Welcome to the Webinar!

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- We will take questions during the Q&A session

Applying a New and Emerging Technology

Lab Centralized Demand Controlled Ventilation (CDCV)

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UNIVERSITY of CALIFORNIA · IRVINE

University of California, Irvine

Category one research university

$16M annual utilities budget

Lab buildings consume 2/3 of campus energy

Many energy initiatives to reduce carbon footprint

This Initiative

Does Centralized Demand Controlled Ventilation (CDCV) Allow Us To Reduce Ventilation Rates & Save Energy Without Compromising Safety?

Lab Ventilation Rates

- Often set at a “constant rate” 24/7
- Recommended range 4 to 12 air changes per hour
- Usually excessive during low-level process activity or non-occupancy
- Explore possibility of “set back” based on lab pollutant concentration

Components of Centralized Demand Controlled Ventilation (CDCV)

“Creating a Smart Lab”


Sensor
Suite
CO
CO_2
RH
TVOCs
Particles
Information
Management
Server
Data
Internet
Web User Interface
Air
Data
Router
Web-Accessible Reports
Room
Sensor
VAV Controller

CDCV & Energy $avings
Monitor Air Contaminants

↓ **Reduce** air changes per hour (ACH) if no contaminants detected

↑ **Increase** air changes per hour (ACH) when contaminants detected

CDCV & Energy $avings
Challenge

Balance energy savings & safety

Maximize Energy Savings

Without Compromising Safety

CDCV & Energy $avings
Recipe for Success

Team Synergy

Safety Management

Engineers

Supportive Users/ Researchers

Visionary & Supportive Upper Management

Patience

Facility Managers

Is CDCV effective in reducing the contaminant concentration from a spill in a lab?

