class
☐		14-Mar-23 8:08:29 AM CDT	AHU_D1025_Da_Temp_Low_Alarm	Alarm	Offnormal	255	1 Acked / 0 Unacked	EHVN_Critical
☐		14-Mar-23 7:37:22 AM CDT	Humidifiers AHU_D1013_Humidifier	Ping Failed	Offnormal	255	0 Acked / 1 Unacked	Default Alarm Class
☐		14-Mar-23 6:43:26 AM CDT	BEXH_2_Fault	Alarm	Offnormal	255	1 Acked / 0 Unacked	EHVN_Critical
☐		14-Mar-23 6:43:26 AM CDT	BEXH2_Fan_Status_Alarm	Alarm	Offnormal	255	1 Acked / 0 Unacked	EHVN_Critical
☐		14-Mar-23 6:43:26 AM CDT	BEXH1_Fan_Status_Alarm	Alarm	Offnormal	255	1 Acked / 0 Unacked	EHVN_Critical
☐		14-Mar-23 6:43:26 AM CDT	BEXH_1_Fault	Alarm	Offnormal	255	1 Acked / 0 Unacked	EHVN_Critical
☐		13-Mar-23 6:51:37 PM CDT	AHU_06 VVS_D06060	Ping Failed	Offnormal	255	0 Acked / 1 Unacked	Default Alarm Class
☐		13-Mar-23 2:11:03 PM CDT	FCU_D1072_Sa_Fan_Status_Alarm		Offnormal	255	1 Acked / 0 Unacked	EHVN_Critical
☐		13-Mar-23 9:40:41 AM CDT	BEXH_Sequence_Alarm	Alarm	Offnormal	255	1 Acked / 0 Unacked	EHVN_Critical
☐		13-Mar-23 7:46:33 AM CDT	Amb_Gar_HV_D1003_High_CO_Alarm	Alarm	Offnormal	255	0 Acked / 1 Unacked	Default Alarm Class
☐		14-Mar-23 1:08:58 PM CDT	AHUs AHU_D1022	Ping Success	Normal	255	0 Acked / 8 Unacked	Default Alarm Class
☐		14-Mar-23 1:04:55 PM CDT	HUM_D1003_Unit Alarm	Normal	Normal	255	0 Acked / 12 Unacked	Default Alarm Class
☐		14-Mar-23 1:04:55 PM CDT	HUM_D1003_DuctHLSwitch	Normal	Normal	255	0 Acked / 12 Unacked	Default Alarm Class
☐		14-Mar-23 12:38:39 PM CDT	Humidifiers HUM_D1001	Ping Success	Normal	255	0 Acked / 1 Unacked	Default Alarm Class



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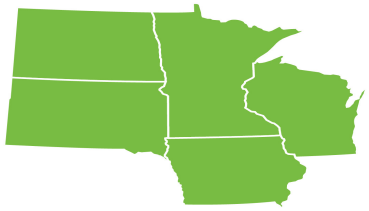
BAS Alarming

- Alarming's 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



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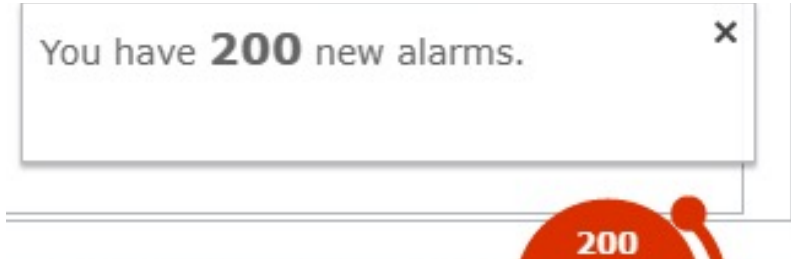
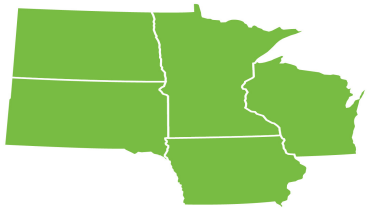
Alarm Saturation



