Failure Mode Testing During Verification Identifies Mechanical Failure in an ABSL-3 Facility

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Agenda

- Background
- Verification parameters
- Results
- Take home messages

Iowa State University 2013-2014

8,780 faculty & staff

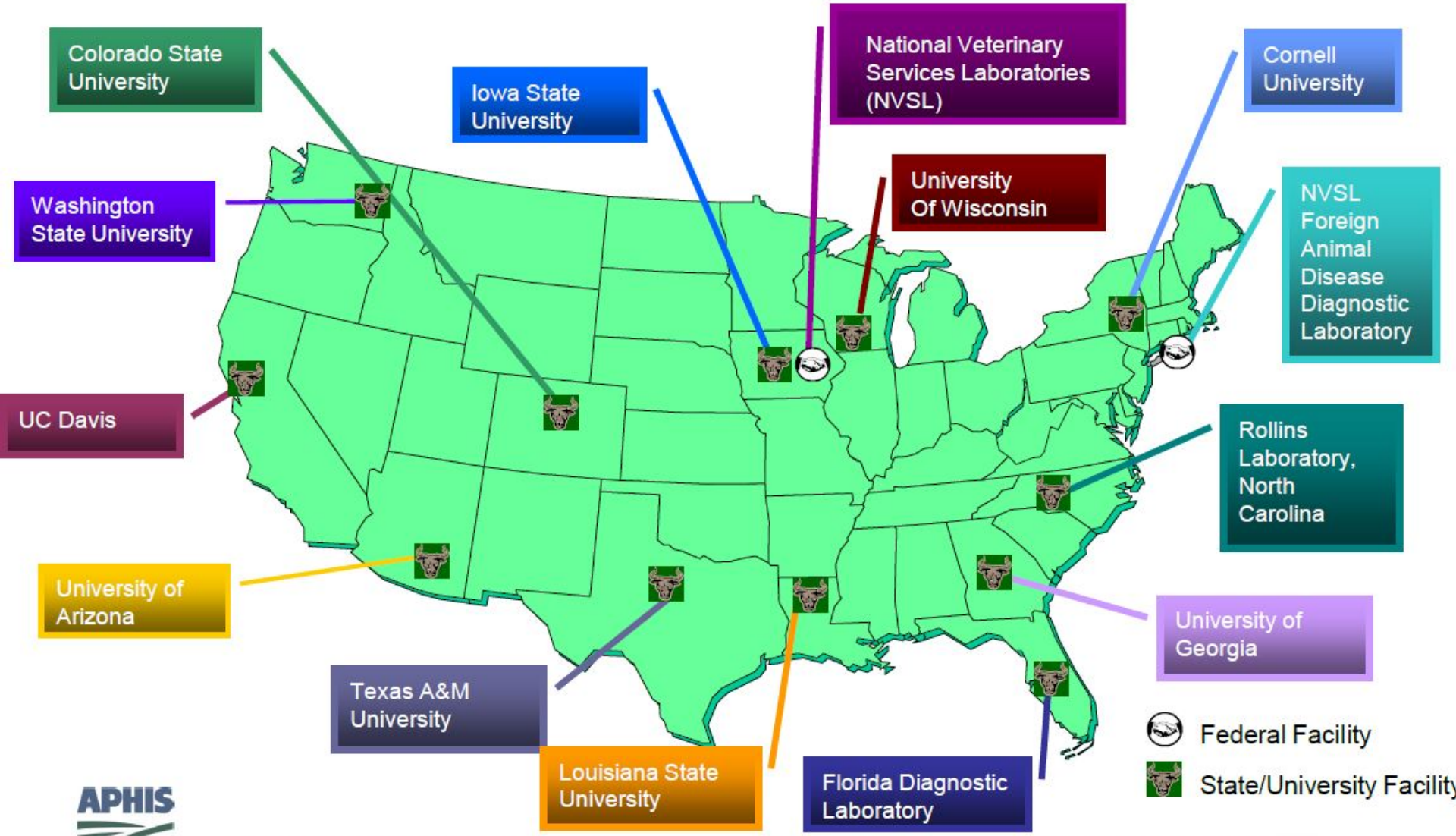
33,241 students
27,659 undergraduates
4,996 graduate students
586 Vet Med students

1,984 acres
802.9 hectares

BSL-3 Experience

- Animal Biosafety Level 3 – Insectary
- Single laboratory BSL3/ABSL3
- Modular BSL-3/ABSL3
- ***Veterinary Diagnostic Laboratory***

The original 12 NAHLN laboratories



NAHLN- A State and Federal Partnership to Safeguard Animal Health

Veterinary Services
Safeguarding Animal Health
July 2013

NAHLN Laboratory Requirements

1. Fully accredited by AAVLD or by an accrediting body to the OIE/ISO 17025 standard to cover the scope of NAHLN testing
2.
3.
4.
5. Competence, capability, and capacity for high-throughput testing
6. Active participation in electronic messaging of surveillance test results
7. Test data reported within time frames indicated in SOPs
8. Agrees to assist other laboratories to develop and implement IT capabilities
9. Shall accept samples from other states impacted by a disease outbreak
10. Provides funding associated with maintaining equipment and laboratory space used for NAHLN purposes

Provides and maintains BSL3 laboratory space with sample handling, processing, and testing capacity.

