Entergy

Indian Point Energy Center
450 Broadway, GSB
P.O. Box 249
Buchanan, N.Y. 10511-0249
Tel (914) 254-6700

Lawrence Coyle
Site Vice President

NL-15-086

July 7, 2015

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

SUBJECT: Licensee Event Report # 2015-002-01, "Technical Specification Prohibited Condition Caused by Four Main Steam Safety Valves Outside Their As-Found Lift Set Point Test Acceptance Criteria"
Indian Point Unit No. 3
Docket No. 50-286
DPR-64

Reference: 1. LER-2015-002-00 submitted by letter NL-15-065 dated April 27, 2015

Dear Sir or Madam:

Pursuant to 10 CFR 50.73(a)(1), Entergy Nuclear Operations Inc. (ENO) hereby provides Licensee Event Report (LER) 2015-002-01. The attached LER is a revision to an LER submitted by Reference 1, that identified an event where there was a Technical Specification prohibited condition for three inoperable Main Steam Safety Valves (MSSVs), which is reportable under 10 CFR 50.73(a)(2)(i)(B). This condition was recorded in the Entergy Corrective Action Program as Condition Report CR-IP3-2015-00898. Due to the number of failures, testing of the remaining MSSV's were performed during power ascension and valve MS-46-3 failed to meet the as-found lift set point test acceptance criteria. This condition was recorded in CR-IP3-2015-02128. However, the additional failure of MSSV MS-46-3 was not included in the LER. This condition was recorded in CR-IP3-2015-03427.

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

cc: Mr. Daniel H. Dorman, Regional Administrator, NRC Region I
NRC Resident Inspector's Office, Indian Point 3
Ms. Bridget Frymire, New York State Public Service Commission

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 Records and FOIA/Privacy Service 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-I0202, (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 3	05000-286	1 OF 5

4. TITLE: Technical Specification Prohibited Condition Caused by Four Main Steam Safety Valves Outside Their As-Found Lift Set Point Test Acceptance Criteria

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
2	27	2015	2015	002	- 01	7	7	2015		05000
									FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

1

10. POWER LEVEL

96%

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

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☒ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☐ 50.73(a)(2)(iv)(A)
- ☐ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER

Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER *(Include Area Code)*
John Garry, Engineering Systems-BOP	(914) 254-6881

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	SB	RV	C710	Yes					

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 February 27, 2015, during the performance of surveillance procedure 3-PT-R006A, three main steam safety valves (MSSV) (MS-46-2, MS-45-4 and MS-47-4) failed their As-Found lift set point test. Per the test, these valves must lift at +/- 3% of their required setting. During the test, 7 other MSSVs tested passed their As-Found test criteria. Technical Specification (TS) 3.7.1 (Main Steam Safety Valves) requires the MSSVs to be operable in accordance with TS Table 3.7.1-1 and Table 3.7.1-2. Due to the number of failures, during power ascension the remaining MSSVs were tested and two failed (MS-46-2, MS-46-3). MSSV MS-46-2 had previously failed and had maintenance performed therefore the failure was considered a post maintenance test failure. MS-46-3 failed its first lift test by 0.6% but met test lift criteria on the second and third test. TS Surveillance Requirement (SR) 3.7.1.1 requires each MSSV be verified to lift per Table 3.7.1-2 in accordance with the In-service Testing Program. Operability of the MSSVs includes the ability to open within the set point tolerances. The direct cause of the failure of these valves was severely worn spindle rods. The apparent cause for the failure of MS-47-4 and MS-46-2 was internal friction due to spindle vibration. The apparent cause of the failure of MS-45-4 was reuse of a worn spindle. The apparent cause of the failure of MS-46-3 is foreign material. Corrective actions included testing all 20 MSSVs and adjusting their set point to be within +/- 1% of design set pressure. Installed new spindles and bronze wear sleeves on valves MS-46-4, MS-46-2, MS-47-4, MS-48-2, MS-49-2, MS-49-1, MS-49-3, and replaced the spindle on valve MS-45-4. The Unit 3 MSSV test frequency will be changed from 4 years to 2 years until all modifications are implemented and IPEC is confident the issue is resolved. The event had no effect on public health and safety.

