NFPA No.

214

WATER COOLING TOWERS 1966

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National Fire Protection Association

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Official NFPA Definitions

Adopted Jan. 23, 1964. Where variances to these definitions are found, efforts to eliminate such conflicts are in process.

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

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

Units of Measurements

Units of measurements used here are U. S. standard. 1 U. S. gallon = 0.83 Imperial gallons = 3.785 liters. One foot = 0.3048 meters. One inch = 25.40 millimeters. One pound per square inch = 0.06805 atmospheres = 2.307 feet of water. One pound = 453.6 grams.

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Water Cooling Towers

NFPA No. 214 — 1966

1966 Edition of No. 214

This 1966 edition of the Standard on Water-Cooling Towers was adopted by the National Fire Protection Association on May 19, 1966. Changes and additions to the 1961 edition included in this 1966 edition are as follows: revisions to the title of 11, and in 134, 151, 152 and 154. New material includes 112, 135, Figures 1111, 1112, 152a through h and the Appendix.

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. A revised edition was published in 1961.

Committee on Water Cooling Towers

C. F. Averill, *Chairman,*
Grinnell Co., Inc., Fire Protection Division, Providence, R. I.
(rep. National Automatic Sprinkler & Fire Control Assn.)

Edward L. Bishop, Cooling Tower Institute.

C. R. Groves, E. I. Du Pont de Nemours & Co.

A. J. Mercurio, Factory Insurance Assn.

E. N. Searl, Western Actuarial Bureau.

J. A. Wilson, Factory Mutual Engineering Division.

Alternate.

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

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Standard on
WATER-COOLING TOWERS

NFPA No. 214 — 1966

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.

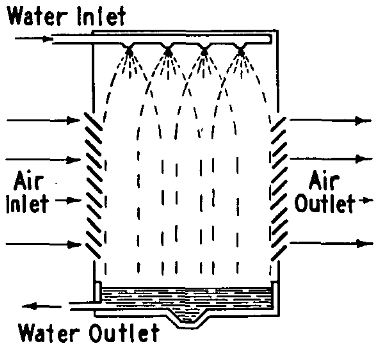
B. A significant percentage of fires in water-cooling towers of combustible construction are caused by ignition from outside sources such as incinerators, smokestacks, or exposure fires. Fires in cooling towers may also create an exposure hazard to adjacent buildings and processing units. Therefore,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

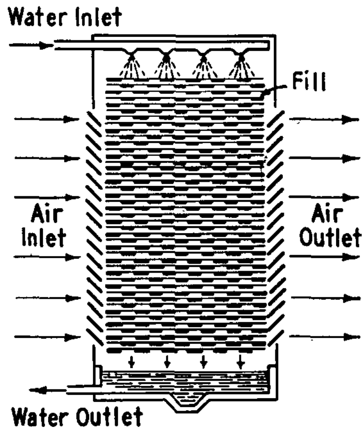
D. Fires have also occurred during the construction of cooling towers. Measures should be taken during construction to prevent the accumulation of combustible waste materials such as wood borings, shavings, scrap lumber or other easily ignited materials. "No Smoking" regulations, and strict control of 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.

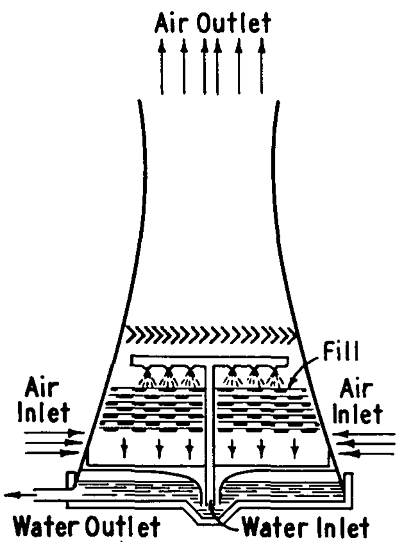
101. This Standard applies to fire protection considerations for field-erected water-cooling towers. It does not apply to small factory assembled towers the main structure of which does not exceed a volume of 2000 cubic feet.