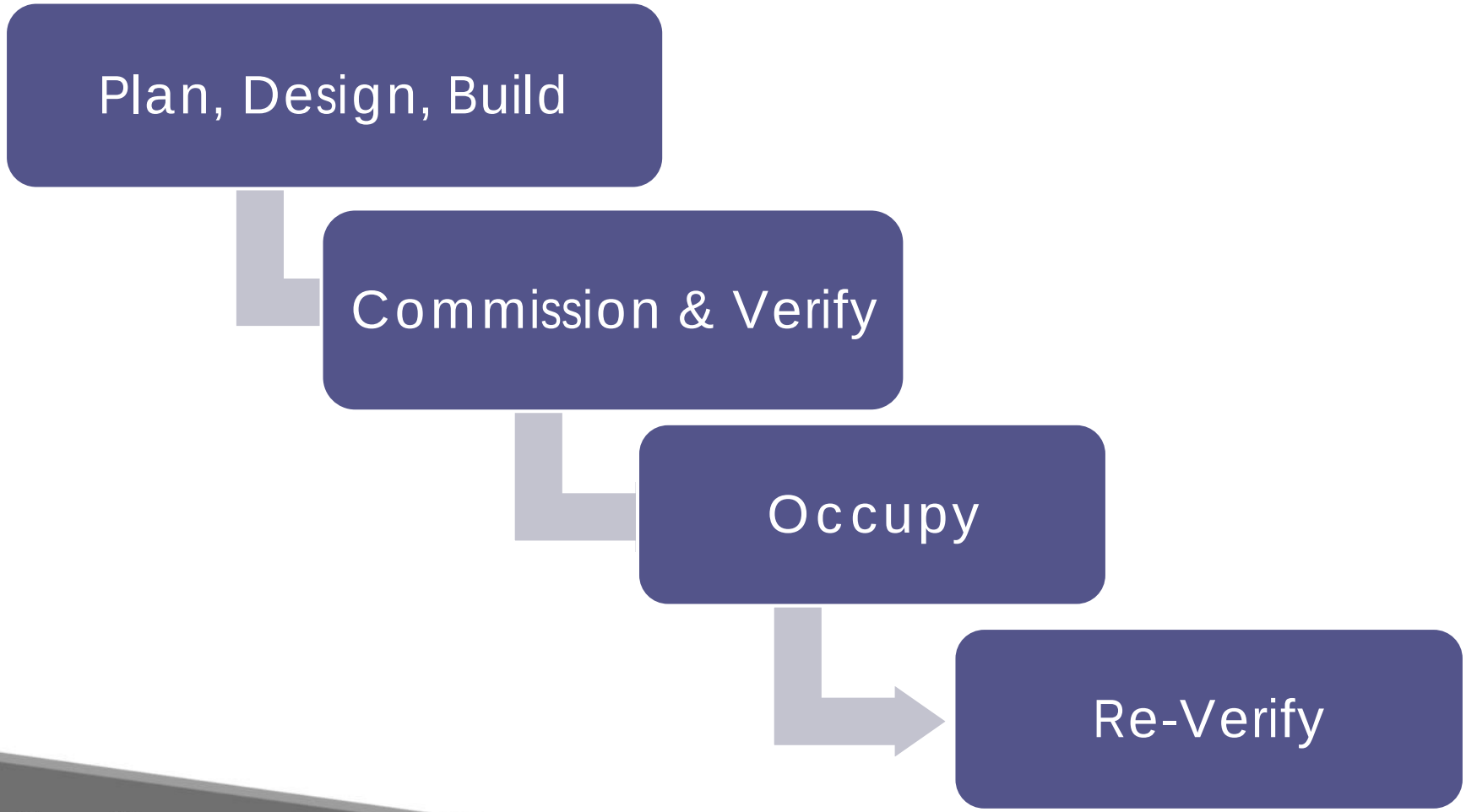
BMBL 5th

- Laboratory Facilities (Secondary Barriers)
  - 15 items to consider

'The (ABSL-3) facility must be tested to verify that the design and operational parameters have been met prior to use.'

'Facilities should be re-verified at least annually against these procedures as modified by operational experience.'

What we do?



Verification parameters

- Review of records (i.e. SOP, training, etc.)
- Physical inspection

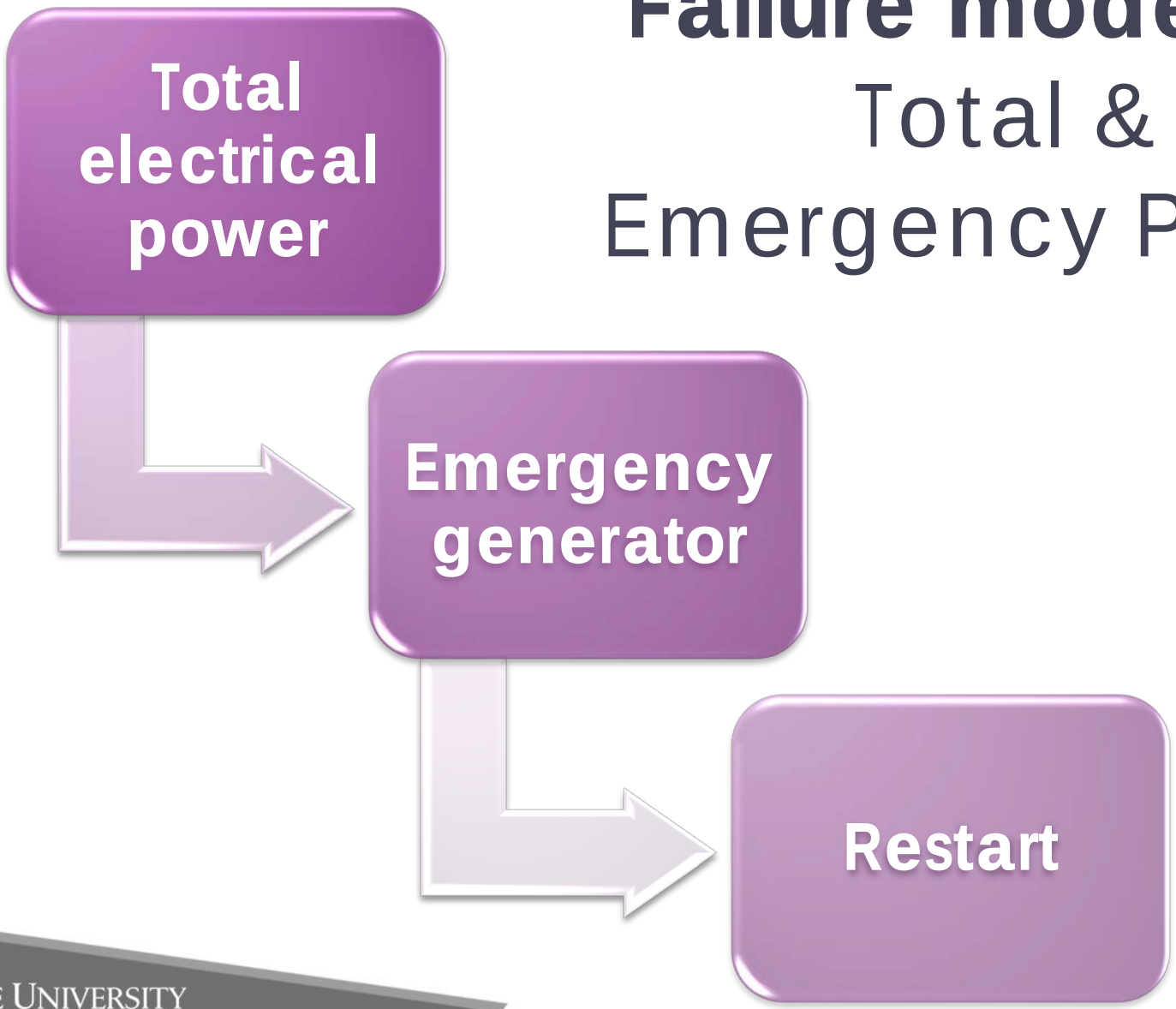
- **Operational performance tests**
  - Mechanical operation
  - Containment

Micromanometers

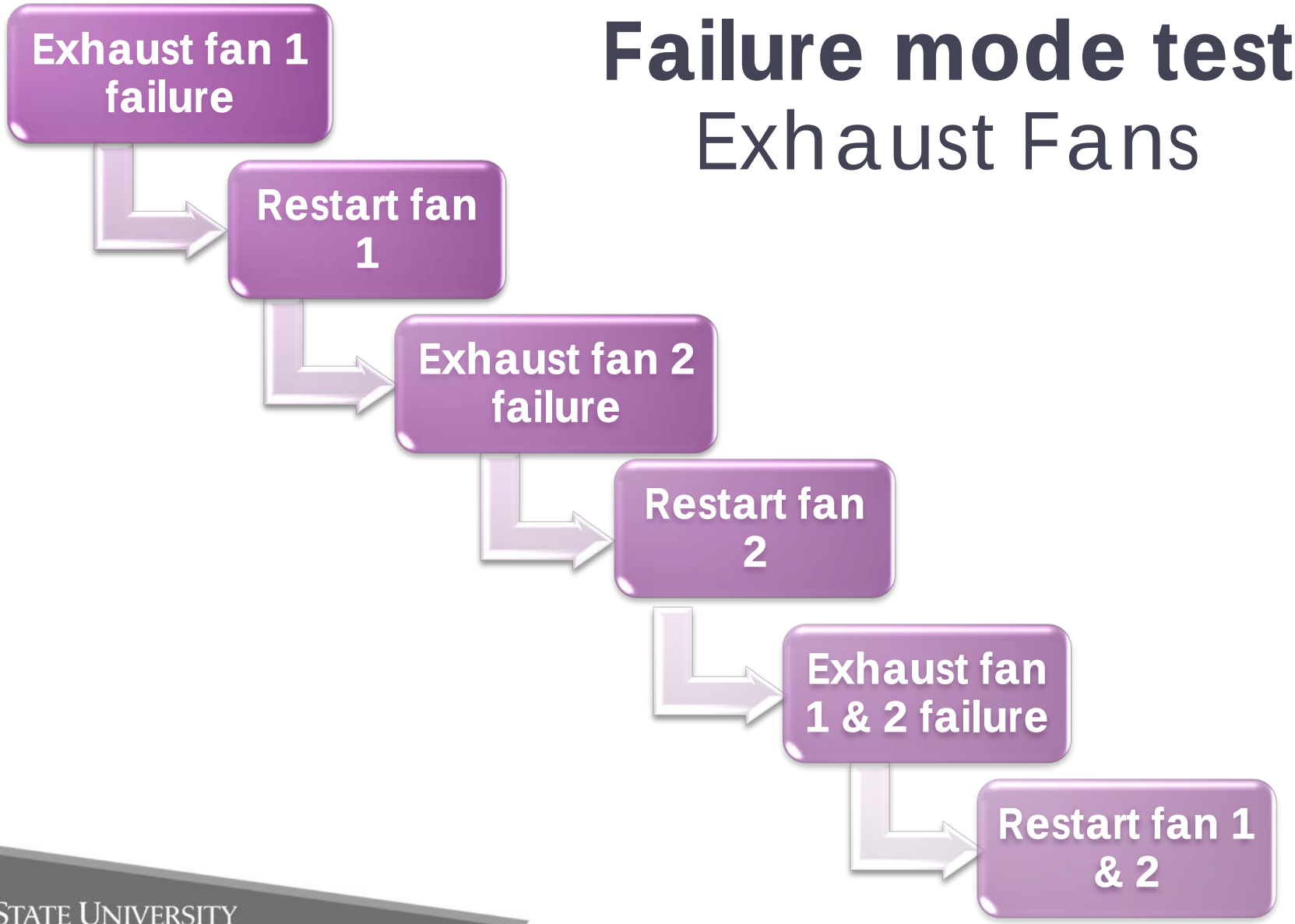
- Differential pressure between spaces
- Placed in doorways between adjoining spaces
- Failure mode testing mirrored previous year

