The Value of MBCx Tools for Laboratory Facilities

Presented by B2Q Associates, Inc.

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A Woman Business Enterprise (WBE)

UMass Amherst

Integrated Sciences Building

Learning Objectives

- Develop an understanding of:
  - What Monitoring-Based Commissioning (MBCx) is
  - The general value proposition of MBCx
  - The specific value and advantages MBCx provides in a lab facility
- Understand the energy, performance, safety, and research impacts of laboratory controls, particularly failed or “out of spec” controls.
- Understand how such failures, deviations, and anomalies can be detected, identified, quantified, and strategies for correcting them.
- Be able to identify candidates for MBCx software and understand the benefits of lab controls re-commissioning.

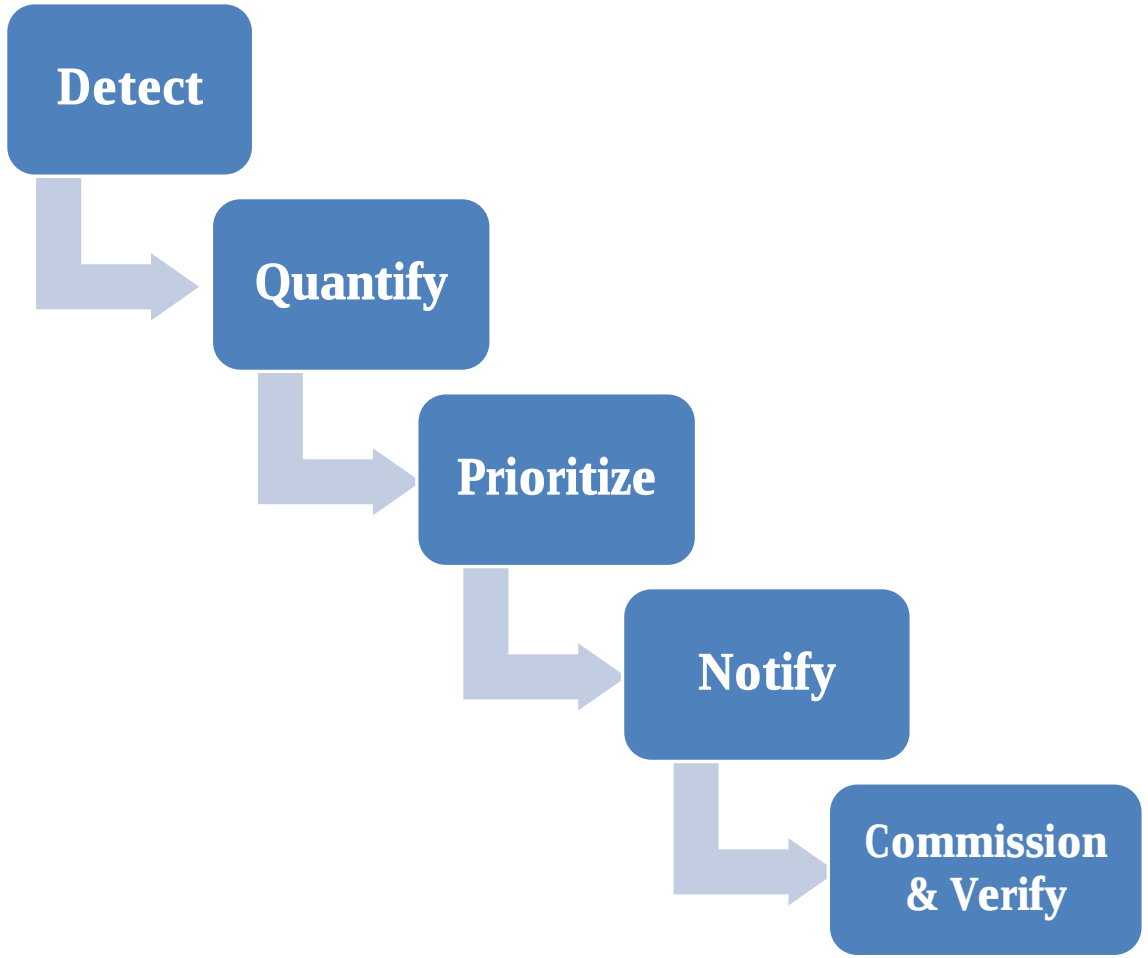
What Is Monitoring-Based Commissioning?

- 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

Adding Value with Monitoring-Based Commissioning

Use MBCx Analytics to:

1. **Detect** Lab controls failures, other HVAC issues, and safety concerns
2. **Quantify** the potential energy and cost savings
3. **Prioritize** issues and the path to resolution
4. **Notify** the appropriate staff resources to take a recommended action based on probable causes
5. **Commission** and **Verify** successful implementation of improvements and protect savings through continued persistence



Why MBCx in a Lab Facility?

- Lab Facilities often have:
  - High energy intensity with high operational costs
  - A focus on safety and reliability
  - High cost of downtime from delayed or lost research
  - Constantly changing environments that may require changes to ventilation rates

- Many facilities engineering and maintenance staff do not have the time, knowledge, or tools to properly manage and maintain their performance

- Laboratory HVAC controls have a large impact on operating costs, building safety, occupant comfort, and research

Why MBCx in a Lab Facility?

- Even the most well-designed, well-commissioned, and well-maintained buildings can operate less efficient and less safe after only a few years after start-up.
- Typically, only fume hoods are tested on a semi-regular basis
- General lab-level ventilation rates, airflow offsets, etc. are ignored and go out of specification without anyone knowing

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

How can MBCx be used in Laboratories?

