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November 09, 1995
C311-95-2472

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Dear Sir:

Subject: Three Mile Island Nuclear Station, Unit I (TMI-1)
Operating License No. DPR-50
Docket No. 50-289
LER 95-005-00

The purpose of this letter is to transmit Licensee Event Report (LER) No. 95-005-00 regarding an invalid Heat Sink Protection System actuation due to the failure of two logic modules. This event did not adversely affect the health and safety of the public.

Sincerely,

J. Knubel
Vice President and Director, TMI

AWM
Attachments
cc: Administrator, Region I
TMI Senior Resident Inspector
TMI Senior NRC Project Manager

IE22

NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), 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)

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TITLE (4)

INVALID HSPS ACTUATION DUE TO THE FAILURE OF TWO LOGIC MODULES

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
10	12	95	95	-- 005 --	00	11	09	95	FACILITY NAME	DOCKET NUMBER

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

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

	20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
	20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
	20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
	20.2203(a)(2)(ii)		20.2203(a)(4)	X	50.73(a)(2)(iv)		OTHER
	20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A	
	20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
A. W. Miller, TMI Licensing Engineer	(717) 948-8128

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
X	JB	IMOD	F180	N						

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
X	YES (If yes, complete EXPECTED SUBMISSION DATE).	NO		06	28	96

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

On October 12, 1995, during zero power physics testing following the 11R refueling outage, I&C Maintenance was troubleshooting a problem with the Heat Sink Protection System (HSPS). The Control Room personnel were aware that Maintenance was going to replace a suspected failed logic module associated with the "B" OTSG low pressure circuits. Prior to replacing this suspect module, the maintenance team inspected the status lights associated with the HSPS cabinets. A potential problem was indicated with the "B" OTSG high-high level logic circuits and reported to the Control Room staff. Poor communication between the Control Room staff and the maintenance team left the Control Room staff with the misunderstanding that these status light indications were also associated with "B" OTSG low pressure. During the replacement of the suspected failed logic module associated with "B" OTSG low pressure, main feedwater was isolated to the "B" OTSG due to the failure of two logic modules associated with "B" OTSG high-high level. The Control Room staff took appropriate action to defeat the invalid actuation and restore main feedwater flow prior to exceeding normal operating limits. The root cause of this event was the failure of two logic modules. An opportunity to prevent the actuation was missed due to less than adequate communications. Logic module failure analysis will continue in order to substantiate the suspected failure mode and to identify a potential fix to prevent recurrence. There were no adverse safety consequences or safety implications that resulted from this event, and this event did not affect the health and safety of the public.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

INVALID HSPS ACTUATION DUE TO THE FAILURE OF TWO LOGIC MODULES

i. Plant Operating Conditions Before Event:

On October 12, 1995, the TMI-1 reactor was critical at 10E-8 amps and zero power physics testing was in progress.

II. Status of Structures, Components or Systems That Were Inoperable At The Start Of The Event And That Contributed To The Event:

No systems, structures or components were out-of-service that contributed to this event.

III. Event Description:

On October 12, 1995, during the startup sequence following the 11R refueling outage, I&C maintenance was troubleshooting a problem in the Heat Sink Protection System (HSPS)*[JB] Train A - Once Through Steam Generator (OTSG)*[AB/SG] B Main Feedwater (MFW)*[SJ] isolation logic on low OTSG pressure. Control Room annunciator*[IB], "OTSG B Pressure Lo," alarmed even though OTSG pressure was normal. Local status lamps*[JB/IL] on the HSPS cabinets*[JB/CAB] were also faintly lit. An "A" train logic module*[JB/IMOD] which is interlocked with the Main and Startup Feedwater (FW) control valves*[SJ/FCV] FW-V-17B and FW-V-16B as well as the Control Room annunciator was believed to have failed. Approval to replace the module was granted.

