NFPA No.

214

WATER COOLING TOWERS 1976

NATIONAL FIRE PROTECTION ASSOCIATION

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See Inside Back Cover for Official NFPA Definitions

Water-Cooling Towers

NFPA No. 214–1976

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, 1968, and 1971.

1976 Edition of No. 214

This edition of the Standard on Water-Cooling Towers was adopted at the Annual Meeting in May 1976, and supersedes the 1971 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

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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

Interpretation Procedure of the Committee on Water-Cooling Towers

Those desiring an interpretation shall supply the Chairman with five identical copies of a statement in which shall appear specific reference to a single problem, paragraph, or section. Such a statement shall be on the business stationery of the inquirer and shall be duly signed.

When applications involve actual field situations they shall so state and all parties involved shall be named.

The Interpretations Committee will reserve the prerogative to refuse consideration of any application that refers specifically to proprietary items of equipment or devices. Generally inquiries should be confined to interpretation of the literal text or the intent thereof.

Requests for interpretations should be addressed to the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

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Standard on
Water-Cooling Towers

NFPA No. 214–1976

Foreword

0-1 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.

0-2 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.

0-3 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.

0-4 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.

0-5 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.

Chapter 1 General

1-1 Scope.

1-1.1 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.

It is recognized that there may be deviations in design from the sketches and schematics integrated in this standard and that these design deviations will require special engineering judgment and design for fire protection considerations.

1-2 Definitions.

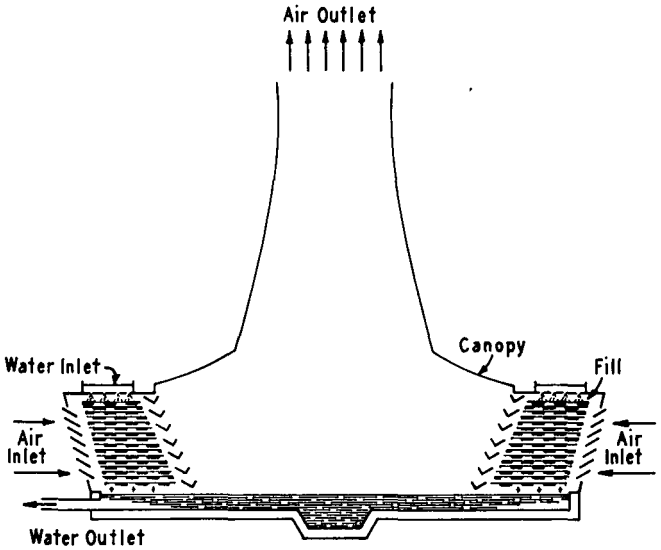
1-2.1 There are two basic types of water cooling towers: natural draft (Fig. 1-2.1a) and mechanical draft (Fig. 1-2.1b). Cooling towers are further classified as counterflow (Fig. 1-2.1c) or crossflow (Fig. 1-2.1d). In a counterflow tower the water flows countercurrent to the air flow, and in a crossflow tower the air flows perpendicular to or across the flow of water.

1-2.1.1 Natural-draft towers depend on the difference in the air temperature inside the tower and outside the tower for air movement.

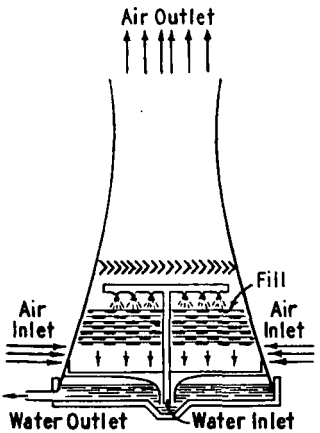
1-2.1.2 Mechanical-draft towers require fans or blowers for the movement of air. There are two general types: induced-draft and forced-draft. In the induced-draft arrangement the fans or blowers are at the air exhaust, and in the forced-draft arrangement, the fans or blowers are at the air inlet.

1-2.2 Cooling towers of combustible construction are those of wood frame construction as defined by Standard Types of Building Construction, NFPA 220–1975, and those in which the fill or fill decks are of combustible material.

Materials with flame spread ratings of 25 or less, defined as limited-combustible in Standard Types of Building Construction, NFPA 220–1975, when used in cooling tower construction, may require fire protection.

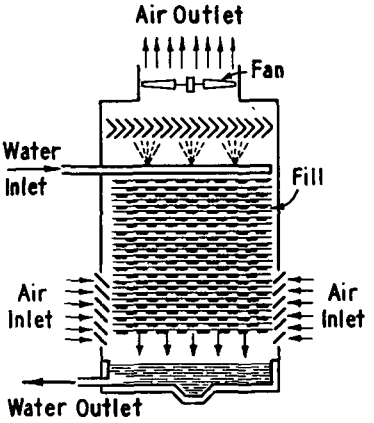


Crossflow hyperbolic tower

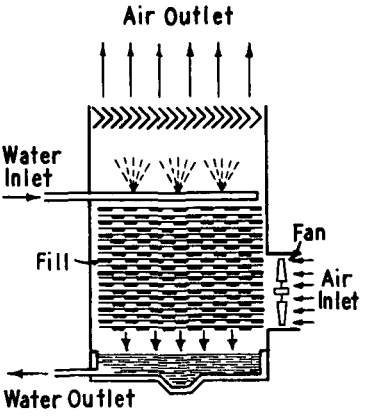


Counterflow hyperbolic tower

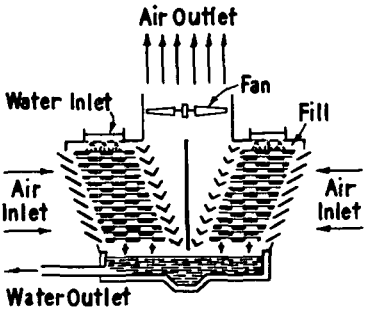
Figure 1-2.1a. Types of natural-draft towers.