1. Establish a performance, energy, and safety baseline for each lab and the building overall. Track and report performance in real-time to Facilities, EH&S, and research staff.
2. Identify “low hanging fruit” opportunities that can be addressed and implemented quickly and potentially at low cost such as mechanical failures, overrides, improper set-points, schedules, etc.
3. Identify larger scale measures for controls re-commissioning, airflow reduction, and/or balancing improvements
4. Commission and maintain persistence of savings over the long term associated with recently implemented measures

Case Study: UMass Amherst
Integrated Sciences Building

Recent project at the University of Massachusetts Amherst including study and implementation of lab optimization measures using MBCx software as a Commissioning and Verification tool

Integrated Sciences Building (ISB) – 8 years old

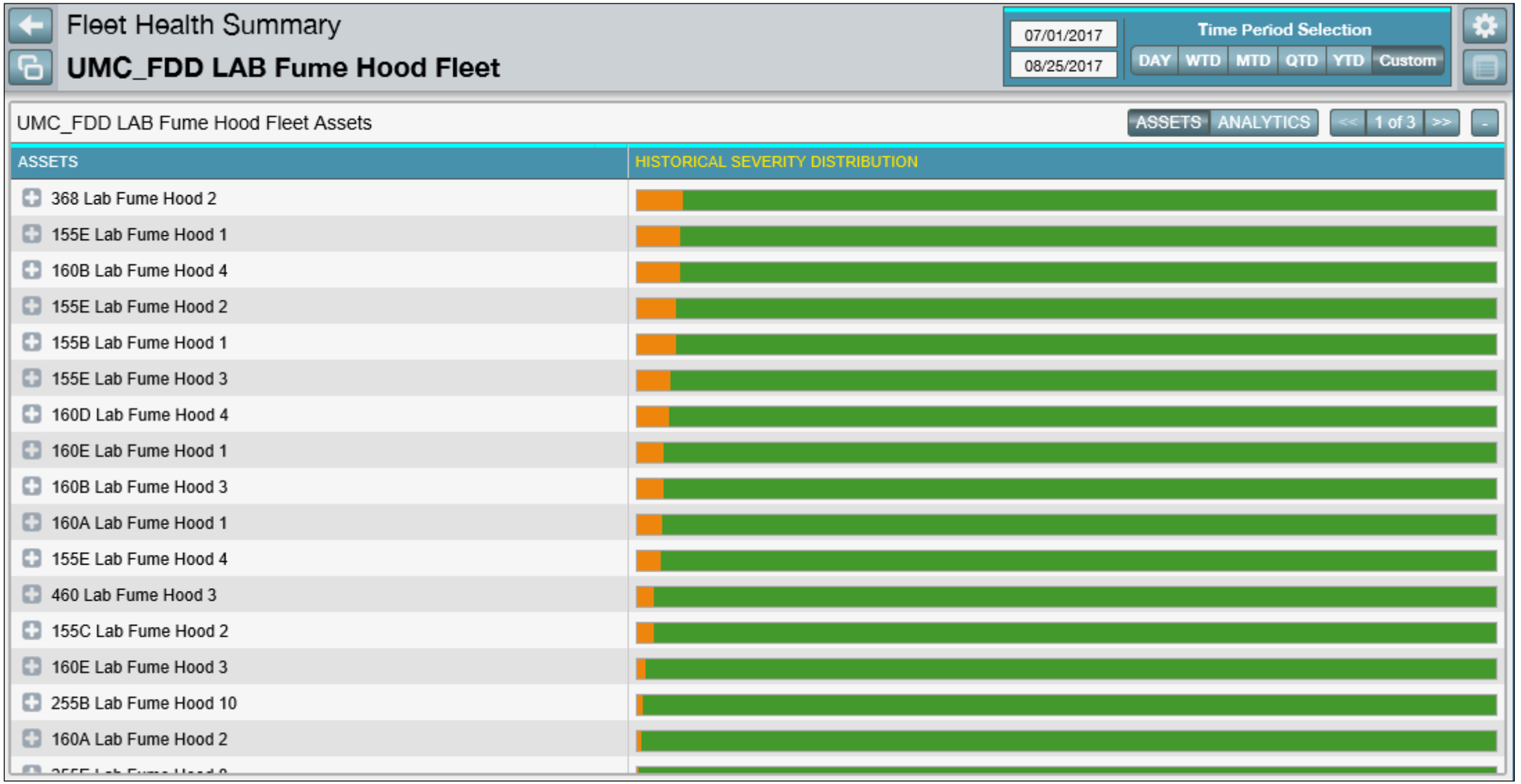
- 150,000 ft² (85,000 ft² of Lab Space)
- Verified Annual Savings:
  - Electricity: 1,851,862 kWh
  - Steam: 10,738 Mlb
  - Total Cost Savings: $399,946
- Total Implementation Cost: $590,968
- Simple Payback Period before Incentive: 1.5 years

5 Step Process

1. Multi-Building Scoping Audits
2. Focused Lab Optimization Studies on Selected Lab Buildings
3. Implementation, **Commissioning** & Owner Training
4. **Measurement & Verification of Safety and Savings**
5. **Persistence via Communication & Continuous Commissioning**

