

**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, 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

Manual Reactor SCRAM Due to Spurious Opening of Safety Relief Valves

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	08	2016	2016	002	00	04	08	2016		05000
9. OPERATING MODE			11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)							
1			<input type="checkbox"/> 20.2201(b)			<input type="checkbox"/> 20.2203(a)(3)(i)			<input type="checkbox"/> 50.73(a)(2)(ii)(A)	
			<input type="checkbox"/> 20.2201(d)			<input type="checkbox"/> 20.2203(a)(3)(ii)			<input type="checkbox"/> 50.73(a)(2)(ii)(B)	
			<input type="checkbox"/> 20.2203(a)(1)			<input type="checkbox"/> 20.2203(a)(4)			<input type="checkbox"/> 50.73(a)(2)(iii)	
			<input type="checkbox"/> 20.2203(a)(2)(i)			<input type="checkbox"/> 50.36(c)(1)(i)(A)			<input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)	
10. POWER LEVEL 100			<input type="checkbox"/> 20.2203(a)(2)(ii)			<input type="checkbox"/> 50.36(c)(1)(ii)(A)			<input type="checkbox"/> 50.73(a)(2)(v)(A)	
			<input type="checkbox"/> 20.2203(a)(2)(iii)			<input type="checkbox"/> 50.36(c)(2)			<input type="checkbox"/> 50.73(a)(2)(v)(B)	
			<input type="checkbox"/> 20.2203(a)(2)(iv)			<input type="checkbox"/> 50.46(a)(3)(ii)			<input type="checkbox"/> 50.73(a)(2)(v)(C)	
			<input type="checkbox"/> 20.2203(a)(2)(v)			<input type="checkbox"/> 50.73(a)(2)(i)(A)			<input type="checkbox"/> 50.73(a)(2)(v)(D)	
			<input type="checkbox"/> 20.2203(a)(2)(vi)			<input type="checkbox"/> 50.73(a)(2)(i)(B)			<input type="checkbox"/> 50.73(a)(2)(vii)	
			<input type="checkbox"/> 50.73(a)(2)(i)(C)			<input type="checkbox"/> OTHER Specify in Abstract below or in NRC Form 366A				

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT

David Lockwood – Regulatory Compliance

TELEPHONE NUMBER (Include Area Code)

440-280-5200

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

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

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 8, 2016, at 1503 hours, control room operators initiated a manual reactor protection system (RPS) actuation in response to rising temperature in the suppression pool. All control rods full inserted. Prior to the RPS actuation the plant was in mode 1 at approximately 96 percent rated thermal power. At 1500 hours, multiple safety relief valves (SRVs) partially opened due to an invalid reactor pressure vessel (RPV) pressure signal. Control room indications showed two SRVs remained open resulting in a suppression pool temperature rise. Suppression pool cooling was initiated and a plant cooldown to Mode 4 was initiated.

The direct cause of the event was a momentary pressure perturbation limited to the RPV B reference leg that caused the connected transmitters to sense RPV pressure and level changes that resulted in SRV actuation. Corrective actions include revision to plant procedures for operation of the RPV reference legs and associated purge panels, and changes to the time constants for the affected RPV transmitters.

The safety significance of this event is considered to be very 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 a manual actuation of the RPS.

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CONTINUATION SHEET**

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				YEAR	SEQUENTIAL NUMBER	REV NO.
Perry Nuclear Power Plant		05000-440		2016	002	0

