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

March 2, 1992

NRC INFORMATION NOTICE 92-19: MISAPPLICATION OF POTTER & BRUMFIELD MDR ROTARY RELAYS

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 failures caused by the misapplication of Potter & Brumfield (P&B) MDR rotary relays. 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 September 11, 1989, operators at the Shearon Harris Nuclear Power Plant (Shearon Harris) performed a periodic test of an emergency load sequencer. When the operators pressed the "Test Stop" button, the sequencer did not properly reset and generated an inadvertent start signal to the emergency service water (ESW) pump. The control room operators noticed the inadvertent start of the pump and secured it.

On June 15, 1990, the licensee for the Waterford Steam Electric Station (Waterford) informed the NRC senior resident inspector that P&B MDR 66-4, MDR-4076, and MDR-5061 rotary latching relays had been determined to have a high failure rate warranting a root cause analysis.

Licensees for other nuclear power plants have reported to the NRC that P&B MDR relays have operated intermittently with failures that could not be duplicated during subsequent testing. These failures occurred in applications of MDR relays for energizing equipment status indication lights, energizing computer input and display lights, and switching low level loads.

Discussion

The Carolina Power and Light Company (CP&L), the licensee for Shearon Harris, investigated the inadvertent start of the ESW pump. CP&L found that a P&B MDR 137-8 relay, installed in the test circuit, failed to reset at the proper time and continued to supply power to the equipment actuation relays longer

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than designed. This failure resulted in the inadvertent start of the ESW pump. When the failed relay was inspected, CP&L found that the contacts were burned and that the leaf spring contact had melted into the plastic armature. CP&L concluded that the relay's contacts had been overloaded.

In reviewing the problem, CP&L found that there is a substantial difference between the current rating of contacts used with direct current and the rating of contacts used with alternating current. The circuit design for the failed relay had been based on only the resistive loads and not the inductive loads carried by the contacts. This was also the case for other circuits using P&B MDR latching relays and Agastat microswitches. CP&L modified the circuits by eliminating the microswitches and connecting two pairs of MDR relay contacts in series to switch the inductive loads. CP&L reviewed Licensee Event Reports 88-29 and 88-08, which documented similar failures at Shearon Harris, and concluded that inductive loads in those circuits may have damaged the MDR relay contacts and caused the relays to fail. Attachment 1 includes a discussion of comments from P&B on the use of relays for switching direct current loads.

Entergy Operations, Incorporated (Entergy), the licensee for Waterford, performed a root cause analysis of the failures of P&B rotary latching relays at Waterford. The analysis found that the design of the electrical system used some of the relays' own contacts to de-energize the relays' operate and reset coils. However, minor variations in the amount of time for the contacts to operate did not allow the relays' mechanisms to consistently reposition and reset contacts for the next operation of the relays. Consequently, the relays would fail in an intermediate position. The licensee subsequently implemented a design change to bypass the internal contacts that were in series with the coils.

P&B engineers informed the NRC that, if P&B had known the intended application of the relays at Waterford, it could have designed and manufactured relays that would have performed reliably. P&B stated that it would assign a specific drawing number for such relays and would expect recipients to reference the drawing number in subsequent purchase orders to ensure that P&B furnished identical relays as replacements.

The NRC staff and P&B engineers investigated the intermittent nonrepeatable MDR relay failures experienced at other plants and concluded that the P&B MDR relays may have been misapplied to switch low level loads. Attachment 1 includes a discussion of comments from P&B on the use of P&B relays for switching low level loads.

Because the use of relays for switching direct current or low level loads may require special features, licensees may wish to review the adequacy of their applications of P&B MDR relays and other similar relays and improve their communications with P&B or other manufacturers in order to accomplish special functions reliably.

The NRC has issued the following related generic communication: NRC Information Notice IN 92-04, "Potter and Brumfield Model MDR Rotary Relay Failures," January 6, 1992.

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

Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical contact: Kamal R. Naidu, NRR
(301) 504-2980

Attachments:
1. P&B's Comments On Switching Direct Current and Low Level Loads
2. List of Recently Issued NRC Information Notices

POTTER & BRUMFIELD A Siemens Company
FAX #812/386-2069

FACSIMILE TRANSMITTAL SHEET

DATE: December 6, 1991

FAX TO: Kamalakar R. Naidu

FAX NUMBER: 301-492-0260

FROM: William Lamb

PAGES TO FOLLOW: 0

Subject: Your 12/5/91 Phone Request for Information.