Lab MBCx: Equipment Dashboard

Fume Hood Analysis: Fault Prioritization



Fume Hood Analysis: Historical Fault View

Analytics Performance

368 Lab Fume Hood 2 368 Lab - Fume Hoods

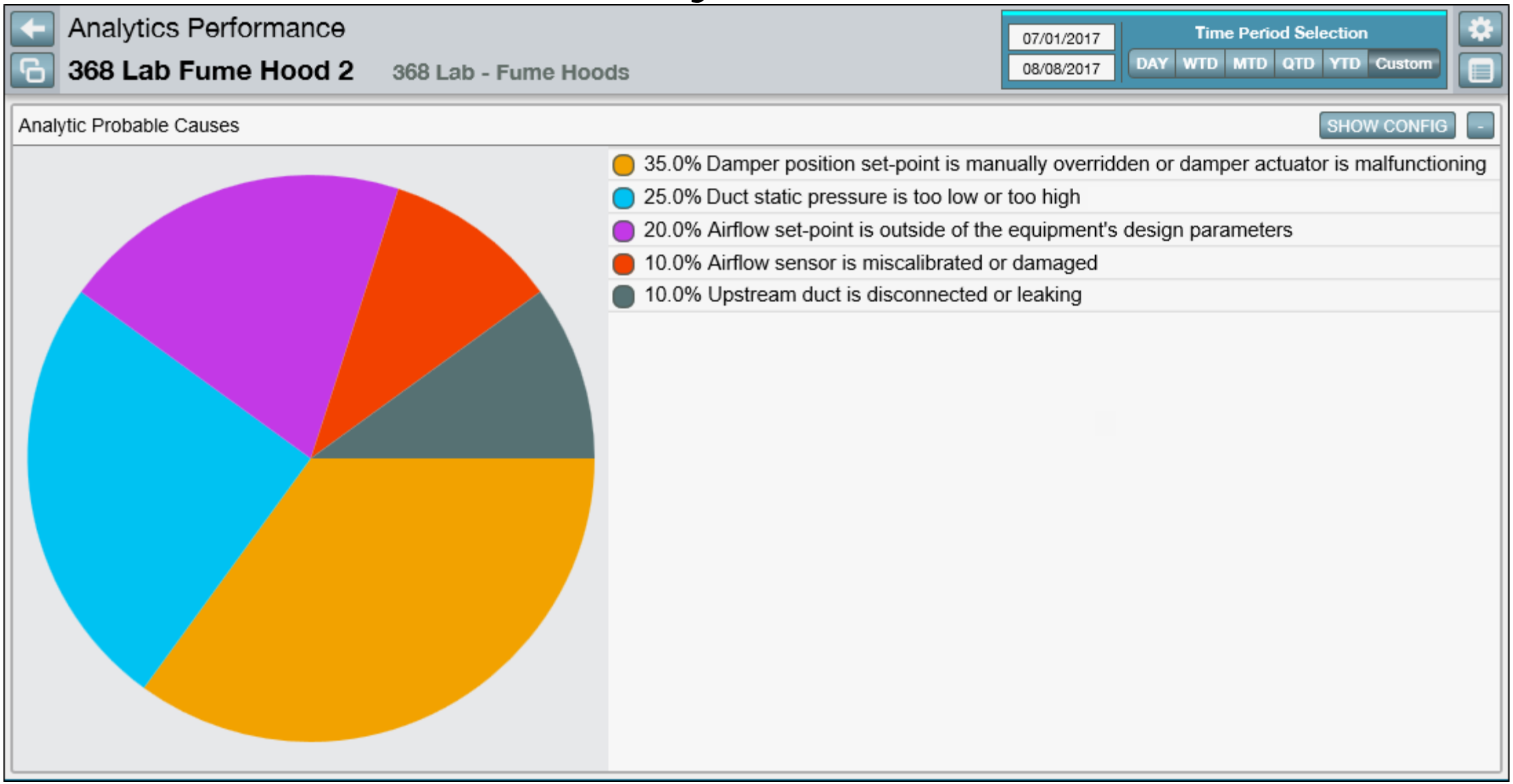
07/01/2017 – 08/08/2017

Time Period Selection: DAY | WTD | MTD | QTD | YTD | Custom

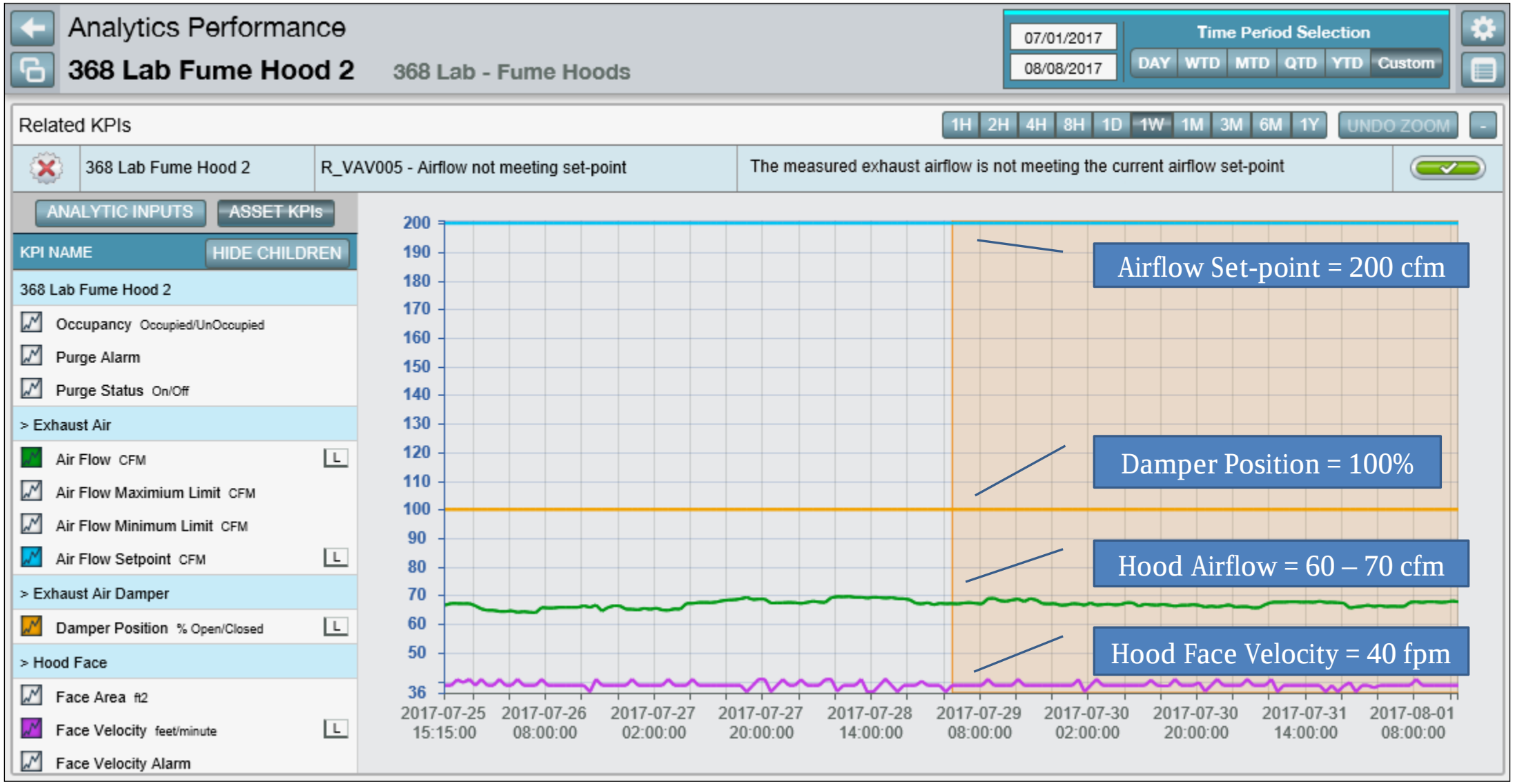
Analytic Result/Finding Transitions — HIDE NORMAL RESULTS