Spray-filled tower

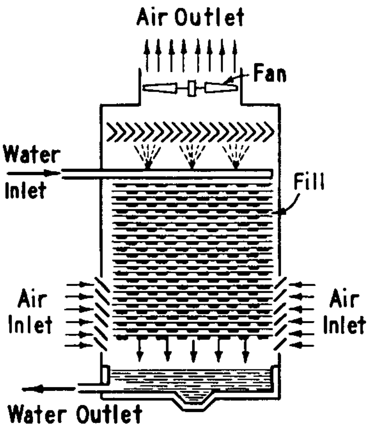


Atmospheric tower

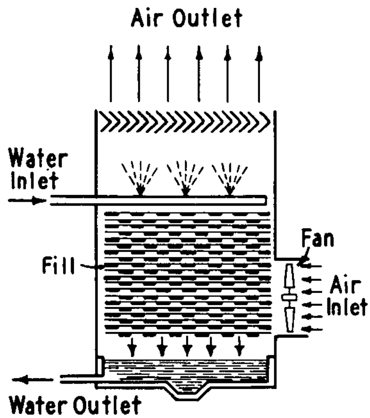


Hyperbolic tower

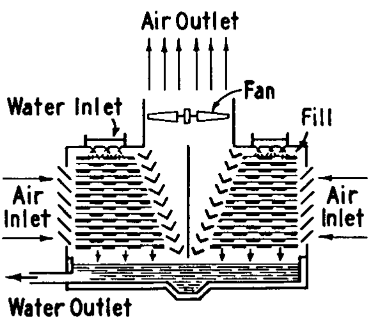
Figure 1111. Types of atmospheric towers.



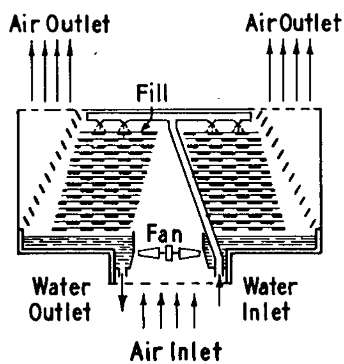
Induced draft counterflow tower



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.

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.

123. Induced draft cooling towers of combustible construction and located on building roofs should be provided with automatic sprinkler protection as indicated in section 15.

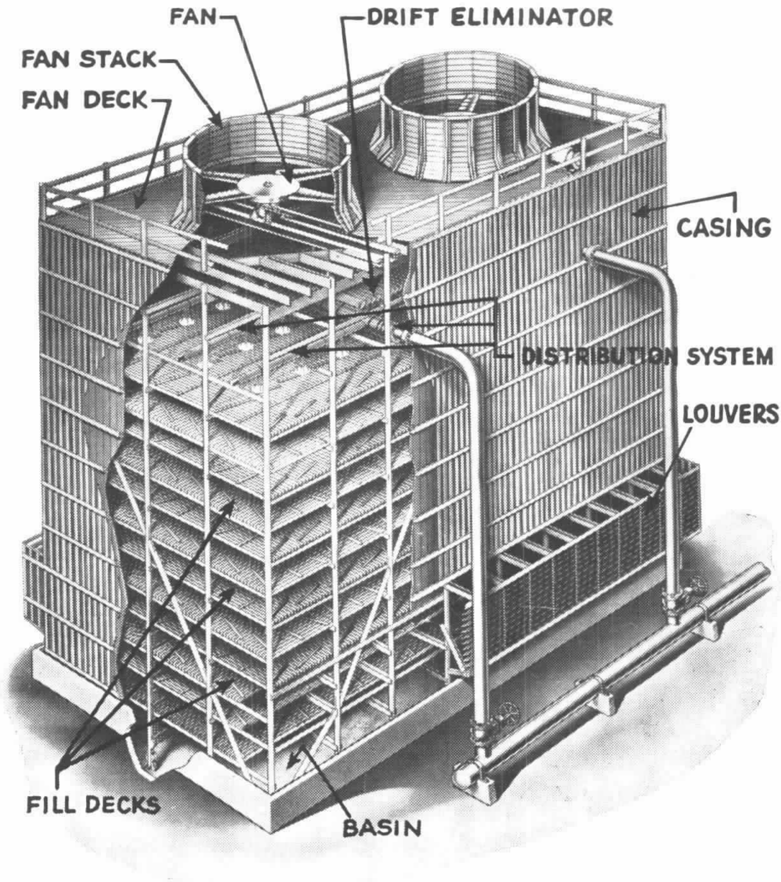


Figure 1112a. Typical induced draft counterflow water-cooling tower.

