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	Engineering and Design NAVIGATION LOCKS - FIRE PROTECTION PROVISIONS	
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DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
CECW-EE Washington, DC 20314-1000

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Manual
No. 1110-2-2608

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Engineering and Design
NAVIGATION LOCKS - FIRE PROTECTION PROVISIONS

1. Purpose. This manual sets forth design criteria and procedures to be used for fire protection systems at USACE navigation locks. The fire hazards addressed herein are those presented by commercial vessels, tows, and recreational craft. The protection to be provided is solely for lock appurtenances, such as miter gates, operating machinery, bridges, and buildings. Any benefit afforded the above-mentioned craft is considered incidental.

2. Applicability. The provisions of this manual are applicable to all HQUSACE elements, major subordinate commands, districts, laboratories, and field operating activities having responsibility for civil works navigation lock projects.

FOR THE COMMANDER:

WILLIAM D. BROWN
Colonel, Corps of Engineers
Chief of Staff

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Chapter 1
Introduction

1-1. Purpose

This manual sets forth design criteria and procedures to be used for fire protection systems at USACE navigation locks. The fire hazards addressed herein are those presented by commercial vessels, tows, and recreational craft. The protection to be provided is solely for lock appurtenances, such as miter gates, operating machinery, bridges, and buildings. Any benefit afforded the above-mentioned craft is considered incidental.

1-2. Applicability

The provisions of this manual are applicable to all HQUSACE elements, major subordinate commands, districts, laboratories, and field operating activities having responsibility for civil works navigation lock projects.

1-3. References

Required publications are listed in Appendix A.

1-4. Policy

The intent of this manual, including the use of all referenced codes and publications, is to provide for practical and economic fire protection for government property at navigation locks without exposing project personnel to undue risk. It is not the intent of this manual to provide a fire-fighting service to the navigation industry nor is it an intent to create that appearance. The design criteria in this manual shall be considered a minimum for all new locks and major lock rehabilitations. Updating existing locks is recommended, especially when service water or deck wash systems are installed or replaced. A policy of coordination with local fire departments shall be established in order to effectively utilize their fire-fighting capabilities, provided that such services are available. All sources of ignition should be prohibited on lock structures within 50 ft [15.24 m] of vessels where flammable and combustible materials are handled. Suitable **NO SMOKING** or **OPEN FLAME** signs, as specified in EP 310-1-6A, Chapter 11, should be posted in all such areas.

Chapter 2
Nature of Fire Hazards

2-1. Commercial

a. Vessels. The hazards from commercial vessels (generally towboats) would most likely be from the diesel fuel used for the marine propulsion units. Fires involving diesel fuel are Class B fires and are generally extinguished by excluding air (oxygen), inhibiting release of combustible vapors, or interrupting the combustion chain reaction. A lesser hazard would be a Class A fire (wood, paper, cloth, rubber, and many plastics). The heat-absorbing effects of water are effective in extinguishing Class A fires. Electrical fires (Class C) are usually extinguished with fire extinguishers. Vessels or tows with flammable or highly hazardous cargo will be passed separately from all other vessels or tows when river traffic in the approaches to a lock is light. When the river approaches to a lock are congested, simultaneous lockage of the aforementioned vessels or tows, other than pleasure craft, shall follow the latest procedure required by EM 385-1-1. Hazardous materials are described in Part 171, Title 49, Code of Federal Regulations. Flammable materials are defined in the National Fire Protection Association's (NFPA) National Fire Codes and Fire Protection Handbook.

b. Barges. Tanker barges carrying flammable or combustible liquids and gases present the greatest risk of a disastrous lock chamber fire. While the frequency of such fires has been extremely low, the damage potential to a navigation lock is very high. While water will have little effect on these large Class B fires, it can be effective in minimizing damage to the lock. Covered barges can carry combustible or oxidizing chemicals that, while not usually as volatile as liquids or gases, can also produce a disastrous fire. The procedure for fighting these fires depends on the chemicals involved. A lesser risk is presented by open barges carrying coal, wood, or other similar materials that would result in Class A fires that can be effectively extinguished with large quantities of water. It is important for lock personnel to know exactly what types of materials are on board an approaching tow in order to be prepared to respond effectively to an emergency.

2-2. Recreational

Recreational boat fires are more common, but the risk of lock damage is much lower due to the size of the crafts. Fuel (Class B) and combustible materials, such as fiberglass and wood (Class A), are normally present. Several of these vessels may be locked simultaneously during peak recreational periods, creating the risk of a fire spreading. Pleasure craft shall not be locked through a lock chamber with a commercial vessel or tow carrying dangerous cargo or containing flammable vapors. Water is effective on Class A fires and could also be effective on small Class B fires.

