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College of Veterinary Medicine

Directional Airflow

What, Where, & When?

J. Paul Jennette, MS, PE, RBP
Director of Biocontainment Operations
Cornell College of Veterinary Medicine



The Purpose of Directional Airflow in Containment Facilities

To *mitigate* the risk of airborne contaminants being released from a containment facility, as a fundamental component of the facility's (*secondary*) barrier function.



What is Directional Airflow?

*Directional Airflow is ***not***
the same as Differential Pressure*





Airflow and DP

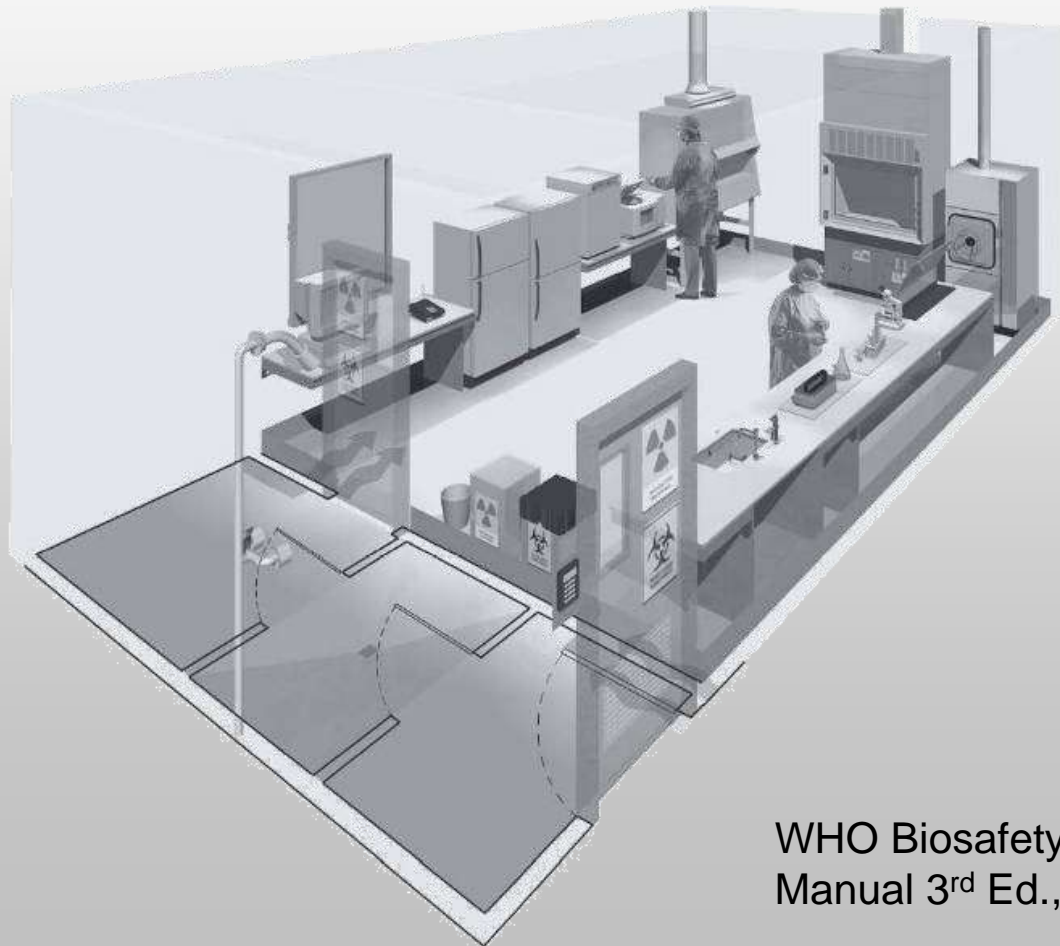
$$DP = \frac{Q^2}{(2610 * A)^2}$$

- DP = differential pressure (inches of water)
- Q = air flow (cfm)
- A = total leak area (square feet)
- 2610 = conversion factor