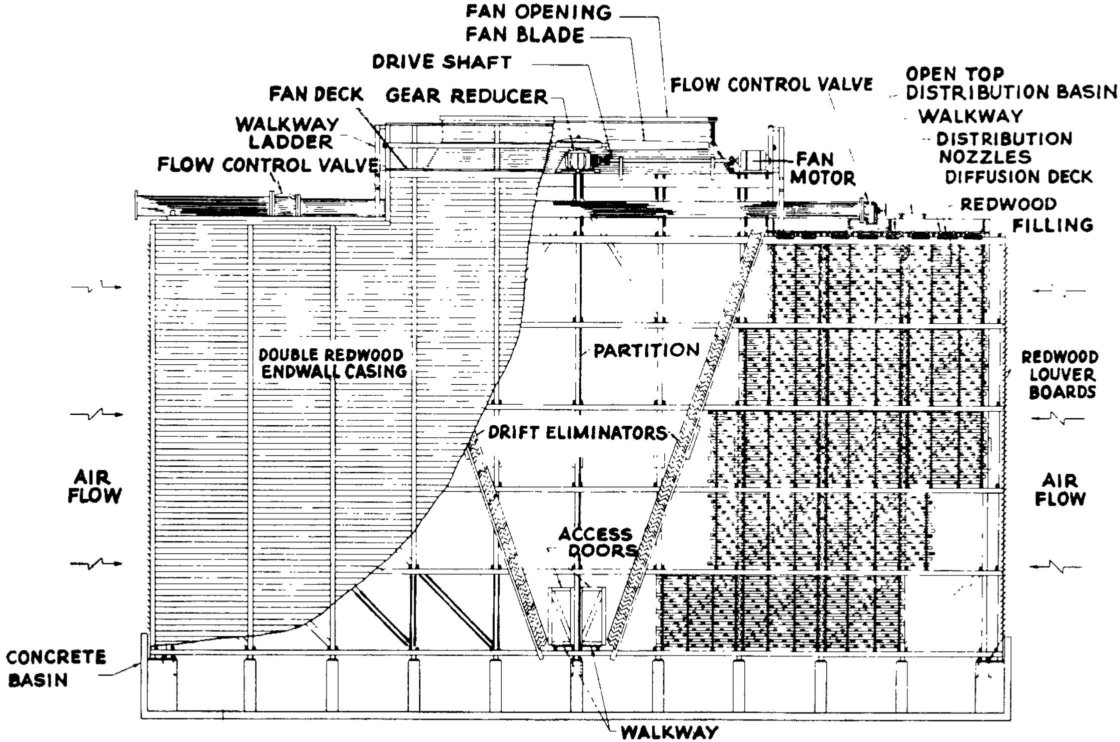


Figure 1112b. Typical induced draft crossflow water-cooling tower.

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 sections 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.

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 sprinkler system is installed, provision shall be made to interlock the fan motors with the sprinkler system so that the cooling tower fans will be stopped upon actuation of the system.

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, Combustion Engines and Gas Turbines, subject to the approval of the authority having jurisdiction.

15. Fire Protection.

151. GENERAL.

1511. Consideration shall be given to the following factors in determining the extent and method of fire protection of induced draft cooling towers:

- a. Important 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 atmospheric and mechanical forced draft towers 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

