Information Notice No. 94-12: Insights Gained From Resolving Generic Issue 57: Effects of Fire Protection System Actuation on Safety-Related Equipment

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

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NRC INFORMATION NOTICE 94-12: INSIGHTS GAINED FROM RESOLVING GENERIC ISSUE 57: EFFECTS OF FIRE PROTECTION SYSTEM ACTUATION ON SAFETY-RELATED EQUIPMENT

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the insights the NRC staff gained from resolving Generic Issue (GI) 57, "Effects of Fire Protection System Actuation on Safety-Related Equipment." It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

The resolution of GI-57 involved gaining a detailed understanding of the potential safety significance of fire protection system intended and inadvertent actuations at U.S. commercial nuclear power plants. During the resolution process, the NRC staff reviewed operational experiences involving fire protection system actuations and developed a methodology for quantifying the effects of such actuations on safety-related equipment. The staff applied this methodology to one boiling-water reactor (BWR) and three pressurized-water reactors (PWRs). In doing this, the staff conducted extensive plant walkdowns and detailed reviews of plant documentation. Building on the insights gained from the analysis of these four plants, the staff also performed a generic risk assessment.

Discussion

The insights presented in this information notice stem from the experience base developed from the detailed study of four operating light-water reactor designs (References 1 - 4), as well as from a generic risk assessment developed in Reference 5 which is summarized in the regulatory analysis for resolving this issue (Reference 6). Attachment 1 summarizes the more significant insights developed during the study. Attachment 2 lists the references.

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The risk reduction estimates, cost/benefit analyses, and other insights gained from resolving GI-57 show that consideration of the matters contained in this information notice (details are given in Reference 6) can reduce risk due to fire protection system actuations. However, in view of the observed large differences in plant-specific characteristics associated with the effects of such actuations, plant-specific analyses would be required to identify risk reductions. Plant-specific analyses of the type needed for this purpose are being carried out as part of the Individual Plant Examination of External Events (IPEEE) program, recommended by Generic Letter 88-20, Supplement 4, issued June 28, 1991.

Related Generic Communications

Information Notice 83-41, "Actuation of Fire Suppression System Causing Inoperability of Safety-Related Equipment"

Information Notice 85-85, "Systems Interaction Event Resulting in Reactor

System Safety Relief Valve Opening Following a Fire-Protection Deluge System Malfunction"

Information Notice 86-106, Supplement 2, "Feedwater Line Break"

Information Notice 87-14, "Actuation of Fire Suppression System Causing Inoperability of Safety-Related Ventilation Equipment"

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

/s/'d by BKGrimes

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Attachments:
1. Summary of the Most Significant Insights Concerning the Effects of Fire Protection System Actuation on Safety-Related Systems
2. References
3. List of Recently Issued NRC Information Notices.

SUMMARY OF THE MOST SIGNIFICANT INSIGHTS CONCERNING THE EFFECTS OF FIRE PROTECTION SYSTEM ACTUATION ON SAFETY-RELATED SYSTEMS

The six most significant insights gained by the NRC staff during the study of the effects of fire protection system (FPS) actuation on safety-related equipment are:

1. Mercury Relays

   a. Mercury relays were present in the fire protection control systems for a diesel generator (DG) room. These relays are susceptible to seismic actuation. If present in common with any of the following features (identified on other plants), the potential for station blackout during a seismic event is increased:

      1) Water deluge-type FPSs in the DG rooms with nozzles aimed at the DG control panel, diesel air intake, or generator cooling air intake.

      2) Fire protection control systems that lock out the diesel generators and/or isolate the diesel generator rooms' cooling when the FPS is actuated in the DG rooms.

      3) A CO_2 FPS in a DG room where the DG control system is designed to shut down the engine due to presence of high CO_2 or low oxygen in the engine air intake.

   b. Mercury relays were present in an auxiliary FPS control circuit designed to isolate cooling in a high-pressure coolant injection (HPCI) pump room. This design could result in the loss of the HPCI pump as the room overheats following a seismic event.

   c. Mercury relays were present in the actuation circuits for a control room Halon FPS. An inadvertent release of Halon could require either donning of emergency breathing apparatus (thus compounding communications problems and increasing the probability of human errors) or abandoning the control room following a seismic event.

2. Seismic Dust/Smoke Detectors

   Smoke detectors present in the fire protection actuation systems in many plants will likely be actuated by the dust that rises during a seismic event. When a fire protection control system is actuated by smoke detectors alone, a seismic event has the potential to lead to an inadvertent release of suppressant. A design of this type was observed for the CO_2 FPS in a cable spreading room.