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 February 27, 2015, while at approximately 96 percent power, during Surveillance Testing of the Main Steam Safety Valves (MSSV) in accordance with procedure 3-PT-R006A, three main steam safety valves (MSSV) (MS-46-2, MS-45-4 and MS-47-4) failed their As-Found lift set point test. Per the test, the MSSVs must lift at +/- 3% of their required setting. At 0833 hours, MSSV MS-45-4 on Steam Generator (SG) 34 failed its As-Found set-point pressure. Valve MS-45-4 lifted at 1120.2 psig, 23.2 psig outside its acceptance range of 1034 to 1097 psig and 5.2% above its 1065 psig set point. Consequently, MS-45-4 was declared inoperable and Technical Specification (TS) 3.7.1 (Main Steam Safety Valves) Condition A was entered. Two subsequent tests were performed without any adjustments to the set-point adjusting bolt and the valve lifted within its required +/- 1% band and the valve was declared operable and TS 3.7.1 exited at 0843 hours.

On February 27, 2015, at approximately 0935 hours, during MSSV surveillance testing, valve MS-46-2 on SG 32 failed its As-Found set-point pressure. MSSV MS-46-2 lifted at 1161.3 psig, 41.3 psig outside its acceptance range of 1048 to 1120 psig and 7.5% above its 1080 psig set point. MS-46-2 was declared inoperable and Technical Specification (TS) 3.7.1 (Main Steam Safety Valves) Condition A was entered. Two subsequent tests were performed without any adjustments to the set-point adjusting bolt and the valve lifted within its required +/- 1% band and the valve was declared operable and TS 3.7.1 exited at 0943 hours.

On February 27, 2015, at approximately 0951 hours, during MSSV surveillance testing, MSSV MS-47-4 failed its As-Found set-point pressure. MSSV MS-47-4 on SG 34 lifted at 1156.7 psig, 61.7 psig outside its acceptance range of 1063 to 1127 psig and 5.6% above its 1095 psig set point. MS-47-4 was declared inoperable and Technical Specification (TS) 3.7.1 (Main Steam Safety Valves) Condition A was entered. Two subsequent tests were performed without any adjustments to the set-point adjusting bolt and the valve lifted within its required +/- 1% band and the valve was declared operable and TS 3.7.1 exited at 1002 hours.

During the surveillance test, seven (7) other MSSVs tested passed their As-Found test criteria and were left within the +/- 1% set point criteria. After verifying the set-point pressure had become repeatable, adjustments were made to MS-46-2, MS-45-4, and MS-47-4 returning the valves to their required +/- 1% As-Left set-pressure band restoring their operability and allowing exit from the Action Statement for TS 3.7.1. On March 22, 2015, during power ascension with the plant in Mode 3, the remaining MSSVs were tested. At 21:41 hours MS-46-3 failed testing due to lifting 3.6% above its TS lift set point of 1080 psig and was declared inoperable. Two subsequent tests were performed without any adjustments to the set-point adjusting bolt and the valve lifted within its required +/- 1% band and the valve was declared operable and TS 3.7.1 exited at 21:51 hours.

TS 3.7.1, requires the MSSVs to be operable in accordance with TS Tables 3.7.1-1 and 3.7.1-2. TS Surveillance Requirement (SR) 3.7.1.1 requires that each MSSV be verified to lift per Table 3.7.1-2 in accordance with the In-service Testing (IST) Program. Operability of the MSSVs is determined by periodic surveillance testing in accordance with the TS and IST program. The conditions were recorded in the Indian Point Energy Center (IPEC) Corrective Action Program (CAP) as Condition Report CR-IP3-2013-00898.

As a result of the failure of MS-45-4, the valve was scoped into the refueling outage for disassembly and inspection. On March 12, 2015, MSSV MS-45-4 was disassembled and inspected by Engineering and the valve vendor.

The valve spindle showed signs of wear and it was determined the spindle was not replaced during the previous cycle. The valve bronze wear sleeve showed significant transfer of material from the spindle. MSSV MS-46-2 was disassembled on March 10, 2015 and inspected. Fretting was noticed on the spindle rod. High vibrations were concluded to be the cause of fretting. Maintenance was performed and the valve retested March 22, 2015, on power ascension and failed its post maintenance test. The valve was adjusted and as-left set points set to within 1% of required set point.

MSSV MS-47-4 was disassembled on March 10, 2015, and all valve parts and internals were inspected. The inspection showed minimal wear on the spindle rod, but there were signs of interference wear on the guide bearing between it and the valve guide. The interference wear is believed to be caused by high vibrations of the spindle rod over the last cycle.