Spill Locations

Farthest point from the hood

Benchtop

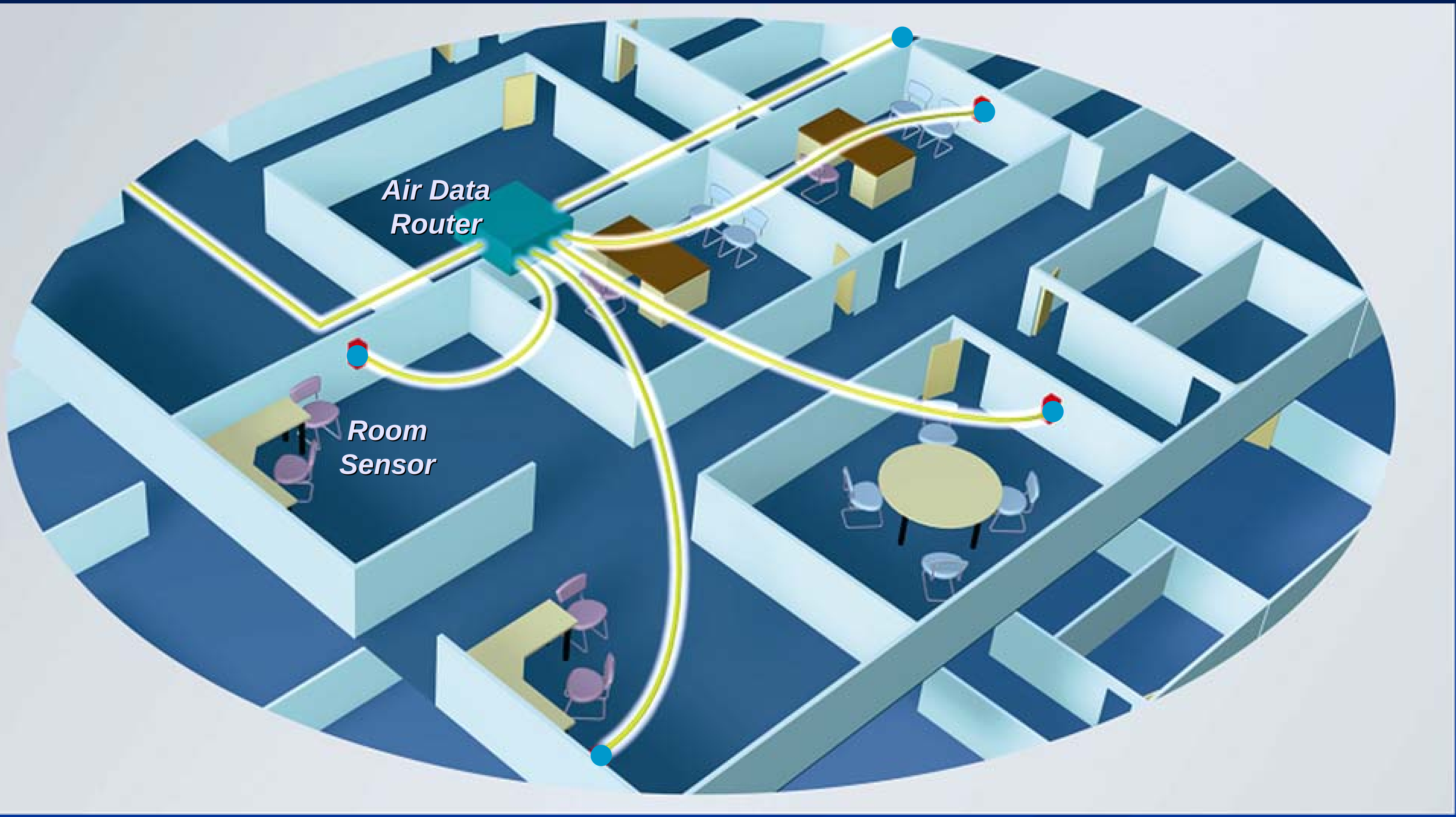
In front of the hood

Spill Test Methodology

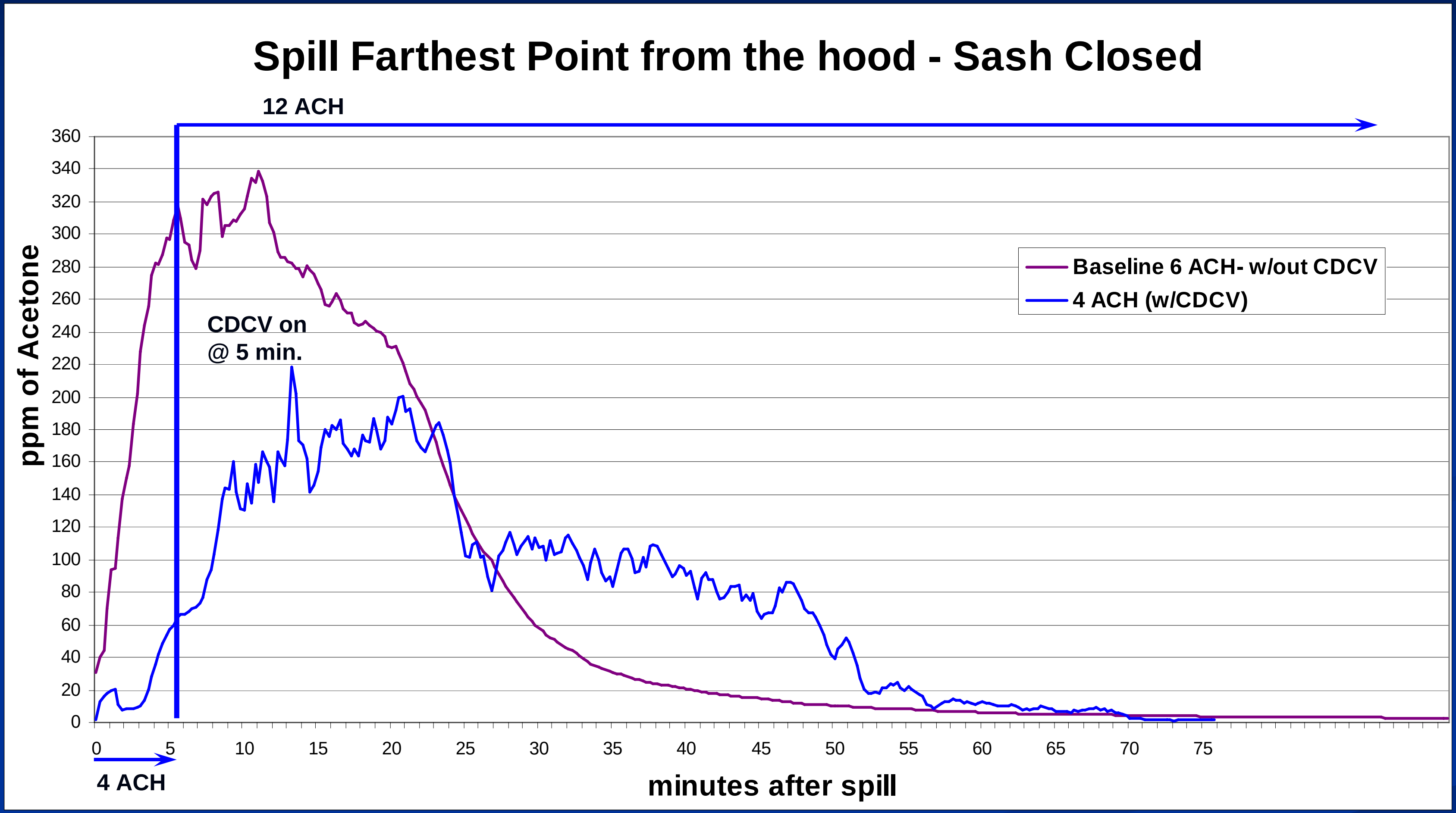
- 500 ml of acetone
- Baseline measurement and with CDCV activated
- Photoionization detector - 10.6 eV lamp
  - MiniRae 2000 instrument
  - CDCV