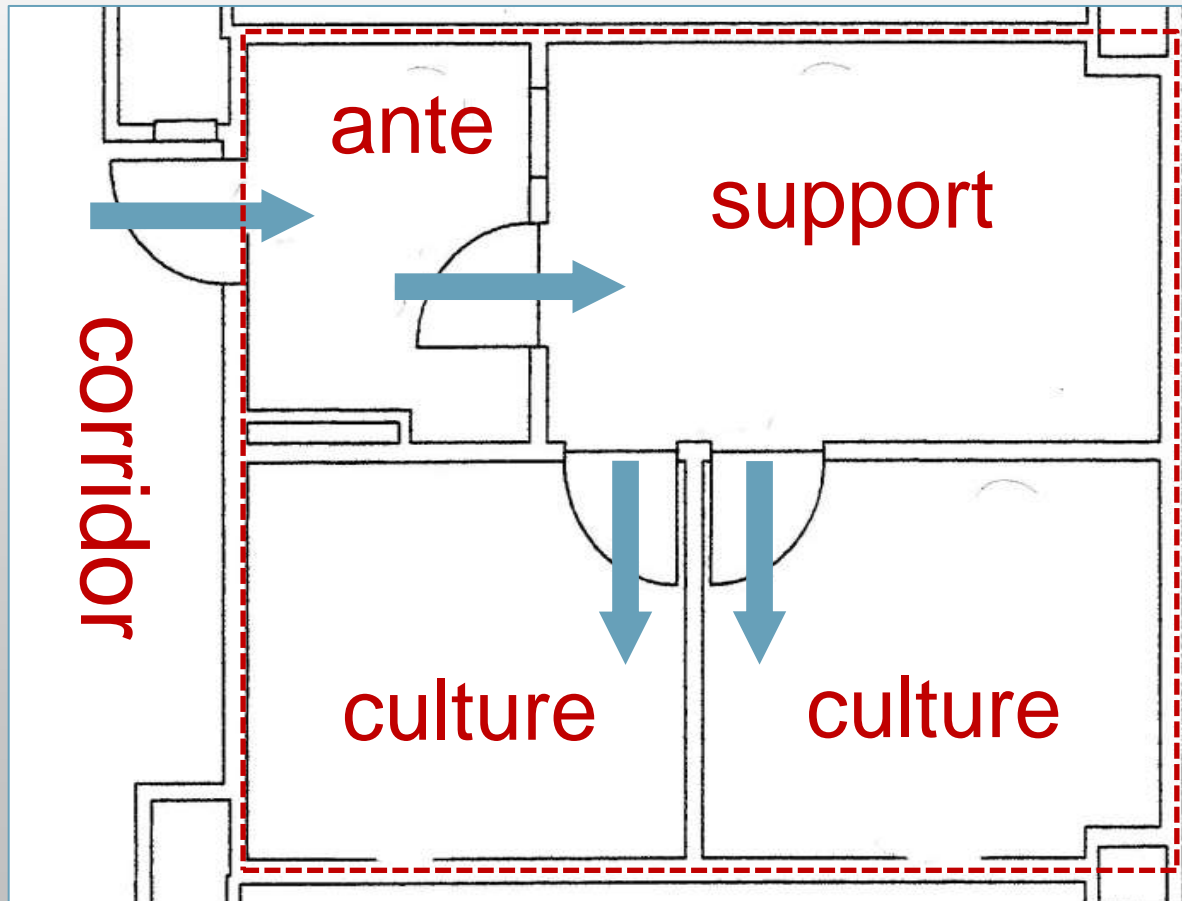
Where *Should* We Expect Directional Airflow to Occur?

- Within Rooms
- Between Rooms
- Across Whole Facilities





Where *Should* We Expect Directional Airflow to Occur?





When Do We Need Directional Airflow?

- Normal, steady-state conditions-?
- Upset conditions
 - Internal Upsets, causing aerosol release
 - External Upsets, causing airflow reversal



Internal Upsets: Aerosol Release

- Equipment Failures
- Accidents
- “Bad Behavior”





