NEXTera ENERGY
DUANE ARNOLD

June 25, 2010

NG-10-0351
10 CFR 50.73

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

Duane Arnold Energy Center
Docket 50-331
License No. DPR-49

Licensee Event Report #2010-003-00

Please find attached the subject report submitted in accordance with 10 CFR 50.73. This letter makes no new commitments or changes to any existing commitments.

Christopher R. Costanzo

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

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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

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 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	2. DOCKET NUMBER	3. PAGE
Duane Arnold Energy Center	05000331	1 OF 4

4. TITLE

Unplanned Manual Reactor Scram due to Increasing Turbine Vibrations

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	DOCUMENT NUMBER 05000
04	26	10	2010	003	0	06	25	10	FACILITY NAME	DOCUMENT NUMBER 05000

9. OPERATING MODE

1

10. POWER LEVEL

14%

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)	VOLUNTARY LER

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (*Include Area Code*)
Bob Murrell, Engineering Analyst	319-851-7900

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

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

On April 26, 2010, at 0300, while in day 1 of a 31 day Limiting Condition for Operation (LCO) for inoperable Primary Containment Isolation Valves (Traversing Incore Probe Drive Ball Valves), during the process of shutting down the plant for a planned outage to investigate an increase in Drywell leakage, a manual scram was inserted. The manual scram was inserted due to elevated vibration readings on Main Turbine Bearing number 6. The reactor scram and associated turbine trip was initiated at approximately 14% power in anticipation of reaching Main Turbine vibration limit.

The cause of the increase in bearing vibration was determined to be from a turbine rub. Turbine rubs can be induced in operating configurations of high turbine gland seal pressure with low main condenser back pressure. This configuration existed during the April 26, 2010 shutdown. The catalyst for inducing the rub was an excessive Low Pressure Turbine cool down rate which allowed one of the two Low Pressure Turbine casings to cool more than the other. This difference in casing temperatures created the formation of a rub which resulted in localized heating of the turbine shaft and resulting increase in vibration readings.

There were no Systems, Structures, or Components inoperable at the time of the scram that contributed to the event. There were no actual safety consequences and no effect on public health and safety as a result of this event.

I. Description of Event:

On April 26, 2010, at 0300, while in day 1 of a 31 day Limiting Condition for Operation (LCO) for inoperable Primary Containment Isolation Valves (Traversing Incore Probe Drive Ball Valves) (IEEE System Identification Code IG – Incore Monitoring System), during the process of shutting down the plant for a planned outage to investigate an increase in Drywell leakage, a manual scram was inserted. The manual scram was inserted due to elevated vibration readings on Main Turbine Bearing number 6 (TA – Main Turbine System). The reactor scram and associated turbine trip was initiated at approximately 14% power in anticipation of reaching the Abnormal Operating Procedure (AOP) 693, Main Turbine/EHC [Electro-Hydraulic Control], vibration limit of 12 mils.

The cause of the increase in bearing vibration was determined to be from a turbine rub. During periods of low turbine loads, turbine rubs can be induced in operating configurations of high turbine gland seal pressure with low main condenser back pressure. Contrary to a Caution Note, that was contained in the procedure for shutting down the reactor, Integrated Plant Operating Instruction (IPOI) 4, Shutdown, this configuration existed during the April 26, 2010 shutdown. The catalyst for inducing the rub was an excessive Low Pressure Turbine cool down rate which allowed one of the two Low Pressure Turbine casings to cool more than the other. This difference in casing temperatures created the formation of a rub which resulted in localized heating of the turbine shaft and resulting increase in vibration readings.

The excessive cool down rate occurred when control valves used to regulate steam flow to Second Stage Moisture Separator Reheaters (MSRs) (SB - Main/Reheat Steam System) were closed sooner than intended. The Second Stage MSRs function to raise the Low Pressure Turbine inlet temperature as turbine load changes. During this event, the two control valves (one control valve per MSR, one MSR per Low Pressure Turbine) closed sooner than intended and approximately four minutes apart from each other. This resulted in the Second Stage MSR heat exchanger tube cool down rate being exceeded. This excessive MSR cool down caused the steam that is supplied to the Low Pressure Turbines to cool down excessively. The control valves closed later than intended due to an incorrect input signal from a faulty resistor in the temperature control circuit and they closed at different times due to one of the control valves operating in a non-controlled manner.

II. Assessment of Safety Consequences:

This event resulted in a manual initiation of the Reactor Protection System (RPS) (JD – Reactor Power Control System) in anticipation of exceeding turbine vibration limits in an AOP. No Emergency Core Cooling System actuations occurred or were required. All rods fully inserted into the core as designed. There were no systems, structures, or components that were inoperable at the start of the event that contributed to the event.

The primary scram signal was the manual input by the operators. Subsequent, expected automatic scram signals were generated following the initial scram input from one of the RPS Reactor Pressure Vessel Level Sensors and each of the Scram Discharge Volume Level sensors.

This event did not result in a Safety System Functional Failure.

III. Cause of Event:

A Root Cause Evaluation (RCE) was completed for this event. The RCE determined the following to be the causes of this event:

Root Cause:

Faulty input to the temperature controllers combined with sluggish valve movement caused a 4-minute delay between closure of the two low load valves and an uneven cooldown rate for the LP turbines.

Contributing Factors:

The caution statement against operating with low condenser backpressure appeared near the beginning of Section 3.0, "35% Power to Reactor Shutdown," of IPOI 4. Securing of Second Stage MSRs occurs later in the shutdown sequence and is not referred to just prior to the removal of the MSRs. Therefore, the caution statement does not appear immediately before the action per the DAEC Technical Procedure Writing Standards.

Operators were not aware of the basis for the caution regarding the effect of low condenser backpressure on causing turbine rubs at low power.

IV. Corrective Actions:

Corrective Actions to Restore:

The following were completed prior to startup from the April 2010 planned outage:

Analyzed oil samples to assure no bearing damage.

Issued revision to IPOI 4 for low power operation to avoid turbine rubs, and inspected bearing number 6 shaft rider.

Monitored select turbine parameters during startup from the planned outage to ensure no damage occurred due to the high vibrations.

Interim Corrective Actions:

Added limits to the "Precautions and Limitations" section of IPOI 4 for condenser pressure, condenser pressure changes, Steam Packing Exhauster vacuum, and Steam Seal Header pressure.

Added new caution statement and additional direction in Operating Instruction (OI) 646, Extraction Steam and Feedwater Heaters, for removing the Second Stage MSRs to direct slowly closing the control valves and emphasize maintaining MSR outlet temperatures within 50 °F of each other.

Corrective Actions to Prevent Recurrence:

Implement existing work orders on the Second Stage MSR steam supply control valves to replace the resistor responsible for providing incorrect input to the controllers prior to shutting down for Refuel Outage 22.

V. Additional Information:

Previous Similar Occurrences:

A review of LERs over the previous 3 years revealed the following similar occurrence:

LER 2009-001 – Manual Reactor Scram due to Loss of Condenser Cooling
LER 2009-003 - Unplanned Manual Scram due to Increasing Reactor Water Level

Neither of the similar events had root causes similar to the event being reported by this LER, and therefore, prior corrective actions from those events could not have prevented this event.

EIIS System and Component Codes:

SB - Main/Reheat Steam System
IG – Incore Monitoring System
TA – Main Turbine System
JD – Reactor Power Control System

Reporting Requirements:

This event is reportable under 10CFR50.73(a)(2)(iv), 'System Actuation.'