Standard on

WATER-COOLING TOWERS

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NATIONAL FIRE PROTECTION ASSOCIATION

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National Fire Protection Association

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Executive Office: 60 Batterymarch St., Boston 10, Mass.

The National Fire Protection Association was organized in 1896 to promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects and to secure the cooperation of its members in establishing proper safeguards against loss of life and property by fire. Its membership includes two hundred national and regional societies and associations (list on outside back cover) and seventeen thousand individuals, corporations, and organizations. Anyone interested may become a member; membership information is available on request.

This pamphlet is one of a large number of publications on fire safety issued by the Association including periodicals, books, posters and other publications; a complete list is available without charge on request. All NFPA standards adopted by the Association are published in six volumes of the **National Fire Codes** which are re-issued annually and which are available on an annual subscription basis. The standards, prepared by the technical committees of the National Fire Protection Association and adopted in the annual meetings of the Association, are intended to prescribe reasonable measures for minimizing losses of life and property by fire. All interests concerned have opportunity through the Association to participate in the development of the standards and to secure impartial consideration of matters affecting them.

NFPA standards are purely advisory as far as the Association is concerned, but are widely used by law enforcing authorities in addition to their general use as guides to fire safety.

Definitions

The official NFPA definitions of shall, should and approved are:

SHALL is intended to indicate requirements.

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

APPROVED refers to approval by the authority having jurisdiction.

Units of measurements used here are U. S. standard. 1 U. S. gallon = 0.83 Imperial gallons = 3.785 liters.

Approved Equipment

The National Fire Protection Association does not "approve" individual items of fire protection equipment, materials or services. The standards are prepared, as far as practicable, in terms of required performance, avoiding specifications of materials, devices or methods so phrased as to preclude obtaining the desired results by other means. The suitability of devices and materials for installation under these standards is indicated by the listings of nationally recognized testing laboratories, whose findings are customarily used as a guide to approval by agencies applying these standards. Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada and the Factory Mutual Laboratories test devices and materials for use in accordance with the appropriate standards, and publish lists which are available on request.

Water-Cooling Towers

NFPA No. 214 — 1959

This 1959 edition of the Standard on Water-Cooling Towers was adopted by the National Fire Protection Association on June 5, 1959. It is a first edition.

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. Further revisions were made in 1959.

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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.

11. Types of Towers.

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

a. 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.

b. 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. 1) and crossflow (Fig. 2). 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.

12. Location and Construction.

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

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

b. 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 pro-

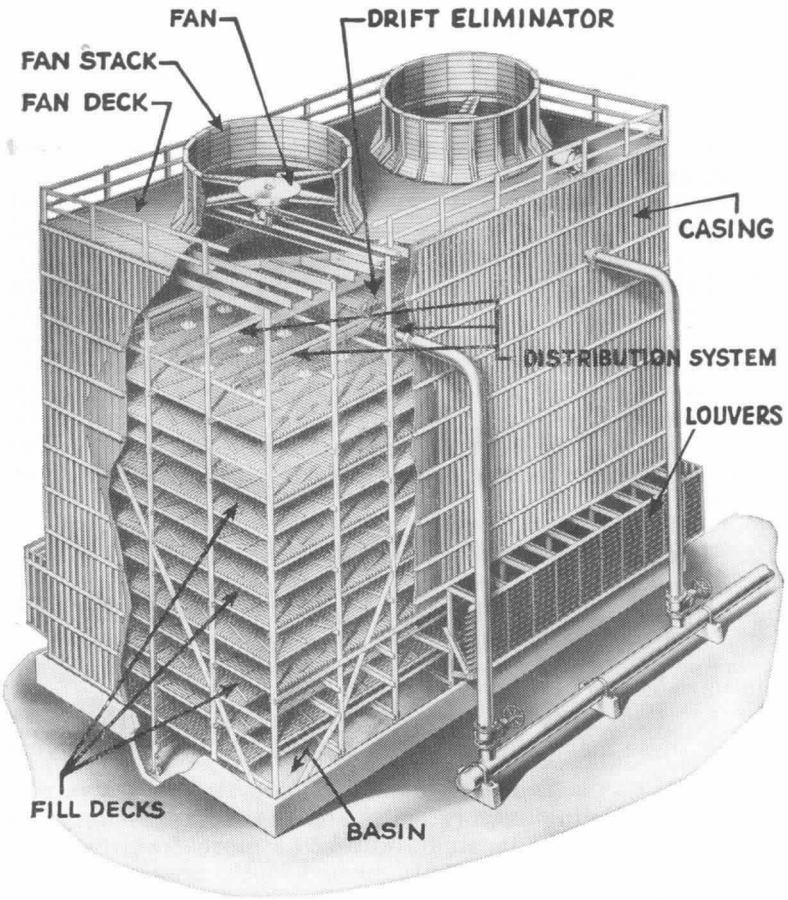

Figure 1. Typical induced draft counterflow water-cooling tower.

vided with automatic sprinkler protection 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 sections 121 - 124 inclusive above, the matter should be referred to the authority having jurisdiction.