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

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



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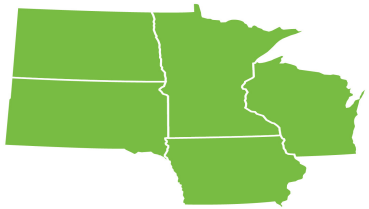
Alarm Saturation

- Three common beliefs amongst building operators who are living in alarm saturation:

"Most of these are just nuisance alarms."

"This system has never operated correctly"

"I don't have time or resources to address these alarms."



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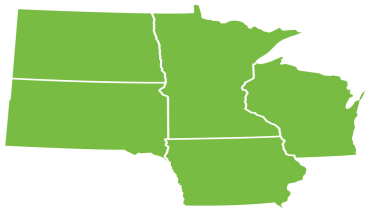
Reasons for Alarm Saturation - Technical

- Unnecessary alarms
  - Does every space need a low temperature alarm configured?
  - Do I need to monitor 87 different alarms from the chiller? Or will a single general alarm suffice?

ALARM/ ALERT CODE	ALARM OR ALERT	DESCRIPTION	WHY WAS THIS ALARM GENERATED?	ACTION TAKEN BY CONTROL	RESET METHOD
A140	Alert	Reverse Rotation Detected	Incoming chiller power leads not phased correctly	Chiller not allowed to start.	Manual
A150	Alarm	Emergency Stop	CCN emergency stop command received	Chiller shutdown without going through pumpdown.	Automatic once CCN command for EMSTOP returns to normal
A151	Alarm	Illegal Configuration	One or more illegal configurations exists.	Chiller is not allowed to start.	Manual once configuration errors are corrected
A152	Alarm	Unit Down Due to Failure	Both circuits are down due to alarms/alerts.	Chiller is unable to run.	Automatic once alarms/alerts are cleared that prevent the chiller from starting.
T153	Alert	Real Time Clock Hardware Failure	Internal clock on MBB fails	Occupancy schedule will not be used. Chiller defaults to Local On mode.	Automatic when correct clock control restarts.
A154	Alarm	Serial EEPROM	Hardware failure with MBB	Chiller is unable	Manual



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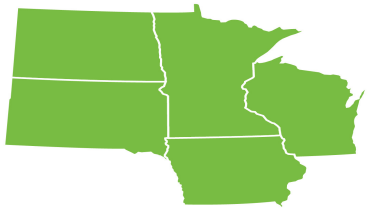
Reasons for Alarm Saturation - Technical

- Inappropriate alarm thresholds and delays
  - If the supply air temperature setpoint is 55°F, should we alarm when it rises above 56°F?
  - If the designed supply air temperature is 55°F, should high alarm threshold be 60°F if supply air temperature setpoint reset is implemented?
  - If pump status is lost for 1 second, but then is proven again, do I want an alarm?



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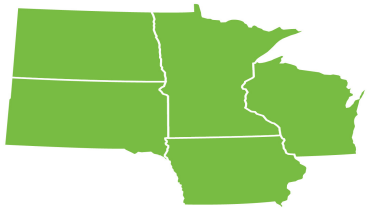
Reasons for Alarm Saturation - Technical

- Unconfigured alarm priority levels
  - Does the Facilities Director need to receive a notification that its time to change the filter on an AHU?
  - What alarm should be more attention grabbing?
    - Time to change filter!
    - All your boilers in your plant have failed!



