Entergy

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Robert Walpole
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NL-15-126

October 19, 2015

U.S. Nuclear Regulatory Commission
Document Control Desk
11545 Rockville Pike, TWFN-2 F1
Rockville, MD 20852-2738

SUBJECT: Licensee Event Report # 2015-002-00, "Safety System Functional Failure Due to Fuses for Residual Heat Removal Heat Exchanger Outlet Valves That Would Not Remain Operable Under Degraded Voltage Conditions"
Indian Point Unit No. 2
Docket No. 50-247
DPR-26

Dear Sir or Madam:

Pursuant to 10 CFR 50.73(a)(1), Entergy Nuclear Operations Inc. (ENO) hereby provides Licensee Event Report (LER) 2015-002-00. The attached LER identifies an event where there was a Safety System Functional Failure due to fuses for Residual Heat Removal Heat Exchanger Outlet Valves that would not remain operable under a degraded voltage conditions resulting in both trains of RHR becoming inoperable. This condition is reportable under 10 CFR 50.73(a)(2)(v) as a safety system functional failure. This condition is also reportable under 10CFR.50(a)(2)(ii)(B) for a condition that resulted in the plant being in an unanalyzed condition that significantly degraded plant safety and under 10CFR.50(a)(2)(vii) for an event where a single cause or condition caused at least two independent trains or channels to become inoperable in a single system. This condition was recorded in the Entergy Corrective Action Program as Condition Report CR-IP2-2015-03688.

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NRR

There are no new commitments identified in this letter. Should you have any questions regarding this submittal, please contact Mr. Robert Walpole, Manager, Regulatory Assurance at (914) 254-6710.

Sincerely,

RW/cbr

Attachment: LER-2015-002

cc: Mr. Daniel H. Dorman, Regional Administrator, NRC Region I
NRC Resident Inspector's Office
Ms. Bridget Frymire, New York State Public Service Commission

NRC FORM 366 (01-2014) U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104 EXPIRES: 1/31/2017
LICENSEE EVENT REPORT (LER)	Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@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: INDIAN POINT 2	2. DOCKET NUMBER 05000-247	3. PAGE 1 OF 5

4. TITLE: Safety System Functional Failure Due to Fuses for Residual Heat Removal Heat Exchanger Outlet Valves That Would Not Remain Operable Under Degraded Voltage Conditions

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 05000
08	18	2015	2015-	002 -	00	10	19	2015	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE: 1

10. POWER LEVEL: 100%

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

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

NAME	TELEPHONE NUMBER *(Include Area Code)*
Frank Bloise, Electrical Engineer, Design Engineering	(914) 254-6678

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
A	BP	FU	S156	Y					

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

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

On August 18, 2015, the operations shift manager entered Technical Specification (TS) 3.0.3 upon determination that the Residual Heat Removal (RHR) heat exchanger outlet valves (MOV-746 and MOV-747) would not remain operable during a degraded voltage (DV) condition. RHR heat exchanger outlet valves MOV-746 and MOV-747 are normally closed therefore their failure would result in both trains of RHR becoming inoperable. The RHR outlet valves are required to open during a Design Basis Accident for the RHR system to perform its safety function. As a result of NRC inspector questioning, an evaluation of the electrical coordination calculations associated with fuses for MOV-746 and MOV-747 determined the fuses would not support continued operability during a DV condition. The fuses were replaced with fuses that would remain operable under DV conditions and the RHR trains restored to operable status. Direct cause was the electrical coordination calculations for MOV-746 and MOV-747 did not support operability during a DV condition. The apparent cause was that the Industry Operating Experience (OE) (prior NRC violations and findings) was not properly acted upon during the Focused Self-Assessment on CDBI Preparations due to an incorrect assumption. Corrective actions included replacement of fuses, and communication to engineering personnel of the lessons learned from the event. Initiated CR-IP2-2015-03725 recording NRC 2015 CBDI Item 103 and CR-IP2-2015-03702 recording NRC 2015 CBDI Item 104 to addresses EOC findings and calculation updates which will be processed via Engineering Changes. The event had no significant effect on public health and safety.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Indian Point Unit 2	05000-247	2015	- 002 -	00	2 OF 5

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

Note: The Energy Industry Identification System Codes are identified within the brackets {}.

