

# Verifying Shut the Sash Programs with System Testing

**I<sup>2</sup>SL Annual Conference**  
**Dallas, Texas 2025**  
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# Learning Objectives

At the end of this presentation, attendees will:

- Know that HVAC testing validates the **outcome** of sash closure initiatives, beyond the **effort**
- Know who might coordinate HVAC testing and what support will be available
- Understand three levels of benchmark testing:
  - 1) fume hood,
  - 2) room
  - 3) whole system

# IFHC HVAC Validation -- Outline

- The Problem: system response unknown
- The systems are huge and complicated
- Goal: Measure dCFM, All Open, All Closed
- Who will test during the contest?
- Success story
- Co-Benefits
- Advanced Testing:
  - VAV response, dP, room tracking; system response

# Why Close the Sash?

“A fume hood uses the energy of 3.5 houses”

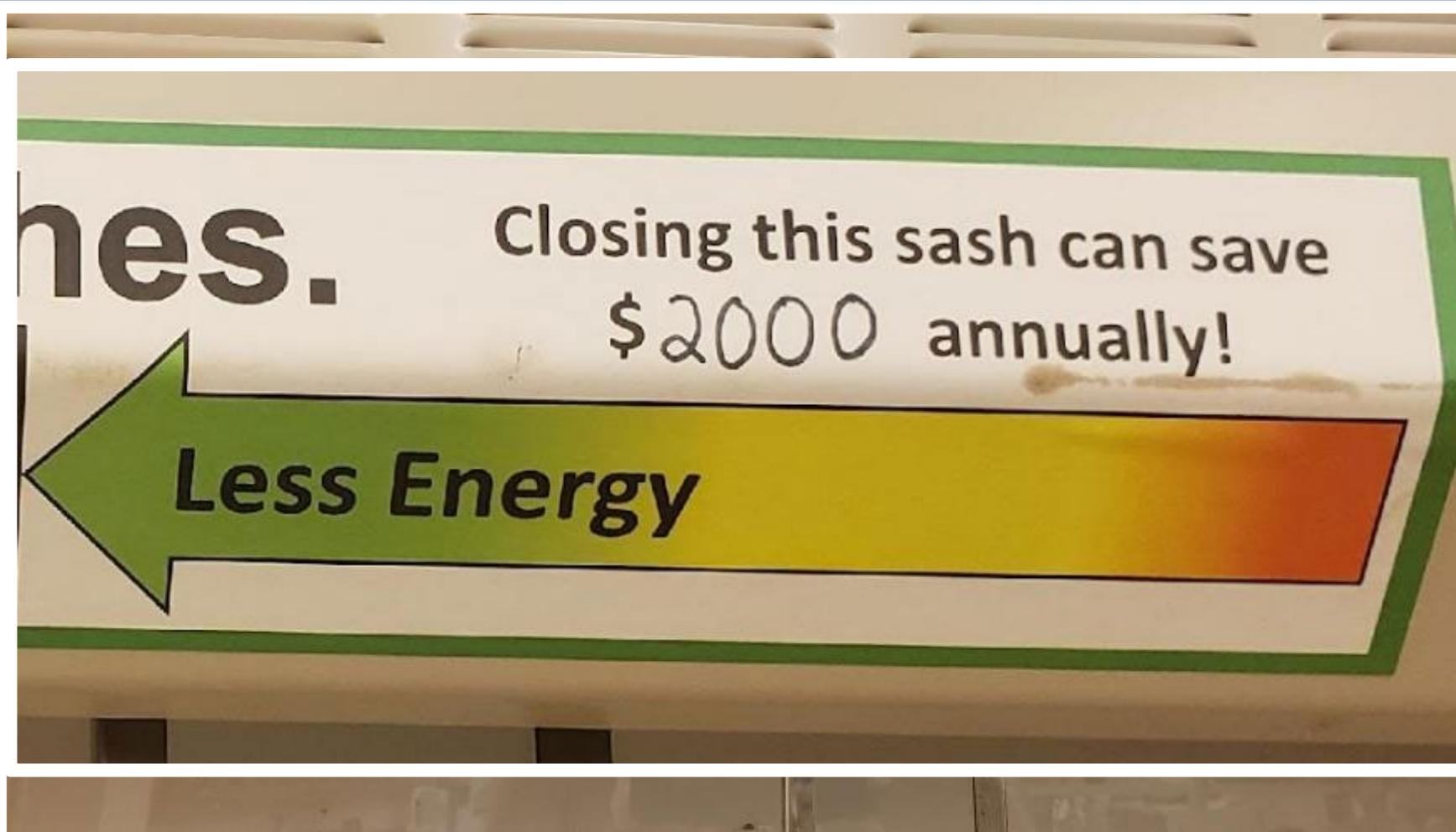


# Wow, to think of the energy I'm saving!

Really?

What's happening at the SYSTEM level?

Is the SYSTEM Sensitive to Sash Closure?



# Wasted CFM and \$\$ ??

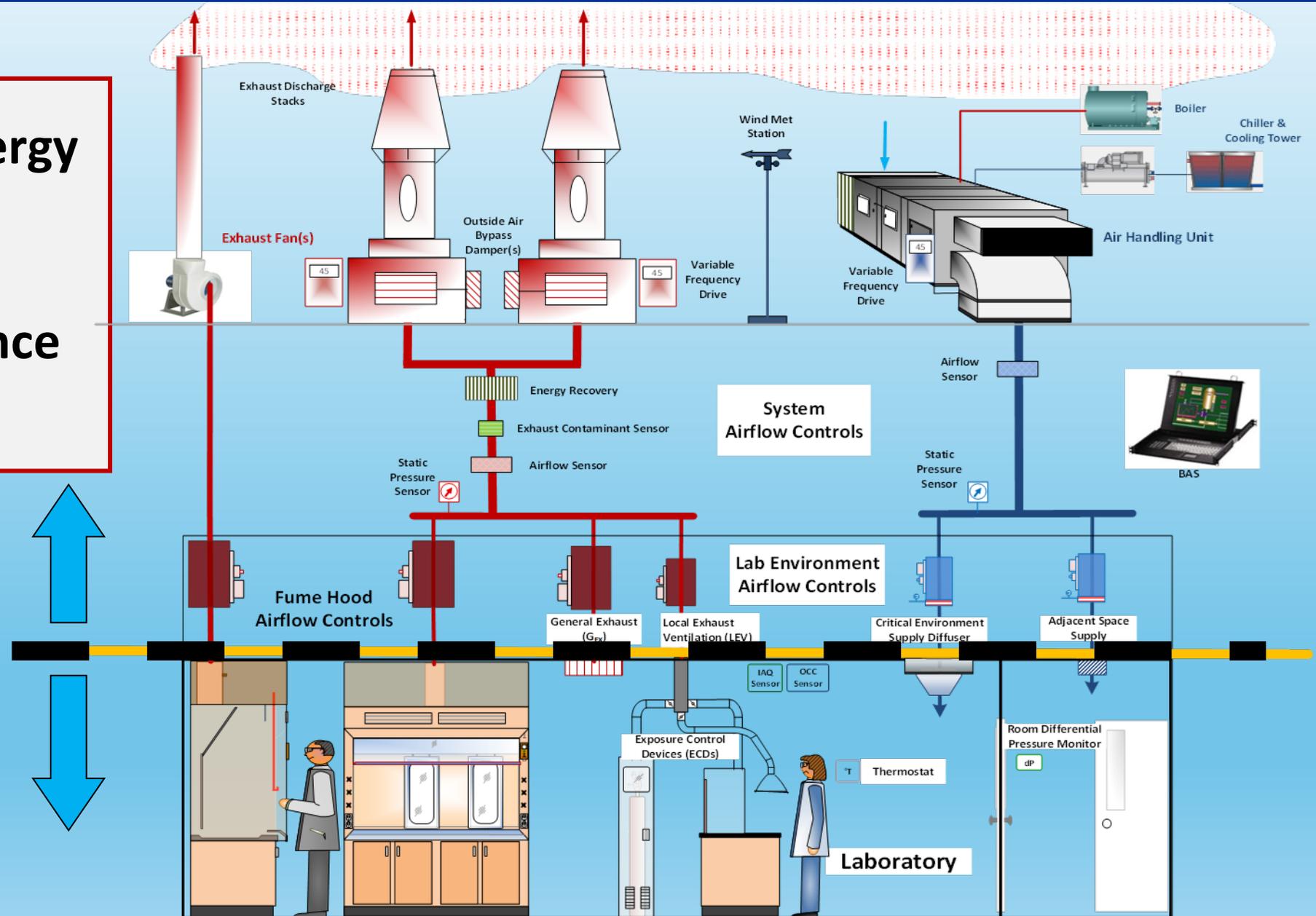
$6 \times 6 \times 100 = 3600 \text{ cfm?}$   
 $= \$18,000 @ \$5/\text{cfm}$

