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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

August 9, 1984

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

Glenn O. Bright
Dr. James H. Carpenter
James L. Kelley, Chairman

In the Matter of CAROLINA POWER AND LIGHT CO. et al. (Shearon Harris Nuclear Power Plant, Unit 1)	Docket 50-400 OL ASLBP No. 82-468-01 OL

Proposed Wells Eddleman Exhibits on Contention 116

As my case in chief on this contention, I am herewith filing the following Exhibits:

116-1: National Fire Protection Assn. NFPA-31 re Oil Burning Equipment, including section 2-4 Installation of Enclosed Supply Tanks Inside Buildings;

116-2: NFPA-30 Table of Contentions re Flammable and Combustible Liquids.

116-3: NFPA-30 pp 8,9,12,13,14,15 Definitions

116-4: NFPA-30 pp 16,17,18,19,30,31-35,38-39,40-45 re Tank Storage

116-5: NFPA-30 pp 68-75 re industrial plants where use of liquids is incidental to the principal business.

116-6: NFPA-30 pp 78-79, Bulk Plants and Terminals, re storage in Buildings (sec. 6-2); Sec. 6-1 re storage.

116-7: NFPA-300 pp 88-89 and 106-107 distinguishing Service Stations and Processing Plants (definitions)

116-8: NFPA-30 Appendix C re information and recommendations for storage of flammable and combustible liquids.

Wells Eddleman

Wells Eddleman D503

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Alternates

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†Nonvoting

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.

Contents

Standard for the Installation of

Oil Burning Equipment

NFPA 31 — 1978

Chapter 1 General Provisions

1-1 Definition of Terms.

1-1.1 For the purpose of this installation standard, the following terms shall be interpreted in accordance with the following definitions.

Air Heater. An indirect-fired appliance intended to supply heated air for space heating and other purposes, but not intended for permanent installation.

Antiflooding Device. A primary safety control which causes the flow of fuel to be shut off upon a rise in fuel level or upon receiving excess fuel, and which operates before the hazardous discharge of fuel can occur.

Appliances, Industrial.

(a) Low-Heat Industrial Appliance. An industrial appliance such as a commercial cooking range, pressing machine boiler at any pressure, bake oven, candy furnace, stereotype furnace, drying and curing appliance, and other process appliances in which materials are heated or melted at temperatures (excluding flue-gas temperatures) not exceeding 600°F. Appliances otherwise classed as medium-heat appliances may be considered as low-heat appliances if not larger than 100 cu ft in size excluding any burner equipment and blower compartment.

(b) Medium-Heat Industrial Appliance. An industrial appliance such as an annealing furnace (glass or metal), charcoal furnace, galvanizing furnace, gas producer, commercial or industrial incinerator, and steam boiler operating at over 50 psig pressure when such appliance is larger than 100 cu ft in size, and other furnaces classified as medium-heat appliances in accordance with nationally recognized good practice. Appliances otherwise classed as medium-heat appliances may be considered as low-heat appliances if not larger than 100 cu ft in size excluding any burner equipment and blower compartment.

1-10 Fuel Oil.

1-10.1 The grade of fuel oil used in a burner shall be that for which the burner is approved and as stipulated by the manufacturer. Crankcase oil or any oil containing gasoline shall not be used. For use of oil fuels other than those defined herein, see 1-2.3.

NOTE: The label of Underwriters Laboratories Inc. stipulates for each burner the grade of fuel oil for which the burner is listed.

1-10.2 Where heavy oils are used, provision shall be made for maintaining the oil at the proper atomizing temperature. Automatically operated burners requiring the preheating of oil shall be arranged so that no oil can be delivered for combustion until the oil is at a suitable atomizing temperature.

1-10.3 Except as permitted in 1-2.3, no steam coil operating at a pressure greater than 15 lbs per sq in. gauge shall be installed in an oil tank. When a pressure reducing valve is used to limit the steam pressure 15 psi or less: (a) a relief valve set at not more than 5 psi above the normal pressure in the coil shall be provided, and (b) provision shall be made to limit the steam temperature to 250°F.

NOTE: Tank heaters which are connected so that the condensate or water is not returned to the boiler are preferred.

1-10.4 Hot water coils may be installed in oil tanks provided they are connected to indirect heaters and provisions are made to limit the water temperature to 250°F.

1-10.5 Electric heaters may be installed in oil tanks provided they are equipped with approved thermostats designed to prevent the oil from exceeding its minimum flash point.

1-10.6 When heaters are installed in an oil tank, provisions shall be made to prevent the oil level in the tank from dropping to a point which exposes the surface of the heater.

Chapter 2 Tank Storage

2-1 Design and Construction of Tanks.

2-1.1 Materials.

2-1.1.1 Tanks shall be built of steel except as provided in 2-1.1.2 through 2-1.1.5.

2-1.1.2 Tanks for underground service may be built of material other than steel.

2-1.1.3 Tanks built of materials other than steel shall be designed to specifications embodying principles recognized as good engineering design for the material used and shall be approved by the authority having jurisdiction.

2-1.1.4 Unlined concrete tanks may be used for aboveground or underground service for fuel oils having a gravity of 40 degrees API or heavier. Concrete tanks shall be built in accordance with sound engineering practice.

2-1.1.5 Tanks may have combustible or noncombustible linings.

2-1.2 Fabrication.

2-1.2.1 Tanks may be of any shape or type consistent with sound engineering design.

2-1.2.2 Metal tanks shall be welded, riveted and caulked, brazed, or bolted, or constructed by use of a combination of these methods. Filler metal used in brazing shall be nonferrous metal or an alloy having a melting point above 1,000°F and below that of the metal joined.

2-1.2.3 Tanks shall be used under substantially atmospheric pressure and shall be built in accordance with approved standards of design. Atmospheric tanks may be built in accordance with:

(a) Underwriters Laboratories Inc., *Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids*, UL 142-1972; *Standard for Steel Underground Tanks for Flammable and Combustible Liquids*, UL 58-1972; or *Standard for Steel Inside Tanks for Oil-Burner Fuel*, UL 80-1974.

(b) American Petroleum Institute Standard No. 650, *Welded Steel Tanks for Oil Storage*, Sixth Edition, 1977.

2-1.2.4 Tanks built according to Underwriters Laboratories Inc. requirements in 2-1.2.3(a) may be used for operating pressures not exceeding 1 psig and shall be limited to 2.5 psig under emergency venting conditions.

2-1.2.5 The tank shall be designed for the maximum static head which will be imposed when the vent or fill pipe is filled with oil. The maximum static head so imposed on tanks built in accordance with 2-1.2.3(a) shall not exceed 10 psig at the bottom of the tank.

2-1.2.6 Pressure tanks if required to conform to 2-1.2.5 shall be built in accordance with the principles of the ASME Boiler and Pressure Vessels Code, Section VIII Pressure Vessels, Division 1 or 2, 1977 Edition, and Addenda dated Summer 1977 and Winter 1977.

2-2 Installation of Underground Tanks (Including Ta ks Under Buildings).

2-2.1 Only a tank complying with the construction provisions of Standard UL 58 [*see 2-1.2.3(a)*] or as provided in 2-1.2.6 shall be buried underground.

2-2.2 Excavation for underground tanks shall be made with due care to avoid undermining of foundations of existing structures. Underground tanks or tanks under buildings shall be so located with respect to existing building foundations and supports that the loads carried by the latter cannot be transmitted to the tank. The distance from any part of a tank storing fuel oil to the nearest wall of any basement, pit or property line shall be not less than 1 ft.

2-2.3 An underground tank shall be set on a firm foundation and surrounded with at least 6 in. of noncorrosive inert materials such as clean sand, earth or gravel well tamped in place. The tank shall be placed in the hole with care since dropping or rolling the tank into the hole can break a weld, puncture or damage the tank metal or scrape off the protective coating of coated tanks. A tank shall be covered with a minimum of 2 ft of earth, or shall be covered with not less than 1 ft of earth on top of which shall be placed a slab of reinforced concrete not less than 4 in. thick. When underground tanks are, or are likely to be, subjected to traffic, they shall be protected against damage from vehicles passing over them by at least 3 ft of earth cover, or 18 in. of well-tamped earth, plus 6 in. of reinforced concrete or 8 in. of asphaltic concrete. When asphaltic or reinforced concrete paving is used as part of the protection, it shall extend at least 1 ft horizontally beyond the outline of the tank in all directions.

2-2.4 Corrosion protection for the tank and its associated buried piping shall be provided by one or more of the following methods: (1) use of protective coatings or wrappings, (2) cathodic protection, or (3) corrosion resistant materials of construction.

2-2.5 Underground tanks shall be equipped with an open vent or an automatically operated vent, arranged to discharge to the open air. Vent openings and vent pipes shall be of ample size to prevent abnormal pressure in the tank during filling but not smaller than the pipe size specified in Table 2-1.

Table 2-1

Capacity of Tank, U.S. Gallons	Approx. Imperial Gallons	Diameter of Vent, Iron Pipe Size
500 or less	500 or less	1¼ inches
501 to 3,000	501 to 2,500	1½ inches
3,001 to 10,000	2,501 to 8,300	2 inches
10,001 to 20,000	8,301 to 16,600	2½ inches
20,001 to 35,000	16,601 to 29,000	3 inches

NOTE: Where tanks are filled by the use of a pump through tight connections, a vent pipe not less in size than the discharge of the pump shall be used.

2-2.6 Except as provided in 3-8.8, all connections to an underground tank shall be made through the top of the tank.

2-2.7 An underground tank shall be provided with means for gauging. (*See 3-6.*)

2-3 Installation of Unenclosed Supply Tank Inside Building.

2-3.1 An unenclosed supply tank inside of a building shall conform to the following provisions:

2-3.1.1 A supply tank not larger than 10 gal shall be specifically approved for the purpose.

2-3.1.2 An approved safety can may be used as a storage tank.

2-3.1.3 A supply tank larger than 10 gal but not larger than 660 gal shall meet the construction provisions of Standard UL 80 [*see 2-1.2.3(a)*], or as provided in 2-1.2.5.

2-3.1.4 A supply tank shall be of such size and shape that it can be installed in and removed from the building as a unit.

2-3.2 The size and location of unenclosed tanks inside of any building or any one portion of a building separated from other portions by a fire wall shall be in accordance with the following:

2-3.2.1 Not more than six safety cans may be located in any one or more stories of a building. No such safety can shall have an individual capacity exceeding 5 gal.

2-3.2.2 A supply or storage tank located above the lowest story, cellar or basement shall not exceed 60 gal capacity and the total capacity of tanks so located shall not exceed 60 gal.

2-3.2.3 A supply tank shall be not larger than 660 gal. Not more than one 660-gal tank or two tanks of aggregate capacity of 660 gal or less shall be connected to oil-burning appliances and the aggregate capacity of such tanks installed in the lowest story, cellar, or basement of a building and unenclosed shall not exceed 1,320 gal, unless separation is provided for each 660 gal of tank capacity. Such separation shall consist of an unpierced masonry wall or partition extending from the lowest floor to the ceiling above the tank or tanks and shall have a fire resistance rating of not less than 2 hrs. See Appendix A, Figure A-3 for further details.

2-3.3 An unenclosed supply tank not larger than 10 gal shall be placed not less than 2 ft horizontally from any source of heat either in or external to the appliance being served but in any case shall be located so that the temperature of the oil in the tank will not exceed 25°F above room temperature.

2-3.4 An unenclosed supply tank larger than 10 gal shall be placed not less than 5 ft from any fire or flame either in or external to any fuel-burning appliance, nor shall such a tank obstruct quick and safe access to any utility service meters, switch panels and shutoff valves.

2-3.5 An unenclosed supply tank shall be securely supported by rigid noncombustible supports to prevent settling, sliding or lifting.

2-3.6 When a supply tank larger than 10-gal capacity is provided with an opening in the bottom for use as a burner supply connection or as a drain, the tank shall be pitched toward the opening with a slope of not less than ¼ in. per ft of length.

2-3.7 A shutoff valve shall be provided immediately adjacent to the burner supply connection at the bottom of a supply tank.

2-3.8 A supply tank larger than 10-gal capacity shall be provided with an open vent pipe not smaller than the pipe size specified in Table 2-1 and a fill pipe, both terminating outside the building.