DESCRIPTION OF EVENT

On August 18, 2015, while at 100% steady state reactor power, the operations shift manager entered Technical Specification (TS) 3.0.3 at 13:31 hours, upon determination that the Residual Heat Removal (RHR) {BP} heat exchanger {HX} outlet valves (MOV-746 and MOV-747) {ISV} would not remain operable during a degraded voltage (DV) condition. RHR heat exchanger outlet valves MOV-746 and MOV-747 are normally closed therefore their failure due to inadequate fuses for DV conditions would result in both trains of RHR being inoperable. These valves are required to open during a Design Basis Accident for the RHR system to perform its safety function. During a scheduled NRC Component Design Basis Inspection (CDBI), an inspector review of the 480 Volt Motor Control Center (MCC) coordination calculation for MCC 26B resulted in a question concerning the survivability of safety related loads following a degraded voltage (DV) condition. Specifically, the NRC inspector questioned the ability of the electrical protective devices (fuses) {FU} to hold during locked rotor currents at degraded voltages for the duration of the degraded voltage time delay. The NRC inspector review of protective device coordination plots for Motor Operated Valves (MOVs) 746 and 747 (RHR heat exchanger outlet valves) questioned whether the Shawmut Type A4J30 {S156} fast acting fuses in the supply circuit would coordinate with the MOV locked rotor currents expected under degraded, normal and higher than normal voltage conditions. As a result of inspector questioning, the fuses for MOV-746 and MOV-747 were evaluated in accordance with the guidance contained in Nuclear Energy Institute (NEI) 15-01 (An analytical Approach for Establishing Degraded Voltage Relay (DVR) Settings). Engineering concluded after review of the NEI 15-01 guidelines that the electrical coordination calculations associated with MOV-746 and MOV-747 did not support continued operability during a DV condition. The condition was recorded in the Indian Point Energy Center (IPEC) Corrective Action Program (CAP) as Condition Report CR-IP2-2015-03688.

On August 18, 2015, Operations entered TS 3.5.2 (ECCS Operating) for two trains of RHR and Recirculation inoperable due to valves MOV-746 and MOV-747 being determined to be inoperable. Entered TS 3.5.2 Condition C for less than 100 percent equivalent flow of one RHR pump and one Recirculation pump available. Required action C.1 is to enter TS Limiting Condition for Operation (LCO) 3.0.3 immediately. Entered TS 3.0.3 at 13:31 hours, whose actions are to place the unit in a mode or other specified condition in which the LCO is not applicable with actions to be initiated within 1-hour. The installed fuses were replaced with Shawmut Type AJT30 time delayed fuses which have no coordination issues. During change out of fuses with replacement fuses that would remain operable under DV conditions, operators changed out one set of fuses affecting one valve at a time. At 14:19 hours the fuses for MOV-746 were installed and TS 3.0.3 exited. Entered TS 3.5.2 Condition A for one or more trains inoperable with required action A.1 to restore train to operable status with completion time of 72 hours. At 14:31 hours, the fuses for MOV-747 were installed and TS 3.5.2 actions exited.

The RHR system is a subsystem of the Emergency Core Cooling System (ECCS) divided into two 100 percent capacity subsystems. Each RHR subsystem consists of one RHR pump and one RHR heat exchanger as well as associated piping and valves to transfer water from the suction source to the reactor core. ECCS analysis assumes RHR injection into all four reactor coolant system (RCS) cold legs. During the injection phase of a LOCA recovery, a suction header supplies water from the Refueling Water Storage Tank (RWST) to the High Head Safety Injection (HHSI) and RHR pumps. The discharge from the HHSI and RHR pumps divides and feeds an injection line to each of the RCS cold legs. During the recirculation phase of LOCA recovery, the Containment Recirculation pumps take suction from the containment recirculation sump and direct flow through the RHR heat exchangers to the cold legs.

