May 26, 1994

Mr. R. B. Miller
Westinghouse Energy Center
MS 4-09 East
P. O. Box 355
Pittsburgh, PA 15230
ATTN: Robert Sterdis

Dear Mr. Miller:

SUBJECT: REQUEST FOR COMMENTS ON PROPOSED INFORMATION NOTICE TITLED "POSSIBLE MALFUNCTION OF WESTINGHOUSE ARD, BFD, AND NBFD RELAYS, AND A200 DC AND DPC 250 MAGNETIC CONTACTORS"

The U.S. Nuclear Regulatory Commission is preparing an information notice (IN) regarding malfunctions of Westinghouse NBFD relays. Please review the enclosed draft IN to ensure that the technical information is correct and return any comments you may have as soon as possible.

Your cooperation is appreciated. If no comments are received by June 4, 1994, we will assume the technical information in the IN is correct. If you have any questions regarding this issue, please contact Nick Fields at (301) 504-1173.

Sincerely,

Original signed by
Andrew J. Kugler, Acting Chief
Generic Communications Branch
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Enclosure:
As stated

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

DRAFT

May xx, 1994

NRC INFORMATION NOTICE 91-45, SUPPLEMENT 1: POSSIBLE MALFUNCTION OF WESTINGHOUSE ARD, BFD, AND NBFD RELAYS, AND A200 DC AND DPC 250 MAGNETIC CONTACTORS

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 supplement to alert addressees and vendors of equipment used by the addressees about continuing malfunctions of Westinghouse NBFD relays. These relays are used extensively in safety-related applications at nuclear power plants with nuclear steam supply systems supplied by Westinghouse as well as other vendors. 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

On July 19, 1993, Northern States Power Company, the licensee for Prairie Island Nuclear Generating Plant conducted a monthly surveillance test on the Unit 2 reactor protection system (RPS). During the test, two normally energized Westinghouse NBFD relays would not re-energize. The coils of the relays were found to have opened electrically. The licensee returned the failed relays to Westinghouse for failure analysis.

On September 24, 1993, during periodic surveillance testing of the Unit 2 reactor protection system, a third NBFD relay failed (open coil). During an inspection of the relay racks prior to testing, Northern States Power Company identified three relays containing longitudinal cracks in their coil cases. There was also evidence that potting compound that encapsulates the relay coil had extruded from these cracks; however, these relays operated satisfactorily during the surveillance test. The licensee manually verified that the plunger in each of the relays moved freely. Northern States Power Company sent the failed relay and one of the three relays with cracked cases to Westinghouse for failure analysis.

On September 27, October 14, and October 21, 1993, Northern States Power Company conducted additional visual inspections of the RPS relay racks, identifying 21 more relays that had cracked coil cases. One of the cracked

cases was on a normally de-energized relay. Following the shutdown of Prairie Island Unit 2 on October 28, 1993, for a refueling outage, the licensee removed all Unit 2 NBFD relays from service. An additional 36 relays were discovered to have cracked coil cases. Northern States Power Company speculates that many of the cracks existed previously, but could not be seen because of the difficulty in inspecting installed relays. In total, Northern States Power Company identified 27 relays with cracks of varying lengths in train A and 33 relays in train B. There are 43 relays in each train. Northern States Power Company speculated that the cracked coil cases were indicative of the premature failure of the relay, therefore, all relays with cracked coil cases were replaced.

Northern States Power Company discussed the issue of the cracked relay cases with the Wisconsin Public Service Corporation, the licensee for the Kewaunee Nuclear Power Plant. Wisconsin Public Service Corporation visually inspected its installed reactor protection system relays and identified 11 cracked relays among the 80 relays in the Kewaunee Nuclear Power Plant system. Wisconsin Public Service Corporation predicted that other relays with cracked cases likely existed, but could not be identified because of the difficulty associated with visual inspection of installed relays. The Kewaunee licensee replaced all relays that were found to have cracked cases.

Discussion

NRC Information Notice 91-45 transmitted to all licensees a Westinghouse 10 CFR Part 21 report to the NRC (Westinghouse Report No. NS-NRC-91-3600 dated June 24, 1991). The Westinghouse report described the potential for malfunction of certain products that are supplied by Westinghouse (including NBFD relays). The potential for malfunction arose from the failure of the epoxy potting compound used to encapsulate the coils of the affected products. The potting compound on certain devices was thought to have been incorrectly manufactured. The failure mode involved the flow of semi-fluid potting compound into the armature of the affected device. This would cause the armature plunger to move sluggishly, resulting in delayed reset of the device.