2-3.9 A supply tank provided with fill and vent pipes shall be equipped with a gauging device. (*See Section 3-6.*)

2-3.10 Any unused opening in a tank equipped with fill and vent pipes shall be closed vapor tight by a pipe plug or cap screwed up tightly.

2-3.10.1 Two supply tanks connected to the same burner as permitted by 2-3.2.3 may be cross-connected and provided with a single fill and a single vent pipe as described in Appendix A.

2-4 Installation of Enclosed Supply Tanks Inside Buildings.

2-4.1 A supply tank larger than 660-gal capacity shall be enclosed when installed inside of a building.

2-4.2 Tankage inside of a building in excess of that permitted in unenclosed tanks by 2-3.2.3 shall be enclosed.

2-4.3 Regardless of enclosure, a supply or storage tank located above the lowest story, cellar, or basement shall not exceed 60-gal capacity and the total capacity of tanks so located shall not exceed 60 gal.

2-4.4 Only a tank meeting the construction provisions of Standards UL 58 and UL 80 [*see 2-1.2.3(a)*], or as provided in 2-1.2.6, shall be installed enclosed inside of a building.

2-4.5 Enclosed tanks in buildings shall be in accordance with the following:

2-4.5.1 In buildings of other than fire-resistive construction the gross capacity of the tank(s) shall be not more than 10,000 gal.

2-4.5.2 In buildings of fire-resistive construction the gross capacity of the tank(s) shall be not more than 15,000 gal.

2-4.5.3 The enclosure for tanks in 2-4.5.1 and 2-4.5.2 shall include walls, a floor and a top and be formed from walls, partitions, floors or floor-ceiling assemblies having a fire resistance rating of not less than 3 hours with the walls bonded to the floor. If the walls of such enclosure extend to and are bonded to the underside of a concrete floor or roof which has a fire resistance rating of not less than 3 hours, a separate top is not required for the tank enclosure.

Exception: The gross capacity of tanks may not be more than 50,000 gal in any building provided:

(*a*) *The individual capacity of any tank is not more than 25,000 gal.*

(b) The tank(s) are in an enclosure having walls, a floor and a top, and constructed of assemblies having a fire resistance rating of not less than 3 hours with walls bonded to the floor.

(c) The tank enclosure is located in a room or area of the building cut off vertically and horizontally from other areas and floors of the building by assemblies having a fire resistance rating of not less than 2 hr. Access into the room shall be by an opening protected with a self-closing listed 3-hr (Class A) fire door. Fire doors shall be installed in accordance with NFPA 80, Standard for Fire Doors and Windows. *The top and walls of the tank enclosure shall be independent of the building construction except that an exterior building wall having a fire resistance rating of not less than 3 hr may serve also as a wall of the tank enclosure.*

2-4.6 The tank shall be supported at least 4 in. above the floor by masonry saddles at least 12 in. thick, spaced not more than 8 ft on centers and extending the full width of the tank. At least 15-in. clearance shall be provided between the tank and the top and walls of the tank enclosure for the purpose of inspection and repair.

2-4.7 All connections to an enclosed supply tank having a capacity of more than 660 gal shall be made through the top of the tank, and the transfer of oil shall be by pump only and through continuous piping to and from the consuming appliances.

2-4.8 Each tank enclosure shall be provided with an opening protected by a self-closing listed 3-hr (Class A) fire door and a noncombustible liquid-tight sill or ramp at least 6 in. high. Fire doors shall be installed in accordance with NFPA 80, *Standard for Fire Doors and Windows.* If the sill or ramp is more than 6 in. high, the walls to a height corresponding to the level of oil that will be retained shall be built to withstand the lateral pressure due to the liquid head.

2-4.9 Provision shall be made for adequate ventilation of such enclosures prior to entering for inspection or repair of tanks.

2-4.10 An enclosed supply tank shall be equipped with an open vent or an automatically operated vent, terminating outside the building. Vent openings and vent pipes shall be of ample size to prevent abnormal pressure in the tank during filling but not smaller than the pipe size specified in Table 2-1.

2-4.11 An enclosed supply tank shall be provided with a gauging device. (*See Section 3-6.*)

2-5 Installation of Outside Aboveground Tanks Not Larger than 660 Gal.

2-5.1 The provisions of Section 2-5 do not apply to centralized oil distribution systems. (*See Section 3-8.*)

2-5.2 Tankage not in excess of that permitted by 2-3.2 may be installed outside aboveground in a built-up area. The tanks may be adjacent to buildings but the distance to the line of adjoining property shall be in accordance with Table 2-2. Such tanks shall be suitably protected from the weather and from physical damage incident to outside use. The tanks shall not block normal means of egress.

2-5.3 A tank not larger than 60-gal capacity may be a DOT-5 Shipping Container (drum), and so marked, a listed safety can, or a tank meeting the provisions of Standard UL 80 [*see 2-1.2.3(a)*], or as provided in 2-1.2.6.

2-5.4 A tank other than a DOT-5 Shipping Container having a capacity of not more than 660 gal shall meet the provisions of Standard UL 80 [*see 2-1.2.3(a)*], or as provided in 2-1.2.6.

2-5.5 Not more than one 660-gal tank or two tanks of aggregate capacity of 660 gal or less shall be connected to oil-burning appliances.

2-5.6 Two supply tanks connected to the same burner as permitted by 2-5.5 above may be cross-connected and provided with a single fill and a single vent as described in Appendix A but when so connected they shall be on a common slab and rigidly secured, one to the other.

2-5.7 Tanks having a capacity of 660 gal or less shall be securely supported by rigid noncombustible supports to prevent settling, sliding or lifting.

2-5.8 The filling of a portable container from a storage tank larger than 60 gal shall be by means of a hand pump only.

Contents

Flammable and Combustible Liquids Code

NFPA 30-1981

Foreword

This standard, known as the Flammable and Combustible Liquids Code, is recommended for use as the basis of legal regulations. Its provisions are intended to reduce the hazard to a degree consistent with reasonable public safety, without undue interference with public convenience and necessity which requires the use of flammable and combustible liquids. Thus, compliance with this standard does not eliminate all hazard in the use of flammable and combustible liquids.

Chapter 1 General Provisions

1-1 Scope and Application.

1-1.1 This code applies to all flammable and combustible liquids except those that are solid at 100°F (37.8°C) or above.

1-1.2 Requirements for the safe storage and use of the great variety of flammable and combustible liquids commonly available depend primarily on their fire characteristics, particularly the flash point, which is the basis for the several classifications of liquids as defined in Section 1-2. It should be noted that the classification of a liquid can be changed by contamination. For example, filling a Class II liquid into a tank which last contained a Class I liquid can alter its classification, as can exposing a Class II liquid to the vapors of a Class I liquid via an interconnecting vapor line (*see 2-2.6.4 and 2-3.5.6*). Care shall be exercised in such cases to apply the requirements appropriate to the actual classification.

1-1.3 The volatility of liquids is increased by heating. When Class II or Class III liquids are heated above their flash points, ventilation and electrical classification may be necessary in the immediate area.

1-1.4 Additional requirements may be necessary for the safe storage and use of liquids which have unusual burning characteristics, which are subject to self-ignition when exposed to the air, which are highly reactive with other substances, which are subject to explosive decomposition, or have other special properties which dictate safeguards over and above those specified for a normal liquid of similar flash point classification.

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1-1.5 In particular installations the provisions of this code may be altered at the discretion of the authority having jurisdiction after consideration of the special features such as topographical conditions, barricades, walls, adequacy of building exits, nature of occupancies, proximity to buildings or adjoining property and character of construction of such buildings, capacity and construction of proposed tanks and character of liquids to be stored, nature of process, degree of private fire protection to be provided and the adequacy of facilities of the fire department to cope with flammable or combustible liquid fires.

1-1.6 Existing plants, equipment, buildings, structures and installations for the storage, handling, or use of flammable or combustible liquids which are not in strict compliance with the terms of this code may be continued in use at the discretion of the authority having jurisdiction provided they do not constitute a recognized hazard to life or adjoining property. The existence of a situation which might result in an explosion or sudden escalation of a fire, such as inadequate ventilation of confined spaces, lack of adequate emergency venting of a tank, failure to fireproof the supports of elevated tanks, or lack of drainage or dikes to control spills may constitute such a hazard.

1-1.7 This code shall not apply to:

1-1.7.1 Transportation of flammable and combustible liquids. These requirements are contained in the U.S. Department of Transportation regulations or in NFPA 385, *Recommended Regulatory Standard for Tank Vehicles for Flammable and Combustible Liquids.*

Refinery areas also attached

1-1.7.2 Storage, handling and use of fuel oil tanks and containers connected with oil burning equipment. These requirements are covered separately in NFPA 31, *Standard for the Installation of Oil Burning Equipment.*

1-1.7.3 Storage of flammable and combustible liquids on farms and isolated construction projects. These requirements are covered separately in NFPA 395, *Standard for the Storage of Flammable and Combustible Liquids on Farms and Isolated Construction Projects.*

1-1.7.4 Liquids without flash points that can be flammable under some conditions, such as certain halogenated hydrocarbons and mixtures containing halogenated hydrocarbons. (*See NFPA 321, Basic Classification of Flammable and Combustible Liquids.*)

Misc. Definitions

1-1.7.5 Mists, sprays or foams. (*Except flammable aerosols in containers, which are included in Chapter 4.*)

1-1.8 Installations made in accordance with the applicable requirements of standards of the National Fire Protection Association: NFPA 32, *Dry Cleaning Plants*; NFPA 33, *Spray Application Using Flammable and Combustible Materials*; NFPA 34, *Dip Tanks Containing Flammable or Combustible Liquids*; NFPA 35, *Manufacture of Organic Coatings*; NFPA 36, *Solvent Extraction Plants*; NFPA 37, *Installation and Use of Stationary Combustion Engines and Gas Turbines*; NFPA 45, *Fire Protection for Laboratories Using Chemicals*; and NFPA 56C, *Laboratories in Health-Related Institutions*, shall be deemed to be in compliance with this code.

1-2 Definitions.

Aerosol. A material which is dispensed from its container as a mist spray or foam by a propellant under pressure.

Apartment House. A building or that portion of a building containing more than two dwelling units.

Approved. Means "acceptable to the authority having jurisdiction."

NOTE: The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment, or material 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 an organization concerned with product evaluations which is in a position to determine compliance with appropriate standards for the current production of listed items.

Assembly Occupancy. The occupancy or use of a building or structure or any portion thereof by a gathering of persons for civic, political, travel, religious or recreational purposes.

Atmospheric Tank. A storage tank which has been designed to operate at pressures from atmospheric through 0.5 psig.

Authority Having Jurisdiction. The "authority having jurisdiction" is the organization, office or individual responsible for "approving" equipment, an installation or a procedure.

The flash point of a liquid having a viscosity of 45 SUS or more at 100°F (37.8°C) or a flash point of 200°F (93.4°C) or higher shall be determined in accordance with ASTM D-93-73.* *Standard Method of Test for Flash Point by the Pensky Martens Closed Tester.*

As an alternate, ASTM D-3243-73T, *Standard Methods of Tests for Flash Point of Aviation Turbine Fuels by Setaflash Closed Tester,* may be used for testing aviation turbine fuels within the scope of this procedure.

As an alternate, ASTM D-3278-73, *Standard Method of Tests for Flash Point of Liquids by Setaflash Closed Tester,* may be used for paints, enamels, lacquers, varnishes and related products and their components having flash points between 32°F (0°C) and 230°F (110°C), and having a viscosity lower than 150 stokes at 77°F (25°C).

Hotel. Buildings or groups of buildings under the same management in which there are sleeping accommodations for hire, primarily used by transients who are lodged with or without meals including but not limited to inns, clubs, motels and apartment hotels.

Institutional Occupancy. The occupancy or use of a building or structure or any portion thereof by persons harbored or detained to receive medical, charitable or other care or treatment, or by persons involuntarily detained.

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Liquid. For the purpose of this code, any material which has a fluidity greater than that of 300 penetration asphalt when tested in accordance with ASTM D-5-73*, *Test for Penetration for Bituminous Materials.* **When not otherwise identified, the term liquid shall mean both flammable and combustible liquids.**

Combustible Liquid. A liquid having a flash point at or above 100°F (37.8°C).

