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United States Nuclear Regulatory Commission
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SUBJECT: DOCKET NO. 50-333
LICENSEE EVENT REPORT: LER-93-022-01:

Vendor Design Deficiencies Allowing Exposed Resistors in the RPS Panels

Dear Sir:

This updated report is submitted in accordance with 10CFR50.73 (a)(2)(ii). It updates the status of the 10CFR21 review and adds a fourth corrective action, which addresses the second identified cause.

Questions concerning this report may be addressed to Mr. David Holliday at (315) 349-6359.

Very truly yours,

HARRY P. SALMON, JR.

HPS:DAH:tlc

Enclosure

cc: USNRC, Region I
USNRC Resident Inspector
INPO Records Center

IE28
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NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
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TITLE (4)
Vendor Design Deficiencies Allowing Exposed Resistors in the RPS Panels

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									N/A	05000
10	29	93	93	022	01	03	15	94	FACILITY NAME N/A	DOCKET NUMBER 05000

OPERATING MODE (9)	N
POWER LEVEL (10)	000

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.402(b)		20.405(c)		50.73(a)(2)(iv)		73.71(b)
	20.405(a)(1)(i)		50.36(c)(1)		50.73(a)(2)(v)		73.71(c)
	20.405(a)(1)(ii)		50.36(c)(2)		50.73(a)(2)(vii)	X	OTHER
	20.405(a)(1)(iii)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)		10 CFR 21
	20.405(a)(1)(iv)	X	50.73(a)(2)(ii)		50.73(a)(2)(viii)(B)		
	20.405(a)(1)(v)		50.73(a)(2)(iii)		50.73(a)(2)(x)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Mr. David Holliday, Senior Licensing Engineer	(315) 349-6359

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

This is an update of LER-93-022, issued 11/29/93

On 10/29/93, the plant was shut down for about one week. After a series of inspections of wiring inside Reactor Protection System (RPS) panels in the Control Room, engineering determined that some of the wires between RPS scram contactors were not installed inside protective conduits as specified in notes on a vendor interconnection diagram and that eight RPS resistors were not installed inside protective enclosures. The exposed resistors (and their associated terminal blocks and wiring) could have allowed a single failure (specifically, a 120VAC hot short across an exposed wire or terminal) to bypass certain RPS relay contact actuations. Although highly unlikely, the superimposed 120VAC source could potentially prevent the automatic insertion of some or all of the control rods into the reactor core. The cause of this event appears to be inadequate design and design review (Cause Code B) by the original Nuclear Steam Supply engineering company in 1975. The resistors have since been relocated inside protective covers and the contactor wires have been relocated, eliminating the single failure design concern. A 10CFR21 notification has been made by the engineering company.

EIIS Codes are in []

Event Description

During original plant construction (around 1972), two Reactor Protection System (RPS) [JC] panels (09-15 and 09-17) were installed, each containing redundant RPS components. The RPS is the primary reactor protection system which initiates a reactor shutdown (scram) by inserting all control rods when certain critical parameters are exceeded to protect the fuel cladding and the reactor coolant pressure boundary. In the original General Electric (GE) design, four lights were mounted on each RPS panel for each trip system (A and B) which where lit whenever the trip system was energized and power was available to the scram pilot valve solenoids (no scram).

A portion of the RPS logic arrangement is shown on Figure 1. There are two separately powered trip systems (A and B), each one having three trip logics. Two trip logics in each system (A1 and A2, B1 and B2) monitor the critical parameters for an automatic scram. The third trip logic is a manual trip (A3 and B3). At least one channel actuation is needed to actuate a trip system (a half scram) and both trip systems have to be actuated for a full scram (1-out-of-2 taken twice logic).

The power supply for RPS is 120 volts AC (VAC), supplied by a motor-generator set for each trip system. The drop-out logic is designed so that if RPS initiation is required, contacts will open causing various RPS relays to de-energize, which then de-energize the scram pilot valve solenoids to insert the 137 control rods.

In 1975, a Field Deviation Disposition Request was prepared by a GE site representative to provide two more sets of four lights on the reactor control panel (09-5) in the Control Room [NA] "horseshoe". The objective of providing the additional sets of lights was to place them in a location where they could be directly observed by control room operators at all times without leaving the control area. The change package was approved by GE in their San Jose office and issued to the site. To be consistent with the original design, the design for the eight new lights also included an isolation resistor installed in series with each light so that a hot short in a light circuit would not keep the scram solenoid valves energized, preventing a scram. However, the design change did not require the new resistors and their associated terminal blocks and wiring to be installed in protective enclosures (like the original sets of lights) making them more vulnerable to potential hot shorts.

In September, 1993, during New York Power Authority's (NYPA) development of RPS Design Basis Documentation in conjunction with GE (the original Nuclear Steam Supply vendor), GE noticed that the eight additional resistors were not in protective enclosures and commented that installing them in the scram contactor boxes would "provide greater hot short protection." On October 14, 1993, engineering issued a Design Document Open Item on the exposed resistors identified by GE. Engineering determined the system was operable since the most recent surveillance tests performed on the system were successful and there was a good operating history for the system. Reportability under 10 CFR 50.72 and .73 would be determined after further engineering review.

