

**LICENSEE EVENT REPORT (LER)**(See Page 2 for required number of  
digits/characters for each block)

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to [Infocollects.Resource@nrc.gov](mailto:Infocollects.Resource@nrc.gov), and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

**1. FACILITY NAME**

Perry Nuclear Power Plant

**2. DOCKET NUMBER**

05000-440

**3. PAGE**

1 OF 4

**4. TITLE**

Loss of Safety Related Electrical Bus Results in a Loss of Shutdown Cooling

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
02	11	2016	2016	003	00	04	08	2016	FACILITY NAME	DOCKET NUMBER
										05000
										05000

**9. OPERATING MODE**

4

☐ 20.2201(b)      ☐ 20.2203(a)(3)(i)      ☐ 50.73(a)(2)(ii)(A)      ☐ 50.73(a)(2)(viii)(A)

☐ 20.2201(d)      ☐ 20.2203(a)(3)(ii)      ☐ 50.73(a)(2)(ii)(B)      ☐ 50.73(a)(2)(viii)(B)

☐ 20.2203(a)(1)      ☐ 20.2203(a)(4)      ☐ 50.73(a)(2)(iii)      ☐ 50.73(a)(2)(ix)(A)

☐ 20.2203(a)(2)(i)      ☐ 50.36(c)(1)(i)(A)      ☒ 50.73(a)(2)(iv)(A)      ☐ 50.73(a)(2)(x)

**10. POWER LEVEL**

000

☐ 20.2203(a)(2)(ii)      ☐ 50.36(c)(1)(ii)(A)      ☐ 50.73(a)(2)(v)(A)      ☐ 73.71(a)(4)

☐ 20.2203(a)(2)(iii)      ☐ 50.36(c)(2)      ☐ 50.73(a)(2)(v)(B)      ☐ 73.71(a)(5)

☐ 20.2203(a)(2)(iv)      ☐ 50.46(a)(3)(ii)      ☐ 50.73(a)(2)(v)(C)      ☐ 73.77(a)(1)

☐ 20.2203(a)(2)(v)      ☐ 50.73(a)(2)(i)(A)      ☐ 50.73(a)(2)(v)(D)      ☐ 73.77(a)(2)(i)

☐ 20.2203(a)(2)(vi)      ☐ 50.73(a)(2)(i)(B)      ☐ 50.73(a)(2)(vii)      ☐ 73.77(a)(2)(ii)

☐ 50.73(a)(2)(i)(C)      ☐ OTHER Specify in Abstract below or in NRC Form 366A

**12. LICENSEE CONTACT FOR THIS LER****LICENSEE CONTACT**

Julie Severino, Regulatory Compliance Engineer

**TELEPHONE NUMBER (Include Area Code)**

440-280-5529

**13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT**

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
B	EB	FU	X999	Y					

**14. SUPPLEMENTAL REPORT EXPECTED**☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE)      ☒ NO**15. EXPECTED SUBMISSION DATE**

MONTH	DAY	YEAR

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

On February 11, 2016, at approximately 1505 hours with the plant in mode 4, an indicated loss of power to the division 1 4160 volt bus, EH11, occurred. An invalid undervoltage signal tripped the bus supply breaker, and the bus loads shed, as expected. The invalid undervoltage signal resulted in a loss of shutdown cooling. The division 1 diesel generator (DG) started and loaded the EH11 bus. Subsequently the division 1 DG was manually shutdown due to cooling water not being available. This de-energized all division 1 equipment, including the train supplying shutdown cooling at the time. Shutdown cooling was re-established 42 minutes later from division 2.

A manufacturing defect in a fuse caused the event. A 10 CFR Part 21 report was filed by the supplier on March 22, 2016. This is being reported under 50.73(a)(2)(iv)(A) as an invalid actuation.

Corrective actions were taken to replace and analyze the defective fuse. Fuses with the same batch will be sent for analysis. The vendor's 10 CFR Part 21 analysis is also being tracked.

