Repurposing Non-Containment Facilities for BSL-3

Save Money and Time by Preventing Scope Creep

Funding shortages are making renovating non-containment buildings into BSL-3 research spaces an attractive alternative to new construction. To avoid "scope creep"—which can increase costs, delay occupancy, and reduce flexibility—start by clearly establishing the intended research requirements in terms of space, workflow, and regulatory compliance.

The University of Wisconsin, Madison, for example, recently opened its BSL-3 level Influenza Research Institute (IRI), which was built from the renovation of a leased wood-framed office building located at an off-campus research park.

The University implemented a design/build contract after determining that renovation rather than new construction was the most cost- and time-effective method for creating the new research space, but changes in regulatory requirements during the design and construction process introduced unexpected compliance issues.

“With a project like this, it’s critical to get facility management staff and controls personnel involved in the process as early as possible,” says Darren Berger, facilities engineer at the University of Wisconsin. “If you have a dedicated team with a background in biocontainment involved from the very beginning, you’ll be able to achieve federal approval and researcher occupancy much faster.”

It is also necessary to conduct an intensive preliminary fit analysis to make sure there is enough space for safe and efficient operations of the intended program.

“Understanding the gross square footage required for your specific research program is critical,” says Lauri Kempfer, a planner at Flad Architects who worked on the IRI facility. “In addition to calculating laboratory, vivarium, and support spaces, you need to look at the total footprint. This varies depending on whether you have HEPA filtration on the exhaust or on the supply, or if you are looking at treating drained waste with an effluent decontamination system. Often 1,000 net square feet of lab space will require 2,500 to 2,700 gross square feet just to accommodate the systems that will effectively operate a high-containment facility.

“A typical safe operating module that allows for proper process flows into and out of the space requires 11 feet of clearance,” adds Kempfer. “You also want to make sure you have proper height clearances for bulk autoclaves so you don’t get boxed into an inefficient design.”

Changing Compliance Requirements

The fifth edition of the CDC’s Biosafety in Microbiological and Biomedical Laboratories manual—which came out as the IRI was being built—requires that containment design be driven by the standard operating procedures of the research program. This means detailing every procedure that might be conducted in the facility along with all physical safety measures and workflow processes.

Establishing proper SOPs begins with identifying the type of pathogens that will be handled in the facility.

“Pathogen type is a significant driver because they each have different separation and workflow requirements, depending on whether you are handling viral or bacterial material, or if you need aerosol equipment,” says Steve Freson, a principal at Flad Architects. “You may determine that you

don't have the interstitial spaces that new facilities provide. In which case you'll either have to attach onto the building or take space from adjacent areas, which can impact other researchers."

Mechanical support space was created in the IRI facility by attaching onto the existing structure. Containment was accomplished using a poured concrete box design. Air handling units and mechanical equipment were mounted on independent steel platforms situated above the roof.

Security Adjacency and Operations

Site-specific security and risk management, adjacency issues, and operational support are all significant considerations when deciding if a building can be cost-effectively adapted for high containment. The Select Agent Program requirements for security and access control account for a significant portion of renovation budgets.

"It can cost between $1 million and $4 million to upgrade security measures and harden the envelope of an existing building," says Kempfer. "Cyber-security is also a big part of risk assessment, particularly with the new Tier One section of the Select Agent Registry. But if you have some security elements in place, or if you already have an appropriate IT staff and infrastructure in the facility, that can really help reduce operational expense."

"If you have a six-story academic health sciences building and you want to renovate the third floor for a BSL-3 facility that will be handling a select agent, you need to back yourself through the entire security system and see where you are going to have to make the necessary additions," says Freson.

It's also important to look at the adjacencies and how they fit into the overall process flow. This includes the location of shipping and receiving areas; how special agents are transported into containment zones; and where sterilization zones are located.

But Freson cautions owners who plan to add a BSL-3 facility to a building that already has some BSL-3 components that the different programs may not be able to share operations such as autoclaving.

"Sometimes these resources are not efficiently sharable," he says. "For example, if you are on a tight schedule going from cell culture to production, shared autoclave operations or shared decontamination operations will result in downtime. An NIH grant-funded researcher has to operate on very tight schedules to maximize funding. So if you are going to delay the research in any way, it might be better to duplicate some of these functions."

Lessons Learned

One of the biggest challenges the University of Wisconsin faced with IRI were the cost and complexity of maintaining operations in an off-campus leased building.

"One thing that helps control these sorts of issues is getting your facilities maintenance and controls personnel involved as early as possible so they understand every nuance of the building," says Berger. "It's important to think about who will be running the facility once it's complete and who will handle the maintenance."

"The indirect costs most research grants assign for operations and maintenance don't begin to cover the actual cost of running a high containment facility," says Kempfer. "Picking an appropriate building that has some of the necessary infrastructure already in place will help control some of that cost."

Eliminating surprises early on through measures like destructive testing is also helpful.

“Unknown factors in the existing construction represent one of your biggest risks when it comes to scope creep,” says Kempfer. “If you start working in an existing building and find that some of the systems or utility connections are not at the level you expected, you can end up having to rip out steam lines or chiller lines to replace them. So you need to understand what condition the building is in, what its structure and lifespan are, and if the systems are already at capacity or overtaxed.”

Controlling costs when remodeling a non-containment facility for BSL-3 means identifying deficiencies that will need to be overcome and clearly establishing the research procedures that will be done in the space.

“It really comes down to what your scientists and researchers are trying to accomplish,” says Freson. “You need to take the time at the outset to clearly identify goals and expectations because those are the things that determine whether you can cost-effectively do a renovation project or whether you need to build new.”

By Johnathon Allen

This report is based on a presentation by Freson and Kempfler at the Tradeline *2012 International Conference on Biocontainment Facilities.*

From Kitchenette to BSL-3

Photos courtesy of Flad Architects

University of Wisconsin's Influenza Research Institute (IRI) was created by retrofitting an existing office complex into a research facility supporting BSL-2, BSL-3, and BSL-3AG programs.

Transforming Research Space

Current industry benchmarks and client-specific research-based needs are used to upgrade existing lab space to meet current standards and federal BSL guidelines for infectious disease research.

Biographies

Steven Freson, AIA, principal at Flad Architects, is nationally recognized for his expertise in the design of high-containment facilities. He serves as a programmer and planner on highly complex facilities for the federal government and several public and private clients including Department of Energy, Department of Homeland Security, National Institutes of Health, National Institutes of Allergy and Infectious Diseases (NIAID), Regional Biocontainment Laboratories, Battelle, and Ohio State University.

Lauri Kempfer, lab planner at Flad Architects, is an experienced laboratory and vivarium designer and project coordinator. For the past 14 years, she has been involved in all phases of national research laboratory and vivarium projects for academic, pharmaceutical, and biotechnology clients.

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