Chapter 3
Protective Measures and Procedures

3-1. Commercial

a. Initial response. Professional fire-fighting services should be relied upon to control and extinguish fires at the facilities. The initial response to a fire emergency should follow a written procedure as required by EM 385-1-1 and agreed to by the local fire departments, the Coast Guard, and the operating District. This procedure should include hardware requirements, method of communications, equipment access, response times, etc.

b. Spray systems. A water spray system should be activated as quickly as possible to cool and help wash flammable liquids away from the miter gates. Fixed sprinkler systems have the advantage of allowing lock personnel to perform other duties or seek shelter once they are activated. Sprinkler systems, however, are expensive to install, test, and maintain. Hose stations, readily available to the lock chamber, can be used to cool the gates, protect adjacent buildings, and assist in controlling fires on board vessels. Hose stations can be supplied at a relatively small cost, especially when combined with service water or deck wash systems, and are more easily maintained.

c. Additional protection. Filling the lock chamber will provide additional protection for the miter gates and lock walls. This is an effective procedure only when it does not expose important buildings and equipment on the lock walls to danger. Flushing a burning vessel out of a lock chamber is another alternative when it can be accomplished quickly enough to prevent damage and it does not endanger other navigators or river facilities. It also could require the installation of an oil boom downstream for liquid containment.

d. Evacuation. The burning vessel's crew and lock personnel should be evacuated as required by the situation. Ambulances and police should be called in to assist.

3-2. Recreational

As with commercial vessel, an emergency response should be initiated and the vessel evacuated as soon as possible. Hose stations should be used to control the fire and protect other vessels that may also be in the chamber. Sprinkler systems should be activated or the gates hosed as necessary.

Chapter 4
Criteria for Design

4-1. Water Supply

a. Fire pumps. The fire pumps should be in accordance with NFPA 20. The shut-off head shall not exceed 120 percent of the total rated head for horizontal pumps or 140 percent of the total rated head for vertical pumps. The pumps should have a pressure rating of not less than 6.89×10^5 Pa [100 psi] with a capacity of 1.6×10^{-2} m^3/s [250 gpm] and have sufficient capability to provide a flow of 3.15×10^{-3} m^3/s [50 gpm] to five hoses simultaneously with an effective pressure at the nozzle of not less than 4.14×10^5 Pa [60 psi]. The fire pumps may be combined with service water or deck wash systems for economies. If a fixed miter gate sprinkler system is used, a separate water supply system should be provided that supplies at least 1.58×10^{-5} m^3/s [0.25 gpm] coverage per 9.29×10^{-2} m^2 [1 ft^2] of gate. Sprinkler pumps should be sized to accommodate the sprinkler head capacities required. A back-up pump should be provided for either system for redundancy. Water supplies for fire protection should be in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, and NFPA 14, Standard for the Installation of Standpipe and Hose Systems. Adequate supplies of spare hose and nozzles should be readily available.

b. Piping. Aboveground and embedded pipe should be corrosion resistant and conform to American Society for Testing and Materials (ASTM) A795 or ASTM A312, Schedule 40. All fittings should have a minimum rated working pressure of 1.2×10^6 Pa [175 psi]. Underground piping should be ductile-iron with a 1.03×10^6 Pa [150 psi] working pressure and should conform to American Water Works Association (AWWA) C151 with a cement-mortar lining conforming to AWWA C104 and polyethylene encasement conforming to AWWA C105. All aspects of the fire water piping systems should comply with appropriate NFPA and AWWA standards and all state and local fire codes.

c. Zebra mussels. In areas contaminated by zebra mussels, water supplies for fire pumps should not be drawn from the river unless suitable zebra mussel control strategies are implemented. For control strategies, refer to "Zebra Mussel Research Technical Notes" as compiled by the Zebra Mussel Research Program at the U.S. Army Engineer Waterways Experiment Station. Other possible water supplies include city or well waters.

4-2. Hose Stations and Hydrants

Hose stations should be provided on all new locks and all existing locks as funding becomes available. Hydrants should be provided, in addition to hose stations, where a local fire department can respond to a fire. Location of the hydrants and connections must be compatible with the fire department's equipment. Hose should be synthetic lined and conform to NFPA 1961. Hose should be 1-1/2 in. with 1.5-9 NH. Hydrants should be the base valve (dry barrel) type with the valve and feed piping protected from freezing. A dry pipe system should be used when this is impractical. Hose stations should consist of 45.72 m [150 ft] of hose in permanent hose cabinets or on wheeled hose carts with hose reels. The stations should be spaced at no more than 91.44-m [300-ft] intervals along the walls on both sides of the lock chamber and no more than 45.72 m [150 ft] from a dead-end area.

4-3. Sprinkler Systems

Sprinkler systems should be considered at locks with lifts over 4.57 m [15 ft]. Tall gates are more susceptible to fire damage, when compared with shorter gates, in that it is possible to expose a higher percentage of gate area at low pool. Piping for fixed sprinkler systems should conform to NFPA 13 and NFPA 15. Sprinkler systems shall be designed in accordance with NFPA 13. Spray nozzles should be the open type with a flat spray pattern for uniform distribution and should operate at 3.1×10^5 Pa [45 psi]. Minimum spray angle should be 50 deg. The nozzles should be constructed of brass or stainless steel and should be sized and spaced to provide complete coverage. The sprinkler piping should be connected to the supply piping with a galvanized steel swivel joint with stainless steel ball bearings and grease fitting for lubrication. The piping should be designed so the water can be easily purged from the nozzles and piping to avoid freezing problems. Sprinkler systems, including bracing, shall be corrosion resistant and shall be properly protected against damage.