The safety significance is determined to be an event of very small risk significance based on a qualitative defensive in-depth risk assessment.

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		3. LER NUMBER		
1. FACILITY NAME	2. DOCKET NUMBER	YEAR	SEQUENTIAL NUMBER	REV NO.
Perry Nuclear Power Plant	05000440	2016	003	0

**NARRATIVE**

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

**INTRODUCTION**

On February 11, 2016, at 1505 hours, the division 1 4160 volt bus lost power, caused by an invalid undervoltage signal from a defective fuse. The division 1 diesel generator (DG) [EB] started and loaded. The division 1 DG's cooling water pump did not start, so the division 1 DG was manually shutdown approximately two minutes later. All division 1 equipment was de-energized, including shutdown cooling. Shutdown cooling was re-established 42 minutes later from division 2.

This event was reported on February 11, 2016, at 1938 hours under 10 CFR 50.72(b)(3)(iv)(A) as a specific system actuation due to the automatic start of the division 1 DG on a valid signal. After troubleshooting and analysis, it was determined that the start of the division 1 DG was due to an invalid undervoltage signal. This is being reported under 50.73(a)(2)(iv)(A) as an invalid actuation.

**DESCRIPTION OF EVENT**

On February 11, 2016, at approximately 1505 hours with the plant in mode 4, a sensed loss of power to the division 1 4160 volt bus [EA], EH11, occurred. A bus potential transformer secondary fuse, which supplies the undervoltage and degraded voltage circuitry, failed. Bus supply breaker, EH1115, tripped open based upon the sensed invalid undervoltage signal, and the bus loads were shed as designed, including residual heat removal (RHR) A [BO], which was supplying shutdown cooling at the time. The invalid EH11 undervoltage signal resulted in the division 1 DG starting and loading the EH11 bus.

Once the division 1 DG started, it did not receive cooling water from emergency service water (ESW) [BI] A. The ESW A pump did not start because the ESW A pump breaker, EH1106, logic sensed an EH11 undervoltage condition. An ESW A pump breaker trip signal was locked in based upon the EH11 bus undervoltage sensing logic indicating that the EH11 bus was not at rated voltage on all phases. A bus undervoltage signal provides a locked in breaker trip signal and also resets a breaker closure permissive on an undervoltage signal. When the DG had started and tied to the bus, proper three phase bus voltage levels were actually present. The division 1 DG was consequently shutdown, due to the lack of cooling water provided by ESW A. The EH11 bus undervoltage relay logic functioned as designed based upon the failed A phase secondary potential transformer fuse. Since the division 1 DG was shutdown, all division 1 equipment was de-energized, with RHR A no longer available to provide shutdown cooling. The following Technical Specifications (TS) were entered as a result of the loss of the division 1 bus:

- TS 3.4.10, Residual Heat Removal (RHR) Shutdown Cooling System - Cold Shutdown
- TS 3.8.2, AC Sources - Shutdown
- TS 3.8.5, DC Sources - Shutdown
- TS 3.8.8, Distribution Systems - Shutdown
- ORM 6.4.8, Emergency Service Water Systems - Shutdown

Operators took action to place RHR B in service. On February 11, 2016, at 1544 hours, the RHR B pump was started, and shutdown cooling was re-established with RHR B at 1547. Shutdown cooling was not in operation for approximately 42 minutes.

Simple troubleshooting was performed to identify the issue, and the A phase potential transformer secondary fuse was found to exhibit intermittent continuity. The defective fuse was replaced and sent out for failure analysis.

