Entergy

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NL-16-012

February 18, 2016

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

SUBJECT: Licensee Event Report # 2015-004-00, "Safety System Functional Failure Due to an Inoperable Containment Caused by a Flawed Elbow on the 21 Fan Cooler Unit Service Water Motor Cooling Return Pipe"
Indian Point Unit No. 2
Docket No. 50-247
DPR-26

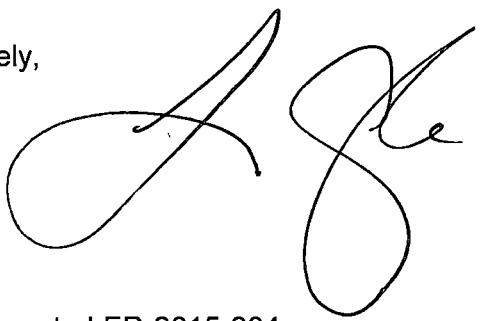
Dear Sir or Madam:

Pursuant to 10 CFR 50.73(a)(1), Entergy Nuclear Operations Inc. (ENO) hereby provides Licensee Event Report (LER) 2014-004-00. The attached LER identifies an event where there was a safety system functional failure due to an inoperable Containment as a result of a Containment Fan Cooler Unit motor cooler service water return pipe flaw. This condition is reportable under 10 CFR 50.73(a)(2)(v). This condition was recorded in the Entergy Corrective Action Program as Condition Report CR-IP2-2015-5755.

IE22
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,



LC/cbr

Attachment: LER-2015-004

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

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-l0202, (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)

1. FACILITY NAME:	2. DOCKET NUMBER	3. PAGE
INDIAN POINT 2	05000-247	1 OF 5

4. TITLE: Safety System Functional Failure Due to an Inoperable Containment Caused by a Flawed Elbow on the 21 Fan Cooler Unit Service Water Motor Cooling Return Pipe

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
12	20	2015	2015-	004 -	00	02	18	2016		05000
									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)*
Christopher Scott, Engineer, Engineering Systems	(914) 254-6876

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
X	BI	PSF	U080	Y					

14. SUPPLEMENTAL REPORT EXPECTED

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

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

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

On December 20, 2015, operator investigations identified service water (SW) leakage in containment and on December 22, 2015 discovered a through wall leak on a socket welded elbow for the 21 Fan Cooler Unit (FCU) motor cooler SW 2 inch copper-nickel return line. The leak was located in a pipe fitting that is within the ASME Section XI Code ISI Class 3 boundary and estimated to be approximately 1 gpm. Since the pipe flaw was through wall and was located within the ASME Section XI boundary, it exceeded the flaw allowable limits provided per IWD-3000. Engineering determined that since the through wall flaw was located on a socket welded fitting, the ASME Code Case N-513-3 did not apply. The 21 FCU was declared inoperable and Technical Specification (TS) 3.6.6 (Containment Spray and Containment FCU System), entered for one FCU train inoperable and TS 3.6.1 Condition A entered for containment inoperable. The 21 FCU SW return line was isolated. The pipe is part of a closed loop system inside containment and is required to meet containment integrity. Since a containment leakage evaluation was not performed, the pipe flaw was conservatively assumed to result in post-accident containment out leakage in excess of the 10CFR50, Appendix J limits resulting in violation of the containment integrity requirements and therefore is a safety system functional failure. The direct cause was flow assisted erosion-corrosion. The apparent cause was high SW flow conditions that caused high localized velocities and flow separation at the sharp interior edge of the socket welded fitting. Corrective actions included replacement of the affected fitting. The faulted fitting was sent out to a vendor for metallurgical failure analysis. The procedure for FCU SW flow balanced will be revised to reduce the SW flow in FCU motor coolers. The event had no significant effect on public health and safety.

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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 December 20, 2015, operator investigations identified service water (SW) leakage in the reactor containment building {NH}, and on December 22, 2015, a through wall leak was discovered on a socket welded fitting {PSF} for the 21 Fan Cooler Unit (FCU) {FCU} motor cooler service water (SW) {BI} return line. The leak was on a socket welded fitting on a 2 inch copper-nickel pipe downstream of the 21 FCU motor cooler outlet flange. The leak was located in a pipe fitting that is within the ASME Section XI Code ISI Class 3 boundary and estimated to be approximately 1 gpm. Since the pipe flaw was through wall and was located within the ASME Section XI boundary, it exceeded the flaw allowable limits provided per IWD-3000. Since the through wall defect was located in a socket welded fitting, the ASME Code Case N-513-3 could not be applied because it excludes socket welds and pipe fittings. On December 20, 2015, at 14:20 hours, the 21 FCU was declared inoperable and Technical Specification (TS) 3.6.6 (Containment Spray and Containment FCU System) Condition C entered for one FCU train inoperable. At 14:20 hours, TS 3.6.1 (Containment) Condition A was also entered for containment inoperable because the through wall defect could have resulted in containment out leakage in excess of the 10CFR50, Appendix J limits. At 15:30 hours the 21 FCU SW return line was isolated and all Action Statements associated with TS 3.6.1 were exited. On December 22, 2015, the FCU leak was determined to be from a through leak on a fitting for the 21 FCU motor cooler return line. Repairs were made to the 21 FCU motor cooler SW return line and on December 23, 2015, the 21 FCU returned to operable and TS 3.6.6 exited at 17:28 hours. The condition was recorded in the Indian Point Energy Center (IPEC) Corrective Action Program (CAP) in Condition Report CR-IP2-2015-05755.