Sequence for Testing

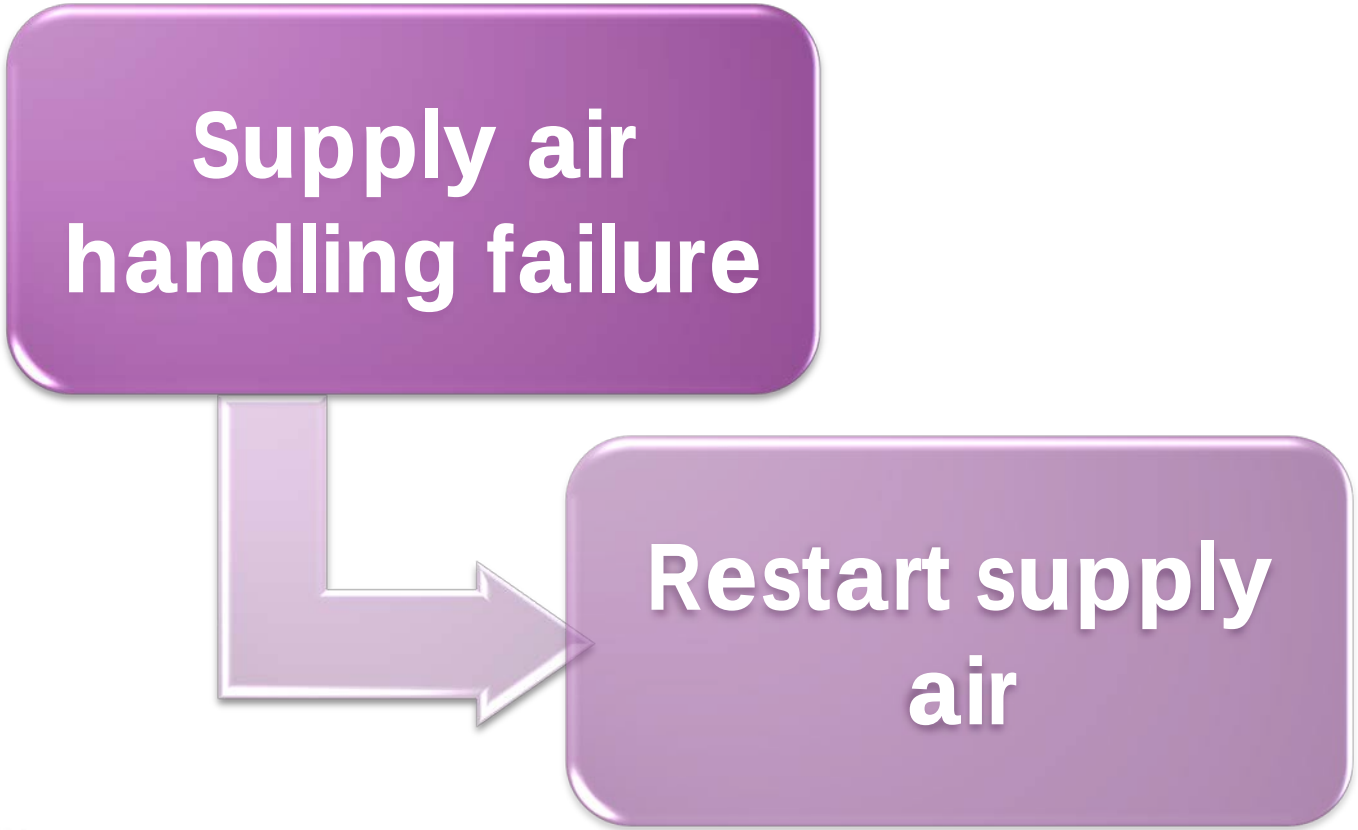
Failure mode test
Total & Emergency Power