The RHR pumps can also be used to provide a backup method of recirculation. MOV-746 and MOV-747 are RHR heat exchanger outlet valves that are normally closed during power operation but are required to open for a DBA (LOCA).

This issue has been an NRC concern regarding the adequacy of power plant electrical distribution systems voltages as a result of previous events with degraded voltage protection for power plant Class 1E electrical safety buses for degraded transmission network (grid) voltage conditions. Previous electrical grid events demonstrated that when Class 1E buses are supplied by the offsite power system, sustained degraded voltage conditions on the grid can cause adverse effects on the operation of class 1E loads. The degraded voltage conditions will not be detected by the Loss-of-Voltage Relays (LVRs) which are designed to detect loss of power to the bus from offsite circuits. The NRC issued actions to licensees followed up with Generic Letter 79-36, Branch Technical Position (BTP) PSB-1 and Regulatory Issues Summary (RIS) 2011-12. Indian Point used the NRC guidance to evaluate the plant and developed calculations to address the issue. In 1997, IEEE Standard 741 was issued providing guidance on the use of degraded voltage relays in protective schemes but the guidance was not endorsed by the NRC. IEEE Standard 741 was not part of the Unit 2 protective setting and coordination criteria which was used to assess the Unit 2 coordination adequacy. As a result, the methodology provided in IEEE Standard 741 was not used to develop the coordination calculations. The current Entergy Engineering Standard (ES) invokes only certain portions of the IEEE Standard 741 criteria. Specifically, the one second margin guideline for prevention of spurious tripping is not included in the ES. RIS 2011-12 was issued to clarify regulatory requirements but did not detail any specific analytical approach to meet the requirements. In March 2015, the Nuclear Electric Institute (NEI) developed technical guidance document NEI 15-01 to provide an analytical approach that could be used to establish the settings for degraded voltage protection schemes. The NRC used NEI 15-01 and RIS 2011-12 in the CDBI to evaluate the current design basis of the electrical protective devices for MOV-746 and MOV-747. In preparation for the CDBI, a Focused Self-Assessment (FSA) was performed and the issued identified but a detailed review was not performed. During the FSA the results of recent NRC CDBI inspections were reviewed and the FSA determined that further review of design basis electrical calculations should be performed to determine if Indian Point was susceptible to similar calculation weaknesses that resulted in NRC findings at other plants. The failure to properly act upon the Industry OE review per the FSA finding resulted in a missed opportunity.

An extent of condition (EOC) review determined the condition is unique to Design Engineering and design basis electrical calculations because the condition specifically concerns survivability of electrical protective devices during a DV condition. As such, this condition does not extend to other equipment, calculations, processes or organizations not already evaluated. As a result of High Risk 1 EOC, an EOC review was performed on the effects of degraded grid voltage on electrical protective devices for safety related motors, motor operated valves and static loads. Loads on the Unit 2 and Unit 3 480 volt safeguards buses and MCCs were reviewed. This review identified two valves, MOV-746 and MOV-747, in need of fuse replacement. Calculation updates associated with this EOC review are tracked by CR-IP2-2015-03725. As a result of High Risk 2 EOC, a review was performed that included an evaluation of all safety related loads at degraded grid voltages. Operating voltage (running and starting) to all Unit 2 and Unit 3 motors, MOVs, static loads and MCC contactors on Unit 2 and 3 480 volt safeguards buses and MCCs were evaluated at degraded voltage conditions. This review determined that the required loads would successfully cope with a DV condition. Calculation updates associated with this EOC review are tracked by CR-IP2-2015-03702. The calculation updates will be processed via Engineering Changes (ECs) and all affected documents will be evaluated for update. The calculation updates will be processed via Engineering Changes and all affected documents, including Engineering Standard ENN-EE-S-003-IP and the 480 Volt Electrical System Design Basis Document will be reviewed and any necessary changes incorporated into the appropriate documents.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Indian Point Unit 2	05000-247	2015	- 002 -	00	4 OF 5

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

Cause of Event

Direct cause was electrical coordination calculations for MOV-746 and MOV-747 did not support continued operability during a degraded voltage condition. The apparent cause was that the Industry Operating Experience (OE) (prior NRC violations and findings) was not properly acted upon during the Focused Self-Assessment on CDBI preparation due to an incorrect assumption.