- CDCV ventilation activation level: 0.5 ppm
- CDCV polling interval time: 14-17 minutes

Distributed, Multi-Point Air-Sampling Network



Air Contaminant Monitoring Results
Spill Farthest Point from Hood - Sash Closed



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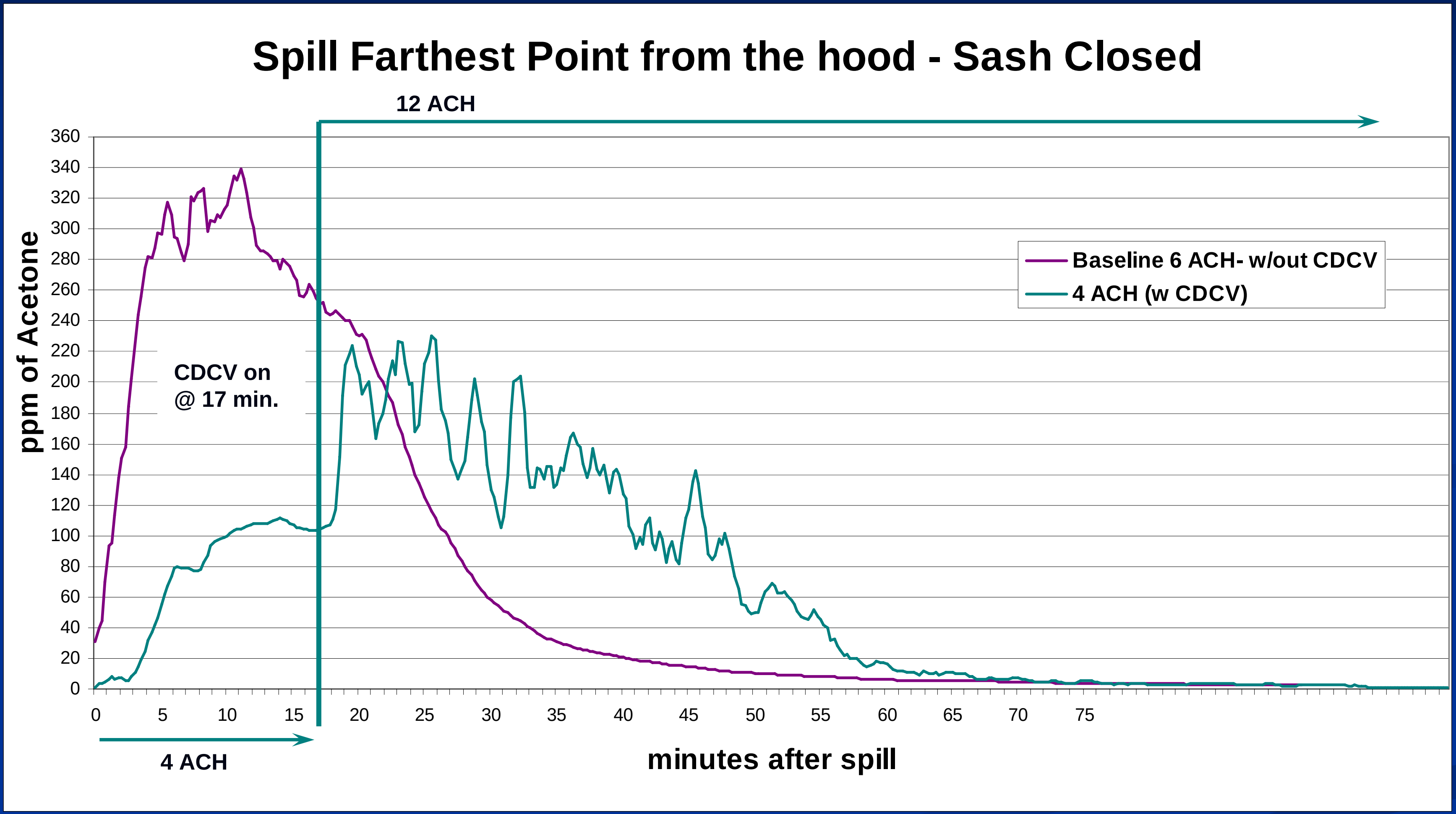
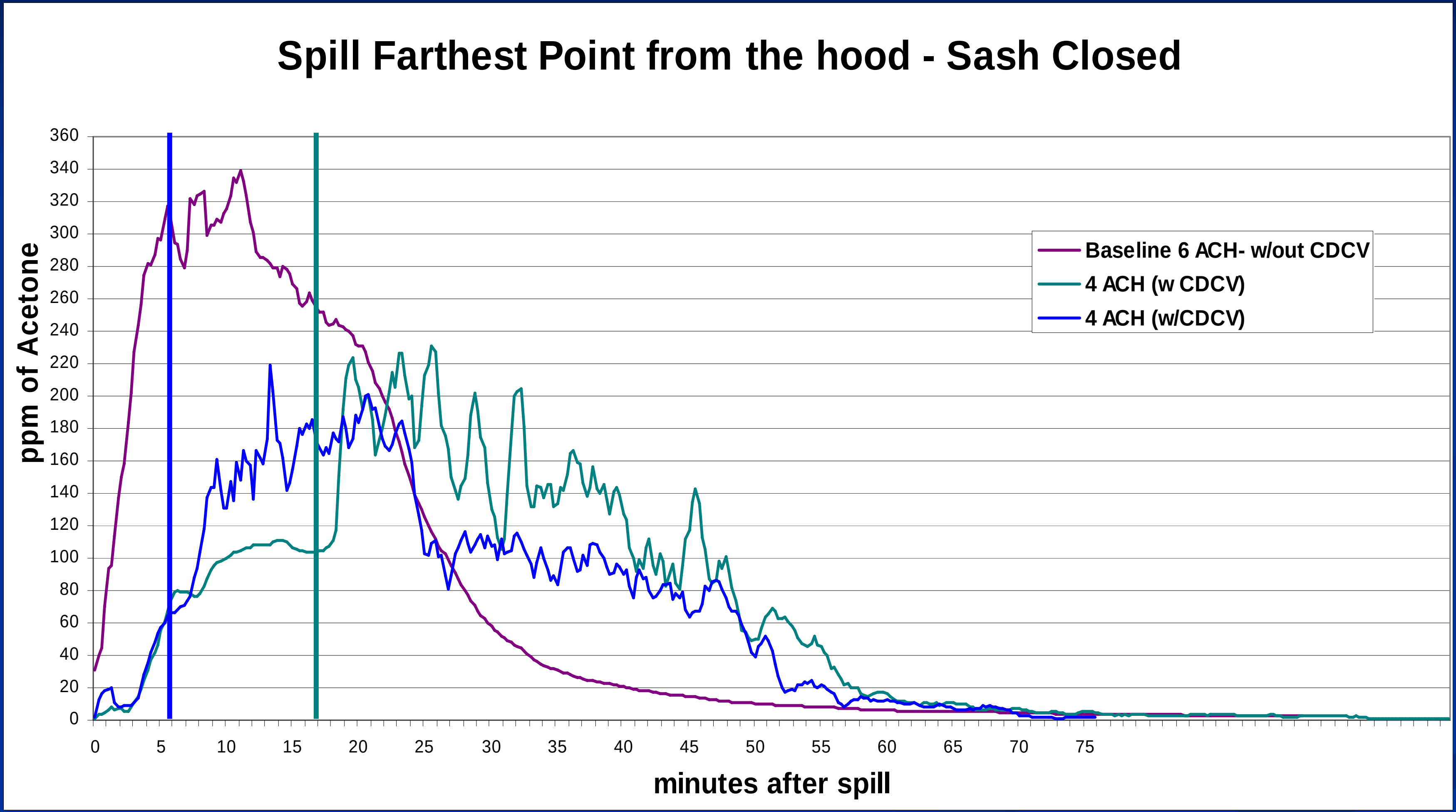