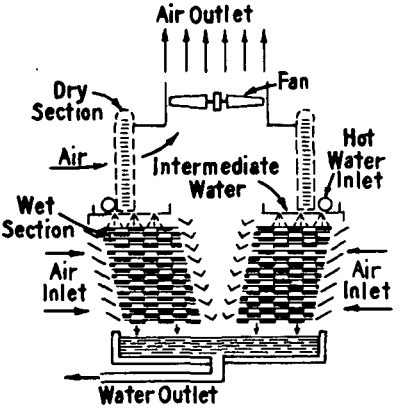
Induced draft counterflow tower



Forced draft tower



Induced draft crossflow tower



Induced draft wet-dry crossflow tower

Figure 1-2.1b. Types of mechanical-draft towers.

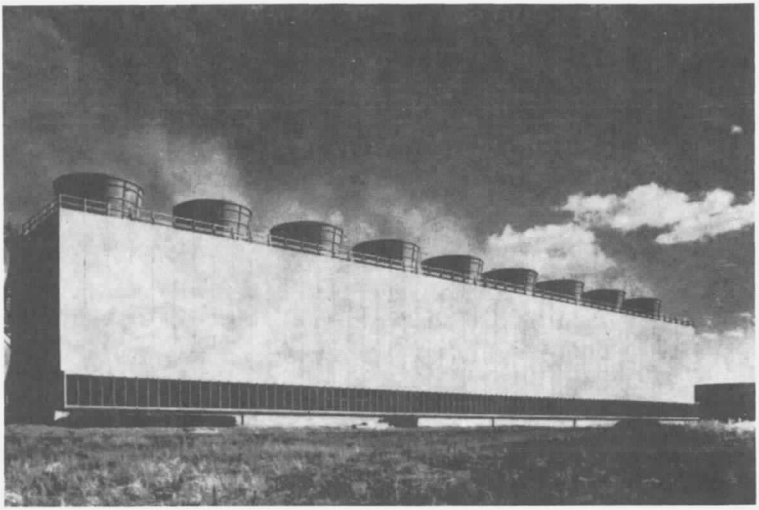


Figure 1-2.1c. Typical induced-draft counterflow water-cooling tower.

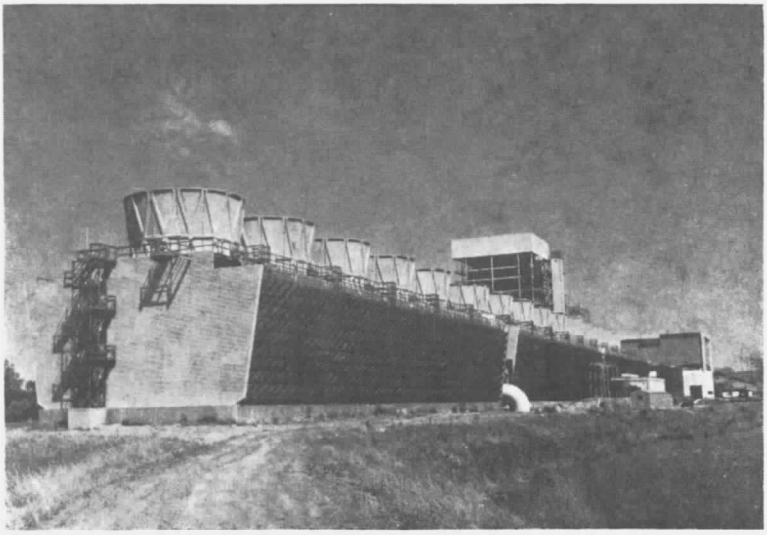


Figure 1-2.1d. Typical induced-draft crossflow water-cooling tower.

Chapter 2 Location and Construction

2-1 Cooling towers may be involved in the following cases of exposure fire hazard:

2-1.1 Proximity to chimneys, incinerators or other similar sources of ignition.

2-1.2 Proximity to hazardous materials or structures; fire in these may constitute a hazard to the tower, and vice versa.

2-2 Cooling towers with combustible exterior construction should be located 100 feet or more from hazards indicated in 2-1; 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 Chapter 5.

2-3 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 Chapter 5.

2-4 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 2-1 to 2-4 inclusive above, the matter should be referred to the authority having jurisdiction.

2-5 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.

Chapter 3 Installation of Electrical Equipment and Wiring

3-1 Installation of all electrical equipment and wiring pertaining to water-cooling towers shall be in accordance with the National Electrical Code, NFPA 70–1975.