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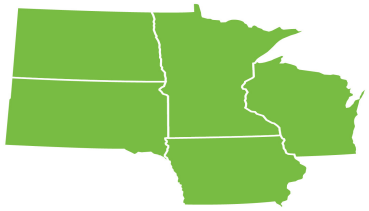
Reasons for Alarm Saturation - Technical

- Lack of alarm suppression
  - Do I have to get high chilled water temperature alarms all winter long when my chilled water system is disabled?
  - Should I be getting high chilled water temperature alarms right after the system is enabled?
  - If an AHU trips on freezestat, do I also need 24 fan failure alarms from the supply and return fan arrays?
  - Do I need 18 low space temperature alarms if the boiler plant is already in alarm?



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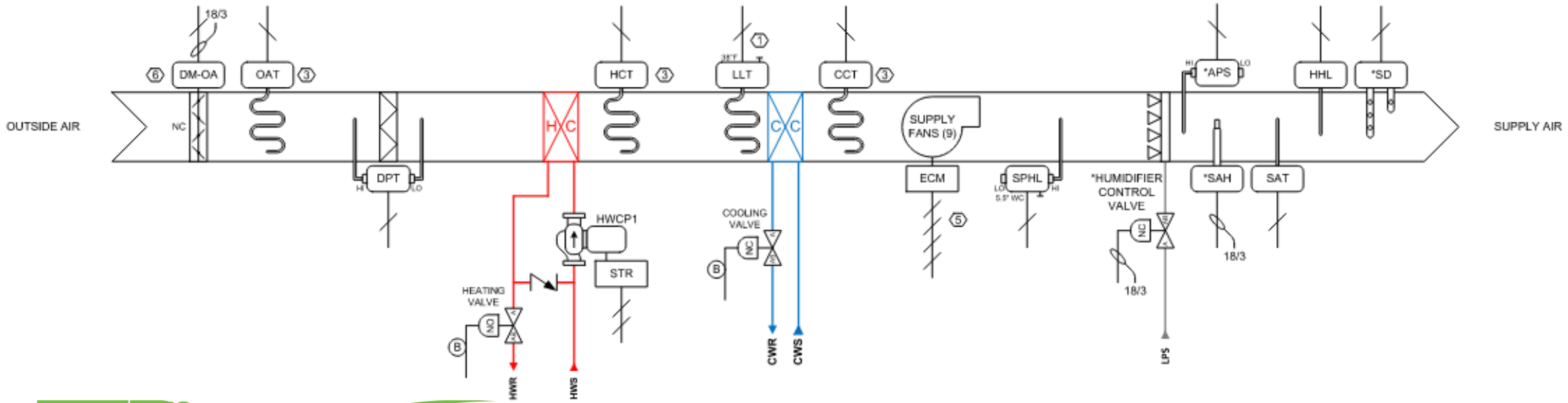
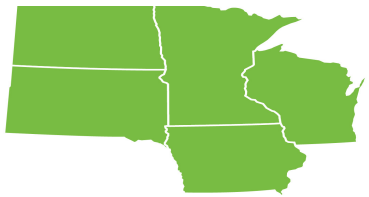
Reasons for Alarm Saturation - Technical

- Lack of alarm suppression
  - Should I be getting a high humidity switch alarm in the summer?





