

NFPA No.

214

# **WATER COOLING TOWERS 1971**



\$1.00

*Copyright © 1971*

**NATIONAL FIRE PROTECTION ASSOCIATION**  
International

4M-6-71-WP-FP

Printed in U.S.A.

60 Batterymarch Street, Boston, Mass. 02110

## Official NFPA Definitions

Adopted Jan. 23, 1964; Revised Dec. 9, 1969. Where variances to these definitions are found, efforts to eliminate such conflicts are in process.

**SHALL** is intended to indicate requirements.

**SHOULD** is intended to indicate recommendations or that which is advised but not required.

**APPROVED** means acceptable to the authority having jurisdiction. The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of nationally recognized testing laboratories,\* i.e., laboratories qualified and equipped to conduct the necessary tests, in a position to determine compliance with appropriate standards for the current production of listed items, and the satisfactory performance of such equipment or materials in actual usage.

\*Among the laboratories nationally recognized by the authorities having jurisdiction in the United States and Canada are the Underwriters' Laboratories, Inc., the Factory Mutual Research Corp., the American Gas Association Laboratories, the Underwriters' Laboratories of Canada, the Canadian Standards Association Testing Laboratories, and the Canadian Gas Association Approvals Division.

**LISTED:** Equipment or materials included in a list published by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

**LABELED:** Equipment or materials to which has been attached a label, symbol or other identifying mark of a nationally recognized testing laboratory that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling is indicated compliance with nationally recognized standards or tests to determine suitable usage in a specified manner.

**AUTHORITY HAVING JURISDICTION:** The organization, office or individual responsible for "approving" equipment, an installation, or a procedure.

### Statement on NFPA Procedures

This material has been developed in the interest of safety to life and property under the published procedures of the National Fire Protection Association. These procedures are designed to assure the appointment of technically competent Committees having balanced representation from those vitally interested and active in the areas with which the Committees are concerned. These procedures provide that all Committee recommendations shall be published prior to action on them by the Association itself and that following this publication these recommendations shall be presented for adoption to the Annual Meeting of the Association where anyone in attendance, member or not, may present his views. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or non-compliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

### Copyright and Republishing Rights

This publication is copyrighted © by the National Fire Protection Association. Permission is granted to republish in full the material herein in laws, ordinances, regulations, administrative orders or similar documents issued by public authorities. All others desiring permission to reproduce this material in whole or in part shall consult the National Fire Protection Association.

# Water Cooling Towers

NFPA No. 214 — 1971

## Origin and Development of No. 214

The subject of the protection of water-cooling towers was first considered by the NFPA Committee on Building Construction in 1957 and a progress report on that subject was published in the Advance Reports of that year. In 1958, a new Committee on Water-Cooling Towers was appointed and a Tentative Standard on Fire Protection of Water-Cooling Towers proposed by the Committee was adopted by the Association in that year. Final adoption was secured in 1959. Revised editions were published in 1961, 1966 and 1968.

## 1971 Edition of No. 214

This Edition of the Standard on Water Cooling Towers was adopted at the Annual Meeting in May 1971, and supersedes the 1968 edition. Changes and additions are concerned primarily with the protection of cooling towers, including earthquake protection, and particularly crossflow towers with completely enclosed distribution basins. Other amendments are essentially editorial for clarification.

## Committee on Water Cooling Towers

**C. F. Averill**, *Chairman*,

Grinnell Co., Inc., Fire Protection Division, Providence, R. I. 02901  
(rep. National Automatic Sprinkler & Fire Control Assn.)

**Robert Grotheer**, Fluor Cooling Products Company, Inc.

**J. R. De Monbrun**, Union Carbide Corp.

**A. J. Mercurio**, Factory Insurance Assn.

**John A. Nelson**, The Marley Co.

**E. N. Searl**, Western Actuarial Bureau

**R. P. Webber**, E. I. duPont de Nemours & Co.

### Alternate.

**W. J. Swingler**, Factory Insurance Assn. (Alternate to A. J. Mercurio)

**SCOPE:** Standards for the design, construction, protection and maintenance of water cooling towers

## CONTENTS

	PAGE
Foreword .....	214-3
Scope .....	214-3
Definitions .....	214-6
Location and Construction .....	214-6
Installation of Electrical Equipment and Wiring .....	214-9
Internal Combustion Engine Driven Fans .....	214-9
Fire Protection .....	214-10
Access .....	214-24
Lightning Protection .....	214-25
Maintenance .....	214-25
Appendix .....	214-26

## **Standard on WATER-COOLING TOWERS**

**NFPA No. 214 — 1971**

### **Foreword**

**A.** The fire record of water-cooling towers indicates the failure to recognize the extent or seriousness of the potential fire hazard of these structures both while in operation or when temporarily shut down. Cooling towers of combustible construction, especially those of the induced draft type, do present a potential fire hazard even when in full operation because of the existence of relatively dry areas within the tower.

