

Fire poses one of the greatest risks to nuclear power plant safety. The Nuclear Regulatory Commission (NRC) estimates that reactor meltdown risk from fire is about 50%, which is roughly equal to all other potential causes combined. Since 1995, there have been over 150 fires at nuclear power plants. Though the NRC cites many of these incidents as non-critical, some—like the recent electrical fires at plants in Arizona and Washington—can disable reactor cooling systems and increase the risk of a core meltdown.

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Nuclear power plant safety relies on redundancy and defense-in-depth: when a pump fails, a backup pump takes over; if a pipe breaks, an independent pipe is available.

Fires can compromise nuclear safety by disabling the power and/or control cables for emergency components and their backups. The NRC has extensive fire protection standards in place intended to prevent a fire from disabling the array of emergency equipment, but has been complacent about plant non-compliance for decades. This lack of oversight and regulatory enforcement on the part of the NRC put workers at risk from a fire, and the public at risk from the possible release of radiation.

Background

On March 22, 1975, a worker used a candle to hunt for air leaks in the electrical control room at the Browns Ferry plant in Alabama. The polyurethane foam seal that insulated the electric cable wall penetrations caught fire and spread to the adjacent reactor building. Before the flames could be smothered, the fire seared through roughly 1,600 electrical cables, 628 of which were crucial for plant safety mechanisms.¹ The fire blazed for seven hours and damaged control systems and instrumentation cables, and impaired reactor core cooling systems. With no pumps to cool the reactor, water in Unit 1 boiled off and dropped nearly 13 feet, leaving only four feet to cover the reactor core. Only thanks to emergency repairs and 15 hours of manual actions were plant operators able to stabilize the cooling systems and prevent a core meltdown.

Revision of Fire Protection Standards

Though most plants, the Browns Ferry reactors included, have redundant electrical systems to provide the main system with backup in the case of an accident, the 1975 Browns Ferry disaster showed that a single fire could take out both systems. The NRC revised its fire protection regulations in 1980 and, among other things, required plants to separate primary cables and backup cables by 20 feet. If this was not possible, the regulations allowed for secondary actions such as fire barriers or fire suppression systems (water sprinklers or carbon dioxide discharges.)

Non-Compliance

Since many plants were built before the revised fire protection regulations were published, industry balked at the cost of retrofitting these plants to meet NRC standards. Just two years after the revised regulations were published, the NRC found that fire protection requirements were not being met, but did nothing other than collect evidence of non-compliance. Fire hazard violations persisted at many plants and included unprotected electrical equipment, inadequate fire doors and barriers, and missing alarms and sprinklers. Some plants did take steps to install fire protection but,

unfortunately the materials were often found to be defective. Many companies side stepped the process of retrofitting their facilities by compensating safety equipment with manual actions. Though the NRC does allow for manual actions to be included in a plant's fire protection plan, these actions must be approved by the commission.

Many of these unapproved "operator manual actions" put workers at extreme risk requiring, at times, for workers to pass through burning rooms to manually shut down systems. In 2001, NRC inspections found that many plants were using an "extreme interpretation" of the rules, some relying on more than 100 operator manual actions for hot shutdown.ⁱⁱ

Re-Revision of standards

In an attempt to confront industry's non-compliance with fire protection regulations, the NRC issued a new fire protection program in 2004. Under the National Fire Protection Association (NFPA) 805 option, nuclear power plants could develop fire protection plans based on individual risk analysis by plant engineers. While the plan, in theory, would allow companies to determine the extent of protection needed in specific plant areas, these predictions are based on imperfect mathematical models that are still maturing. This tailored approach to fire protection gives the plants flexibility in implementation, and makes NRC regulations much more difficult to enforce.

There are currently 47 U.S. nuclear reactors that are not in compliance with NRC fire regulations.

The owners of 51 reactors have informed the NRC of their intent to transition to compliance with the NFPA 805 option. These owners are implicitly conceding that their facilities are not in compliance with the 1980 regulations; it would otherwise be an unwise business decision to spend millions of dollars to switch from complying with the 1980 regulations to complying with the 2004 regulations. Through October 2011, the NRC determined that 4 reactors have transitioned to NFPA 805, leaving 47 other reactors not in compliance with the 1980 regulations and not yet in compliance with the 2004 regulations.

State of Fire Protection today

Despite these alternative regulations, plants continue to operate in non-compliance with fire protection standards. For example, rather than conforming to regulations about fire detection and suppression systems, many plants continue to employ "temporary" manual actions such as fire watches. Reliance on these compensatory measures allows for a great degree of human error, and thus a puts the safety of the workers and surrounding populations at higher risk.

The NRC has knowledge of many cases of non-compliance at plants, but has opted to grant enforcement extensions rather than issue violation notices. Since the NRC has no centralized database of non-compliance citations, follow up and subsequent enforcement seems unlikely.

The NRC recently extended the deadline for compliance with the NFPA 805 option until 2016.

UCS recommendations:

The NRC should **enforce its fire protection regulations** and compel the owners of more than forty reactors to comply with regulations they currently violate. The NRC should amend its current 2016 compliance policy, and issue an order for compliance within the next one or two years.

ⁱ The Nuclear Regulatory Commission, [Fact Sheet on Fire Protection for Nuclear Power Plants](#), 2011.

ⁱⁱ The Nuclear Regulatory Commission, [NRC Fire Protection Training Materials](#), 2001.

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