*Available from American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103.

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Combustible Liquids shall be subdivided as follows:

Class II liquids shall include those having flash points at or above 100°F (37.8°C) and below 140°F (60°C).

Class IIIA liquids shall include those having flash points at or above 140°F (60°C) and below 200°F (93.4°C).

Class IIIB liquids shall include those having flash points at or above 200°F (93.4°C).

Flammable Liquid. A liquid having a flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 pounds per square inch (absolute) at 100°F (37.8°C) shall be known as a Class I liquid.

Class I liquids shall be subdivided as follows:

Class IA shall include those having flash points below 73°F (22.8°C) and having a boiling point below 100°F (37.8°C).

Class IB shall include those having flash points below 73°F (22.8°C) and having a boiling point at or above 100°F (37.8°C).

Class IC shall include those having flash points at or above 73°F (22.8°C) and below 100°F (37.8°C).

Unstable (Reactive) Liquid. A liquid which in the pure state or as commercially produced or transported will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure, or temperature.

Listed. Equipment or materials included in a list published by an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

Low Pressure Tank. A storage tank designed to withstand an internal pressure above 0.5 psig (3.45 kPa) but not more than 15 psig (103.4 kPa).

Mercantile Occupancy. The occupancy or use of a building or structure or any portion thereof for the displaying, selling or buying of goods, wares, or merchandise.

Office Occupancy. The occupancy or use of a building or structure or any portion thereof for the transaction of business, or the rendering or receiving of professional services.

Portable Tank. Any closed vessel having a liquid capacity over 60 U.S. gallons (227.1 L) and not intended for fixed installation.

Pressure Vessel. Any fired or unfired vessel within the scope of the applicable section of the ASME Boiler and Pressure Vessel Code, available from American Society of Mechanical Engineers, United Engineering Center, 345 East 47th St., New York, NY 10017.

Protection for Exposures. Fire protection for structures on property adjacent to liquid storage. Fire protection for such structures shall be acceptable when located (1) within the jurisdiction of any public fire department, or (2) adjacent to plants having private fire brigades capable of providing cooling water streams on structures on property adjacent to liquid storage.

Refinery. A plant in which flammable or combustible liquids are produced on a commercial scale from crude petroleum, natural gasoline, or other hydrocarbon sources.

Safety Can. An approved container, of not more than five gallons capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

Separate Inside Storage Area. A room or building used for the storage of liquids in containers or portable tanks, separated from other types of occupancies. Such areas may include:

Inside Room. A room totally enclosed within a building and having no exterior walls.

Cut-Off Room. A room within a building and having at least one exterior wall.

Attached Building. A building having only one common wall with a building having other type occupancies.

Service Stations.

Automotive Service Station. That portion of property where liquids used as motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles and shall include any facilities available for the sale and service of tires, batteries and accessories, and for minor automotive maintenance work. Major automotive repairs, painting, body and fender work are excluded.

Marine Service Station. That portion of a property where liquids used as fuels are stored and dispensed from fixed equipment on shore, piers, wharves, or floating docks into the fuel tanks of self-propelled craft, and shall include all facilities used in connection therewith.

Service Station Located Inside Buildings. That portion of an automotive service station located within the perimeter of a building or building structure that also contains other occupancies. The service station may be enclosed or partially enclosed by the building walls, floors, ceilings, or partitions, or may be open to the outside. The service station dispensing area shall mean that area of the service station required for dispensing of fuels to motor vehicles. Dispensing of fuel at manufacturing, assembly, and testing operations is not included within this definition.

Vapor Pressure. The pressure, measured in pounds per square inch (absolute), exerted by a volatile liquid as determined by ASTM D323-72*, *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method)*.

Vapor Processing Equipment. Those components of a vapor processing system which are designed to process vapors or liquids captured during filling operations at service stations, bulk plants, or terminals.

Vapor Processing System. A system designed to capture and process vapors displaced during filling operations at service stations, bulk plants, or terminals by use of mechanical and/or chemical means. Examples are systems using blower-assist for capturing vapors, and refrigeration, absorption and combustion systems for processing vapors.

*Available from American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103.

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Vapor Recovery System. A system designed to capture and retain, without processing, vapors displaced during filling operations at service stations, bulk plants, or terminals. Examples are balanced-pressure vapor displacement systems and vacuum assist systems without vapor processing.

Ventilation. As specified in this code, ventilation is for the prevention of fire and explosion. It is considered adequate if it is sufficient to prevent accumulation of significant quantities of vapor-air mixtures in concentration over one-fourth of the lower flammable limit.

Warehouses.

General Purpose Warehouse. A separate, detached building or portion of a building used only for warehousing-type operations.

NOTE: Warehousing operations referred to above are those operations not accessible to the public and include general purpose, merchandise, distribution and industrial warehouse-type operations.

Liquid Warehouse. A separate, detached building or attached building used for warehousing-type operations for liquids.

1-3 Storage. Liquids shall be stored in tanks or in containers in accordance with Chapter 2 or Chapter 4.

1-4 Pressure Vessel. All new pressure vessels containing liquids shall comply with 1-4.1, 1-4.2 or 1-4.3, as applicable.

1-4.1 Fired pressure vessels shall be designed and constructed in accordance with Section I (Power Boilers) 1971, or Section VIII, Division 1 or Division 2 (Pressure Vessels) 1974, as applicable, of the ASME *Boiler and Pressure Vessel Code*[*].

1-4.2 Unfired pressure vessels shall be designed and constructed in accordance with Section VIII, Division 1 or Division 2, 1974 of the ASME *Boiler and Pressure Vessel Code*[*].

1-4.3 Fired and unfired pressure vessels which do not conform to 1-4.1 or 1-4.2 may be used provided approval has been obtained from the state or other governmental jurisdiction in which they are to be used. Such pressure vessels are generally referred to as "State Special."

1-5 Exits.

1-5.1 Egress from buildings and areas covered by this code shall be in accordance with NFPA *101®*, the *Life Safety Code®*.

[*]Available from the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th St., New York, NY 10017.

Chapter 2 Tank Storage

2-1 Design and Construction of Tanks.

2-1.1 Materials. Tanks shall be designed and built in accordance with recognized good engineering standards for the material of construction being used, and shall be of steel with the following limitations and exceptions:

(a) The material of tank construction shall be compatible with the liquid to be stored. In case of doubt about the properties of the liquid to be stored, the supplier, producer of the liquid, or other competent authority shall be consulted.

(b) Tanks constructed of combustible materials shall be subject to the approval of the authority having jurisdiction and limited to:

1. Installation underground, or

2. Use where required by the properties of the liquid stored, or

3. Storage of Class IIIB liquids aboveground in areas not exposed to a spill or leak of Class I or Class II liquid, or

4. Storage of Class IIIB liquids inside a building protected by an approved automatic fire extinguishing system.

(c) Unlined concrete tanks may be used for storing liquids having a gravity of 40 degrees API or heavier. Concrete tanks with special linings may be used for other services provided the design is in accordance with sound engineering practice.

(d) Tanks may have combustible or noncombustible linings.

(e) Special engineering consideration shall be required if the specific gravity of the liquid to be stored exceeds that of water or if the tank is designed to contain liquids at a liquid temperature below 0°F (−17.8°C).

2-1.2 Fabrication.

2-1.2.1 Tanks may be of any shape or type consistent with sound engineering design.

2-1.2.2 Metal tanks shall be welded, riveted and caulked, or bolted, or constructed by use of a combination of these methods.

2-1.3 Atmospheric Tanks.

2-1.3.1 Atmospheric tanks shall be built in accordance with recognized standards of design. Atmospheric tanks may be built and used within the scopes of the following:

(a) Underwriters Laboratories Inc., *Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids*, UL142 – 1972; *Standard for Steel Underground Tanks for Flammable and Combustible Liquids*, UL58 – 1976; or *Standard for Steel Inside Tanks for Oil Burner Fuel*, UL80 – 1974.*

(b) American Petroleum Institute Standard No. 650, *Welded Steel Tanks for Oil Storage*, Sixth Edition, 1978.**

(c) American Petroleum Institute Specifications 12B, *Bolted Tanks for Storage of Production Liquids*, Twelfth Edition, January 1977**; 12D, *Field Welded Tanks for Storage of Production Liquids*, Eighth Edition, January 1977**; or 12F, *Shop Welded Tanks for Storage of Production Liquids*, Seventh Edition, January 1977**.

(d) Steel Tank Institute Standard No. STI-P3, *Specification for STI-P3 System of Corrosion Protection of Underground Steel Storage Tanks*, 1980***.

2-1.3.2 Low pressure tanks and pressure vessels may be used as atmospheric tanks.

2-1.3.3 Atmospheric tanks shall not be used for the storage of a liquid at a temperature at or above its boiling point.

2-1.4 Low Pressure Tanks.

2-1.4.1 The normal operating pressure of the tank shall not exceed the design pressure of the tank.

2-1.4.2 Low pressure tanks shall be built in accordance with recognized standards of design. Low pressure tanks may be built in accordance with:

(a) American Petroleum Institute Standard No. 620, *Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage Tanks*, Fifth Edition, 1973.**

*Available from Underwriters Laboratories Inc., 333 Pfingsten Rd., Northbrook, IL 60062.

**Available from America Petroleum Institute, 2101 L St., N.W., Washington, DC 20037.

***Available from Steel Tank Institute, 666 Dundee Rd, Northbrook, IL 60062.

(b) The principles of the *Code for Unfired Pressure Vessels*, Section VIII, Division 1 of the ASME *Boiler and Pressure Vessels Code*, 1974 Edition*.

2-1.4.3 Tanks built according to Underwriters Laboratories Inc. requirements in 2-1.3.1 may be used for operating pressures not exceeding 1 psig (6.895 kPa) and shall be limited to 2.5 psig (17.24 kPa) under emergency venting conditions.

2-1.4.4 Pressure vessels may be used as low pressure tanks.

2-1.5 Pressure Vessels.

2-1.5.1 The normal operating pressure of the vessel shall not exceed the design pressure of the vessel.

2-1.5.2 Storage tanks designed to withstand pressures above 15 psig shall meet the requirements of Section 1-4.

2-1.6 Provisions for Internal Corrosion.

2-1.6.1 When tanks are not designed in accordance with the American Petroleum Institute, American Society of Mechanical Engineers or the Underwriters Laboratories Inc. Standards, or if corrosion is anticipated beyond that provided for in the design formulas used, additional metal thickness or suitable protective coatings or linings shall be provided to compensate for the corrosion loss expected during the design life of the tank.

2-2 Installation of Outside Aboveground Tanks.

2-2.1 Location With Respect to Property Lines, Public Ways and Important Buildings on the Same Property.

2-2.1.1 Every aboveground tank for the storage of Class I, Class II or Class IIIA liquids, except as provided in 2-2.1.2 and those liquids with boil-over characteristics and unstable liquids, operating at pressures not in excess of 2.5 psig (17.24 kPa) and designed with a weak roof-to-shell seam or equipped with emergency venting devices which will not permit pressures to exceed 2.5 psig (17.24 kPa), shall be located in accordance with Table 2-1.

(a) For the purpose of Section 2-2, a floating roof tank is defined as one which incorporates either:

1. A pontoon or double deck metal floating roof in an open top tank in accordance with API Standard 650, or

*Available from the American Safety of Mechanical Engineers, United Engineering Center, 345 East 47th St., New York, NY 10017.

2-2.4.7 Flame arresters or venting devices required in 2-2.4.6 may be omitted for IB and IC liquids where conditions are such that their use may, in case of obstruction, result in tank damage. Liquid properties justifying the omission of such devices include, but are not limited to, condensation, corrosiveness, crystallization, polymerization, freezing or plugging. When any of these conditions exist, consideration may be given to heating, use of devices employing special materials of construction, the use of liquid seals, or inerting (*see* NFPA 69, *Standard on Explosion Prevention Systems*).

2-2.5 Emergency Relief Venting for Fire Exposure for Aboveground Tanks.

2-2.5.1 Except as provided in 2-2.5.2, every aboveground storage tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires.