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 should 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.

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.

a. Consideration shall be given to the following factors in determining the extent and method of fire protection

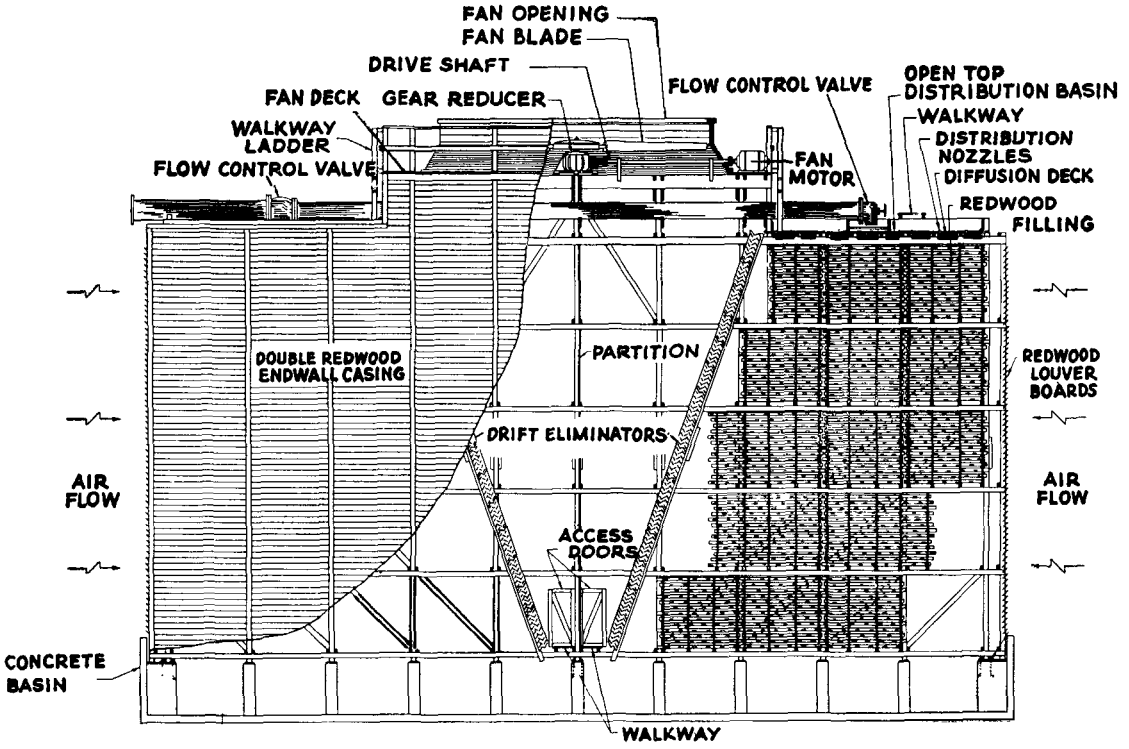

Figure 2. Typical induced draft crossflow water-cooling tower.

of induced draft cooling towers:

1. Importance to continuity of operation
2. Size and construction of tower
3. Type of tower
4. Location of tower
5. Water supply
6. Value of tower

NOTE: Fire records for atmospheric and mechanical forced draft towers do not indicate the general need for automatic fire protection systems.

b. Depending on factors indicated above where a fire protection system is required, one of the following general types of systems may be used:

1. Open head deluge system
2. Closed head pre-action system
3. Closed head dry pipe system
4. Wet pipe automatic sprinkler system

152. FIRE PROTECTION SYSTEM DESIGN.

a. Piping of fire protection systems enumerated in 151 b. shall be hydraulically calculated to give an even distribution of water throughout the protected area. The fire protection system should be designed upon a rate of water application basis as follows:

1. Under fan decks of counterflow towers an average water density of 0.5 gpm per square foot.
2. Under fan decks of crossflow towers a water density of 0.33 gpm per square foot.
3. Over filled areas of crossflow towers a water density of 0.5 gpm per square foot. This required water density shall be equally divided when a redistribution basin is used.
4. 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.

b. Where deluge or preaction systems are used an adequate number of heat responsive devices shall be installed under the fan deck, or distribution basin, or other locations where necessary for the proper activation of the fire protection system. Some tower designs may require

the installation of heat responsive devices within the fan opening. Where heat responsive devices are inaccessible, an adequate number of test heat responsive devices to properly test the system shall be installed.

c. 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.

a. 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.

b. 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. 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.