RESULT	DESCRIPTION	DURATION	START TIME	LAST SEVERITY
✗	The measured exhaust airflow is not meeting the current airflow set-point	1w 3d	03:20:00 AM 07/29/2017	
✓	The measured exhaust airflow is not meeting the current airflow set-point	30m 0s	02:50:00 AM 07/29/2017	
✓	The Air Handling Unit serving the terminal device is off	1h 0m	01:50:00 AM 07/29/2017	
✗	The measured exhaust airflow is not meeting the current airflow set-point	15m 0s	01:35:00 AM 07/29/2017	
✓	The measured exhaust airflow is not meeting the current airflow set-point	30m 0s	01:05:00 AM 07/29/2017	
✓	The Air Handling Unit serving the terminal device is off	15m 0s	12:50:00 AM 07/29/2017	
✓	The measured exhaust airflow is not meeting the current airflow set-point	30m 0s	12:20:00 AM 07/29/2017	
✓	The Air Handling Unit serving the terminal device is off	4h 45m	07:35:00 PM 07/28/2017	
✗	The measured exhaust airflow is not meeting the current airflow set-point	19h 15m	12:20:00 AM 07/28/2017	
✓	The measured exhaust airflow is not meeting the current airflow set-point	30m 0s	11:50:00 PM 07/27/2017	
✓	The Air Handling Unit serving the terminal device is off	6h 15m	05:35:00 PM 07/27/2017	
✗	The measured exhaust airflow is not meeting the current airflow set-point	2h 0m	03:35:00 PM 07/27/2017	
✓	The measured exhaust airflow is not meeting the current airflow set-point	30m 0s	03:05:00 PM	