There are five code safety valves (MSSVs) and one atmospheric dump valve (ADV) {RV} on each main steam (MS) line outside the Reactor Containment {NH} and upstream of the MS isolation valves {ISV}. The MSSVs consist of four 6-inch by 10-inch and one 6-inch by 8-inch valve per SG on each of four MS lines for a total of 20 valves. The MSSV's also provide a heat sink for the reactor coolant system if the Main Condenser is unavailable and the Atmospheric Dump Valves cannot relieve steam line pressure. The five valves on each steam line are nominally set to open at 1065, 1080, 1095, 1110, and 1120 psig. The operability of the MSSVs is defined as the ability to open within the set point tolerances, relieve SG overpressure, and reset when pressure has been reduced. The applicable accident/transient analyses require five MSSVs per SG to provide overpressure protection for design basis transients occurring at 102% reactor thermal power. The MSSVs are ASME Code relief valves, manufactured by Crosby Valve and Gauge Company {C710}. Valve MS-45-4 is a 6-inch by 8-inch Crosby Model HC-65W 6Q8 Safety Valve. MS-46-2 and MS-47-4 are 6-inch by 10-inch Crosby Model HC-65W 6R10 Safety Valves.

In accordance with the IST program, all MSSV's (20) were tested in the last four years. Due to the amount of failures experienced in 2015, all MSSV's were tested in refueling outage 3R18.

An extent of condition (EOC) was performed to determine where potential conditions with similar valves and environments could occur. The review determined that EOC found in the failure of MSSV MS-45-4, MS-46-2 and MS-47-4 is restricted to the other 17 MSSVs at unit 3 and the 20 MSSVs at unit 2 due to the valve design. All MSSVs are exposed to high vibrations during their operating cycle during which wear can occur. Previous failures of MSSVs have included wear due to spring skewing and set point drift. Spring skewing can occur in any of the MSSVs and cause side loading frictional forces which prevent the valve from lifting. Set point drift can occur due to age of the components and the operating cycle it is exposed to (e.g., changes in temperature, pressure and vibrations).

The Cause of Event

The direct cause of the failure of these valves was severely worn spindle rods. The apparent cause for the failure of MS-47-4 and MS-46-2 was internal friction due to spindle vibration. The spindle rods had severe wear from the internal friction between the spindle rod and spring washer and adjusting bolt. The internal friction was due to the high vibrations of the spindle rods when the spindle rods come in contact with the spring washers and adjusting bolts. The contact areas cause fretting of the spindle rod over the course of the cycle. The apparent cause of the failure of MS-45-4 was reuse of a worn spindle. The valve failed to lift within its set pressure range due to binding on the worn spindle rod. The spindle rod was binding due to fretting wear found on the rod from previous wear.

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

MSSV's MS-46-2 and MS-46-3 were outside the Code requirement of +/- 3% of the set point during testing on startup from the March 2015 refueling outage (3R18). Because MS-46-2 was modified during the outage, the test was considered a post modification test and not a Code test failure since the valve had not yet been declared operable. MSSV MS-46-2 was adjusted to within +/-1% and placed in service. The first of three test lift pressures for MSSV MS-46-3 was 1119.6 psig (+3.6%) which was outside the Code required range of 1048 to 1112 psig. However, the second and third tests resulted in lift pressures within the required +/- 1%. Since the second and third tests showed MS-46-3 was back to within the required range of +/-1%, no valve adjustments were performed prior to returning it to service. The apparent cause of the initial test failure of MS-46-3 was likely foreign material introduced during valve modification performed during the previous refueling outage (3R17). Because the valve's spindle and all other parts that could have impacted the valve lift pressure were replaced, other failure modes were considered not likely. Engineering judged that the first lift of MS-46-3 dislodged the foreign material.

Corrective Actions

The following corrective actions have been or will be performed under the Corrective Action Program (CAP) to address the causes of this event.

- All 20 MSSVs were tested and their set point adjusted to be within +/- 1% of design set pressure.
- Installed new spindles and bronze wear sleeves on valves MS-46-4, MS-46-2, MS-47-4, MS-48-2, MS-49-2, MS-49-1, MS-49-3
- Replaced the old spindle on valve MS-45-4.
- The MSSV test frequency will be changed for Unit 3 from 4 years to 2 years until all modifications are implemented and IPEC is confident that the cause of the failures has been corrected.

