Entergy

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J. E. Pollock
Site Vice President

NL-09-074

July 27, 2009

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Stop O-P1-17
Washington, D.C. 20555-0001

SUBJECT: Licensee Event Report # 2009-004-00, "Automatic Reactor Trip Due to a High Steam Generator 32 Water Level Caused by Inadequate 31 Main Feedwater Pump Governor Valve Setting and 32 Main Steam Generator Level Controller Set-up "
Indian Point Unit No. 3
Docket No. 50-286
DPR-64

Dear Sir or Madam:

Pursuant to 10 CFR 50.73(a)(1), Entergy Nuclear Operations Inc. (ENO) hereby provides Licensee Event Report (LER) 2009-004-00. The attached LER identifies an event where the reactor automatically tripped, which is reportable under 10 CFR 50.73(a)(2)(iv)(A) . As a result of the reactor trip, the Auxiliary Feedwater system was actuated which is also reportable under 10 CFR 50.73(a)(2)(iv)(A). This condition was recorded in the Entergy Corrective Action Program as Condition Report CR-IP3-2009-02494 and CR-IP3-2009-02710.

There are no new commitments identified in this letter. Should you have any questions regarding this submittal, please contact Mr. Robert Walpole, Manager, Licensing at (914) 734-6710.

Sincerely,

JEP/cbr

cc: Mr. Samuel J Collins, Regional Administrator, NRC Region I
NRC Resident Inspector's Office, Indian Point 3
Mr. Paul Eddy, New York State Public Service Commission
LEREvents@inpo.org

IE22
NRR

NRC FORM 366 (9-2007) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES: 8/31/2010

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-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
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4. TITLE: Automatic Reactor Trip Due to a High Steam Generator 32 Water Level Caused by Inadequate 31 Main Feedwater Pump Governor Valve Setting and 32 Steam Generator Level Controller Set-up

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
5	28	2009	2009-	004 -	00	7	27	2009		05000
									FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

1

10. POWER LEVEL

61%

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)*
Tom Pulcher, Sr. Project Engineer-Turbine, Maintenance	(914) 734-5812

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
E	JK	V	W120	Y	X	JB	LC	N430	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 May 28, 2009, the Control Room received 32 MBFP vibration alarms and reduced power to approximately 65% and removed the 32 MBFP from service. The 31 MBFP was unable to supply sufficient feedwater (FW) flow to maintain Steam Generator (SG) levels which resulted in all four main FW regulating valves (FRV) opening. SG-31, 33, 34 water levels recovered but the SG-32 water level increased and continued increasing after the 32 FRV was placed in manual. The 32 SG level reached the high level trip initiating a turbine trip that resulted in a reactor trip. All control rods fully inserted and all required safety systems functioned properly. The Auxiliary Feedwater System automatically started as expected. The root cause was improper MBFP governor valve stroke due to poor vendor oversight of a maintenance work order which was performed without completing MBFP governor valve stroke readings, and 32 SG level controller set-up due to inadequate programmatic control of controller settings. Contributing causes included 1) an inadequate MBFP turbine inspection procedure which did not specify a check of governor linkage clearances, 2) failure of vendor to adhere to procedure by not documenting 31 MBFP governor valve settings, 3) Ineffective corrective action due to failure to check HP governor stroke as planned. Significant corrective actions include: adjustment of the 31 MBFP governor and coaching of Maintenance personnel on requirements for contractor oversight, and including the event in maintenance training. Procedure 0-TUR-402-MFW will be revised to require stroke measurement of governor valves and linkage clearance check, and SG Level Control settings will be reviewed for adequacy. The event had no 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 May 28, 2009, at 5:50 hours, while at approximately 100% steady state reactor power, Control Room operators received vibration alarms {JK} (B.F.P. Turbine 32 Vibration & Thrust) and notification of an unusual noise on the 32 main boiler feedwater pump (MBFP) {SJ} bearing 3. The 32 MBFP was taken to idle and as per design the 32 MBFP discharge recirculation valve {FCV} opened. The 31 MBFP speed stopped increasing even though the Start-Up speed control was set 86%. At approximately 6:17 hours, steam generator (SG) {AB} levels decreased from 45 percent to approximately 38 percent. While in automatic, all four main feedwater (FW) regulating valves (FRV) {FCV} opened and SG-31, 33 and 34 water levels started increasing. FW flow to the 32 SG was not increasing and SG water level was not increasing. At approximately 6:20 hours, Operators reduced power to approximately 61%. FRV-31, 33 and 34 were responding in Auto to control SG level, while the 32 FRV remained at 100 percent demand signal. At 6:22 hours, SG-32 level was high and increasing. At approximately 6:23 hours, with 32 SG water level at approximately 71 percent, operators placed the 32 FRV in manual in an attempt to control SG level but the level reached the high level trip set point {JB} initiating a turbine trip (TT) {JJ} that resulted in an automatic reactor trip (RT) {JC}. All control rods {AB} fully inserted and all required safety systems functioned properly. The plant was stabilized in hot standby with decay heat being removed by the main condenser {SG}. There was no radiation release. The Emergency Diesel Generators {EK} did not start as offsite power remained available. The Auxiliary Feedwater (AFW) System {BA} automatically started as expected due to Steam Generator low level from shrink effect. The event was recorded in the Indian Point Energy Center corrective action program (CAP) as CR-IP2-2009-02494 and CR-IP3-2009-02710. A post transient evaluation was initiated and completed on May 28, 2009.

