FIRE PROTECTION PROGRAM RESOURCES

Alternate Fire Protection Rule

NFPA 805, Performance-Based Standard for Fire Protection for Light-Water Reactor Electric Generating Plants

http://www.nrc.gov/reactors/operating/ops-experience/fire-protection/protection-rule.html

NRC Regulatory Guide 1.189

Fire Protection for Nuclear Power Plants

http://pbadupws.nrc.gov/docs/ML0925/ML092580550.pdf

Plant Exemption Requests

10 CFR 50.12

http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-0012.html

Separation and Fire Walls

NUREG-1552, Fire Barrier Penetration Seals in Nuclear Power Plants

http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1552/

Fire Wrapped Cabling

NUREG-1924, Electrical Raceway Fire Barrier Systems in U.S. Nuclear Power Plants

http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1924/

National Fire Protection Association

www.nfpa.org

Underwriters Laboratory

www.ul.com

YouTube

NRC Fire Protection Program at Nuclear Power Plants

http://youtu.be/MuRwxP3Sq5A

NUREG/BR-0522
August 2014

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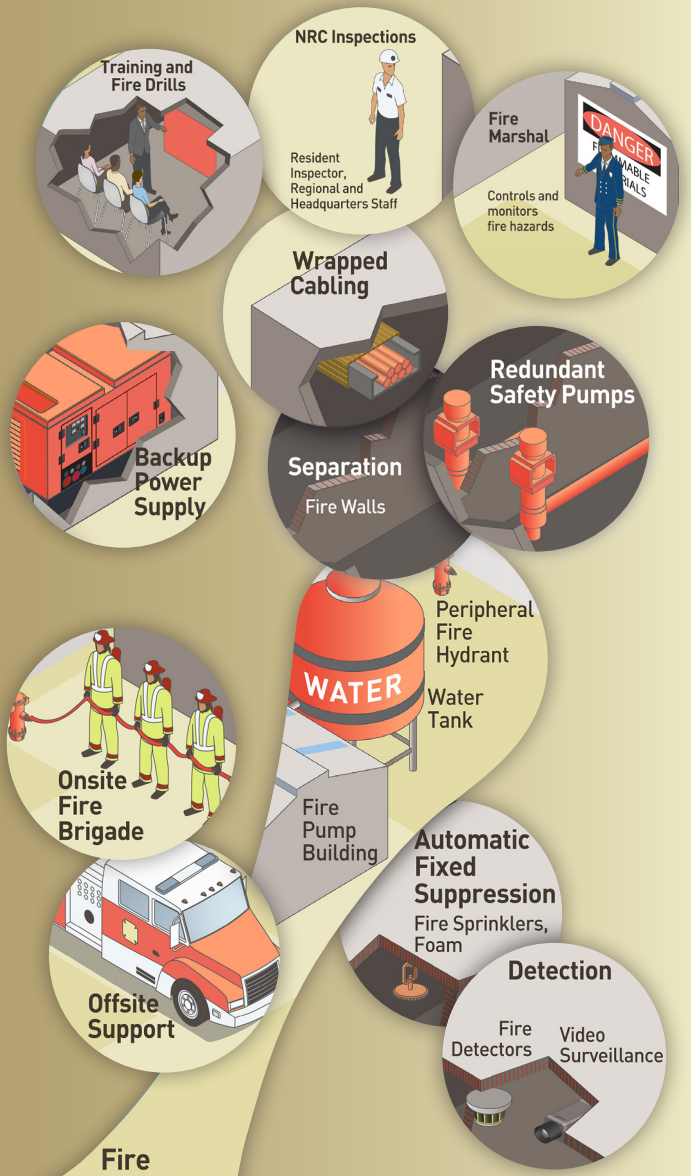
United States Nuclear Regulatory Commission
Protecting People and the Environment

Fire Protection Program for Operating Reactors



OVERVIEW

The U.S. Nuclear Regulatory Commission (NRC) requires every U.S. nuclear power plant to reduce the chances of a fire and be able to safely handle the consequences of any fires that might occur. Each plant owner, or licensee, must maintain a robust fire protection program and ensure the reactor can shut down safely in the event of a fire. The NRC uses operational experience and information about fires in making regulatory decisions about U.S. commercial nuclear power plants. Only the March 1975 fire at the Browns Ferry plant near Decatur, AL., has affected the safe operation of a U.S. reactor. Even in that case, plant personnel were able to safely shut down the Browns Ferry reactors.

