

NFPA 803

Standard for Fire Protection for Light Water Nuclear Power Plants

1998 Edition



National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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NFPA 803
Standard for
Fire Protection for Light Water Nuclear Power Plants
1998 Edition

This edition of NFPA 803, *Standard for Fire Protection for Light Water Nuclear Power Plants*, was prepared by the Technical Committee on Fire Protection for Nuclear Facilities and acted on by the National Fire Protection Association, Inc., at its Fall Meeting held November 17–19, 1997, in Kansas City, MO. It was issued by the Standards Council on January 16, 1998, with an effective date of February 6, 1998, and supersedes all previous editions.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

This edition of NFPA 803 was approved as an American National Standard on February 6, 1998.

Origin and Development of NFPA 803

The Committee on Atomic Energy was organized in 1953 for the purpose of providing guidance on practices necessary for fire safety in facilities handling radioactive materials. A *Recommended Fire Protection Practice for Nuclear Reactors*, NFPA 802, was developed and officially adopted in 1960. Following a serious fire in 1975 at the Brown's Ferry Plant of the TVA, the Nuclear Regulatory Commission expressed the need for a fire protection standard specifically covering nuclear power plants. The committee started work on the preparation of this document early in 1976, and its efforts resulted in the first edition, which was issued in 1978.

Changes in the 1983 edition included a more precise title for the document as well as a complete revision of the chapter on fire alarm systems. The 1988 edition brought the standard into conformance with the NFPA *Manual of Style* and included several editorial changes to better explain various sections. The 1993 edition incorporated a variety of changes into the document.

The 1998 edition includes a new section on the equivalency concept. A new section on inspection, testing, and maintenance of fire protection systems that introduces the concept of a performance-based option has also been added.

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Committee Scope: This Committee shall have primary responsibility for documents on the safeguarding of life and property from fires in which radiation or other effects of nuclear energy might be a factor.

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Appendix A.

Information on referenced publications can be found in Chapter 18 and Appendix B.

Chapter 1 Introduction

1-1* Scope. This standard covers the protection of light water nuclear power plants from the consequences of fire, including safety to life of on-site personnel, protection of property, and continuity of production. Nuclear safety is provided for in other documents such as the regulations published by the Nuclear Regulatory Commission (NRC).

1-2 Purpose. This standard is prepared for the use and guidance of those charged with the design, construction, operation, and protection of light water nuclear power plants. This standard covers those requirements essential to ensure that the consequences of fire will have minimum impact on the safety of construction and operating personnel, the physical integrity of plant components, and the continuity of plant operations. Additional emphasis is on requirements dictated by the need to protect the lives of constructors and operators from the consequences of fire and to conform to the best fire protection engineering practices.

1-3 Equivalency Concepts.

1-3.1 Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety as alternatives to those prescribed by this standard, provided that technical documentation is submitted to the authority having jurisdiction to demonstrate equivalency, and the system, method, or device is approved for the intended purpose.

1-3.2 The specific requirements of this standard shall be permitted to be modified by the authority having jurisdiction to allow alternative arrangements that will secure as nearly as practical the level of fire protection intended by this document, but in no case shall the modification afford less fire protection than that which, in the judgment of the authority having jurisdiction, would be provided by compliance with the corresponding provisions contained in this standard.

1-3.3 Alternative fire protection methods accepted by the authority having jurisdiction shall be considered as conforming with this standard.

1-4 Definitions.

Approved.* Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Combustible. Any material that, in the form in which it is used and under the conditions anticipated, will ignite and burn.

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

Fire Area. That portion of a building or plant that is separated from other areas by fire barriers.

Fire Barrier. Those components of construction (walls, floors, or floor/ceiling assemblies and their supports, including beams, joists, columns, penetration seals or closures, fire doors, and fire dampers) that are rated by approval laboratories in hours of resistance to fire and are used to prevent the spread of fire.

Fire Brigade. As used in this standard, refers to those persons trained in plant fire-fighting operations.

Fire Door. A door assembly rated in accordance with NFPA 252, *Standard Methods of Fire Tests of Door Assemblies*, and installed in accordance with NFPA 80, *Standard for Fire Doors and Fire Windows*.

Fire Loading. The amount of combustibles present in a given situation, expressed in Btu per square foot.

Fire Prevention. Measures directed towards avoiding the inception of fire.

Fire Protection. Methods of providing for fire control or fire extinguishment.

Fire Protection Manager. The person directly responsible for the fire prevention and fire protection program at the plant.

Fire-Rated Penetration. An opening in a fire barrier for the passage of pipe, cable, duct, and so forth, that has been sealed so as not to reduce the integrity of the fire barrier.

Fire Resistance Rating. The time, in minutes or hours, that materials or assemblies have withstood a fire exposure as established in accordance with the test procedures of NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*.

