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1CAN021603

February 12, 2016

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

Subject: Licensee Event Report 50-313/2015-001-00
Arkansas Nuclear One, Unit 1
Docket No. 50-313
License No. DPR-51

Dear Sir or Madam:

Pursuant to the reporting requirements of 10 CFR 50.73, attached is the subject Licensee Event Report entitled, "Manual Reactor Trip Due to Oscillations in the Feedwater System."

There are no new commitments contained in this submittal.

Should you have any questions concerning this issue, please contact me.

Sincerely,

ORIGINAL SIGNED BY STEPHENIE L. PYLE

SLP/rwc

Attachment: Licensee Event Report 50-313/2015-001-00

cc: Mr. Marc L. Dapas
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
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NRC FORM 366 (11-2015)	U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2018
	LICENSEE EVENT REPORT (LER) (See Page 2 for required number of digits/characters for each block)	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 FOIA, Privacy and Information Collections 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-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.

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4. TITLE
Manual Reactor Trip Due to Oscillations in the Feedwater System

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 05000
12	15	2015	2015	001	- 00	02	12	2016	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*			
1	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
10. POWER LEVEL	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(C)	☐ 73.77(a)(1)
100	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(2)(i)
	☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(ii)
		☐ 50.73(a)(2)(i)(C)	☐ OTHER Specify in Abstract below or in NRC Form 366A	

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT	TELEPHONE NUMER *(Include Area Code)*
Stephenie Pyle, Manager, Regulatory Assurance	479-858-4704

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	IMOD							

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 December 15, 2015, at approximately 0544, Arkansas Nuclear One, Unit 1 (ANO-1), manually scrammed during a scheduled automatic down power to 35% power for planned maintenance. The Integrated Control System (ICS) (JB) was being utilized for the down power. During the down power, oscillations occurred in the Main Feedwater (MFW) (SJ) system. The ICS was placed in manual and efforts were made to dampen the MFW oscillations. The Operators manually tripped the reactor from approximately 43% power when it became evident that an automatic reactor trip was imminent, based on the observed Reactor Coolant System (RCS) (AB) pressure rise caused by the significant reduction in MFW flow.

The direct cause of the manual plant trip is currently considered a result of placing the “B” startup valve in HAND (manual) when the valve was ~36% open, which resulted in a significant underfeed condition of the “B” Once-Through Steam Generator (OTSG). There are currently two root causes considered for this condition: (1) inadequate maintenance practices applied to the ICS modules, and (2) inadequate procedural guidance to address ICS malfunctions.

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(11-2015)

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NARRATIVE

A. Plant Status

At the time this condition was identified, Arkansas Nuclear One, Unit 1 (ANO-1) was performing a scheduled down power from 100% to ~ 35% power. Reactor power was ~ 43% at the time of the manual reactor trip. Emergency Feedwater (EFW) automatically initiated. No structures, systems or components were out of service at the time of this event that contributed to this event.

B. Event Description

On December 15, 2015, at approximately 0100 ANO-1 commenced a scheduled down power from 100% to approximately 35% for maintenance of Electro-Hydraulic Control system power supplies. The Integrated Control System (ICS) (JB) was adjusted to perform the down power. Both of the Main Feedwater (MFW) (SJ) block valves closed at approximately the same time (~ 0425) at ~ 48% reactor power, as designed. It was then noted by the Operator that the Once-Through Steam Generators (OTSGs) were being fed unevenly and that a difference in Reactor Coolant System (RCS) (AB) cold-leg temperature (Tcold) was developing between the two OTSGs.

An alarm was received in the Control Room at ~ 0441, when the difference in the RCS Tcolds between the OTSGs exceeded 5 °F, with the “A” OTSG being higher due to the overfeeding of the “B” OTSG. Overfeeding of the “B” OTSG was due to the “B” low-load control valve not starting to close as power was lowered. Subsequently, the valve was placed into a HAND (manual). The power reduction was also terminated by placing the SG / RX master hand / auto station in HAND.

The Operators attempted to manually control the “B” MFW low-load control valve. A closed signal from 100% open to ~90% was provided. At this time, the Operators did not believe any valve motion occurred. Based on this lack of movement, it was assumed that the valve was physically malfunctioning and would not control in either automatic or manual.

The difference in the RCS cold-leg temperatures continued to build as the plant stabilized. With the “B” MFW low-load control valve considered non-functional, it was determined that the most conservative action would be to raise power slightly so the MFW block valves would re-open and the MFW pumps would shift back to the “Flow Control” mode. A slight power increase using the ICS station in manual was initiated at ~ 0455. Power began to rise as expected and the RCS Tcold condition improved as MFW flows became more evenly matched due to increased feedwater flow to the “A” OTSG.

