

**ENVIRONMENTAL QUALIFICATION OF SAFETY-RELATED ELECTRICAL EQUIPMENT
AT NUCLEAR POWER PLANTS**

The NRC staff initiated a series of actions to confirm the environmental qualification of electrical equipment required to perform a safety function under postulated accident conditions. These actions are summarized in the Commission's April 13, 1978 Order in response to a petition from the Union of Concerned Scientists. Information obtained from recent licensee equipment tests and evaluations have indicated potential problems in qualification of installed equipment. As a result, the NRC expanded these actions to include an environmental review of safety-related electrical equipment at selected older plants. This review did not identify generic qualification deficiencies. However, as a result of IE Bulletins and the aforementioned testing to confirm qualification, specific deficiencies were identified. Poor installation practices, inadequate consideration of subcomponents and omission of certain environmental parameters in the design are examples of such deficiencies. In addition, the documentation of qualification was found to be inadequate in many cases and the initial response to some licensees indicated a lack of detailed knowledge of the quality of installed equipment.

The purpose of this Circular is to bring to your attention such deficiencies and to highlight the important lessons learned. In its April 13, 1978 Order, the Commission indicated that

"In order to fulfill its regulatory obligations, NRC is dependent upon all of its licensees for accurate and timely information. Since licensees are directly in control of plant design, construction, operation and maintenance, they are the first line of defense to ensure the safety of the public. NRC's role is one primarily of review and audit of licensee activities, recognizing that limited resources preclude 100 percent inspection.

Furthermore, the Commission notes that some of the licensee's initial responses indicate a lack on their part of detailed knowledge of the quality of installed plant equipment. Licensees must have this detailed understanding of their own plants in order to meet their obligations for public safety by ensuring a sound basis for making assessments of plant safety. The NRC establishes general safety criteria, sets specific requirements for many aspects of reactor design and operation, and ensures compliance with these criteria and requirements by independent audit. While, in the Commission's view, these activities play a vital role in ensuring safe plant operation, they are not a substitute for licensee safety reviews. The licensees must be knowledgeable and vigilant and must take more initiative in ferreting out details of potential plant weaknesses."

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As part of this obligation, you should examine installed safety-related electrical equipment, and ensure appropriate documentation of its qualification to function under postulated accident conditions. Specific guidance on the subject of environmental qualification can be found in IEEE 323-1971 and 1974, as augmented by Regulatory Guide 1.89.

Examples of specific deficiencies identified in information provided by licensees are as follows:

1. Connectors: Responses to IE Bulletins 77-05 and 77-05A revealed in certain instances a lack of qualification data for environmental parameters and inadequate design of connectors for postulated accident conditions.^{2/}
2. Penetrations: A failed penetration prompted issuance of IE Bulletin 77-06. Responses to this bulletin showed adequate documentation for the qualification of the penetration assembly was not readily available in some cases.^{2/} In one instance, the electrical connections of the penetrations were not qualified in conjunction with the penetration assembly,^{3/} which demonstrates a lack of consideration for qualification of interfacing components.
3. Terminal blocks: Because of unprotected terminal blocks in penetration areas inside containment of Haddam Neck, Bulletin 78-02 was issued. These unprotected blocks were replaced with blocks designed to function in the LOCA and main steam line break environments.^{4/} Responses to the Bulletin revealed two other facilities, Yankee Rowe and Ginna, with such unprotected blocks.^{5/}, ^{6/} Other terminal blocks were found to be inadequately qualified due to poor design or installation practices, even though they were in enclosures.^{7/}, ^{8/}, ^{9/} and ^{10/}
4. Limit switches: While examining the documentation for the qualification of all safety-related equipment installed inside containment, a vendor identified limit switches mounted on otherwise qualified valves at certain facilities. Preliminary review by the staff of responses to IE Bulletin 78-04 indicates such switches are installed in similar applications at other facilities. Corrective action is presently in progress.
5. Cable splices: Electrical cable splices associated with electrical penetration assemblies were determined to be unqualified by licensees during their search for qualification documentation.^{11/}

6. Other potential problems for specific components currently under staff review include:
- radiation and temperature effects on electrical cables^{10/}
 - adequacy of qualification testing of components by separate effects versus sequential testing of environmental parameter^{10/}
 - temperature limitations on nylon components of solenoid valves^{12/}
 - qualification of electrical transmitters^{13/, 14/}

The review of these issues may result in the need for other followup or corrective actions.