2-2.5.2 Tanks larger than 12,000 gal (45,420 L) capacity storing Class IIIB liquids and not within the diked area or the drainage path of Class I or Class II liquids do not require emergency relief venting.

2-2.5.3 In a vertical tank the construction referred to in 2-2.5.1 may take the form of a floating roof, lifter roof, a weak roof-to-shell seam, or other approved pressure relieving construction. The weak roof-to-shell seam shall be constructed to fail preferential to any other seam.

2-2.5.4 Where entire dependence for emergency relief is placed upon pressure relieving devices, the total venting capacity of both normal and emergency vents shall be enough to prevent rupture of the shell or bottom of the tank if vertical, or of the shell or heads if horizontal. If unstable liquids are stored, the effects of heat or gas resulting from polymerization, decomposition, condensation, or self-reactivity shall be taken into account. The total capacity of both normal and emergency venting devices shall be not less than that derived from Table 2-8 except as provided in 2-2.5.6 or 2-2.5.7. Such device may be a self-closing manhole cover, or one using long bolts that permit the cover to lift under internal pressure, or an additional or larger relief valve or valves. The wetted area of the tank shall be calculated on the basis of 55 percent of the total exposed area of a sphere or spheroid, 75 percent of the total exposed area of a horizontal tank and the first 30 ft (9.1 m) abovegrade of the exposed shell area of a vertical tank. (*See Appendix A for the square footage of typical tank sizes.*)

Table 2-8

Wetted Area Versus Cubic Feet Free Air per Hour*

(14.7 psia and 60° F) (101.3 kPa and 15.6 C)

Sq. Ft.	CFH	Sq. Ft.	CFH	Sq. Ft.	CFH
20	21,100	200	211,000	1,000	524,000
30	31,600	250	239,000	1,200	557,000
40	42,100	300	265,000	1,400	587,000
50	52,700	350	288,000	1,600	614,000
60	63,200	400	312,000	1,800	639,000
70	73,700	500	354,000	2,000	662,000
80	84,200	600	392,000	2,400	704,000
90	94,800	700	428,000	2,800	742,000
100	105,000	800	462,000	and over	
120	126,000	900	493,000		
140	147,000	1,000	524,000		
160	168,000				
180	190,000				
200	211,000				

SI Units: 1 sq ft = 0.0929 sq m; 1 cu ft = 0.02832 cu m.

*Interpolate for intermediate values.

Table 2-9

Wetted Area Over 2,800 sq ft and Pressures Over 1 psig

Sq. Ft.	CFH	Sq. Ft.	CFH
2,800	742,000	9,000	1,930,000
3,000	786,000	10,000	2,110,000
3,500	892,000	15,000	2,940,000
4,000	995,000	20,000	3,720,000
4,500	1,100,000	25,000	4,470,000
5,000	1,250,000	30,000	5,190,000
6,000	1,390,000	35,000	5,900,000
7,000	1,570,000	40,000	6,570,000
8,000	1,760,000		

SI Units: 1 sq ft = 0.0929 sq m; 1 cu ft = 0.02832 cu m.

2-2.5.5 For tanks and storage vessels designed for pressures over 1 psig (6.895 kPa), the total rate of venting shall be determined in accordance with Table 2-8, except that when the exposed wetted area of the surface is greater than 2,800 sq ft (260 m²), the total rate of venting shall be in accordance with Table 2-9 or calculated by the following formula:

$$CFH = 1{,}107\ A^{0.82}$$

Where:

CFH = venting requirement, in cubic feet of free air per hour

A = exposed wetted surface, in square feet

The foregoing formula is based on $Q = 21{,}000\ A^{0.82}$.

2-2.5.6 The total emergency relief venting capacity for any specific stable liquid can be determined by the following formula:

$$\text{Cubic feet of free air per hour} = V \frac{1{,}337}{L\sqrt{M}}$$

V = cubic feet of free air per hour from Table 2-8

L = latent heat of vaporization of specific liquid in Btu per pound

M = molecular weight of specific liquids

2-2.5.7 For tanks containing stable liquids, the required airflow rate of 2-2.5.4 or 2-2.5.6 may be multiplied by the appropriate factor listed in the following schedule when protection is provided as indicated. Only one factor can be used for any one tank.

.5 for drainage in accordance with 2-2.3.2 for tanks over 200 sq ft (18.6 m²) of wetted area

.3 for water spray in accordance with NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, and drainage in accordance with 2-2.3.2

.3 for insulation in accordance with 2-2.5.7(a)

.15 for water spray with insulation in accordance with 2-2.5.7(a) and drainage in accordance with 2-2.3.2 (*see Appendix A*)

(a) Insulation systems for which credit is taken shall meet the following performance criteria:

1. Remain in place under fire exposure conditions.

2. Withstand dislodgment when subjected to hose stream impingement during fire exposure. This requirement may be waived where use of solid hose streams is not contemplated or would not be practical.

3. Maintain a maximum conductance value of 4.0 Btu's per hour per square foot per degree F (Btu/hr/sq ft/°F) when the outer insulation jacket or cover is at a temperature of 1,660°F (904.4°C) and when the mean temperature of the insulation is 1,000°F (537.8°C).

2-2.5.8 The outlet of all vents and vent drains on tanks equipped with emergency venting to permit pressures exceeding 2.5 psig (17.2 kPa) shall be arranged to discharge in such a way as to prevent localized overheating of or flame impingement on any part of the tank, in the event vapors from such vents are ignited.

2-2.5.9 Each commercial tank venting device shall have stamped on it the opening pressure, the pressure at which the valve reaches the full open position and the flow capacity at the latter pressure. If the start to open pressure is less than 2.5 psig (17.2 kPa) and the pressure at full open position is greater than 2.5 psig (17.2 kPa), the flow capacity at 2.5 psig (17.2 kPa) shall also be stamped on the venting device. The flow capacity shall be expressed in cubic feet per hour of air at 60°F (15.6°C) and 14.7 psia (101.3 kPa).

(a) The flow capacity of tank venting devices under 8 in. (203.2 mm) in nominal pipe size shall be determined by actual test of each type and size of vent. These flow tests may be conducted by the manufacturer if certified by a qualified impartial observer, or may be conducted by a qualified, impartial outside agency. The flow capacity of tank venting devices 8 in. (203.2 mm) nominal pipe size and larger, including manhole covers with long bolts or equivalent, may be calculated provided that the opening pressure is actually measured, the rating pressure and corresponding free orifice area are stated, the word "calculated" appears on the nameplate, and the computation is based on a flow coefficient of 0.5 applied to the rated orifice area.

(b) A suitable formula for this calculation is:

$$CFH = 1{,}667\ C_f\ A\ \sqrt{P_t - P_a}$$

where CFH = venting requirement in cubic feet of free air per hour

C_f = 0.5 [the flow coefficient]

A = the orifice area in sq in.

P_t = the absolute pressure inside the tank in inches of water

P_a = the absolute atmospheric pressure outside the tank in inches of water

2-2.6 Vent Piping for Aboveground Tanks.

2-2.6.1 Vent piping shall be constructed in accordance with Chapter 3.

2-2.6.2 Where vent pipe outlets for tanks storing Class I liquids are adjacent to buildings or public ways, they shall be located so that the vapors are released at a safe point outside of buildings and not less than 12 ft (3.7 m) above the adjacent ground level. In order to aid their dispersion, vapors shall be discharged upward or horizontally away from closely adjacent walls. Vent outlets shall be located so that flammable vapors will not be trapped by eaves or other obstructions and shall be at least 5 ft (1.5 m) from building openings.

2-2.6.3 The manifolding of tank vent piping shall be avoided except where required for special purposes such as vapor recovery, vapor conservation or air pollution control. When tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapors they may be required to handle when manifolded tanks are subject to the same fire exposure.

2-2.6.4 Vent piping for tanks storing Class I liquids shall not be manifolded with vent piping for tanks storing Class II or Class III liquids unless positive means are provided to prevent the vapors from Class I liquids from entering tanks storing Class II or Class III liquids, to prevent contamination (*see 1-1.2*) and possible change in classification of the less volatile liquid.

2-2.7 Tank Openings Other Than Vents for Aboveground Tanks.

2-2.7.1 Each connection to an aboveground tank through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank.

2-2.7.2 Each connection below the liquid level through which liquid does not normally flow shall be provided with a liquidtight closure. This may be a valve, plug or blind, or a combination of these.

2-2.7.3 Openings for gaging on tanks storing Class I liquids shall be provided with a vaportight cap or cover. Such covers shall be closed when not gaging.

2-2.7.4 For Class IB and Class IC liquids other than crude oils, gasolines and asphalts, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity. A fill pipe entering the top of a tank shall terminate within 6 in. (152.4 mm) of the bottom of the tank and shall be installed to avoid excessive vibration.

2-2.7.5 Filling and emptying connections for Class I, Class II and Class IIIA liquids which are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than 5 ft (1.5 m) away from any building opening. Such connections for any liquid shall be closed and liquidtight when not in use and shall be properly identified.

2-3 Installation of Underground Tanks.

2-3.1 Location. Excavation for underground storage tanks shall be made with due care to avoid undermining of foundations of existing structures. Underground tanks or tanks under buildings shall be so located with respect to existing building foundations and supports that the loads carried by the latter cannot be transmitted to the tank. The distance from any part of a tank storing Class I liquids to the nearest wall of any basement or pit shall be not less than 1 ft (0.3048 m), and to any property line that can be built upon, not less than 3 ft (0.91 m). The distance from any part of a tank storing Class II or Class III liquids to the nearest wall of any basement, pit or property line shall be not less than 1 ft (0.3048 m).

2-3.1 Burial Depth and Cover.

2-3.2.1 Steel underground tanks shall be set on firm foundations and surrounded with at least 6 in. (152.4 mm) of noncorrosive inert material such as clean sand or gravel well-tamped in place. The tank shall be placed in the hole with care, since dropping or rolling the tank into the hole can break a weld, puncture or damage the tank, or scrape off the protective coating of coated tanks.

2-3.2.2 Steel underground tanks shall be covered with a minimum of 2 ft (.6096 m) of earth, or shall be covered with not less than 1 ft (0.3048 m) of earth, on top of which shall be placed a slab of reinforced concrete not less than 4 in. (101.6 mm) thick. When they are, or are likely to be, subjected to traffic, they shall be protected against damage from vehicles passing over them by at least 3 ft (0.91 m) of earth cover, or 18 in. (457.2 mm) of well-tamped earth plus either 6 in. (152.4 mm) of reinforced concrete or 8 in. (203.2 mm) of asphaltic concrete. When asphaltic or reinforced concrete paving is used as part of the protection, it shall extend at least 1 ft (0.3048 m) horizontally beyond the outline of the tank in all directions.

2-3.2.3 Nonmetallic underground tanks shall be installed in accordance with the manufacturer's instructions. The minimum depth of cover shall be as specified in 2-3.2.2 for steel tanks.

2-3.5.5 When tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapors they can be required to handle when manifolded tanks are filled simultaneously. Float-type check valves installed in tank openings connected to manifolded vent piping to prevent product contamination may be used provided that the tank pressure will not exceed that permitted by 2-3.2.4 when the valves close.

Exception: For service stations, the capacity of manifolded vent piping shall be sufficient to discharge vapors generated when two manifolded tanks are simultaneously filled.

2-3.5.6 Vent piping for tanks storing Class I liquids shall not be manifolded with vent piping for tanks storing Class II or Class III liquids unless positive means are provided to prevent the vapors from Class I liquids from entering tanks storing Class II or Class III liquids, to prevent contamination (*see 1-1.2*) and possible change in classification of the less volatile liquid.

2-3.6 Tank Openings Other Than Vents for Underground Tanks.

2-3.6.1 Connections for all tank openings shall be liquidtight.

2-3.6.2 Openings for manual gaging, if independent of the fill pipe, shall be provided with a liquidtight cap or cover. Covers shall be kept closed when not gaging. If inside a building, each such opening shall be protected against liquid overflow and possible vapor release by means of a spring loaded check valve or other approved device.

2-3.6.3 Fill and discharge lines shall enter tanks only through the top. Fill lines shall be sloped toward the tank. Underground tanks for Class I liquids having a capacity of more than 1,000 gal (3,785 L) shall be equipped with a tight fill device for connecting the fill hose to the tank.

