Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802
Tel 479-858-4710

David B. Bice
Acting Manager, Licensing
Arkansas Nuclear One

2CAN021001

February 02, 2010

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

Subject: Licensee Event Report 50-368/2009-005-00
Manual Reactor Trip and Emergency Feedwater Actuation
Arkansas Nuclear One – Unit 2
Docket No. 50-368
License No. NPF-6

Dear Sir or Madam:

Pursuant to the requirements of 10 CFR 50.73(a)(2)(iv)(A), enclosed is the subject Licensee Event Report concerning a manual Reactor trip and Emergency Feedwater actuation on December 8, 2009.

There are no new commitments contained in this submittal.

Sincerely,

DBB/slc

Enclosure

cc: Mr. Elmo Collins
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
612 E. Lamar Blvd., Suite 400
Arlington, TX 76011-4125

NRC Senior Resident Inspector
Arkansas Nuclear One
P.O. Box 310
London, AR 72847

Institute of Nuclear Power Operations
700 Galleria Parkway
Atlanta, GA 30339-5957
LEREvents@inpo.org

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 information 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 Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@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 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
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4. TITLE Manual Reactor Scram and Emergency Feedwater Automatic Actuation due to an Unexpected Plant Response Following the Loss of a Main Feedwater Pump at Full Power.

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	08	2009	2009	005	00	02	02	2010	FACILITY NAME	DOCKET NUMBER

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- Specify in Abstract below or in NRC Form 366A
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
David B. Bice, Acting Manager, Licensing	479-858-4710

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
X	SJ	P	D055	Y					

14. SUPPLEMENTAL REPORT EXPECTED

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

15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR

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

On December 08, 2009, at 0837 Central Standard Time (CST), Arkansas Nuclear One, Unit 2 (ANO-2) was operating near 100 percent power when the 'A' Main Feedwater Pump (MFWP) was manually tripped in response to high thrust bearing temperature. The Loss of MFWP Abnormal Operating Procedure (AOP) was executed. A manual Reactor trip was initiated when the 'A' Steam Generator (SG) water level decreased to approximately 27 percent. The Emergency Feedwater (EFW) system automatically actuated at the designed setpoint of 22.2 percent to restore SG levels. The Loss of MFWP AOP contained instructions which limited the Main Turbine load reduction rate (plant power reduction rate) that was necessary to recover SG water levels prior to reaching the EFW automatic actuation setpoint. The ANO-2 plant simulator response had previously indicated that SG levels could be recovered following the loss of a MFWP from full power without requiring a Reactor trip. Following the subject event, the plant simulator software was revised to incorporate observed plant data. The Loss of MFWP AOP was revised to provide a mitigation strategy based on actual plant response data, and was validated using the revised ANO-2 plant simulator model. After replacement of the 'A' MFWP thrust bearing, ANO-2 returned to near full power on December 13, 2009, at approximately 1813 CST.

NARRATIVE

A. Plant Status

At the time of the event, Arkansas Nuclear One – Unit 2 (ANO-2) was operating near 100 percent power. All structures, systems, and components that were used, or could have been used to mitigate, reduce the consequences of, or limit the safety implications of the event were available.

B. Event Description

On December 08, 2009, at approximately 0837 Central Standard Time, Arkansas Nuclear One Unit 2 (ANO-2) was operating near 100 percent power when the 'A' Main Feedwater Pump (MFWP) [SJ] [P] was manually tripped due to high thrust bearing temperature. The subject MFWP is one of two installed MFWPs manufactured by Delaval, and utilizes an outboard Kingsbury double thrust bearing. In response to the manual trip of the MFWP, ANO-2 Operators entered the Loss of MFWP Abnormal Operating Procedure (AOP) and commenced Reactor Coolant System (RCS) [AB] boration while decreasing Main Turbine [TA] load. The Loss of MFWP AOP contained instructions that limited the Main Turbine load reduction rate (plant power reduction rate) that was necessary to recover Steam Generator (SG) [JB] water levels using the operating MFWP prior to reaching the Emergency Feedwater (EFW) [BA] automatic actuation setpoint of 22.2 percent. When water level in the 'A' SG decreased to approximately 27 percent, a manual Reactor trip was initiated. The EFW system automatically actuated as designed to restore SG levels. Operator response was consistent with recent simulator training using the Loss of MFWP AOP; however, the ANO-2 plant simulator response had indicated that SG levels could be successfully recovered following the loss of a MFWP from full power without requiring a Reactor trip and without EFW automatic actuation.

