

NRC Form 366  
(9-83)U.S. Nuclear Regulatory Commission  
Approved OMB No. 3150-0104  
Expires: 8/31/85

## LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) Arkansas Nuclear One, Unit One										DOCKET NUMBER (2)   PAGE (3)   05   01   01   3   1   3   1   0   1   4														
TITLE (4) Reactor Trip and Emergency Feedwater Actuation During Power Ascension Due To Main Feedwater Pumps Control System Problems																								
EVENT DATE (5)					LER NUMBER (6)					REPORT DATE (7)					OTHER FACILITIES INVOLVED (8)									
Month	Day	Year	Year		Sequential Number	Revision Number	Month	Day	Year	Facility Names					Docket Number(s)									
01	08	11	58	78	01	04	01	09	11	N/A					01510101									
OPERATING MODE (9) N THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 8: (Check one or more of the following) (11)																								
POWER LEVEL (10)   01   12					20.402(b)					20.405(c)					X 50.73(a)(2)(iv)					73.71(b)				
					20.405(a)(1)(i)					50.36(c)(1)					50.73(a)(2)(v)					73.71(c)				
					20.405(a)(1)(ii)					50.36(c)(2)					50.73(a)(2)(vii)					Other (Specify in				
					20.405(a)(1)(iii)					50.73(a)(2)(i)					50.73(a)(2)(viii)(A)					Abstract below and				
					20.405(a)(1)(iv)					50.73(a)(2)(ii)					50.73(a)(2)(viii)(B)					in Text, NRC Form				
					20.405(a)(1)(v)					50.73(a)(2)(iii)					50.73(a)(2)(x)					366A)				
LICENSEE CONTACT FOR THIS LER (12)																								
Name										Telephone Number														
Patrick C. Rogers, Plant Licensing Engineer										Area   Code   51011916141-13111010														
COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)																								
Cause	System	Component	Manufacturer	Reportable to NPRDS	Cause	System	Component	Manufacturer	Reportable to NPRDS															
X	J	K	S	C	L	3	2	1	Y															
SUPPLEMENT REPORT EXPECTED (14)																								
Yes (If yes, complete Expected Submission Date)   No										EXPECTED SUBMISSION DATE (15)														
										Month   Day   Year														

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On 8/15/87 during power ascension operations at approximately 12 percent power, 'B' main feedwater (MFW) pump control was shifted from manual to automatic. Feedwater oscillations ensued resulting in the MFW pump turbine controls shifting to a 'track and hold' mode. 'B' MFW pump turbine speed unexpectedly decreased to a speed lower than that required to supply feedwater to the steam generators. Emergency feedwater (EFW) subsequently actuated on low steam generator water level. A reactor trip occurred due to high reactor coolant system pressure. After the trip, control of the 'B' MFW pump was regained and EFW was secured. Post trip plant response was satisfactory. The plant startup procedure was modified to provide guidance to plant operators to keep MFW pumps in manual control until at least 20 percent power before switching to automatic control. This provides for more stable operating conditions for transfer from manual to automatic. Troubleshooting revealed that the integrated control system (ICS) was supplying a negative voltage to the MFW pump turbine Lovejoy control system. This is believed to have caused the abnormal pump operation. A damaged chip in the 'track and hold' circuit was replaced and modifications to the ICS were made to prevent the input of a negative voltage to the MFW pump turbine control system.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

I. Description of Event

A. Unit status

On 8/15/87, Arkansas Nuclear One, Unit One was starting up from Hot Standby following a maintenance shutdown to isolate a small leak in the upper seal pressure sensing line for 'B' reactor coolant pump. The unit was at approximately 12 percent power when the emergency feedwater initiation and control (EFIC) system actuated on low steam generator water level and a reactor trip on high reactor coolant system (RCS) pressure occurred. At the time of the trip, the turbine-generator was not synchronized with the grid. RCS average temperature was 558 degrees Fahrenheit and RCS pressure was 2155 psig.

B. Component Identification

During troubleshooting following this event, a bad chip was found in the 'track and hold' circuit board for the 'B' main feedwater (MFW) pump turbine control system. This equipment was supplied by Lovejoy Controls Corporation (L321). EIS Identifier = JK-SC.

C. Sequence of Events

On 8/15/87 at 1648 hours, power increase from Hot Standby commenced. At the time, the auxiliary feedwater (AFW) pump was being used to maintain water levels in the steam generators. The AFW pump is designed for low power startup operations. At 1722 hours the 'A' MFW pump was started and the 'A' MFW pump turbine control system minimum speed setpoint (3000 RPM) was verified. The 'A' MFW pump was then secured. At 1734 hours the 'B' MFW pump was started and its pump turbine control system minimum speed setpoint verified. The 'B' MFW pump was then placed in service in the manual control mode supplying feedwater to the steam generators. With the 'B' MFW pump operating, the AFW pump was secured and power ascension continued. When reactor power reached approximately 12 percent, control room operators shifted the 'B' MFW pump from manual to automatic control. When this was done, divergent feedwater flow oscillations ensued. Within a minute the 'B' MFW pump unexpectedly went to less than minimum speed (a momentary speed as low as approximately 1400 RPM was observed by control room operators). The operators were not able to regain manual control of the 'B' MFW pump. As a result, steam generator water levels decreased to the EFIC system actuation setpoint. Also, due to the decrease in primary to secondary heat transfer associated with the decreasing feedwater flow, RCS pressure increased to the reactor protection system (RPS) high pressure trip setpoint. The EFIC system actuation and reactor trip occurred at 1919 hours. The control room operators regained manual control of the 'B' MFW pump because the 'track and hold' circuit reset following the reactor trip. Emergency feedwater (EFW) was then secured. The operators placed the AFW pump in service to maintain steam generator water levels and the 'B' MFW pump was removed from service. Post trip plant response was satisfactory. The plant was stabilized at Hot Shutdown within two minutes of the reactor trip.