The leak was on a socket welded copper-nickel fitting in 2 inch diameter SW line #497-SWN-NF located in Containment at elevation 68 feet. The affected location is downstream of 21 FCU motor cooler tubes. The 21 FCU can be supplied with SW via either 18 inch line #408 (4-5-6 SW Header) or 18 inch line #409 (1-2-3 SW Header). At the time of discovery, the SW System (SWS) was aligned with the 1-2-3 SW Header as the Essential Header for Modes 1-4 Operations per Technical Specification (TS) 3.7.8 (Service Water System). The fitting had a through wall flaw in the middle of the fitting. Sections of the supply and return piping on all five FCUs were replaced inside the motor cooler enclosure in July 1998. The piping modification implementing this replacement changed the pipe fittings (elbows) on the return piping from butt welded long radius and short radius elbows to the current configuration of socket welded fittings. This change was a result of the discovery of pitting at butt welds. The modification also changed the last supply piping elbow upstream of the motor cooler from butt welded elbow to a socket welded elbow.

The SWS is designed to supply cooling water from the Hudson River to various heat loads in both the primary and secondary portions of the plant. The design ensures a continuous flow of cooling water to those systems and components necessary for plant safety during normal operation and under abnormal or accident conditions. The SWS consists of two separate, safety related cooling water headers. Each header is supplied by 3 pumps each having its own strainer, with SWS heat loads designated as either essential or non-essential. The essential SWS heat loads are those which must be supplied with cooling water immediately in the event of a Design Basis Accident (DBA). The essential SWS heat loads can be cooled by any two of the three SW pumps on the essential header. Either of the two SWS headers can be aligned to supply the essential heat loads or the non-essential SWS heat loads. The design pressure and temperature of the SWS is 150 psig and 160 degrees F. The function of line #497 is to return the SW that was used to cool the 21 FCU fan motor out of containment and discharge it to the discharge canal.

Each FCU consists of a motor, fan, cooling coils, dampers, duct distribution system and instrumentation and controls. Each FCU fan motor is equipped with a cooler supplied by SW. SW is supplied to the cooling coils to perform the heat removal function. During normal operation, SW is supplied to all five FCUs and one or more FCUs may be operated for containment cooling to limit the ambient containment temperature to less than the limit specified in TS 3.6.5 (Containment Air Temperature).

An extent of condition (EOC) review determined other socket welded fittings at Unit 2 could be susceptible to similar failures. EOC inspections will be performed in the spring 2016 Unit 2 refueling outage (2R22), by cutting out seven similar socket welded fittings. A previous leak identified in CR-IP2-2015-03550 occurred at a butt-welded long radius elbow for the 24 FCU SW motor cooler return line therefore does not qualify as the same type of leak. This elbow is scheduled to be removed in 2R22 and sent for failure analysis. There is no evidence of additional leakage at any other location on 2 inch line #497-SW-NF. The FCU motor cooler tubing is 6 percent molybdenum stainless steel (SS) which has a higher resistance to corrosion. Unit 3 piping has a similar configuration and the same function as Unit 2 but the piping has been upgraded to AL6XN material (6 percent Molybdenum) and therefore is not considered susceptible to this failure mode.

Cause of Event

The direct cause was localized flow assisted erosion/corrosion attack which originated near the sharp ridge at the intrados of the fitting. The sharp ridge was a function of the socket welded construction of the fitting. The sharp ridge caused disruptions in the water flow such that turbulence occurred at the outlet edge of the ridge. The fluid shear stress associated with turbulent flow initiated and supported erosion/corrosion of the elbow inner surface.

The apparent cause was high SW flow conditions that caused localized higher velocities and flow separation at the sharp interior edge of the socket welded fitting. SW system conditions were evaluated and it was determined the design flow rate for the FCU motor cooler is 17 gpm. However, the current flow rate is approximately 55 to 60 gpm. The high fluid velocity through the 2 inch elbow and the sharp bend radius at the elbow intrados greatly enhanced turbulence in this region. The vendor evaluation recommends a flow velocity of 6 feet per second. As the current SW flow rates are 55 to 60 gpm they exceed the recommended flow velocity and will be reduced. To limit localized erosion/corrosion the flow rate will be reduced to 25 to 30 gpm. The current flow rate was higher than needed because the SW System was not optimally flow balanced.