Prior to replacing the "A" train module, the maintenance team inspected status lights on both the "A" and "B" train HSPS cabinets. Status lights are normally either on or off, where the on state indicates that some portion of the HSPS actuation logic has been satisfied. The two "A" train lights associated with the module being replaced were still faintly lit. However, eight "B" train lights were also observed to be faintly lit. The dim lamps were indicative of a potential problem in the "B" train actuation logic since the lamps are not designed to have a "dim" state.

All 8 of the "B" train lights were associated with OTSG B high-high level MFW isolation logic. If the dim lamps were valid indications, OTSG B Main and Startup FW block valves*[SJ/ISV] FW-V-5B and FW-V-92B would have been receiving a close signal. Actuation relay status lamps were immediately checked and showed that an isolation signal was not applied to the valves' closing circuit. The presence of dim lamps in the "B" Train and their association with the high-high level MFW isolation logic was reported to the Control Room.

The HSPS FW isolation feature on high-high OTSG level is not required by plant Technical Specifications; thus, the "Train B - OTSG B MFW Isolation on Hi-Hi Level defeat/enable switch*[JB/HS]" could have been placed in Defeat once the dim lamps were recognized. However, poor communication between the maintenance team and the Control Room staff led to the misunderstanding that the additional dim lamps were associated with the Train A lo-lo OTSG pressure logic which can not be defeated above 750 psig. Maintenance personnel did not believe that an HSPS actuation was imminent and decided to complete the "A" train repair work prior to seeking approval to troubleshoot the dim lamps in Train B.

The defective Train A module was removed. Configuration of the removed and replacement module was being compared (prior to installation of the new module) when Control Room alarm "OTSG B MFW Isolated" actuated and the OTSG B Startup FW block valve FW-V-92B closed. Main FW block valve FW-V-5B was normally closed at this point in the startup and did not change position. There was no valid reason for the actuation signal; OSTG B pressure and level were normal. Operations attempted to defeat the actuation by first pressing the Train B Lo-Lo

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Pressure defeat pushbutton switch. FW-V-92B could not be re-opened because of the HSPS Interlock. The Train B Lo-Lo Level defeat/enable switch was then placed in Defeat, allowing FW-V-92B to be opened. OTSG B level had dropped from approximately 25 to 17 inches. Normal OTSG level of 25 inches was restored and no Emergency Feedwater (EFW) actuation on lo-lo OTSG level (10 inch setpoint) occurred.

The breaker for FW-V-92B was opened to prevent a second actuation while the cause for the event was being evaluated. With the breaker open and the "A" train module not yet returned to service, both trains of the OTSG B MFW Isolation on Low Pressure were inoperable per Technical Specification 3.5.1.9.1, requiring that one train be restored to operable within 1 hour or be in Hot Shutdown within the next 6 hours. FW-V-92B's breaker was closed 1.5 hours later restoring the "B" train to Operable status. Since the reactor was only at 10E-8 amps, no immediate action had been taken to place the plant in Hot Shutdown. The Tech Spec action statement was fulfilled.

Maintenance on the "A" train module was completed and successfully tested restoring the Train A - OTSG B MFW Isolation on Low Pressure actuation logic to Operable status. Troubleshooting and repair of the "B" train commenced shortly thereafter.

Each HSPS train is arranged in a two out of four twice, energize to actuate logic scheme so that no single failure can prevent or cause an actuation. The logic modules operate in a "negative logic mode" where logic 1 is negative with respect to logic 0 (nominally +15 volts). Two logic modules, one in each of the two Train B OTSG B two out of four high-high level actuation circuits, were determined to have failed in the actuated state (significantly less than +15 volts). With both 2/4 logic circuits satisfied, the FW-V-5B and FW-V-92B actuation relays energized causing isolation of FW to OTSG B. The maintenance work being performed in Train A HSPS cabinets had no effect on the invalid Train B actuation.