$1 \times 10 \times 100 = 1000 \text{ cfm}$   
 $= \$5,000 ?$



# Fume Hoods are the front end of a SYSTEM

Lab safety and Energy Conservation depends on proper performance of the system



*Above Ceiling*

*Below Ceiling*

Laboratory

# The System has BIG fans, boilers, chillers ...



If they don't  
slow down,  
*What's the  
point?*



# Many factors can affect performance and savings

Many factors contribute to or degrade system modulation and efficiency

Exhaust Discharge & Energy Recovery

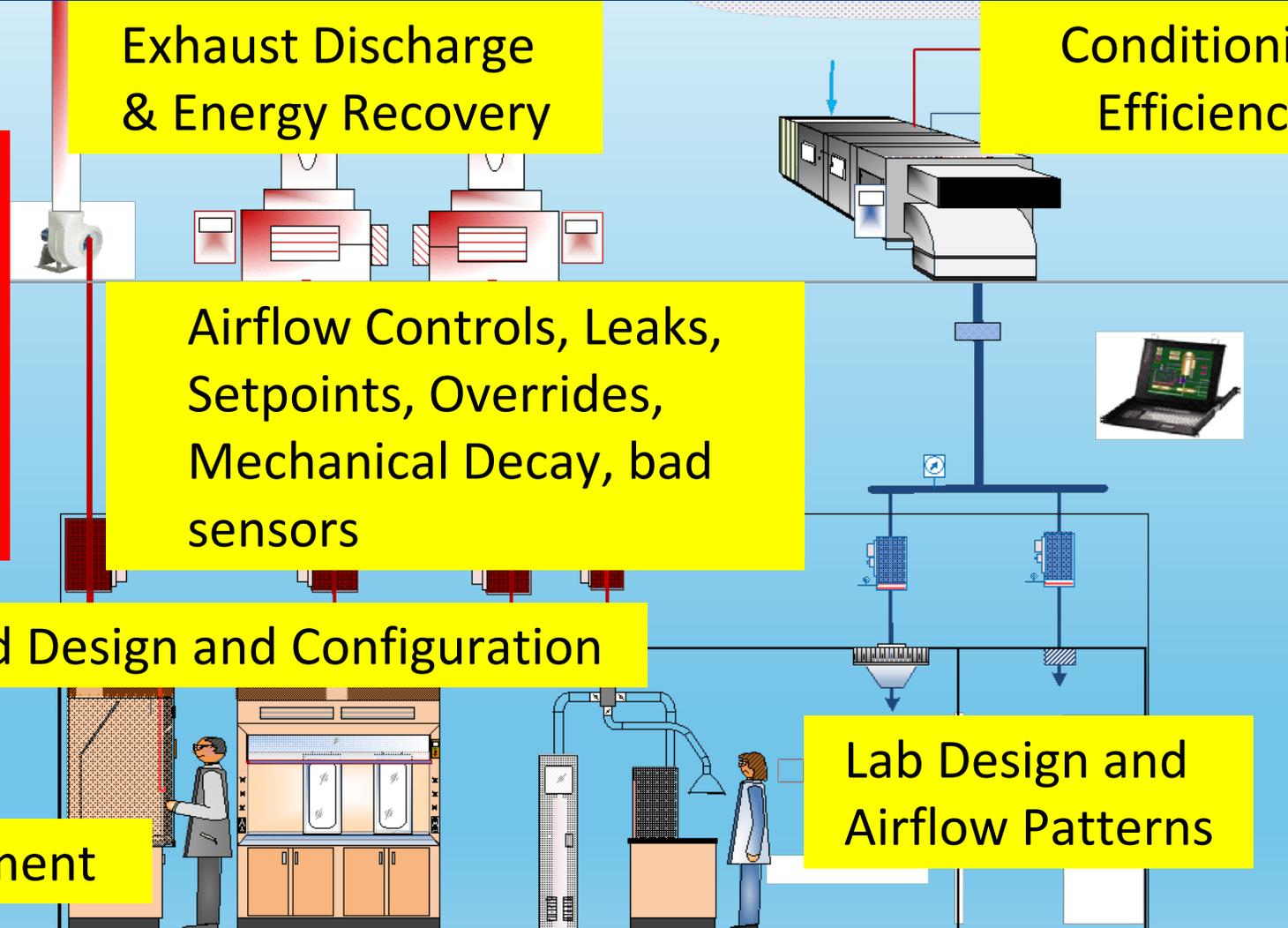
Conditioning Efficiency

Airflow Controls, Leaks, Setpoints, Overrides, Mechanical Decay, bad sensors

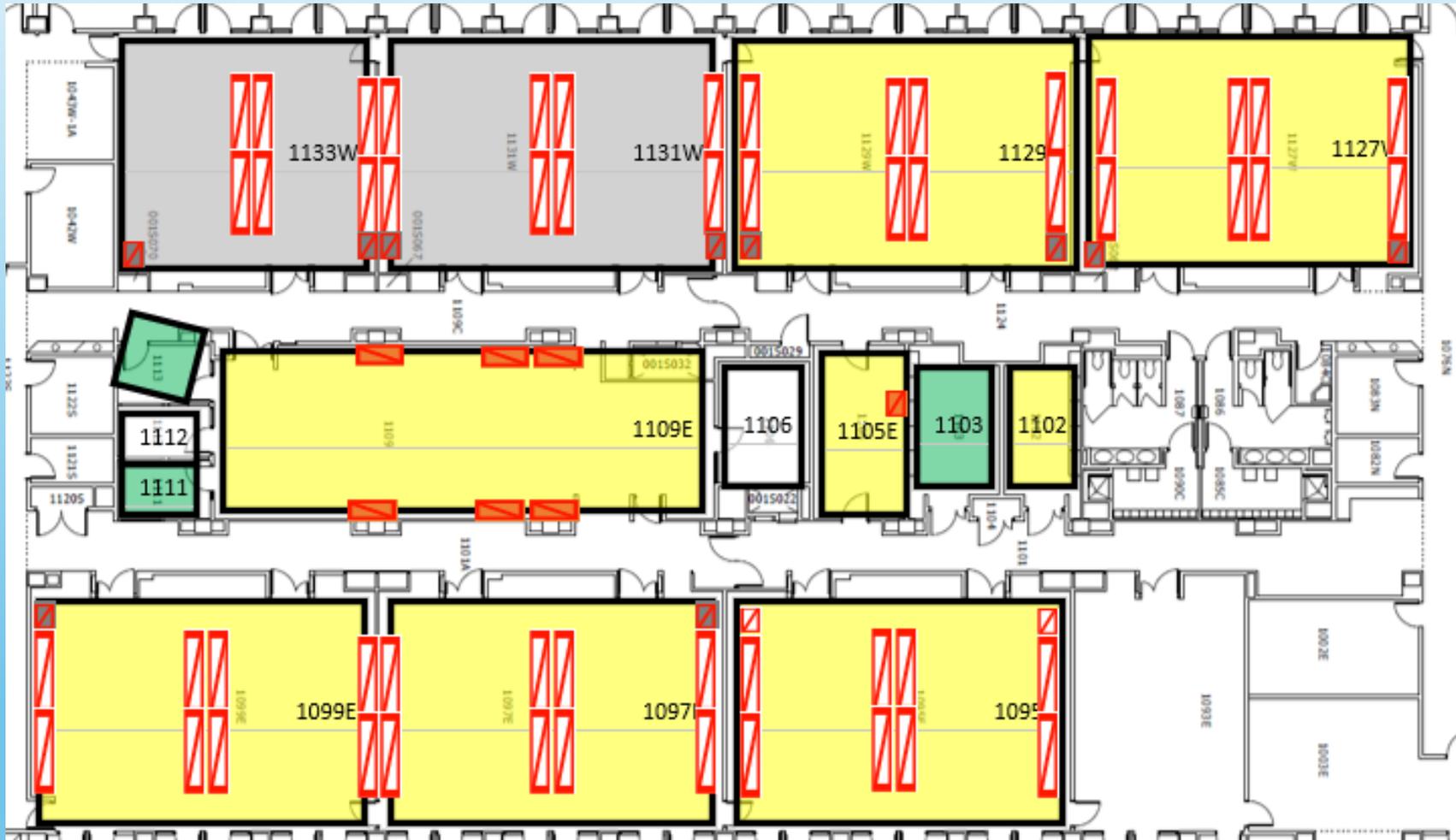
Hood Design and Configuration

Lab Design and Airflow Patterns

Sash Management



# Some labs are “hood driven”



 10' Fume Hood

**High Abundance, Hood Exhaust Dominated**

# Some labs are not “hood driven”



  
6' Fume Hood

**Low Abundance, General Exhaust (GEx) Dominated**

# ASSESSMENT GOAL: Get the RANGE of FLOW

Supply &

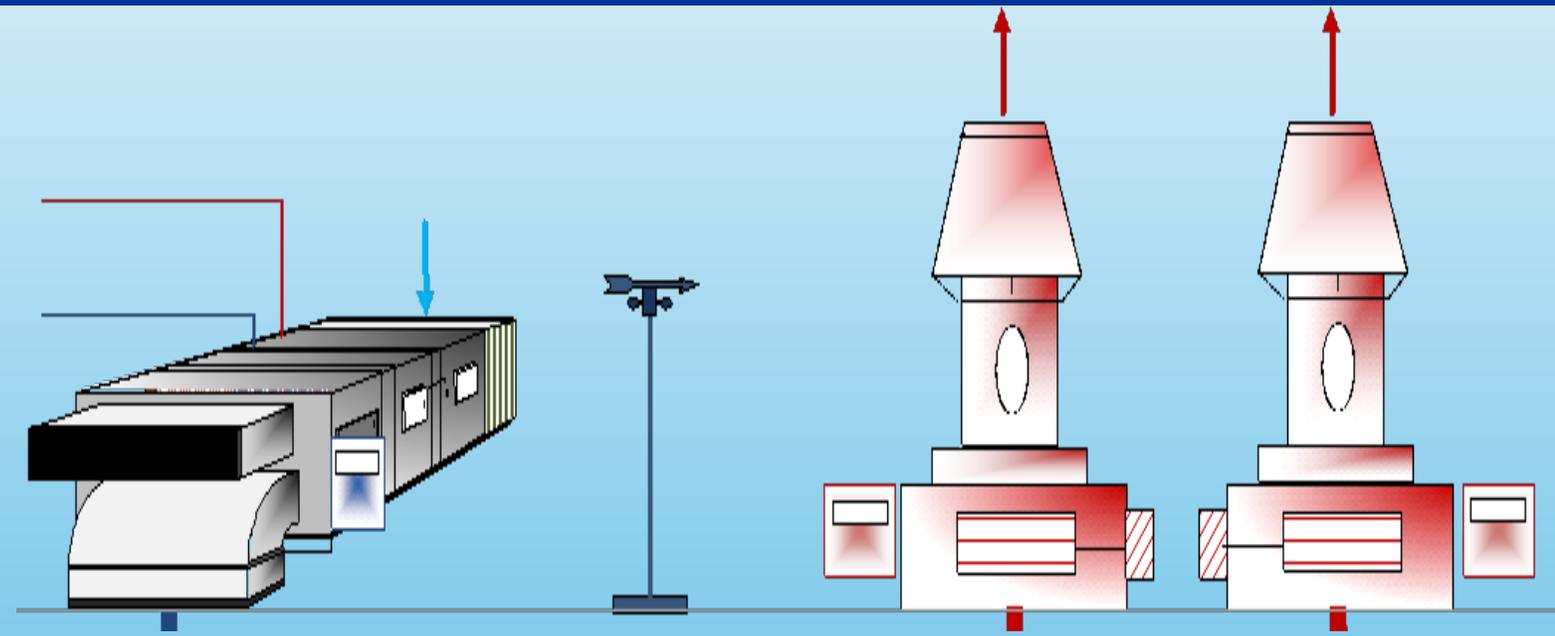
Exhaust

What is the range (aka delta) of flow for the fans and AHUs?

- All Hoods Open
- All Hoods Closed

What are the capabilities of the airflow controls?

