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United States Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Perry Nuclear Power Plant
Docket No. 50-440
LER 97-003

Ladies and Gentlemen:

Enclosed is Licensee Event Report (LER) 97-003, "Loss of Electrical Power to Reactor Protection System Bus Due to Electrical Protective Assembly Trip Results in Engineered Safety Feature Actuation."

If you have questions or require additional information, please contact Mr. Henry L. Hegrat, Manager - Regulatory Affairs, at (216) 280-5606.

Very truly yours,

for Lew W. Myers

Enclosure: LER 97-003

cc: NRC Region III Administrator
NRC Resident Inspector
NRC Project Manager

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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)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Perry Nuclear Power Plant, Unit 1	05000440	1 OF 6

TITLE (4)

Loss of Electrical Power to Reactor Protection System Bus Due to Electrical Protective Assembly Trip Results in Engineered Safety Feature Actuation

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
										05000
03	22	97	97	-- 003 --	00	04	21	97	FACILITY NAME	DOCKET NUMBER
										05000

OPERATING MODE (9)	1
POWER LEVEL (10)	100

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)
Todd A. Henderson, Supervisor-Compliance	(216) 280-5889

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
B	JC	BKR	G080	Yes						

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION	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)

On March 22, 1997, at approximately 1938 hours, the Perry Nuclear Power Plant, Unit No. 1, was operating at 100 percent of rated thermal power when electrical power from the Reactor Protection system (RPS) motor generator (MG) set "B" to RPS bus "B" was lost. As a result, RPS "B" electrical power was removed from Division 2 and 4 RPS logic as well as Division 2 Nuclear Steam Supply Shutoff system (NSSSS) isolation logic. Subsequent to the loss of RPS "B" electrical power, an RPS B and D channel half scram and the expected annunciations were received. The loss of RPS "B" electrical power to the Division 2 NSSSS isolation logic resulted in the initiation of Balance of Plant isolation, Reactor Water Cleanup isolation, Residual Heat Removal isolation, Main Steam Line Drain isolation, and Reactor Sampling isolation actuation signals. RPS bus "B" was aligned to its alternate power source, the half scram and Division 2 NSSSS isolation signals were reset, and plant operators restored from the event in accordance with plant procedures.

The event resulted from the trip of an Electrical Protective Assembly (EPA) due to random failure of the associated logic control board. Results of the failure analysis by the vendor indicate that integrated circuit chips associated with the undervoltage and underfrequency trip circuitry were found to be in a defective/degraded condition. The logic control board for the EPA was replaced with an updated board. Additionally the eight logic control boards currently installed in the plant are scheduled to be replaced with a newer designed logic control board.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Perry Nuclear Power Plant, Unit 1	05000440	97	-- 003 --	00	2 OF 6

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

I. Introduction

On March 22, 1997, at approximately 1938 hours, the spurious actuation of an electrical protective assembly [BKR] (EPA), General Electric company, model number 914E175G001, resulted in a loss of electrical power to Reactor Protection system (RPS) bus "B" causing initiation of Division 2 Nuclear Steam Supply Shutoff system [JM] (NSSSS) actuation signals resulting in Balance-of-Plant (BOP), Main Steam Line Drain, and Reactor Sampling isolations.

Notification was made to the NRC via the Emergency Notification System at 2027 hours (ENF No. 32001), in accordance with the requirements of 10CFR50.72(b)(2)(ii). This event is being reported in accordance with 10CFR50.73(a)(2)(iv) as an event that resulted in an automatic actuation of an engineered safety feature.

At the time of the event initiation, the plant was in Mode 1 at 100 percent of rated thermal power. The reactor pressure vessel pressure was at approximately 1024 psig with reactor coolant at saturated conditions.

II. Event Description

On March 22, 1997, at approximately 1938 hours, electrical power from the RPS motor generator (MG) set "B" to RPS bus "B" was lost. As a result, RPS "B" electrical power was removed from Division 2 and 4 RPS logic, Division 2 NSSSS isolation logic, and from the input optical isolator cards that are utilized in the annunciator logic circuitry. Subsequent to the loss of RPS "B" electrical power, an RPS B and D channel half scram and the expected annunciations were received. The loss of RPS "B" electrical power to the Division 2 NSSSS isolation logic resulted in the initiation of BOP isolation, Reactor Water Cleanup (RWCU) isolation, Residual Heat Removal (RHR) isolation, Main Steam Line Drain isolation, and Reactor Sampling isolation actuation signals to close the associated valves.