Fire Zone. Subdivisions of fire areas in which fire detection and/or suppression systems provide alarm information indicating the location of fire at a central fire control center.

Flame Spread Rating. A relative measurement of the surface burning characteristics of building materials when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

Flammable Liquid. Any liquid having a flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psi (276 kPa) absolute pressure at 100°F (37.8°C).

Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is 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.

Limited Combustible.* A building construction material that, in the form in which it is used, has a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg) and either has a structural base of noncombustible material with a surfacing not exceeding a thickness of 1/8 in. (3.2 mm) that has a flame spread rating not greater than 50, or other material having neither a flame spread rating greater than 25 nor evidence of continued progressive combustion, even on surfaces exposed by cutting through the material on any plane.

Listed.* Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

Noncombustible Material. A material that, in the form in which it is used and under the conditions anticipated, will not ignite, support combustion, burn, or release flammable vapors when subjected to fire or heat. Materials reported as noncombustible, when tested in accordance with ASTM E 136, *Test for Behavior of Materials in a Vertical Tube Furnace at 750°C*, shall be considered noncombustible materials.

Shall. Indicates a mandatory requirement.

Should. Indicates a recommendation or that which is advised but not required.

Standard. A document, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

1-5 Introduction and Special Problems Relating to the Protection of Light Water Nuclear Electric Generating Stations.

1-5.1 General Introduction. Fire protection is both an art and a science. Perfection and practice in this art is the objective, with fire prevention being the ultimate goal. Fire prevention in the absolute sense is only possible where there is no combustible material to fuel a fire. The presence of combustible material creates a fire potential, no matter how slight. As a first priority, fire prevention must regard, the presence of any combustible material as a variable.

The total elimination of combustible material is seldom possible; therefore, fire protection requires additional measures to limit the consequences of fire.

A defense-in-depth philosophy of fire prevention, control, and extinguishment shall be adopted and implemented to minimize and mitigate the effects of fire and reduce hazards to personnel and property damage to acceptable minimums.

A well-balanced fire protection program includes prevention, detection, extinguishment of fires, safety to life, and preservation of property. The protection of the environment and of the public against nuclear hazards takes priority over that of the plant itself and is addressed by the appropriate regulatory agencies. However, the size of nuclear power plants makes the economic impact of a forced outage such that protection measures must be extended to include provisions to ensure their continued operation.

1-5.2 Special Considerations in Fire Protection Encountered at Light Water Nuclear Power Plants. Consideration of the need for nuclear safety results in several areas of fire protection emphasis unique to the nuclear electric generating station (see Appendix C). For example,

- (a) Reactor shutdown systems
- (b) Cooling system integrity
- (c) Filtering system integrity
- (d) Ventilating system integrity

1-5.3 Defense-in-Depth.

1-5.3.1 Light water nuclear power plants use the concept of defense-in-depth to achieve the high degree of safety required in the nuclear safety systems of the plant. This concept shall be extended to fire protection for the remaining areas of the plant.

1-5.3.2* With respect to the fire protection program, the defense-in-depth principle is aimed at achieving an adequate balance in the following:

- (a) Preventing fires from starting
- (b) Detecting fires quickly and suppressing those fires that occur, thereby limiting damage
- (c) Designing the plant to limit the consequences of fire

1-5.4 Fire Protection Management Program. The fire protection program for a nuclear power plant shall cover design features, personnel, procedures, plans, and equipment. Senior management participation in this program shall begin with early design concepts and plant layout and continue through plant operation. In order to effectively develop and conduct this program, a fire protection manager shall be appointed at the conceptual stage of the project. The manager shall be selected on the basis of education, experience, and advancement as an industrial fire protection engineer. The manager shall establish liaison with all internal departments, with all authorities having jurisdiction, and with the public fire department.

1-5.5 Inspection, Testing, and Maintenance of Fire Protection Systems.

1-5.5.1 Fire Protection Systems. Fire protection systems designed and installed in accordance with Chapters 9, 10, 11, 12, and 13 shall be considered as meeting the objectives of this standard.

1-5.5.2 Equivalency. Nothing in this chapter is intended to prevent the use of calculation methods, test methods, systems, methods, or devices of superior strength, fire resistance, effectiveness, durability, and safety as alternatives to those required by this standard, provided that technical documentation is submitted to the authority having jurisdiction to demonstrate equivalency, and the system, method, or device is approved for the intended purpose.

1-5.5.3 Prescriptive-Based Option. Fire protection systems designed and installed in accordance with Chapters 9, 10, 11, 12, and 13 shall be inspected, tested, and maintained in accordance with the referenced publications in Chapter 18.

1-5.5.4 Performance-Based Option. Fire protection systems designed and installed in accordance with Chapters 9, 10, 11, 12, and 13 shall be permitted to be inspected, tested, and maintained based on a performance-based program accepted by the authority having jurisdiction.