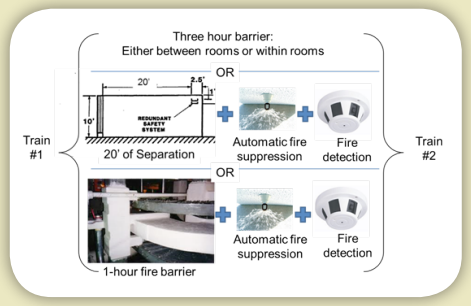
DETERMINISTIC FIRE PROTECTION

The 1975 fire at one of the Browns Ferry reactors in Alabama prompted the NRC to establish deterministic fire protection requirements. Since that time, U.S. plants have always shut down safely following a fire. Every plant's fire protection plan must meet NRC requirements to outline the overall fire protection program and installed fire protection systems, as well as the means to ensure safe reactor shutdown in the event of a fire.

The NRC's requirements assume a serious fire in establishing generic criteria for all plants. For some operating or proposed plants the generic approach was impractical, or the plant demonstrated a better approach to achieving the same level of safety. In these cases, the NRC reviewed and approved plant-specific exemptions and amendments.

For example, plants must ensure one of several sets of safe shutdown systems will remain free of fire damage. The regulation prescribes that the safe shutdown equipment sets will:

1. **Be separated by a barrier that protects one set from fire for 3 hours; or**
2. **Be at least 20 feet apart and have automatic fire suppression and detection systems; or**
3. **Be separated by a barrier that protects one set from fire for an hour and have automatic fire suppression detection systems.**



In some cases, equipment sets had to be less than 20 feet apart, but the plant could still meet the overall goal of keeping one set free of fire damage. In these cases, the licensee applied for and in many cases were granted an exemption by the NRC.

The NRC's regulations allow plants to request exemptions if the plants can show specific special circumstances. The NRC only grants exemptions if they do not present an undue risk to health and safety and if other relevant requirements are met. A plant operating with an approved exemption and other regulatory requirements complies with the NRC's regulations.

RISK-INFORMED, PERFORMANCE-BASED FIRE PROTECTION

In 2004, the NRC modified its fire protection regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) 50.48, "Fire Protection," to give U.S. reactors the choice of using an updated, scientifically sound way of reducing fire risks. Plants can adopt National Fire Protection Association Standard 805 (NFPA 805) in place of their existing fire protection approach.

NFPA 805 uses computer models of fire progression and other ways of quantifying fire risk. This approach focuses fire protection resources where they're most needed. The standard establishes a fundamental fire protection program, as well as requirements for fire protection systems and features, including prevention, fire detection and suppression, and safe shutdown. This effort is part of how the NRC enhances safety by incorporating risk information into regulations and oversight. The risk-informed approach relies on a required outcome rather than requiring a specific process or technique to achieve that outcome.

DEFENSE-IN-DEPTH

The NRC's approach to fire protection includes the multi-layered concept of defense-in-depth to keep the public safe from the effects of fires at nuclear power plants. A proper defense-in-depth fire protection program will:

- **Prevent fires from starting;**
- **Rapidly detect, control, and extinguish promptly those fires that do occur;**
- **Protect the reactor's ability to safely shut down if a fire is not promptly extinguished.**

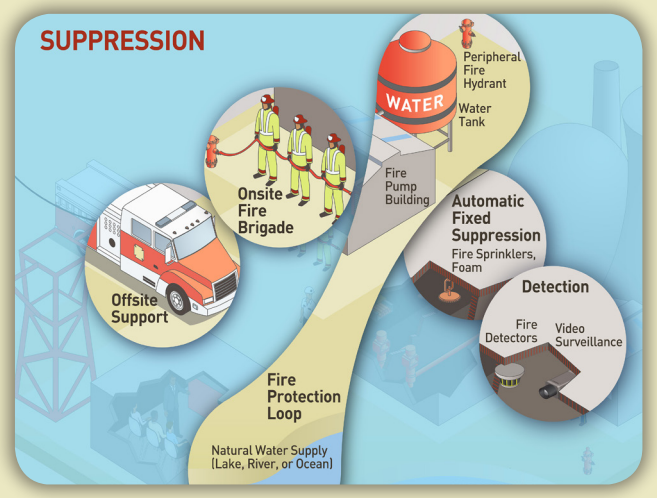
The NRC's requirements incorporate the work of experts such as the National Fire Protection Association and Underwriters Laboratory.

Prevention: Keeping combustibles and potential fire starters out of the plant as much as possible to reduce the chances of a fire. Prevention features and activities involve:

- ***Fire Marshal***—Nuclear power plant staff monitor fire hazards such as the storage of combustibles, and control ignition sources such as metal cutting and welding.

- ***NRC Inspections***—The NRC's resident inspectors monitor daily plant activities and perform specific fire safety inspections every 3 months, plus an additional yearly inspection. Inspectors from the NRC's regional offices inspect a plant's fire protection approach in depth every 3 years. Engineers and technical staff from NRC headquarters review plant changes to ensure that fire safety is acceptably maintained. Headquarters staff also support the resident and regional inspectors.
- ***Training and Fire Drills***—Nuclear power plants train their staff on fire safety, including regular drills on responding to possible fires. Plants also map out the types of fire hazards at the plant and the location of firefighting equipment in the event of a fire.