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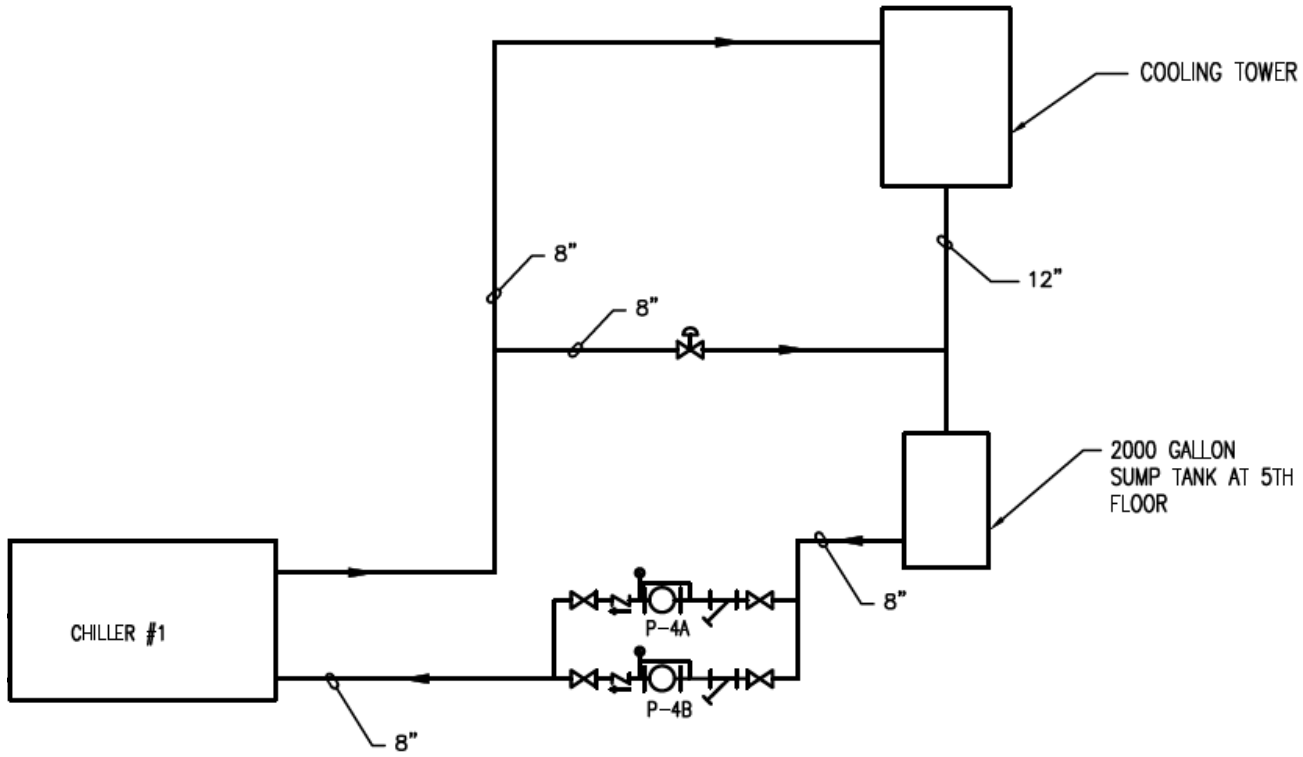
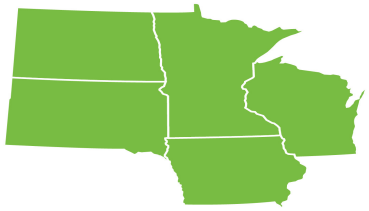
Reasons for Alarm Saturation - Technical

- Inappropriate latching of alarms
  - Lack of latching can lead to:
    - Instability
    - Risk to equipment
    - Alarm saturation





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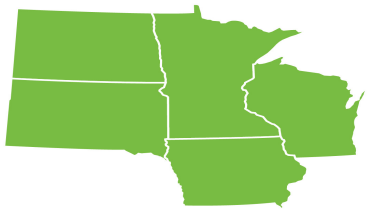
Reasons for Alarm Saturation - Technical

- Inappropriate latching of alarms
  - Inappropriate latching leads to:
    - Alarm saturation
      - Ex: Low hot water temperature alarm generates at 30 minutes after system enable, 2 minutes later temperature reaches setpoint. Do you want this showing as an active alarm?
    - Allow the system to drown out remaining nuisance alarms



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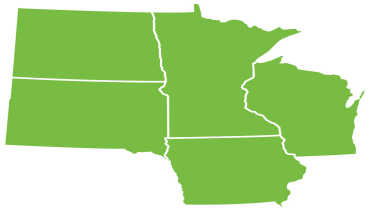
Reasons for Alarm Saturation – Process-Related

- Lack of specifics provided in the design package regarding alarming

"The temperature controls contractor is to coordinate with the owner's staff on what they would like for alarming."