1-5.5.5 Performance-Based Program. Performance-based programs for fire protection system inspection, testing, and maintenance shall be approved by the authority having jurisdiction. Technical justification for inspection, testing, and maintenance intervals shall be provided. The performance goal for operability is to provide reasonable assurance that the fire protection system or feature will perform its intended function on demand. This shall include historical data acceptable to the authority having jurisdiction. Plant-specific failure rate data shall be reviewed on a case-by-case basis to determine whether extensions are warranted.

1-6 Units of Measurement. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). The liter, which is a unit outside of but recognized by SI, is commonly used in international fire protection. If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated is to be regarded as the requirement. A given equivalent value can be approximate.

Chapter 2 Functional Subdivisions of the Plant Layout

2-1* General. Safety to the lives of on-site personnel, protection of property, and continuity of power production as affected by the possibility of fires shall be given appropriate consideration in the general arrangement of the nuclear power plant. For the purposes of fire hazard analysis, the plant component facilities shall be divided into primary facilities, secondary facilities, and support facilities as follows (see Figure 2-1).

(a) Typical Primary Facilities

Reactor Building. Houses the reactor within a containment structure and its integral or freestanding shield.

Reactor Auxiliary Building. Contains reactor auxiliary and emergency core cooling system (ECCS) equipment.

Control Building. Houses the main and auxiliary control panels, emergency switchgear, and batteries.

Turbine Building. Houses the turbine generator and turbine generator auxiliaries.

Steam Generator Building. Houses the steam generator.

Intake Pumping Station. Houses the condenser circulating water makeup pumps, the raw service water and fire protection pumps, and all necessary valves and strainers for these systems.

Electrical Switchyard. Encompasses the electrical transmission system coming into the site and leaving the site.

Emergency Power Generation Facility. Provides on-site emergency power in the event of an off-site power failure.

Emergency Service Water Pumping Station. Houses the emergency service water pumps and all necessary valves, strainers, and electrical switchgear for these systems.

Condenser Circulating Water Pumping Station. Houses the condenser circulating water pumps, pump isolation valves, pump suction and discharge conduits, and associated electrical equipment.

Electrical Control and Communications Building. Houses the switchyard relays and terminal communications equipment and can act as a control center for the switchyard up until the time the main control room becomes operational.

Main Heat Rejection System. Includes cooling towers and facilities associated with spray ponds and canals.

Station Transformers. Provide auxiliary power to the plant or transmit power from the plant.

(b) Typical Secondary Facilities

Fuel Building. Inclusion of primary equipment in this building would require upgrading of the affected portions of the building to primary facility status.

Radwaste Building. Houses the equipment for processing radioactive waste from the plant.

Makeup Water Treatment Plant. Produces high-purity water before use in the reactor or its support systems.

Condenser Circulating Water Treatment Building. Houses the plant and condenser circulating water biocide treatment system.

Demineralizer Regeneration Building. Contains facilities for regeneration and cleaning of resins from the plant condensate polishing system.

(c) Typical Support Facilities

Office Building. Houses the offices for the plant's administrative employees and contains plant records.

Service Building. Encompasses the guard house, main gate, and office space for the plant's security force.

Auxiliary Boiler Building. Contains boilers for providing heating steam and steam to operate plant auxiliary equipment during the time that the nuclear steam supply is not available.

2-2 Reactor, Fuel, and Auxiliary Life Safety. For these three types of facilities, safety to the lives of on-site construction and operating personnel and loss of property shall be given consideration as specified in Chapter 17 and elsewhere in this standard.

2-3 Cost Benefit. For primary and secondary facilities, the cost of lost revenue and replacement power in addition to property loss shall be factored into the fire hazard analysis for determining the cost/benefit ratio for selecting the appropriate fire protection systems.

2-4* Fire Hazard Analysis. A fire hazard analysis shall be developed that will define the fire hazards that can exist and describe the loss-limiting criteria to be used in the design of the facility. The fire hazard analysis shall take into consideration the basic data of the plant, such as the functional subdivision of the facility, the controlled zones that have limited access, and the general plant layout of equipment or systems to develop the fire zone and the ratings of fire barriers.

Chapter 3 Inventory of Flammable and Combustible Materials

3-1 Combustible Materials. Combustible materials in both large and small concentrations will be present in nuclear power plants, as in most other industrial plants, and it shall be assumed that outbreaks of fire occur for a variety of reasons.

3-2 Fire Loading. For the purpose of assessing the fire loading, an inventory of all flammable and combustible materials shall be made for each fire area. This inventory shall identify the location, type, quantity, and form of the materials. The materials shall be classified as follows:

(a) *Flammable and Combustible Materials.* Typical examples of flammable and combustible materials found in a nuclear power plant are as follows:

1. Conventional fuels for emergency power units, auxiliary boilers, and so forth
2. Lubricants and hydraulic oil
3. Insulating materials (thermal and electric)