Event Analysis

The event is reportable under 10CFR50.73(a)(2)(i)(B). The licensee shall report any operation or condition which was prohibited by the plant TS. TS 3.7.1 (Main Steam Safety Valves), requires the MSSVs to be operable in accordance with TS Tables 3.7.1-1 and 3.7.1-2. TS Surveillance Requirement (SR) 3.7.1.1 requires each MSSV be verified to lift per Table 3.7.1-2 in accordance with the In-service Testing Program (IST). Operability of the MSSVs includes the ability to open within the set point tolerances. On February 27, 2015, MSSV valve MS-45-4 was found outside its limit therefore, it failed its As-Found testing criteria and was declared inoperable. Subsequently, valve MS-46-2 was tested and failed its as-found set pressure and declared inoperable. Subsequently MS-47-4 was tested and failed its as-found set pressure and declared inoperable. These valves were disassembled and inspected and determined to have conditions preventing their proper operation. On March 25, 2015, the apparent cause determined that valves MS-47-4 and MS-46-2 failure was due to internal friction caused by spindle wear from vibration during the operating cycle. The apparent cause of MS-45-4 to fail was determined to be binding due to use of a worn spindle. Spindle wear is not normal drift therefore, the valve may have been inoperable during past operation. The failure of valve MS-46-2 on power ascension was considered a post maintenance test failure. The failure of MSSV MS-46-3 on power ascension was most likely foreign material. As it is not possible to determine when the valve would not have met its set point lift pressure range, the valve was concluded to be inoperable for greater than the TS allowed completion time. An evaluation of applicable accident/transient analyses was performed to determine the impact of four MSSVs with a higher opening set point. The evaluation concluded the condition would not result in loss of safety function. Therefore, this condition is not reportable under 10CFR50.73(a)(2)(v) as a safety system functional failure.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Indian Point Unit 3	05000-286	2015	- 002	- 01	5 OF 5

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

Past Similar Events

A review was performed of Licensee Event Reports (LERs) for the past three years for any events reporting TS prohibited conditions due to multiple valve test failures. LER-2011-004 reported two MSSV's outside their as-found lift set point acceptance criteria due to spindle wear and spring skew. LER-2013-001 reported two MSSVs (MS-46-3 and MS-48-3) outside their as-found set point acceptance criteria. The cause of MS-46-3 failure was galling around the circumference of the spindle rod as a result of vibration. MS-48-3 evidenced similar fretting on one side of the spindle consistent with what was found on valve MS-46-3. Failure cause was determined to be due to internal friction caused by foreign material between the guide bearing and spindle. The causes for the previous events reported in LER-2011-004 are similar to this event.

The corrective actions for that event included implementation of a bronze wear sleeve modification. All the unit 3 MSSVs are scheduled to have the bronze sleeve modification implemented by the next refueling outage. LER-2011-004 corrective actions included replacement of the valve spindle for valves MS-47-4 and MS-48-4. Corrective actions for this LER included replacement of the worn spindle for valve MS-45-4 and new spindles installed on valves MS-46-4, MS-46-2, MS-47-4, MS-48-2, MS-49-2, MS-49-1 and MS-49-3 during the bronze wear sleeve installation. LER-2013-001 cause was foreign material which has not been identified in this LER or previous LER except LER-2013-001. Corrective actions for LER-2013-001 included replacement of the spindle rod for valve MS-46-3, installation of bronze wear sleeves in valves MS-46-3,MS-48-3, MS-45-4, MS-47-1, MS-47-2, MS-47-3 and MS-49-4, and the increase in the PM frequency from an 8 year cycle to a 6 year cycle. The increased frequency of testing is expected to identify degraded conditions so that corrective actions can be implemented to prevent valve lift failures.

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 transients requiring the MSSVs.

There was no significant potential safety impact of the condition under reasonable and credible alternate conditions. Had an accident or transient occurred during the condition of the out of tolerance MSSV, the condition would not have significantly affected accident mitigation capability and the MSSVs overpressure function would have been adequate. The design basis of the MSSVs is to limit the secondary system pressure to 110% of design pressure when passing 100% of design steam flow. Each MS line has an ADV capable of releasing steam to the atmosphere. The ADVs have the capability to relieve approximately 10% of total steam.

The MSSV design basis is sufficient to cope with any anticipated operational occurrence or accident considered in the Design Basis Accident and transient analysis. The events that challenge the relieving capacity of the MSSVs, and thus Reactor Coolant System pressure, are those characterized as decreased heat removal events, whose evaluations are presented in UFSAR Section 14. Of these, the full power loss of external electrical load without steam dump is the limiting event.

The limiting UFSAR Chapter 14 transients which do not credit the ADVs and which are impacted by the higher MSSV set point were evaluated and it was concluded that the acceptance criteria for the transients would have been met with the out of tolerance MSSVs.