

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

September 5, 1989

NRC INFORMATION NOTICE NO. 89-63: POSSIBLE SUBMERGENCE OF ELECTRICAL  
CIRCUITS LOCATED ABOVE THE FLOOD LEVEL  
BECAUSE OF WATER INTRUSION AND LACK OF  
DRAINAGE

Addressees:

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

Purpose:

This information notice is being provided to alert addressees that electrical circuits located above the plant flood level within electrical enclosures may become submerged in water because appropriate drainage has not been provided. Failure of electrical circuits during service conditions, including postulated accidents, can occur due to submergence if water enters these enclosures and there is no provision for drainage. The electrical enclosures addressed by this notice include terminal boxes, junction boxes, pull boxes, conduits, condulets, and other enclosures for end-use equipment (such as limit switches, motor operators, and electrical penetrations), the contents of which may include cables, terminal blocks, electrical splices and connectors. It is expected that recipients will review this information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On March 20, 1989, the Clinton Power Station experienced an unexpected ingress of water into the drywell. About 10 feet of water from the dryer pool drained into the reactor cavity pool causing about 4 inches of standing water in the drywell. Following the event, the licensee found evidence of water intrusion in several electrical enclosures located above the flood level. These enclosures did not have drain holes. The licensee corrected the problem by drilling holes in all appropriate junction boxes, terminal boxes, pull boxes, condulets, and end-use equipment enclosures inside the drywell and the containment.

The Monticello plant found that a junction box for RHR pump motor leads contained several inches of water (NRC Inspection Report 50-263/87-013-DRS). The box did not have a drain hole. The licensee initially determined that the associated conduits were routed through humid areas, which could have resulted

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in condensation from the conduits accumulating in the box. However, the licensee later postulated that hosing down of equipment in that area may have caused water to enter the box through unsealed openings. In this instance, the circuits were found wet but not yet submerged in the accumulating water. The licensee drilled weep holes in all appropriate motor-lead junction boxes and other enclosures to correct the problem.

During an inspection performed at Clinton Power Station from August 17 through August 21, 1987, NRC inspectors identified a terminal box without drain holes. The box was required to be environmentally qualified in accordance with the requirements of 10 CFR 50.49. Although the box was located above the postulated plant flood level, it was subject to possible water and moisture intrusion that could submerge the contents of the box in an accident. Subsequently, the licensee identified 156 terminal boxes without drain holes, which could affect multiple safety systems. The licensee drilled drain holes in the affected terminal boxes. During a followup inspection performed from February 6 through February 24, 1989, the NRC identified six additional junction boxes requiring drain holes. Several of these boxes contained taped electrical splices which the licensee's environmental qualification program had not demonstrated to be environmentally qualified to perform their required function for the required duration if they became submerged following a loss-of-coolant accident (LOCA). Following this finding, the licensee identified numerous other enclosures with taped splices that required drain holes.

#### Discussion:

The NRC regulation pertaining to environmental qualification specifically regarding submergence is addressed in 10 CFR 50.49(e)(6), which states that the electrical equipment qualification program must consider submergence (if subject to being submerged). The regulation also makes reference to two guidance documents: "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors," November 1979 (DOR Guidelines), and NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment." NUREG-0588, Paragraph 2.2(5) states that where equipment could be submerged, it should be identified and demonstrated to be qualified by test for the duration required. DOR Guidelines, Section 6, state that particular emphasis should be placed on common problems, such as protective enclosures installed upside down with drain holes at the top and penetrations in equipment housings for electrical connections being left unsealed or susceptible to moisture intrusion through stranded conductors.

Water can enter and accumulate in electrical enclosures located above the flood level through various unsealed openings, including enclosure covers, conduits, and conduit fittings. Water may enter an enclosure through a run of conduit from an upper elevation or by directly impinging on unsealed openings. Steam and humidity also may enter an enclosure through conduits and unsealed openings and then condense and accumulate at the bottom of the enclosure. The content of the enclosure may become submerged as a result. Proper drain holes will prevent this.

Submergence could occur during service conditions, including accidents such as a LOCA or other high-energy line break. For clarity, a component is considered submerged if it is partially or completely immersed in water. Submergence of components in electrical enclosures may occur even though the enclosures are located above the plant flood level because of inadequate drainage in the enclosure.

Water intrusion also may occur from hosing down the equipment during house-keeping. It is important to note that extreme care needs to be taken during such activities so that the water does not penetrate unsealed enclosure openings and travel through conduits to enclosures at lower elevations.

Information Notice 84-57, "Operating Experience Related to Moisture Intrusion on Safety-Related Electrical Equipment at Commercial Power Plants," addressed watertight sealing of all electrical conduits to junction boxes and conduit-to-terminal box connection points for safety-related equipment located in areas of the reactor building as well as for areas that are potentially subject to high temperature steam or water impingement. This notice further addressed the importance of ensuring that box drain holes and equipment interfaces are in conformance with the test setup established during equipment qualification testing and with the vendor's recommendations.

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 NRR project manager.

*Charles E. Rossi*

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Office of Nuclear Reactor Regulation

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Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED  
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
89-62	Malfunction of Borg-Warner Pressure Seal Bonnet Check Valves Caused By Vertical Misalignment of Disk	8/31/89	All holders of OLs or CPs for nuclear power reactors.
89-61	Failure of Borg-Warner Gate Valves to Close Against Differential Pressure.	8/30/89	All holders of OLs or CPs for nuclear power reactors.
88-46, Supp. 2	Licensee Report of Defective Refurbished Valves	8/22/89	All holders of OLs or CPs for nuclear power reactors.
89-6C	Maintenance of Teletherapy Units	8/18/89	All NRC Medical Teletherapy Licensees.
89-59	Suppliers of Potentially Misrepresented Fasteners	8/16/89	All holders of OLs or CPs for nuclear power reactors.
89-58	Disablement of Turbine-Driven Auxiliary Feedwater Pump Due to Closure of One of the Parallel Steam Supply Valves	8/3/89	All holders of OLs or CPs for PWRs.
89-57	Unqualified Electrical Splices in Vendor-Supplied Environmentally Qualified Equipment	7/26/89	All holders of OLs or CPs for nuclear power reactors.
89-56	Questionable Certification of Material Supplied to the Defense Department by Nuclear Suppliers	7/20/89	All holders of OLs or CPs for nuclear power reactors.
89-45, Supp. 1	Metalclad, Low-Voltage Power Circuit Breakers Refurbished With Substandard Parts	7/6/89	All holders of OLs or CPs for nuclear power reactors.
89-55	Degradation of Containment Isolation Capability by a High-Energy Line Break	6/30/89	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License  
 CP = Construction Permit

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