What are the required operating conditions?



Fan Power + Conditioning

Fan Power

LONG TERM: How do we manage and maintain performance?

# Basic Data: VFD Readings ~ Power

## Best Data: CFM Hi, CFM Lo

For Example, Read in BAS

% All Open

100% = 60 Hz

% All Closed

75% = 45 Hz



Measure @ coils?

Inspect filters



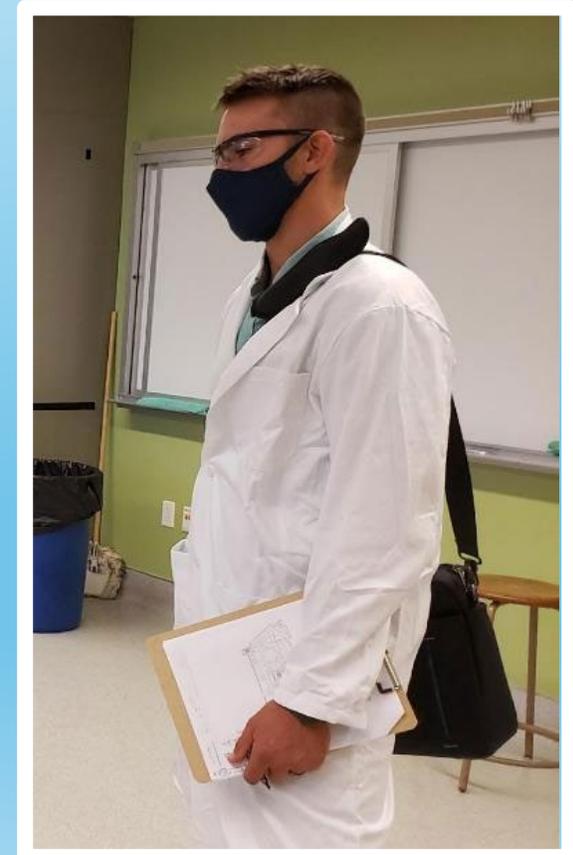
# HVAC Testing Coordinator



- Facilities
- Sustainability Coordinators
- EH&S
- ✓ Eager
- ✓ Good Communicator
- ✓ Project Manager
- ✓ 2-3 Assistants
- ✓ Class Project?

# Facilities Collaboration

- The Coordinator must have support from Facilities
  - Get data
  - Calculate results
  - Consider mechanical or automation improvements
- BPG's will describe goals and roles



# EHS Connections

- Gain support from Health & Safety
  - Best Practices, Safe Use
  - Sash Management
- Meet Facilities Colleagues!



# Teamwork on Test Day

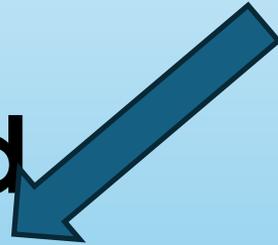
- The FHC Coordinator will explain the testing to staff or volunteers
- Test Method: TBD by TAG
- The BPG's will:
  - Inform the coordinator
  - Inform the team



# After Testing...

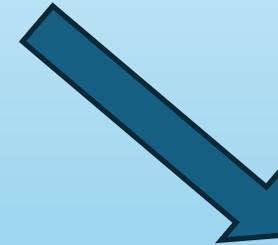
## HVAC Delta CFM

**As  
expected**



Proceed with FHC and  
celebrate!!