  - How can this be accurately bid? Is this statement enforceable?
- Alarming viewed as "minor details" by nearly all involved
- Alarm parameters not tailored for the project/client/system
  - Facilities staff's experience, standard operating procedures, appetite for risk, etc.



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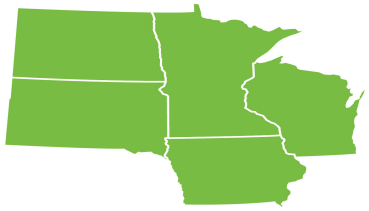
Reasons for Alarm Saturation – Process-Related

- Inconsistencies amongst different designers/contractors serving the same Owner
- It's a lot of additional programming/work
- Lack of verification prior to occupancy
  - Rush to occupy
  - Phased turnover



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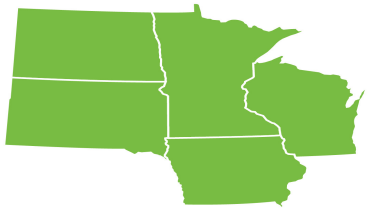
Facilities Standard

- Owners can develop a facilities standard for alarming
- Considerations
  - Which alarms are to be configured?
  - Which alarms are to be latching vs unlatching?
  - Alarm thresholds and delays
  - When are certain alarms suppressed?
  - Alarm priority levels
  - Notification Protocols / Alarm Repetition / Alarm Escalation

Design Standards and Procedures

DESIGNING FOR FACILITIES STEWARDSHIP



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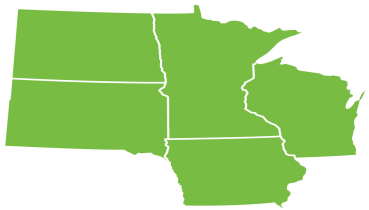
Facilities Standard

Alarm Name	Explanation	Alarm Threshold	Alarm Delay	Return to Normal Value	Priority Level	Repeating?	Escalation?	Latching?	Suppression?	Shown on Graphic?	Shown on Alarm Summary?
Low HWST	Hot water supply temperature is too low	15°F < setpoint	20 min	5°F < setpoint	1	Yes	N/A	No	When hot water system is disabled. For 20 minutes after hot water system enabled.	Yes	Yes
Low Space Temp	Space temp too low	50°F	5 min	55°F	2	Yes	Yes	No	If serving AHU is in alarm If serving hot water system is in alarm	Yes	Yes
Exhaust Fan Failure	Fan is command ON, but status shows OFF	Command/ Status Mismatch	30 sec	Command/Status Match	2	Yes	N/A	No	None	Yes	Yes



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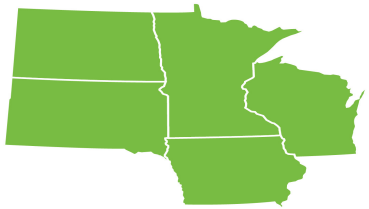
Facilities Standard

IOWA Facilities Management

Design Standards and Procedures

DESIGNING FOR FACILITIES STEWARDSHIP

- Process
  - Convene development meeting
    - Facility operations staff
    - Capital projects staff
    - Servicing controls contractor
    - Consultant (design and/or commissioning provider)
  - Develop document
- Identify when it applies
  - New construction
  - Major renovation
  - Equipment replacement
  - Work orders
- Incorporate into:
  - Project delivery process for New Construction
  - Ongoing commissioning process for Existing Buildings



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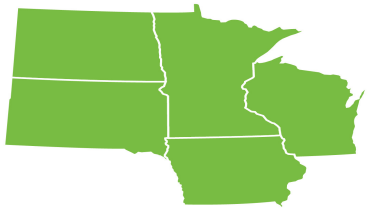
Effective Alarm Management for New Construction