3-2 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.

3-3 A remote fan motor switch shall be provided to stop fan in case of fire.

3-4 When a fire protection system is installed, provision shall be made to interlock the fan motors with the sprinkler system (see 5-2.7).

3-5 An automatic vibration controlled switch should be provided to automatically shut down fan motors.

Chapter 4 Internal Combustion Engine Driven Fans

4-1 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 the Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37–1975, subject to the approval of the authority having jurisdiction.

Chapter 5 Fire Protection

5-1 General.

5-1.1 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 towers do not indicate the general need for automatic fire protection systems. However, exposure protection may be necessary as provided in 5-4.

5-1.2 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.

5-1.3 **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.

5-1.4 The design and installations shall comply with the applicable sections of the Standard for the Installation of Sprinkler Systems, NFPA 13–1975.

5-2 Fire Protection System Design.

5-2.1 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 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-sprinkler deluge system does this and, therefore, is the type that should be used in crossflow towers.

5-2.2 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.

5-2.3 In counterflow towers, the discharge outlets shall be located under the fan deck and fan opening (Figs. 5-2a, 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. 5-2e, 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. Where joist channels are wider than 2 feet, more than one discharge device may be required per joist channel.

On towers having extended fan decks which completely enclose the distribution basin, the discharge outlets protecting the fill area shall be located over the basin, under the extension of the fan deck. These discharge outlets shall be open directional spray nozzles arranged to discharge 0.4 gpm per square foot directly on the distribution basin, and 0.1 gpm per square foot on the underside of the fan deck extension (Figs. 5-2i, j). Care shall be taken in the application of nozzle types. Location of nozzle from surfaces to be protected shall be guided by the particular nozzle's discharge characteristics. Care shall also be taken in the selection of nozzles to obtain waterways which are not easily obstructed by debris, sediment, sand, etc. in the water. Strainers are required for systems utilizing nozzles with waterways less than $\frac{3}{8}$ inch. (See Water Spray Fixed Systems for Fire Protection, NFPA No. 15–1973, for further details.)

5-2.4 Pipe sizing shall be based on hydraulic calculations to give an even distribution of water throughout the protected area. The flow from any one discharge outlet shall not vary from the specified rate of application by more than 15 percent above the specified density, and no outlet shall discharge less than the specified density.

Hydraulic calculations shall be made in accordance with Chapter 7 of the Standard for the Installation of Sprinkler Systems, NFPA 13–1975.

5-2.5 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 mechanical induced-draft towers, heat detectors shall be located under the fan deck at the circumference of the fan opening and under the fan opening when necessary to comply with the following spacing requirements.

Fixed-temperature detectors shall be spaced not over 8 feet apart in any direction including the fan opening. Temperature ratings shall be selected in accordance with operating conditions, but shall be no less than intermediate.

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

Where heat detectors are inaccessible during tower operation, test detectors, accessible from the ground or roof, shall 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. (See applicable sections of Standard on Automatic Fire Detectors, NFPA 72E–1974, for additional information.)

5-2.6 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.

5-2.7 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.

