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Safety and Security By Design

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Designed like a box within a box within a box within a box, Kansas State University’s Biosecurity Research Institute provides multiple levels of safety and protection between pathogens that are being researched and the people who work with them.

“There is no single most important safety feature,” said Julie Johnson, the institute’s biosafety officer and assistant vice president for research compliance. “The combination of facility design, ongoing maintenance, safety equipment and thorough training of personnel are all necessary for safe operation.”

Facility design and maintenance
Pat Roberts Hall, home of the institute, is constantly monitored by security. To keep the facility secure on the outermost level, the building is surrounded by a reinforced fence and it has identification badge scanners at entrances.

The building has a reinforced structure that makes it an ideal place to seek shelter during a tornado. It was built using federal guidelines for constructing community shelters, called a box-within-a-box design. Containment labs are inside the building’s reinforced shell, and the backup power safeguards operation of the building’s critical safety systems.

“The backup diesel generator will keep critical systems like air and waste-handling running at full capacity if there is an interruption of power, thus protecting the integrity of the research and keeping the community safe,” said Scott Rusk, director of Pat Roberts Hall.

Inside, the building uses a directional airflow system with high-efficiency particulate air — or HEPA — filters. They filter the air coming into the building, inside containment labs and before the air is exhausted from the building. The system is constantly monitored and tested annually to confirm that each room’s airflow is isolated.

“Since all the air that comes in to and out of the institute is HEPA-filtered, it is actually cleaner than it was when it came in,” Johnson said. “It’s a great place to work if you have allergies because the air is very clean inside containment.”

Safety equipment
Each piece of lab equipment is consistent with the building’s safety components. Biosafety cabinets, containment-specific clothing, personal respirators, showers and autoclaves are just a few of the many pieces of safety equipment frequently used inside containment.

Pathogens are only handled inside biosafety cabinets. These safety enclosures use HEPA filters and directional airflow to contain pathogens in the cabinet and prevent their release in the lab.

Personnel are issued personal respirators and special clothing. As they exit the lab, workers use an autoclave to disinfect everything before it can leave the lab, including clothing. Certain agents also require researchers to shower before leaving the lab.

All liquid waste from drains inside containment is sent to the effluent decontamination system before leaving the building. The tanks of the system, similar to oversized pressure cookers, decontaminate the liquid.

Solid materials used in research are disposed of in the alkaline tissue digester. The digester is similar to the effluent decontamination system in that it is like an oversized pressure cooker, but chemicals are added to raise the pH-level in order to break down tissues.

“When we say nothing leaves containment without being decontaminated, that means nothing: air, liquid, waste, equipment and people,” Johnson said.

Training of personnel
The institute’s comprehensive training program adds another safety level.

“How personnel work in a biocontainment facility is just as important as the physical biocontainment features of the building and safety equipment,” Johnson said. “That’s why it’s important to have a robust, comprehensive, ongoing training program for personnel who work in biocontainment facilities.”

Researchers and support staff are required to attend and pass an annual training course covering biocontainment design, safety equipment, medical surveillance issues, agent specific information, emergency response procedures and proper waste handling.

The training lab mimics everything researchers would do inside containment. They are given fluorescent or dyed liquid to simulate a microorganism. Purple smoke represents airborne pathogens in biosafety cabinets to monitor for disruption of the air curtain that keeps pathogens contained.

“In the training lab there is no risk, so researchers can practice and make mistakes,” Johnson said. “Then they can keep practicing until they are able to work safely in the lab.”

The multiple levels of protection, coupled with the ongoing training of personnel, make the institute an ideal location to safely perform research that will protect the nation’s health and food supply.

“The biocontainment capabilities are unique and contribute to continued growth and leadership of Kansas State University in the areas of agriculture and public health,” Rusk said.

By Stephanie Jacques, Communications and Marketing