The feedwater flow characteristics programmed into the ANO-2 simulator were based on engineering analysis following the ANO-2 power uprate in 2002. Subsequent to the power uprate, feedwater modifications were implemented and mitigation strategies were changed which included the use of a fourth (standby) Condensate Pump [SD] in a loss of MFWP event to maximize available main feedwater flow. Analysis concluded that a slight increase in total feedwater flow would be achieved by starting the standby condensate pump with only one MFWP operating. Given the absence of actual plant data for a post-uprate MFWP trip, the ANO-2 simulator was validated against the predicted engineering data and vendor supplied pump curves. The post-uprate modifications and estimated main feedwater flows were programmed into the ANO-2 simulator, which indicated that a MFWP trip at full power could be mitigated using the revised strategy. The Loss of MFWP AOP was revised to incorporate the post-uprate mitigation strategy.

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C. Apparent Causes

The thrust bearing failure was caused by excessive thrust loading. The equipment degradation causing the excessive thrust loading could not be definitively determined without an internal inspection of the pump; however, changes in hydraulic performance, combined with the thrust bearing inspection, indicate a potential defect or degradation associated with the pump internals.

Analysis of the December 08, 2009 plant transient data revealed differences between the actual plant response and the ANO-2 simulator program. SG levels decreased much faster during the plant transient than previously indicated by the simulator. Actual plant feedwater flows after a loss of MFWP were less than the original engineering estimates programmed into the simulator, with no discernable increase in actual plant feedwater flows when the fourth condensate pump was started. ANO-2 had not experienced a MFWP trip from full power since power uprate; therefore, actual plant data for maximum achievable feedwater flows at full power with a single MFWP in service were not available until the subject event occurred. Additionally, the Loss of MFWP AOP mitigation strategies based on the main feedwater power uprate analysis and simulator performance contained instructions that limited the Main Turbine load reduction rate (plant power reduction rate) required to recover SG water levels for the subject event using the remaining operating MFWP prior to reaching the EFW automatic actuation setpoint.

D. Corrective Actions

The ANO-2 plant simulator software was revised to incorporate actual plant data observed from the loss of MFWP at full power event. The Loss of MFWP AOP was revised to provide a mitigation strategy based on data from the actual plant response, and was validated using the revised ANO-2 plant simulator model. The ‘A’ MFWP thrust bearing was replaced, with plans to disassemble the subject MFWP to determine the cause of pump hydraulic degradation and excessive thrust loads when spare parts become available. An enhanced monitoring program has been established to ensure early detection of thrust bearing degradation until MFWP maintenance can be initiated.

E. Safety Significance

Systems and components required to shutdown the Reactor, maintain safe shutdown conditions, remove residual heat, and control the release of radioactive material were available and performed as required. Following the manual Reactor trip, the EFW system automatically actuated as designed to restore SG levels. No safety limits were exceeded. The safety significance of this event is considered to be minimal.

F. Basis for Reportability

10 CFR 50.73(a)(2)(iv)(A) “Any event or condition that resulted in manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B).”

G. Additional Information

A review of the last five years of reportable events reveals one event that could potentially be considered similar in that the event resulted in a manual Reactor trip and EFW automatic actuation due to equipment failure in the Main Feedwater system; however the initiating cause of the event was not similar.

Licensee Event Report 50-368/2009-001-00:

> "On Friday, March 13, 2009, at approximately 21:51 CDT, Arkansas Nuclear One, Unit 2 was manually tripped from 84% power due to decreasing level in the "B" Steam Generator caused by the "B" Main Feedwater Regulating Valve moving in the closed direction without input demand to close. The trip was manually initiated at approximately the 25% Steam Generator water level. Due to the valve malfunction the system was unable to restore the Steam Generator water level before the 22.2% Emergency Feedwater System Control actuation set point was reached. The Emergency Feedwater System actuated, as designed, restoring Steam Generator water levels to normal. Post trip responses were normal with all plant safety systems functioning as expected. Investigation revealed that the most probable root cause of the event was a foreign substance in the clearance area of the armature, internal to a current-to-pressure (I/P) converter in the "B" Main Feedwater Regulating Valve positioner. The positioner was replaced and tested, and Unit 2 returned to 100% power operation, Mode 1, at 17:01 CDT on March 17, 2009."

Energy Industry Identification System (EIIS) codes and component codes are identified in the text as [XX].