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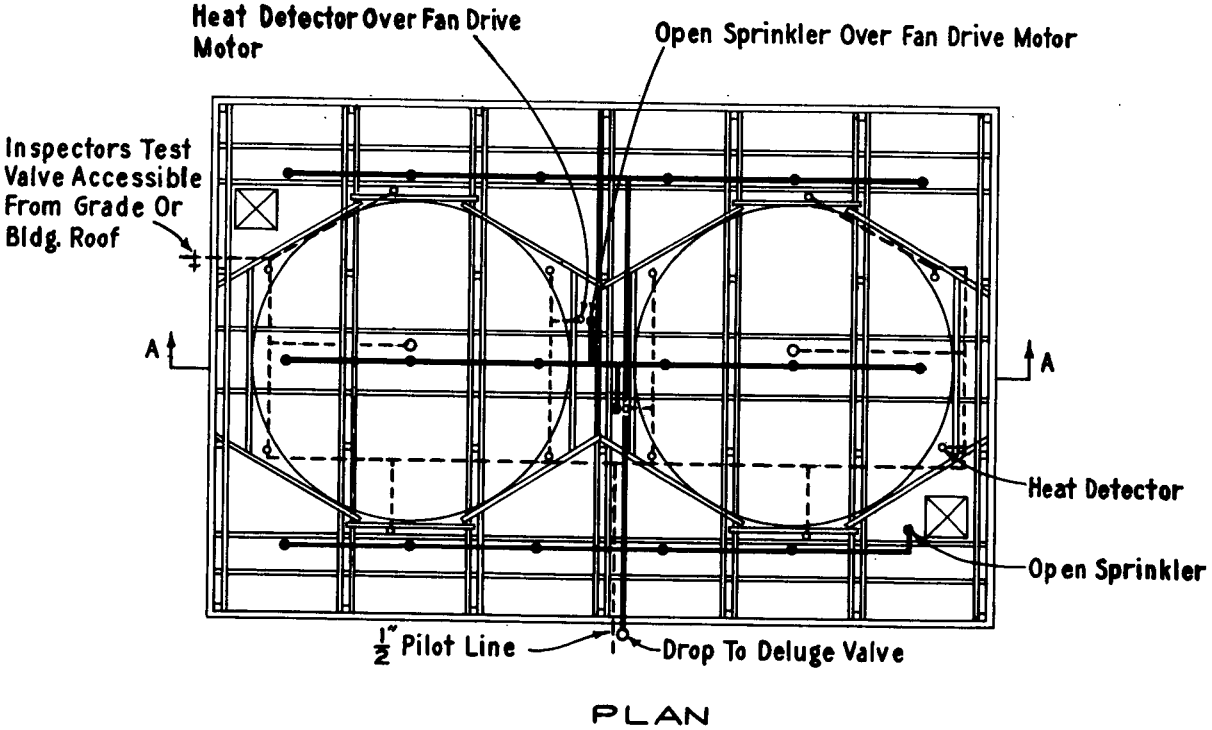
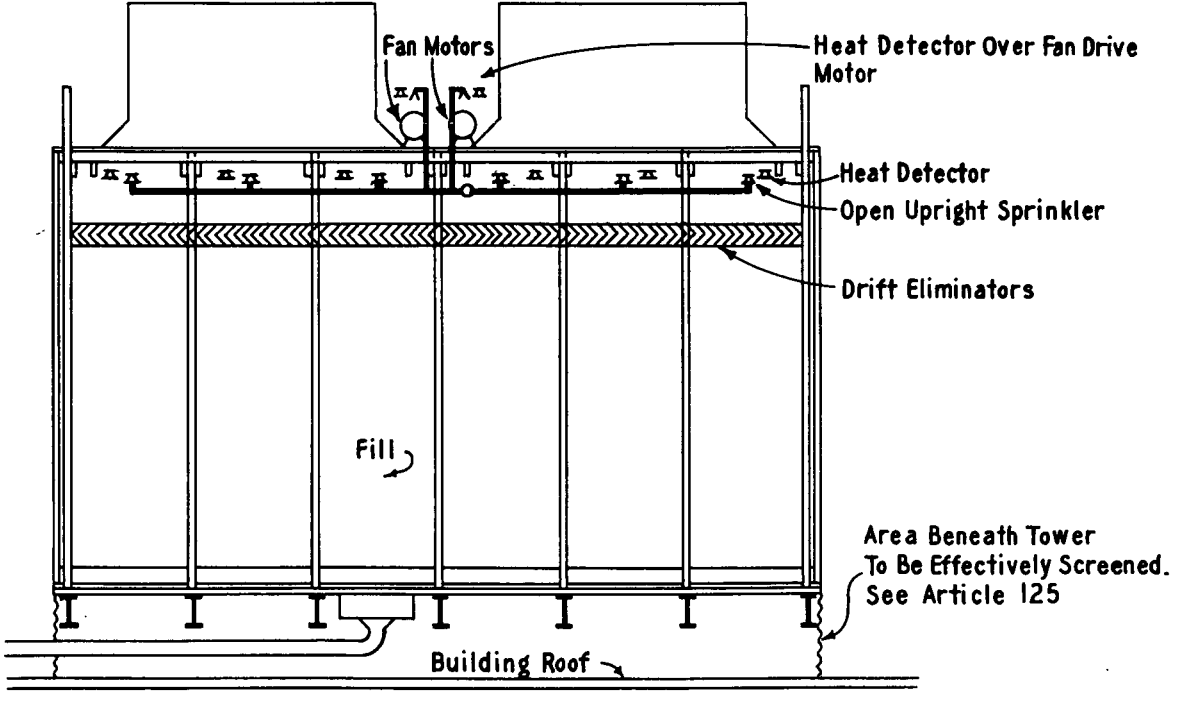


Figure 5-2a. Typical deluge fire protection arrangement for counterflow towers.



SECTION A – A

Figure 5-2b. Typical deluge fire protection arrangement for counterflow towers.