2-3.6.4 For Class IB and Class IC liquids other than crude oils, gasolines and asphalts, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity by terminating within 6 in. (152.4 mm) of the bottom of the tank.

2-3.6.5 Filling and emptying and vapor recovery connections for Class I, Class II or Class IIIA liquids which are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than 5 ft (1.5 m) away from any building opening. Such connections shall be closed and liquidtight when not in use and shall be properly identified.

2-3.6.6 Tank openings provided for purposes of vapor recovery shall be protected against possible vapor release by means of a spring-loaded check valve or dry-break connection, or other approved device, unless the opening is pipe-connected to a vapor processing system. Openings designed for combined fill and vapor recovery shall also be protected against vapor release unless connection of the liquid delivery line to the fill pipe simultaneously connects the vapor recovery line. All connections shall be vaportight.

2-4 Installation of Tanks Inside of Buildings.

2-4.1 Location. Tanks shall not be permitted inside of buildings except as provided in Chapters 5, 6, 7, 8 or 9.

2-4.2 Vents. Vents for tanks inside of buildings shall be as required in 2-2.4, 2-2.5, 2-2.6.2 and 2-3.5, except that emergency venting by the use of weak roof seams on tanks shall not be permitted. Automatic sprinkler systems designed in accordance with the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems*, may be accepted by the authority having jurisdiction as equivalent to water spray systems for purposes of calculating the required air flow rates for emergency vents in 2-2.5.7. Except for tanks containing Class IIIB liquids, vents shall terminate outside the buildings.

Basically = to the Greater of Fill Rate or Exit Rate unless both performed at same time the = to Both.

2-4.3 Vent Piping. Vent piping shall be constructed in accordance with Chapter 3.

2-4.4 Tank Openings Other Than Vents for Tanks Inside Buildings.

2-4.4.1 Connections for all tank openings shall be liquidtight.

2-4.4.2 Each connection to a tank inside of buildings through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank.

2-4.4.3 Tanks for storage of Class I or Class II liquids inside buildings shall be provided with either:

(a) a normally closed remotely activated valve,

(b) an automatic-closing heat-activated valve, or

(c) another approved device on each liquid transfer connection below the liquid level, except for connections used for emergency disposal, to provide for quick cut-off of flow in the event of fire in the vicinity of the tank.

This function can be incorporated in the valve required in 2-4.4.2, and if a separate valve, shall be located adjacent to the valve required in 2-4.4.2.

2-4.4.4 Openings for manual gaging of Class I or Class II liquids, if independent of the fill pipe, shall be provided with a vaportight cap or cover. Openings shall be kept closed when not gaging. Each such opening for any liquid shall be protected against liquid overflow and possible vapor release by means of a spring loaded check valve or other approved device. Substitutes for manual gaging include, but are not limited to, heavy-duty flat gage glasses, magnetic, hydraulic or hydrostatic remote reading devices and sealed float gages.

2-4.4.5 For Class IB and Class IC liquids other than crude oils, gasolines and asphalts, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity by terminating within 6 in. (152.4 mm) of the bottom of the tank.

2-4.4.6 The fill pipe inside of the tank shall be installed to avoid excessive vibration of the pipe.

2-4.4.7 The inlet of the fill pipe and the outlet of a vapor recovery line for which connections are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than 5 ft (1.5 m) away from any building opening. Such connections shall be closed and tight when not in use and shall be properly identified.

2-4.4.8 Tanks storing Class I, Class II and Class IIIA liquids inside buildings shall be equipped with a device, or other means shall be provided, to prevent overflow into the building. Suitable devices include, but are not limited to, a float valve, a preset meter on the fill line, a valve actuated by the weight of the tank contents, a low head pump which is incapable of producing overflow, or a liquidtight overflow pipe at least one pipe size larger than the fill pipe discharging by gravity back to the outside source of liquid or to an approved location.

2-4.4.9 Tank openings provided for purposes of vapor recovery shall be protected against possible vapor release by means of a spring-loaded check valve or dry-break connections, or other approved device, unless the opening is pipe-connected to a vapor processing system. Openings designed for combined fill and vapor recovery shall also be protected against vapor release unless connection of the liquid delivery line to the fill pipe simultaneously connects the vapor recovery line. All connections shall be vaportight.

2-5 Supports, Foundations and Anchorage for All Tank Locations.

2-5.1 Tanks shall rest on the ground or on foundations made of concrete, masonry, piling or steel. Tank foundations shall be designed to minimize the possibility of uneven settling of the tank and to minimize corrosion in any part of the tank resting on the foundation. Appendix E of API Standard 650, *Specification for Welded Steel Tanks for Oil Storage*, and Appendix B of API Standard 620, *Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage Tanks*,* provide information on tank foundations.

2-5.2 When tanks are supported above the foundations, tank supports shall be installed on firm foundations. Supports for tanks storing Class I, Class II or Class IIIA liquids shall be of concrete, masonry or protected steel. Single wood timber supports (not cribbing) laid horizontally may be used for outside aboveground tanks if not more than 12 in. (304.8 mm) high at their lowest point.

2-5.3 Steel supports or exposed piling for tanks storing Class I, Class II or Class IIIA liquids shall be protected by materials having a fire resistance rating of not less than 2 hrs, except that steel saddles need not be protected if less than 12 in. (304.8 mm) high at their lowest point. At the discretion of the authority having jurisdiction, water spray protection in accordance with NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, or NFPA 13, *Standard for the Installation of Sprinkler Systems*, or equivalent may be used.

2-5.4 The design of the supporting structure for tanks such as spheres shall require special engineering consideration. Appendix N of the API Standard 620, *Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage Tanks*,* contains information regarding supporting structures.

2-5.5 Every tank shall be so supported as to prevent the excessive concentration of loads on the supporting portion of the shell.

2-5.6 Where a tank is located in an area subject to flooding, provisions shall be taken to prevent tanks, either full or empty, from floating during a rise in water level up to the established maximum flood stage.

2-5.6.1 Aboveground Tanks.

2-5.6.1.1 Each vertical tank shall be located so that its top extends above the maximum flood stage by at least 30 percent of its allowable storage capacity.

*Available from American Petroleum Institute, 2101 L St., N.W., Washington, DC 20037.

2-5.6.1.2 Horizontal tanks located so that more than 70 percent of the tank's storage capacity will be submerged at the established flood stage shall be anchored; attached to a foundation of concrete or of steel and concrete of sufficient weight to provide adequate load for the tank when filled with flammable or combustible liquid and submerged by flood water to the established flood stage; or adequately secured from floating by other means. Tank vents or other openings which are not liquidtight shall be extended above maximum flood stage water level.

2-5.6.1.3 A dependable water supply shall be available for filling an empty or partially filled tank, except that where filling the tank with water is impractical or hazardous because of the tank's contents, tanks shall be protected by other means against movement or collapse.

2-5.6.1.4 Spherical or spheroid tanks shall be protected by applicable methods as specified for either vertical or horizontal tanks.

2-5.6.2 Underground Tanks.

2-5.6.2.1 At locations where there is an ample and dependable water supply available, underground tanks containing flammable or combustible liquids, so placed that more than 70 percent of their storage capacity will be submerged at the maximum flood stage, shall be so anchored, weighted or secured as to prevent movement when filled or loaded with water and submerged by flood water to the established flood stage. Tank vents or other openings which are not liquidtight shall be extended above maximum flood stage water level.

2-5.6.2.2 At locations where there is no ample and dependable water supply or where filling of underground tanks with water is impractical because of the contents, each tank shall be safeguarded against movement when empty, and submerged by high ground water or flood water by anchoring or by securing by other means. Each such tank shall be so constructed and installed that it will safely resist external pressures if submerged.

2-5.6.3 Water Loading. The filling of a tank to be protected by water loading shall be started as soon as flood waters are predicted to reach a dangerous flood stage. Where independently fueled water pumps are relied upon, sufficient fuel shall be available at all times to permit continuing operations until all tanks are filled. Tank valves shall be closed and locked in closed position when water loading has been completed.

2-5.6.4 Operating Instructions.

2-5.6.4.1 Operating instructions or procedures to be followed in a flood emergency shall be readily available.

2-5.6.4.2 Personnel relied upon to carry out flood emergency procedures shall be informed of the location and operation of valves and other equipment necessary to effect the intent of these requirements.

2-5.7 In areas subject to earthquakes, the tank supports and connections shall be designed to resist damage as a result of such shocks.

2-6 Sources of Ignition.

2-6.1 In locations where flammable vapors may be present, precautions shall be taken to prevent ignition by eliminating or controlling sources of ignition. Sources of ignition may include open flames, lightning, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical and mechanical), spontaneous ignition, chemical and physical-chemical reactions and radiant heat. NFPA 77, *Recommended Practice on Static Electricity*, and NFPA 78, *Lightning Protection Code*, provide information on such protection.

2-7 Testing.

2-7.1 All tanks, whether shop-built or field-erected, shall be tested before they are placed in service in accordance with the applicable paragraphs of the Code under which they were built. The ASME Code stamp, API monogram, or the Listing Mark of Underwriters Laboratories Inc. on a tank shall be evidence of compliance with this test. Tanks not marked in accordance with the above Codes shall be tested before they are placed in service in accordance with good engineering principles and reference shall be made to the sections on testing in the Codes listed in 2-1.3.1, 2-1.4.2, or 2-1.5.2.

2-7.2 When the vertical length of the fill and vent pipes is such that when filled with liquid the static head imposed upon the bottom of the tank exceeds 10 lbs per sq in. (68.95 kPa), the tank and related piping shall be tested hydrostatically to a pressure equal to the static head thus imposed. In special cases where the height of the vent above the top of the tank is excessive, the hydrostatic test pressure shall be determined by using recognized engineering practice.

2-7.3 In addition to the test called for in 2-7.1 and 2-7.2, all tanks and connections shall be tested for tightness. Except for underground tanks, this tightness shall be made at operating pressure with air, inert gas or water prior to placing the tank in service. In the case of field-erected tanks the test called for in 2-7.1 or 2-7.2 may be considered to be the test for tank tightness.

Underground tanks and piping, before being covered, enclosed, or placed in use, shall be tested for tightness hydrostatically, or with air pressure at not less than 3 lbs per sq in. (20.68 kPa) and not more than 5 lbs per sq in. (34.475 kPa). (*See 3-7.1 for testing pressure piping.*)

2-7.4 Before the tank is initially placed in service, all leaks or deformations shall be corrected in an acceptable manner. Mechanical caulking is not permitted for correcting leaks in welded tanks except pin hole leaks in the roof.

2-7.5 Tanks to be operated at pressures below their design pressure may be tested by the applicable provisions of 2-7.1 or 2-7.2 based upon the pressure developed under full emergency venting of the tank.

2-8 Fire Protection and Identification.

2-8.1 A fire extinguishing system in accordance with an applicable NFPA standard shall be provided or be available for vertical atmospheric fixed roof storage tanks larger than 50,000 gal (189,250 L) capacity storing Class I liquids if located in a congested area where there is an unusual exposure hazard to the tank from adjacent property or to adjacent property from the tank. Fixed roof tanks storing Class II or III liquids at temperatures below their flash points and floating roof tanks storing any liquid generally do not require protection when installed in compliance with Section 2-2.

2-8.2 The application of NFPA 704, *Identification of the Fire Hazards of Materials*, to storage tanks containing liquids shall not be required except when the contents have a health or reactivity degree of hazard of 2 or more or a flammability rating of 4. The marking need not be applied directly to the tank but located where it can readily be seen, such as on the shoulder of an accessway or walkway to the tank or tanks or on the piping outside of the diked area. If more than one tank is involved, the markings shall be so located that each tank can readily be identified.

2-9 Prevention of Overfilling of Tanks.

2-9.1 Tanks receiving transfer of Class I liquids from mainline pipelines or marine vessels and located in an area where overfilling may endanger a place of habitation or public assembly shall be either:

(a) Gaged at frequent intervals while receiving transfer of product, and communications maintained with mainline pipeline or marine personnel so that flow can be promptly shut down or diverted, or

(b) Equipped with an independent high level alarm located where personnel are on duty during the transfer and can promptly arrange for flow stoppage or diversion, or

(c) Equipped with an independent high level alarm system that will automatically shut down or divert flow.