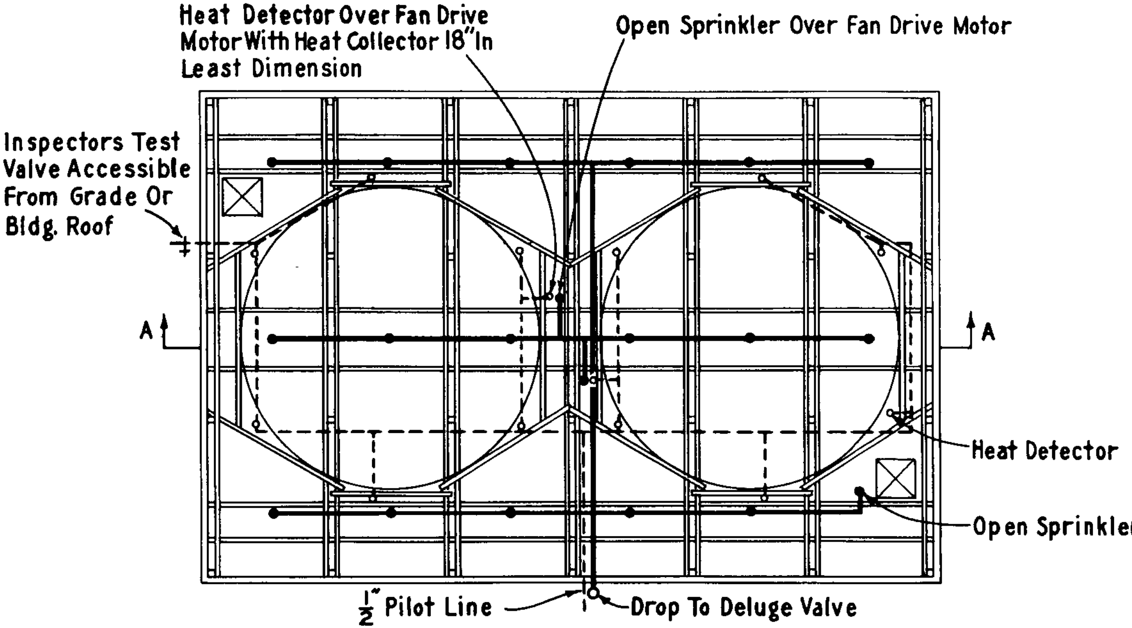
152. FIRE PROTECTION SYSTEM DESIGN.

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.

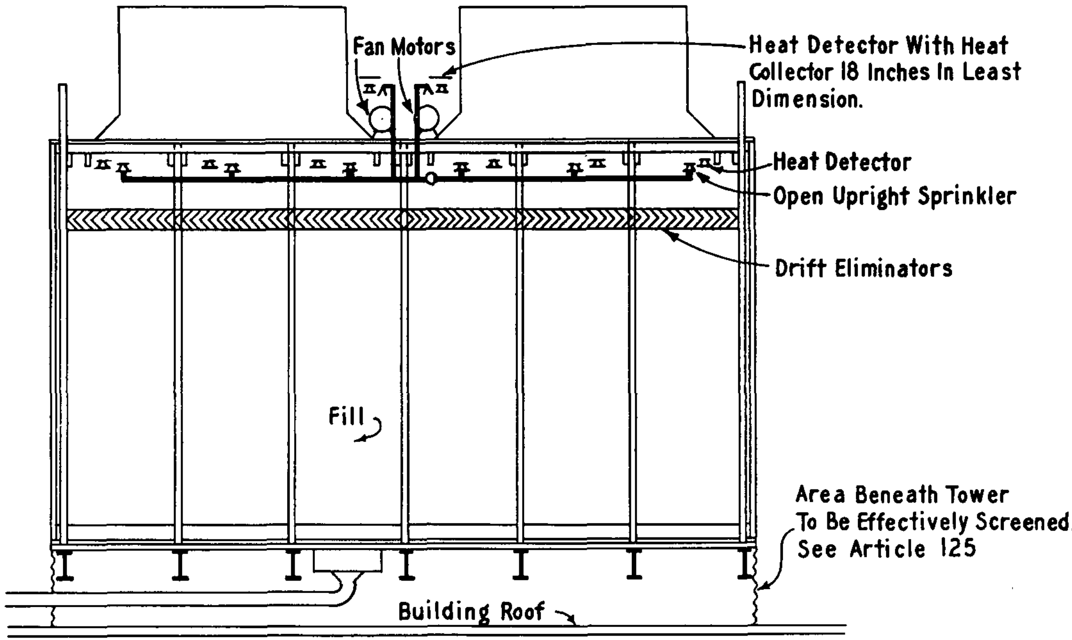
The crossflow design is such that it is difficult to locate sprinklers in the most desirable spots for both water distribution and heat detection. This situation can be solved by separating these two functions and using separate water discharge and detection systems. The open head deluge system does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