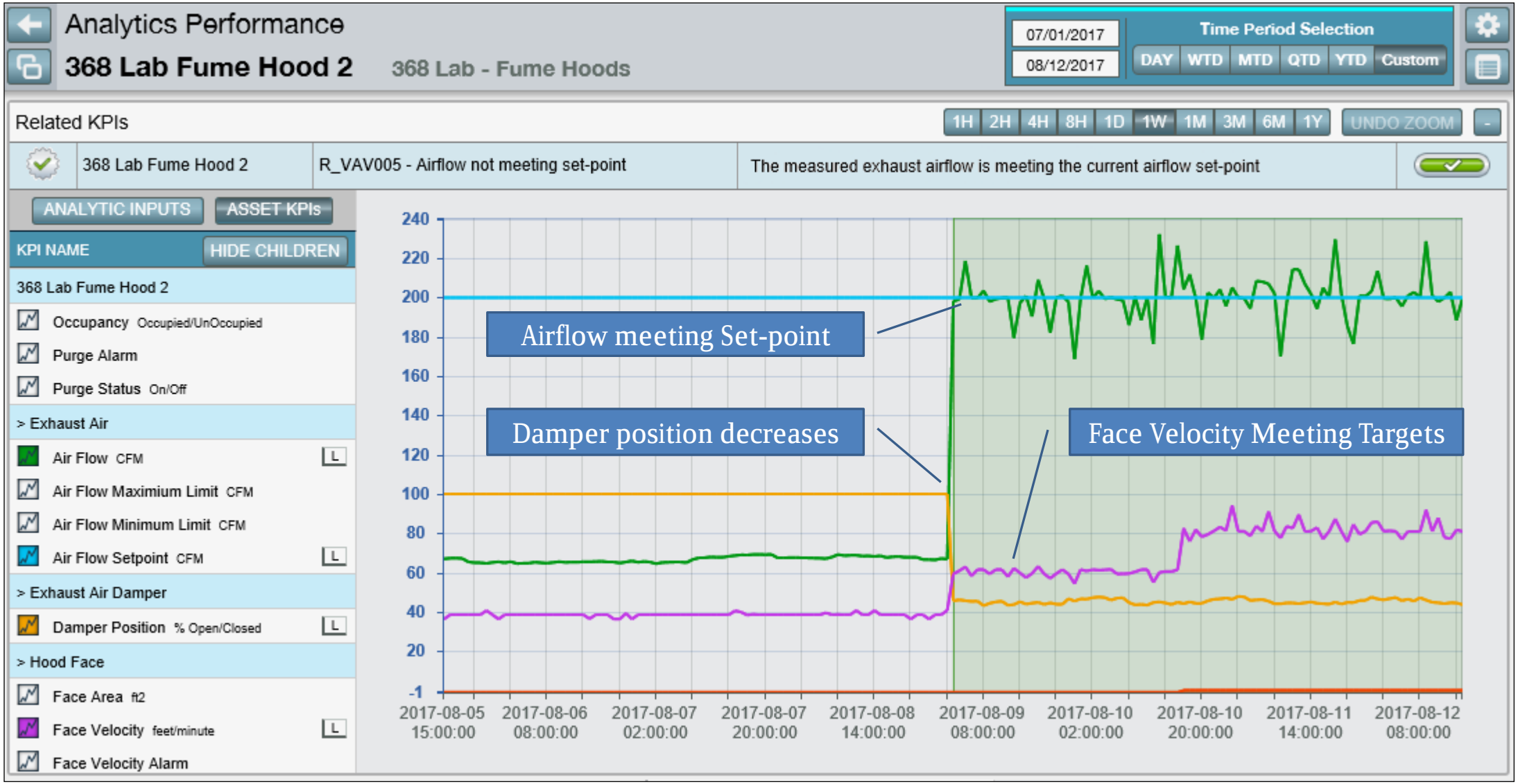
Fume Hood Analysis: Probable Causes



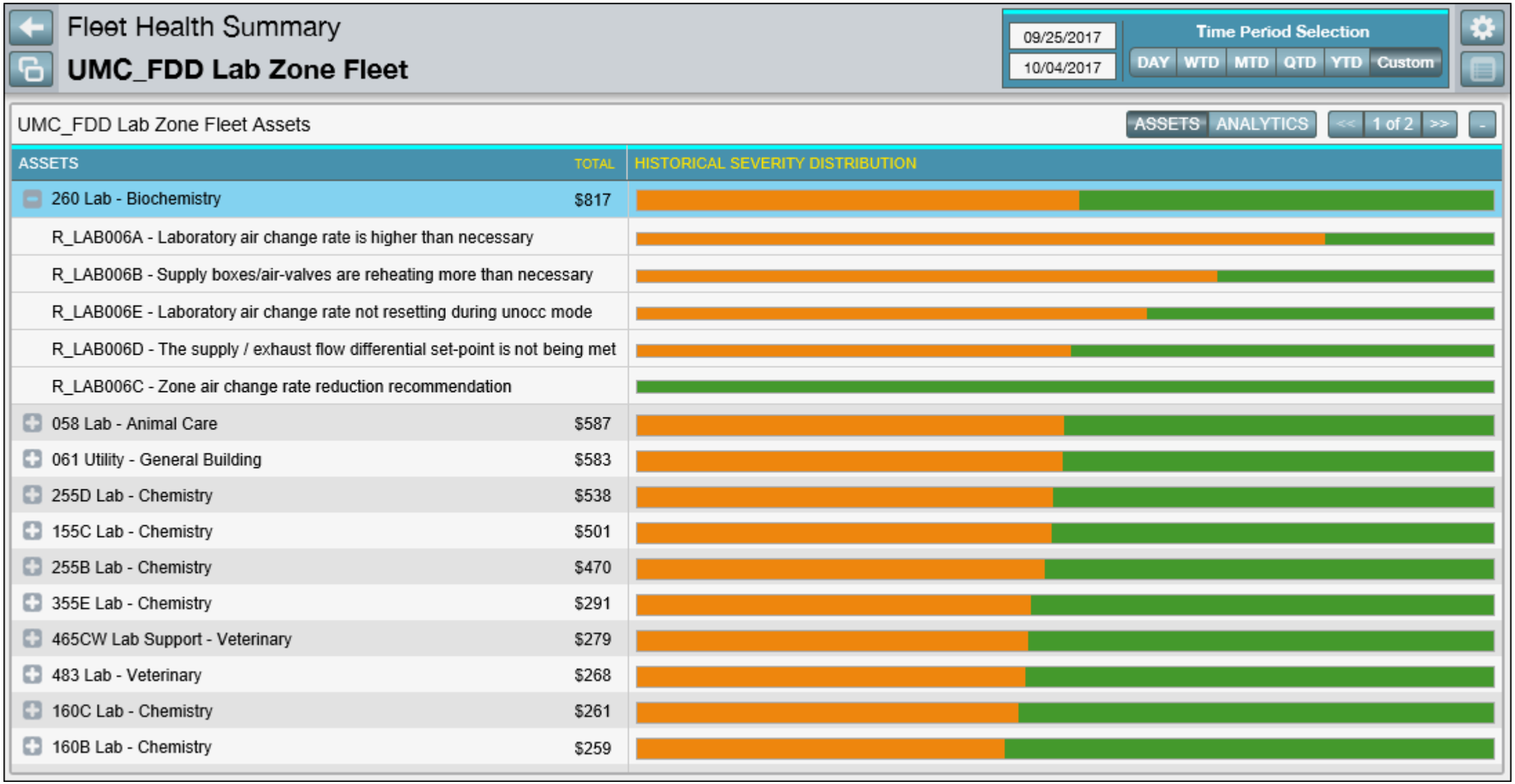
Fume Hood Analysis: Trend of Issue



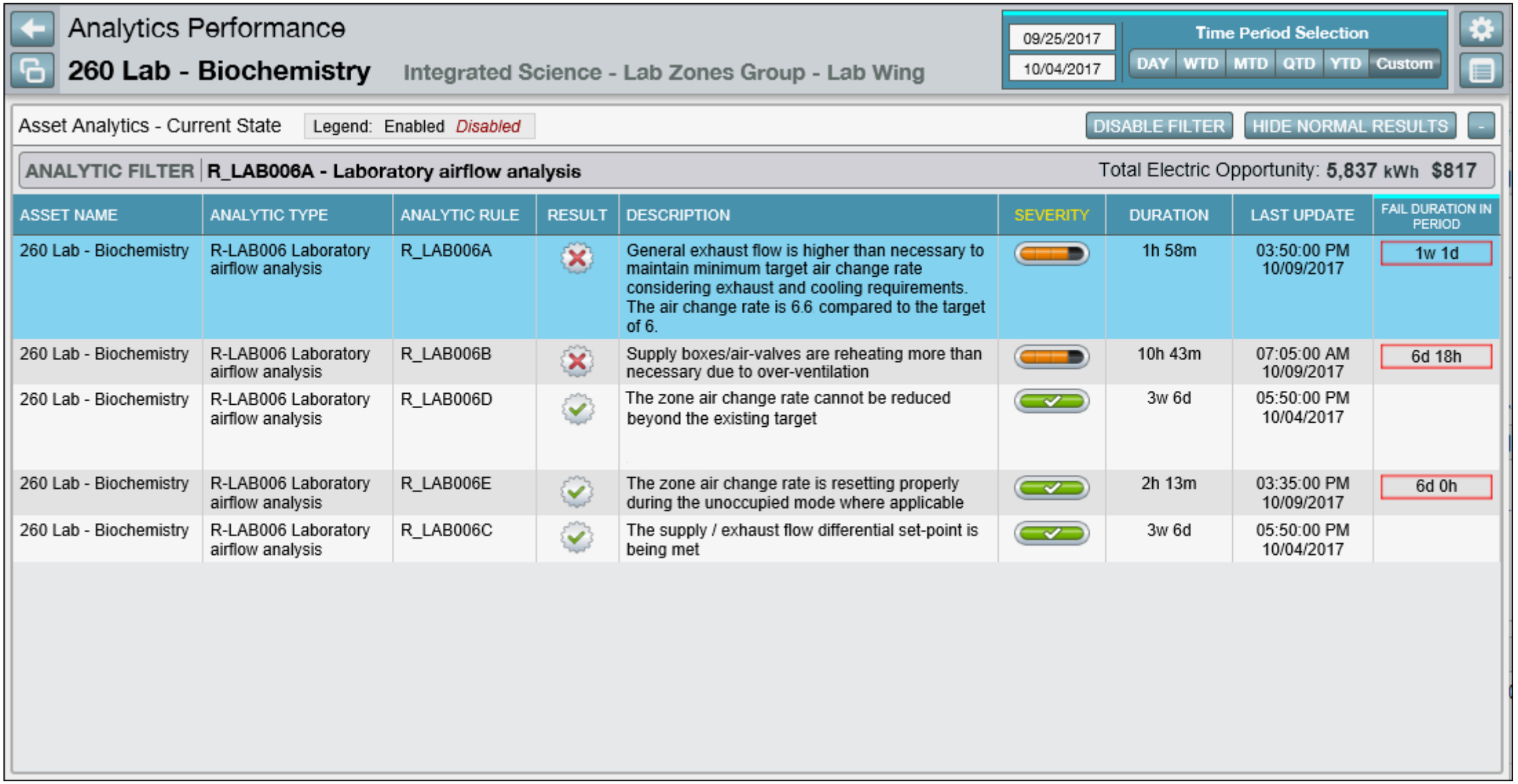
Fume Hood Analysis: Trend After Damper Fixed