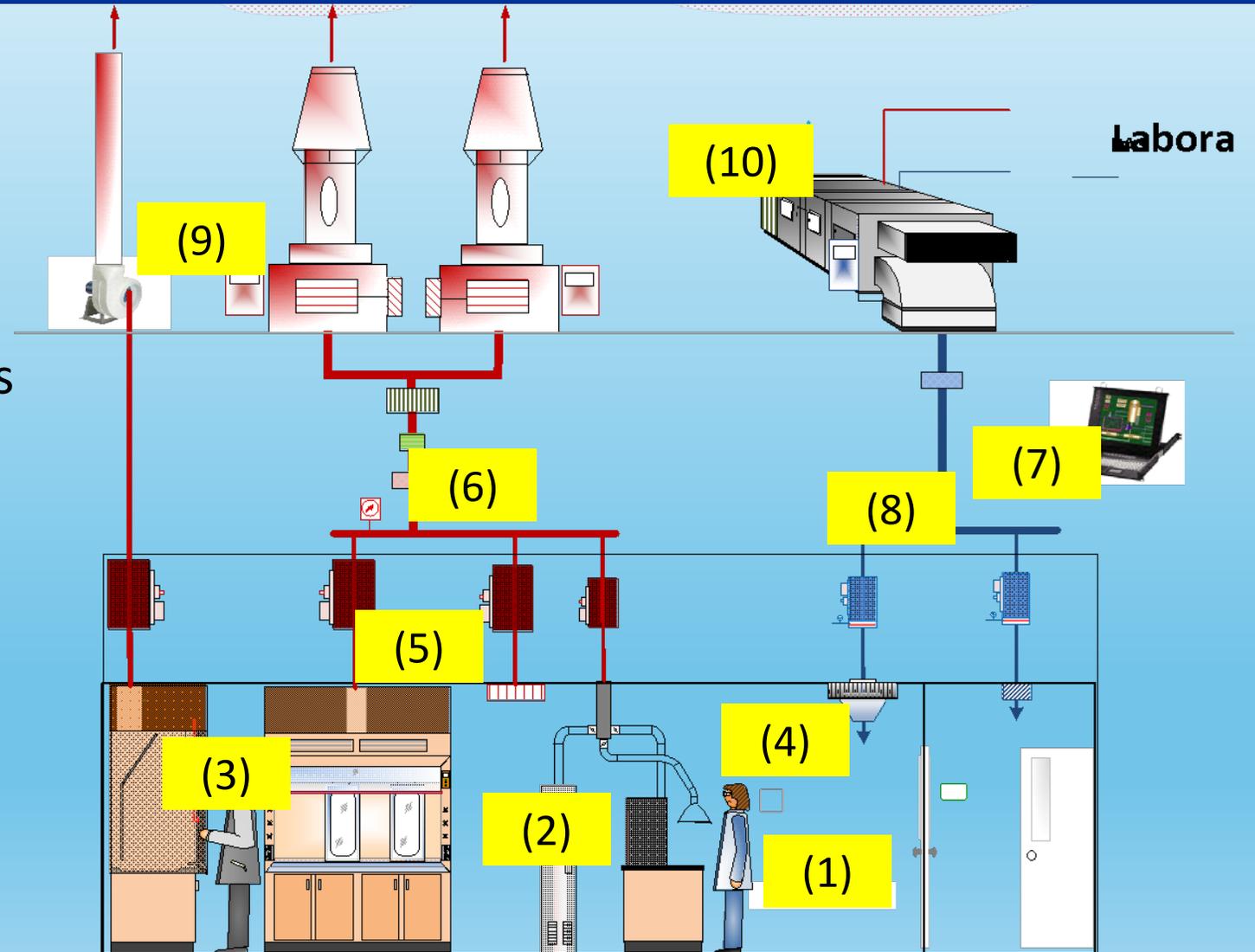
**Less  
than expected**



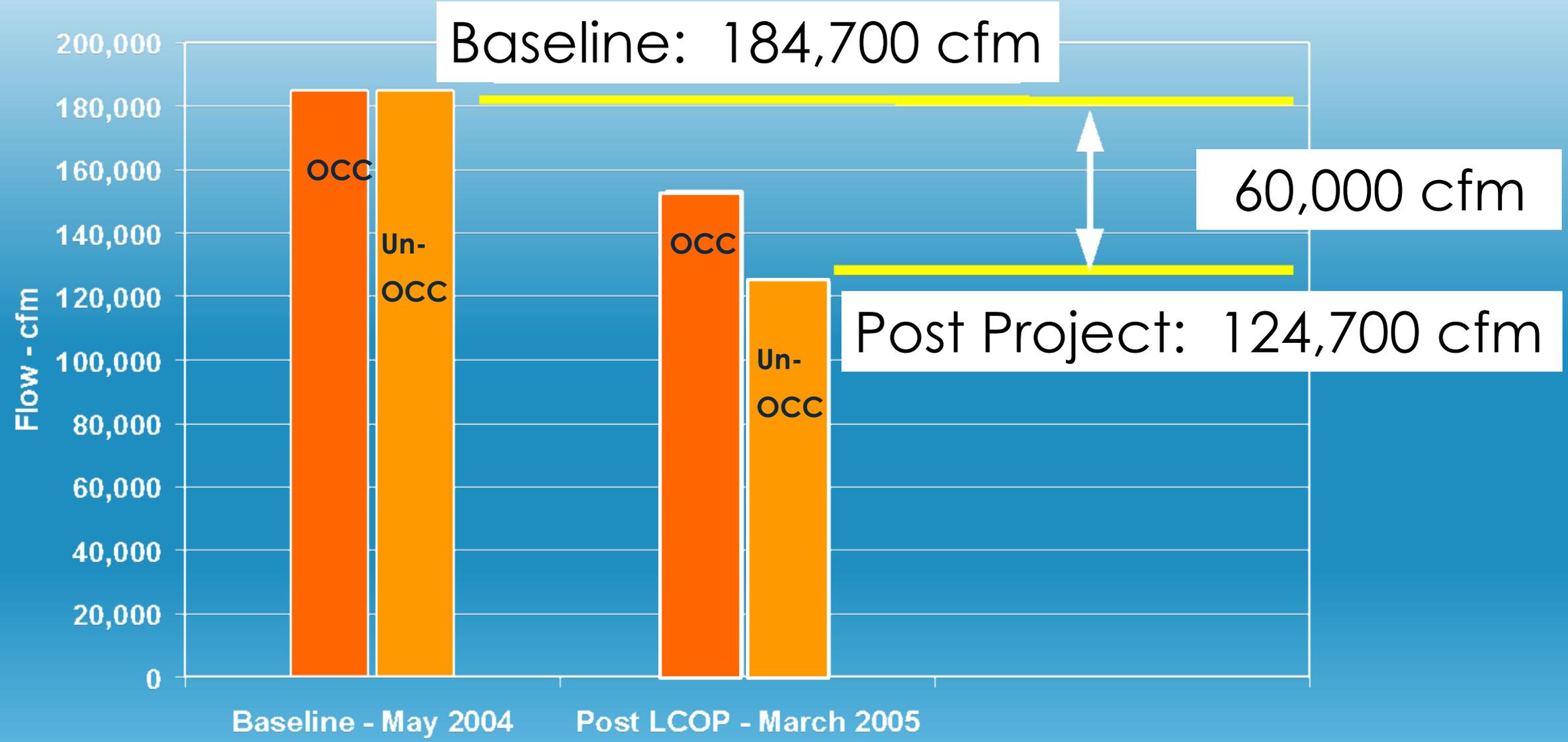
Investigate  
deficiencies with  
professional testing &  
ECM's

# Opportunities to improve performance

- 1) New airflow specifications
- 2) Hibernate Unused Hoods *and snorkels*
- 3) Upgrade Fume Hoods
- 4) Improve Ventilation Effectiveness
- 5) Repair/Upgrade Controls
- 6) Install Enhanced Monitoring
- 7) Upgrade BAS analytics
- 8) Optimize System Static Pressure
- 9) Optimize Exhaust Discharge
- 10) Optimize AHU performance