2-10 Leakage Detection and Inventory Records for Underground Tanks.

2-10.1 Accurate inventory records or a leak detection program shall be maintained on all Class I Liquid Storage Tanks for indication of possible leakage from the tanks or associated piping. (*See NFPA 329, Underground Leakage of Flammable and Combustible Liquids.*)

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4-8.2.1 The quantity of liquids stored adjacent to a building protected in accordance with 4-8.2(b) may exceed that permitted in 4-8.2, provided the maximum quantity per pile does not exceed 1,100 gal (4163.5 L) and each pile is separated by a 10 ft (3.05 m) minimum clear space along the common wall.

4-8.2.2 Where the quantity stored exceeds the 1,100 gal (4163.5 L) permitted adjacent to the building given in 4-8.2(a), or the provisions of 4-8.2(b) cannot be met, a minimum distance in accordance with column 4 of Table 4-8 shall be maintained between buildings and nearest container or portable tank.

4-8.3 The storage area shall be graded in a manner to divert possible spills away from buildings or other exposures or shall be surrounded by a curb at least 6 in. (152.4 mm) high. When curbs are used, provisions shall be made for draining of accumulations of ground or rain water or spills of liquids. Drains shall terminate at a safe location and shall be accessible to operation under fire conditions.

4-8.4 Storage area shall be protected against tampering or trespassers where necessary and shall be kept free of weeds, debris and other combustible materials not necessary to the storage.

Chapter 5 Industrial Plants

5-1 Scope.

5-1.1 This chapter shall apply to those industrial plants where (1) the use of liquids is incidental to the principal business (*see Section* 5-2), or (2) where liquids are handled or used only in unit physical operations such as mixing, drying, evaporating, filtering, distillation, and similar operations which do not involve chemical reaction (*see Section* 5-3). This chapter shall not apply to chemical plants, refineries or distilleries, as defined, which are covered in Chapter 9, Refineries, Chemical Plants and Distilleries.

5-1.2 Where portions of such plants involve chemical reactions such as oxidation, reduction, halogenation, hydrogenation, alkylation, polymerization, and other chemical processes, those portions of the plant shall be in accordance with Chapter 8, Processing Plants.

5-2 Incidental Storage or Use of Liquids.

5-2.1 Section 5-2 shall be applicable to those portions of an industrial plant where the use and handling of liquids is only incidental to the principal business, such as automobile assembly, construction of electronic equipment, furniture manufacturing or other similar activities.

5-2.2 Liquids shall be stored in tanks or closed containers.

5-2.2.1 Except as provided in 5-2.2.2 and 5-2.2.3, all storage shall comply with Chapter 4, Container Storage.

5-2.2.2 The quantity of liquid that may be located outside of an inside storage room or storage cabinet or in any one fire area of a building shall not exceed the greater of that given in (a) or (b), (c) and (d) below:

(a) A supply for one day, or

(b) 25 gal (94.6 L) of Class IA liquids in containers, and

(c) 120 gal (454.2 L) of Class IB, IC, II or III liquids in containers, and

(d) One portable tank not exceeding 660 gal (2498.1 L) of Class IB, IC, Class II or Class III liquids.

5-2.2.3 Where large quantities of liquids are necessary, storage may be in tanks, which shall comply with the applicable requirements of Chapter 2, Tank Storage, and Sections 5-3, 5-4, 5-5, 5-6, 5-7 and 5-8.

5-2.3 Areas in which liquids are transferred from one tank or container to another container shall be separated from other operations in the building by adequate distance or by construction having adequate fire resistance. Drainage or other means shall be provided to control spills. Adequate natural or mechanical ventilation shall be provided. NFPA 91, *Standard for the Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying*, provides information on the design and installation of mechanical ventilation.

5-2.4 Handling Liquids at Point of Final Use.

5-2.4.1 Class I and Class II liquids shall be kept in covered containers when not actually in use.

5-2.4.2 Where liquids are used or handled, except in closed containers, means shall be provided to dispose promptly and safely of leakage or spills.

5-2.4.3 Class I liquids may be used only where there are no open flames or other sources of ignition within the possible path of vapor travel.

5-2.4.4 Class I and Class II liquids shall be drawn from or transferred into vessels, containers, or portable tanks within a building only from (1) original shipping containers with a capacity of 5 gal (18.92 L) or less, or (2) from safety cans, or (3) through a closed piping system, or (4) from a portable tank or container by means of a device drawing through an opening in the top of the tank or container, or (5) by gravity through a listed self-closing valve or self-closing faucet.

5-2.4.5 Transferring liquids by means of pressurizing the container with air is prohibited. Transferring liquids by pressure of inert gas is permitted only if controls, including pressure relief devices, are provided to limit the pressure so it cannot exceed the design pressure of the vessel, tank or container.

5-3 Unit Physical Operations.

5-3.1 Section 5-3 shall be applicable in those portions of industrial plants where liquids are handled or used in unit physical operations such as mixing, drying, evaporating, filtering, distillation, and similar operations which do not involve chemical change. Examples

are plants compounding cosmetics, pharmaceuticals, solvents, cleaning fluids, insecticides and similar types of activities.

5-3.2 Industrial plants shall be located so that each building or unit of equipment is accessible from at least one side for fire fighting and fire control purposes. Buildings shall be located with respect to lines of adjoining property which may be built upon as set forth in 8-2.1 and 8-2.1.1, except that the blank wall referred to in 8-2.1.1 shall have a fire resistance rating of at least 2 hr.

5-3.3. Areas where unstable liquids are handled or small scale unit chemical processes are carried on shall be separated from the remainder of the plant by a fire wall having a fire resistance rating of not less than 2 hr.

5-3.4 Drainage.

5-3.4.1 Emergency drainage systems shall be provided to direct flammable or combustible liquid leakage and fire protection water to a safe location. This may require curbs, scuppers, or special drainage systems to control the spread of fire (*see 2-2.3.1*). Appendix A of NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, provides information on such protection. DON'T HAVE!

5-3.4.2 Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separators.

5-3.4.3 The industrial plant shall be designed and operated to prevent the normal discharge of flammable or combustible liquids into public waterways, public sewers, or adjoining property.

5-3.5 Ventilation.

5-3.5.1 Areas as defined in 5-3.1 using Class I liquids shall be ventilated at a rate of not less than 1 cu ft (0.028 m^3) per min per sq ft (0.0929 m^2) of solid floor area. This shall be accomplished by natural or mechanical ventilation with discharge or exhaust to a safe location outside of the building. Provision shall be made for introduction of make-up air in such a manner as not to short circuit the ventilation. Ventilation shall be arranged to include all floor areas or pits where flammable vapors can collect. Local or spot general ventilation may be needed for the control of special fire or health hazards. Such ventilation, if provided, may be utilized for up to 75 percent of the required ventilation. NFPA 91, *Standard for the Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying*, and NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*, of other than residence type, provide information on this subject.

5-3.5.2 Equipment used in a building and the ventilation of the building shall be designed so as to limit flammable vapor-air mixtures under normal operating conditions to the interior of equipment, and to not more than 5 ft (1.5 m) from equipment which exposes Class I liquids to the air. Examples of such equipment are dispensing stations, open centrifuges, plate and frame filters, open vacuum filters, and surfaces of open equipment.

5-3.6 The storage, transfer and handling of liquids shall comply with Section 8-4 of Chapter 8, Processing Plants.

5-4 Tank Vehicle and Tank Car Loading and Unloading.

5-4.1 Tank vehicle and tank car loading or unloading facilities shall be separated from aboveground tanks, warehouses, other plant buildings or nearest line of adjoining property which can be built upon by a distance of 25 ft (7.62 m) for Class I liquids and 15 ft (4.57 m) for Class II and Class III liquids, measured from the nearest position of any fill stem. Buildings for pumps or shelters for personnel can be a part of the facility. Operations of the facility shall comply with the appropriate portions of Section 6-3 of Chapter 6, Bulk Plants.

5-5 Fire Control.

5-5.1 Portable fire extinguishment and control equipment shall be provided in such quantities and types as are needed for the special hazards of operation and storage. NFPA 10, *Standard for Portable Fire Extinguishers*, provides information as to the suitability of various types of extinguishers and their number and location.

5-5.2 Water shall be available in volume and at adequate pressure to supply water hose streams, foam-producing equipment, automatic sprinklers or water spray systems as the need is indicated by the special hazards of operation, dispensing and storage.

5-5.3 Special extinguishing equipment such as that utilizing foam, inert gas, or dry chemical shall be provided as the need is indicated by the special hazards of operation, dispensing and storage.

5-5.4 Where the need is indicated by special hazards of operation, liquid processing equipment, major piping, and supporting steel shall be protected by approved water spray systems, deluge systems, approved fire resistant coatings, insulation, or any combination of these. NFPA 13, *Standard for the Installation of Sprinkler Systems*, and NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, provide information on this subject.

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5-5.5 An approved fire alarm system is recommended for prompt notification of fire. Where service is available, it is recommended that a public fire alarm box be located nearby. It may be advisable to connect the plant system with the public system. NFPA 72D, *Standard for the Installation, Maintenance and Use of Proprietary Protective Signaling Systems for Watchman, Fire Alarm and Supervisory Service*, provides information on this subject.

5-5.6 All plant fire protection facilities shall be adequately maintained and periodically inspected and tested to make sure they are always in satisfactory operating condition, and they will serve their purpose in time of emergency.

5-6 Sources of Ignition.

5-6.1 Precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include but are not limited to: open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical and mechanical sparks; spontaneous ignition, including heat-producing chemical reactions; and radiant heat.

5-6.2 Class I liquids or Class II or Class III liquids at a temperature above their flash points (*see 1-1.3*) shall not be dispensed into metal containers unless the nozzle or fill pipe is in electrical contact with the container. This can be accomplished by maintaining metallic contact during filling, by a bond wire between them, or by other conductive path having an electrical resistance not greater than 10^6 ohms. Bonding is not required where a container is filled through a closed system, or the container is made of glass or other nonconducting material. NFPA 77, *Recommended Practice on Static Electricity*, provides information on static protection; NFPA 78, *Lightning Protection Code*, provides information on lightning protection.

5-7 Electrical Equipment.

5-7.1 This Section, 5-7, shall apply to areas where Class I liquids are stored or handled or where Class II or Class III liquids are stored or handled at a temperature above their flash points (*see 1-1.3*.) For areas where Class II or Class III liquids only are stored or handled at a temperature below their flash points, the electrical equipment may be installed in accordance with provisions of NFPA 70, *National Electrical Code*, for ordinary locations; however, care shall be used in locating electrical apparatus to prevent hot metal from falling into open equipment.

5-7.2 All electrical equipment and wiring shall be of a type specified by and shall be installed in accordance with NFPA 70, *National Electrical Code*.

5-7.3 So far as it applies, Table 5-7.3 shall be used to delineate and classify areas for the purpose of installation of electrical equipment under normal circumstances. In the application of classified areas, a classified area shall not extend beyond an unpierced floor, wall, roof or other solid partition. The designation of classes and divisions is defined in Chapter 5, Article 500, of NFPA 70, *National Electrical Code*.

5-7.4 The area classifications listed in Table 5-7.3 are based on the premise that the installation meets the applicable requirements of this code in all respects. Should this not be the case, the authority having jurisdiction shall have the authority to determine the extent of the classified areas.

5-7.5 Extent of classified areas shall be as shown in Table 5-7.3.

5-7.6 Where the provisions of 5-7.1, 5-7.2, 5-7.3, 5-7.4 and 5-7.5 require the installation of electrical equipment suitable for Class I, Division 1 or Division 2 locations, ordinary electrical equipment including switchgear may be used if installed in a room or enclosure which is maintained under positive pressure with respect to the classified area. Ventilation makeup air shall be uncontaminated by flammable vapors. NFPA 496, *Standard for Purged Enclosures for Electrical Equipment in Hazardous Locations*, provides details for these types of installations.

5-8 Repairs to Equipment.

5-8.1 Hot work, such as welding or cutting operations, use of spark-producing power tools, and chipping operations shall be permitted only under supervision of an individual in responsible charge. The individual in responsible charge shall make an inspection of the area to be sure that it is safe for the work to be done and that safe procedures will be followed for the work specified. NFPA 327, *Standard Procedures for the Standard for Cleaning or Safeguarding Small Tanks and Containers*, and NFPA 36, *Standard for Solvent Extraction Plants*, provide information on such operations.