The defective "B" train modules were replaced and the Train B - OTSG B MFW isolation logic was successfully tested. The Train B Hi-Hi Level defeat/enable switch was placed in Enable and HSPS was returned to a fully operational state.

The root cause of this event was failure of two logic modules. Invalid HSPS actuation could have been prevented if the communication between the maintenance team and the Control Room staff had not been terminated without reaching a thorough understanding of the abnormal indications and prompt action had been taken to defeat Train B - OTSG B MFW Isolation on Hi-Hi Level.

Preliminary analysis of the removed logic modules indicates that failure was due to blown board level fuses. Without an operating supply voltage, the normally high output impedance of the module (cutoff transistor) is degraded. The modules' output stages degraded to the point of passing an erroneous logic 1 signal resulting in the inadvertent MFW isolation. Although there are no lamps to indicate a blown module fuse, it is now understood that dim lamps can provide an early indication of a blown module fuse. Power switching transients, due to de-energizing and re-energizing the train cabinets during the refueling outage, are believed to have caused the fuses to blow. Discussions with the equipment manufacturer are underway to confirm and preclude the presumed failure mode.

Technical Specifications 3.5.1 does not include operability requirements for OTSG high-high level actuation. Technical Specification Change Request (TSCR) 166 which placed the HSPS requirements into the TMI-1 Technical Specifications specifically stated that HSPS is not considered an Engineered Safety Feature. However, TMI later verbally committed to NRC Region I personnel to report actuations of HSPS in order to be consistent with other plants. This commitment is reflected in site administrative procedure 1044, "Event Review and Reporting Requirements." Accordingly, the Plant Review Group agreed to report this HSPS actuation to the NRC in accordance with 10CFR50.72(b)(2)(ii) and 10CFR50.73(a)(2)(iv).

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IV. Component Failure Data:

Solid State Logic Card, Foxboro Spec 200 Model N-2AX+DSS.

V. Automatic Or Manually Initiated Safety System Responses:

Although the OTSG B high-high level actuation signal was invalid, Startup FW block valve FW-V-92B responded to the HSPS "B" Train isolation signal as designed. Main FW block valve FW-V-5B was already closed at this point in the plant startup and, therefore, did not change position. However, status lamps for the FW-V-5B actuation relays indicated that the relays energized as designed in response to the isolation signal.

VI. Assessment Of The Safety Consequences And Implications Of The Event:

Automatic isolation of FW to the "B" OTSG was not required for the plant conditions. Although it is undesirable to unnecessarily challenge safety related equipment, the FW block valve responded to the isolation signal as designed. The reduction in OTSG B level was minimal.

If the plant had been at full power when the FW isolation occurred, RCS pressure would likely have increased above the Reactor Protection System trip setpoint resulting in a reactor trip.

VII. Previous Events Of A Similar Nature:

There have been no previous HSPS actuations due to module failures.

VIII. Corrective Actions Planned:

1. Continue module failure analysis efforts to substantiate the suspected failure mode, and work with the equipment manufacturer to identify a potential fix to prevent recurrence. It is expected to complete this work by mid-June 1996.

2. Until a hardware resolution is implemented, require testing of the HSPS train logic after any complete loss of train power or after removing or losing power to any nest(s) containing N-2AX+DSS logic modules.

3. Instruct Operators to reduce ambient lighting when inspecting HSPS cabinet lamps so that dim lamps may be easily identified during daily inspections. Provide guidance for reporting of and response to dim lamps. It is expected that this will be completed by December 15, 1995.

4. Emphasize to plant staff the use of a formal communication technique (similar to the Operations Standing Order) when reporting abnormal conditions or indications to the Control Room. It is expected that this will be completed by March 29, 1996.

*The Energy Industry Identification System (EIIS), System Identification (SI) and Component Function Identification (CFI) Codes are included in brackets, "[SI/CFI]," where applicable, as required by 10 CFR 50.73 (b)(2)(ii)(F).