# Example: Supply Airflow, Before & After

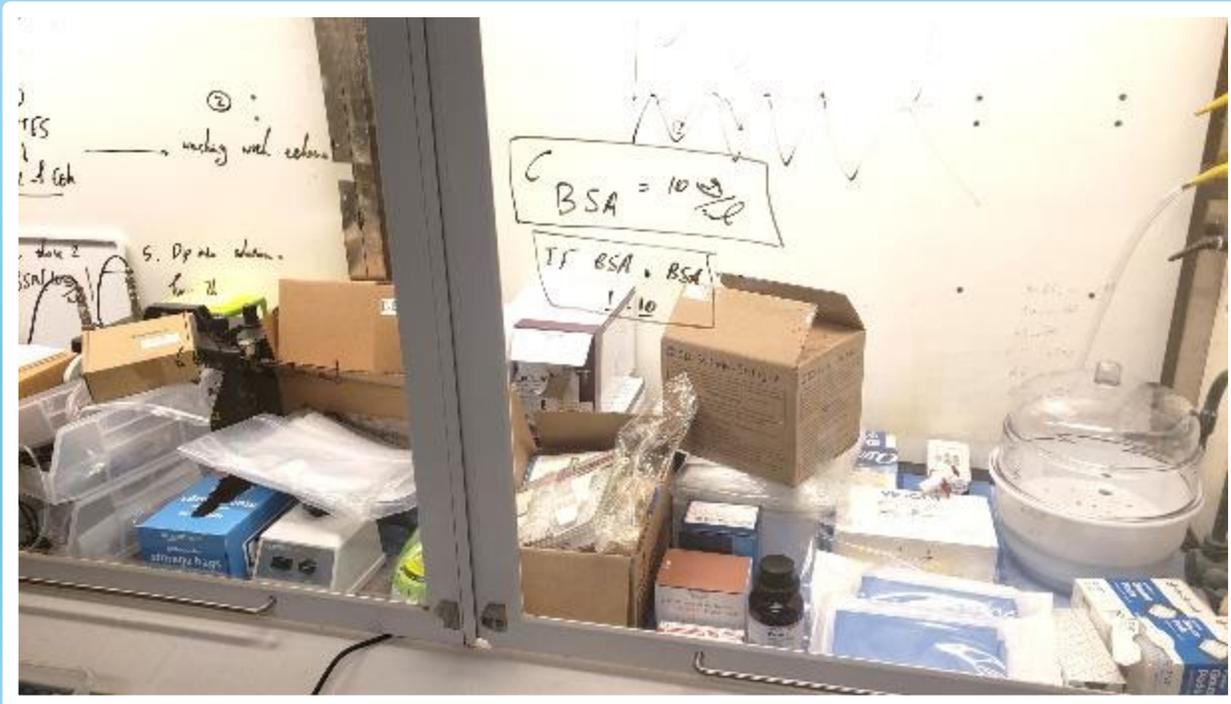


# Co-Benefits: Identify inappropriate Fume Hood Use

Acid "Rain"  
Valve Corrosion



# Identify Hibernation Candidates —Start Internal Review



# Next: What rigorous tests may reveal



# 3Flow Advanced Testing Framework

1. Fume Hood Containment Tracer Test
1. Fume Hood Minimum Flow Tracer Test
1. Ventilation Effectiveness and ACH Tracer Test
1. VAV Testing
  1. Fume Hood Operational Tests
  2. Fume Hood VAV Response and Stability Tests
  3. Lab Environment Tests
  4. System Operation Mode Tests
2. Demand Control Ventilation Test



# Purpose of the Ventilation System VAV Function Test

1. Confirm full system coordination from the hood to the lab and system level
1. Verify airflow control and accuracy
1. Tests communication and integration with BAS
1. Ensure safety, containment, energy performance
1. Identify problems typically not found through BAS or alarms

# Ventilation System VAV Function Test Components

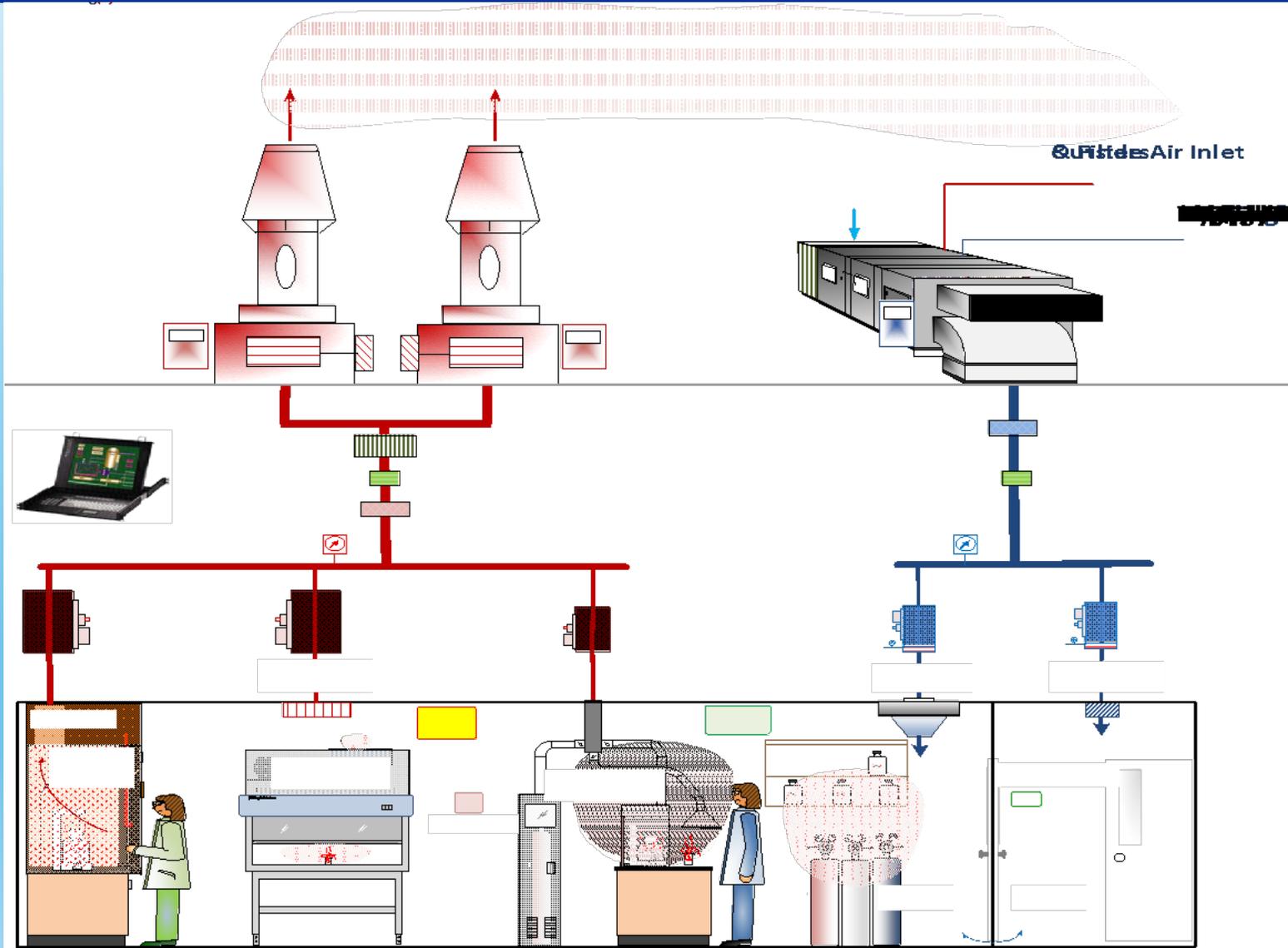
## 1. Fume Hood Operational Tests

- a. Face Velocity
- b. Minimum and Design Flow
- c. Cross Drafts
- d. Smoke Testing
- e. dP measurement