Lab-Level Analysis: Fault Prioritization



Lab Level Analysis: Findings Summary



Analytics Performance

260 Lab - Biochemistry Integrated Science - Lab Zones Group - Lab Wing

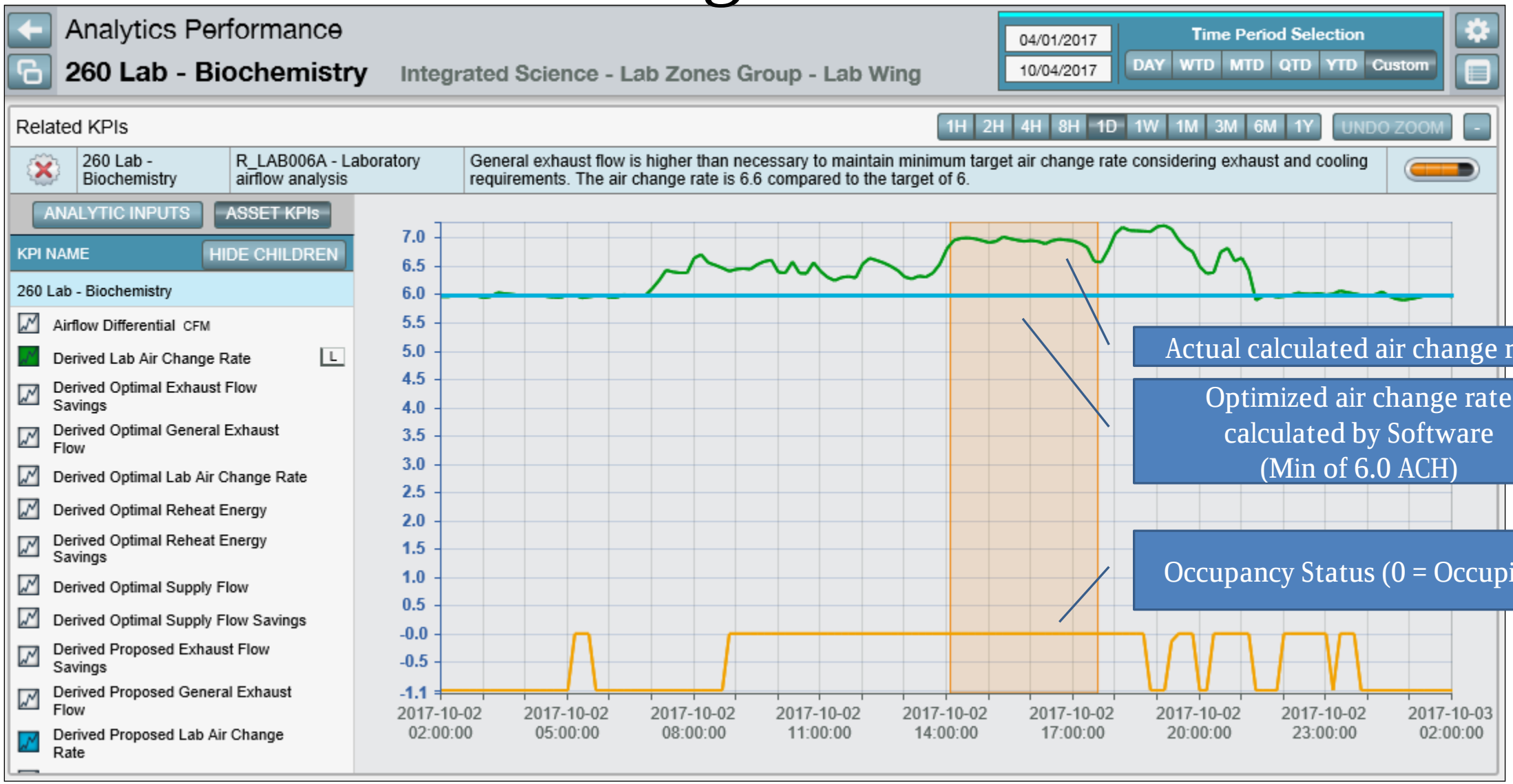
09/25/2017 – 10/04/2017 | Time Period Selection: DAY | WTD | MTD | QTD | YTD | Custom

Asset Analytics - Current State | Legend: Enabled *Disabled* | DISABLE FILTER | HIDE NORMAL RESULTS