Review of conditions prior to the event determined there were problems with the FRVs and MBFP in the March 11, 2009, shutdown for the unit 3 cycle 15 refueling outage. During the shutdown, the 32 MBFP was taken out of service and power reduced to approximately 38 percent. During the shutdown the 31 MBFP speed increased to assume the flow required but the MBFP speed did not go above 4000 RPM. The percent FW demand signal was in excess of the FW start-up signal, which was set at 85 percent. Decreasing 31 MBFP discharge pressure caused reduced FW flow that resulted in decreasing SG levels. The resulting transient caused the FRVs to fully open which resulted in a rise in SG levels which overshot their normal operating levels. The control room operators switched to manual control of the 31 and 32 FRVs to stabilize level and a normal shutdown for the outage continued. This event was recorded in the CAP as CR-IP3-2009-00730 which included a corrective action (CA) that required a dimensional check of the MBFP high pressure (HP) governor valve stroke. Maintenance was to perform the check in accordance with procedure 0-TUR-402-MFW, "Main Boiler Feed Pump Turbine Inspection." The actual data recorded did not include the stroke displacement of the HP governor valve itself. Additionally, the procedure did not contain specific steps to check for "slop" or looseness in the actuating linkages between the governor hydraulic servo motor and the governor valve. On April 15, 2009, work on the 31 MBFP HP governor linkages was completed by a vendor in accordance with procedure 0-TUR-402-MFW. However, the vendor did not complete the procedure sections which require recording governor valve stroke. The need for governor valve stroke data was added to the procedure to ensure that the valve would provide an acceptable steam supply for satisfactory operation of HP steam for the MBFP. There was inadequate Entergy oversight and verification to check that the vendor captured the procedurally requested data before the MBFP was returned to operations for startup from the cycle 15 refueling outage.

On April 23, 2009, Maintenance performed adjustments to the opening set point on the HP governor. Operation of the 31 MBFP was then stable on the low pressure (LP) governor only. On May 15, 2009, Maintenance adjusted the HP governor servomotor (S/M) stroke which was found to be only 5/8 inch and not at the normal 1.5 inches (limited stroke). No CR recorded this condition. The limited stroke of the servomotor was communicated to the outage control center (OCC) by email and verbally. Operations and maintenance considered the adjustments to be routine and that any adverse condition would be self-revealing before any problems might occur. Additionally, the plant was to be started up on the 32 MBFP therefore there would be limited operation on the 31 MBFP on the HP governor since at higher power levels, operation would be on the LP steam supply. On May 28, 2009, the 32 MBFP was removed from service in a controlled manner, and operators expected that the 31 MBFP would be able to assume the reduced load. At reduced power level, the MBFP steam supply would be from the HP steam inlet valve.

Further investigation into the event discovered that the original Westinghouse Precautions, Limitations and Setpoints (PL&S) basis document indicated that the SG level controllers (LC) used for the three element FRV controller should have a reset time of 30 minutes. Transient data from a turbine runback in 1997 indicated that the actual LC reset at that time was 20 minutes for all four SGs. As-Found data from 2001 indicated that, at that time, the LCs had a reset time of 90 seconds. A review of simulator response information from 2009 trial runs showed that there would be no trip with a reset of 20 minutes given a degraded HP governor valve and that a reset time of 3 minutes or less would result in a simulator trip. A review of Work Orders failed to determine the basis for the reset time change to 90 seconds. The short reset time caused the 32 FRV controller to go into saturation and it could not recover in time to avert over feeding the SG and causing a high level trip.