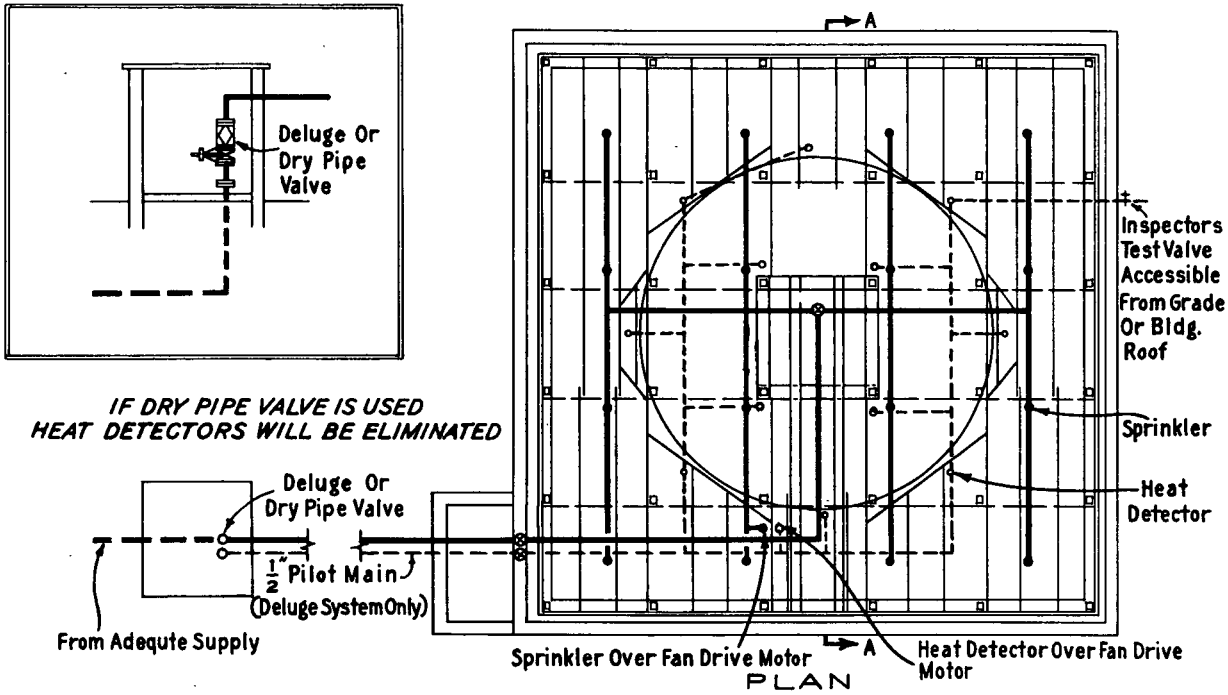


Figure 5-2c. Typical deluge or dry pipe fire protection arrangement for counterflow towers.

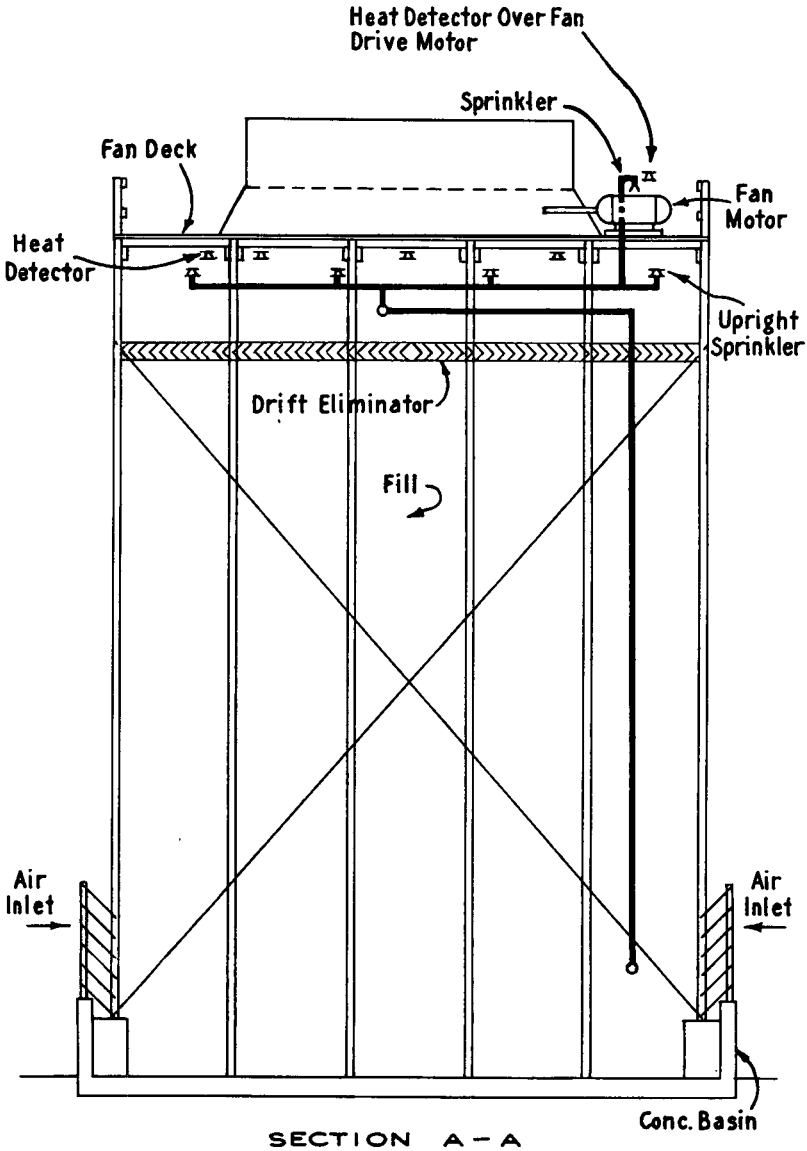


Figure 5-2d. Typical deluge or dry pipe fire protection arrangement for counterflow towers.