## 2. Fume Hood VAV Response and Stability Testing

### 1. Lab Environment Tests

### 1. System Operation Mode Tests



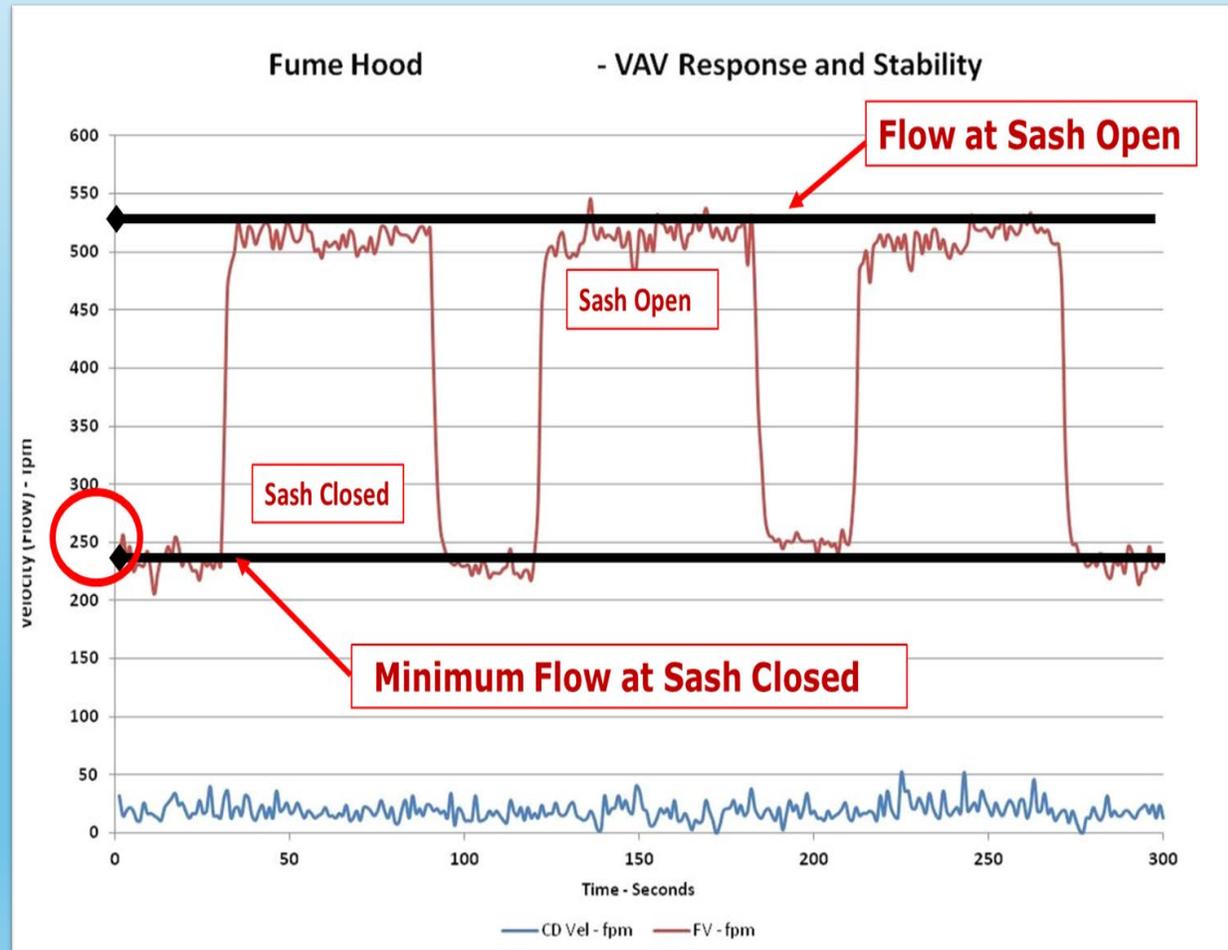
# Fume Hood Operational Tests

1. Face velocity determines whether a fume hood is performing at facility standards
1. Establish the minimum (sash closed) and design (sash set to operational height) flow
1. Cross draft testing identifies shearing air patterns that can compromise performance and containment
1. Smoke allows for a visualization of airflow patterns within the fume hood, and to diagnose potential problems
1. dP measurement shows whether the supply is tracking fume hood exhaust

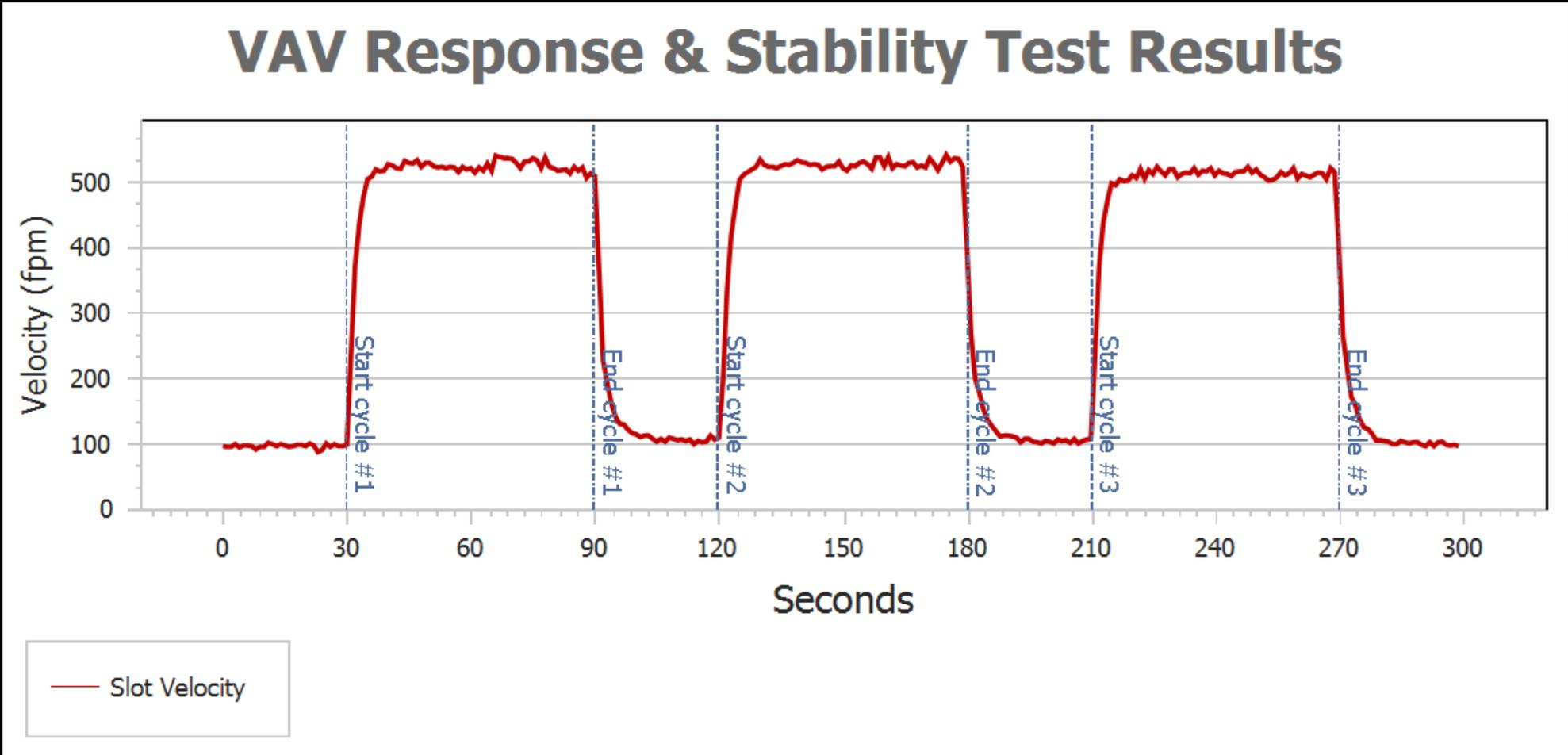


# Fume Hood VAV Response and Stability Test

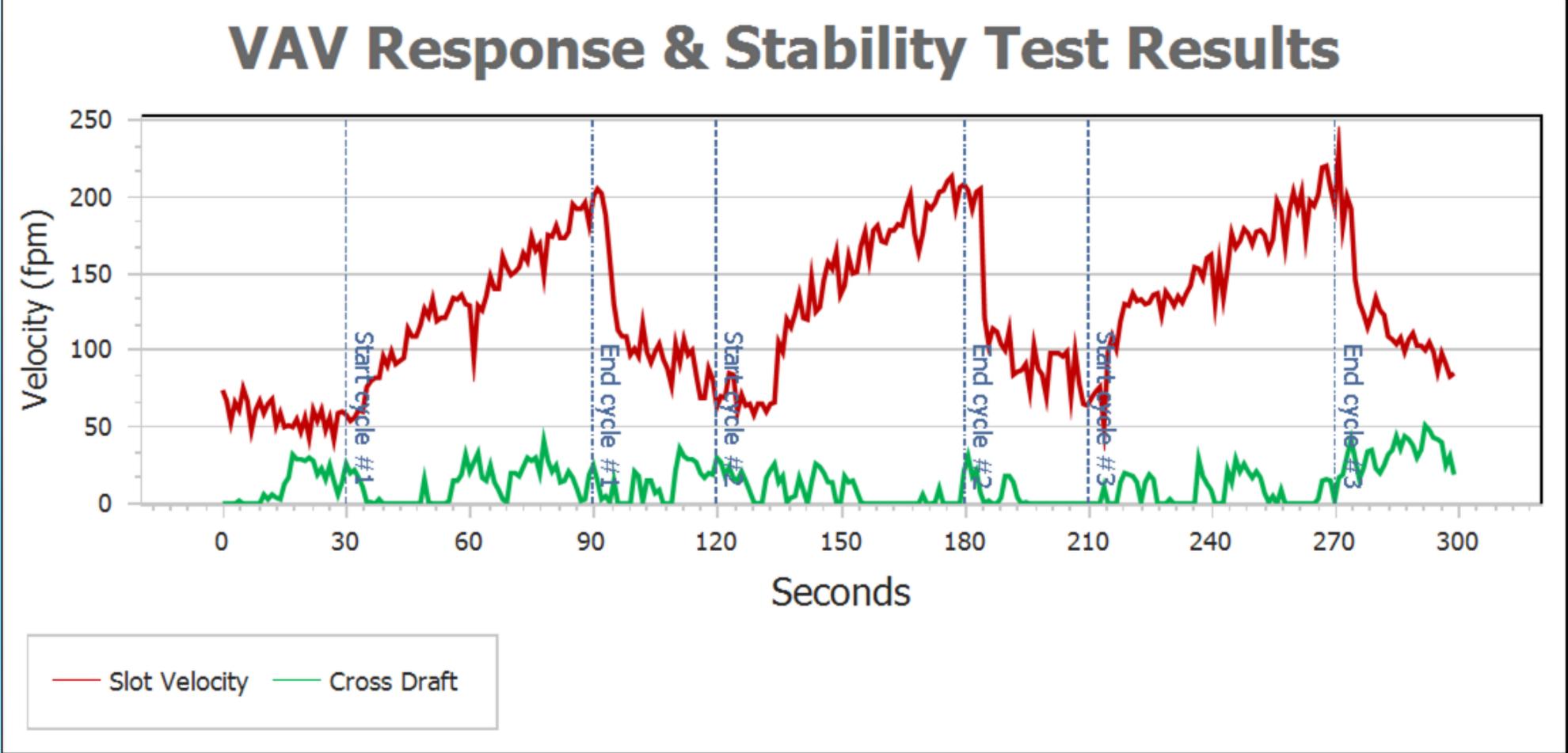
1. An underutilized test described in the ASHRAE 110
1. Determines the speed that flow will modulate based on sash movement
  1. Acceptable criteria states reaching 90% of steady state velocity within 5 seconds
1. Establishes the stability of the flow once it has reached the steady state
  1. Acceptable criteria states no variation above 20% of the steady state velocity