5-9 Housekeeping.

5-9.1 Maintenance and operating practices shall be in accordance with established procedures which will tend to control leakage and prevent the accidental escape of flammable or combustible liquids. Spills shall be cleaned up promptly.

5-9.2 Adequate aisles shall be maintained for unobstructed movement of personnel and so that fire protection equipment can be brought to bear on any part of flammable or combustible liquid storage, use, or any unit physical operation.

5-9.3 Combustible waste material and residues in a building or unit operating area shall be kept to a minimum, stored in covered metal receptacles and disposed of daily.

5-9.4 Ground area around buildings and unit operating areas shall be kept free of weeds, trash or other unnecessary combustible materials.

Chapter 6 Bulk Plants and Terminals

6-1 Storage.

6-1.1 Class I liquids shall be stored in closed containers, or in storage tanks aboveground outside of buildings, or underground in accordance with Chapter 2.

6-1.2 Class II and Class III liquids shall be stored in containers, or in tanks within buildings or aboveground outside of buildings, or underground in accordance with Chapter 2.

6-1.3 Containers of liquids when piled one upon the other shall be separated by dunnage sufficient to provide stability and to prevent excessive stress on container walls. The height of pile shall be consistent with stability and strength of containers.

6-1.4 Piping, Valves and Fittings. Piping systems shall be in accordance with Chapter 3.

6-2 Buildings.

6-2.1 Exits. Rooms in which liquids are stored or handled by pumps shall have exit facilities arranged to prevent occupants being trapped in the event of fire. NFPA 101, *Life Safety Code*, provides information on the number and location of exits.

6-2.2 Heating. Rooms in which Class I liquids are stored or handled shall be heated only by means not constituting a source of ignition, such as steam or hot water. Rooms containing heating appliances involving sources of ignition shall be located and arranged to prevent entry of flammable vapors.

6-2.3 Ventilation.

6-2.3.1 Ventilation shall be provided for all rooms, buildings, or enclosures in which Class I liquids are pumped or dispensed. Design of ventilation systems shall take into account the relatively high specific gravity of the vapors. Ventilation may be provided by adequate openings in outside walls at floor level unobstructed except by louvers or coarse screens. Where natural ventilation is inadequate, mechanical ventilation shall be provided. NFPA 91, *Standard for Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying*, provides information on the installation of mechanical exhaust systems.

6-2.3.2 Class I liquids shall not be stored or handled within a building having a basement or pit into which flammable vapors may travel, unless such area is provided with ventilation designed to prevent the accumulation of flammable vapors therein.

6-2.3.3 Containers of Class I liquids shall not be drawn from or filled within buildings unless provision is made to prevent the accumulation of flammable vapors in hazardous concentrations. Where mechanical ventilation is required, it shall be kept in operation while flammable liquids are being handled.

6-3 Loading and Unloading Facilities.

6-3.1 Tank vehicle and tank car loading or unloading facilities shall be separated from aboveground tanks, warehouses, other plant buildings or nearest line of adjoining property that can be built upon by a distance of at least 25 ft (7.62 m) for Class I liquids and at least 15 ft (4.57 m) for Class II and Class III liquids, measured from the nearest position of any fill spout. Buildings for pumps or shelters for personnel may be a part of the facility.

6-3.2 Equipment such as piping, pumps, and meters used for the transfer of Class I liquids between storage tanks and the fill stem of the loading rack shall not be used for the transfer of Class II or Class III liquids.

6-3.3 Top Loading.

6-3.3.1 When top loading a tank vehicle with Class I and Class II liquids without vapor control, valves used for the final control of flow shall be of the self-closing type and shall be manually held open except where automatic means are provided for shutting off the flow when the vehicle is full.

6-3.3.2 When top loading a tank vehicle with vapor control, flow control shall be in accordance with 6-3.4.1 and 6-3.4.2.

6-3.4 Bottom Loading.

6-3.4.1 When bottom loading a tank vehicle, with or without vapor control, a positive means shall be provided for loading a predetermined quantity of liquid, together with an automatic secondary shut-off control to prevent overfill. The connecting components between the loading rack and the tank vehicle required to operate the secondary control shall be functionally compatible.

6-3.4.2 When bottom loading a tank vehicle that is equipped for vapor control, but when vapor control is not used, the tank shall be vented to the atmosphere to prevent pressurization of the tank. Such venting shall be at a height not lower than the top of the cargo tank on the vehicle.

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6-7 Drainage and Waste Disposal.

6-7.1 Provision shall be made to prevent liquids which can be spilled at loading or unloading points from entering public sewers and drainage systems, or natural waterways. Connection to such sewers, drains, or waterways by which liquids might enter shall be provided with separator boxes or other approved means whereby such entry is precluded. Crankcase drainings and liquids shall not be dumped into sewers, but shall be stored in tanks or tight drums outside of any building until removed from the premises.

6-8 Fire Control.

6-8.1 Listed portable fire extinguishers of appropriate size, type and number shall be provided. NFPA 10, *Standard for Portable Fire Extinguishers*, provides information on this subject. At least one extinguisher with a minimum classification of 20-B shall be provided at each loading or unloading facility. Where piped water is available, ready-connected hose in size appropriate for the water supply shall be provided at locations where fires are likely to occur.

6-8.2 All plant fire protection facilities shall be adequately maintained and periodically inspected and tested to make sure they are always in satisfactory operating condition, and they will serve their purpose in time of emergency.

6-8.3 Bulk plants and terminals shall have a written emergency procedure plan. The plan shall be designed to minimize the hazard to the public and to plant employees in the event of a fire or other emergency conditions. The plan shall be posted, or located in a strategic and accessible location. Plant personnel assigned to emergency duties shall be trained in these duties.

Chapter 7 Service Stations

7-1 Scope.

7-1.1 This chapter applies to automotive and marine service stations and to service stations located inside buildings. Reference shall also be made to NFPA 302, *Fire Protection Standard for Motor Craft*, for safety precautions while fueling at marine service stations, and to NFPA 303, *Fire Protection Standard for Marinas and Boatyards*, for additional requirements applicable to marine service stations.

7-2 Storage.

7-2.1 General Provisions.

7-2.1.1 Liquids shall be stored in approved closed containers not exceeding 60 gal (227.1 L) capacity, in tanks in special enclosures as described in 7-2.2, in aboveground tanks as provided for in 7-2.1.5, or in tanks located underground as in Section 2-3. Vent pipes on tanks storing gasoline shall be in accordance with 2-3.5.1, 2-3.5.2 and 2-3.5.6, as applicable, and shall discharge only upward in order to disperse vapors. (*Also see 7-8.3.4 and 7-8.3.5.*)

7-2.1.2 Aboveground tanks, located at a bulk plant, shall not be connected by piping to service station underground tanks. Apparatus dispensing Class I liquids into the fuel tanks of motor vehicles of the public shall not be located at a bulk plant unless separated by a fence or similar barrier from the area in which bulk operations are conducted.

7-2.1.3 Class I liquids shall not be stored or handled within a building having a basement or pit into which flammable vapors can travel, unless such area is provided with ventilation which will prevent the accumulation of flammable vapors therein.

7-2.1.4 Accurate daily inventory records shall be maintained and reconciled on all Class I liquid and diesel fuel storage tanks for indication of possible leakage from tanks or piping. The records shall be kept at the premises, available for inspection by the enforcing authority, and shall include, as a minimum, records showing by product, daily reconciliation between sales, use, receipts, and inventory on hand. If there is more than one system consisting of a tank(s) serving separate pump(s) or dispenser(s) for any product, the reconciliation shall be maintained separately for each tank system. API Publication 1621, *Recommended Practice for Bulk Liquid Stock Control at Retail Outlets*, provides information on this subject.*

*Available from American Petroleum Institute, 2101 L St. N.W., Washington, DC 20037.

Chapter 8 Processing Plants

8-1 Scope.

8-1.1 This chapter shall apply to those plants or buildings which contain chemical operations such as oxidation, reduction, halogenation, hydrogenation, alkylation, polymerization, and other chemical processes but shall not apply to chemical plants, refineries or distilleries as defined and covered in Chapter 9, Refineries, Chemical Plants and Distilleries.

8-2 Location.

8-2.1 The location of each processing vessel shall be based upon its liquid capacity. Processing vessels shall be located, with respect to distances to lines of adjoining property which can be built upon, in accordance with Table 8-2.1, except when the processing plant is designed in accordance with 8-2.1.1.

Table 8-2.1

Location of Processing Vessels from Property Lines

Processing Vessels with Emergency Relief Venting to Permit Pressure	Stable Liquids	Unstable Liquids
Not in excess of 2.5 psig (17.2 kPa)	Table 2-6*	2½ times Table 2-6*
Over 2.5 psig (17.2 kPa)	1½ times Table 2-6*	4 times Table 2-6*

*Double distances where protection of exposure is not provided.

8-2.1.1 The distances required in 8-2.1 may be waived when the vessels are housed within a building and the exterior wall facing the line of adjoining property which can be built upon is a blank wall having a fire resistance rating of not less than four hours. When Class IA or unstable liquids are handled, the blank wall shall have explosion resistance in accordance with good engineering practice (*see 8-3.4*).

8-3 Processing Buildings.

8-3.1 Construction.

8-3.1.1 Processing buildings shall be of fire-resistive or noncombustible construction, except heavy timber construction with load-bearing walls may be permitted for plants utilizing only stable Class II or Class III liquids. Except as provided in 8-2.1.1 or in the case of explosion resistant walls used in conjunction with explosion relieving facilities (*see 8-3.4*), load-bearing walls shall be prohibited. Buildings handling Class I or Class II liquids shall be without basements or covered pits. Processing buildings are normally limited in height and area, depending upon the type of construction and private fire protection provided, to minimize the possibility of fire of such extent as to jeopardize public safety. Processing buildings with numerous accessible exterior openings offer favorable features for fire fighting. Provision for smoke and heat venting may be desirable to assist access for fire fighting. NFPA 204, *Guide for Smoke and Heat Venting*, provides information on this subject.

8-3.1.2 Areas shall have adequate exit facilities arranged to prevent occupants from being trapped in the event of fire. Exits shall not be exposed by the drainage facilities described in 8-3.2. NFPA 101, *Life Safety Code*, provides information on this subject.

8-3.2 Drainage.

8-3.2.1 Emergency drainage systems shall be provided to direct flammable or combustible liquid leakage and fire protection water to a safe location. This may require curbs, scuppers, or special drainage systems to control the spread of fire (*see 2-2.3.1*). Appendix A of NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, provides information on this subject.

8-3.2.2 Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separators.

8-3.2.3 The processing plant shall be designed and operated to prevent the normal discharge of flammable or combustible liquids to public waterways, public sewers, or adjoining property.

8-3.3 Ventilation.

8-3.3.1 Enclosed processing buildings handling Class I or Class II liquids shall be ventilated at a rate of not less than 1 cu ft (0.02832 m^3) per minute per sq ft (0.0929 m^2) of solid floor area. This shall be

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Appendix C

This Appendix is not part of the requirements of this NFPA document, but is included for information purposes only.

The following contains additional information and recommendations bearing the same number as the text of the *Flammable and Combustible Liquids Code* to which they apply:

C-4-4 The preferred method of storage of liquids in buildings is in cutoff rooms or in attached buildings rather than in inside rooms because of fire department accessibility and the advantages of providing explosion venting where needed.

C-4-6.2 (a) Sprinkler system densities and areas of application presented in this appendix are based upon limited test data and fire experience. Design criteria in this appendix do not apply to storage in plastic drums. (*See Appendix D for additional information on this subject.*)

(b) For design criteria for specific installations, insurance engineers, fire protection consultants, and other knowledgeable persons should be consulted.

(c) **Palletized and Solid Pile Storage.** For protected storage of liquids, as specified in Table 4-6.1(a), automatic sprinkler protection should be provided in accordance with Table C-4-6.2(a).

