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Kansas State's New BRI Facilitates High-Containment Research

Integrated Training Suite Qualifies Those to Work in Biocontainment Areas

The Biosecurity Research Institute (BRI) in Pat Roberts Hall on the campus of Kansas State University began as a mere vision that has evolved into a high-containment facility capable of handling a variety of research with an emphasis on agricultural disease issues. As far back as 1999, K-State developed a comprehensive "Homeland Defense Food Safety, Security, and Emergency Preparedeness Program (FS^2)." K-State President Jon Wefald testified before the U.S. Senate Emerging Threats Subcommittee that same year recognizing the need to build biocontainment facilities and to address potential agricultural diseases. The first concept for the $48-million BRI was developed in 2003. With support from the Kansas State Legislature, construction began in 2004 and was completed in 2007.

The BRI represents a milestone as the first BSL-3 and BSL-3Ag facility on campus, featuring BSL-3Ag space for livestock disease research, enhanced BSL-3 space for plant infectious disease research, BSL-3 food processing space for food safety research, along with BSL-3 support laboratories. In addition to the biocontainment spaces, there is an education and training wing with meeting rooms, conference space, a classroom, and a BSL-3 simulated training laboratory.

"We are in the process of developing the scientific research programs that will be conducted in the building," says Scott Rusk, associate director of operations at the BRI. "This is a biosecurity research institute located at an agricultural-based university, so many of the programs will pertain to agricultural pathogens and diseases and food-borne pathogens. Before research begins in the building, however, our efforts and goals are to ensure that the facility supports the research needs with consistent policies and procedures for safety and regulatory compliance."

The primary objectives of the BRI are to provide a versatile and safe research facility that facilitates innovative scientific research. The operations model for the facility, which does not belong to any particular University department, is driven by potential clients, research programs, staffing plans and resources, funding sources, operating costs, and the occupancy model in terms of what type of scientists will work in the building. It is estimated that utilities alone will cost $1.2 million per year, but an overall cost to operate the facility has not been determined.

Rusk expects researchers to start working at the BRI in early 2008. The occupancy level for the 113,000-sf facility has not been finalized, although Rusk estimates that between 50 and 75 research and technical personnel, as well as 35 administrative and operational support staff, will work in the building. The integrated training laboratory will begin holding sessions in late 2007 as part of the orientation and educational process to qualify personnel for clearance to work in the biocontainment areas.

Education and Training

The education and training wing, which encompasses approximately 11,000 sf, is slated to start conducting educational sessions in the fall of 2007. Candidates for training will be laboratory workers who must complete educational programs in order to qualify to work in biocontainment areas. It will also be used to conduct proficiency or technique training. Individuals from other biocontainment research facilities will also be able to receive training on all topics involving the daily operations, policy, and procedures of a biocontainment facility. In the future, BRI will offer training courses related to lab safety, biosafety, and biocontainment operations to other outside groups and individuals who need training, and also will offer a place for others to hold educational sessions.

"The education and training suite will serve the purpose of helping us achieve overall assurances of operations and safety goals," notes Rusk. "The training and education component fits well with the academic setting of the University and provides a unique asset for K-State. As a tool, it will provide a service in the area of biocontainment and disease research."

The integrated training suite, located in the administrative and education section of the building away from containment areas, features a classroom and laboratory to be used for educational purposes. It includes a fully simulated BSL-3 lab with an adjustable layout system, shower-out module, pass-through dunk tank, pass-through gas box, pass-through autoclave, biosafety cabinets, chemical fume hood, and standard laboratory casework.

A classroom with tiered seating for about 18 people is separated from the simulated BSL-3 lab by a 17 x 4-foot window that allows students to see what is taking place in the training lab. Extensive audio-visual capabilities, including high-definition projector screens, enhance the educational experience by bringing the activities of the lab into the classroom. Digital compatability between the simulated lab and the classroom gives students the ability to ask questions in real-time while demonstrations are taking place in the lab.

"The vision is that we can train people to safely work in a BSL-3 setting in a low-hazard biocontainment environment before it actually counts," says Rusk. "We can do that without inconveniencing scientists by using existing containment laboratories and we can get people well indoctrinated into what it is like to work in biocontainment before they do it 'for real.'"