Aerosol Containment Testing, 1



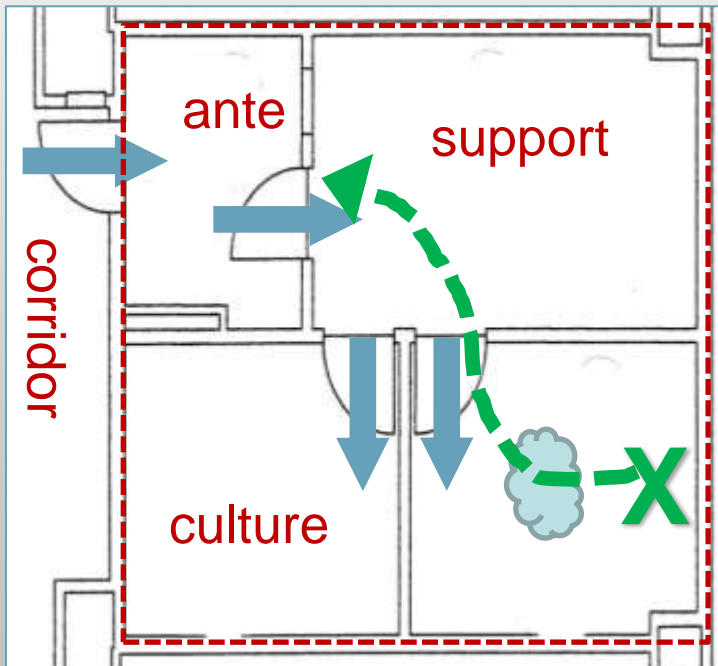


Aerosol Containment Testing, 2





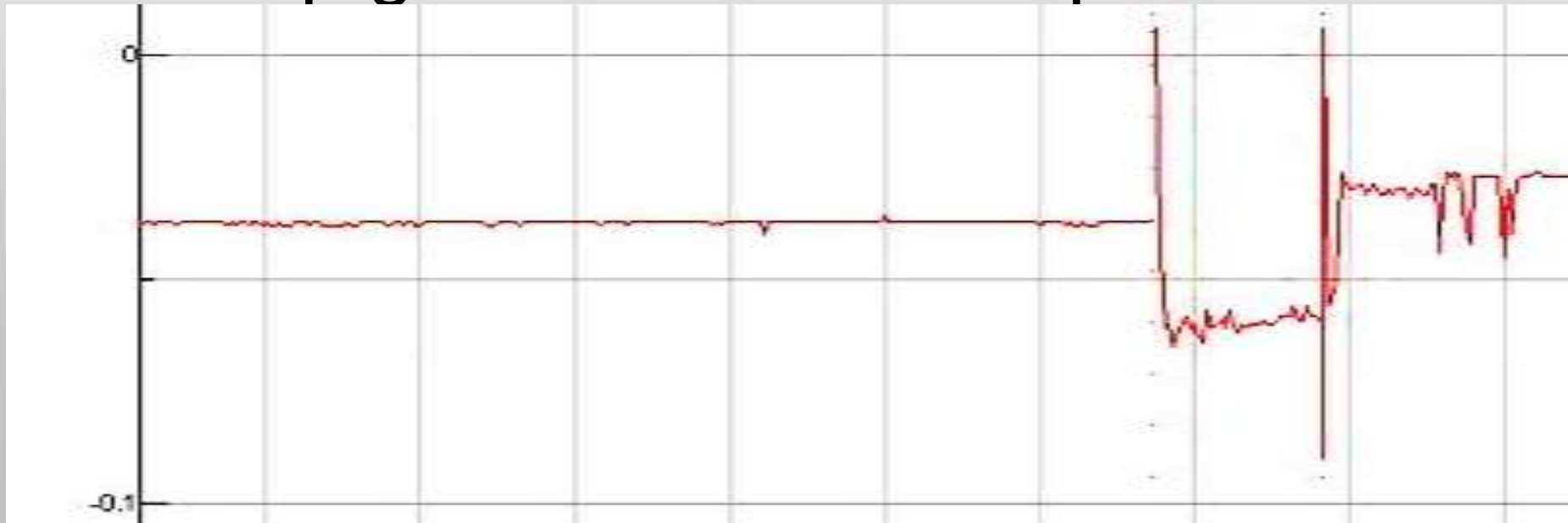
Aerosol Containment Testing, 3





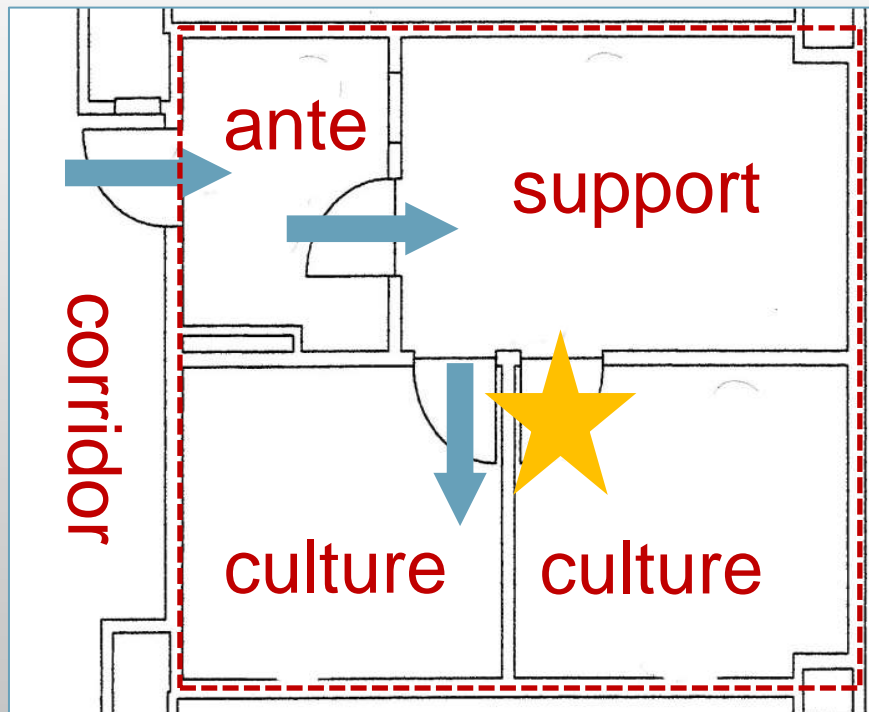
External Upsets: Airflow Reversal

- Power failure & transition to backup generator
- Exhaust Fan failure & transition to backup fan





Airflow Reversal Testing



("Downstream" Side)



