

Tradeline Publications: USDA's Animal Health Facility Keeps Workers Safe

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Risk of injury is a given for people working with large animals. Approximately 25 percent of injuries to animal-handling personnel are due to poorly designed equipment and facilities. Even in relatively pastoral farm settings, one-third of worker injuries are animal-related. In research laboratory environments, large animals pose an even greater threat because they are housed in facilities that are different from their usual environment. Their movements are restricted, they are physically isolated from other animals, and sounds and lights are unfamiliar.

The range of injuries commonly sustained in such facilities is wide and daunting: stepped-on hands and feet; bruised or broken bones from an animal's kick or sudden movement; pinches or other injuries from penning, gating, and latching systems; slip-and-fall injuries from wet floors; and ergonomic injuries such as back strains, torn ligaments, and dislocated joints from moving feed bins, animal cages, or hog panels. Other less visible injuries include allergies from animal dander and hearing loss resulting from loud animal noises—pigs are particular offenders—occurring in acoustically live concrete-and-steel spaces.

The biocontainment environment poses the risk of exposure to decontaminants, infectious agents, and other toxic substances, such as the chemicals employed for the temporary immobilization of animals. Relatively small holding spaces also increase the likelihood of mishaps. Compounding the problem is the fact that many of the animals in research facilities are infected with *zoonotic* diseases—diseases humans can catch—which means that workers must wear personal protective equipment (PPE) that can restrict mobility and that make the difficult job of controlling animals even more challenging.

“Wearing the protective equipment—normally a Tyvek suit and an air-purifying respirator—you're a little less agile,” says Brad Andersen, vice president at Merrick & Company. “It's constraining from a visibility standpoint, and because you're working in wet environments and showering every time you move from one space to the next, there's a considerable slip risk.”

The USDA's largest animal research lab, the Animal Health Facility in Ames, Iowa, is designed to minimize risk of injury to workers wherever possible, incorporating advances in penning and gating systems, flooring, drainage systems, BSL-3 operations, and decontamination.

“Biocontainment facilities are traditionally expensive, so if the animal care standard says you have to use a certain number of square feet per animal, that's probably

what you're going to build, and no more,” says Scott Rusk, associate director of operations at Kansas State University. “So it tends to make it close quarters when people have to go in with the animals. Human error can be a big factor resulting in accidents, injury, or exposures.”

The Animal Health Facility is a component of a \$460-million modernization effort that is replacing older facilities at Ames with a new state-of-the-art complex for diagnostics, research, and biologics evaluation for agricultural animal health. The new 153,650-sf large-animal facility, which features 22 separate animal rooms to accommodate various animal species and multiple agents simultaneously, is constructed to BSL-3Ag biosafety level standards. The BSL-3Ag standard, unique to the agriculture industry, uses rooms themselves as the primary containment measure.

Penning and Gating

The range of species handled in the Ames facility—from poultry to bison—posed a particular design challenge.

“Obviously, when you're dealing with bison, these pens and gates have to be extremely robust,” says Andersen. “We figured out that an angry buffalo trying to get out could exert a force equivalent to that of a Volkswagen traveling 30 miles per hour. For deer and elk, the issue is height, because they're jumpers. The pens are designed to provide the animals with a little more privacy—they're solid panels with holes drilled in them to allow airflow and some visibility for handlers—but they're also built much taller, because a deer can clear an 8'-high panel.”

To ensure that the pens and gates, which cost millions of dollars, would work well for both animals and handlers, full-size mock-ups were built and tested to ensure that pens, panels, gates, and latches all would work together for maximum safety, with quick escape routes for handlers, latches that animals could not learn to operate, and strong, flexible materials with no protruding sharp surfaces or pinch points.

Flooring

Slip-resistant flooring is a must in animal facilities, where floors are hosed down twice a day and workers shower frequently. Because gritted epoxy flooring, although durable and slip-resistant, can injure animals'

hooves and legs over time, the Ames facility employs a channel-cut, grooved, rubberized flooring system that confers numerous advantages: It directs water toward drains, keeping floors as dry as possible; it's soft enough for animals to lie on comfortably, eliminating the need for animal bedding; and it absorbs noise. As installed at the Ames facility, it also serves as the biocontainment barrier.

Drainage

Animal facilities aren't just wet. They're also messy. Animals eat, urinate, and defecate in their pens, and animal workers hose as much of it down the drain as they can.

"The animal handlers naturally want to cram every bit of stuff they can down the drains so they don't have to haul it out some other way, and the maintenance crew of course wants nothing but clear liquids going down the drain so that they don't have to clear the blockages," says Andersen. "As designers, we had to come up with a solution that would satisfy everyone."

The drainage solution at the Ames facility consists of a multistage drain system with a covered, oversized trench drain and an inner basket that catches solids before they reach piping and create clogs. If clogs do form, a system of steam jetting ports in the piping system clears traps without the need to open potentially contaminated waste lines.

Washdown equipment—consisting of high-temperature, high-pressure sprayers—is ergonomically designed for worker safety, without locking handles, but with grips that workers can safely operate over long periods without repetitive strain.

BSL-3 Ag Operations

In addition to protecting workers from animals through the use of well-designed penning and gating and other features, a BSL-3 Ag environment also needs to keep the pathogens under study from escaping the facility.

Air-pressure-resistant doors, in excess of 400 pounds each, were tested to ensure that workers could operate them multiple times a day without injury. Inflatable-seal doors that use air pressure to expand the seal against the doorframe eliminated the need for raised thresholds, which pose a trip hazard and block wheeled carts from passing through.