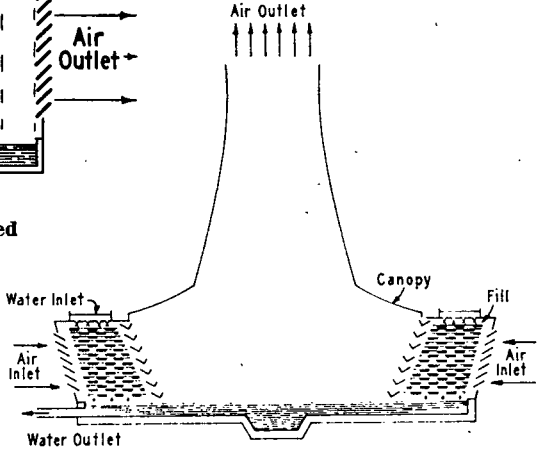
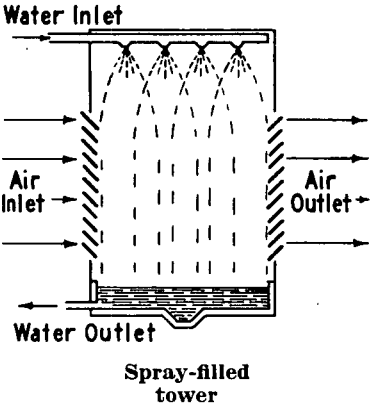
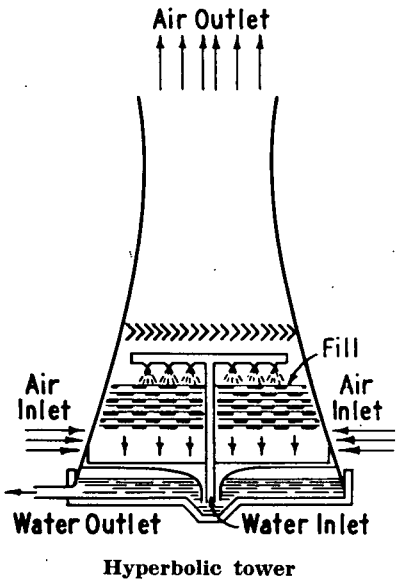
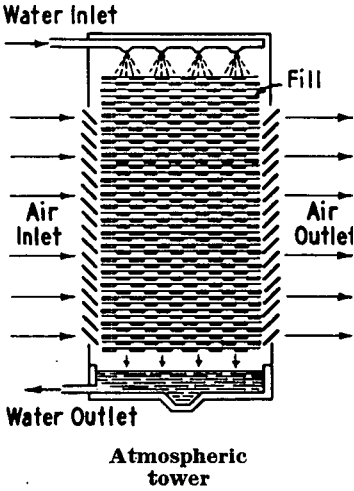
**B.** A significant percentage of fires in water-cooling towers of combustible construction are caused by ignition from outside sources such as incinerators, smokestacks, or exposure fires. Fires in cooling towers may also create an exposure hazard to adjacent buildings and processing units. Therefore, distance separation from buildings and sources of ignition or the use of noncombustible construction are primary considerations in preventing these fires.

**C.** Consideration should also be given to sources of ignition from within these structures, including welding and cutting operations, smoking, overheated bearings, electrical failures and other heat or spark producing sources.

**D.** Fires have also occurred during the construction of cooling towers. Measures should be taken during construction to prevent the accumulation of combustible waste materials such as wood borings, shavings, scrap lumber or other easily ignited materials. "No Smoking" regulations, and strict control of welding operations and other heat or spark producing devices should be enforced. Wetting down combustible portions of the tower during idle periods of construction is a good fire prevention practice.

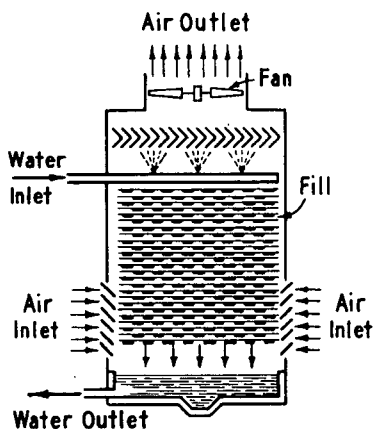
### **10. Scope.**

**101.** This Standard applies to fire protection considerations for field-erected water-cooling towers. It does not apply to small factory assembled towers the main structure of which does not exceed a volume of 2000 cubic feet.

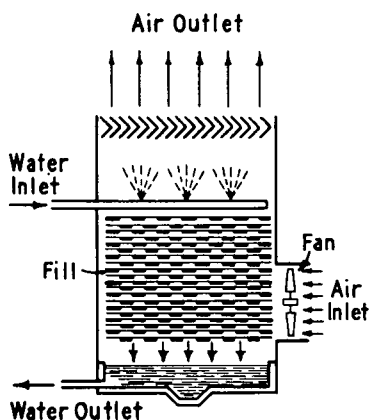


**Crossflow Hyperbolic Tower**

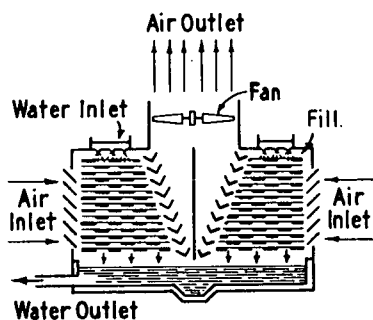
**Figure 1111. Types of atmospheric towers.**



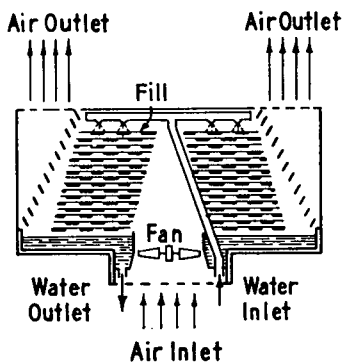
**Induced draft  
counterflow  
tower**



**Forced draft tower**



**Crossflow  
induced draft  
tower**



**Underflow tower**

**Figure 1112. Types of mechanical-draft towers.**

## 11. Definitions.

111. There are two basic types of industrial water-cooling towers: ATMOSPHERIC AND MECHANICAL-DRAFT.

1111. ATMOSPHERIC TOWERS depend upon natural movement of the wind for air circulation to accomplish cooling. They usually consist of a louvered enclosure with a spray system for distribution of water.

1112. MECHANICAL-DRAFT TOWERS are towers through which air movement is effected by one or more fans or other mechanical means. There are two general types: forced draft, with one or more fans located at the air inlet; induced draft, with one or more fans located at the air exhaust.

Induced draft towers are further classified by design as counterflow (Fig. 1112a.) and crossflow (Fig. 1112b.). Forced draft towers may be of counterflow or crossflow design. A counterflow design is arranged so that the circulated water flows countercurrent to the flow of air induced by the fans. In a crossflow tower, the air flows perpendicular to or across the flow of water. The latter design is usually characterized by an open basin at the top of the tower for the distribution of water.

112. Cooling towers of combustible construction are those of wood frame construction as defined by NFPA No. 220, Standard Types of Building Construction, and those in which the fill or fill decks are of combustible material.