A lecture hall, with a seating capacity of up to 48 people, is available for larger groups and may be used for conferences or distance education via satellite hookup.

Building Features and Components

Although the exact research projects that will take place in the BRI are still undetermined, the facility is well equipped and flexible enough to accommodate a

plethora of research ranging from animal infectious diseases and food-borne pathogens to plant infectious diseases and basic pathogen biology. The projected areas of emphasis include vector-pathogen biology, diagnostic technology, protocol validation, mitigation and decontamination of pathogens. Housing all of these different disciplines under one roof will promote collaborative research between scientists who might not normally work together. The special training and education component will focus on biosafety, food safety and security, agricultural biosecurity, and crisis communications.

Approximately 21 different laboratories, along with the necessary preparation space, are located in the building. A small animal vivarium is available to house a limited number of small animals. Since the majority of the research will center on large animals like cattle, another BSL-3Ag maximum-containment holding area can accommodate 32 animals each weighing 800 pounds or a lesser number if the animals weigh more. The large animal holding areas provide the utmost flexibility to accommodate various species and to change the configuration of the gating and penning.

The building also includes slaughter and food processing space--a BSL-3 containment area to enable enhanced study of specific pathogens. This area allows researchers to study animal and meat products that would be sold to consumers at stores. Microbiological studies can be conducted throughout the food processing chain simulating farm-to-fork with support from a dedicated laboratory directly adjacent to the food processing area.

Additional space is designated for research related to infectious diseases affecting crops. The containment areas designed specifically for studying plant diseases feature environmental growth chambers, five BSL-3 labs and a BSL-3E laboratory suite with shower-out capabilities to foster research involving plant diseases.

Of the total square footage in the BRI, about 30,000 sf are designated for biocontainment laboratory and animal holding space, while the remainder is used for administrative offices, training, and support components.

Mechanical Space

The building features a full mechanical that provides plenty of space, for example, to change a HEPA filter when necessary. Six independent air handling systems supply various parts of the building to meet the intake and exhaust needs of each particular area, such as animal holding or plant sciences. There are 131 HEPA filter housings, with some containing two filters; the air systems circulate approximately 5.4 million cubic feet of air per hour.

The mechanical penthouse floor is painted with a colored floor plan corresponding with the space that is located directly underneath. For instance, green paint on the floor means the space below is BSL-3Ag, while blue designates BSL-3, and gray signifies circulation corridors.

"We have a floor plan painted on the mechanical space so when the HVAC mechanics need to go up there, they know exactly where they are," says Rusk. "They can cross reference the room number which is painted on the floor with the HEPA housing number. The need to be highly coordinated when performing maintenance on biocontainment systems is something we won't take for granted."

System Controls

The BRI boasts a full Johnson Controls building management system with approximately 2,400 monitoring points and nearly 800 alarm points. Controlled access provides the maximum level of security. Real-time data is available on a continuous basis with remote access to facilitate trouble shooting no matter what time of day or night an alarm might sound.

"Building management systems are very robust and provide opportunities to customize alarm and control point strategies. As a result, it is important to carefully think through the alarm and control point needs as they relate to the operations of the facility," says Rusk. "Alarm tolerances can be determined by the system programming and if tolerances are set too close, the usefulness and intent of the alarm and notification strategies may be lost in the technology. The opposite may be experienced if critical alarm and control points are missed, excluded, or not considered."

Infrastructure Support

The infrastructure consists of six dual-fuel, high-pressure boilers with a total capacity of 36 million BTUs. The boilers produce about 95 pounds per square inch of steam pressure and must be monitored around the clock by a qualified boiler operator, meaning additional staff may be required to handle this responsibility.

Other features include a central reverse osmosis water system, dual electrical feeds, three chillers, a 2000-kw backup generator, and a 10,000-gallon fuel tank with a 14-day reserve to support biocontainment operation of the building.

Biocontainment Features

The large animal species holding space at BSL-3Ag has been pressure-decay tested. Two BSL-3Ag labs support these holding areas and one has a gas-tight door, while the other has cast-in-place framework for gas type doors if they need to be added in the future. Overall, the facility has 21 compression seal gas-tight doors and nine air gasket sealed doors. Air gasketed doors are more expensive than the compression seal doors. However, the air-gasketed doors have a zero threshold and are ideal for areas where there is frequent movement of people, carts, materials, and large animals.