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

each hydrant. (See NFPA Standard No. 24, Outside Protection, for further details.)

156. STANDPIPE PROTECTION. Standpipe protection shall be provided at the roof of the supporting building within 200 feet of all parts of a tower with any combustible construction located on a building 50 feet or more in height. Such standpipes should be located preferably in stair towers but if on open roofs, not closer than 40 feet to cooling towers. Sufficient hose shall be provided to reach all parts of the tower. Provision shall be made for completely draining all exposed standpipe lines in winter. Hose equipment at each standpipe hose connection on the roof shall be protected from the weather in a suitable cabinet or enclosure. (See NFPA Standard No. 14, Standpipe and Hose Systems, for further details.)

157. WATER SUPPLY.

a. Water supply for multi-cell towers, one cell in width, shall be adequate to supply all heads in two cells simultaneously at the specified rate of application. Where multi-cell towers are two cells in width, the water supply shall be adequate to supply four cells.

b. When tight continuous partitions of 2-inch tongue and groove wood plank or one-half inch thick asbestos cement board on both sides of wood studs, or the equivalent, are provided between cells, the water supply for one cell may be considered adequate subject to approval of authority having jurisdiction.

NOTE: The intent of this subsection is to provide a fire stop with a fire-resistance rating of not less than one-half hour. In the absence of test information on materials suitable for this use the above materials are suggested as an alternate.

c. Water supply shall be sufficient to include 500 gallons per minute for hose streams in addition to the sprinkler requirement.

16. Access.

161. Access to the top of water-cooling towers for fire fighting and maintenance shall be provided by an approved stairway or ladder. Towers in excess of 120 feet in any dimension shall be provided with not less than two means of access remote from each other.

162. Motors, speed reduction units and drive shafts shall be accessible for servicing and maintenance.

17. Lightning Protection.

171. Where deemed necessary by the authority having jurisdiction, the tower shall be equipped with lightning protection installed in accordance with the provisions of NFPA No. 78, Code for Protection Against Lightning.

NOTE: Towers located on roofs of buildings in certain geographical locations may be particularly susceptible to lightning damage.

18. Maintenance.

181. Forced and induced draft towers in continuous operation should be checked frequently for excessive heating in motors.

182. At least semiannually the fan assemblies including the motors and speed reducers should be checked, both during operation and when shut down, for excessive wear or vibration, improper lubrication, corrosion, or other features that could result in failure.

183. Where work on the tower requires welding or cutting, it shall be done in accordance with NFPA Standard No. 51, Gas Systems for Welding and Cutting.

184. Combustible cooling towers are particularly susceptible to ignition when they are shut down for repairs or other reasons and the wood becomes dried out. During these periods it is imperative that all automatic fire protection on the tower is operable, or if the tower is not so protected, special protection such as watchmen and intermittent wetting be provided until the tower is back in service.

185. Areas around towers located on the ground shall be kept free of grass, weeds, brush, or combustible waste materials.

186. Smoking shall not be permitted on or adjacent to any cooling tower of combustible construction. Signs to this effect shall be posted and maintained and this regulation strictly enforced.

REFERENCES TO NFPA STANDARDS

The following standards are mentioned in the following text and are useful for reference. These standards will be generally found available for distribution from the same sources that distribute the Standard for Water-Cooling Towers. The number designations are those used by the National Fire Protection Association and the National Board of Fire Underwriters. The abbreviations after the titles indicate the publication sources. Where two or more sources are indicated, the texts are identical from each source, except for cover and introductory matter.

NFPA — Published by the National Fire Protection Association in pamphlet form and available from them at 60 Batterymarch Street, Boston.

NBFU — Published by the National Board of Fire Underwriters in pamphlet form and available from them at 85 John Street, New York 38; 222 West Adams Street, Chicago 6; or 465 California St., San Francisco 4.

NFC I, II, III, IV, V or VI — Published by the National Fire Protection Association in the National Fire Codes volume indicated. These codes, republished annually, are available from the National Fire Protection Association, 60 Batterymarch Street, Boston.

14. Standpipe and Hose Systems (NFPA, NBFU, NFC IV)

24. Outside Protection (NFPA, NBFU, NFC IV)

37. Combustion Engines and Gas Turbines (NFPA, NFC I)

51. Gas Systems for Welding and Cutting (NFPA, NBFU, NFC I)

70. National Electrical Code (NFPA, NBFU, NFC V)

78. Code for Protection Against Lightning (NFPA, NFC V)