Materials with flame spread ratings of 25 or less, defined as noncombustible in NFPA No. 220, Standard Types of Building Construction, when used in cooling tower construction, may require fire protection.

## 12. Location and Construction.

121. Cooling towers may be involved in the following cases of exposure fire hazard:

1211. Proximity to chimneys, incinerators or other similar sources of ignition.

1212. Proximity to hazardous materials or structures; fire in these may constitute a hazard to the tower, and vice versa.

122. Cooling towers with combustible exterior construction should be located 100 feet or more from hazards indicated in paragraph 121; towers with noncombustible



exterior construction should be located 40 feet or more from such hazards; if a tower must be located closer than 40 feet from such a hazard, it should be noncombustible throughout, or of noncombustible exterior construction and provided with automatic sprinkler protection as indicated in section 15.

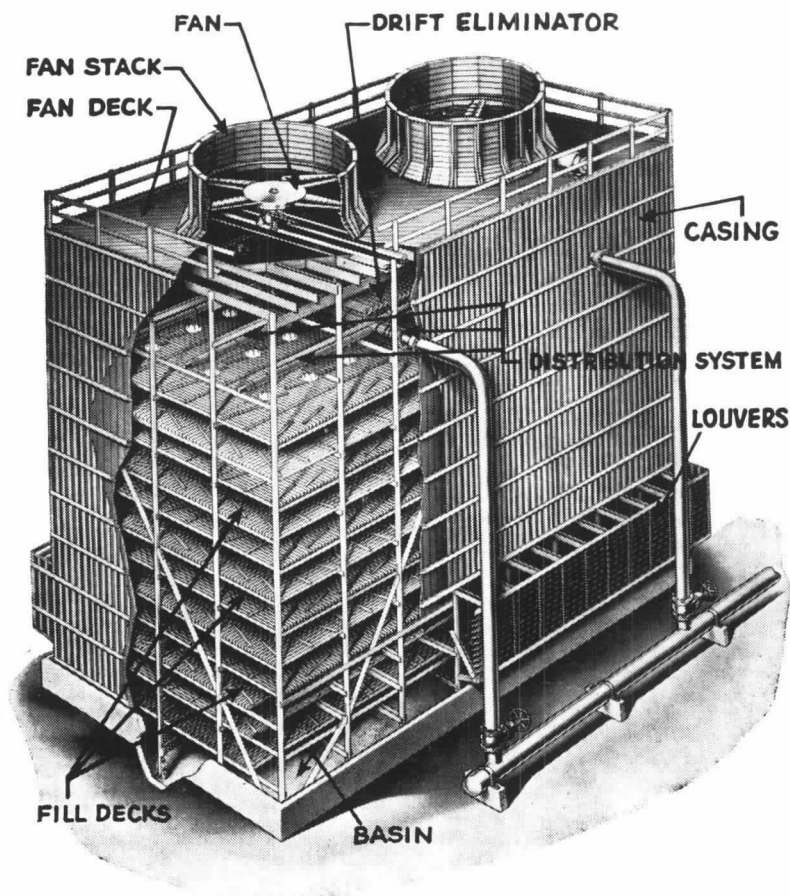


Figure 1112a. Typical induced draft counterflow water-cooling tower.

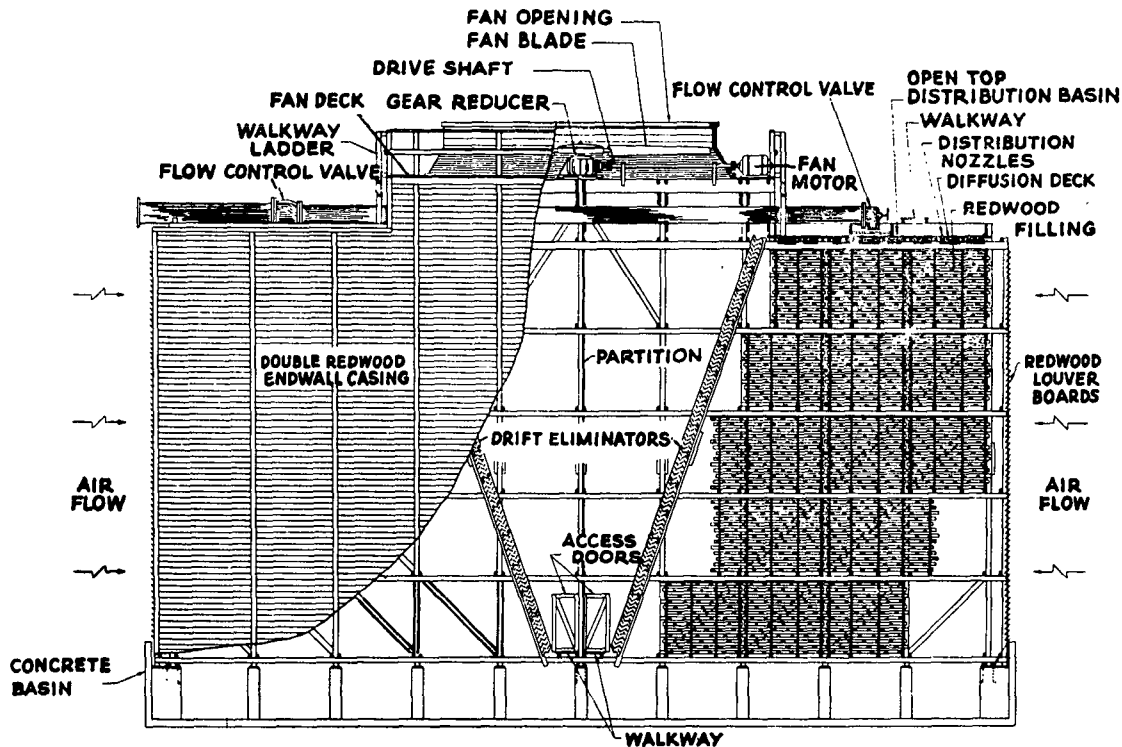


Figure 1112b. Typical induced draft crossflow water-cooling tower.