The MBFPs (2) are driven by steam turbines and their speed controlled to maintain the pump discharge pressure as a function of unit load. Steam flow to the MBFPs is controlled by governor valves. There are two sources of steam to the turbine; high pressure steam from main steam and low pressure steam from the Moisture Separator Reheaters (MSRs). The MBFP turbines are a Westinghouse {W120} Model EMM-25-32, 8350 HP turbine {SJ}. The governor valves are a Westinghouse diffuser type plug valve {V} actuated by a 150 pound Westinghouse hydraulic control system {JK}. MBFP discharge flow of FW to the four SGs is controlled by FRVs. FRV-32 is an air operated flow control globe valve (AOV) manufactured by Copes Vulcan {C635}, Model D-100-160 actuator and valve.

The SG Water Level Control (SGWLC) system {JB} consists of four three element controllers, one for each SG, to control the position of its associated FRV. The SGWLC system senses steam flow and FW flow mismatch and deviation from level set point and sends a signal to the FRV controllers to modulate the FRVs. The three element controller has inputs of SG level error, pressure compensated SG steam flow, and SG FW flow. The three element controller has a proportional plus integral controller and because it has an integral (reset) function, the controller output signal does not exactly equal the algebraic sum of the flow and level errors. The controller output is increased in magnitude based on the length of time the total error signal is not zero. A total error signal is sent to a controller to position the FRVs. The SGWLC is a proportional controller {JB} manufactured by NUS Corporation {N430}

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

An extent of condition (EOC) review was performed and determined that the MBFP hydraulic control system is similar between unit 2 and 3, as is the Lovejoy speed control and FW controllers. The FRV controllers are also the same for both units. The Lovejoy speed control system is unique to the MBFP turbines. The problems with relay spring constants and linkage looseness are applicable to the Main Turbines however, the size and configuration of these components on the Main Turbine are sufficiently different as to exclude them from being considered a EOC of the MBFP control problems. The AFW turbine driven pumps have control systems that rely on mechanical driven components and not hydraulic components.

Cause of Event

The direct cause of the RT was a TT from a high SG-32 level. The cause of the high SG level was overfeed of the 32 SG by the 31 MBFP due to the inability of the 31 MBFP turbine to operate at higher speeds on HP steam and due to the 32 FRV SG water level controller (LC) going into saturation. The limited ability of the 31 MBFP to operate on HP steam was due to improper HP governor valve stroke. The root cause was poor vendor oversight which allowed the vendor performing maintenance on the MBFP to close the work package without completing the governor valve stroke readings, and inadequate programmatic control of controller settings. Contributing causes include: CC1: Inadequate procedure (0-TUR-402-MFW) which did not specify the check of linkages for excessive clearance which causes binding and limited stroke of the HP governor valve. Additionally, the procedure was weak on the intent of always requiring measurement of governor valve stroke. Maintenance failed to provide a comprehensive review of the completed procedure used (0-TUR-402-MFW) to ensure the proper check of linkage clearances prior to the 31 MBFP being placed in service. CC2: The oversight of the vendor was ineffective in ensuring that station requirements and expectations regarding procedure adherence are followed. The supervisor review of the work package was ineffective in recognizing the incomplete step of the procedure prior to the MBFP being placed in service. CC3: Ineffective corrective action for CR-IP3-2009-00730 CA-5 which referenced a scope add to verify full stroke of the 31 MBFP turbine control valves but the HP governor valve stroke was never checked so the outage work order never measured the valve stroke.