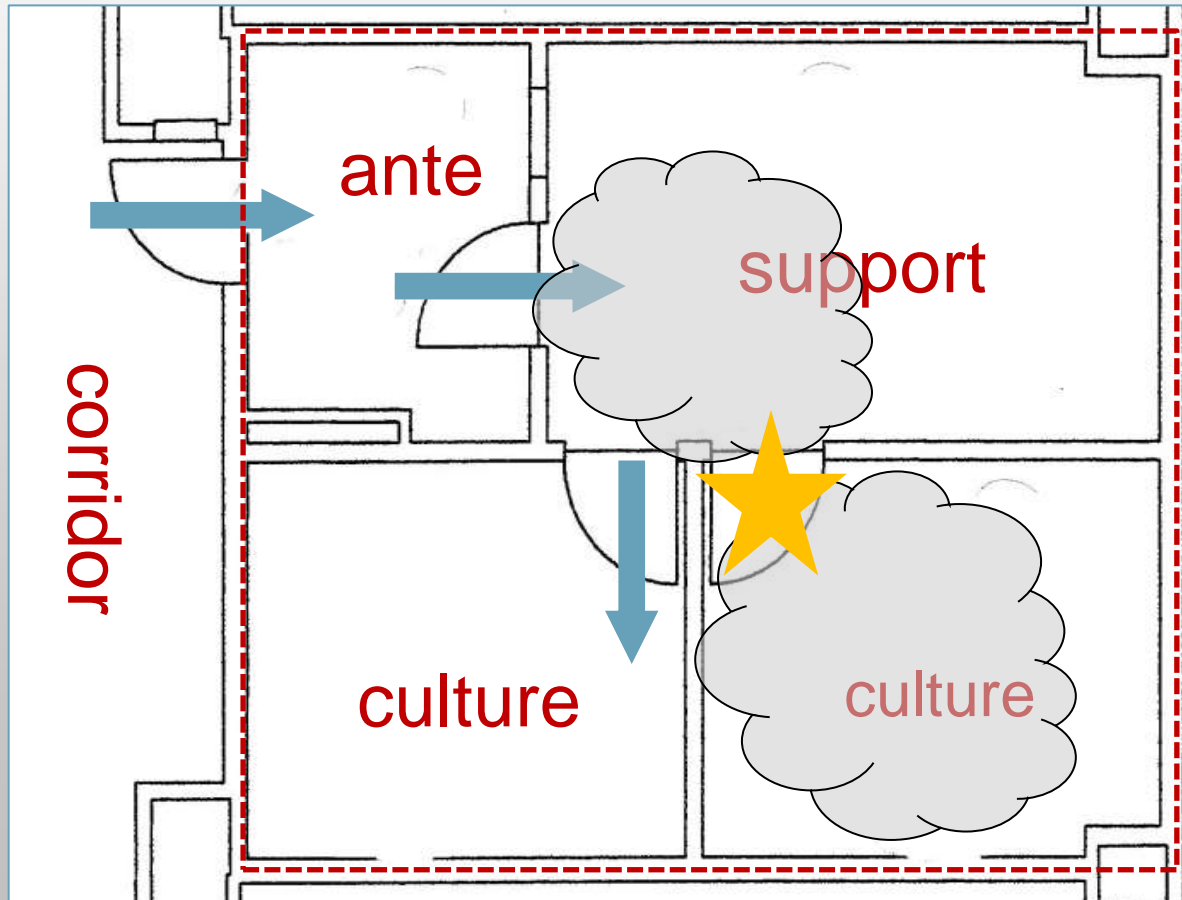
Airflow Reversal – Before Tuning



("Upstream" Side)



Airflow Reversal Impacts, Before





Airflow Reversal – After Tuning



("Upstream" Side)