Shower and change rooms—built small to conserve space, constantly wet, and often cluttered with extraneous objects—pose a particular slip hazard. At Ames, these rooms are equipped with medium epoxy slip-resistant flooring, shelves and benches, hands-free levers, and foot test faucets that enable workers to test the shower temperature with a toe before entering, avoiding the slips that can result when workers encounter water that is too hot or cold.

Windows to all animal holding areas allow handlers to monitor animal pens—and the welfare of other han-

dlers in those pens—without having to "suit up." Similarly, communications systems consisting of intercoms, closed circuit television, voice paging, and biosafety alarms enable comprehensive monitoring of the highly compartmentalized facility. Wall-mounted biosafety monitor panels outside rooms provide workers with an overview of air pressures and directional air flows to ensure containment of airborne pathogens.

Decontamination

The Ames facility employs a number of decontamination methods for different purposes.

"There is really no silver bullet application for decontamination," says Rusk. "All methods have their limitations. You really have to assess what you are trying to decontaminate and what decontamination levels you are trying to achieve. Sometimes it takes a couple of different applications."

The Ames facility uses heat sterilization (autoclaving), dunk tanks, and gas pass boxes to decontaminate equipment, clothing, and other items. To decontaminate entire rooms after research programs conclude, hydrogen peroxide vapor, or HPV, is used to kill all remaining microorganisms. The Ames facility employs a recent innovation in HPV application.

"It used to be that we'd bring a frypan into the middle of the room, put the chemicals in, plug it in, and run like heck out of that room before the vapor started coming off," says Andersen. "Now we control the duration and energizing of that circuit from the outside."

Necropsy Suites

Necropsy suites—where postmortem exams are conducted—are particularly hazardous due to a high concentration of aerosolized pathogens, not to mention the use of numerous sharp tools and a wide-open carcass disposal chute.

At the Ames facility, necropsy suites are designed with slip-resistant flooring, safety harnesses and raised rims at carcass disposal chutes, well-lit procedure areas, an adjustable-height necropsy table, capture hoods over key procedure areas, and CCTV and other emergency communication devices.

"Proper risk management for work in these areas helps to mitigate injury potentials," says Rusk.

Staff Considerations

"You need a well-designed facility that has considered the safety of the handlers, the researchers, and the animals to make sure the whole thing can work together as it should," says Andersen.

Training and education are part of mitigating the risk of injury, and not just for handlers.

“The individuals who manage the handlers and the individuals who manage those managers need to be trained as well,” says Rusk.

A comprehensive occupational safety program, proper staffing and buddy systems, breakrooms, and the right tools and PPE equipment, with adequate training, also help to reduce injuries. Communication of the science programs with standard operating procedures to match the science and facility are important.

“It is incredibly important that people working with these animals understand why the animals are on study, and understand the pathogen being used,” says Rusk. “Otherwise, you may find yourself with some animal handlers unknowingly taking shortcuts.”

Biographies

Brad Andersen, RA, PMP, is vice president, buildings and infrastructure, at Merrick & Company. With 24 years of experience as a designer and project manager for the planning and design of large, technically complex, multi-discipline projects focusing primarily on institutional and laboratory facilities, he currently oversees a 60-person operations unit focusing on the design of these facility types. He has significant experience in the management, planning, and programming of complex projects, including the National Seed Storage Laboratory in Fort Collins, Colorado; the National Wildlife Refuge Visitor Center and laboratory at Patuxent, Maryland, and numerous National laboratory facilities for the Department of Agriculture, the Department of Interior, and the National Renewable Energy Laboratory in Golden, Colorado.

J. Scott Rusk is associate director for the Biosecurity Research Institute at Kansas State University. He has 24

years of work experience in biological safety and infectious disease containment facilities, and has participated nationally and internationally in defining approaches for facility needs, design, operations and management of containment facilities. Rusk previously held positions as assistant center director at the USDA, National Animal Disease Center managing operations and support services, and as a biocontainment operations and management specialist with Flad & Associates. He has been involved in design for multiple project types, including BSL-4 at the USAMRIID; BSL-3 Ag at the USDA, Ohio State University, and the University of Wisconsin; BSL-3 Enhanced at Battelle’s Medical Testing & Evaluation Facility; and BSL-3 Regional Biocontainment Facilities for the University of Chicago and Tufts University. He is a member of the American Biological Safety Association and a charter member of the International Veterinary Biosafety Working Group.

This report is based on a presentation given by Andersen and Rusk at the *Tradeline Animal Research Facilities* conference in November 2006.

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Figure 1

Full-size mockups of pens and gates were built and tested to ensure maximum safety, with quick escape routes for handlers, latches that animals could not learn to operate, and strong, flexible materials with no protruding sharp surfaces or pinch points. (Photo courtesy of Merrick & Company.)



Figure 2

The channel-cut, grooved, rubberized flooring system in use at the Ames facility directs water toward drains, eliminates the need for animal bedding, and absorbs noise. (Photo courtesy of Merrick & Company.)



Figure 3

Necropsy suites—where postmortem exams are conducted—should include slip-resistant flooring, a safety harness and/or raised rim at open carcass disposal loading chutes, well-lit procedure areas, adjustable-height tables, capture hoods, and CCTV and other emergency communication devices. (Photo courtesy of Merrick & Company.)