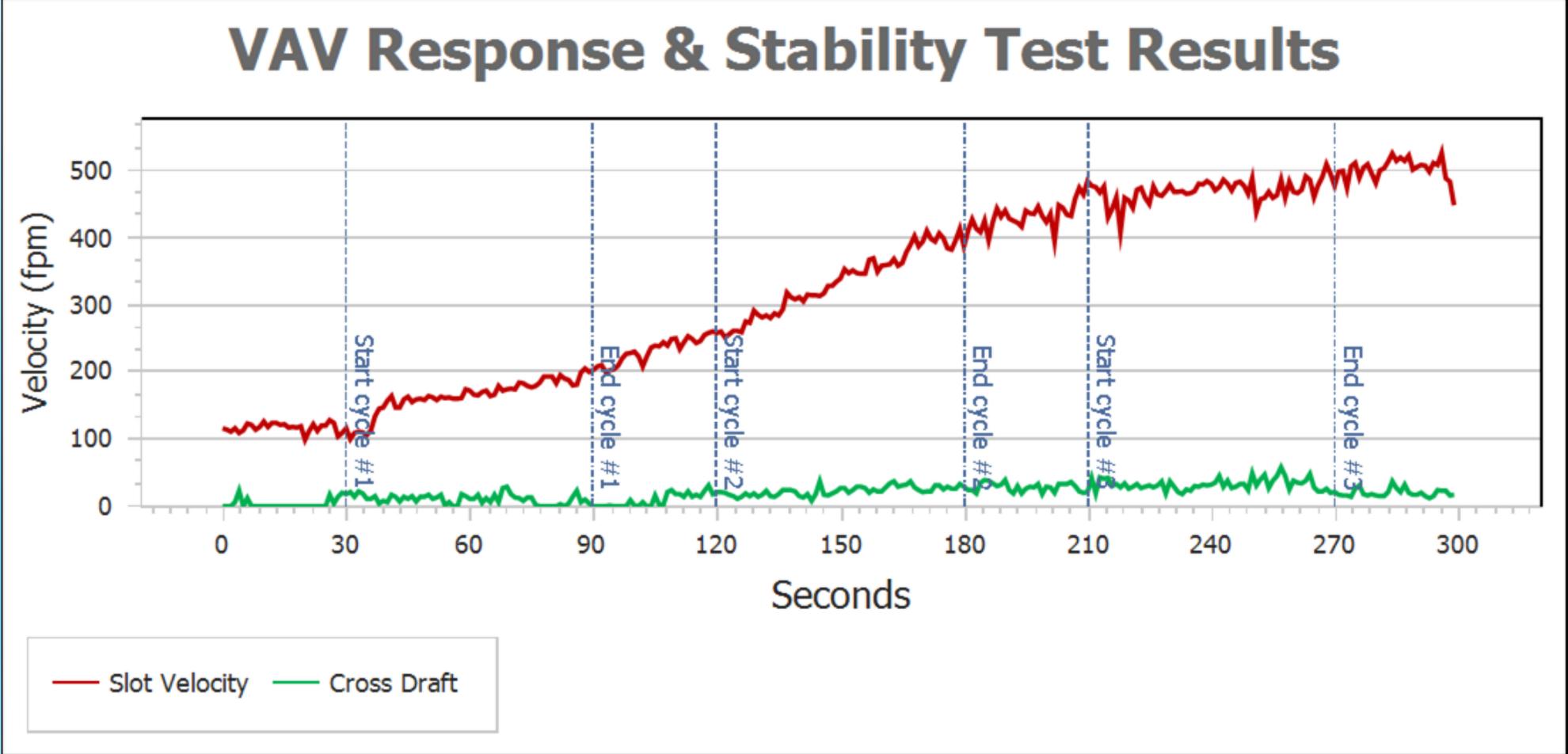
# Fume Hood VAV Response and Stability Test