4-4. Access for Fire Trucks

Suitable access for fire trucks and other emergency vehicles should be provided where physically possible.

4-5. Alarm Systems

A fire alarm system should be provided, in addition to existing air whistle systems, to alert personnel quickly to

a lock chamber fire. The system should consist of an outside electric gong with alarm switches located strategically throughout the project. Electric power for the alarm should be taken from the house-current supply line on the line side of the main switch through an independent switch and circuit breaker. Automatic dialers should be considered, where the capability exists, to facilitate a quick emergency response.

4-6. Fire Extinguishers

Fire extinguishers should be the industrial usage type, rated for Class A, B, and C fires. Fire extinguishers shall be labeled to identify the listing and labeling organization and the fire test and performance standard that the fire extinguisher meets. They shall be marked with class of fire and numeric classification for relative extinguishing effectiveness. Placement of the fire extinguishers shall be in accordance with Chapter 3, NFPA 10, Standard for Portable Fire Extinguishers. Possible vandalism of fire extinguishers should also be considered. Cabinets should be provided at control shelters and near potential sources of ignition. The glass door cabinets should be weather-resistant, recessed or flush type, for either wall or pedestal mounting.

Chapter 5
Testing and Maintenance

5-1. Water Supply System

The water supply system should be tested periodically for leaks, pump performance, and overall system readiness. The Lockmaster should add to the weekly checklists the task of checking and clearing fire pump intakes and intake screen of debris and drift.

5-2. Sprinkler System

Sprinkler systems should be inspected and maintained in accordance with NFPA 13A.

5-3. Fire Extinguishers

All fire extinguishers should be examined at regular intervals several times each year to make certain that they have not been tampered with and have not suffered corrosion or damage. Seals should be inspected to determine that the extinguishers have not been operated since last being charged. Personnel making inspections should keep records of those extinguishers that were found to require correction.

Chapter 6
Training

6-1. Personnel

Lock personnel should be trained, in accordance with EM 385-1-1, to respond quickly to lock chamber fires of all types, in order to minimize damage to the lock until professional fire-fighting help arrives. Personnel should work with local organizations to promote safety and enhance safety programs.

6-2. Fire Drills

Fire drills should be conducted periodically so each lock operator knows exactly what to do in an emergency. The local fire department shall be encouraged to visit the lock facility annually to become acquainted with every part of the lock facility. Fire department personnel should be familiar with entries and access routes for fire-fighting equipment within the premises, location and extent of outside working area, type and capacity of water lines on the lock, and point of connection to the hydrants. Annual fire safety inspections, involving local fire officials, should be conducted.

Chapter 7
Coordination

7-1. Emergency Response

Districts should establish emergency response procedures and training suitable to the level of fire-fighting equipment and services available, and the ease of accessibility to same, for each of its locks. These procedures should be coordinated with local fire departments, emergency squads, and police to ensure an effective response when needed. In some areas, the Coast Guard may also be available to assist in an emergency response.

Appendix A
References

A-1. Required Publications

Code of Federal Regulations (CFR)
Title 49-Transportation, Part 171

EP 310-1-6A
Signs Standards Manual

EM 385-1-1
Safety and Health Requirements Manual

[1]**ASTM A312**
Specifications for Seamless and Welded Austenitic Stainless Steel Pipe

[1]**ASTM A795**
Specifications for Black and Hot-Dipped Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

[2]**AWWA C104**
American National Standard for Cement Mortar lining for Ductile-Iron Pipe and Fittings for Water

[2]**AWWA C105**
American National Standard for Polyethylene Encasement for Ductile-Iron Pipe for Water

[2]**AWWA C151**
American National Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water

[3]**National Fire Protection Association**
Fire Protection Handbook

[3]**National Fire Protection Association**
National Fire Codes

[3]**NFPA 10**
Standard for Portable Fire Extinguishers

[3]**NFPA 13**
Standard for the Installation of Sprinkler Systems

[3]**NFPA 13A**
Recommended Practice for the Inspection, Testing and Maintenance of Sprinkler Systems

[3]**NFPA 14**
Standard for the Installation of Standpipe and Hose Systems

[3]**NFPA 15**
Standard for Water Spray Fixed Systems for Fire Protection

[3]**NFPA 20**
Standard for the Installation of Centrifugal Fire Pumps

[3]**NFPA 1961**
Standard for Fire Hose

U.S. Army Engineer Waterways Experiment Station
"Zebra Mussel Research Technical Notes," 3909 Halls Ferry Road, Vicksburg, MS 39180

[1] Available from American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103.
[2] Available from American Water Works Association, 6666 West Quincy, Denver, CO 80235.
[3] Available from National Fire Protection Association, P.O. Box 9146, Quincy, MA 02269.