On October 18, 1993, a meeting was held with GE in San Jose to review the resistor concern. It was concluded that GE would notify their licensing group of the condition and would determine whether the condition required reporting to the NRC under 10 CFR 21.

On October 20, 1993, during a comprehensive review of the routing of wiring inside the RPS panels in response to the resistor concern, engineering also noted another concern. Some of the wiring between half of the twelve scram contactors was not enclosed in conduits even though a general note on a GE interconnection diagram stated: "Power wiring between scram contactors shall be in metallic conduit." However, the more specific wiring diagrams issued by GE for each panel did not require the wires be completely protected. After verification that the as-built wiring agreed with the more specific wiring diagrams and that no wire insulation deterioration existed, engineering requested further evaluation of the potential impact and corrective actions.

On October 22, 1993, a plant shutdown was commenced for a planned, four week maintenance outage. A modification was scheduled to relocate the resistors inside protective relay enclosures and to re-route the wiring between contactors.

After further evaluation, engineering determined that the wiring configuration between the scram contactors could (however unlikely) allow a hot short to the wiring between the scram contactors (a single failure), thus bypassing one of the two automatic trip logics and the manual trip logic for either trip system A or B for one of the four groups of control rods. However, a full scram would still be generated from a second set of contacts from the A2 or B2 trip logics. On October 29, engineering issued a Design Document Open Item to document the deviation.

On October 31, 1993, the RPS was declared inoperable due the resistor and the wiring configuration single failure concerns.

Engineering determined that the exposed resistors (and their associated terminal blocks and wiring) could potentially allow a single failure (specifically a 120VAC hot short across the common lead of the additional resistor) to bypass certain relay contact actuations and prevent the automatic insertion of some of the control rods into the reactor core if a scram was required at the same time. A modification was implemented to relocate the resistors inside the contactor enclosures like the originally installed resistors.

Cause

The cause of this event appears to be inadequate design and design review (Cause Code B) by General Electric, the original Nuclear Steam Supply engineering vendor in 1975.

The failure to recognize the deviations since that time was caused by a lack of a comprehensive RPS design basis document.

Analysis

This event is reportable under the provisions of 10 CFR 50.73 (a)(2)(ii)(B) since the condition resulted in the nuclear power plant being "in a condition that was outside the design basis".

The Updated FSAR, Section 7.2.2.7.g states: "There is sufficient electrical and physical separation between [the four] channels and between [the two] logics monitoring the same variable to prevent environmental factors, electrical transients, and physical events from impairing the ability of the system to respond correctly."

The Updated FSAR, Section 7.2.3.1, states that the RPS "is designed to meet the intent of the ... Proposed Criteria for Nuclear Power Plant Protection Systems (IEEE 279 as amended)." The Technical Specifications, Bases for Section 3.1A, states that for the RPS, "the system meets the intent of IEEE-279 (1971) for Nuclear Power Plant Protection Systems." IEEE-279, Paragraph 4.2, Single Failure Criterion, states: "Any single failure within the protection system shall not prevent proper protective action at the system level when required. NOTE: 'Single failure' includes such events as the shorting or open-circuiting of interconnecting signal or power cables."

In the upper portion of each RPS panel, four resistors were mounted on open terminal blocks. The wires from the resistors were run in a bundle with other wires to the scram contactors.

Although highly unlikely due to the limited access to Control Room panels and the static nature of these panels, a postulated 120VAC hot short on one of the two bare resistor leads, on one terminal screw, or on one wire within the wire bundle, could potentially superimpose 120VAC on the electrical circuit without detection (until the next weekly surveillance test). If the RPS channels detected a condition requiring a scram, the appropriate relays would de-energize, but the superimposed 120VAC source would prevent the de-energizing of the scram pilot valve solenoids in one of the four groups of control rods. Only about three-quarters of the control rods would insert, resulting in an incomplete scram, although reactor power would be reduced significantly.

If the 120VAC hot short was across all four common resistor leads or terminal screws, or involved the four wires in the wire bundle, all four groups of control rods would be affected.

An independent backup scram system would still function as designed. Engineering concluded that no fault mechanism affect this subsystem. If a scram was required, this subsystem would depressurize the scram air header, opening the scram valves to complete the full scram. However, the backup scram would not occur fast enough to fully protect the fuel cladding and pressure boundary during limiting design basis transients. The Technical Specifications and FSAR do not discuss the backup scram functions.

Corrective Actions

1. The eight resistors were relocated to the contactor enclosures, like the originally installed resistors. Completed November 18, 1993.

2. The exposed wires between the contactors were rewired inside conduit. Completed November 18, 1993.

3. The design conditions described above have been reviewed by General Electric, the designer of the additional circuits, for potential 10CFR21 reportability. GE concluded that a reportable condition does exist and notified all GE BWR owners and the NRC in December, 1993.

4. The Design Basis Document for the Reactor Protection System was issued on December 22, 1993.

Additional Information

Failed Components: None

Previous Similar Events: None

Related Industry Experience: None

GE Potentially Reportable Condition: 93-07, Inadequate separation in a BWR/4 Reactor Protection System December 15, 1993.

Updated information is indicated by a vertical revision bar in the right margin.

FIGURE 1

SIMPLIFIED PORTION OF THE RPS LOGIC