Four plant growth chambers are located within the plant containment suites. The building's biocontainment amenities also include a USDA-style slaughter floor and food processing area at BSL-3 with enhancements.

Waste Management

The waste management system required for the BRI includes four large pass-through autoclaves, gas boxes, dunk tanks for materials flow, liquid effluent decontamination, and a tissue digester. Three 4,000-gallon liquid effluent decontamination tanks can be processed sequentially and capabilities are available to inject potassium hydroxide if necessary for treating prion wastes. A 5,500-pound tissue digester is in place for contaminated tissue disposal.

When discharge is made from the tissue digester and the liquid effluent decontamination system, it goes into a blend tank which also collects water and condensate from the air handling units coming from non-contaminated areas of the building. The waste stream is blended in the tank before being discharged into the municipal waste system.

The BRI has a memorandum of understanding (MOU) in place with the City of Manhattan, Kansas, regarding waste stream management. The provisions of the MOU include sampling and providing laboratory test results on waste stream parameters and notifications of the digester and effluent decontamination system operation.

Steps to Make the Facility "Research-Ready"

It is critical to understand all aspects of the facility in order to ensure that it is ready to accommodate research activities and to assure efficient daily operations. Understanding the building includes having a detailed plan to address preventative maintenance and repairs, knowing how the building management system works, being aware of what is covered under warranty, determining which services will be outsourced and which will be done in-house, maintaining an inventory management system, storing spare parts that are critical to operations, and having the necessary tools, equipment, and supplies on hand to deal with a wide variety of circumstances.

Administrative issues that must be addressed include staffing plans, short-term and long-term strategic planning, budget planning and management, as well as operational readiness review.

"We plan to have an extensive external review by other people in the industry before we are research-ready," says Rusk.

The proper permits from regulatory agencies must be obtained and an emergency preparation and response plan must be put into place before the building officially opens for research. In addition, a security approach and policy development must be created,

along with a memorandum of understanding with the city, the local fire department, and other emergency management services.

The Bottom Line

"Biocontainment operations must be married to planning, design, construction, and commissioning of biocontainment facilities," advises Rusk. "The marriage should be considered part of the project cost."

The benefits of getting input as early as possible from the people who will operate the facility include:

- enhanced understanding of building systems as designed,
- enhanced troubleshooting ability,
- enhanced commissioning plan, and
- dramatic decrease in time to reach the "research-ready" stage.

"A dramatic decrease in the time until a biocontainment facility can be operational will be realized by early staffing and involvement of the operational staff," says Rusk. "It helps squeeze the overall project time down to when research can begin in the building."

Biography: **Scott Rusk** is the associate director for operations at the Biosecurity Research Institute at Kansas State University. He has more than 20 years of work experience in biological safety and infectious disease containment facilities and has participated nationally and internationally in defining approaches for the design, operations, and management of containment facilities. Prior to assuming the role at KSU, he held safety and operations positions at the USDA, National Animal Disease Center, and served as a biocontainment operations and management specialist at Flad & Associates, an architectural, engineering, and planning firm in Madison, Wis. He received a master's degree in veterinary microbiology and preventive medicine from Iowa State University.

This report is based upon a presentation given by Rusk at the Tradeline *2007 International Conference on Biocontainment Facilities* in March.

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Six independent air handling systems supply various parts of the BRI at Kansas State University. There are 131 HEPA filter housings and the air systems circulate about 5.4 million cubic feet of air per hour. (*Photo courtesy of Scott Rusk, Kansas State University*.)

K-State's Biosecurity Research Institute has 21 compression seal gas-tight doors and nine air gasket sealed doors. (*Photo courtesy of Scott Rusk, Kansas State University*.)

The BRI features dual electrical feeds, three chillers, a 2000-kw backup generator, and a 10,000-gallon fuel tank with a 14-day reserve to support biocontainment operation of the building. (*Photo courtesy of Scott Rusk, Kansas State University*.)