Numerous associated BOP isolation valves isolated and the RWCU system isolated and caused the operating RWCU pump to trip per design. The inboard Main Steam Line Drain valve and a Reactor Water Sample isolation valve isolated per design. The associated RHR isolation valves were already closed as required by the plant conditions before the event initiation and therefore did not change position in response to the isolation actuation signals.

Off-Normal Instruction (ONI)-C71-2, "Loss of One RPS Bus (Unit 1)," was entered by the control room operators. At 1940 hours, control room operators shifted RPS bus "B" to the alternate electrical power source. Subsequently, the RPS B and D channel half scram was reset and at 1942 hours, the NSSSS isolation logic was reset. Restoration from the isolations continued and at 1950 hours, a nonlicensed operator reported to the control room operators that an RPS "B" EPA (1C71-S003D) had tripped and that the RPS "B" motor generator (MG) set was running with normal indications. Restoration efforts were concluded on March 22, 1997, at 2313 hours, when ONI-C71-2 was exited.

Troubleshooting efforts were focused on the cause of 1C71-S003D tripping. Review of Emergency Response Information system computer point traces of RPS "B" bus voltage prior to the event did not indicate a problem with the RPS "B" MG set output voltage, and the fact that the upstream redundant EPA (1C71-S003B) did not trip indicates that 1C71-S003D did not trip on a valid signal. Additionally, when RPS bus "B" was re-energized using the alternate power source during the event recovery, no problems were identified with the RPS bus "B" loads. On March 25, 1997, testing of the RPS "B" bus voltage, EPA breaker, and the EPA logic control board [CBD], General Electric company, model number 147D8652G001 (group 1), was started and results of the testing did not indicate any equipment problems. The group 1 logic control board has a history of spurious trips which resulted in the design of an improved model, General Electric company, model number 147D8652G009 (group 9). On March 26, 1997, the installed group 1 EPA logic control board was replaced with a group 9 EPA logic control board. The group 9 EPA logic control board was calibrated and tested in accordance with the appropriate plant procedures. On March 27, 1997, the RPS "B" MG set and EPAs were declared operable. On March 31, 1997, the suspect logic control card was sent to the vendor for failure analysis. On April 8, 1997, a disturbance analyzer was connected to the RPS "B" MG set output to monitor for and record anomalies. Although the RPS bus "B" is currently being supplied by its alternate power source, the RPS "B" MG set is considered to be fully operable and may be aligned to supply electrical power to RPS bus "B" at the operators' discretion.

III. Cause of Event

The engineering root cause analysis has concluded that the event is the result of the tripping of EPA 1C71-S003D due to random failure of the associated logic control board. Results of the failure analysis by the vendor (i.e., General Electric company) indicate that integrated circuit chips associated with the undervoltage and underfrequency trip circuitry were found to be in a defective/degraded condition. Potential problems with spurious trips caused by the logic control boards have been addressed by General Electric company Service Information Letters (SILs) 496 and 496-1, which recommend installing boards of an improved design if problems with spurious trips are encountered.

IV. Safety Analysis

The RPS power system prevents auxiliary power system switching transients from causing an inadvertent reactor scram due to a transient disturbance of power to the reactor scram logic. The RPS power system is designed to provide electrical power to the two RPS buses. The RPS power system includes two high inertia, alternating current MG sets, and distribution equipment. Each RPS bus supplies control power for independent trip systems of the NSSSS, the power range neutron monitoring system, parts of the process radiation monitoring system, and the RPS trip system.

Electrical power to each of the RPS buses is supplied from two 120-volt AC power sources. The primary source of power to each RPS bus is an MG set. The alternate source of 120-volt AC power is the station non-Class 1E power supply. The two MG sets are supplied from separate 480 volt motor control centers fed from non-Class 1E buses. The alternate power switch design and arrangement prevents paralleling of the power sources. During operation, the RPS buses are energized by the respective MG sets. Either MG set can be taken out-of-service by manually operating the power source selector switch which disconnects the MG set and connects the respective RPS bus to the alternate power source. Provision is made to

prevent connection of both RPS buses to the alternate power source at the same time. A loss of power to either MG set is monitored in the control room where the operator, upon detecting such a condition, can switch to the alternate power source. The RPS power is classified as nonessential because failure of the power supply causes a trip condition; however, the power feeds to independent divisions are physically separated and supply redundant logic.

Since the RPS electrical power is classified as nonessential, it has electrical protective assemblies (EPAs) which consist of Class 1E protective circuitry between the RPS buses and each of the power sources. Two EPAs provide redundant protection to each RPS bus by acting to disconnect the RPS bus from the power source circuits. The EPA consists of a circuit breaker with a trip coil driven by logic circuitry which senses line voltage and frequency and trips the circuit breaker open on the conditions of over voltage, under voltage, and under-frequency. Provision is made for setpoint verification, calibration, and adjustment under administrative control. After tripping, the circuit breaker must be reset manually. Trip setpoints are based on providing 120 volt AC, 60 Hz power at the logic cabinets. The protective circuit functional range is ±10 percent of nominal AC voltage and -5 percent of nominal frequency.