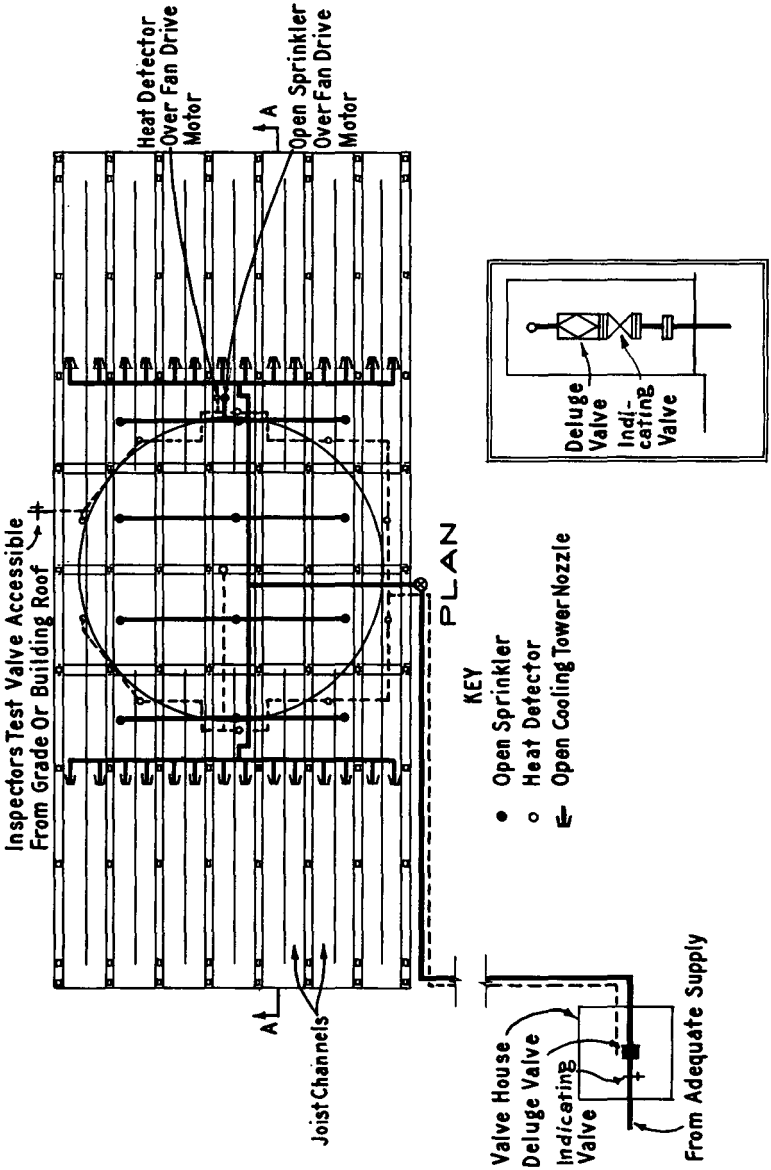


Figure 5-2e. Typical deluge fire protection arrangement for crossflow towers.

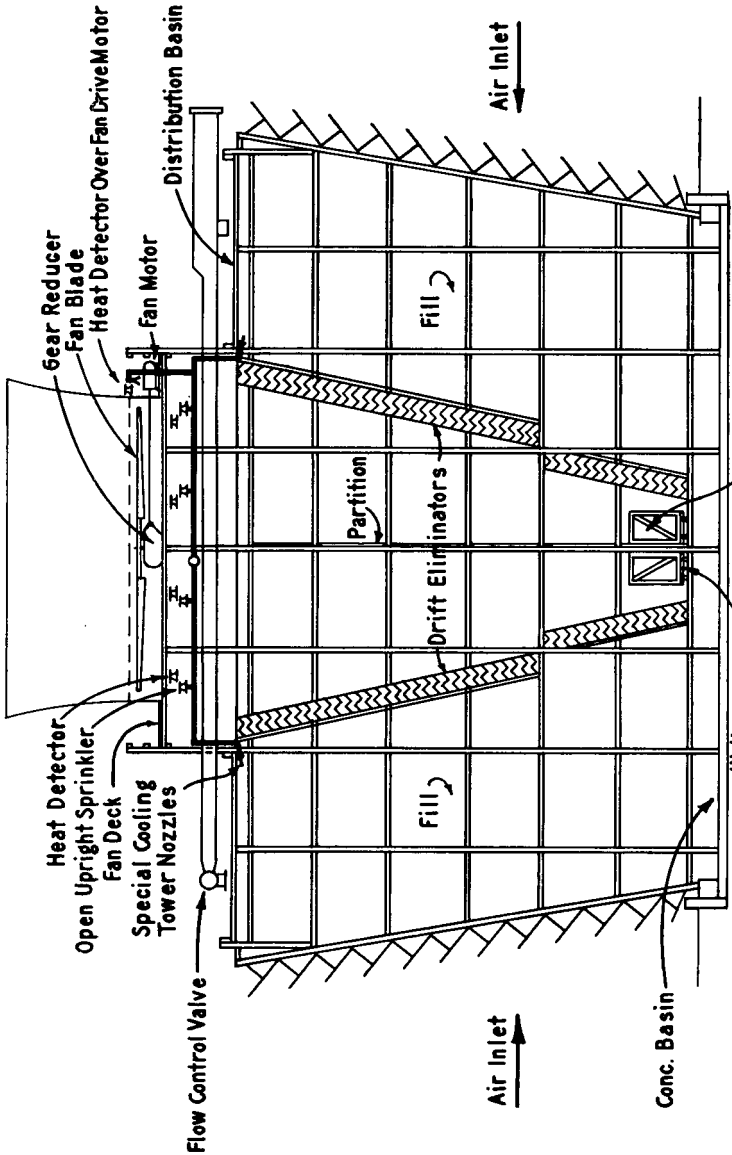


Figure 5-2f. Typical deluge fire protection arrangement for crossflow towers.