**123.** Induced draft cooling towers of combustible construction located on building roofs or other locations at which access for manual fire fighting is restricted or difficult, shall be provided with a fire protection system as indicated in Section 15.

**124.** Towers located on the ground and in areas not otherwise fenced should be enclosed by a fence not less than 20 feet from the tower.

**NOTE:** Where conditions vary from those outlined in paragraphs 121 - 124 inclusive above, the matter should be referred to the authority having jurisdiction.

**125.** Open areas or space between the base of a cooling tower and the ground or the roof of a building upon which it is located should be effectively screened to prevent the accumulation of waste combustible material under the tower, or to prevent the use of such areas or space under the tower for the storage of combustible material.

### **13. Installation of Electrical Equipment and Wiring.**

**131.** Installation of all electrical equipment and wiring pertaining to water-cooling towers shall be in accordance with the National Electrical Code (NFPA No. 70-ANSI C1).

**132.** Electric motors driving fans shall be provided with overcurrent protective devices as recommended by the National Electrical Code. Motors should be totally enclosed to protect them from dirt or moisture and to prevent sparks from reaching adjacent combustible construction.

**133.** A remote fan motor switch shall be provided to stop fan in case of fire.

**134.** When a fire protection system is installed, provision shall be made to interlock the fan motors with the sprinkler system (see paragraph 1527).

**135.** An automatic vibration controlled switch should be provided to automatically shut down fan motors.

### **14. Internal Combustion Engine Driven Fans.**

**141.** Electric motors or steam should be used to operate fans on cooling towers. When neither is available, internal combustion engines may be used provided they are installed, used and maintained in accordance with NFPA

Standard No. 37, Stationary Combustion Engines and Gas Turbines, subject to the approval of the authority having jurisdiction.

## **15. Fire Protection.**

### **151. GENERAL.**

**1511.** The following are some of the factors to be considered in determining the extent and method of fire protection of induced draft and hyperbolic cooling towers:

- a. Importance to continuity of operation
- b. Size and construction of tower
- c. Type of tower
- d. Location of tower
- e. Water supply
- f. Value of tower

NOTE: Fire records for mechanical forced draft and atmospheric, other than hyperbolic, do not indicate the general need for automatic fire protection systems. However, exposure protection may be necessary as provided in 154.

**1512.** Depending on factors indicated above where a fire protection system is required, one of the following general types of systems may be used (See Appendix):

- a. Open head deluge system
- b. Closed head dry pipe system
- c. Wet pipe automatic sprinkler system

**1513.** Complete plans and data required. A complete plan showing piping arrangement, location of sprinklers, fixed detectors, operating equipment such as valves, deluge valves, etc., together with hydraulic calculations, water requirements and water supply information, shall be submitted to the authority having jurisdiction for approval before installation. Plans shall be drawn to scale and include the details necessary to indicate clearly all of the equipment and its arrangement. Plans shall show location of new work with relation to existing structures, cooling towers and water supplies. Plans should be accompanied by specifications covering the character of the materials and the features relating to the installation.

**1514.** Cooling water supplied to heat exchangers used for cooling flammable gases or liquids or combustible liquids where the cooling water pressure is less than that of the material being cooled may constitute a hazard to the cooling

tower by the return of the flammables or combustibles to the cooling tower water distribution system.

## 152. FIRE PROTECTION SYSTEM DESIGN.

### 1521. Types of Systems.

The counterflow tower design lends itself to either closed or open head systems. Therefore, wet pipe, dry pipe, or deluge systems may be used. Where water supplies are adequate, the deluge system usually provides a higher degree of protection.

The crossflow design is such that it is difficult to locate sprinklers in the most desirable spots for both water distribution and heat detection. This situation can be solved by separating these two functions and using separate water discharge and detection systems. The open head deluge system does this and, therefore, is the type of system most applicable to crossflow towers.

In large multicell towers, normal water supplies may be inadequate for deluge systems. Closed head systems (dry or wet) could be considered in these cases. Authorities having jurisdiction should be consulted as to the type of system to be used.

1522. The fire protection system should be designed on a rate of application basis as follows:

a. Under fan decks of counterflow towers a water density of 0.5 gpm per square foot (including fan opening).

b. Under fan decks of crossflow towers a water density of 0.33 gpm per square foot (including fan opening).

c. Over fill areas of crossflow towers a water density of 0.5 gpm per square foot.

1523. In counterflow towers, the discharge outlets shall be located under the fan deck and fan opening (Figs. 152 a, b, c, and d).

In crossflow towers, the discharge outlets protecting the plenum area shall be located under the fan deck and in the fan opening. Discharge outlets protecting the fill shall be located under the distribution basin on either the louver or drift eliminator side, discharging horizontally through the joint channels (Figs. 152 e, f, g, h). On towers with a fill air travel greater than 18 feet, the outlets shall be located on opposite sides of the basins, in alternate joist channels. On towers having completely enclosed distribution basins, the outlets may be located over the basin under the extension of the fan deck (Figs. 152 i, j).