PLAN

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



SECTION A — A

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

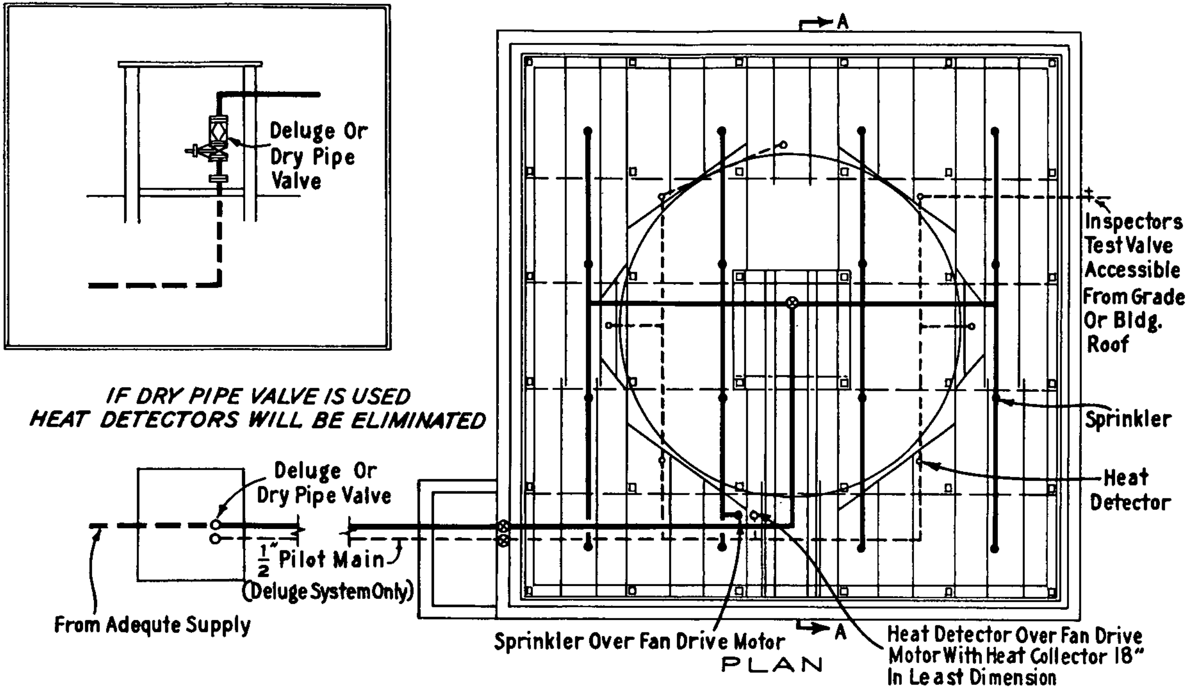


Figure 152c. Typical deluge or dry pipe fire protection arrangement for counterflow towers.