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3. Water Deluge Systems

Critical cabinets with open conduit penetrations on top, or any non-sprayproofed, safety-related cabinets or components that can be sprayed by deluge system spray heads are susceptible to damage. For example, the control panel, the diesel engine air intake, and the electric generator cooling air intake on DG units are vulnerable if water deluge nozzles are aimed to spray on any of these areas.

4. Fire Suppressant Availability During a Seismic Event

a. One water FPS was installed with one pump driven by an electric motor and the other driven by a diesel engine. During a seismic-related loss of offsite power, the electric pump's non-vital power source could be lost, and the diesel-driven pump might not start because the lead-acid batteries powering its starter could become disconnected (the batteries were located on a weakly anchored metal storage rack, and were not fastened to the rack). Thus, in a seismic event, the fire main could fail to remain pressurized. At this plant, water was the agent used in the FPSs for the cable spreading room, the emergency diesel generator rooms, and many other areas (a seismic event potentially increases the likelihood of a fire in those and other critical areas of the plant).

b. The supply reservoir for one CO2 FPS was a non-seismically mounted tank, and the batteries that supplied power to the tank outlet valve were weakly anchored to a shelf that had no end restraints. The tank outlet piping could be damaged and/or valve power could be unavailable during a seismically induced fire. In this plant, CO2 was the FPS agent for the cable spreading room, the emergency diesel generator rooms, and other plant areas.

c. The supply bottles for one Halon FPS were attached to a non-seismically qualified wall by a single metal strap, providing a high likelihood that the bottle outlet piping could be damaged and the Halon could fail to be distributed if demanded by a fire during a seismic event. In this plant, the Halon was the suppressant agent for the cable spreading room.

5. Switchgear Fires

Seismic/fire interaction is a contributor to risk in the emergency electrical distribution rooms due to the presence of a fire source (the switchgear itself). In some switchgear rooms, many critical cables are routed along the tops of the switchgear cabinets so that large numbers of these cables are vulnerable to a fire in any cabinet subdivision. To reduce the potential risk associated with these areas, some licensees have implemented the following options:

a. Reduction of fire probability by securing the cabinets with seismic anchors to prevent tipping or sliding.

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b. Distancing the safety-related cables from the fire source or separating safety-related equipment cables by distance or physical barriers.

c. Routing some cables out of the switchgear cabinets through locations other than the top of the switchgear to reduce the likelihood that a fire in a single cubicle could damage a large number of safety-related cables.

6. Electro-Mechanical Components in Cable Spreading Rooms

Many cable spreading rooms contain electrical cabinets, increasing the risk due to seismic/fire interaction in these rooms. When such cabinets are present, fire probability can be reduced by securing the cabinets with seismic anchors to prevent tipping or sliding.

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REFERENCES

1. J. A. Lambright et al., Risk Evaluation for a Westinghouse Pressurized Water Reactor, Effects of Fire Protection System Actuation on Safety-Related Equipment (Evaluation of Generic Issue 57), NUREG/CR-5789, SAND91-1534, December 1992.

2. J. A. Lambright et al., Risk Evaluation for a Babcock and Wilcox

Pressurized Water Reactor, Effects of Fire Protection System Actuation on Safety-Related Equipment (Evaluation of Generic Issue 57), NUREG/CR-5790, SAND91-1535, December 1992.

3. J. A. Lambright et al., Risk Evaluation for a General Electric Boiling Water Reactor, Effects of Fire Protection System Actuation on Safety-Related Equipment (Evaluation of Generic Issue 57), NUREG/CR-5791, SAND91-1536, December 1992.

4. G. Simion et al., Risk Evaluation of a Westinghouse 4-Loop PWR, Effects of Fire Protection System Actuation on Safety-Related Equipment (Evaluation of Generic Issue 57), EGG-NTA-9081 Letter Report, Idaho National Engineering Laboratory, December 1991.

5. J. A. Lambright et al., Evaluation of Generic Issue 57: Effects of Fire Protection System Actuation on Safety-Related Equipment (Main Report), NUREG/CR-5580, SAND90-1507, December 1992.

6. Regulatory Analysis for the Resolution of Generic Issue 57: Effects of Fire Protection System Actuation on Safety-Related Equipment, NUREG-1472, October 1993.

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