The Westinghouse report stated that the issue was limited to continuously energized, direct current devices. The heat from continuously energized devices was thought to be sufficient to soften non-homogeneous potting compound. According to Westinghouse, a continuously energized relay would exhibit deficient potting compound within two surveillance cycles. For devices that had not been in-service for at least two surveillance cycles, Westinghouse recommended either replacement of the suspect devices with devices that had been subjected to updated dedication procedures and processes to identify any non-homogeneous potting compound, or conducting a specific inspection of the epoxy potting compound following continuous energization for a period of two hours (or simulated service conditions). Any device that exhibited evidence of epoxy softening should be discarded.

On December 13, 1991, Westinghouse issued a supplement to the original Westinghouse Part 21 report. Westinghouse recommended that all spare relays be tested at 250 degrees F (121.1 degrees C) for 2.5 hours in a preheated oven

and then checked for epoxy softening (referred to as the heat-and-probe test). Westinghouse concluded that if the epoxy did not soften as a result of this test, then the device was suitable for continued in-service application.

When the Westinghouse 10 CFR Part 21 report was issued, all the relays in the Prairie Island Unit 2 reactor protection system had been in service for at least two surveillance cycles, and were therefore not tested or replaced. However, relays with the case cracking problems and the relay with the open coil failure had all satisfied the original Westinghouse Part 21 in-service acceptance criteria. In Prairie Island Unit 1, eleven new relays were installed in the reactor protection system subsequent to the Westinghouse Part 21 report. These relays had been satisfactorily heat-and-probe tested as recommended by the Westinghouse Part 21 supplement report issued December 13, 1991. The remaining Prairie Island Unit 1 RPS relays were purchased and installed after Westinghouse had corrected the inadequate process that had resulted in the manufacture of the non-homogeneous potting compound. There have been no similar open coil failures or observed cracking of Prairie Island Unit 1 RPS relay coil cases.

The Westinghouse analysis of the two relay coils that failed on July 19, 1993, at Prairie Island, attributed the root cause of the open coil failures to the deficient potting compound issue. The coil failures were attributed to the normal inductive voltage spike that is generated when the coil is de-energized. This spike, about 2000 volts, was thought to be sufficient to breach degraded coil insulation, resulting in coil failure. The insulation degradation was attributed to heat and poorly manufactured potting compound. However, in their failure analysis report for the September 24, 1993 open coil failure, Westinghouse stated that improper or inconsistent application of Mylar insulation during the manufacturing process may have contributed to the failures of all three relay coils. Westinghouse stated in subsequent correspondence to the Northern States Power Company that the Mylar insulation inadequacies have been identified and corrected. However, no definitive failure mode was identified for the relay failures at Prairie Island.

Regarding the coil case cracking phenomenon observed at Prairie Island and Kewaunee, Westinghouse stated that the coil case cracking phenomenon is likely caused by thermal expansion. The coil case is molded from a stable phenolic material but is thin-walled and thus subject to stress cracking when exposed to temperature extremes and internal pressures. Westinghouse stated that in laboratory tests, only four relays out of 1059 NBFD relay coils that were heat-and-probe tested for potting compound integrity, exhibited coil case cracking. Further, Westinghouse stated that few NBFD relays returned for failure analysis have had cracked coil cases. The Westinghouse experience does not appear consistent with the experience of the Prairie Island and Kewaunee licensees. Collectively, Northern States Power Company and Wisconsin Public Service Company have identified 74 of 166 NBFD relays with cracked coil cases. The Prairie Island and Kewaunee licensees have not identified any unusual operating or environmental conditions that would account for the relay case cracking or coil failures. Although the cracked coil cases may not be indicative of a premature relay failure, the NRC staff is concerned that the number of cracked relay cases found by the Prairie Island and Kewaunee licensees is greater than Westinghouse predicted.

Westinghouse states that since the original Part 21 Report was issued, there have been no reported instances in which deficient potting compound impaired the operation of NBFD relays. NBFD relays may fail due to improper or inconsistent application of Mylar insulation placement alone or in conjunction with potting compound flow. In addition, potting compound flow may cause increased internal pressure which may result in coil case cracking. The heat-and-probe test and two surveillance cycle acceptance criteria recommended by Westinghouse may be inadequate in identifying relays which are subject to premature failure.

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

Brian K. Grimes, Director
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Technical contacts: M. Dapas, RIII
(612) 388-8209

N. Fields, NRR
(301) 504-1173

Attachment: List of Recently Issued NRC Information Notices