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On February 12, 2016, at 0032 hours, EH11 was re-energized. The following TSs were declared met:

- TS 3.4.10, Residual Heat Removal (RHR) Shutdown Cooling System - Cold Shutdown, February 12, 2016 at 1311 hours
- TS 3.8.2, AC Sources - Shutdown, February 12, 2016 at 1140 hours
- TS 3.8.5, DC Sources - Shutdown, February 12, 2016 at 1140 hours
- TS 3.8.8, Distribution Systems - Shutdown, February 12, 2016 at 1140 hours
- ORM 6.4.8, Emergency Service Water Systems - Shutdown, February 12, 2016 at 1140 hours

**CAUSE OF EVENT**

During the performance of simple troubleshooting on February 11, 2016, a Ferraz Shawmut OT-15 fuse in the A phase bus potential transformer secondary fuse location, which supplies the undervoltage and degraded voltage circuitry, was found to exhibit intermittent continuity. Failure analysis and simple troubleshooting methods determined the cause of the loss of the division 1 bus, EH11, was due to an invalid undervoltage signal caused by the failure of the fuse which supplies the undervoltage and degraded voltage protection circuitry. The failure analysis revealed that the fuse internals were not soldered correctly during the manufacturing process. One of the fuse elements to fuse ferrule connections had flux applied but no solder.

The apparent cause for the loss of division 1 bus, EH11, was a latent manufacturing defect in the A phase bus potential transformer secondary fuse that resulted in a loss of A phase indicated voltage to the undervoltage sensing logic. This latent manufacturing defect led to an intermittent connection which resulted in a loss of sensed bus voltage.

**ANALYSIS OF EVENT**

The undervoltage signal that the division 1 DG received due to the failed fuse is not a valid actuation of the system. Per NUREG-1022 Rev. 3, Event Report Guidelines 10 CFR 50.72 and 50.73, it states the following:

Valid actuations are those actuations that result from valid signals or from intentional manual initiation, unless it is part of a preplanned test. Valid signals are those signals that are initiated in response to actual plant conditions or parameters satisfying the requirements for initiation of the system. They do not include those that are the result of other signals.

Since at the time of the fuse failure proper three phase bus voltage was present and the signal was from a latent manufacturing defect, this is not a valid actuation.

A qualitative defense-in-depth risk assessment was performed for the February 11, 2016, loss of shutdown cooling event. Based on the conclusions of the condition report investigation, an event of very small risk significance was concluded. Assuming the loss of EH11 could have occurred at any point in time, a delta core damage frequency of 8.2E-08 per year was calculated that also indicates a very small risk significance event. These conclusions were based on the nature of the failure immediately being identifiable, appropriate levels of defense-in-depth at the time of the loss, and timely and appropriate operator response to the event.

**CORRECTIVE ACTIONS**

The defective fuse with the intermittent continuity had an Underwriters Laboratories (UL) provided manufacturing/licensing code of FP22-66. The extent of condition has been limited to fuses obtained under a specific batch number. The remaining stock found in maintenance inventory and the warehouse stock had the

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same UL manufacturing code associated with the batch number. A sampling of other Ferraz Shawmut OT-15 fuses with or without the same manufacturing code have been examined without any further soldering defects identified. The defective fuse was purchased through United Controls International Inc. (UCI), which performs Commercial Grade Dedication under a 10 CFR Appendix B Program. The defective fuse and failure analysis have been provided to UCI as information for their 10 CFR Part 21 investigation.

UCI has received eight of the twenty-two fuses that are in the same purchase order. This included the defective fuse. UCI currently considers this issue to be an isolated event as no previous instances of this failure have been observed and dissection of additional fuses of the same part number and from the same manufacturing lot have provided no additional supporting evidence that the manufacturing error identified a recurring event. UCI is investigating this issue to identify the possible cause.

The follow-up corrective actions are to replace the Ferraz Shawmut OT-15 fuses that were installed under the suspect batch number and to document their laboratory analysis. UCI has subsequently issued a 10 CFR Part 21 evaluation.

**PREVIOUS SIMILAR EVENTS**

A review of LERs and the corrective action database for the past three years did not have any previous similar events.

**COMMITMENTS**

There are no regulatory commitments contained in this report. Actions described in this document represent intended or planned actions, are described for the NRC's information, and are not regulatory commitments.