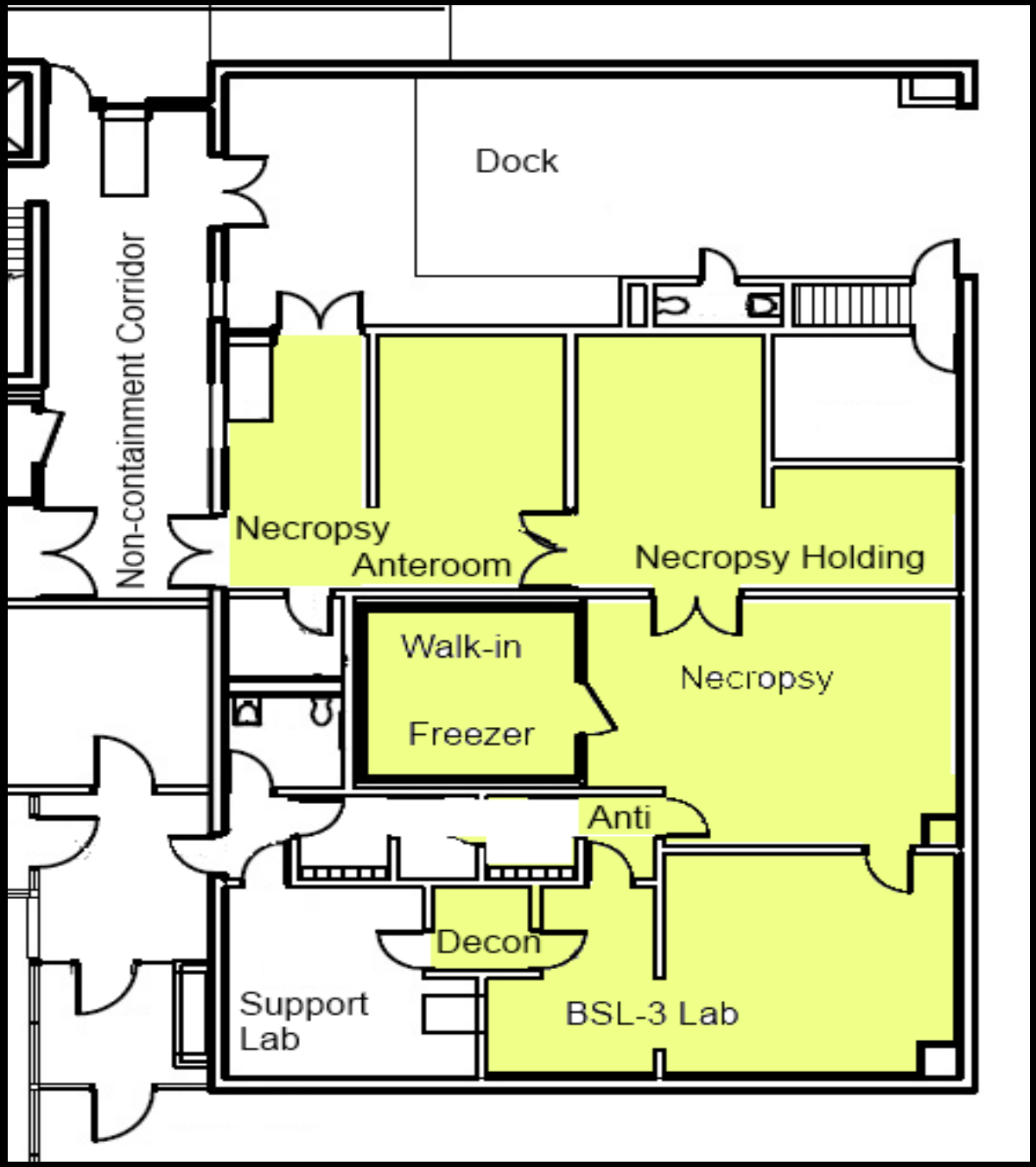
Failure mode test
Exhaust Fans



Failure mode test
Supply Fan



Facility description



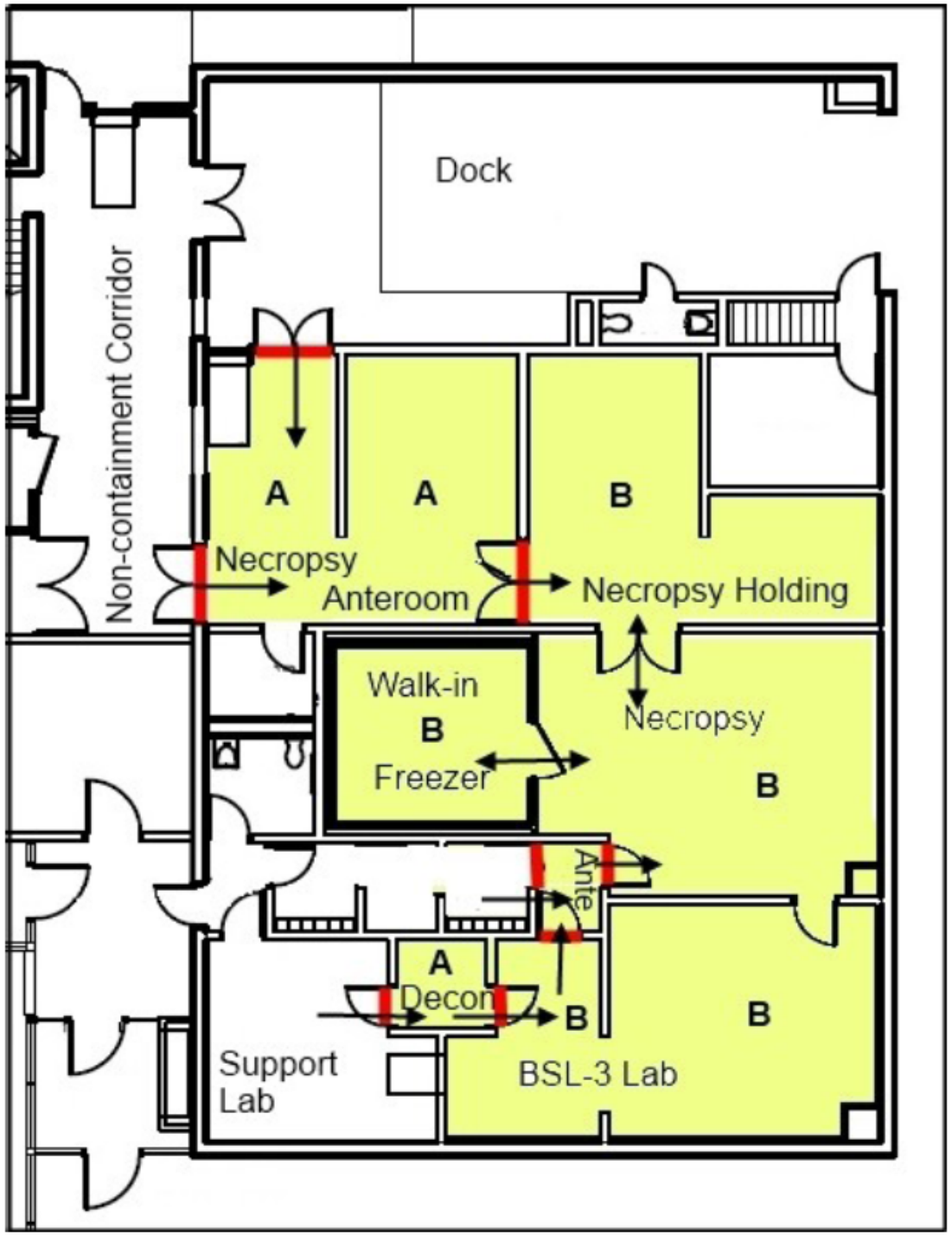
2,942 ft2 ABSL-3

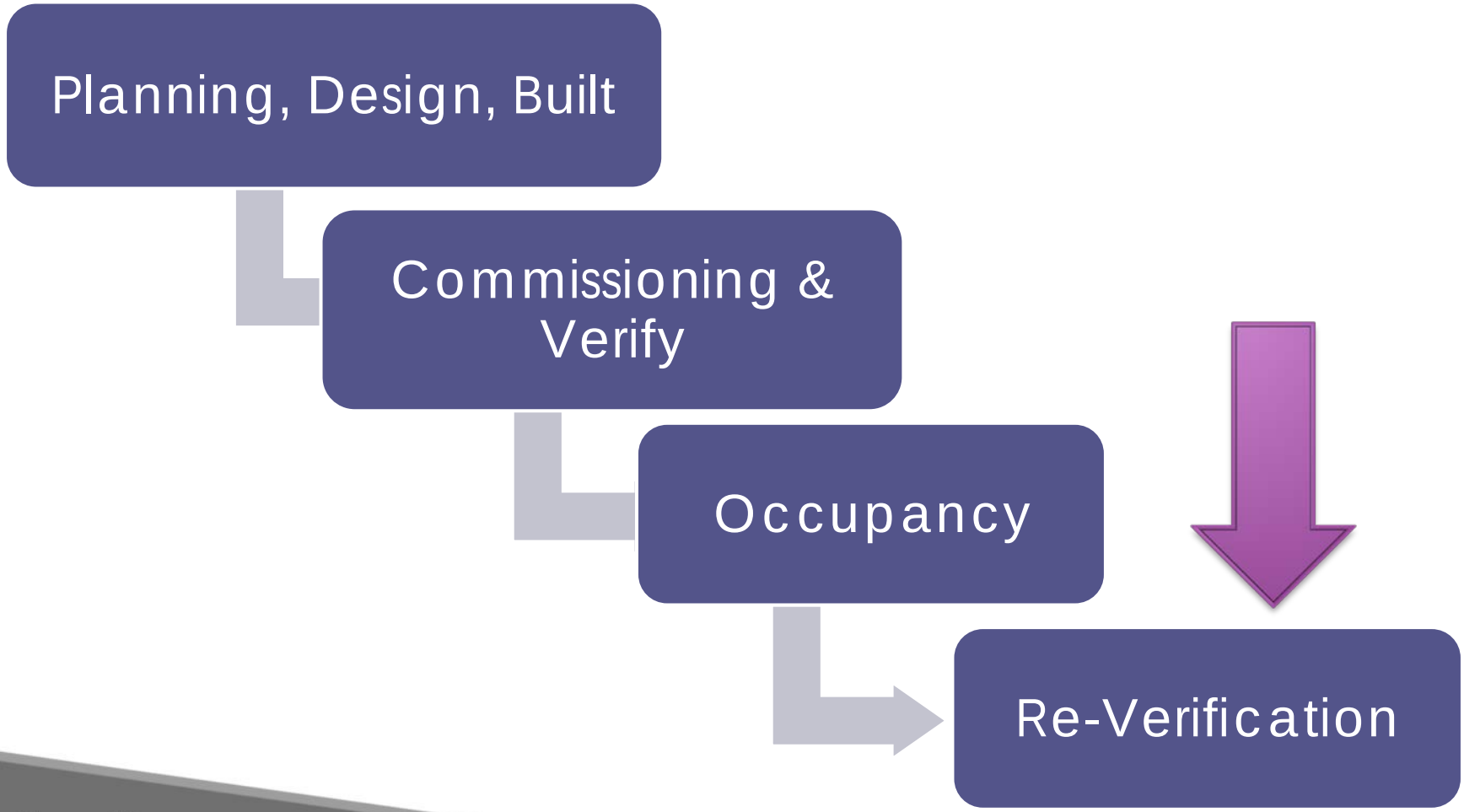
Ceiling Rail System

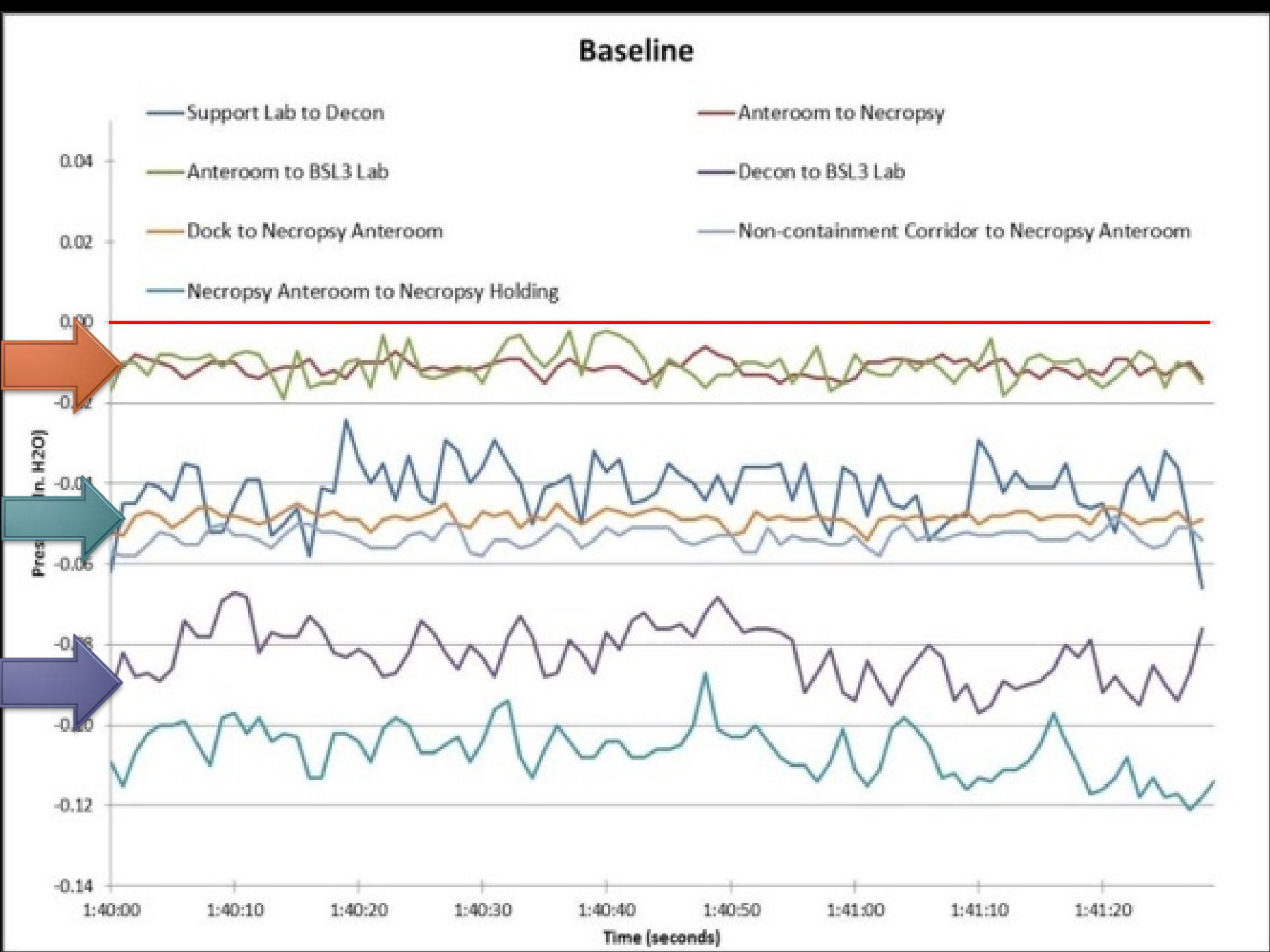
HVAC system

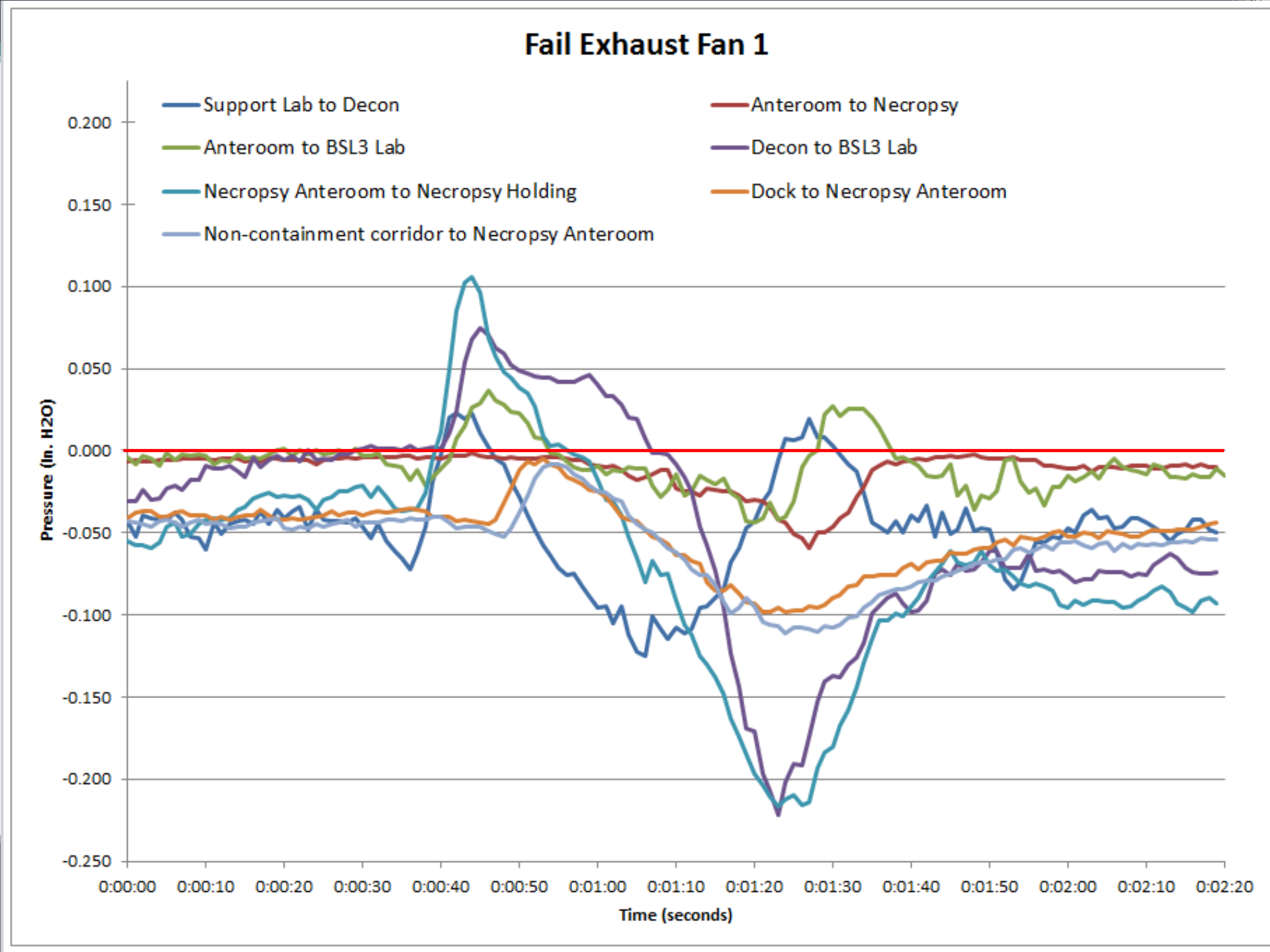
VAV 8-15
AIR
SUPPLY AHU-8
