Integration of BSL-3 Laboratories into Existing Facilities

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Agenda

- Introduction
- General BSL-3 Design Issues
- Modular Options
- Equipment Considerations
- Case Study: ABSL3 Lab for BSL4 Support
  - Existing Conditions
  - As Constructed
- Summary / Questions

General BSL-3 Design Issues

Before You Start

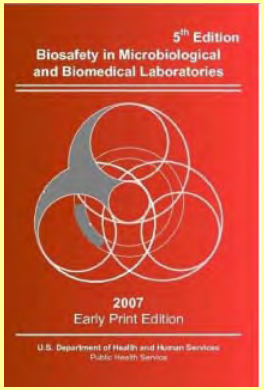
Experience, Understanding

- An integrated team and process begins early in the planning phase; document goals and expected outcomes; revisit continually
- Focus is on the process in planning of facility, combining understanding of process with facility design
- Life Safety a key part of planning and development

Integrated Process

- All team members “vertically integrated” for project responsibility; streamlines the process
- Drives the commissioning process, and ensures a well documented end product
- Delivers facility that meets functional and operational goals

Summary of Design Features (Secondary Barriers)



	Double Door Entry	Access Control Devices	Personnel Shower-Out	Hand Washing Sink	Hands Free Hand Washing Sink	Autoclave Available	Pass-through Autoclave	Dunk Tank and/or Fumig Chamber	Single-Pass Air, Directional Airflow	HEPA Filtered Exhaust	HEPA Filtered Supply	Supply/Exhaust Interlock	Gas-Tight Dampers (Room Level)	Visual Airflow/Pressure Monitor	HEPA Plumbing Vents	Effluent Decontamination	Vacuum Line Protection	Monolithic Walls & Ceiling	Seamless Flooring	Airtight Construction	Breathing Air System	Chemical Shower
BSL-2 Laboratory		❍		●		●			❍								●		❍			
ABSL-2 Animal Facility		●		●		●	❍		●								●	❍	❍			
BSL-3 Laboratory	●	●	❍	●	●	●	❍	❍	●	❍	❍	●	❍	●	❍	❍	●	●	●			
ABSL-3 Animal Facility	●	●	❍	●	●	●	❍	❍	●	❍	❍	●	❍	●	❍	❍	●	●	●			
BSL-3 Ag Animal	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		
BSL-4 Lab/Animal (Suit)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

●= Required by BMBL (5th ed.)
❍= Not required by BMBL (5th ed.), however, generally considered as an enhancement

General BSL-3 Design Issues

Waste Treatment

HEPA Filter Exhaust ?

Location in Building

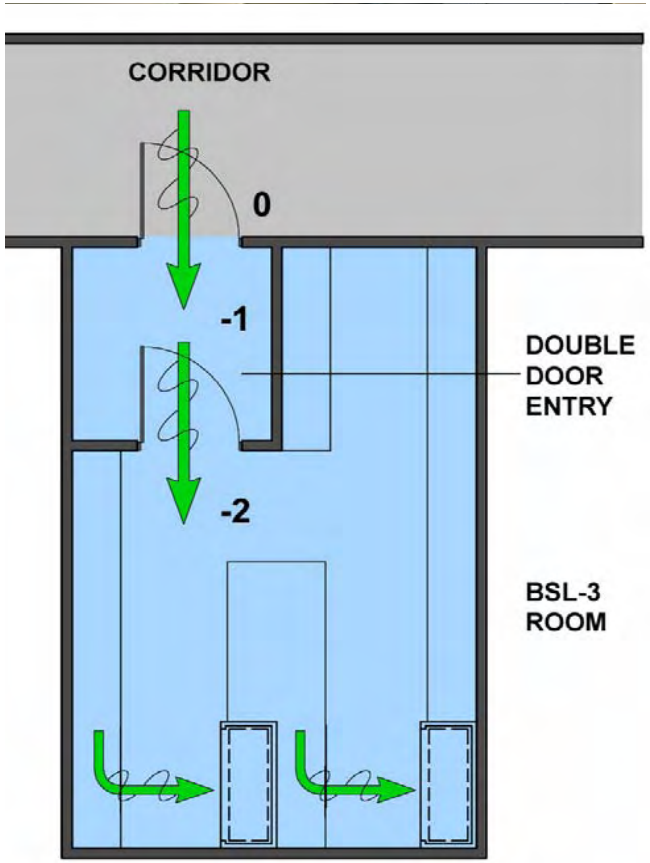
- Life Safety
- Utility Routing
- Mechanical Equipment Room Location