Corrective Actions

The following corrective actions have been or will be performed under Entergy's Corrective Action Program to address the cause and prevent recurrence:

- Evaluated and replaced the fuses in the supply circuit for MOV-746 and MOV-747 in accordance with Engineering Change (EC) 59435. Issued EC mark-ups for the affected calculations as part of EC-59435.
- Communicated to Design and Programs Engineering Personnel the lessons learned from this event and to raise the level of awareness regarding recent guidance on the evaluation of degraded voltage conditions and to reinforce importance of verifying assumptions.
- Initiated CR-IP2-2015-03725 recording NRC 2015 CBDI Item 103 and CR-IP2-2015-03702 recording NRC 2015 CBDI Item 104 to addresses EOC findings and calculation updates which will be processed via ECs. All affected documents, including Engineering Standard ENN-EE-S-003-IP and the Design Basis Document for the 480 Volt Electrical System (IP2-480V DBD) will be evaluated for update as part of the ECs for this issue.
- Performed and documented EOC review for CBDI Item 103 and Item 104 per EC-59116 and EC-59123.

Event Analysis

The event is reportable under 10CFR50.73(a)(2)(v) as an event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to: (A) shut down the reactor and maintain it in a safe shutdown condition, (B) remove residual heat, (D) mitigate the consequences of an accident (safety system functional failure), and is also reportable under 10CFR50.73(a)(2)(ii)(B) for any event or condition that resulted in the nuclear power plant being in an unanalyzed condition that significantly degraded plant safety and under 10CFR50.73(a)(2)(vii) for any event where a single cause or condition caused at least two independent trains or channels to become inoperable in a single system designed to: (A) shut down the reactor and maintain it in a safe shutdown condition, (B) remove residual heat, (D) mitigate the consequences of an accident. The condition recorded in CR-IP2-2015-03688 meets these reporting criteria since the possible failure of the fuses under degraded voltage conditions for RHR heat exchanger outlet valves MOV-746 and MOV-747 could result in the loss on both RHR trains.

Past Similar Events

A review was performed of the past three years of Licensee Event Reports (LERs) for events that involved a SSFF, Unanalyzed Condition or common mode failure due to loss of redundant ECCS trains as a result of inadequate engineering. No LERs were identified reporting a loss of ECCS function.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Indian Point Unit 2	05000-247	2015	- 002 -	00	5 OF 5

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Safety Significance

This event had no significant effect on the health and safety of the public. There were no actual safety consequences for the event because there were no accidents or transients during the time of the event.

A risk assessment was performed by the NRC as discussed in Inspection Report 05000247/2015-007 dated October 5, 2015. The NRC reviewed the Entergy operability assessment and determined it was adequate. However, for the degraded voltage issue, the originally installed fast-acting Shawmut Type A4J30 fuses would likely actuate prior to the RHR MOVs successfully stroking open. That condition results in the potential inoperability of both trains of low pressure injection/recirculation for longer than the TS LCO allowed outage time. A detailed risk evaluation was performed for that condition. The calculated cumulative conditional core damage probability (CCDP) was determined to be 5.5E-6 with an exposure time of one year. To account for the consequential degraded grid voltage condition, the CCDP value was multiplied by 2E-2 to approximate the probability of a LOOP given a LOCA has occurred. The evaluation determined that the estimated increase in core damage frequency (CDF) associated with this performance deficiency is 1E-7/year or very low safety significance. The risk significance approximation is overly conservative and is considered a worst case bounding evaluation. The risk assessment included a review for potential LERF and external events contributions. Based on Unit 2 being a pressurized water reactor with a large dry containment, the finding screens out for LERF consideration. Because the conditional event sequences of interest involve loss of coolant accidents, external events coincident with or contributing to these accidents would be of extremely low probability and considered beyond the plants design basis. Accordingly, there is no external event contribution to core damage risk for this issue.