*Continued on page 214-22*

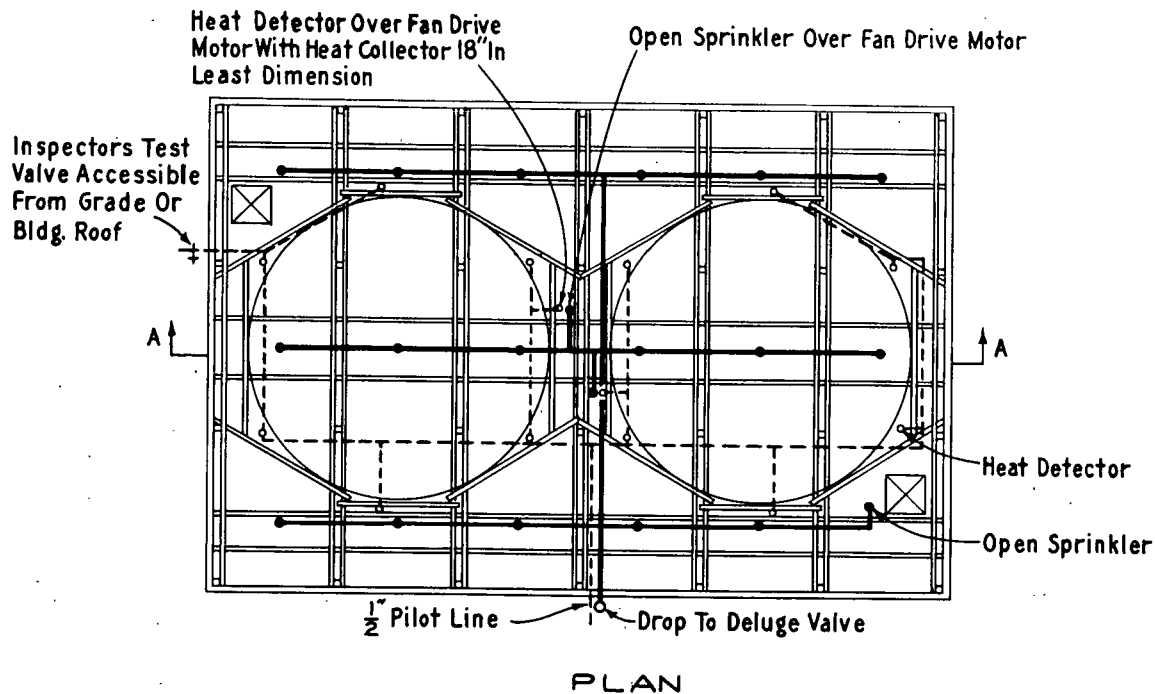
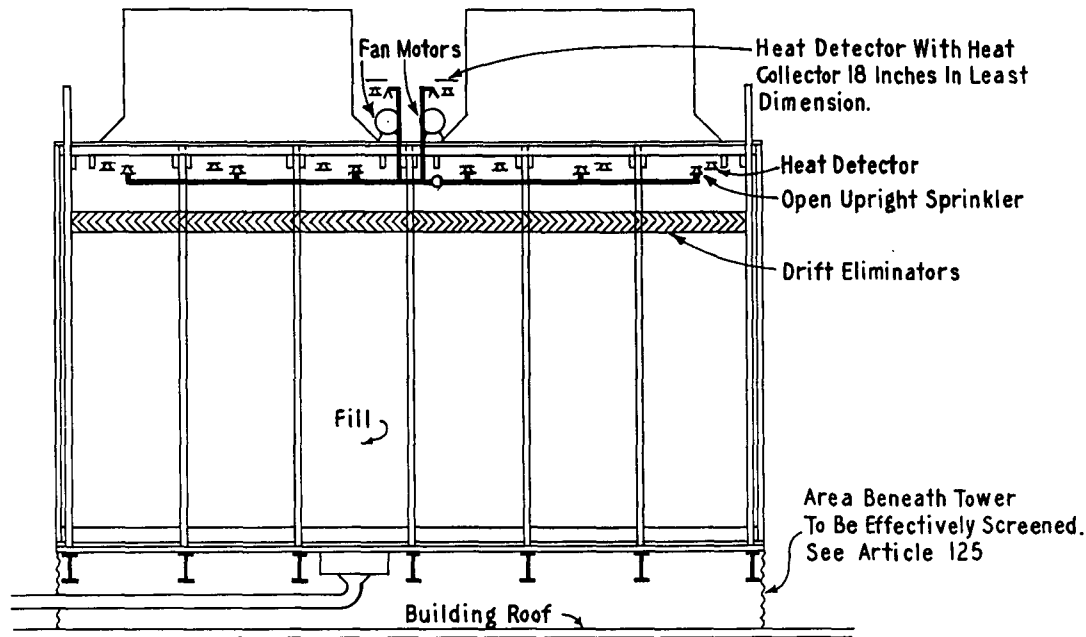


Figure 152a. Typical deluge fire protection arrangement for counterflow towers.



SECTION A - A

Figure 152b. Typical deluge fire protection arrangement for counterflow towers.





