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

September 26, 2003

NRC INFORMATION NOTICE 2003-18: GENERAL ELECTRIC TYPE SBM CONTROL SWITCHES WITH DEFECTIVE CAM FOLLOWERS

Addressees

All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to inform addressees of recent and long-term operational experience with control switches and relays incorporating a polycarbonate plastic material manufactured by General Electric known as Lexan®. 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 January 5, 2003, at Calvert Cliffs Unit 1, an emergency diesel generator (EDG) output breaker failed to close on demand. The licensee found that a single block module (SBM) type auxiliary switch on the General Electric (GE) Magne-Blast type breaker had a broken cam follower. The cam follower consists of a steel pivot pin centered in clear Lexan®. The pin had sheared and fallen to the bottom of the switch. At the pin location, the Lexan® was cracked with some pieces missing. Because the cam follower was broken, contact 152/b in the closing coil circuit failed open, preventing the completion of the logic permitting closure of the breaker.

The licensee inspected individual breaker components affected by this deficiency. Of the 24 breakers inspected, 5 had defective SBM switches. At Unit 1, the defective switches were on the EDG output breaker discussed above and a service water pump breaker; at Unit 2, a service water pump breaker, a high-pressure injection system breaker, and an EDG output breaker. All these switches had noticeably cracked Lexan® but were not in as bad a condition as the switch on the Unit 1 EDG output breaker. The licensee replaced these switches with GE Type SB-12 switches. Both SBM and SB-12 switches contain Lexan® cam followers but the SB-12 switch was fabricated with Lexan® not exposed to hydrocarbons, a potential failure mechanism discussed in Information Notice 80-13, "General Electric Type SBM Control Switches with Defective Cam Followers."

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Background

In 1976, GE recognized this problem (GE Service Information Letter [SIL] No. 155). The SIL stated that the material used for the cam followers prior to July 1972 was an acetyl resin composition called Delrin®. Delrin® is easily distinguishable by its milky opaque appearance from the clear Lexan®. The SIL recommends replacement of the SBM switches in safety applications. GE replaced Lexan® in these switches with Valox®, which has a white opaque appearance similar to Delrin®.

No failures of SBM switches have been reported attributable to cam followers made of Delrin® or Valox®. However, properties of these or related materials have been discussed in NRC generic communications, as noted below.

The cause of the Lexan® failures was believed to be exposure of the switches to hydrocarbon chemicals during manufacture or maintenance. With respect to the manufacturing process, switches made between July 1972 and May 1975 were believed to be suspect. GE SIL No. 155 provided date codes to aid in the identification of suspect switches.

The Maine Yankee licensee had previously (in 1972) experienced failures of SBM switches during maintenance when using contact cleaner and discontinued use of any type of contact cleaner on SBM switches.

In 1976, GE supplemented SIL No. 155, adding a recommendation to inspect all SBM switches that have polycarbonate cam followers and to replace those found to have severely cracked cam followers.

In 1979, GE again supplemented SIL No. 155, reminding BWR operators of the need to inspect the SBM switches according to Supplement 1 and discussing manufacturing changes made since January 1976: discontinuing use of nonvirgin Lexan® materials, discontinuing use of hydrocarbons, and reducing stress during roll pin insertion.

In 1980, NRC issued Information Notice 80-13 to describe the SBM switch cam follower defects found at Cooper and Diablo Canyon Unit 1. These switches are used broadly and thus represent a potential common-mode failure affecting multiple safety-related systems. At Cooper, SBM switches are used primarily as hand control switches in the control room. At Diablo Canyon Unit 1, they provide auxiliary contacts in three switch applications on 4 kV and 12 kV Magne-Blast breakers: a breaker-mounted auxiliary switch, a cell-mounted auxiliary switch, and a cell interlock switch. These defects were described as severe cracking with a rock salt appearance that could ultimately progress to mechanical failure.

Additional, more recent operating experience may be cited. In 1998, the Perry licensee mistakenly determined that IN 80-13 and SIL No. 155 did not apply to local control switches on installed ABB HK breakers. The licensee committed to reevaluate the applicability and take appropriate corrective action.

In 1996, the LaSalle licensee experienced problems while downshifting the recirculation pump. The licensee failed to take appropriate corrective action for safety-related SBM switch degradation concerns identified in 1979, 1990, and 1995.

Also in 1996, the Turkey Point licensee observed that a 4 kV bus clearing relay failed to actuate in test. An intake cooling water system pump motor breaker stationary switch failed to operate its contacts as required. The licensee found a cracked internal cam follower on this switch. The licensee also observed that all four 4 kV buses contained SBM switches but concluded that all four 4KV buses were operable, characterizing the problem as an isolated random failure and noting the manufacturer's assessment that the switches would function 45,000 cycles with existing cracks and the licensee's plans to replace the switches at the next opportunity.