Tek-Air Job # 23359 Item # 23
Unit Tag # VAV 8-15 SUPPLY
Model # T-AV4112-12-SGN
Description:
VAV 8-15
CW
OPENS

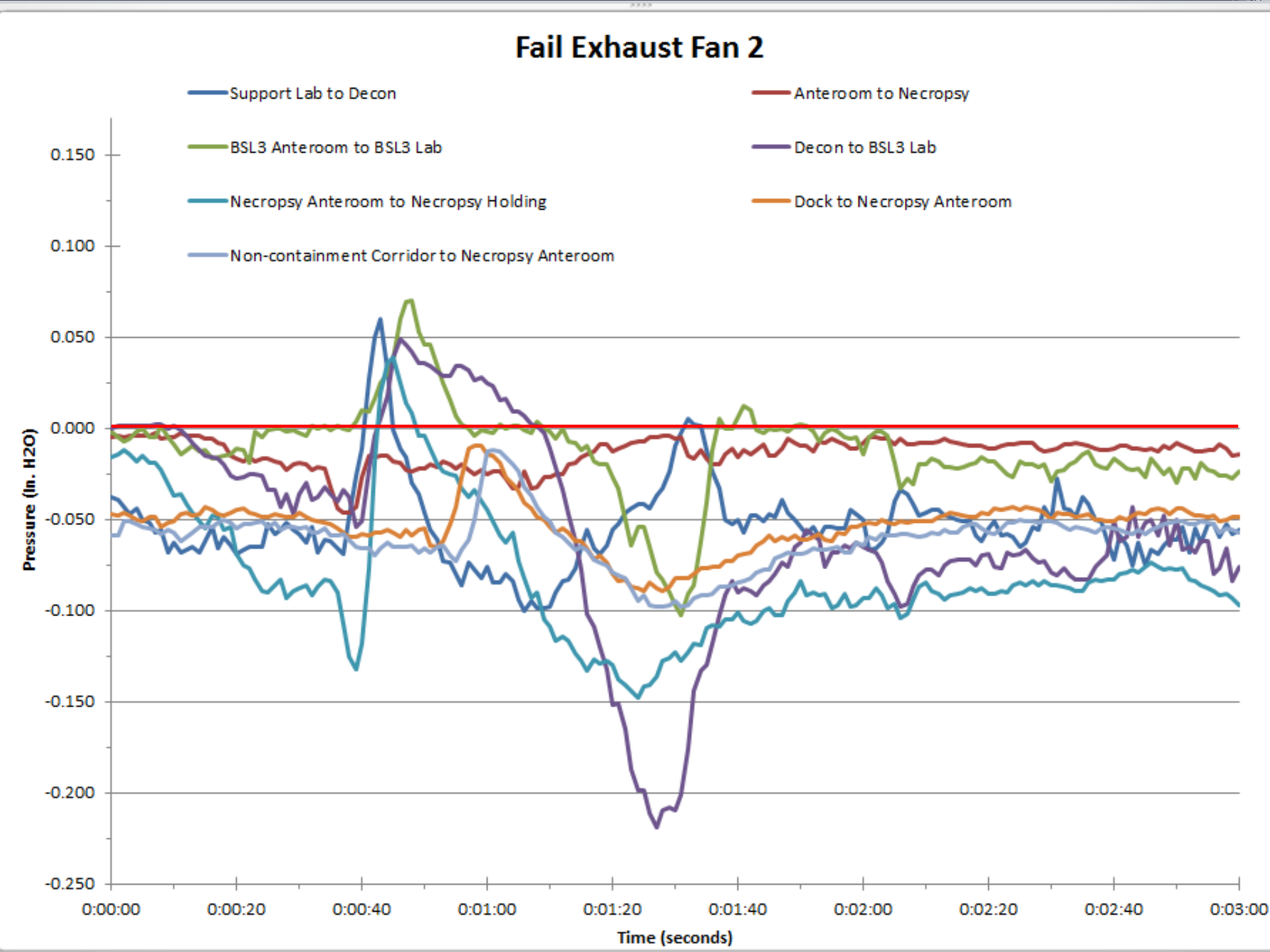
Magnehelic gauges


Dock
Non-containment Corridor
A
A
B
Necropsy
Anteroom
Necropsy Holding
Walk-in
B
Freezer
Necropsy
B
Ante
A
Decon
B
B
Support
Lab
BSL-3 Lab

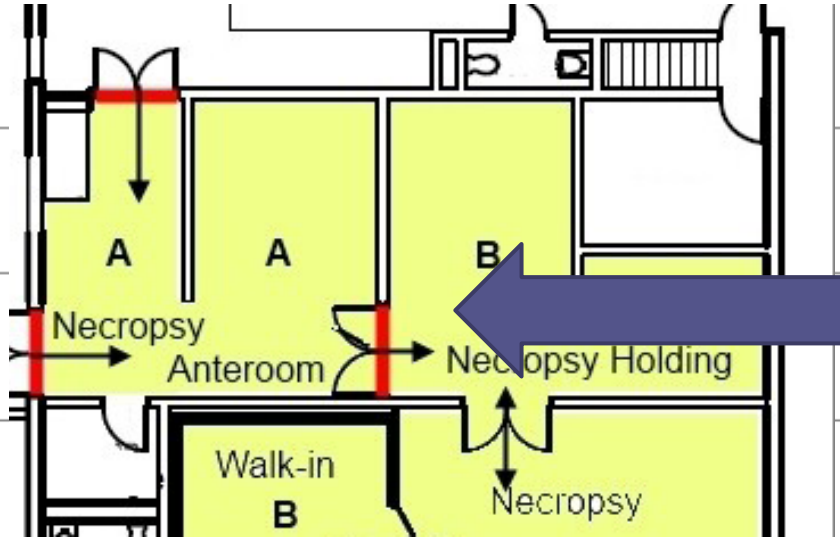

Planning, Design, Built
Commissioning & Verify
Occupancy
Re-Verification


Baseline
Support Lab to Decon
Anteroom to Necropsy
Anteroom to BSL3 Lab
Decon to BSL3 Lab
Dock to Necropsy Anteroom
Non-containment Corridor to Necropsy Anteroom
Necropsy Anteroom to Necropsy Holding
0.04
0.02
-0.12
-0.14
1:40:00
1:40:10
1:40:20
1:40:30
1:40:40
1:40:50
1:41:00
1:41:10
1:41:20
Time (seconds)