- Utilize facility standard as baseline for alarming requirements
- If no alarming standard exists, include alarming requirements in Owner's Project Requirements
- Facilitate alarming requirements meeting between designer, commissioning provider, controls contractor (if onboard) and facility operations during Design Development



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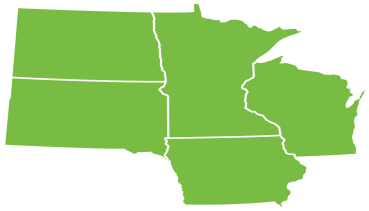
Effective Alarm Management for New Construction

- Advocate for clarity in project documentation
  - Review design for inclusion of alarming requirements
  - Review controls submittal for inclusion of alarming requirements
- Include alarming/notifications tested during functional performance testing
  - Higher sample rates are required for more sophisticated alarms with latches and suppression requirements
  - Alarm testing and notification testing may need to occur at separate times



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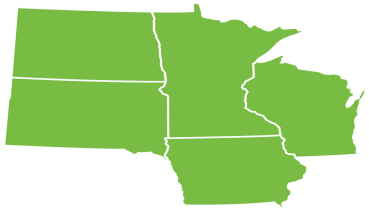
Effective Alarm Management for New Construction

- Turnover Group Meetings
  - Owner's personnel engaged early and often through project delivery process
- Post-Turnover Alarm Reviews
  - 1-month after turnover
  - 10-month warranty walk
- Update Facility Standard with Lessons Learned



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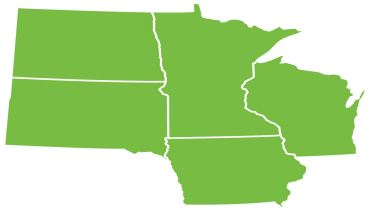
Effective Alarm Management for Existing Buildings

- Establish an On-Going Commissioning Process
  - Improves performance, reduces energy consumption, helps staff truly learn the sequence of operation
  - Internally executed
  - Hybrid solution led by Cx Provider already familiar with the building



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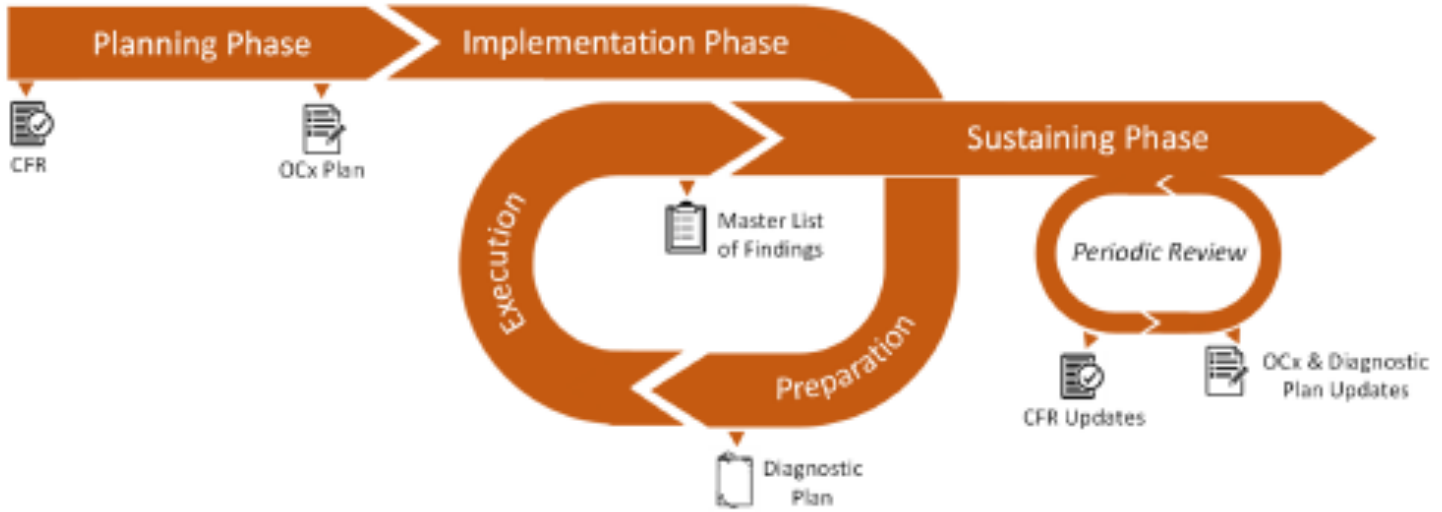
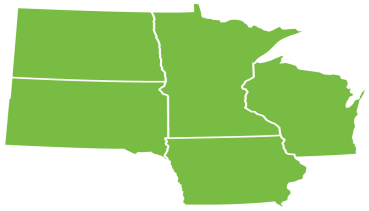
Effective Alarm Management for Existing Buildings