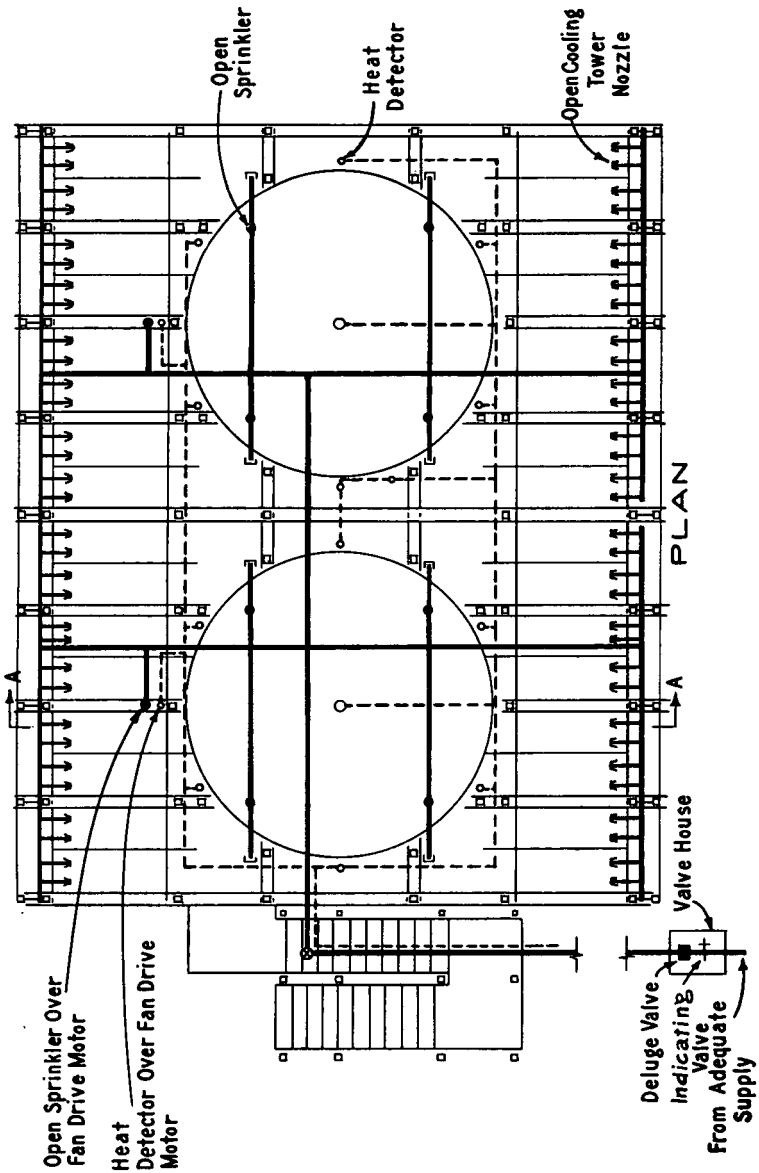


Figure 5-2g. Typical deluge fire protection arrangement for crossflow towers. (See Note following caption of Figure 5-2h.)

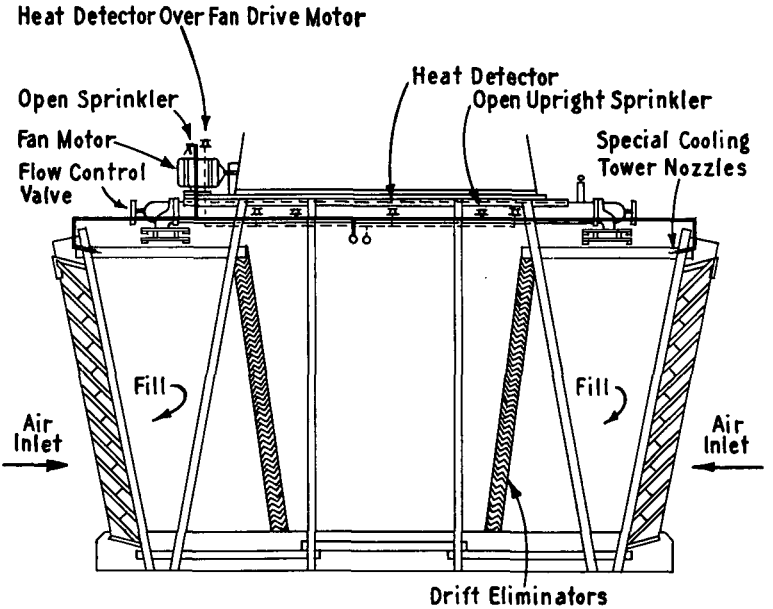


Figure 5-2h. Typical deluge fire protection arrangement for crossflow towers.