(d) **Rack Storage.** In protected storage of liquids arranged, as specified in Table 4-6.1(b), automatic sprinkler protection should be provided in accordance with Tables C-4-6.2(b) and C-4-6.2(c), as applicable, except that racks with solid shelves should be provided with in-rack sprinklers at every tier or level.

C-4-6.2.1 (a) Automatic aqueous film forming foam (AFFF)-water sprinkler systems for container storage of liquids has been shown to be an acceptable method for providing fixed protection. (*See Appendix D for additional information on this subject.*)

(b) For design criteria for specific installations, insurance engineers, fire protection consultants and other knowledgeable persons should be consulted.

(c) Rack storage of liquids in containers [drums of 55 gal (208.1 L) capacity] stored on-end on wood pallets on conventional double-row racks to a maximum height of storage of 25 ft (7.62 m) should be provided protection in accordance with Table C-4-6.2.1.

Table C-4-6.2(a) Automatic Sprinkler Protection for Solid Pile and Palletized Storage of Liquids in Containers and Portable Tanks

Storage Conditions		Ceiling Sprinkler Design and Demand				Minimum Hose Stream Demand (gpm)	Minimum Duration Sprinklers & Hose Streams
			Area (sq ft)				
Class Liquid	Container Size and Arrangement	Density gpm/sq ft	High Temp.	Ord. Temp.	Maximum Spacing		
IA	5 gal. or less, with/without cartons, palletized or solid pile	0.30	3000	5000	100 sq ft	750	2 hrs
	flammable aerosols in cartons, palletized or solid pile	0.30	6000	10,000	100 sq ft	1000	
	containers greater than 5 gal., on end or side, palletized or solid pile	0.60	5000	8060	80 sq ft	750	
IB, IC, & II	5 gal. or less, with/without cartons, palletized or solid pile	0.30	3000	5000	100 sq ft	500	2 hrs
	containers greater than 5 gal., on pallets or solid pile, one high	0.25	5000	8000	100 sq ft		
II	containers greater than 5 gal., on pallets or solid pile, more than one high on end or side	0.60	5000	8000	80 sq ft	750	2 hrs
IB, IC, II	portable tanks, one high	0.30	3000	5000	100 sq ft	500	2 hrs

Table C-4-6.2(a) Continued

Storage Conditions		Ceiling Sprinkler Design and Demand					
Class Liquid	Container Size and Arrangement	Density gpm/ sq ft	Area (sq ft) High Temp.	Area (sq ft) Ord. Temp.	Maximum Spacing	Minimum Hose Stream Demand (gpm)	Minimum Duration Sprinklers & Hose Streams
II	portable tanks, two high	0.60	5000	8000	80 sq ft	750	2 hrs
III	5 gal. or less, with/without cartons, palletized or solid pile	0.25	3000	5000	120 sq ft	500	1 hr
	container greater than 5 gal., on pallets or solid pile, on end or sides, up to three high	0.25	3000	5000	120 sq ft	500	1 hr
	container greater than 5 gal., on pallets or solid pile, on end or sides up to 18 feet high	0.35	3000	5000	100 sq ft	750	2 hrs
	portable tanks, one high	0.25	3000	5000	120 sq ft	500	1 hr
	portable tanks, two high	0.50	3000	5000	80 sq ft	750	2 hrs

Notes: (1) See Table 4-6.1(a) and Section 4-6 for additional information pertaining to protected palletized or solid piling of liquids.

(2) Minimum hose stream demand includes small hand hose (1½ inches) required in 4-7.1.3.

(3) The design area contemplates the use of wet pipe systems. Where dry pipe systems are required, it introduces a possible delay which needs to be compensated for by increased areas of application (plus 30 percent).

SI Units: 1 gal = 3.785 L; 1 sq ft = 0.0929 m²; 1 ft = 0.3048 m.

Table C-4-6.2(b) Automatic Sprinkler Protection Requirements for Rack Storage of Liquids in Containers of Five Gallon Capacity or Less,* in Cartons on Conventional Wood Pallets or Without Cartons but Strapped to Pallets

*Flammable Aerosols Not Included

Ceiling Sprinkler Design & Demand				In-Rack Sprinkler Arrangement and Demand				Minim. Hose Stream Demand (gpm)	Minim. Duration Sprinkler & Hose Stream
Class Liquid	Density gpm/ sq ft	Area (sq ft) High Temp.	Area (sq ft) Ord. Temp.	Max. Spacing	Racks up to 9 ft. (2.7m) deep	Racks over 9 ft. (2.7m) to 12 ft. (3.7m) deep	Minim. Nozzle Pressure	Number of Sprinklers Operating		
I (max. 25' height)	0.40	3000	5000	80 sq ft/bd.	a) ord. temp. sprinklers 8 feet apart horizontally b) one line sprinklers above each level of storage c) locate in longitudinal flue space, staggered vertical d) shields req'd where multilevel	a) ord. temp. sprinklers 8 feet apart horizontally b) two lines sprinklers above each level of storage c) locate in transverse flue spaces, staggered vertical and within 20 in. of aisle d) shields required where multilevel	30 psi.	a) 8 sprinklers if only one level b) 6 sprinklers ea. on two levels if only two levels c) 6 sprinklers ea. on top 3 levels, if 3 or more levels d) hydraulically most remote	750	2 hrs

Table C-4-6.2(b) Continued

Class Liquid	Ceiling Sprinkler Design & Demand				In-Rack Sprinkler Arrangement and Demand				Minim. Hose Stream Demand (gpm)	Minim. Duration Sprinkler & Hose Stream
	Density gpm/sq ft	Area (sq ft) High Temp.	Area (sq ft) Ord. Temp.	Max. Spacing	Racks up to 9 ft. (2.7m) deep	Racks over 9 ft. (2.7m) to 12 ft. (3.7m) deep	Minim. Nozzle Pressure	Number of Sprinklers Operating		
II (max. 25′ height)	0.30	3000	5000	100 sq ft/hd.	a) ord. temp. sprinklers 8 feet apart horizontally b) one line sprinklers betw. levels at nearest 10 foot vertical intervals c) locate in longitudinal flue space, staggered vertical d) shields required where multilevel	a) ord. temp. sprinklers 8 feet apart horizontally b) two lines betw. levels at nearest 10 foot vertical intervals c) locate in transverse flue spaces, staggered vertical and within 20 in. of aisle d) shields required where multilevel	30 psi.	a) hydraulically most remote — 6 sprinklers at each level, up to max. of three levels	750	2 hrs
III max.	0.25	3000	5000	120 sq ft/hd.	Same as Class II	Same as Class II	30 psi.	Same as Class II	500	2 hrs

Notes: (1) See Table 4-6.1(b) and Section 4-6 for additional information pertaining to protected rack storage.
(2) Additional in-rack protection required for solid shelves, as indicated in D-4-6.2(d).
(3) See 4-6.3 for types of racks permitted.
(4) See 4-6.5 for additional information pertaining to in-rack sprinklers.
(5) Minimum hose stream demand includes small hand hose (1½ inches) required in 4-7.1.3.
(6) The design area contemplates the use of wet pipe systems. Where dry pipe systems are required, it introduces a possible delay which needs to be compensated for by increased areas of application (plus 30 percent).

SI Units: 1 gal = 3.785 L; 1 sq ft = 0.0929 m²; 1 ft = 0.3048 m; 1 in. = 25.40 mm.

Table C-4-6.2(c) Automatic Sprinkler Protection for Rack Storage of Liquids in Containers Greater Than 5 Gallon Capacity

(See notes on following page.)

Class Liquid	Ceiling Sprinkler Design & Demand				In-Rack Sprinkler Arrangement and Demand				Minim. Hose Stream Demand (gpm)	Minim. Duration Sprinkler & Hose Stream
	Density gpm/sq ft	Area (sq ft) High Temp.	Area (sq ft) Ord. Temp.	Max. Spacing	On-Side Storage Racks up to 9 ft.	On-End Storage (on pallets) up to 9 ft. deep racks	Minim. Nozzle Pressure	Number of Sprinklers Operating		
IA (max. 25′ height)	0.60	3000	5000	80 sq ft/hd.	a) ord. temp. sprinklers 8 feet apart horizontally b) one line sprinklers above each tier of storage c) locate in longitudinal flue space, staggered vertical d) shields required where multilevel	a) ord. temp. sprinklers 8 feet apart horizontally b) one line sprinklers above each tier of storage c) locate in longitudinal flue space, staggered vertical d) shields required where multilevel	30 psi.	a) hydraulically most remote 6 sprinklers at each level	1000	2 hrs
IB, IC & II (max. 25′ height)	0.60	3000	5000	100 sq ft/hd.	a) see a) above b) one line sprinklers every three tiers of storage c) see c) above d) see d) above	a) see a) above b) see b) above c) see c) above d) see d) above	30 psi.	a) see a) above	750	2 hrs
III (max. 40′ height)	0.25	3000	5000	120 sq ft/hd.	a) see a) above b) one line sprinklers every sixth level (maximum) c) see c) above d) see d) above	a) see a) above b) one line sprinklers every third level (maximum) c) see c) above d) see d) above	15 psi.	a) see a) above	500	1 hr

(See over.)

SI Units: 1 gal = 3.785 L; 1 sq ft = 0.0929 m²; 1 ft = 0.3048 m; 1 in. = 25.40 mm.

Notes to Table C-4-6.2(c)

(1) See Table 4-6.1(b) and C-4-6.2(b) for additional information pertaining to protected rack storage.

(2) Additional in-rack protection required for solid shelves, as indicated in C-4-6.2(d).

(3) See 4-6.3 for types of racks permitted.

(4) See 4-6.5 for additional information pertaining to in-rack sprinklers.

(5) Minimum hose stream demand includes small hand hose (1½ in.) required in 4-7.1.3.

(6) The design area contemplates the use of wet pipe systems. Where dry pipe systems are required, it introduces a possible delay which needs to be compensated for by increased areas of application (plus 30 percent).

Table C-4-6.2.1 Automatic AFFF-Water Protection (1) Requirements for Rack Storage of Liquids* in Containers

*Flammable Aerosols Not Included

Class Liquid	Ceiling Sprinklers Design & Demand			In-Rack Sprinkler Arrangement and Demand (4)			Hose Stream Demand (3)	Duration AFFF Supply	Duration Water Supply
	Density gpm/sq ft	Area (sq ft) High Temp.	Area (sq ft) Ord. Temp.	On-End Storage, of drums (on pallets) up to 25 ft	Minimum Nozzle Pressure	Number of Sprinklers Operating			
IA, IB, IC, II	0.30	1500	2550	a) ord. temp. sprinkler up to 10 feet apart horizontally b) one line sprinklers above each level of storage c) locate in longitudinal flue space, staggered vertically d) Shields required for multilevel	30 psi.	3 sprinklers per level	500	15 min	2 hrs

Notes: (1) System shall be a closed head wet system with approved devices for proportioning AFFF.

(2) Except as modified herein, in-rack sprinklers shall be installed in accordance with *Rack Storage of Materials*, NFPA 231C.

(3) Hose stream demand includes inside hand hose (1½ inches) required in 4-7.1.3.

(4) Maximum height of storage should be limited to 25 feet.

SI Units: 1 gal = 3.785 L; 1 sq ft = 0.0929 m²; 1 ft = 0.3048 m; 1 in. = 25.40 mm.

(2)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the matter of CAROLINA POWER & LIGHT CO. Et al.) Docket 50-400
Shearon Harris Nuclear Power Plant, Unit 1) O.L.

DOCKETED USNRC

CERTIFICATEOF SERVICE

I hereby certify that copies of WE Notice of Documents Relied Upon and Previously Served. As Testimony-in-Chief and case-in-chief on Joint Contention I and Eddleman 65, and of Proposed W.E. Exhibits on Contention 116 and of Interrogatories to Staff & FEMA & to Applicants/NC Emergency Planners and E-41 Exhibits† HAVE been served this 9 day of August 1984, by deposit in the US Mail, first-class postage prepaid, upon all parties whose names are listed below, except those whose names are marked with an asterisk, for whom service was accomplished by _____

†Due to copy center problems, Judge Kelley orally approved filing as much of this as I can tonight (8-09) + the rest tomorrow. I had discussed this w/ Applicants' attorney Baxter before contacting Judge Kelley.

Judges James Kelley, Glenn Bright and James Carpenter (1 copy each)
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