Air Contaminant Monitoring Results Spill Farthest Point from Hood - Sash Closed



Spill Results Summary

Event	Pre-spill ACH	Post-spill ACH	Minutes post- spill ventilation increased	*Peak Conc. (ppm)	Clearance Time (min.)
Baseline Spill w/o CDCV	6	6	n/a	339	73
Spill 1 w/CDCV	4	12	5	219	70
Spill 2 w/CDCV	4	12	17	227	76

* MiniRae 2000

Conclusions

- CDCV
  - Effective at sensing acetone levels
  - Is responsive
  - When activated, lower peak concentration in open areas
- Polling time could result in delay in detecting spill
- No significant difference in clearance time

Lessons Learned ~ Next Steps

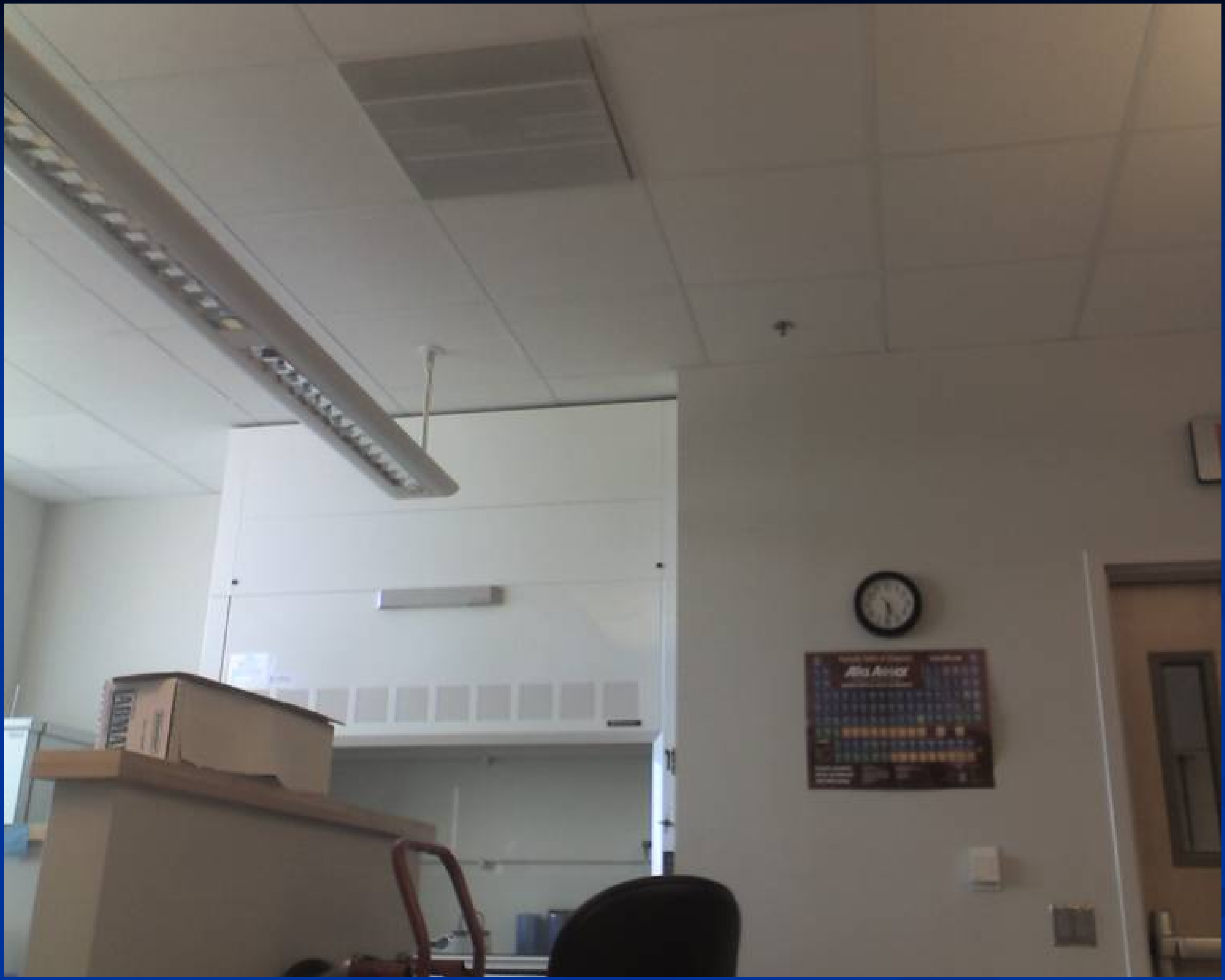
- Set polling interval frequency based on risk assessment
- Current sensor suite does not detect all chemicals
- Sensor selection should be based on risk assessment
- Calibration frequency at 6 months (+/- 15%)
- Sensor failure must “fail safe” to 6 ACH
- Sensor saturation / sensitivity
- Additional spill testing needed

