Issue 07
July 2012
Division of Technical Resources
Office of Research Facilities
National Institutes of Health
Technical News BULLETIN

Aquatic Facilities: Think Beyond 'The Guide'- Part III: Architectural, HVAC and MEP

Overview

The water system supporting the various components of the aquatic system must be sized properly. All systems and equipment must be easily accessible for operation and maintenance and must not interfere with the well-being of the fish or the work of the personnel.[1] Facility design shall allow for future addition of services for water, air, and electrical power.

Special Engineering and Design Features

Structural:[2]

The floor must be sufficiently strong to support the weight of the water filled tanks and other associated equipment.

Architectural:

Ceilings, walls, sills and floors should be water resistant.

Monitoring Systems:1

Monitoring systems should be in place to detect failures of all critical systems in order to maintain a healthy non-toxic environment for the fish. Monitoring systems should be considered for:

- Water flow to detect a loss in pressure or decline in water levels.
- Pressure gauges and flow meters should be installed at points throughout the system to monitor the condition of the lines and the performance of the pumps and filters.
- Performance should be monitored by flow, concentration of dissolved gases, temperature, pH, salinity, dissolved oxygen, etc.

Equipment Servicing Water Supply:

- Compressors providing gases to the system should have devices to remove moisture, and oil traps to prevent any oil that leaks from compressors from entering the fish tanks through the aeration system.
- Food-grade lubricants should be used wherever possible.
- Intakes to compressors should be located so that only clean air is used, free of airborne contaminants.
- Drains and gutters should be designed to self-clean under normal flow, and easily accessible clean-out ports.
- Effluent treatment and release must follow regulatory requirements. When effluent treatment is required, an appropriate back-up system must be in place to ensure effluent treatment remains valid during times of power outages.[1]

Room Ventilation and Airflow:

- The HVAC system should work in tandem with the water supply system in controlling the room and water temperature.[2]
- Airflow should be sufficient to ensure that surfaces dry properly and ensure a comfortable working environment for personnel.
- Airflow directions should be from cleaner areas to the designed spaces to minimize the spread of aerosols and to allow for the safe handling of any dangerous substances.[1,2]

Mechanical and Electrical Requirements:1

- Electrical systems must be professionally installed and include proper grounding and ground-fault interrupters on all circuits.
- Electrical components and equipment should be located outside the splash zone, and housed in moisture-proof enclosures.
- Electrical fixtures should be secured with gaskets and located above pipe runs.
- All electrical boxes and conduits should be corrosion resistant and splash resistant UL listed for wet location, minimum 85 PSI or minimum IP65 rated.

Lighting:

- Lighting fixtures should be splash resistant.
- Lighting should be timer controlled.
- Light should incorporate wavelengths and intensities appropriate for the species.
- Task lighting should be restricted in its dispersion throughout the room or be placed at a lower level than the tank surface.[1]
- Override switches for fish room lights should only be used if they automatically turn off.

Streisinger and Walker determined optimal light levels for zebra fish breeding to be 5-30 foot-candles (about 54 - 323 lux) at the tank's surface. The usual zebra fish light cycle is 14 hours on, ten hours off. Offsetting the light cycle from normal triggers breeding at different times.[3]

Redundancy in Aquatic Life Support Systems:

- Have an emergency contingency capacity, capable of maintaining aerated and filtered water and assuring the continuation of life support.
- Generators or other emergency power sources should be available to support vital functions during power shortages and should be tested regularly.
- Plans for longer-term power outages must be in place.
- Critical systems, including pumps, should be duplicated to ensure that failures cause only minimal interruptions in service.
- Main system water pumps, filters and other essential life support components should have back up so that they may be replaced without affecting the supply of water or operation of the system.[1]

Controls Systems:

Control Systems can be simple digital timers that control water exchange pumps or be fully integrated into an Aquatics Housing System SCADA. Typically, peristaltic pumps are used to control pH and conductivity levels in the water, activated by relays built-in to the pH and conductivity meters. Set-points and hysteresis values can be defined right in the meter, or programmed into the SCADA system. Control systems can also perform automatic water exchanges, backwash filters, and pump control.[4]

Filters, particularly for marine systems, should be as large as necessary to maintain appropriate water quality. Regular changing of charcoal filters is required before saturation occurs to ensure that toxicants are not released back into the water.

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. National Institutes of Health (NIH). Design Requirements Manual. Bethesda, MD. NIH, Division of Technical Resources, 2008. http://orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/DesignRequirementsManualPDF.htm
3. Trevarrow, B. Rack 'em Up -- Racks for Tanks for Small Fish in Biomedical Aquatics Facilities, ALN January 01, 2009.
4. Francis, R. Monitor and Control Systems for Aquatic Housing, ALN Jan1, 2009.