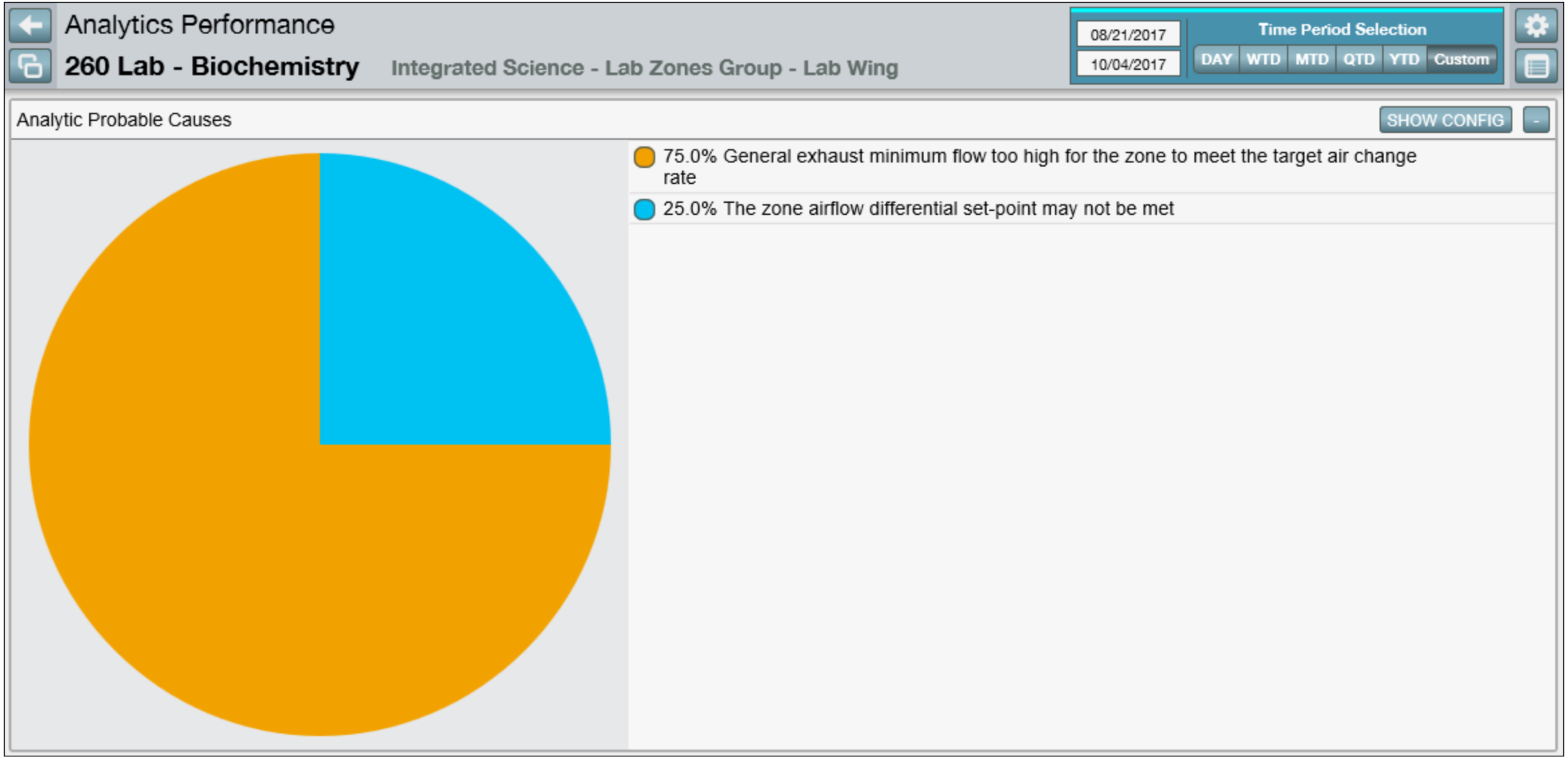
ANALYTIC FILTER | **R_LAB006A - Laboratory airflow analysis** | Total Electric Opportunity: **5,837 kWh $817**

ASSET NAME	ANALYTIC TYPE	ANALYTIC RULE	RESULT	DESCRIPTION	SEVERITY	DURATION	LAST UPDATE	FAIL DURATION IN PERIOD
260 Lab - Biochemistry	R-LAB006 Laboratory airflow analysis	R_LAB006A	✗	General exhaust flow is higher than necessary to maintain minimum target air change rate considering exhaust and cooling requirements. The air change rate is 6.6 compared to the target of 6.		1h 58m	03:50:00 PM 10/09/2017	1w 1d
260 Lab - Biochemistry	R-LAB006 Laboratory airflow analysis	R_LAB006B	✗	Supply boxes/air-valves are reheating more than necessary due to over-ventilation		10h 43m	07:05:00 AM 10/09/2017	6d 18h
260 Lab - Biochemistry	R-LAB006 Laboratory airflow analysis	R_LAB006D	✓	The zone air change rate cannot be reduced beyond the existing target		3w 6d	05:50:00 PM 10/04/2017	
260 Lab - Biochemistry	R-LAB006 Laboratory airflow analysis	R_LAB006E	✓	The zone air change rate is resetting properly during the unoccupied mode where applicable		2h 13m	03:35:00 PM 10/09/2017	6d 0h
260 Lab - Biochemistry	R-LAB006 Laboratory airflow analysis	R_LAB006C	✓	The supply / exhaust flow differential set-point is being met		3w 6d	05:50:00 PM 10/04/2017	