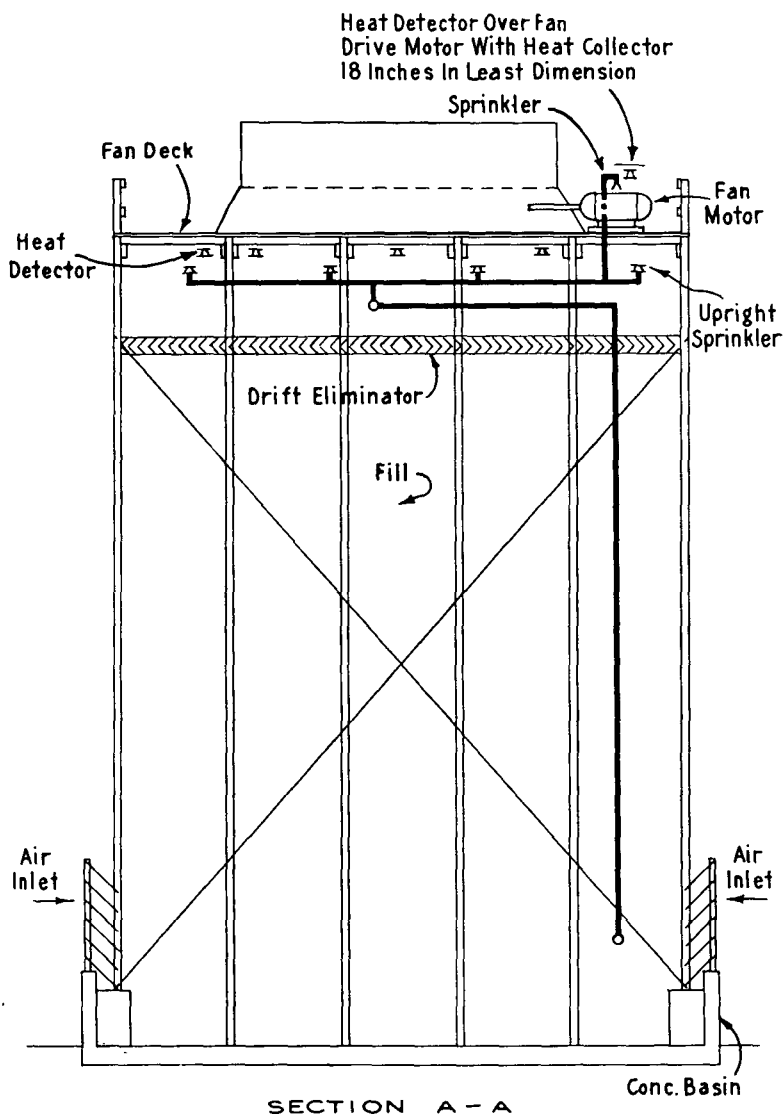
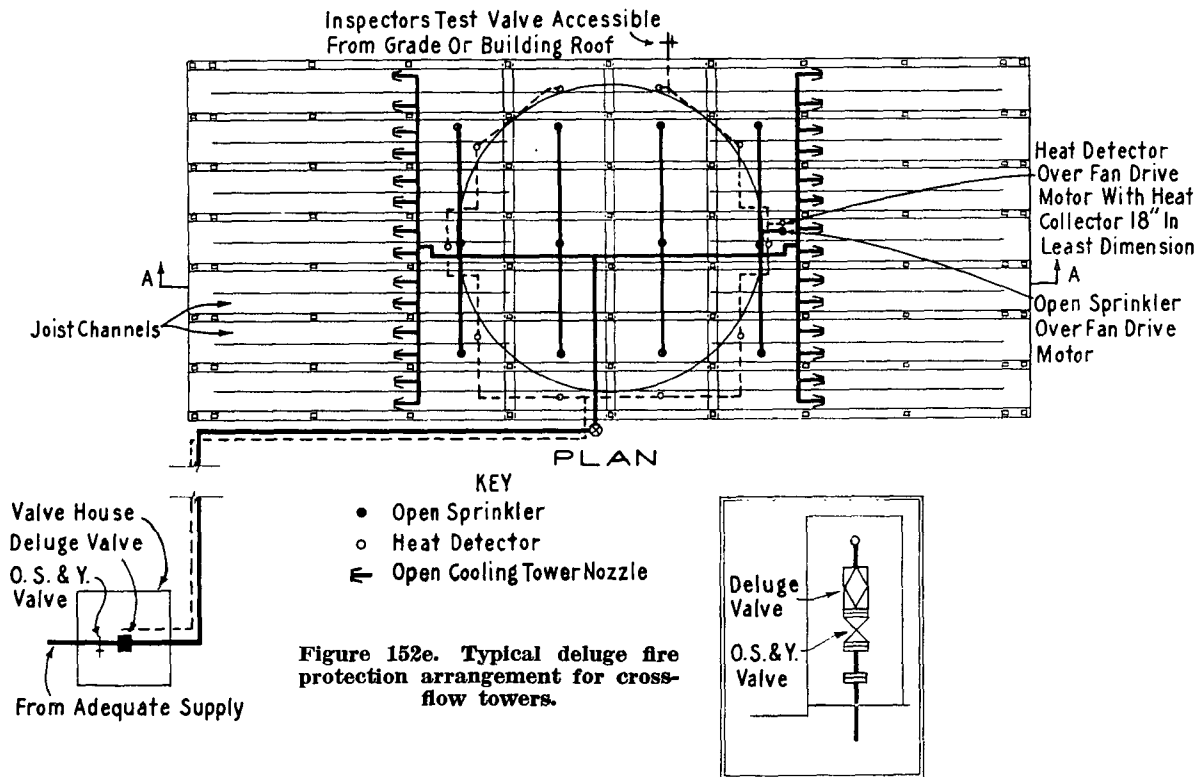
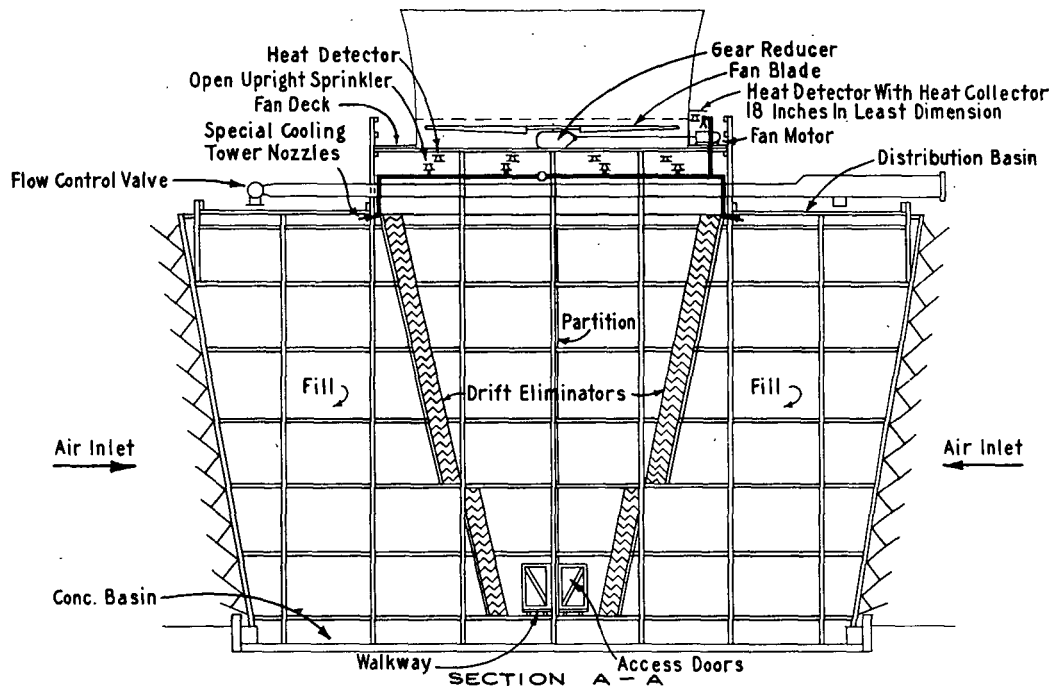
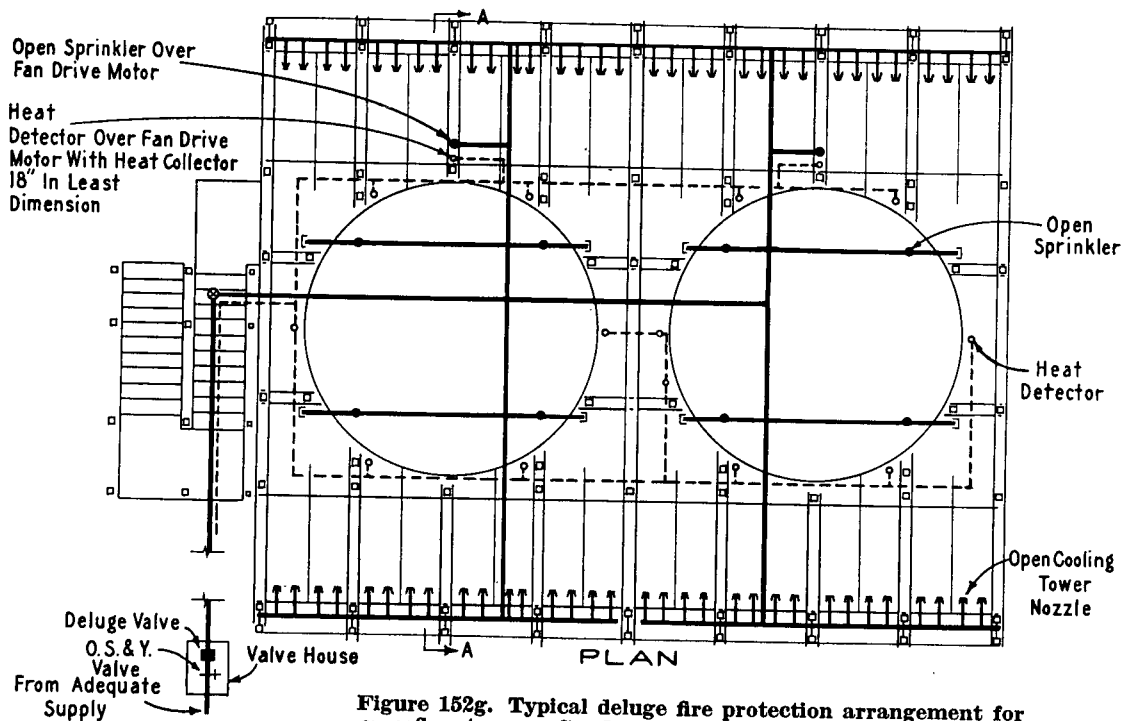