Chapter 15 of the USAR discusses the accident analyses for PNPP. The worst case scenario affecting the non-class 1E 480V Distribution System and supplied equipment is the total loss of offsite power (LOOP). Under this scenario, AC power to the non-class 1E transformers and busses would be lost except for backup safety related power sources for specific loads. The worst case failure mode of these transformers is a fault condition which will be cleared through existing breaker coordination and protection circuitry. The worst case failure of a non-class 1E transformer is loss of the associated bus. Therefore, operation with or without non-class 1E load centers (i.e., loss of electrical power to RPS buses) is bounded by the LOOP event.

The NSSSS includes the instrument channels, trip logics, and actuation circuits that automatically initiate valve closure providing isolation of the containment and/or reactor vessel, and initiation of systems provided to limit the release of radioactive materials. During normal plant operation, the isolation control system sensors and trip logic that are essential to safety are energized. When abnormal conditions are sensed, instrument contacts open, de-energize the trip logic, and initiate an isolation. The design objective for the containment isolation system is to allow normal or emergency passage of fluids through the containment boundary while preserving the ability of the boundary to prevent or limit the escape of fission products that may result from postulated accidents so that site boundary dose guidelines specified by 10CFR100 are not exceeded. This objective is achieved by provisions for automatic isolation of appropriate lines that penetrate the containment boundary.

During the event, the NSSSS instruments, trip logics, actuation circuits, and valves responded as designed to the loss of electrical power. Closure of these valves, to their required safeguards position, did not adversely affect safe operation of the plant; therefore, this event is considered to have minimal safety significance.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Perry Nuclear Power Plant, Unit 1	05000440	97	-- 003 --	00	5 OF 6

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

V. Similar Events

LER 86-044 documented an event in which failing capacitors on a logic control board resulted in a spurious EPA trip and loss of electrical power to RPS bus "A" as well as resulting in the generation of the associated isolation signals. Corrective actions included replacement of both RPS bus "A" and "B" logic control boards and the initiation of a repetitive task to periodically change out the logic control boards.

LER 87-042 documented an event in which the spurious EPA trip and loss of electrical power to RPS Bus A was attributed to the failure of a logic control board due to abnormal voltage pulses on the output of an integrated circuit chip. Corrective actions included replacement of both RPS bus "A" and "B" logic control boards and investigation of other boards for similar conditions. No abnormal voltage pulses were noted on other boards.

LER 90-029-01 documented an event in which two EPAs unexpectedly tripped resulting in a loss of electrical power to RPS bus "B". The cause of the trip was indeterminate; but, a spike suppressor was replaced to eliminate potential sources of noise that might cause the EPAs to trip without a valid trip signal.

LER 92-001 documented an event in which a malfunctioning EPA logic control board unexpectedly tripped resulting in loss of electrical power to RPS bus "B". The cause of the trip was attributed to an EPA logic control board. The logic control board was replaced and calibrated in accordance with plant procedures.

LER 97-002 documented a recent event in which RPS bus "B" electrical power was lost due to the tripping of a non-class 1E breaker which supplies, among other loads, electrical power to the RPS "B" MG set. The cause of the event was attributed to an isolated random component failure (i.e., the ground fault relay). The ground fault relay was replaced and tested prior to returning the breaker to service. This event is discussed due to the similar plant response and not due to a similar cause.

The corrective actions for the LERs listed above could not be reasonably expected to prevent the March 22, 1997 event.

VI. Corrective Actions

The logic control board for EPA 1C71-S003D was replaced with a group 9 board. Additionally the eight logic control boards currently installed in the plant are scheduled to be replaced with a newer designed logic control board, General Electric company, model number 148D611G002. The board replacements will be completed by June 30, 1998.

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Perry Nuclear Power Plant, Unit 1	05000440	97	-- 003 --	00	6 OF 6

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

The following table identifies those actions which are considered to be regulatory commitments. Any other actions discussed in this document represent intended or planned actions, are described for the NRC's information, and are not regulatory commitments. Please notify the Manager - Regulatory Affairs at the Perry Nuclear Power Plant of any questions regarding this document or any associated regulatory commitments.

Commitments

The eight logic control boards currently installed in the plant are scheduled to be replaced with a newer designed logic board, General Electric company, model number 148D611G002. The board replacements will be completed by June 30, 1998.