The following are comments based partially on The Engineers' Relay Handbook published by The National Association of Relay Manufacturers (NARM):

SWITCHING DC LOADS

D.C. loads are more difficult to turn off than A.C. loads because the DC voltage never passes through zero. As the contacts open, an arc is struck and may be sustained by the applied voltage until the distance between opening contacts becomes too great for the arc to sustain itself. The arc energy can seriously erode away the contacts. Frequently arc extinguishing capabilities for D.C. inductive loads can be enhanced by connecting two contacts in series. This provides a larger total contact gap and a faster rate of contact separation, thereby providing improved performance.

Paralleling sets of relay contacts to switch loads greater than a single set can handle is often unsuccessful. Lack of absolute simultaneity of contact opening results in one contact taking all the load causing early failure.

LOW LEVEL LOADS

A relay contact rating does not necessarily apply for all loads from zero up to the magnitude specified. The fact that a contact can reliably switch 10 amperes does not necessarily mean it can reliably switch 10 milliamperes. The MDR contact structure is designed for 10 amp 115V AC 50% PF, 3 amp 28V DC resistive and 0.8 amp 125V DC resistive load switching. It does not have the contact structure design configuration necessary for low level switching applications that inhibit contact resistance build up.

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
92-18	Potential for Loss of Remote Shutdown Capability during A Control Room Fire	02/28/92	All holders of OLs or CPs for nuclear power reactors.
92-17	NRC Inspections of Programs being Developed at Nuclear Power Plants in Response to Generic Letter 89-10	02/26/92	All holders of OLs or CPs for nuclear power reactors.
92-16	Loss of Flow from the Residual Heat Removal Pump during Refueling Cavity Draindown	02/25/92	All holders of OLs or CPs for nuclear power reactors.
92-15	Failure of Primary System Compression Fitting	02/24/92	All holders of OLs or CPs for nuclear power reactors.
92-14	Uranium Oxide Fires at Fuel Cycle Facilities	02/21/92	All fuel cycle and uranium fuel research and development licensees.
92-02, Supp. 1	Relap5/Mod3 Computer Code Error Associated with the Conservation of Energy Equation	02/18/92	All holders of OLs or CPs for nuclear power reactors.
92-13	Inadequate Control Over Vehicular Traffic at Nuclear Power Plant Sites	02/18/92	All holders of OLs or CPs for nuclear power reactors.
92-12	Effects of Cable Leakage Currents on Instrument Settings and Indications	02/10/92	All holders of OLs or CPs for nuclear power reactors.
92-11	Soil and Water Contamination at Fuel Cycle Facilities	02/05/92	All uranium fuel fabrication and conversion facilities.

OL = Operating License
CP = Construction Permit

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Attachments:
1. P&B's Comments On Switching Direct Current and Low Level Loads
2. List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCES

		D/DOEA:NRR	*C/OGCB:DOEA:NRR	*RPB:ADM
		CERossi	CHBerlinger	TechEd
		02/26/92	02/14/92	02/03/92
*OGCB:DOEA:NRR	*VIB:DRIS:NRR	*VIB:DRIS:NRR	*C/VIB:DRIS:NRR	*D/DRIS:NRR
JBirmingham	KRNaidu	GCwalina	LNorrholm	BKGrimes
02/11/92	02/11/92	02/11/92	02/12/92	02/12/92

DOCUMENT NAME: IN 92-19

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Document Name: MISAPPLICATION IN

		D/DOEA:NRR	C/OGCB:DOEA:NRR	RPB:ADM
		CERossi	CHBerlinger	TechEd for J. Main
		02/ /92	02/ /92	02/03/92
OGCB:DOEA:NRR	VIB:DRIS:NRR	VIB:DRIS:NRR	C/VIB:DRIS:NRR	D/DRIS:NRR
JBirmingham	KRNaidu	GCwalina	LNorrholm	BKGrimes
02/11/92	02/11/92	02/11/92	02/12/92	02/12/92