Other Safety Considerations

- Energy Management System
  - Not meant to be a life safety system
  - Provides IAQ info
- Minimize impact of fugitive emissions
- Emergency override exhaust ventilation "red" button
- Provide visual display outside lab
- Notification to EH&S staff of spill
- Instant messaging to facility staff of system problems
- Preventative maintenance issues

Energy Savings?

- Goal: Reduce ACH rate by reducing CFM delivered to individual laboratory rooms by way of CDCV
- Step 1 – Select Building/Labs
  - ACH Reduction Constraints (FH, Freezers, Solar Heat)
  - VAV Controls and EMS
- Step 2 – Retro-Commissioning
  - Bad Cards
  - Bad Poppets
  - Poor Thermostat Location
  - Economizer (temp. reset 65 deg F)
  - Low Duct Static Pressure
  - CFM Adjustment for Actual Room Size


Alfa Aesar

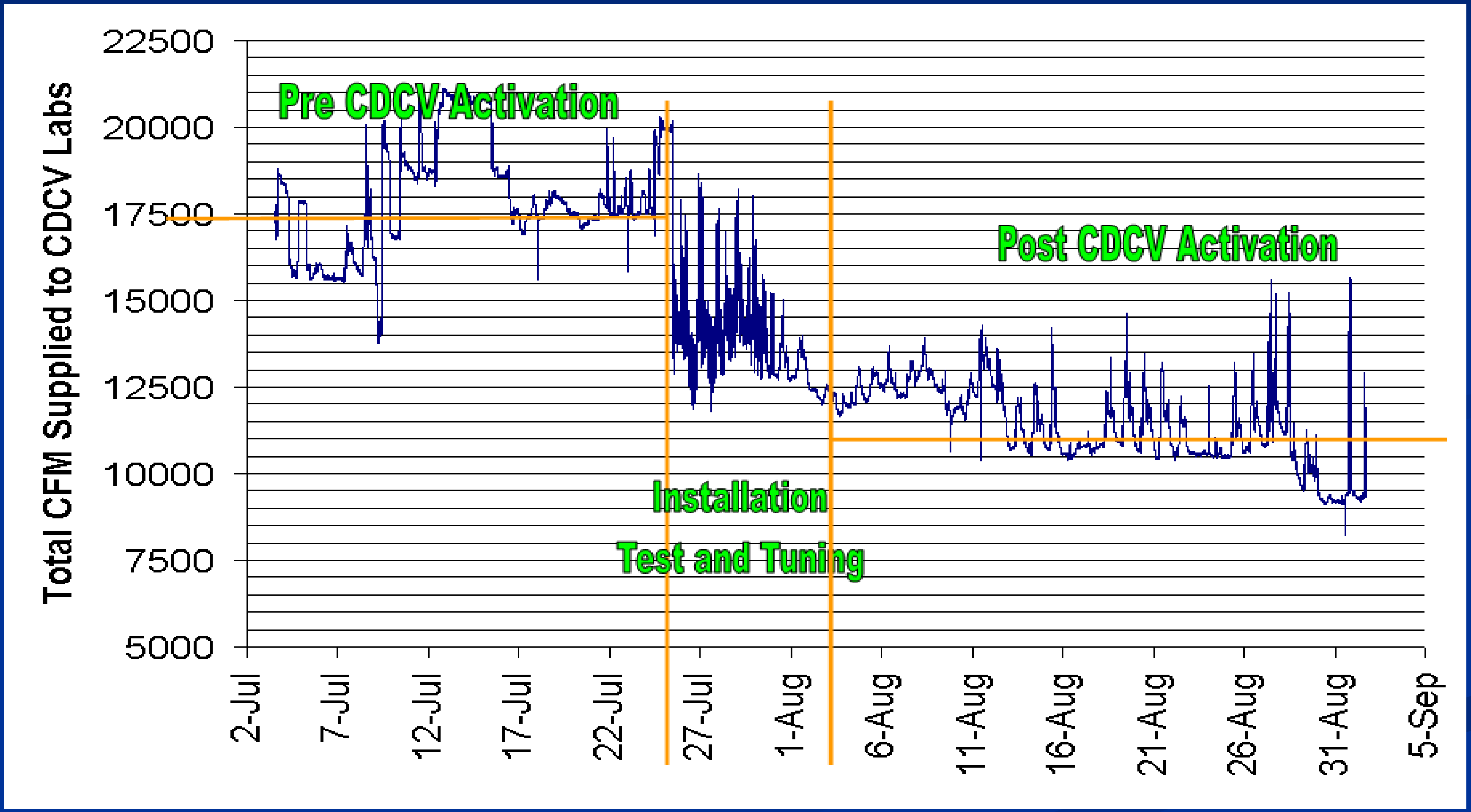
Energy Savings?