In 1995, the Maine Yankee licensee found three broken cam followers in SBM switches on medium-voltage breakers. Two did not prevent switch function and the third affected only a spare contact. The licensee did not identify a safety concern but did identify a need for more effective communications with GE, including obtaining an index of all GE service letters to evaluate against the affected components in the plant.

Also in 1995, the Pilgrim licensee encountered an SBM switch cam follower failure of the high-pressure coolant injection system suction valve from the torus. A similar failure occurred in 1992. The NRC cited the licensee for not promptly correcting the 1992 failure and noted that the 1995 failure was corrected satisfactorily. Previous similar failures at this plant can be cited as well: a core spray inboard injection valve in 1988, and a hydrogen analyzer sample flow line in 1993.

In 1994, the Cooper licensee inspected 130 SBM switches and found cracking, opaqueness, and missing pieces of cam followers on 34 of them.

In 1992, the Fort Calhoun licensee experienced a failed switch for a raw water pump because of a cracked cam follower. At the time, the licensee was replacing switches with open cracks or missing pieces.

Discussion

Though failure of SBM switches because of cracked or broken cam followers was noted some 30 years ago, problems persist. Guidance on avoiding the problem is available.

Licensees have found SBM switches with degraded Lexan® cam followers of the affected date codes among their stored components in addition to those installed in the plant. In addition to replacing the affected switches in service, licensees have determined that eliminating affected switches, whether degraded or not, from the stored components effectively prevents inadvertent use of such defective switches.

Other operating experience that differs from the above in one or more respects might nevertheless apply to the general problem of degradation of plastic materials used in nuclear power plants. Degradation of Delrin®-related materials in applications different from control switches is described in NRC Information Notices 83-45 and 92-85. Thermal properties of Valox® or related material are discussed in NRC Bulletin 78-01.

In 2003, NRC inspectors at the Surry plant learned of degradation of zippertubing, a plastic product of Zippertubing Company, used to bundle electric cable inside the safety injection cabinets at both Units 1 and 2. This product was qualified and delivered as part of the original

equipment during plant construction. Zippertubing sold the product as ZIP-31 at that time, discontinued its manufacture 10-12 years ago, and now markets a similar product as ZIP-41. The Surry licensee removed this covering. This operating experience relates to NRC Information Notice 91-20 "Electrical Wire Insulation Degradation Caused Failure in a Safety-Related Motor Control Center."

In 2002, the San Onofre licensee reported degradation of contacts due to excessive use of Inhibisol, a cleaning solvent based on trichloroethane (TCE). The cleaning solvent caused the plastic housing for the contacts to break down. Over time, small amounts of the plastic came loose and interfered with the contacts, resulting in linestarter degradation and the failure of safety-related valves. The NRC issued Information Notice 2003-06, "Failure of Safety-Related Linestarter Relays at San Onofre Nuclear Generating Station." Information Notice 93-76, "Inadequate Control of Paint and Cleaners for Safety-Related Equipment," may also apply.

In 1995, the Browns Ferry licensee reported GE Type HFA 51 Series AC relay failures involving shorting of coil wire insulation made of nylon or Lexan®. After its review, the licensee replaced 308 such relays at Unit 3. The NRC issued Information Notice 81-01, "Possible Failures of General Electric Type HFA Relays" and Bulletin 84-02, "Failures of General Electric Type HFA Relays in Use in Class 1E Safety Systems."

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

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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
2003-17	Reduced Service Life of Automatic Switch Company (ASCO) Solenoid Valves With Buna-N Material	09/29/2003	All holders of operating licenses for nuclear power reactors.
2003-16	Icing Conditions Between Bottom of Dry Storage System and Storage Pad	Pending	All 10 CFR Part 72 licensees and certificate holders.
2003-15	Importance of Followup Activities in Resolving Maintenance Issues	09/05/2003	All holders of operating licenses for nuclear power reactors except those who have permanently ceased operation and have certified that fuel has been permanently removed from the reactor vessel.
2003-14	Potential Vulnerability of Plant Computer Network to Worm Infection	08/29/2003	All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
2003-13	Steam Generator Tube Degradation at Diablo Canyon	08/28/2003	All holders of operating licenses for pressurized-water reactors (PWRs), except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.

Note: NRC generic communications may be received in electronic format shortly after they are issued by subscribing to the NRC listserver as follows:

To subscribe send an e-mail to <listproc@nrc.gov >, no subject, and the following command in the message portion:

subscribe gc-nrr firstname lastname

OL = Operating License
CP = Construction Permit