Suppression: Detecting and extinguishing fires that are not prevented. Suppression involves:



- ***Automatic Fixed Fire Sprinklers, Foam***—Plants' installed firefighting systems operate automatically to control and extinguish plant fires. These general area protection systems are usually fire sprinklers. Special hazards such as oils can require foam-based systems.
- ***Detection***

  Fire Detectors—Plant fire detectors, including some very high-sensitivity systems, identify fires before significant plant damage occurs. The detectors alert a constantly staffed location, which investigates the alarm and calls the onsite fire brigade to respond.

  Video Surveillance—Plants may temporarily rely on constantly monitored video surveillance to detect fires in high-radiation areas.
- ***Fire Protection Loop***

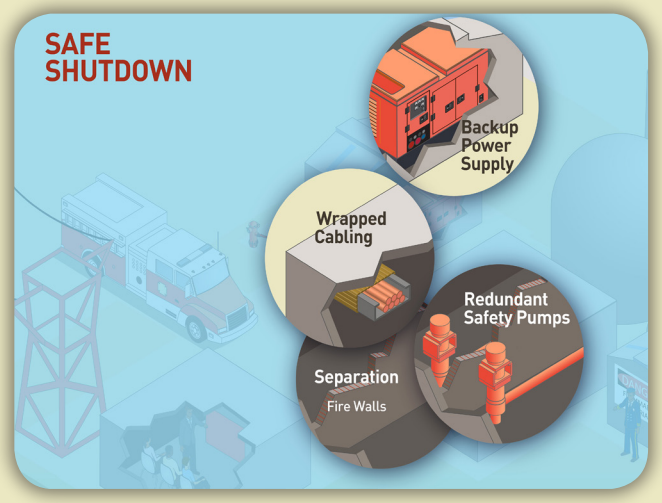
  Fire Pump Building—Nuclear power plants have several pumps whose only purpose is providing firefighting water throughout the plant. These pumps can provide up to thousands of gallons of water per minute.

  Natural Water Supply (Lake, River, or Ocean)—Some nuclear plants use the essentially unlimited water supply of nearby lakes, rivers, or the ocean for their firefighting systems. Plants use filters and other precautions to ensure that the water from natural supplies does not damage fire protection systems through corrosion or due to obstructions.

  Peripheral Fire Hydrant—The plant fire pumps and water supplies also feed fire hydrants located strategically around the plant. Plant fire brigades and offsite fire departments use these hydrants to supply water to extinguish fires outside of the plant.

  Water Tank—Many plants dedicate large water tanks (hundreds of thousands of gallons) to firefighting.
- ***Offsite Support***—Nuclear operators have agreements with nearby fire departments to support firefighting operations if needed.
- ***Onsite Fire Brigade***—Each nuclear plant's fire brigade (or department) has staff trained and equipped for firefighting. These firefighters' training includes understanding the plant layout and hazards located in and around the plant site.

Safe Shutdown: Using installed equipment and procedures that reasonably ensure the reactor can shut down safely if a plant fire is not prevented or rapidly suppressed. Safe shutdown features include:



- ***Backup Power Supply***—If the plant loses power from the transmission grid, reliable alternative power sources such as diesel generators power equipment to safely shut down the plant. Plants also have diesel-powered fire pumps to supply firefighting water.
- ***Redundant Safety Pumps***—Multiple sets of different pumps can provide cooling water to keep the nuclear fuel safe. Fire protection programs separate these pump sets to keep them from being damaged by a single fire.
- ***Separation and Fire Walls***—Fire walls separate sets of safety equipment, including pumps, into areas that would be impacted by a single fire. The walls are typically concrete or concrete block with fire-resistant sealant protecting the openings for pipes and cables.
- ***Wrapped Cabling***—Fire-resistant material protects cables for redundant safe-shutdown components located in one fire area. This material will have been tested to last 1 to 3 hours, depending on the application.

The NRC's Fire Protection Regulations, Inspections, And Research Activities Focus On:

Prevention	**Suppression**	**Safe Shutdown**
Minimizing the potential for fires and explosions	Rapidly detecting, controlling, and extinguishing fires that do occur	Ensuring operators can shut down the reactor safely despite a fire

The NRC requires every U.S. nuclear power plant to have a robust fire protection program to ensure the reactors are safe from plant fires. Plants can manage their fire safety with either a deterministic or a risk-informed, performance-based approach. Both methods use the "defense in depth" concept to meet fire protection objectives.