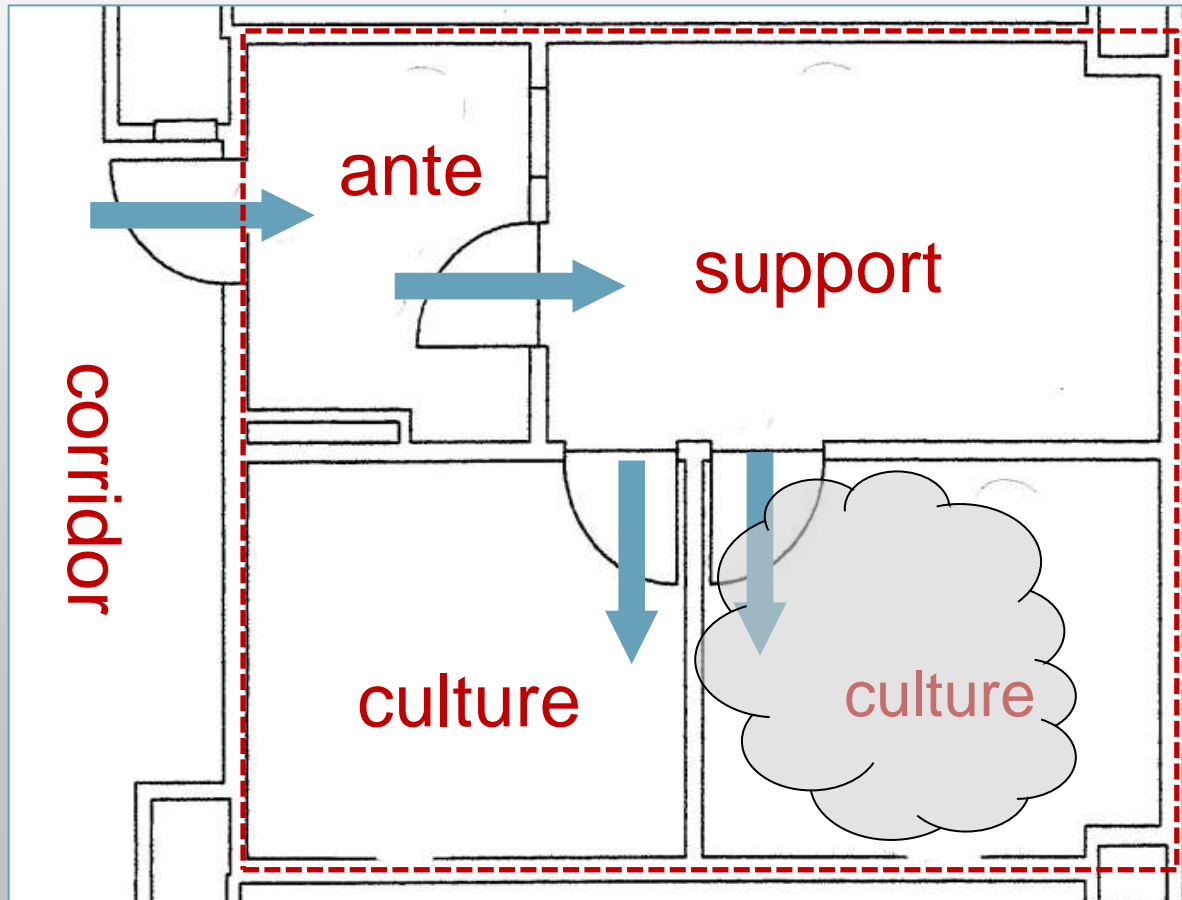


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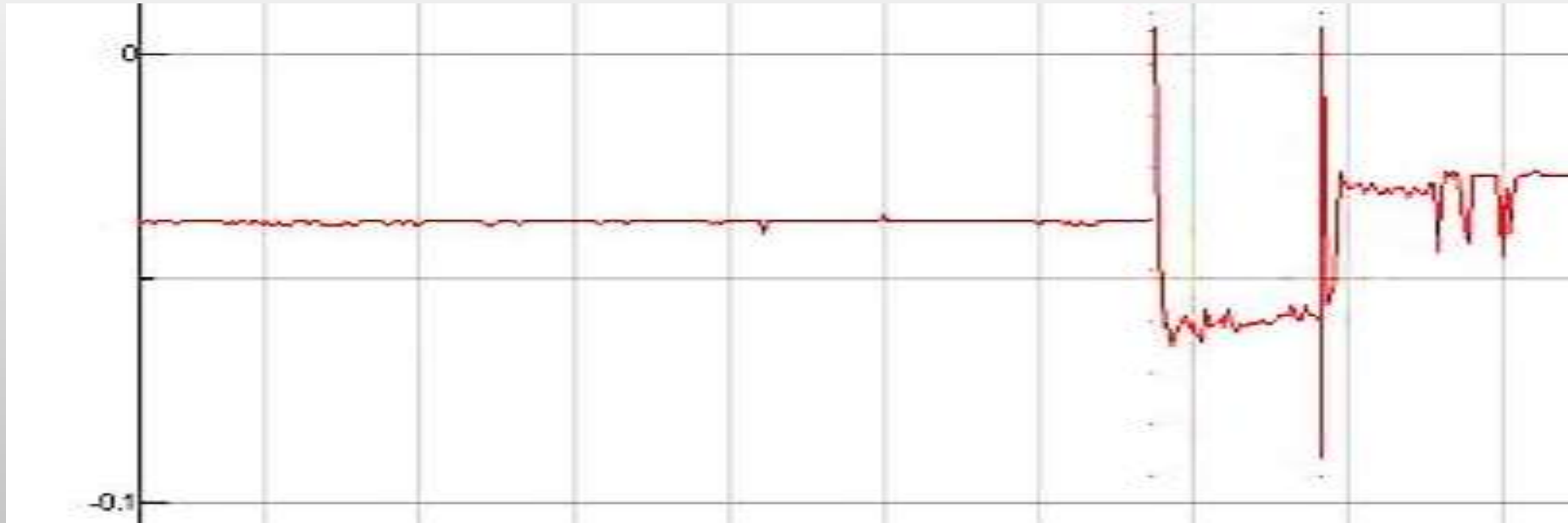


Airflow Reversal Impacts, After





Airflow Reversal? Release of Contaminated Air?





Coincident Events for Elevated Risk of Aerosol Release From Facility

- Internal Upset:
Aerosol Release in Lab + Open Door(s)
- External Upset:
Airflow Reversal + Internal Upset



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Relative Probabilities





Relative Probabilities

- Internal Upset:

(Aerosol Release in Lab) \times (Open Door)

- External Upset:

(Airflow Reversal) \times (Internal Upset)



Conclusions, 1

- Understanding Directional Airflow (D.A.) performance at doorways is critical
- Making conclusions about D.A. performance based on D.P. alone is incomplete
- Risk related to internal upsets is greater than from external upsets



Conclusions, 2

- Attention given to airflow reversals could be better spent on D.A. performance
- Holistic consideration of D.A. for an entire facility may be appropriate
- Holistic consideration of the containment performance of the total facility operation may be even better



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Thank You!