II. Event Cause

A. Event Analysis

Feedwater oscillations have been previously observed when the MFW is shifted from manual to automatic control at power levels less than approximately 20 percent. However, the plant startup procedure provided no guidance as to when to place the first MFW pump into automatic control or what to expect if a MFW pump were placed in service at lower power levels.

These oscillations apparently caused the MFW pump turbine control system to enter a 'track and hold' condition. A 'track and hold' condition occurs when the MFW pump turbine control system senses a rapidly changing feedwater demand input signal from the Integrated Control System (ICS) and senses that a demand limit has been reached. This condition exists until the controller is reset. 'Track and hold' can be reset by control room operators with a pushbutton on the MFW pump turbine controller or will automatically reset after a reactor trip. The control room operator was attempting to take manual control of the MFW pump at the ICS station on the

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adjacent control panel when the EFIC system actuated and the reactor trip occurred. These events occurred within approximately 40 seconds of the beginning of feedwater transient. For this event, the 'track and hold' condition was reset by the reactor trip which explains the fact that control of the 'B' MFW pump was regained after the reactor trip.

The MFW pump turbine unexpectedly went to a speed less than the minimum speed setpoint of the MFW pump turbine control system. However even at minimum speed the MFW pump discharge pressure is not high enough to supply feedwater to the steam generators. The design of the MFW pump turbine control system is such that the pump speed should not go below the minimum speed setting even if a 'track and hold' condition exists.

To determine the cause of the pump speed control problem, extensive troubleshooting of the pertinent portions of the ICS was performed. No apparent failures were discovered, however, it was discovered that the ICS was supplying negative voltages to the MFW pump turbine control system under low load conditions. The MFW pump turbine control system was not designed for negative voltage inputs. The negative voltage is believed to have caused the MFW pump to go to less than the minimum speed setpoint during this transient.

Also during the troubleshooting of the MFW pump turbine control system, a damaged 'chip' was discovered in the 'track and hold' circuit board. This damaged chip is believed to be the cause of not being able to reset the 'track and hold' condition during a previous feedwater transient which occurred on 8/8/87 and discussed in LER 50-313/87-003. During the event on 8/8/87, the 'track and hold' condition would not release the MFW pump controls even after the reset button was pressed.

This event posed no threat to the health and safety of the public. The EFIC system actuated on low level as designed for steam generator water level control. The RCS pressure reached the high pressure trip setpoint on only two of the four RPS channels. The RPS functioned as designed. Post trip plant responses were satisfactory and no safety limits were exceeded.

B. Root Cause

The root cause of the event was placing the MFW pump in automatic control at a power level which was too low for stable feedwater system operations.

C. Basis for Reportability

This event resulted in an unplanned automatic actuation of the RPS and EFIC system and is thereby reportable under the provisions of 10CFR50.73(a)(2)(iv). This event was reported per 10CFR50.72(b)(2)(ii) at 1925 hours on 8/15/87.

III. Corrective Actions

A. Immediate

Proper actuation of the EFIC system and RPS was verified. Post trip actions were carried out as required by procedures. The plant was stabilized at Hot Shutdown within two minutes of the reactor trip. Control of main feedwater was regained as a result of the reactor trip. Emergency feedwater was secured, the AFW pump was placed in service to maintain steam generator water levels and the MFW pump was removed from service.



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Arkansas Nuclear One, Unit One		<table border="1"> <tr> <td>Sequential</td> <td>Revision</td> </tr> <tr> <td>Year</td> <td>Number</td> </tr> </table>	Sequential	Revision	Year	Number	
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TEXT (If more space is required, use additional NRC Form 366A's) (17)

B. Subsequent

Signal limiters were added to the ICS to eliminate a negative voltage being supplied to the Lovejoy MFW pump turbine control systems. This modification should prevent pump speed from going below minimum speed.

Although not related to this event, filter capacitors were installed on the 'track and hold' circuit boards to eliminate noise as a source of 'track and hold' problems. Additionally, the damaged chip in the 'track and hold' circuitry was replaced.

The plant startup procedure was modified to provide operator guidance to keep the MFW pump in manual control until 20 percent power is reached. This provision allows for more stable operating conditions when the transition from manual to automatic MFW pump operation is made. This proved to be adequate during the subsequent startup.

C. Future

No future actions are planned.

IV. Additional Information

LER 50-313/87-003 reported a similar event regarding the MFW pump turbine control system problems. A supplemental report is not planned.



ARKANSAS POWER & LIGHT COMPANY

September 10, 1987

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U. S. Nuclear Regulatory Commission  
Document Control Desk  
Washington, D.C. 20555

SUBJECT: Arkansas Nuclear One - Unit 1  
Docket No. 50-313  
License No. DPR-51  
Licensee Event Report No. 313/87-004-00

Gentlemen:

In accordance with 10CFR50.73(a)(2)(iv), attached is the subject report concerning an unplanned Emergency Feedwater System actuation and reactor trip during power ascension due to main feedwater pump control system problems.

Sincerely,

*J. M. Levine/smd*

J. M. Levine  
Executive Director,  
Site Operations

JML:PCR:djm  
Attachment

cc w/att: Regional Administrator  
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