- The On-Going Commissioning Process



(BCxA – Ongoing Commissioning Best Practices)



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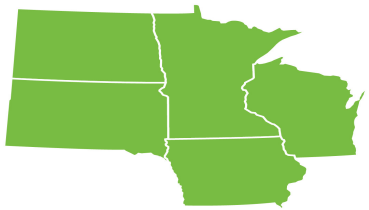
Effective Alarm Management for Existing Buildings

Use the addressing alarms as a proactive means to improve building operations



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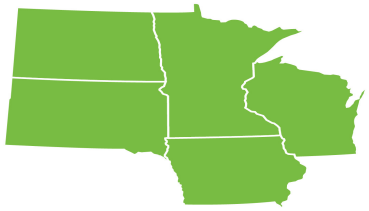
Effective Alarm Management for Existing Buildings

- Review of alarms on reoccurring basis
- “Override report” generated at set intervals
  - Reviews all operator overrides to equipment, setpoints, etc.
  - Often provide explanations to experienced alarms



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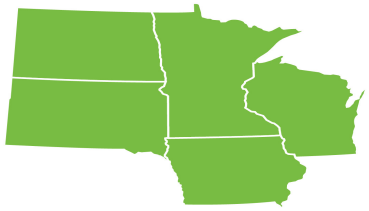
Effective Alarm Management for Existing Buildings

- Address suspected nuisance alarms first (low hanging fruit)
  - Identify root cause of alarm
    - Value of interest?
    - Inappropriate threshold?
    - Inappropriate delay?
    - Lack of suppression?



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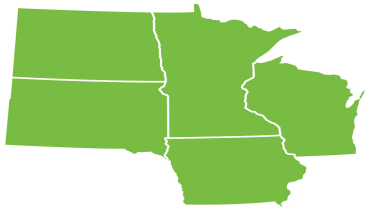
Effective Alarm Management for Existing Buildings

- Address suspected nuisance alarms first (low hanging fruit)
  - Utilize Facility Standard to guide solutions
  - Remove alarm or adjust alarm parameters as necessary
  - Test alarm modifications meet expectations
  - Replicate solutions to all other systems



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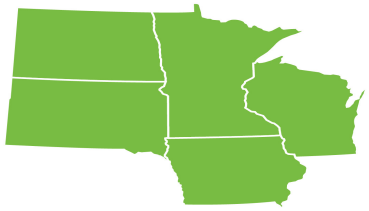
Effective Alarm Management for Existing Buildings

- 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



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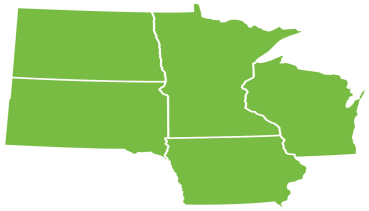
Conclusion

- Building Automation Systems
- BAS Alarming
- Alarm Saturation
- Reasons for Alarm Saturation
- Facilities Standard
- Effective Alarm Management for New Construction
- Effective Alarm Management for Existing Buildings



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