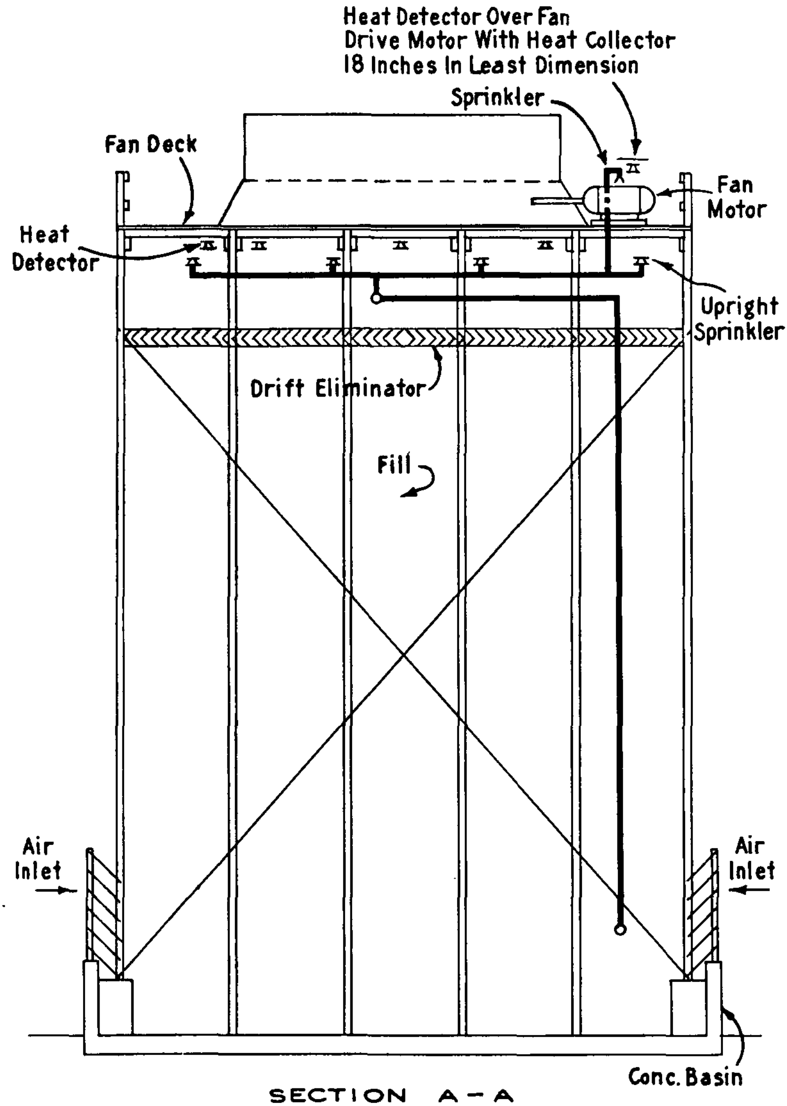
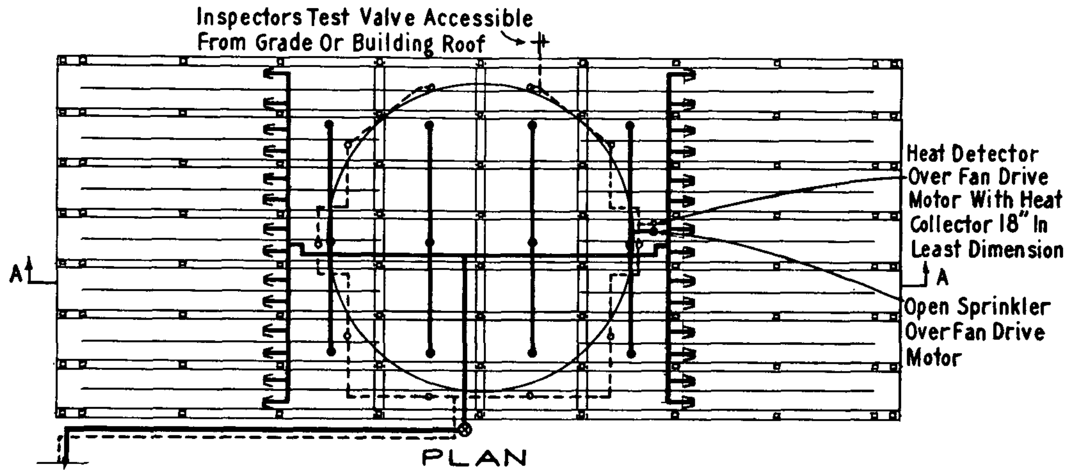
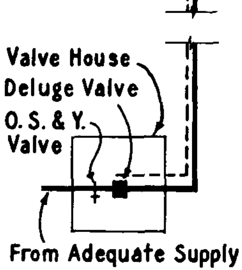


Figure 152d. Typical deluge or dry pipe fire protection arrangement for counterflow towers.





KEY
- ● Open Sprinkler
- ○ Heat Detector
- ⇐ Open Cooling Tower Nozzle

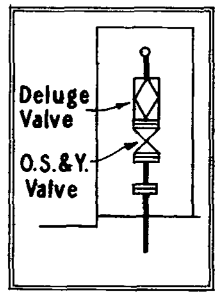


Figure 152e. Typical deluge fire protection arrangement for cross-flow towers.