Double door access (vestibule)

Negative Airflow

Plan to include personnel shower

Decontamination



General BSL-3 Design Issues

Pressure Differential vs. “Airtight”

- Sealing surface penetrations
- Pressure Decay test required for BSL-3-Ag

Finishes

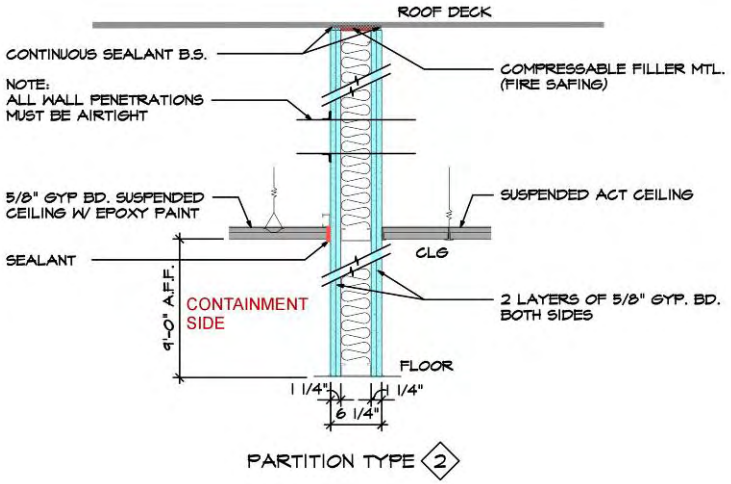
- Seamless flooring options
- Washable/scrubbable surfaces

Room Layout Issues

- Design for mobile casework
- High concentration of BSC’s
- Substantial Lab Equipment

Planning for Ductwork

- Access to filters, caissons, bioseal valves



General BSL-3 Design Issues

Dedicated MEP Systems

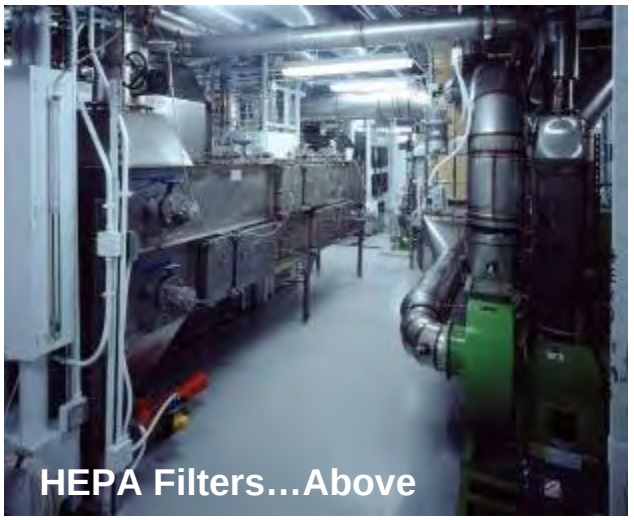
Critical Systems Back-Up
- N+1 Systems Redundancy
- Back-up Power for Fans