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:

- The leaking SW socket welded fitting for the 21 FCU motor cooler return line was replaced.
- The removed pipe/elbow was sent for independent vendor inspection and performance of a metallurgical analysis to determine the specific cause.
- Seven socket welded elbows will be cut out and replaced with new elbows and the removed elbows will be sent out to a vendor for failure analysis.
- Procedure 2-PT-R093 (Essential Service Water Header Flow Balance) will be revised to reduce the SW flow on FCU motor coolers and a flow balance will be performed on the SW system.

Event Analysis

The event is reportable under 10 CFR 50.73(a)(2)(v)(C). The licensee shall report any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to (C) Control the release of radioactive material. This condition meets the reporting criteria because TS 3.6.1 Containment Operability was not met. Because the FCUs are utilized to maintain normal containment temperature within accident analysis input limits and for accident mitigation, SW flow is not isolated following a Design Basis Accident (DBA). SW piping supply and discharge for the FCUs is considered to be a closed system in containment or an extension of the containment boundary. Consequently, defects discovered within this piping may adversely affect containment integrity, and the ability to control release of radioactive materials. Both containment isolation valves in the affected FCU SW piping were operable and the line isolated after discovery. As a result of revised reportability guidance provided by Entergy fleet experience, single train systems (e.g., containment barrier) are to be considered as a safety system functional failure (SSFF) even though resolved (SW pipe penetration isolated) within the TS Allowed Outage Time. This event was not at the time considered a SSFF therefore an event notification under 10CFR50.72(b)(3)(v) was not provided. This condition was entered into the IPEC CAP.

Past Similar Events

A review was performed of the past three years of Licensee Event Reports (LERs) for events reporting a TS violation due to inoperable SW piping caused by leaks and two LERs was identified. LER-2015-001 reported that on August 11, 2015, a through wall leak was discovered on a butt weld for the 24 FCU SW motor cooler return line. LER-2013-004 reported pin hole leaks in Code Class 3 SW piping elbows for series 300 stainless steel. The pin hole leaks were due to pitting corrosion. The cause of the event reported in LER-2013-004 was not the same as this event as the piping material was different (copper-nickel vs stainless steel).

Safety Significance

This event had no effect on the health and safety of the public. There were no actual safety consequences for the event because there were no accidents or events during the degraded condition.

There were no significant potential safety consequences of this event. The leakage from the affected SW pipe was within the capability of the SW system to provide adequate SW flow to SW loads. The degraded piping was on the discharge of the FCU motor therefore any failure would not prevent the SW cooling function.

Current analysis for SW pipe failures are postulated to be limited to small through-wall leakage flaws as SW is defined as a moderate energy fluid system. The SW leak would eventually drain to the containment sump. The containment sumps have pumps with sufficient capacity to remove excessive leakage. The leak was just downstream of the FCU Motor cooler heat exchanger outlet nozzle.

The Containment Spray System (CSS) and Containment Fan Cooler Unit (FCU) System are Engineered Safety Feature systems designed to ensure that the heat removal capability required during the post-accident period can be attained. The CSS and the Containment FCU System provide redundant methods to limit and maintain post accident conditions to less than the containment design value. Five FCUs alone, or 3 FCUs and 1 Containment Spray Pump (CSP), or no FCUs and 2 CSPs possess this capability. The configuration with one CS train and two FCU trains is the configuration available following the loss of any safeguards power train (e.g., diesel failure).

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

The containment consists of the concrete reactor building, its steel liner, and the penetrations through the structure. The containment building is designed to contain radioactive material that might be released from the reactor following a design basis accident (DBA). The containment building steel liner and its penetrations establish the leakage limiting boundary of the containment. Maintaining the containment operable limits the leakage of fission product radioactivity from the containment to the environment. The DBA analysis assumes that the containment is operable such that, for the DBAs involving release of fission product radioactivity, release to the environment is controlled by the rate of containment leakage. The containment was designed with an allowable leakage rate of 0.1 percent of containment air weight per day. Containment isolation valves form a part of the containment pressure boundary. Two barriers in series are provided for each penetration so that no single credible failure or malfunction of an active component can result in a loss of isolation or leakage that exceeds limits assumed in the safety analysis. One of these barriers may be a closed system such as the SW piping for the FCUs. The only time containment integrity can be effected is post accident when the FCUs safety function is being performed and SW pressure for the FCU cooling piping and coils fall below peak accident pressure. SW effluent is monitored by radiation monitors R-46 and R-53 prior to discharge. If radiation is detected, each FCU heat exchanger can be individually sampled to determine the leaking unit. The SW for the 21 FCU and 21 FCU fan motor cooler can be isolated to prevent radioactive effluent releases. During the time the FCU SW piping was degraded there was no leakage out of containment.