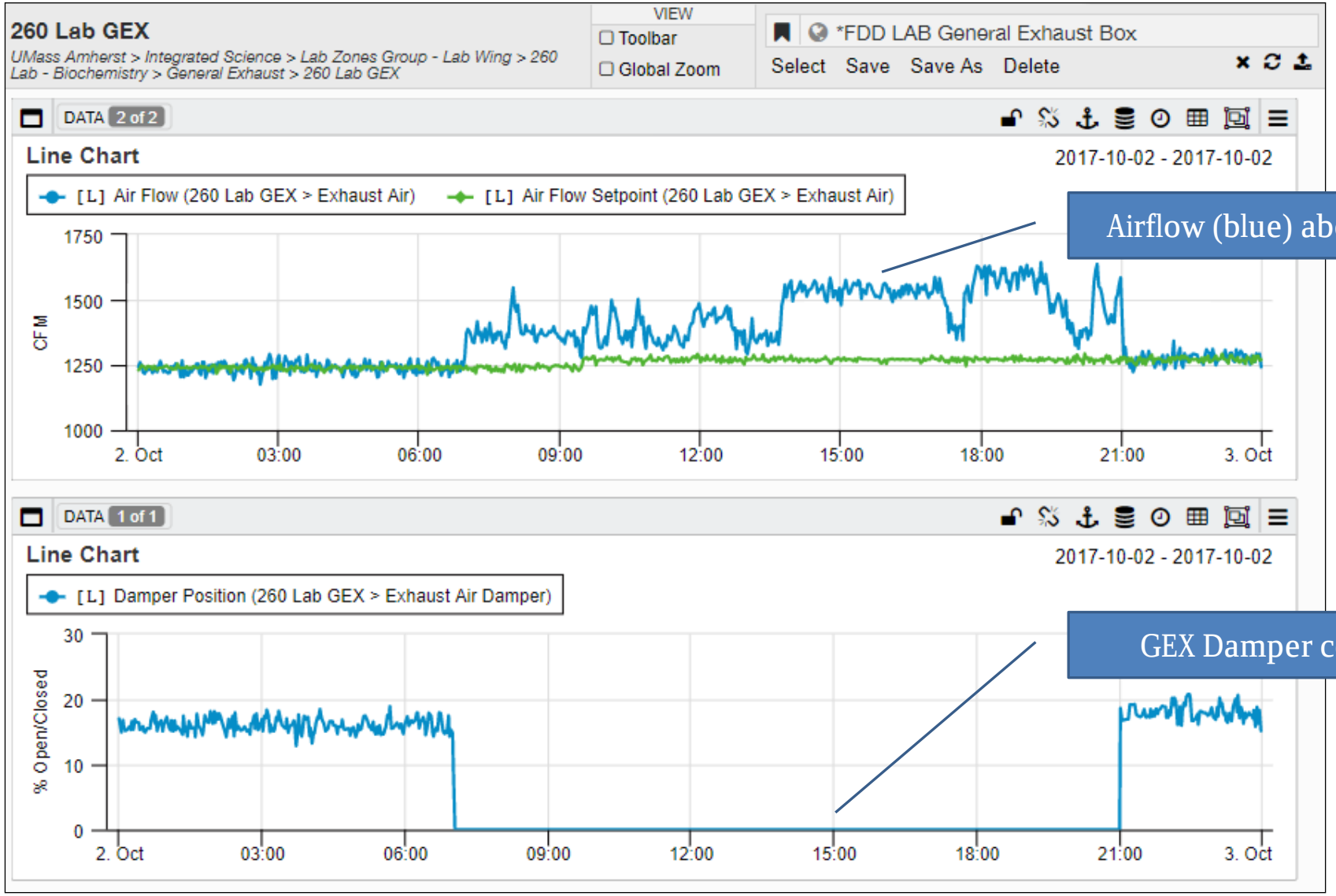
Trend of Air Change Rate Control Issue



Air Change Rate Fault Probable Causes



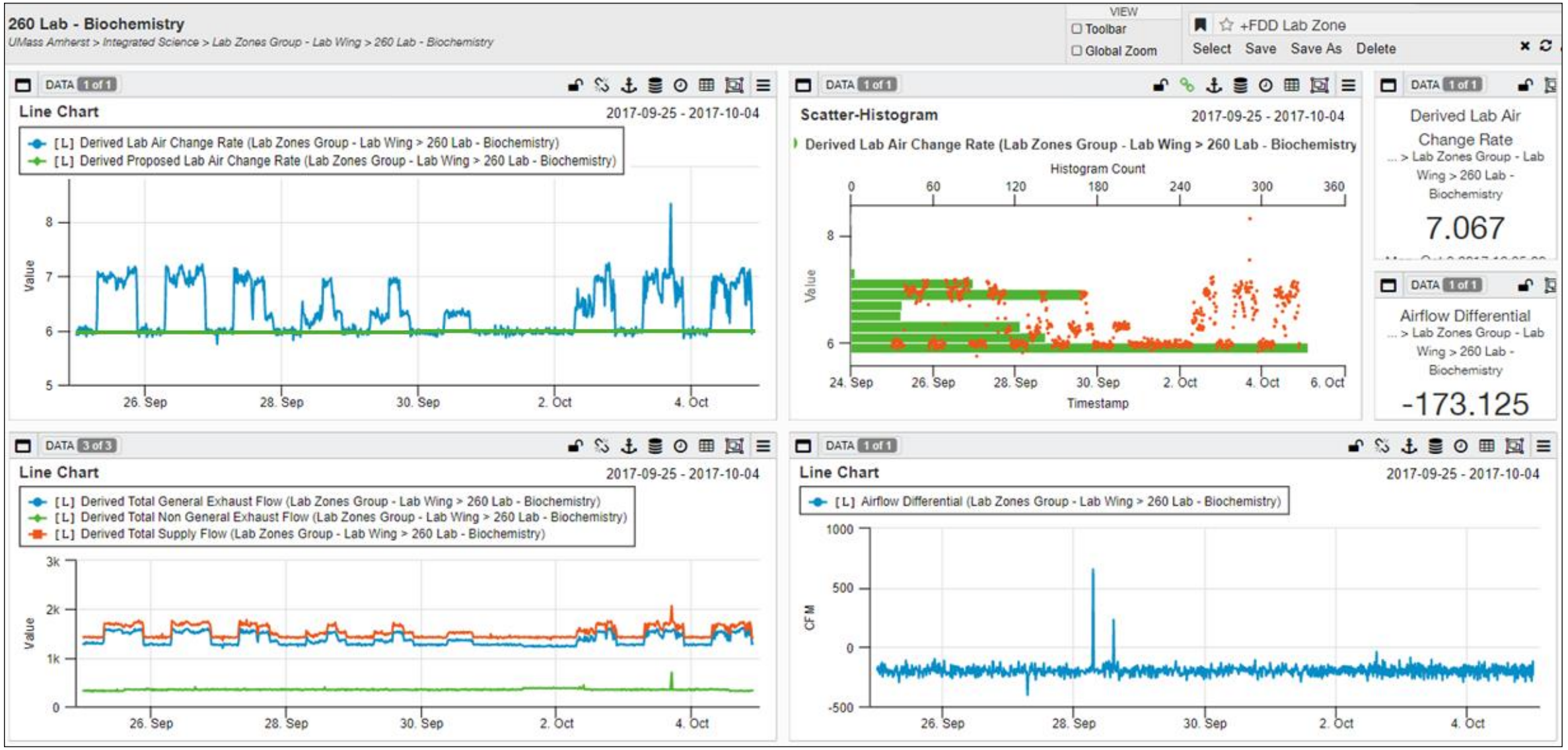
Trend of General Exhaust Box Operation



Airflow (blue) above set-point (green)

GEX Damper commanded closed

Laboratory HVAC Performance Dashboard



Best Candidates for MBCx in Labs

- Larger buildings to leverage the power and scalability of MBCx platform
- DDC Building Automation System(s) / Facilities with multiple control systems
- Documentation of controls and mechanical equipment
- Critical research requires monitoring of equipment performance
- Resources available and commitment to act on software recommendations

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Questions?