Fail Exhaust Fan 1
Support Lab to Decon
Anteroom to Necropsy
Anteroom to BSL3 Lab
Decon to BSL3 Lab
Necropsy Anteroom to Necropsy Holding
Dock to Necropsy Anteroom
Non-containment corridor to Necropsy Anteroom
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
-0.250
Pressure (In. H2O)
0:00:00
0:00:10
0:00:20
0:00:30
0:00:40
0:00:50
0:01:00
0:01:10
0:01:20
0:01:30
0:01:40
0:01:50
0:02:00
0:02:10
0:02:20
Time (seconds)


Fail Exhaust Fan 2
Support Lab to Decon
Anteroom to Necropsy
BSL3 Anteroom to BSL3 Lab
Decon to BSL3 Lab
Necropsy Anteroom to Necropsy Holding
Dock to Necropsy Anteroom
Non-containment Corridor to Necropsy Anteroom
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150
-0.200
-0.250
Pressure (In. H2O)
0:00:00
0:00:20
0:00:40
0:01:00
0:01:20
0:01:40
0:02:00
0:02:20
0:02:40
0:03:00
Time (seconds)

Fail Both Exhaust Fans



Support Lab to Decon
BSL3 Anteroom to Necropsy
BSL3 Anteroom to BSL3 Lab
Decon to BSL3 Lab
Necropsy Anteroom to Necropsy Holding
Dock to Necropsy Anteroom
Non-containment Corridor to Necropsy Anteroom

Pressure (In. H2O)

0.250
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
-0.150

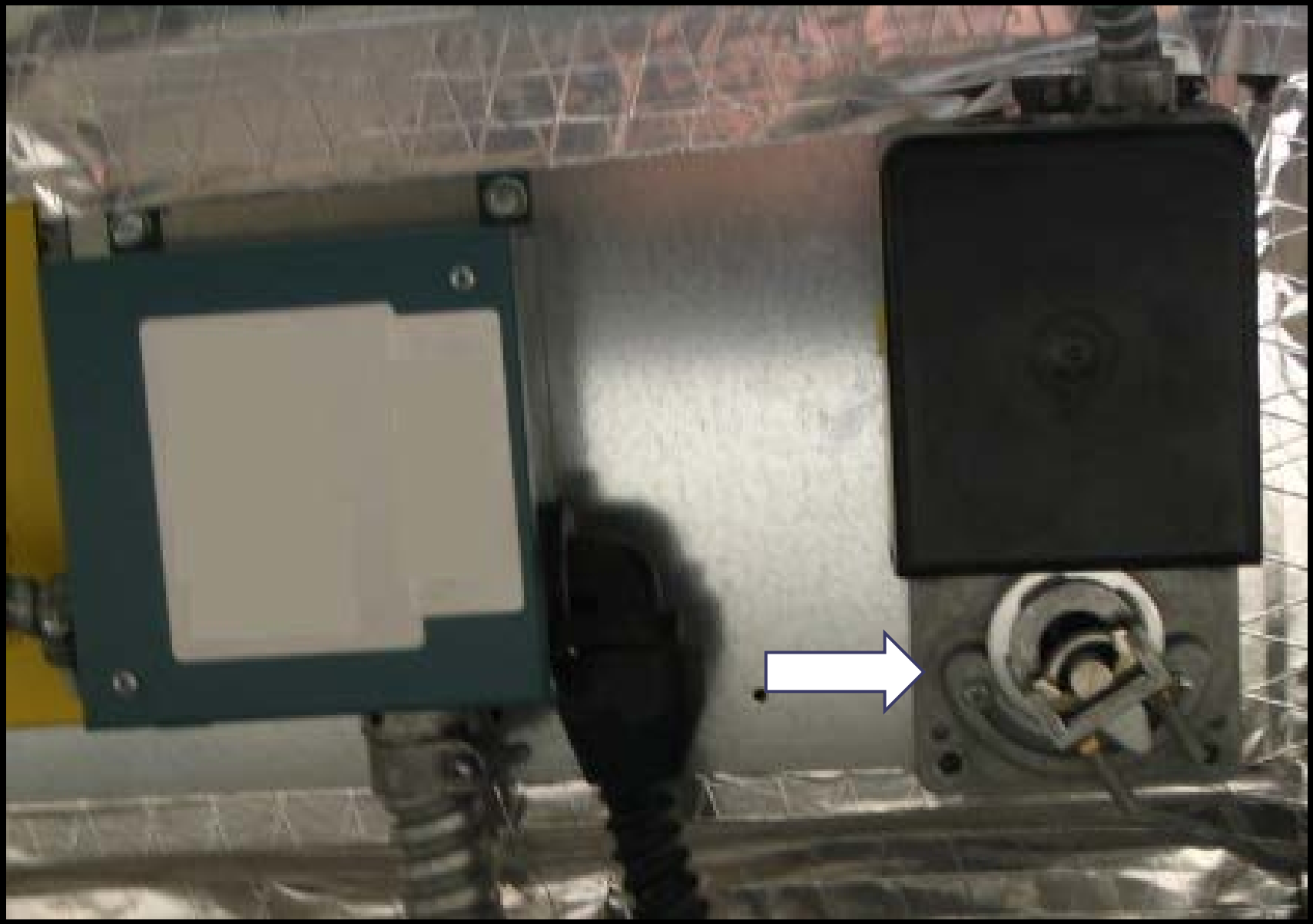
0:00:00
0:00:10
0:00:20
0:00:30
0:00:40
0:00:50
0:01:00
0:01:10
0:01:20
0:01:30

Time (seconds)