MFW flow to the “B” OTSG then began oscillating on an ~30 second period at ~ 0532, causing reactor power to lower ~13% in approximately one minute as the plant attempted to stabilize automatically. The oscillations were due to the original ICS malfunction self-correcting, and ICS transmitting a large error

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signal to both the “B” low-load control valve and the “B” startup valve. With the “B” low-load control valve in HAND, the error signal drove only the “B” startup valve in the closed direction, which then caused the “B” low-load block valve to automatically start travelling closed as the “B” startup valve position lowered to less than 50% open (note that the “B” low-load block valve is in series with the “B” low-load control valve). At the current power level, the majority of the feedwater flow to the “B” OTSG was being supplied through the “B” low-load control valve, such that when the “B” low-load block valve began travelling closed, significant underfeeding of the “B” OTSG occurred.

The MFW system recognized the underfeed condition, and fully opened the “B” startup valve. When the “B” startup valve was greater than 80% open, the “B” low-load block valve began to re-open, re-establishing flow through the “B” low-load control valve. Because the “B” low-load control valve remained in manual, a sequence of oscillations commenced where the “B” OTSG was alternately overfed and underfed.

During the flow oscillation, the lead bank of control rods began to insert continuously from 68% withdrawn to 58% withdrawn to control RCS temperature, which resulted in the initial power reduction of ~13%. As stated previously, Operators appropriately manually stopped the rod motion. Because this action did not stabilize the plant as expected, the ICS was placed in a “full manual” configuration by placing the Reactor Demand and both MFW loop demands in HAND at ~ 0537.

In an attempt to stabilize the large “B” startup valve and feedwater oscillations, the “B” startup valve was placed in HAND and controlled manually. The operators intended to place the “B” startup valve in manual when the valve reached the near fully open position; however, the valve was actually less than 50% open when place in manual. This caused the “B” low-load block valve to fully close, severely underfeeding the “B” OTSG. The underfeed condition was recognized and Operators attempted to open the “B” startup valve to raise flow. At this time it was recognized that an automatic reactor trip was imminent as RCS pressure rose due to the “B” OTSG underfeeding event; subsequently, the reactor was manually tripped at ~0544. EFW was initiated automatically based on low level in the “B” OTSG.

C. Event Cause

The direct cause of the manual plant trip is currently considered a result of placing the “B” startup valve in HAND when the valve was ~36% open, which resulted in a significant underfeed condition of the “B” OTSG. There are currently two root causes considered for this condition: (1) inadequate maintenance practices applied to the ICS modules, and (2) inadequate procedural guidance to address ICS malfunctions.

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D. Corrective Actions

Interim measures completed include additional monitoring of ICS performance during planned power maneuvers and changes to appropriate operating procedures where the mode of operation of the MFW pumps shifts from Flow Control to/from Differential Pressure control.

Additional corrective actions are under development in accordance with the root cause evaluation process.

E. Safety Significance Evaluation

The actual consequence of this event was a manual plant trip. The Operator decision to perform a manual reactor trip was a conservative measure and avoided challenging automatic trip setpoints. A manual or automatic reactor trip is considered a protective measure to mitigate transients and events experienced by the plant that could lead an eventual challenge to nuclear or public safety. Safety systems operated as designed and no radiological releases were involved with this event. Therefore, this event has minimal safety significance.

F. Basis for Reportability

This event is reported pursuant to the following criteria:

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

The bullets applicable to the subject ANO-1 event under 10 CFR 50.73(a)(2)(iv)(B) are:

(1) Reactor protection system (RPS) including: reactor scram or reactor trip

(6) PWR auxiliary or emergency feedwater system

In accordance with the guidance provided in NUREG 1022, Revision 3, Supplement 1, the paragraphs listed above require events to be reported whenever one of the specified systems actuate manually or automatically. In addition, the guidance states that if an Operator were to manually scram the reactor in anticipation of receiving an automatic reactor scram, this would be reportable just as the automatic scram would be reportable.

The ANO-1 EFW system actuated in response to the reactor trip.

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G. Additional Information

10 CFR 50.73(b)(5) states that this report shall contain reference to “any previous similar events at the same plant that are known to the licensee.” NUREG-1022, Revision 3, Supplement 1, reporting guidance states that term “previous occurrences” should include previous events or conditions that involved the same underlying concern or reason as this event, such as the same root cause, failure, or sequence of events.

A review of the ANO corrective action program and Licensee Event Reports for the previous three years was performed. One relevant similar event was identified. This event is discussed below.

On April 27, 2014, during a power reduction on ANO-1, Loop B feedwater flow controls did not properly function after the MFW block valve closed. When control was transferred from the MFW pump, the valve controllers did not respond to maintain feedwater flow at setpoint.

The low-load control valve was operated in manual to restore control of MFW flow. The startup valve was operated in automatic mode for approximately 4 hours. Although not recognized until extensive data review was performed, approximately 30 minutes from the initial failure, the valve controller circuit began to function properly. The reactor did not trip during this condition.

This failure was corrected through troubleshooting work order steps and module replacements. The condition cleared during the system responses following the noted condition (condition self-cleared within approximately 30 minutes of initial condition).

Post replacement tests revealed that a module contained signs of relay contact degradation. Although relay contact degradation is a known potential as a result of relay module aging, these relays were frequently actuated during the event and the actuation could have cleaned or wiped the contacts, masking other possible failure mechanisms. Therefore, the other modules that were replaced.

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