Use of Interstitial Space Highly Recommended

Detailing/Constructability/ Commissioning

“Off-the Shelf” Technology

Energy Conservation/ Sustainability should be a concern


HEPA Filters…Above


Effluent decon if desired below

General BSL-3 Design Issues

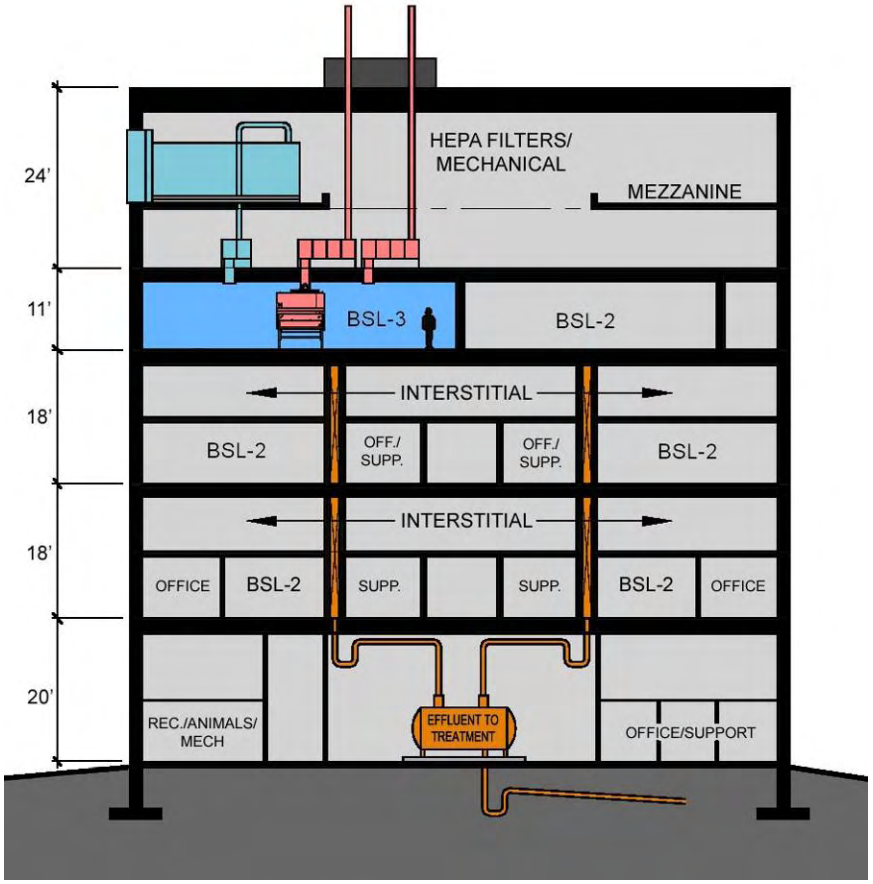
Future Planning

Consider locating lab on the upper-most lab floor

- Interstitial access or mechanical penthouse is preferable

Consider GLP & Life Safety in locating lab

Consider support space adjacency BSL-2 & Core labs



General BSL-3 Design Issues

Interstitial Option: Accessed from Corridor

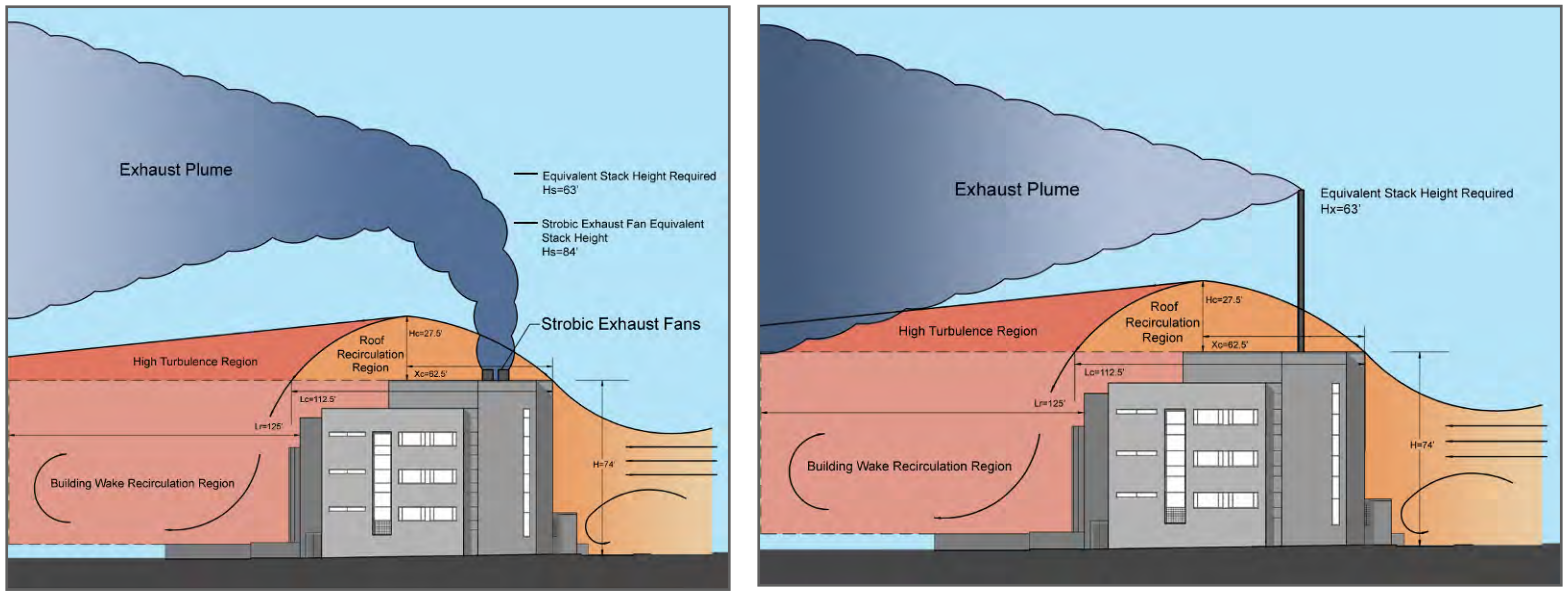
General BSL-3 Design Issues

Operations and Maintenance

- Plan for layout & utility systems redundancy
- Location for Spares?
- Add excess electrical capacity for exhaust fans

Environmental Considerations

- Wind Analysis & HVAC Entrainment Study



Exhaust Entrainment Study

General BSL-3 Design Issues

Future Planning

Plan for vertical exhaust duct runs

- Stub stainless steel ductwork in now

Plan for layout & utility systems redundancy

Add excess electrical capacity for exhaust fans

Modular Lab Option

- Rapid reconfiguration
- Modules are 10’x12’
- Flexibility in HVAC Systems location

Courtesy of Dovetail Biocontainment

Pass-thru Sterilizers

Layout Opportunities

- Right-size the chamber (study loads, items and run frequency)
- Share autoclaves between lab suites if protocol permits
  - evaluate system redundancy needs
- Newer designs incorporate water economizer cycles & crushed door seals.

Pass-thru Sterilizers

Utility Opportunities

- Re-circulate cooling water, use bldg. process water instead of domestic cold water (confirm w/ bio-safety protocol)
- Utilize bldg. plant steam vs. local electric steam generation
- Recover and re-circulate jacket condensate
- Utilize building plant compressed air

Pass-thru Sterilizer Design

Biological Safety Cabinet (BSC) selection and optimization

Class II, Type A & B1

- Recirculating design utilizing HEPA filtration:
  - Up to 30% exhausted via HEPA into room (A)
  - 70% returned to work zone (A)

  Thimble design for exhaust ducted installation (B1 – 30% recirc.)

Class II, Type B2 & B3

- Total exhaust cabinet design

  Exhausts conditioned air up to 1200 cu.ft/minute

HEPA Filtration on Exhaust

- Exhaust Filtration is not required by BMBL for BSL-3's
- Filtration is becoming more common due to perceptions of User & community sensitivity
- Consider size and number of filters required
- Select and specify Lower DP HEPA Filters

Bag-in, bag-out HEPA filtration caisson

Case Study: ABSL-3 Lab for BSL-4 Support

Aerial view of Keiller Building & BSL-4 Addition

Keiller, Shope Lab & GNL

Case Study: ABSL-3 Lab for BSL-4 Support

Case Study: ABSL-3 Lab for BSL-4 Support

Existing Facility Conditions

- **Unfinished basement**
- **Low floor to floor height**

Case Study: ABSL-3 Lab for BSL-4 Support

Low Headroom, Coordination of Underslab Utilities (Waste and Vent!)

Case Study: ABSL-3 Lab for BSL-4 Support

Low Headroom, Limitations due to Existing Structure, Equipment Coordination

Case Study: ABSL-3 Lab for BSL-4 Support

VFD Exhaust Drives

HEPA Exhaust with Decon Port

Exhaust manifold in service closet

Case Study: ABSL-3 Lab for BSL-4 Support

Finished!

Portable isolators and change station

Micro Isolator racks

Case Study: ABSL-3 Lab for BSL-4 Support

ARC Sink – Utility Station

Raised Ceiling for BSC installation

Case Study: ABSL-3 Lab for BSL-4 Support

Finished Corridor

Animal Room Entry Detail

Summary

PERKINS + WILL

- Hire a BSL3-experienced design team with a demonstrated commitment to understanding of how the lab is going to be used and maintained.
- Insist on an integrated approach to planning, design and construction.
- The devil is in the details: operational and physical!
- HVAC system retrofit is often difficult due to space constraints and adjacency issues
- Don’t depend on published cost data!
- Plan for BSL-3 expansion now if it may be a possibility; route ductwork and provide adequate utility services