- Step 3 – Installation
  - Hard wired approach vs. EMS control
  - Valve adjustment (clamps)
- Step 4 – Trial and Error
  - Fail Safe Mode?? (no notification)
  - ACH verification (Room CF)
  - Spill Testing
  - CFM verification with EMS (same source!)

Lessons Learned

- Step 5 – Evaluation of the System
  - There is an inherent gain of useful information such as lab temperature, sensed data, and potential commissioning data (LEED).
  - Areas for improvement:
    - Front End with ACH would be helpful
    - Direct user notification of failure
    - Considerations: User training and service contract for sensor change-out in original contract.

Croul Hall CFM Rate Change



System Payback?

- System Installation Cost approx. $125,000 not including deferred maintenance and retro-commissioning.
- Observed CFM reduction in installed labs during a two week snapshot comparison ~6,100
- Anticipated payback: 2-5 years
- Still fine tuning the system

Next Steps - 1

- Croul Hall - CDCV
  - 4/2 ACH setback with occupancy sensing
  - Emergency exhaust red button
- Croul Hall – Occupancy Based
  - 4/2 ACH setback with occupancy sensing
  - Visual and audible signal to occupant of AC's
  - Emergency exhaust red button
  - EH&S lab oversight (additional)

Next Steps - 2

- Additional Testing (3^{rd} Party) of System Components
- MBCx and Energy Savings Verification
- LEED-EB Certification
- Maintenance Costs vs Energy Costs – further analysis

Next Steps - 3

- New Construction UC Irvine Gross Hall - CDCV
  - 4/2 ACH occupancy sensing
  - Emergency exhaust red button
  - CDCV - visible and audible signal to occupant

Next Steps - 4

- Your input
- Other studies

CDCV - A Retrofit Opportunity

- Classification of Hazardous Labs
  - Scrutinize air change rates
  - Consider Control Banding
- Baseline Lab Facility Operation
  - Perform Lab Airflow Survey
  - Test Lab VAV system periodically
- Labs21 Partnership Program
  - Benefits are numerous…

Question

Does Centralized Demand Controlled Ventilation (CDCV) Allow Us To Reduce Ventilation Rates & Save Energy Without Compromising Safety?

Answer

CDCV has merits. Further study is needed to gain a better understanding of the system. There is energy savings, further quantification is also needed.

Webinar Q&A

- Use chat box to send questions to “all participants”, preface your question with “Question to Panel”
- If you cannot write in your question, “raise hand” and we will un-mute you to talk
- If you want to view the panel:
  - At top right corner – click on panel, then click on video

Thank You!