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

INTRODUCTION

On February 8, 2016, at 1503 hours, control room operators initiated a manual reactor protection system (RPS) [JC] actuation in response to rising temperature in the suppression pool. Prior to the RPS actuation the plant was in mode 1 at approximately 96 percent rated thermal power. At 1500 hours, multiple safety relief valves (SRVs) [RV] partially opened due to an invalid reactor pressure vessel (RPV) [RCT] pressure signal. Control room indications available to the operators showed two SRVs, 1B21F0051C and 1B21F0051D, received open signals and remained opened resulting in a suppression pool temperature rise. At 95 degrees Fahrenheit (F) average temperature and rising in the suppression pool, a manual RPS actuation was initiated as required by plant procedures. All control rods fully inserted. Safety relief valves 1B21F0051C and 1B21F0051D closed following the RPS actuation based on RPV pressure lowering below the low-low set reset closure setpoints, as designed. At 1750 hours, notification was made to the NRC Operations Center (Reference ENF No. 51716) in accordance with 10CFR 50.72(b)(2)(iv)(B), manual actuation of the RPS when the reactor is critical. This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A) as an event or condition that resulted in manual actuation of the RPS.

EVENT DESCRIPTION

On February 8, 2016, at 1500 hours, with the plant in mode 1 at 100 percent rated thermal power, 11 SRVs partially opened and immediately closed. Two additional SRV's, 1B21F0051C and 1B21F0051D, fully opened as a result of the actuation of the low-low set function of the SRVs. With two SRVs open, suppression pool temperature began to increase. Initial suppression pool average temperature was approximately 79.6 degrees F. In accordance with plant operating procedures, control room operators initiated action to reduce reactor power to less than 96 percent before attempting to close the open SRVs.

At 1503 hours, with reactor power at approximately 96 percent, suppression pool average temperature reached 95 degrees F and control room operators initiated a manual RPS actuation by placing the mode switch in the shutdown position as required by plant procedures. All control rods fully inserted. SRVs 1B21F0051C and 1B21F0051D closed following the RPS actuation based on RPV pressure lowering below the low-low set reset closure setpoints as designed. At 1505 hours, emergency operating procedure, Containment Control, (EOP-02) was entered based upon suppression pool temperature greater than 95 degrees F. RPV pressure was stabilized and controlled by the turbine bypass valves [JI] exhausting to the main condenser [SG]. Residual Heat Removal system A (RHR) [BO] was placed in suppression pool cooling at 1516 hours, and removed from suppression pool cooling at 1611 hours, with suppression pool average temperature at 83 degrees F. EOP-02 was exited at 1557 hours, following actions to lower suppression pool temperature below the entry condition.

Subsequent review of plant data identified that:

- A momentary perturbation occurred (20 to 40 milliseconds) that only affected the RPV B reference leg instruments and not a valid reactor level or pressure transient as RPV pressure and level remained constant until the SRVs opened.
- Thirteen SRV's had opened, 11 partially, as indicated by elevated tail pipe temperatures. Plant computer indications showed five additional SRV's received an open signal. The initiation signal for the nineteenth SRV was too short in duration to be detected by the plant computer.
- The division 2 1B21F051C and 1B21F051D solenoid indicated energized on control room panels.
- Division 2 RPV Water Level 8 signal was received.
- Division 2 SCRAM signal received. (1/2 Scram received)
- Division 2 Redundant Reactivity Control system [JC] low water level signal was received.
- Main turbine, feedwater and Reactor Core Isolation Cooling [BN] system level 8 trips were received, although no actual trip occurred, as designed.

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Located on the Main Steam Lines, between the RPV and the inboard main steam isolation valves (MSIVs) [SB], are 19 SRVs. These valves provide overpressure protection for the RPV. Each SRV is a spring-loaded, seal-bonnet, angle-globe valve with an externally attached pneumatic operating cylinder. Each SRV can be operated either in the 'safety mode' or the 'relief mode'.

In the 'safety mode', the SRVs open when system pressure rises above the SRV spring closing force. In the 'relief mode' pneumatic operation of an SRV is the result of an electric command to an actuator solenoid. Energizing either the division 1 or the division 2 solenoid will open the SRV. The SRV opening logic is initiated on the receipt of a high reactor pressure vessel signal from two pressure transmitters. RPV instrumentation is connected to four reference legs. The pressure transmitters that actuate the SRV division 2 solenoids are both connected to the RPV B reference leg.