Figure 152d. Typical deluge or dry pipe fire protection arrangement for counterflow towers.

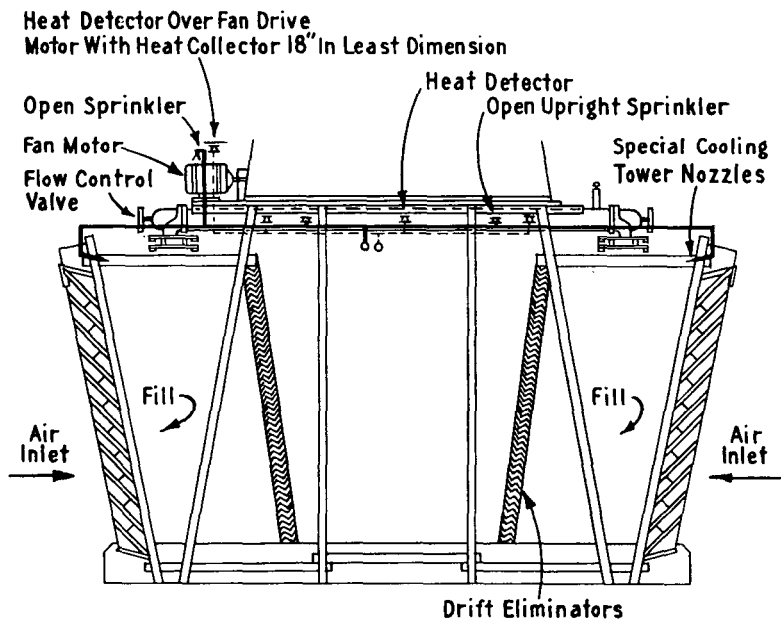




**Figure 152f. Typical deluge fire protection arrangement for crossflow towers.**



**Figure 152g. Typical deluge fire protection arrangement for crossflow towers. See Note following caption of Figure 152h.**