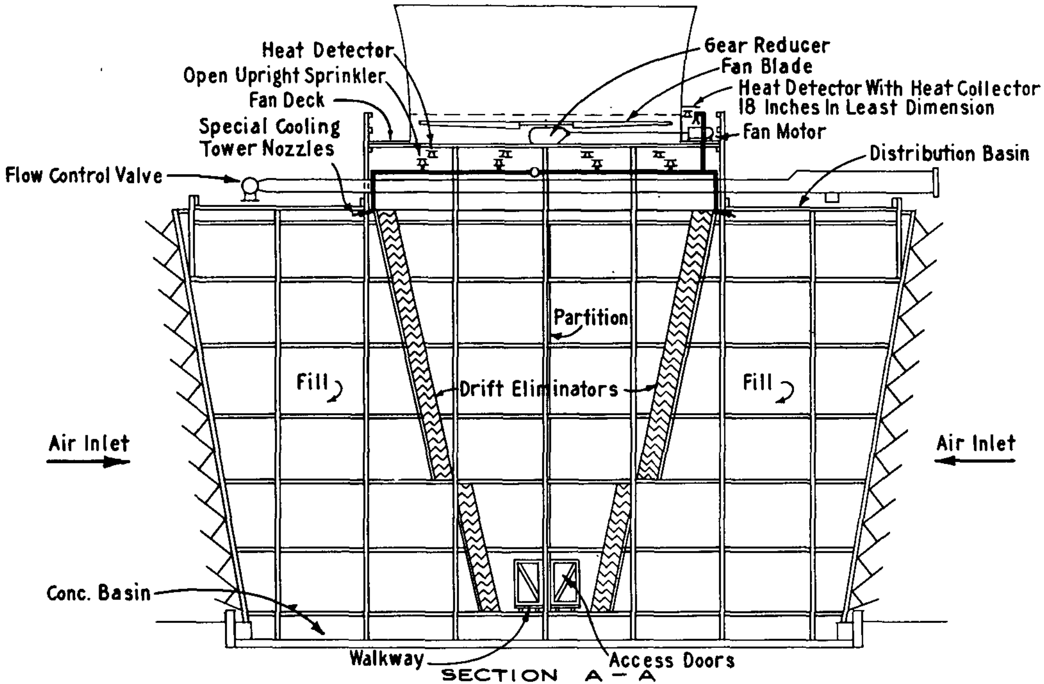


Figure 152f. Typical deluge fire protection arrangement for crossflow towers.

