

2015 Annual Conference



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Seminar 12 - Biocontainment Facility Design, Commissioning and Certification Strategies

Commissioning Strategies For Effective Functional Testing and Integrated System Testing of BSL-3 Facilities

Atlanta, Georgia

Learning Objectives

- Describe the concept of pressure reversal, also known as air flow reversal in containment laboratories and define where the pressure reversals are not allowed, and where they are permitted.
- Describe the National Institutes of Health and Centers for Disease Control oversight of BSL-3 facilities.
- Explain differences between biocontainment facility commissioning and annual performance verification and understand the distinction of ANSI Z9.14 and "Select Agent" rules as they relate to performance verification.
- Understand what options are available to simplify the design of biocontainment facility HVAC to reduce costs.

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Agenda

1. Understand the biggest challenge of commissioning a BSL-3 Facility
2. How to meet that challenge through effective testing
3. What testing needs to be done
4. When to perform those tests



CDC / NIH – BMBL (5th Edition)

Section IV

Laboratory Biosafety Level Criteria

Biosafety Level 3

D. Laboratory Facilities (Secondary Barriers)

9. "A ducted air ventilation system is required. This system must provide sustained directional airflow by drawing air into the laboratory from "clean" areas toward "potentially contaminated" areas. The laboratory shall be designed such that under failure conditions the airflow will not be reversed."



Failure Conditions

1. Exhaust Fan Failures
2. Electrical Power Failures

Other failure scenarios:

- Supply Fan Failures
- Air Terminal Unit Failures (zone level)
- Building Management System (BMS) Failures



Commissioning Testing

1. Functional Performance Tests (FPT)
2. Integrated Systems Tests (IST)



Functional Performance Testing

1. Mechanical Systems – Exhaust fans, Supply air handlers, HEPA filter banks, air terminal units, bubble tight dampers, etc.
2. Electrical Systems – Emergency generator, Automatic Transfer Switch, etc.
3. Plumbing Systems – Emergency shower, eyewash, hand sink, etc.
4. Architectural – Secondary Containment Barrier (all penetrations), doors and hardware, etc.
5. Security – Access control devices, door interlocks, cameras, etc.
6. Specialty – Bio Safety Cabinets, Glove Box, Autoclaves, etc.
7. Building Management System (BMS)

Functional Performance Testing

Order of tests:

1. Wet systems – Heating water, chilled water, condensate, etc.
2. Air Handling Units and Exhaust Fans
3. Zone level – Supply and Exhaust Air Terminal Units
 - a. Room Integrity Testing
 - b. Room sensors (pressure, temperature, RH, etc.



Steps for Successful ISTs

- All FPTs completed no outstanding issues that will affect the outcome of the ISTs.
- Verify room airflow and pressure control devices with accuracy and operation
- Verify room temperature control devices
- Calibration of sensors: temperature, humidity, pressure and airflow measurement
- Steady supply and exhaust air duct pressures (AHU and EF loops are tuned)
- All systems/ equipment are in normal (automatic) operation with no overrides in the BAS or lab control system
- All doors in the building are closed
- All surrounding non containment areas and equipment in normal operation, as they would be when the building is in use by the owner
- All alarms are clear for the containment area
- Containment area is closed to all personnel not involved with ISTs
- Setup differential pressure test equipment across all the doors in the containment barrier to measure and record the pressure readings during the tests. This will determine if the IST passes or fails.

Integrated Systems Tests (ISTs)

1. Exhaust Fan Failure Tests
2. Electrical Power Failure Tests



Capturing the results of the ISTs

- Setup differential pressure test equipment across all the doors in the containment barrier to measure and record the pressure readings during the tests. This will determine if the IST passes or fails.
 - BMS pressure sensors can be used if installed, but something independent from the BMS is preferred.
- Test equipment:
 - Analog gauges
 - Digital micro manometer
 - Smoke bottles/ small smoke generating devices for airflow visualization

Items to note during the ISTs

- Does the supply air handling unit fan freewheel longer than the exhaust fans?
- When power is restored, does the automatic switch do a closed transition or an open transition?
- What effects does this have on the supply air handling unit? The Exhaust Fans?



Conclusions

- It is possible to meet the CDC/ NIH BMBL 5th requirement for no reversal of airflow through effective setup and testing.

Bibliography

- *Biosafety in Microbiological and Biomedical Laboratories*. 5th ed. Washington D.C.: U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institutes of Health, 2009.

Questions?

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