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 HP governor valve on the 31 MBFP was adjusted to achieve acceptable performance.
- Coaching will be provided to the responder to CA-5 of CR-IP3-2009-00730 to ensure CAs in the response are completed as written. Coaching is scheduled to be complete by August 15, 2009.
- Maintenance personnel will be coached on management expectations on the requirements of procedure EN-MA-126, "Control of Supplemental Personnel," relating to oversight of contractors. Scheduled completion is September 30, 2009.
- Maintenance, Operations, System Engineering and Outage Management personnel will be briefed on the root cause and lessons learned from this event especially in the areas of vendor oversight, inadequate procedures, informal communications and complacency. Scheduled completion is September 30, 2009.
- A review will be performed of the SG LC reset times to determine if any changes are required. Any CAs identified will be recorded in the CAP including an action for training to adjust simulator settings. Scheduled completion is September 30, 2009.

- Management expectations will be provided to planners when creating or modifying work orders that have CRs attributed to them that they must ensure the instructions resolve the issue in the CR. Scheduled completion is September 30, 2009.
- Procedure 0-TUR-402-MFW will be revised to always require stroke measurement of HP governor valves, and the linkage inspection step will be revised to specify a check of the linkages for excessive clearance to ensure there is no binding to limit the stroke of the HP governor valve. Procedure revision is scheduled to be complete by October 15, 2009.
- Procedure adherence will be included in the pre-outage just-in-time presentation for vendor personnel for the next refueling outage in the Spring of 2010. Scheduled completion is March 31, 2010.
- This event will be incorporated into the Maintenance Supervisor continuing training highlighting the oversight of contractors. Scheduled completion is March 30, 2010.

Event Analysis

The event is reportable under 10CFR50.73(a)(2)(iv)(A). The licensee shall report any event or condition that resulted in manual or automatic actuation of any of the systems listed under 10CFR50.73(a)(2)(iv)(B). Systems to which the requirements of 10CFR50.73(a)(2)(iv)(A) apply for this event include the Reactor Protection System (RPS) including RT and AFWS actuation. This event meets the reporting criteria because an automatic RT was initiated at 06:23 hours, on May 28, 2009, and the AFWS actuated as a result of the RT. The RT did not result in the failure of any primary system to function properly. Therefore, there was no safety system functional failure reportable under 10CFR50.73(a)(2)(v). On May 28, 2009, at 07:12 hours, a 4-hour non-emergency notification was made to the NRC for an actuation of the reactor protection system while critical and included an 8-hour notification under 10CFR50.72(b)(3)(iv)(A) for a valid actuation of the AFW System (Event Log # 45098).

Past Similar Events

A review was performed of the past three years of Licensee Event Reports (LERs) for unit 3 events that involved a RT from a MBFP failure or malfunction of a FW FCV. One potential LER was identified. LER-2007-001 reported a manual RT due to decreasing SG levels as a result of the loss of FW flow caused by the failure of the 32 MBFP Train A control logic power supply. The cause of this event was a failed auctioneered power supply for the Lovejoy control system for MBFP control. The cause of the event reported in LER-2007-001 was not the same as this event therefore the corrective actions would not have prevented this event.

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 the event was an uncomplicated reactor trip with no other transients or accidents. Required primary safety systems performed as designed when the RT was initiated. The AFWS actuation was an expected condition as a result of low SG water level due to SG void fraction (shrink), which occurs after a RT and main steam back pressure as a result of the rapid reduction of steam flow due to turbine control valve closure.

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There were no significant potential safety consequences of this event under reasonable and credible alternative conditions. A RT and the increase in SG level is a condition for which the plant is analyzed. This event was bounded by the analyzed event described in FSAR Section 14.1.10, "Excessive Heat Removal Due to Feedwater System Malfunctions." Excessive FW additions is an analyzed event postulated to occur from a malfunction of the FW control system or an operator error which results in the opening of a FW control valve. The analysis assumes one FW valve opens fully resulting in the excessive FW flow to one SG. For the FW system malfunction at full power, the FW flow resulting from a fully open control valve is terminated by the SG high level signal that closes all FW control valves and trips the MBFPs and the main turbine. A TT initiates a RT. The analysis for all cases of the excessive FW addition initiated at full power conditions with and without automatic rod control, show that the minimum DNBR remains above the applicable safety analysis DNBR limit, the primary and secondary side maximum pressures are less than 110% of the design values, and all applicable Condition II acceptance criteria are met. For this event, rod control was in automatic and all rods inserted upon initiation of the RT. The AFWS actuated and provided required FW flow to the SGs. RCS pressure remained below the set point for pressurizer PORV or code safety valve operation and above the set point for automatic safety injection actuation. Following the RT, the plant was stabilized in hot standby.