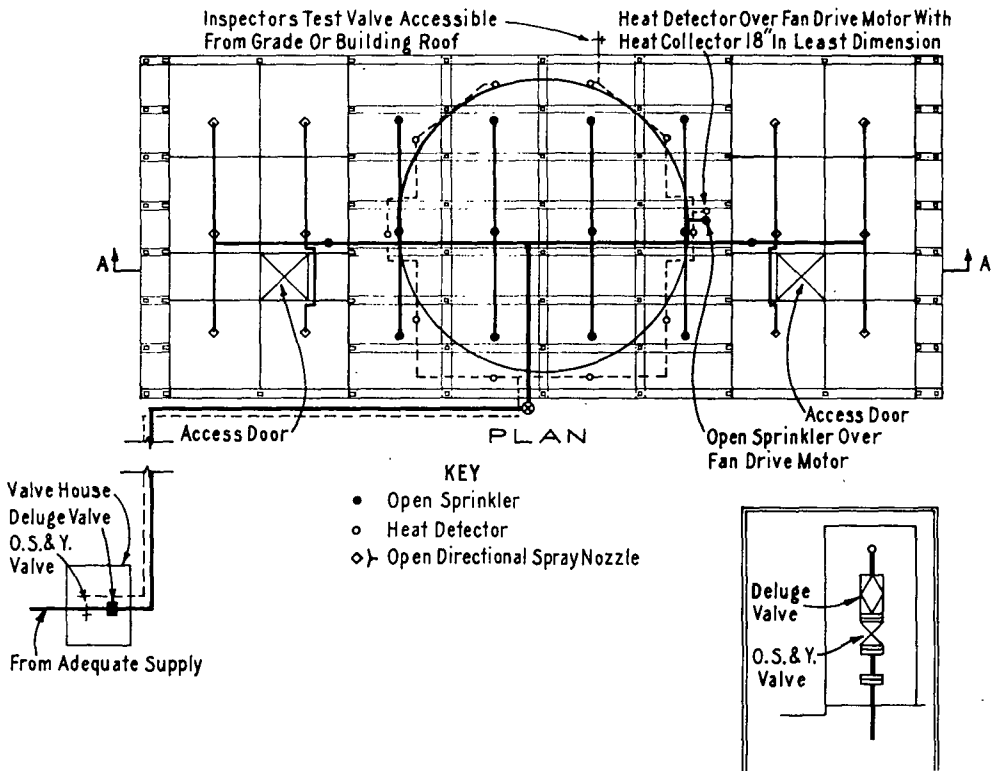


## SECTION A-A

**Figure 152h. Typical deluge fire protection arrangement for crossflow towers.**

**NOTE:** Where air seal boards prevent installation of cooling tower nozzles on drift eliminator side of fill, this nozzle location should be used.

Fig. 152i. Typical Deluge Fire Protection Arrangement for Crossflow Towers with Completely Enclosed Distribution Basins.



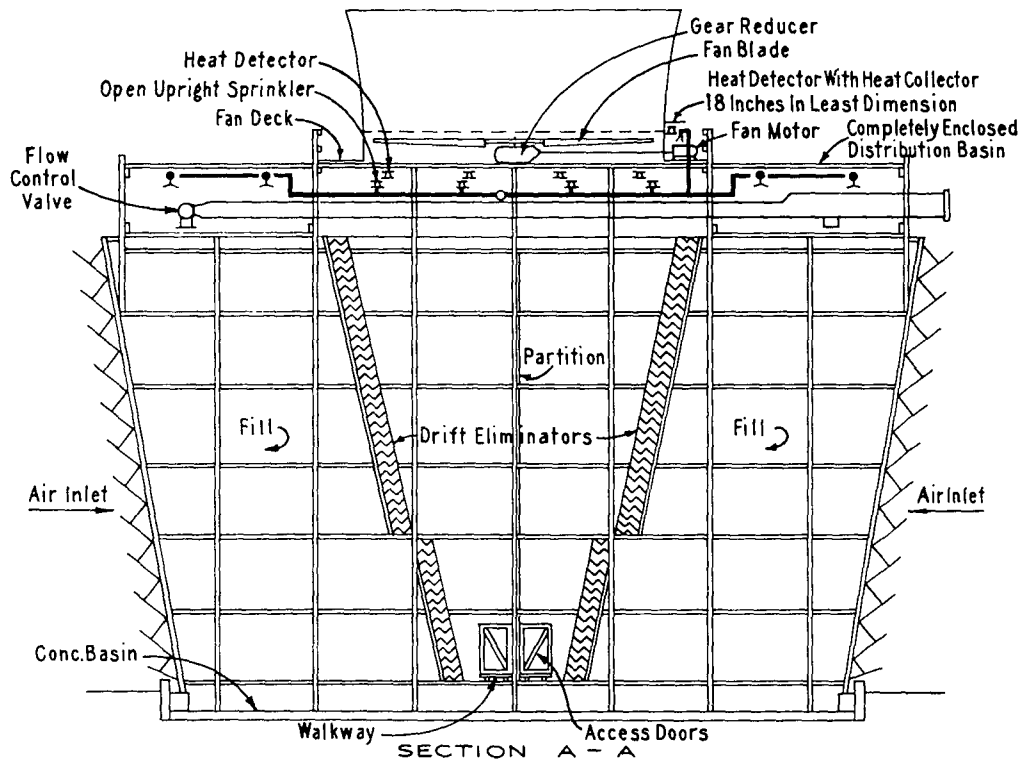


Fig. 152j. Typical Deluge Fire Protection Arrangement for Crossflow Towers with Completely Enclosed Distribution Basins.

1524. Pipe sizing shall be based on hydraulic calculations to give an even distribution of water throughout the protected area. The discharge from any one head or nozzle shall not vary from the specified rate of application more than plus or minus 15 per cent and the total discharge from a system shall not be less than the specified rate of application.

Hydraulic calculations shall be made in accordance with Chapter 7, of NFPA No. 13, Installation of Sprinkler Systems.

1525. Where deluge systems are used, an adequate number of heat detectors shall be installed. They shall be located in the path of natural air flow through the tower.

In counterflow and crossflow towers, heat detectors should be located under the fan deck around the circumference of the fan opening and spaced in accordance with the following rules.

Where rate-of-rise detectors are used, they shall be spaced not over 15 feet apart. In pneumatic type systems, for detectors inside the tower, there should be no more than one per mercury check in towers operating year round in cold climates, and two per mercury check in towers used during the warm months only or year round in warm climates. There may be four detectors per mercury check when the detectors are located outside the tower.

Where fixed temperature detectors are used, they shall be spaced not over 8 feet apart, in any direction, including the fan opening. Temperature rating should be selected in accordance with operating conditions but should be no less than intermediate.

Where heat detectors are inaccessible during tower operation, test detectors, accessible from the ground or roof, should be provided for each circuit. In the case of pilot head operated systems, an inspector's test connection shall be installed on the pilot line and arranged to be accessible during tower operation.

1526. A heat detector and water discharge outlet shall be provided over each fan drive motor when the motor is so located that it is not within the protected area of the tower.

1527. Provision shall be made to interlock the fan motors with the fire protection system so that the cooling tower fan motors will be stopped upon actuation of the system.