# Fume Hood VAV Response and Stability Test



# Fume Hood VAV Response and Stability Test



# Lab Environment Tests

1. Assess flows and room pressure under changing fume hood sash configuration



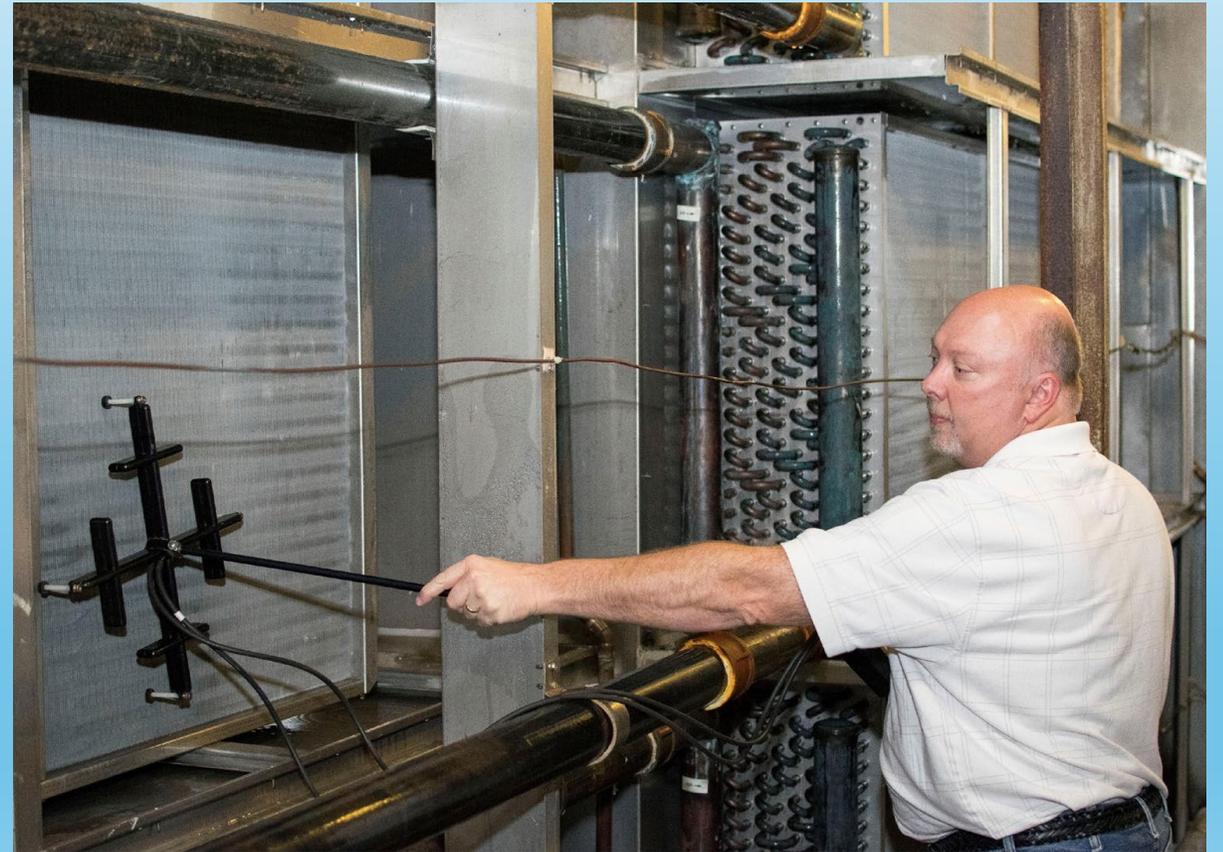
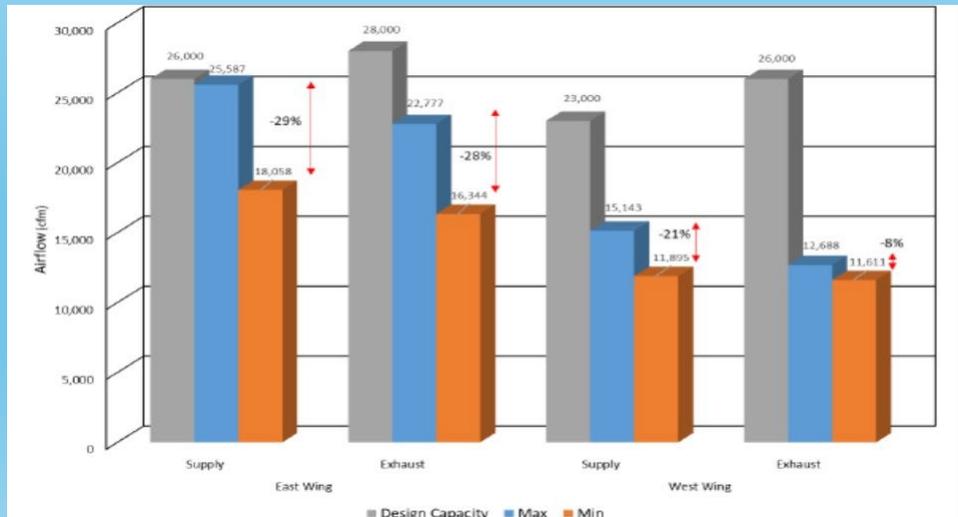
Lab	Supply (cfm)		Exhaust (cfm)		Tot. Exh		Exh. ACH at Min	Exh. ACH at Max	RCB Rating	RCB Min. ACH Occupied	RCB Min ACH Unoccupied	
	Min	Max	Type	Min.	Max.	Min.						Max.
134	5817	5817	6' FH	872	803	5382	5970	15	16	2	6	3
			8' FH	562	1255							
			Snorkel	145	145							
			Snorkel	165	165							
			Snorkel	176	176							
			Snorkel	231	231							
			GEX	76	539							
			GEX	1157	661							
			GEX	1048	1086							
			GEX	931	936							
180	2380	2362	Transfer	48	0	2661	2976	7	7	1	4	2
			Transfer	-29	-27							
			FH	490	633							
			Snorkel	300	300							
			FH	484	625							
			GEX	260	269							
			GEX	288	287							
			GEX	94	95							
			GEX	124	116							
			GEX	188	195							
			GEX	181	264							
			GEX	252	192							
			234	10596	13193							
FH	721	1178										
FH	779	1245										
FH	693	1174										
FH	580	1100										

# Lab Environment Tests



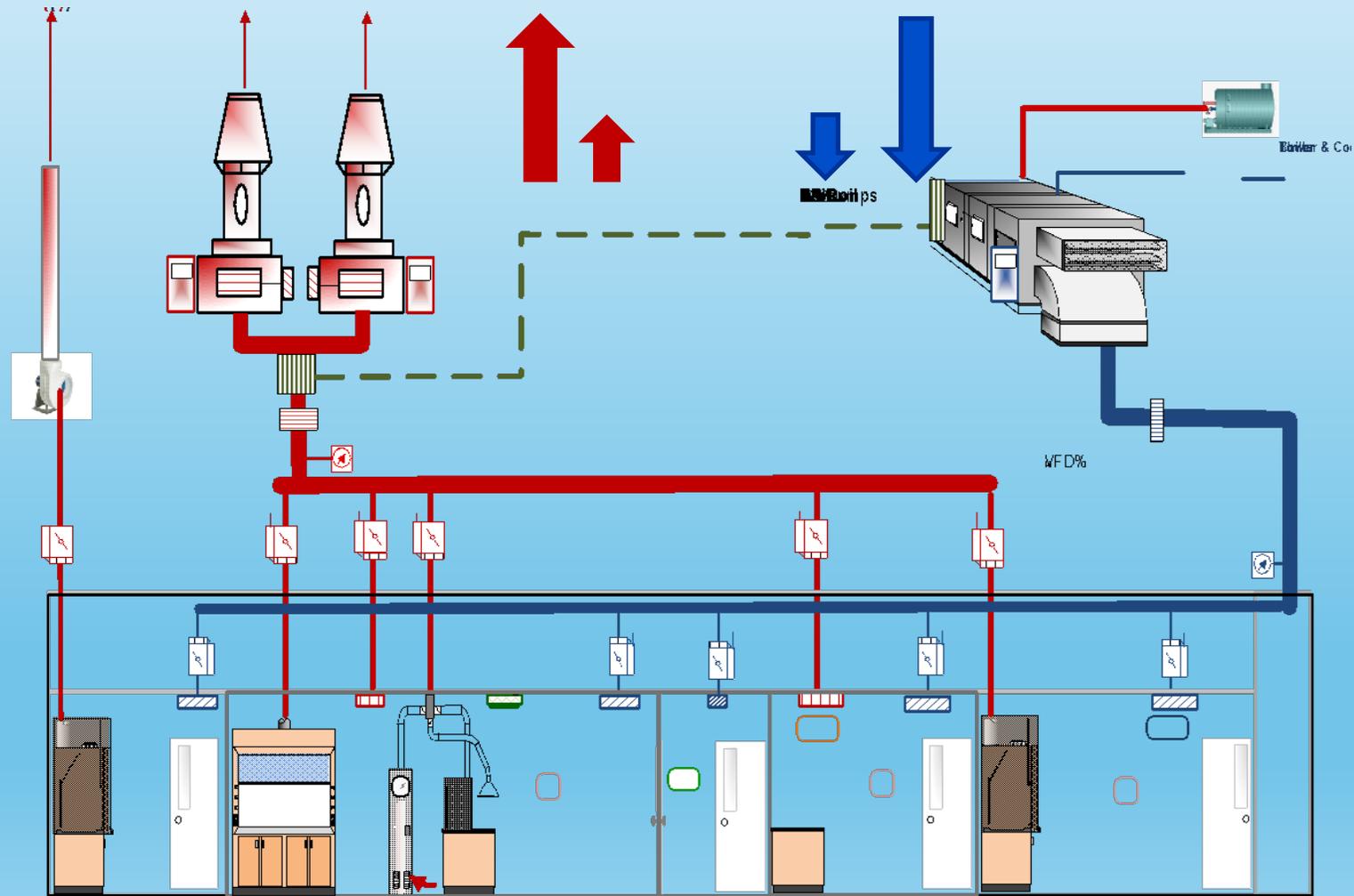
# System Operating Mode Tests

1. Assess the systems' speed and response stability to change in flow
1. Assess modulation in flow between sash open and sash closed
1. Determine if the flow reductions from the hoods translate through the system



# Common Reasons Systems Don't Respond

1. CAV Fume Hoods and Devices
2. Improper air supply tracking
3. AHU Response and Sequence of operations
4. BAS and Sensor Accuracy and Control
5. Improper flow set points
6. Improper VAV Response
7. Dysfunctional Flow Controls



# Know the Flow. Prove the Flow. Ensure Safety and Energy Savings

## Ventilation System VAV Function Test

- Fume Hood Operational Tests
- Fume Hood VAV Response and Stability Tests
- Lab Environment Tests
- System Operation Mode Tests

1. Validates VAV system performance
  2. When users trust performance, they comply with sash management
  3. “Reliable systems encourage reliable behavior”
  4. Ensures safety compliance
  5. Savings are realized to protect the return on investment
- How confident are you that your systems are performing as intended?
  - How confident are you that sash closures in your facility will lead to energy savings?

Questions?