Each reference leg has an associated reference leg purge system. The reference leg purge system provides a constant flow of Control Rod Drive system (CRD) [AA] water into the four reference legs which is intended to prevent the migration of noncondensable gases into the reference leg. The CRD Purge system taps off the CRD charging water header and supplies purge water through separate reference leg purge panels into the reference legs.

In order to reduce the number of SRVs that reopen following a reactor isolation event, 6 of the SRVs have a low-low set function. This function is armed whenever any SRV opens in the relief mode. When the low-low set function is armed, the normal setpoints for the affected SRVs are overridden by the low-low set setpoints. For two of the SRVs (i.e., B21F0051C and B21F0051D), the low-low set function lowers both the open and close setpoints. For the other 4 valves, only the close setpoint is lowered.

CAUSE OF EVENT

The direct cause of the event was a momentary pressure perturbation that was limited to the RPV B reference leg which caused the connected transmitters to sense RPV pressure and level changes that resulted in SRV actuation.

Air intrusion, most likely from not completely venting the B reference leg purge panel, due to not fully understanding the design of the purge panels, likely caused the pressure transient in the B RPV reference leg pressure transmitters.

EVENT ANALYSIS

The inadvertent actuation of all 19 SRVs is not an event that is specifically analyzed in the Perry Updated Safety Analysis Report (USAR). However, the plant response would be similar and would be bounded by existing USAR analysis for the inadvertent/stuck open SRV (USAR Section 15.1.4) and MSIV Closure (USAR Section 15.2.4 and USAR 15B.5.2.2).

For a stuck open SRV event (ref USAR Section 15.1.4), the operators are directed by plant procedures to attempt closure of the open SRV to terminate the event but may eventually manually shutdown the reactor based on reaching Technical Specification limits on suppression pool temperature. As such, if multiple SRVs opened, the response would be similar with a manual reactor SCRAM inserted based on suppression pool temperature as was the case in this event.

For the MSIV closure/reactor over pressurization event (ref. USAR Section 15.2.4 and USAR 15B.5.2.2), all available SRVs are assumed to open based on the increasing reactor pressure and the reactor will automatically shutdown on high flux (no credit taken for initial shutdown signal with the MSIVs going closed for over-pressurization analysis). After the shutdown, steam will continue to blow down into the suppression pool to control pressure. For this event, the analysis assumes that six SRVs are out of service to maximize the over pressurization of the reactor. As such, from an over-pressurization perspective it bounds the opening of all 19 SRVs.

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During this event normal operational suppression pool temperature bands were challenged and suppression pool cooling was placed into service, however there was no challenge to suppression pool or containment temperature design based on the SRVs going closed immediately at the onset of the shutdown. Maximum suppression pool temperature was approximately 98.1 degrees F. With the plant in mode 3 at less than one percent thermal power the requirements of Technical Specification 3.6.2.1, Suppression Pool Average Temperature, were not exceeded as the average temperature remained less than 110 degrees F, as required by Limiting Condition for Operation 3.6.2.1.c. Outside of the initial heat rejection to the suppression pool, no heat rejection to the containment structure was encountered as a result of the event.

A Probabilistic Risk Assessment (PRA) evaluation was performed for the manual RPS actuation. A conservative analysis of this plant shutdown indicates a conditional core damage probability (CCDP) of $2.81E-7$ which corresponds to a delta CDF of $2.81E-7$ /year. This delta CDF is well below the acceptable threshold of $1E-6$ /year as discussed in Regulatory Guide 1.174. The risk of this event is therefore considered very small in accordance with the Regulatory Guidance.

CORRECTIVE ACTIONS

Plant procedures will be revised, to ensure proper direction and guidance for when to startup, shutdown, and fill and vent of the purge panels. Additionally, a design change will be made to adjust the time constants for affected transmitters to preclude actuation from short duration perturbations in the reference legs.

PREVIOUS SIMILAR EVENTS

A review of LERs and the corrective action database for the past three years identified no 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.

Enclosure B
L-16-109

LER 2016-003, Loss of Safety Related Electrical Bus Results in a Loss of Shutdown Cooling