Risk Analysis of Lab Bench
Top Processes to Ensure Safety in Smart Labs

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Large research university
$16M annual utilities budget
Lab buildings consume 2/3 of campus energy
Many energy initiatives to reduce carbon footprint
Goal

Balance energy savings & safety

Maximize Energy Savings

Without Compromising Safety
Learning Objectives

1. Centralized demand controlled ventilation (CDCV) overview
2. Lab bench top hazard screening process
3. Risk assessment criteria
4. Risk assessment-based air changes/hour (ACH) decision tree

Excluded from discussion:
- Fire and Mechanical Codes applicability
Centralized Demand Controlled Ventilation (CDCV)

- Air quality monitor varies lab ventilation rates depending on contaminant levels sensed by sensor suite
- Monitors and/or controls ACH
- Variable air volume (VAV) labs
CDCV Components

- Sensor Suite
- Information Management Server
- Web User Interface
- Web-Accessible Reports
- VAV Controller

Components:
- CO
- CO₂
- RH
- TVOCs
- Particles

Data

Internet

Air Data Router

Room Sensor
Air Changes (ACH)

- 4/2 ACH setback with occupancy sensing
- Sensor failure must “fail safe” to 6 ACH
  - Sensor suite does not detect all chemicals
  - Calibration frequency at 6 months
- Visual signal to occupant of ACH
- Emergency exhaust red button
Air Changes (ACH) Continued

- ACH reduction not for:
  - Fume hood driven labs
  - Heat load driven labs
  - High risk labs
  - Chemical dispensing/storage areas
Smart Lab “Safety Net”

- Emergency General Ventilation Purge “Red Button”
  - Fully opens general exhaust ventilation valves
  - Response within minutes
  - Integrated alarm system
  - Deactivates when button is pulled out
Bench Top Screening Process

- Conduct room by room hazard screening
  - Industrial hygienist (IH) evaluates worker exposure
  - Review chemicals/operations
  - Interview lab staff
  - Review chemical inventory
  - Review engineering controls
- Fume hood operations excluded
Bench Top Screening Process
Continued

- Compare screening data with risk assessment criteria
- Enter screening data in database
  - Indicate follow-up needed
  - No ACH reduction
High risk labs – No ventilation reduction

- Biosafety Level 3 (airborne biohazard)
- Highly toxic gases
- Special ventilation requirements
- Chemicals/operations identified as high risk by bench top assessment or follow-up exposure monitoring
Risk Assessment Criteria
Continued

- **Chemicals of concern**
  - Acutely toxic by inhalation
  - Asphyxiants
  - Anesthetic gases
  - Carcinogens
  - Reproductive toxins
  - Air contaminants that have occupational exposure limits (PELs, TLVs)
  - Strong odor producer
Industrial Hygiene Follow-up

- Follow-up for chemicals of concern
  - Lab staff exposure monitoring studies
  - Work with lab staff to improve work practices
  - Training/standard operating procedures
  - Ventilation reduction possible if exposures can be controlled (improved work practices)
  - ACH may be increased until work practices are improved
Industrial Hygiene Follow-up
Continued

- Follow-up for complaints or “other” issues of concern not previously identified (professional judgment)
Work Practice Improvements

- Use local exhaust ventilation for source control
- Substitute less hazardous chemical
- Obtain pre-packaged mixtures
- Reduce quantity/frequency
- Modify operation procedures
Lab Bench Top Risk Assessment-based ACH Decision Tree (qualitative)
Other Considerations

- **Good practice:**
  - Control contaminants at the “source”
  - Don’t rely only on general dilution for control
  - Review lab operations/chemicals
  - Communication with lab staff

- **ACH & exposure:**
  - Exposure limits are not based on ACH
  - No known correlation between ACH and exposure or disease
Challenges

- Lack of “universal” CDCV sensor for all chemicals
- Ongoing need for risk assessments of lab operations
- Incomplete chemical inventories
- Great variety of hazardous operations and chemicals
- Changes in research operations and staff
- Uncertainty of health effects of chemicals
- Future research needs unknown
- Restrictions on research operations not tenable
Challenges Continued

- EH&S resource demand for:
  - Ongoing need for hazard assessments
  - Exposure monitoring
  - Work practice corrections
  - Training
  - Potential complaint investigations
Next Steps

- Develop system to identify changes in lab operations
- Re-assess bench top operations:
  - New researchers arrive
  - Lab moves (notification)
  - Periodic
- Promote more current/complete chemical inventories
Conclusions

- Energy savings can be achieved without compromising safety
- Lab ACH determination requires:
  - Flexibility (evolving process)
  - Contaminant source control
  - Active EH&S involvement in risk assessment of lab operations with lab staff
  - Reassessment when lab changes occur
  - Current/complete chemical inventories
This concludes the University of California, Irvine presentation, “Risk Analysis of Lab Bench Top Processes to Ensure Safety in Smart Labs”