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Flood Risk Mitigation Measures for Plumbing Systems

Introduction

Plumbing systems provide potable and laboratory cold, hot, and purified water to laboratories, vivariums, clinical centers, and administrative support areas and convey sanitary waste, storm water, and equipment condensate from these areas for appropriate collection and treatment. These systems, which travel across and between all levels in a building, impose a risk of flooding if they are improperly designed, coordinated, or installed. This article highlights several plumbing design considerations—addressed in the NIH *Design Requirements Manual (DRM)*—whose implementation can reduce the potential for flooding.

Critical Areas

System designers can avoid damage to critical infrastructure by locating piping outside of (but not above) sensitive areas such as electrical, data, storage, and clean rooms. Designers must submit justification to the Office of Research Facilities (ORF) if they cannot avoid installing piping within electrical or switchgear rooms and must also provide secondary protection like monitored double containment piping or drip pans with alarms connected to the Building Automation System (BAS).

The *DRM* prohibits drains in laboratories, electrical rooms and other high-voltage spaces, or areas where waste backup poses a risk to users or the facility. Key areas (e.g., a mechanical penthouse with central CHW service) must be evaluated for appropriate leak detection sensors (connected to the BAS) where the consequences of flooding may be catastrophic. Designers should work with NIH to coordinate placement of drains outside of sensitive spaces and at approved locations. NIH recommends that designers do not place rooms requiring heavy water use, drains, sinks, and drainage piping (e.g., ARF areas, mechanical rooms, food service or equipment washer areas) above or adjacent to critical areas.

Floor Penetrations, Drainage, and Backflow Devices

Failed piping systems resulting in water loss may damage facilities below the point of failure through floor penetrations that are improperly sealed against water intrusion. Minimizing damage depends on these penetrations being water-tight. Components like floor drains, floor sinks, and trough drains must use appropriate sealant and corrosion-resistant clamping collars and be installed with safing membranes for penetrations in wet areas. Designers can reference Exhibit 13.6 and Appendix L of the *DRM* for suitable types of sealants for floor and wall penetrations in non-lab, BSL, and APF facilities.

Drain assemblies serving high-temperature equipment must accommodate different rates of thermal expansion between the drain and connected piping to maintain waterproofing at penetrations. Floor drains in high traffic areas shall be sufficiently load-rated so as not to be displaced under pedestrian or equipment traffic. It is important to consider point loading of wheels from animal cages in ARFs and cage wash to prevent drain displacement or breakage.

The *DRM* also requires pipe sleeves to extend a minimum of 2 inches above the floor at all penetrations and be provided with a built-in water stop with seal and sleeves cast into the original floor slab construction. Where penetrations are created in existing floor slabs, core-drilled holes must be sealed with the appropriate UL-listed fire stop assembly.

Designers must consider the proper location for backflow preventers and required drainage. Where required, ASSE 1013 devices shall be placed in a readily serviceable location and provided with a drain receptor that can accommodate peak relief valve discharge flow, and shall not be located above ceilings or critical spaces.

Designers must tailor construction drawing details to reflect these and other water-proofing requirements for all devices that penetrate floors and provide backflow protection.

Testing Requirements

The designer must ensure all components of a pressurized plumbing system can withstand system working pressures, surge pressures, and operational temperatures. Water systems at NIH are hydrostatically pressure-tested with potable water to a minimum of 150% of the maximum working pressure but at least to 150 psig (whichever is greater) for four hours. Lab and domestic water systems are flushed, adjusted, commissioned, and disinfected prior to use to control biofilm and system corrosion. After testing and flushing, systems shall be maintained in operation or routinely flushed as a measure to control biofilm and prevent corrosion.

Summary

Designers must familiarize themselves with all potential causes of flood risks at NIH facilities. During the design process, they are encouraged to scrutinize the *DRM* and, if needed, contact the Division of Technical Resources (DTR) to clarify requirements.