FENOC™
FirstEnergy Nuclear Operating Company

Perry Nuclear Power Plant
P.O. Box 97
10 Center Road
Perry, Ohio 44081

Ernest J. Harkness
Vice President

440-280-5382
Fax: 440-280-8029

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L-14-418

10CFR50.73(a)(2)(iv)(A)

ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT:
Perry Nuclear Power Plant
Docket No. 50-440, License No. NPF-58
Licensee Event Report Submittal

Enclosed is Licensee Event Report (LER) 2014-005, "Loss of Feedwater Results in Automatic Reactor Protection System Actuation". There are no regulatory commitments contained in this submittal.

If there are any questions or if additional information is required, please contact Mr. Nicola Conicella, Manager – Regulatory Compliance, at (440) 280-5415.

Sincerely,

Ernest J. Harkness

Enclosure:
LER 2014-004

cc: NRC Project Manager
NRC Resident Inspector
NRC Region III

IE22
NRR

NRC FORM 366 (01-2014) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 01/31/2017

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, 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.

LICENSEE EVENT REPORT (LER)

(See Page 2 for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
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4. TITLE

Loss of Feedwater Results in Automatic Reactor Protection System Actuation

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
11	07	2014	2014	005	00	1	6	2015	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*			
1	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
10. POWER LEVEL	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
98.6	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71 (a)(4)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71 (a)(5)
	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☒ OTHER
	☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Julie Severino, Engineer – Regulatory Compliance	(440) 280-5529

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

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

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

On November 7, 2014, at 0847 hours, the reactor protection system (RPS) automatically actuated due to a loss of feedwater flow to the reactor pressure vessel (RPV). There were no complications during the shutdown as all control rods fully inserted and pressure was maintained by normal means. The high pressure core spray (HPCS) and the reactor core isolation cooling (RCIC) systems actuated based on a valid low reactor water level initiation and injected to restore RPV water level.

The cause of the event was determined to be the injection of an invalid runback signal from the redundant reactivity control system (RRCS) into the digital feedwater control system (DFWCS). The design change which implemented DFWCS was identified to have a latent design flaw and a design change will be implemented to eliminate these single point vulnerabilities.

The safety significance of this event is considered to be small. This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A) as an event or condition that resulted in an automatic actuation of the RPS, HPCS, and RCIC systems, and also Operational Requirements Manual (ORM) section 7.6.2.1, which requires a special report submittal following an emergency core cooling system actuation and injection into the reactor coolant system.

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

INTRODUCTION

On November 7, 2014 at 0847 hours, the reactor protection system (RPS) [JC] automatically actuated in response to a low reactor water level (i.e., Level 3, 178 inches above the top of active fuel (TAF)) signal due to a loss of feedwater [JB] flow to the reactor pressure vessel (RPV). At the time of the event, the plant was in Mode 1 with the reactor operating at 98.6 percent of rated thermal power (RTP). Reactor water level continued to decrease until the HPCS [BG] and RCIC [BN] systems automatically started on an RPV Level 2 signal (130" above TAF). At 1113 hours, notification was made to the NRC Operations Center (Reference ENF No. 50601) in accordance with 10 CFR 50.72(b)(2)(iv)(A), emergency core cooling system (ECCS) discharge into the reactor coolant system; 10 CFR 50.72 (b)(2)(iv)(B), actuation of the reactor protection system when the reactor is critical; and 10 CFR 50.72(b)(3)(iv)(A), valid actuation of several specified systems. This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A) as an event or condition that resulted in automatic actuation of the RPS, HPCS, RCIC, division 3 emergency diesel generator (EDG) [EK], division 3 emergency service water (ESW) [BI], division 1 ESW, and containment isolation valves [JM].

This report also satisfies ORM section 7.6.2.1, which requires a special report submittal following an ECCS actuation and injection into the reactor coolant system.

DESCRIPTION OF EVENT

On November 7, 2014, the plant was operating in Mode 1 at 98.6 percent RTP. The plant was in a normal electrical line-up with all EDGs [ED] and all ECCS systems operable. The feedwater system was in its normal alignment with turbine-driven reactor feedwater pumps (RFP) A and B in automatic 3-element level control. The motor-driven feedwater pump (MFP) was in standby.

At 0847 hours, an RPS actuation occurred resulting in an automatic plant scram. The RPS actuated in response to a low reactor water level (Level 3) signal as a result of a loss of feedwater flow to the RPV. The loss of feedwater flow was the result of an invalid feedwater signal from the redundant reactivity control system (RRCS) [JE]. All control rods fully inserted into the core.