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

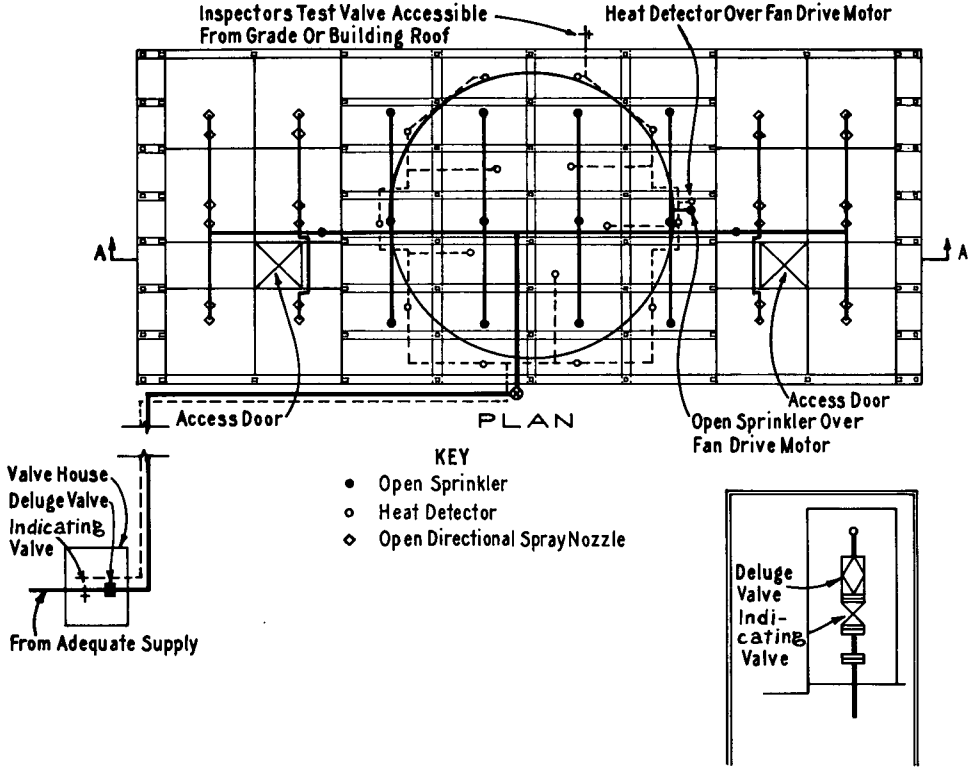


Figure 5-2i. Typical deluge fire protection arrangement for crossflow towers with completely enclosed distribution basins.

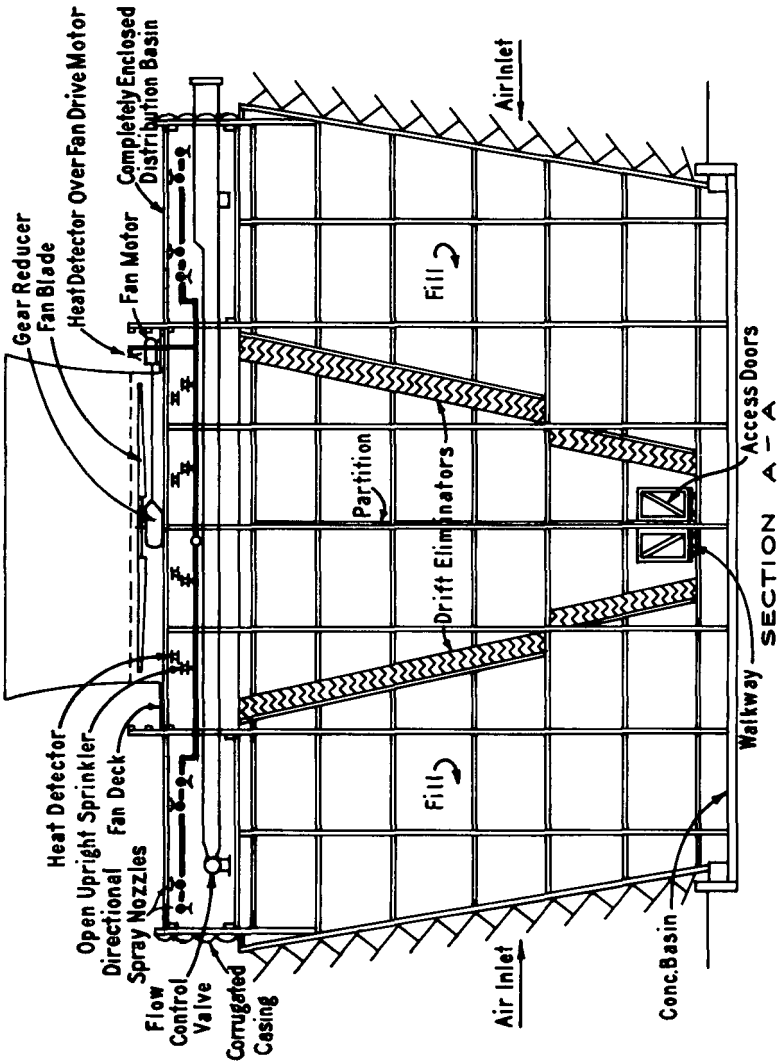


Figure 5-2j. Typical deluge fire protection arrangement for crossflow towers with completely enclosed distribution basins.