No written response to this Circular itself is required. Each licensee should determine the applicability of the qualification items identified above for its facility. Appropriate corrective action should be taken for any problem identified by the licensee as a result of its review. NRC inspectors will review these matters with licensees in future inspections. If further information is required, contact the Director of the appropriate Regional Office.

Attachment 1:
References

REFERENCES

1. "Short Term Safety Assessment on the Environmental Qualifications of Safety-Related Electrical Equipment of SEP Operating Reactors," May 1978, enclosure to staff memorandum to Commission, dated May 12, 1978 and issued as NUREG Report 0458.
2. "NRC Staff Report on Union of Concerned Scientists' Petition for Emergency and Remedial Action," December 15, 1977, enclosure to staff memorandum to Commission, dated December 15, 1977.
3. Letter from Consumers Power Company to NRC dated April 6, 1978, including, "Summary of Qualifications of Electrical Penetration Assembly Connectors for the Palisades Plant," Docket No. 50-255.
4. NRC Summary of January 29, 1978 meeting on "Environmental Qualification of Terminal Blocks and Replacement of Terminal Blocks, Haddam Neck Plant," Docket No. 50-213, dated January 30, 1978.
5. NRC Summary of February 1, 1978 meeting, Yankee Rowe Nuclear Power Station (terminal blocks), Docket No. 50-29, dated February 3, 1978.
6. NRC Summary of February 1, 1978 meeting on "Environmental Qualification of Terminal Blocks and Replacement of Terminal Blocks," R. E. Ginna Nuclear Plant, Docket No. 50-244 dated February 2, 1978.
7. Letter from Connecticut Yankee Atomic Power Company to NRC, dated March 29, 1978, including "Haddam Neck Plant Summary of Environmental Qualification Test Program, Terminal Block/Box Combinations," Docket No. 50-213.
8. Letter from Consumers Power Company to NRC, dated April 12, 1978, including information on terminal blocks at Palisades, Docket No. 50-255.
9. Letter from Indiana & Michigan Power Company to NRC, dated March 22, 1978 regarding terminal blocks at D. C. Cook Unit No. 2, Docket No. 50-316
10. Letter from Indiana & Michigan Power Company to NRC, dated April 21, 1978, regarding terminations at D. C. Cook Unit Nos. 1 and 2, Docket Nos. 50-315 and 50-316.
11. Staff memorandum, "Status of Monticello Electrical Splice Upgrade," dated May 10, 1978, Docket No. 50-263.
12. Letter from Consumers Power Company to NRC, "Environmental Qualification for Big Rock Point," dated February 24, 1978, Docket No. 50-135.
13. Letter from Consumers Power Company to NRC, "Environmental Qualification for Palisades," dated February 24, 1978, Docket No. 50-255.
14. Letter from Westinghouse to E. G. Case, dated April 26, 1978, regarding environmental qualification status for D. C. Cook Unit 2, Docket No. 50-316.

LISTING OF IE CIRCULARS ISSUED IN 1978

Circular No.	Subject	Date of Issue	Issued To
78-01	Loss of Well Logging Source	4/5/78	All Holders of Well Logging Source Licenses
78-02	Proper Lubricating Oil for Terry Turbines	4/20/78	All Holders of Reactor Operating Licenses (OL) or Construction Permits (CP)
78-03	Packaging Greater Than Type A Quantities of Few Specific Activity Radioactive Material for Transport	5/12/78	All Holders of Reactor Operating Licenses (OL), Construction Permits (CP), Fuel Cycle, Priority I Material and Waste Disposal Licenses
78-04	Installation Error That Could Prevent Closing of Fire Doors	5/15/78	All Holders of an NRC Operating Licenses (OL) or Construction Permits (CP)
78-05	Inadvertent Safety Injection During Cooldown	5/23/78	All Holders of an NRC Operating Licenses (OL) or Construction Permits (CP)
78-06	Potential Common Mode Flooding of ECCS Equipment Rooms at BWR Facilities	5/25/78	All Holders of Reactor Operating Licenses (OL), Construction Permits (CP)
78-07	Damaged Components On a Bergen-Paterson Series 25000 Hydraulic Test Stand	5/31/78	All Holders of Reactor Operating Licenses (OL), or Construction Permits (CP)