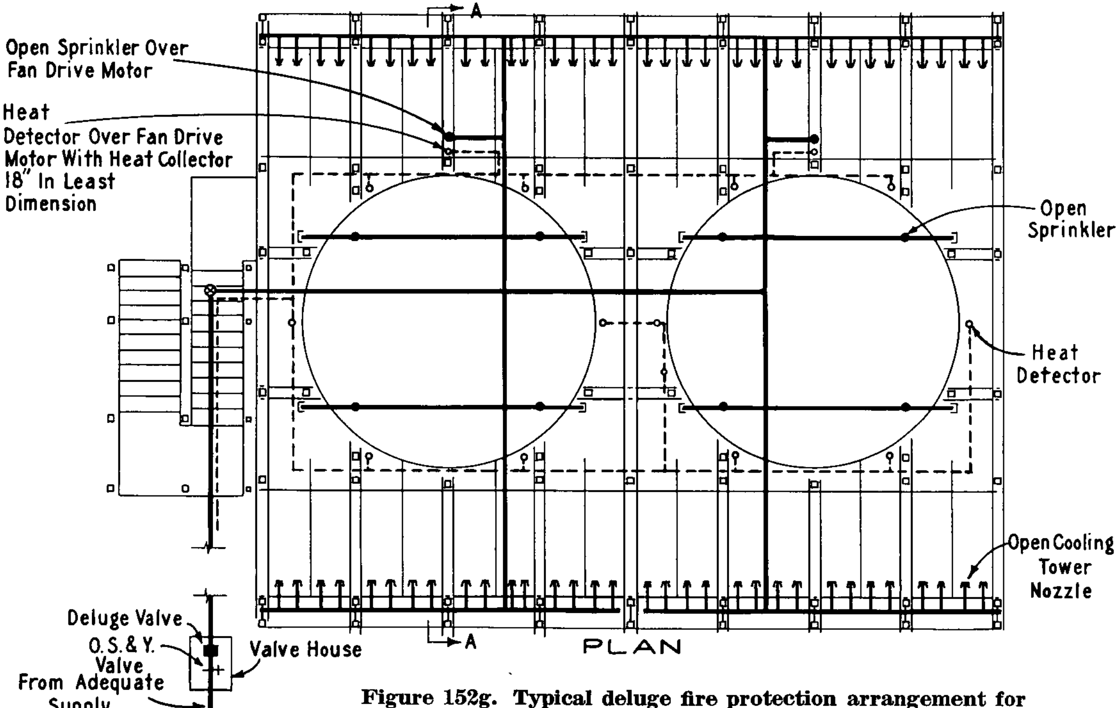
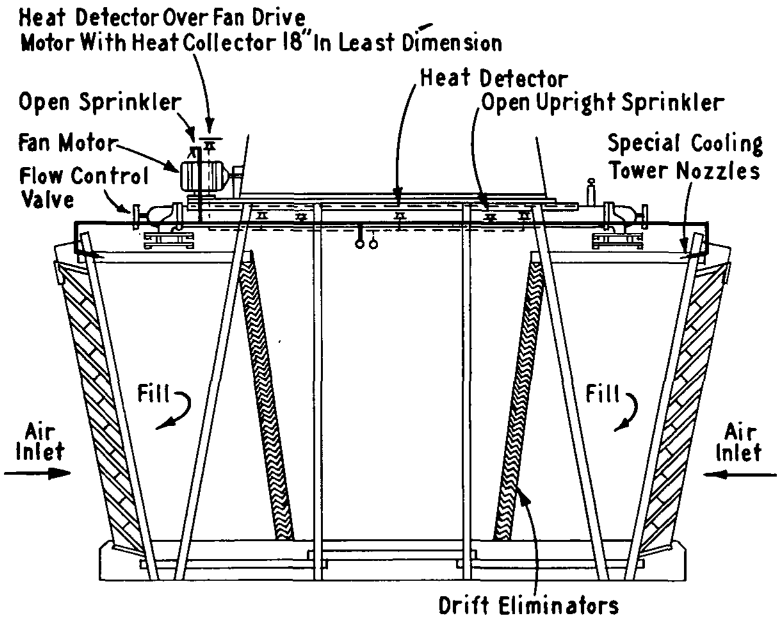


Figure 152g. Typical deluge fire protection arrangement for crossflow towers. See Note following caption of Figure 152h.



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.

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

a. Under fan decks of counterflow towers an average 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. 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.

1524. 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. Some towers may require heat detectors within the fan opening.

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. 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.

1525. 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.

1526. Provision should be made to interlock the fan motors with the sprinkler system so that the cooling tower fan motors will be stopped upon actuation of the system.

NOTE: Consideration should be given to any unusual or abnormal operating or climatic conditions in the design and selection of equipment for the fire protection system.

153. CORROSION PROTECTION.

1531. Piping, fittings and hangers where exposed to atmosphere and inside cooling tower cells shall be corrosion resistant or protected against corrosion by a suitable coating.

1532. Sprinkler heads shall be approved corrosion resistant or special coated types. Special care shall be taken in the handling and installation of wax coated or similar sprinklers to avoid damaging the coating. Corrosion resistant coatings shall not be applied to the sprinklers by anyone other than the manufacturer of the sprinklers, except that in all cases any damage to the protective coating occurring at the time of installation shall be repaired at once using only the coating of the manufacturer of the sprinkler in approved manner so that no part of the sprinkler will be exposed after the installation has been completed. Otherwise, corrosion will attack the exposed metal and will in time creep under the wax coating.

154. EXPOSURE PROTECTION.

1541. A tower of combustible exterior located less than 100 feet from any hazardous materials or structures should be properly protected by an automatic water spray system on the exterior of the tower.

1542. Systems for exterior protection should be designed with the same attention and care as interior systems. Pipe sizing shall be based on hydraulic calculations. Water supply and discharge rate should be based on 0.15 gpm per square foot for all surfaces being protected.

155. HYDRANT PROTECTION. Hydrant protection should be provided within 200 feet of all parts of towers having combustible construction located on the ground or on buildings less than 50 feet in height. Hydrants shall not be located closer than 40 feet to towers. A hose house and standard hose house equipment should be provided at