Potential culprits

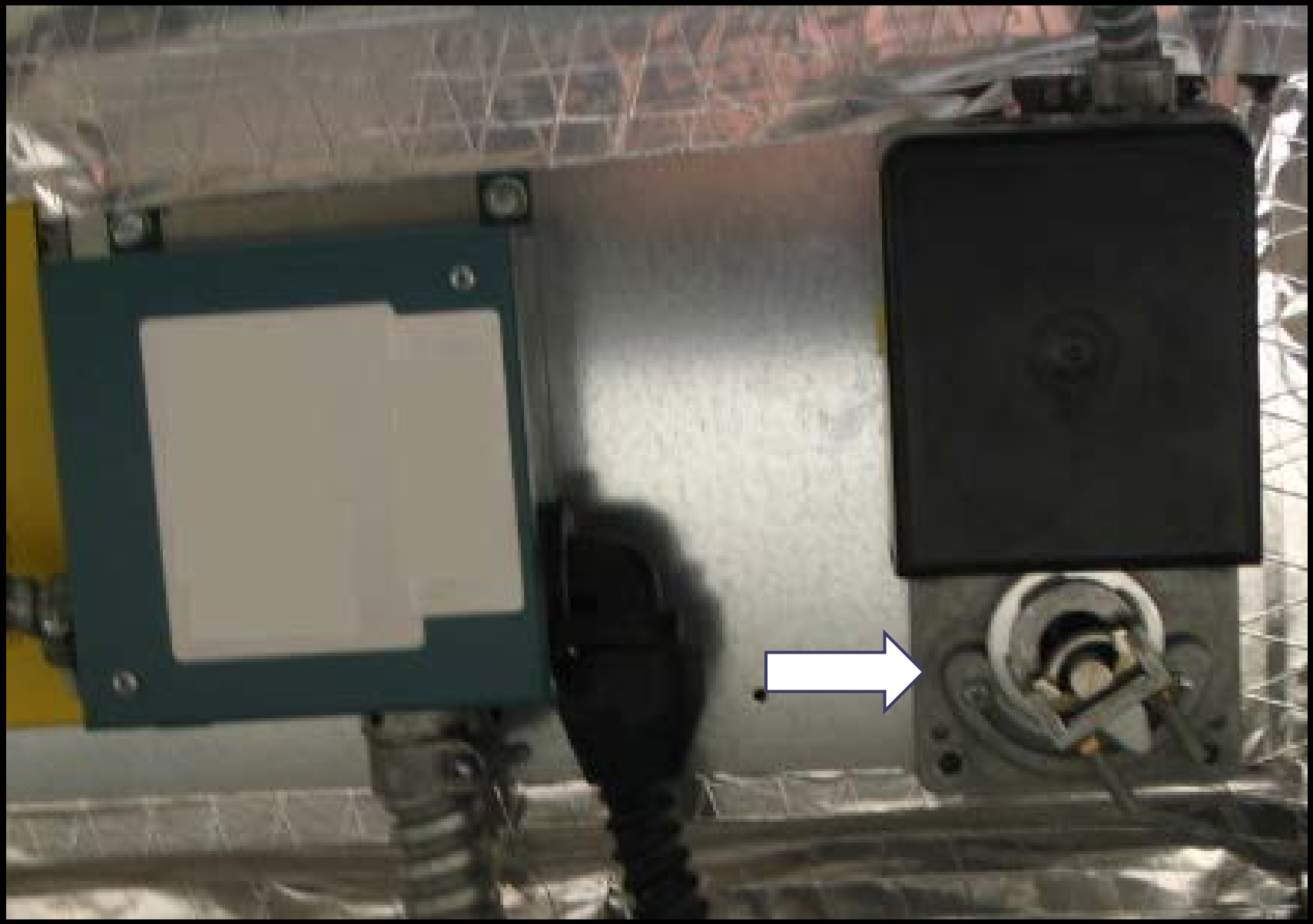
- Improper air valve settings
- Unsynchronized supply and exhaust
- Dry plumbing traps

Three failed verification attempts later…

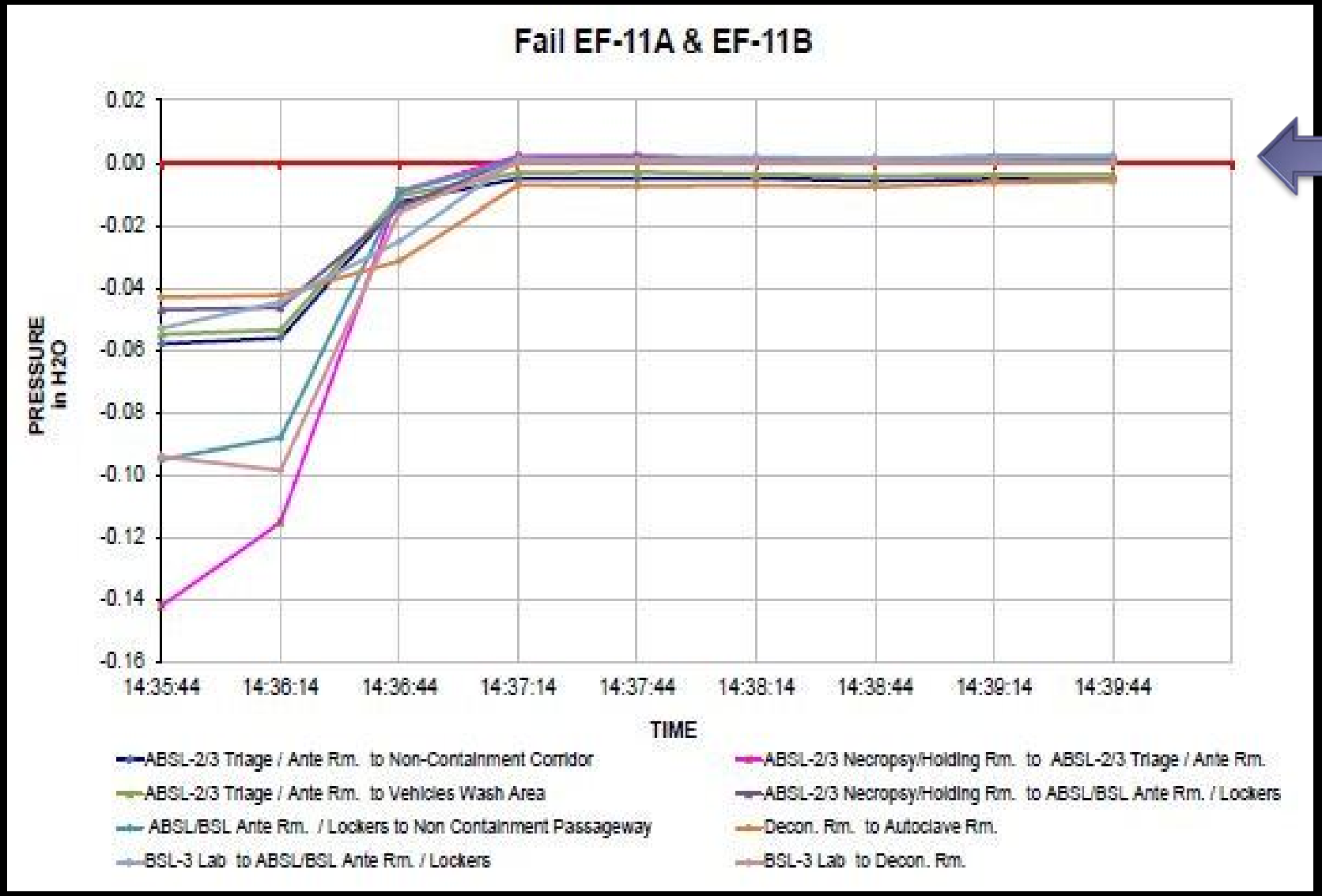


Culprit…..Air valves

- *Supposed* to close the duct to prevent or restrict airflow
- Actuated by small electric motors
- Constantly adjusted by BAS



Next time….


Fail EF-11A & EF-11B
PRESSURE in H2O
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
-0.16
14:35:44
14:36:14
14:36:44
14:37:14
14:37:44
14:38:14
14:38:44
14:39:14
14:39:44
TIME
ABSL-2/3 Triage / Ante Rm. to Non-Containment Corridor
ABSL-2/3 Necropsy/Holding Rm. to ABSL-2/3 Triage / Ante Rm.
ABSL-2/3 Triage / Ante Rm. to Vehicles Wash Area
ABSL-2/3 Necropsy/Holding Rm. to ABSL/BSL Ante Rm. / Lockers
ABSL/BSL Ante Rm. / Lockers to Non Containment Passageway
Decon. Rm. to Autoclave Rm.
BSL-3 Lab to ABSL/BSL Ante Rm. / Lockers
BSL-3 Lab to Decon. Rm.

Take home messages

- Failure mode testing is recommended
- Failure mode testing revealed mechanical deficiencies
- Equipment failure occurred even though the BAS indicated everything was functioning correctly

Steven Ziegenfuss

Jessica Boor

Leroy Brown

Steven Prater

Thanks!

Questions?

Ziegenfuss, S., Helgerson, A., Matos, B., Dombroski-Brokman, A.
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Adventure Safely!