RPV water level continued to decrease to the Level 2 setpoint (130 inches above TAF) when the RCIC and HPCS systems started and injected into the RPV. Balance of plant isolation occurred with isolation of all required valves. Both reactor recirculation [AD] pumps tripped as designed. The division 3 EDG, which supplies emergency electrical power to the HPCS system started but, as designed, did not load onto the bus. The MFP started as designed on a RFP trip signal. At approximately 0850 hours, the HPCS and RCIC system injections terminated on a Level 8 setpoint (219 inches above the TAF) as designed. The lowest RPV water level reached during the event was 77.2 inches above the TAF. RPS was reset at 0915 hours. Mode 4, Cold Shutdown was entered at 1752 hours.

CAUSE OF EVENT

The RPS scram was caused by an invalid feedwater runback signal from the division 1 RRCS. A recorder was installed for additional monitoring purposes and identified signals being injected from the RRCS self-test system (STS) feature into the DFWCS. Data analysis determined that the voltage perturbations correlated to the STS within RRCS. The voltage perturbations had amplitudes of ~ 66 VDC with pulse durations of ~ 1 msec. These pulses would repeat in a repetitive pattern between 5 to 7 pulses with noted frequencies varying as short as 130 – 230 msecs. The patterns would occur for a period of ~ 10 seconds on 2 minute intervals. This signal has a large enough amplitude for actuating the input on the field bus module (FBM); however, the DFWCS software has a 1 scan (200 msec) delay feature to prevent the actuation. A DFWCS runback signal can occur when a signal is in for greater than 200 msecs or these 1 msec pulses align exactly at 200 msec apart.

The root cause was determined to be a latent design flaw in the upgrade design package of the DFWCS modification in 2005. Due to implementing the new digital upgrade, the interface between RRCS and DFWCS involving the runback signal was altered. The original design used interposing relays as the interface between the RRCS and the feedwater control system. The digital upgrade changed the design interface and removed the interposing relays tying the output of RRCS directly into DFWCS.

EVENT ANALYSIS

There were no complications during the shutdown as all control rods fully inserted and pressure was maintained by normal means. The RPS functioned as designed.

The scram event, including plant response, is bounded by the Loss of Feedwater Flow transient evaluated in the Updated Safety Analysis Report (USAR) Chapter 15, Accident Analysis, Section 15.2. 7. As a direct result of the scram, no plant parameters challenged the transients as described in the USAR. This transient is categorized as an incident of moderate frequency.

ORM section 7.6.2.1 requires a special report be submitted following an ECCS actuation and injection into the reactor coolant system. The report shall include a description of the circumstances of the actuation and the total accumulated actuation cycles to date. The current value of the usage factor for each affected safety injection nozzle shall be provided when its value exceeds 0.70. Following the scram, the HPCS system actuated once for level control and injected into the RPV for approximately 2 minutes. This injection brings the total number of HPCS injections to 45 over the life of the plant. The current design Cumulative Fatigue Usage Factor (CFUF) for the limiting location of the HPCS nozzle is 0.567. The number of design HPCS injections is 60. The number of operating HPCS injections is bounded by the design allowance. The current design CFUF value is less than ORM Special Report Limit (0. 70).

A Probabilistic Risk Assessment (PRA) evaluation was performed for the November 07, 2014 loss of feedwater and reactor scram event. An analysis of this plant trip indicates a delta core damage frequency (CDF) of 1E-8/yr, and a delta large early release frequency (LERF) of 3E-10/yr. The delta CDF and delta LERF values are well below the acceptable thresholds of 1E-6/yr and 1E-7/yr, respectively, as discussed in Regulatory Guide 1.174. The risk of this event is therefore considered small in accordance with the Regulatory Guidance.

CORRECTIVE ACTIONS

The immediate corrective action was to isolate the STS to prevent another inadvertent feedwater runback signal.

An engineering design change will be implemented to eliminate this SPV.

PREVIOUS SIMILAR EVENTS

A review of LERs and the corrective action database for the past three years identified two similar events.

LER 13-001, Loss of Feedwater Results in Automatic Reactor Protection System Actuation, documents a similar event due to an electrical transient in the balance-of-plant 120 volt AC uninterruptable power supply system [EJ]. The cause was identified as inadequate reliability improvement for the UPS.

The corrective actions from LER 13-001 would not have prevented the current event because the current event was a result of a spurious signal from RRCS.

LER 14-004, Loss of Feedwater Results in Automatic Reactor Protection System Actuation, state the cause of the event was a failure of a balance-of-plant inverter/static transfer switch, which provides electrical power to the digital feedwater control system. A circuit card in the static transfer switch degraded, which caused a loss of power during manual transfer operations.

The corrective actions from LER 14-004 would not have prevented this event because this event is from spurious signals from the RRCS and not from a manufacturing defect.

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.