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Aquatic Facilities: Think Beyond 'The Guide': Part IV- Biocontainment

Overview

Biocontainment strategies (barrier and containment) in an aquatic facility require quite a different approach from that of a rodent facility and can be challenging. Since aquatic facilities are "wet" facilities, the media that gives lives to organisms also facilitates the spread of potential pathogens. Facility-wide outbreak of disease can be disastrous for research. There are currently no national standards developed and approved by federal agencies that are specific for aquatic biocontainment systems. Most agents are considered as Biosafety Level I or II. Facility-wide air balancing and UV air sterilization technology helps to assure that facility air is contaminant-free.[2]

Disease Transmission

Aquatic pathogens can be transferred to the tanks from contaminated surfaces and equipment. The disease transmission methods pertinent to the designer include:

- A centralized water system, where pathogens can be introduced into the water and re-circulated to other locations or
- Airborne transfer which may occur if the pathogen exists in some form, outside of the water.[2]
- Improper sterilization of equipment resulting in tank to tank contamination.

Biocontainment

All of the design features discussed in Parts I, II and III are applicable to a biocontainment facility. In addition, the following features should be addressed per programmatic requirements for containment.

- Containment facility should be physically separated from other holding rooms and facility functions.
- Quarantine area and protocol for incoming fish to prevent spreading of disease.
- Foot baths and hand wash stations at the entry and exit points.
- Independent water system and the distribution lines to establish separate zones within the fish room.
- Provide tank closure and seal to prevent spills or water splashing.
- Provide sterile air supply to the spaces including the use of UV air sterilizers.
- Controlled access with secured entry systems.
- A clothing transfer area adjacent to the entry area.[1]
- Separate locker area outside the facility for personal effects.
- Sinks in individual rooms.[1]
- The location and physical attributes of a containment facility should prevent accidental release during natural disasters.
- Close attention given to pest control in the design.
- Mechanical and accessory systems accessible without entry to the containment area from outside of the facility.[1]
- Special attention to use of materials that can withstand rigorous decontamination procedures.
- Room surfaces smooth, impervious and sanitizable.
- Floor surfaces smooth, sealed, nonporous, and corners coved.
- Ceilings should be smooth, impervious and sanitizable.
- Ventilation system and temperature control permits drying conditions and even air mixing but prevents airborne pathogens from escaping via air movement or condensation on surfaces.
- All pathogen control processes should have fail-safe backup in the event of a failure in any automated system.
- Emergency alert system to ensure quick response for personnel.
- Automated systems programmed to measure residual disinfectant concentrations for pathogen inactivation.
- Effluent should be rendered noninfectious and neutralized before being returned to the environment.
- Effluent water should be routed and collected and held in treatment tanks for a recommended disinfectant contact time. Inflow systems engineered to shut off, preventing overflow of the system.
- Release of effluent to the environment meets local regulations.
- Disinfected products neutralized prior to release.
- Rooms engineered so that untreated effluent is prevented from escape.
- Floor drains routed to a holding reservoir that can process all water held within the facility.
- The reservoir tank should have an automated disinfectant system which is monitored by an alarm system in case of failure.
- Individual rooms have door and wall seals, raised dams across the doors and floors, with waterproof seals running along the walls to a depth sufficient to hold all water within the containment room in event of a leak or spill from tank or water supply reservoirs.
- Room surfaces, piping, tanks and water transfer systems in rooms should be designed for complete access and sterilization between studies.
- Plumbing systems designed to prevent back flow from animal holding tanks and effluent handling systems.
- All pipes hard-plumbed with removable access points for cleaning and quality control culture following studies.
- Fail-safe plumbing systems should be used that prevent tanks from self-draining in the event of loss of water supply. [1]
- Electrical fixtures ground fault interrupted, gasketed, sanitizable and provided with emergency back-up power.
- Wall switches sealed and waterproof to allow disinfection.
- Ceiling light fixtures gasketed, waterproof and sanitizable.
- Electrical outlets should be positioned well above floor level, and water supply lines. [1]
- Valves should be accessible from within and outside individual rooms to regulate flows.
- All penetrations should be caulked, sealed and gasketed.
- Provisions should be made to store spill kits.
- Space should be allotted for immersion disinfection buckets for the regular sanitation of room-specific equipment.
- A means of sterile disposal of carcasses and other contaminated biological wastes including incineration, autoclaving or rendering should be considered.
- Exposed piping should be accessible for cleaning.

[1]Canadian Council on Animal Care (CCAC), Guidelines on: the care and use of fish in research, teaching and testing. 2005, Pp. 21-30.
[2]Bailey, A. Redefining "Containment" for Aquatic Facilities, ALN November 01, 2008.