



October 26, 1990

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U. S. Nuclear Regulatory Commission
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SUBJECT: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Licensee Event Report No. 50-368/90-020-00

Gentlemen:

In accordance with 10CFR50.73(a)(2)(iv), attached is the subject report concerning the failure of a motor operated valve on a main condenser circulating water pump to close resulting in the loss of main condenser vacuum and subsequent manually initiated reactor trip.

Very truly yours,

James J. Fisicaro
Manager, Licensing

JJF/LAT/sgw
Attachment

cc: Regional Administrator
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LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) Arkansas Nuclear One, Unit Two DOCKET NUMBER (2) | PAGE (3)
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TITLE (4) Failure of Motor Operated Valve on Main Condenser Circulating Water Pump to Close
Results in Loss of Vacuum and Subsequent Manually Initiated Reactor Trip

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)															
0	9	2	8	9	0	9	0	--	0	2	0	--	0	0	1	0	2	6	9	0	0	5	0	0	0

OPERATING MODE (9) 1 THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §:
(Check one or more of the following) (11)

POWER LEVEL	20.402(b)	20.405(a)(1)(i)	20.405(a)(1)(ii)	20.405(a)(1)(iii)	20.405(a)(1)(iv)	20.405(a)(1)(v)	20.405(c)	50.36(c)(1)	50.36(c)(2)	50.73(a)(2)(i)	50.73(a)(2)(ii)	50.73(a)(2)(iii)	50.73(a)(2)(iv)	50.73(a)(2)(v)	50.73(a)(2)(vii)	50.73(a)(2)(viii)(A)	50.73(a)(2)(viii)(B)	50.73(a)(2)(x)	73.71(b)	73.71(c)	Other (Specify in Abstract below and in Text, NRC Form 366A)
(10) 0 8 2													X								

LICENSEE CONTACT FOR THIS LER (12)

Name	Telephone Number
Larry A. Taylor, Nuclear Safety and Licensing Specialist	Area Code: 5 0 1 9 6 4 - 3 1 0 0

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

SUPPLEMENT REPORT EXPECTED (14)

EXPECTED SUBMISSION DATE (15)	Month	Day	Year
<input type="checkbox"/> Yes (If yes, complete Expected Submission Date) <input checked="" type="checkbox"/> No			

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

At 2142 hours on September 28, 1990, during a planned power reduction from full power, main condenser circulating water pump 2P-33 was secured. The pump discharge valve failed to automatically close allowing a flowpath for circulating water flow to bypass the main condenser. At 2143 hours an automatic main turbine trip on High Condenser Pressure occurred and control room personnel manually tripped the reactor in anticipation of an automatic reactor trip. The Emergency Feedwater System, actuated automatically and was used to restore and maintain normal steam generator water levels. The plant was subsequently stabilized in Mode 3 (Hot Standby) conditions. Investigations revealed that the valve failed to close due to a mechanical key which disengaged from the motor shaft allowing the motor pinion gear to turn freely on the shaft. Vibration caused a setscrew used to secure the key to loosen. The root cause was determined to be inadequate work instructions leading to the previous installation of a setscrew that was too small to allow proper lockwiring. The procedure for motor pinion gear installation has been changed to include detailed instructions on motor pinion gear installation. However, the procedure will be evaluated to determine if additional guidance concerning the selection of setscrews is warranted.

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

A. Plant Status

At the time of occurrence of this event, Arkansas Nuclear One, Unit 2 (ANO-2) was operating at approximately 82 percent of rated thermal power in Mode 1 (Power Operation). Reactor coolant system (RCS) [AB] temperature was 573 degrees Fahrenheit and pressurizer pressure was approximately 2250 psia.

B. Event Description

On September 28, 1990 at 2001 hours, ANO-2 commenced a power reduction from 100 percent power at the request of the offsite power distribution system dispatcher. Operations personnel planned to secure the power reduction and stabilize reactor power at approximately 70 percent. At 2142 hours, one of the two operating main condenser circulating water pumps, 2P-3B, was secured in anticipation of a maintenance evolution inside the condenser water boxes while at the reduced power level. While securing the pump, the pump discharge valve, 2CV-1215, failed to close. With 2CV-1215 not fully closed and 2P-3B not running, a flow path for the discharge from the operating circulating water pump, 2P-3A, was created that diverted cooling water flow from the condenser. This decrease in circulating water flow caused a subsequent rapid loss of condenser vacuum. Efforts to restart 2P-3B were unsuccessful due to a start interlock which requires 2CV-1215 to be fully closed prior to pump start. At 2143 hours an automatic main turbine generator trip on high condenser pressure occurred. Control Room personnel manually tripped the reactor to preclude an automatic reactor trip on high RCS pressure due to loss of secondary heat sink. Operations personnel responded to the transient by performing the immediate actions of the Emergency Operating Procedure.

All Control Element Assemblies (CEAs) inserted fully into the core. The Emergency Feedwater (EFW) System [BA] actuated automatically due to post reactor trip Steam Generator (S/G) water level response (shrink) with both EFW pumps starting and supplying feedwater to the S/Gs.

Operations personnel were dispatched to the circulating water pump and were able to manually close the discharge valve. This restored cooling water to the main condenser. Vacuum was restored and the main turbine steam dump bypass valves were used for post trip decay heat removal. The plant was stabilized in a hot standby (Mode 3) condition. Actions were initiated to determine the cause of the loss of main condenser vacuum.

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C. Root Cause

The cause of the loss of main condenser vacuum which resulted in the automatic main turbine trip on high condenser pressure and subsequent manually initiated reactor trip was the failure of the circulating water pump, 2P-3B, discharge valve (2CV-1215) to automatically close while securing the pump.

The valve operator is a Limitorque model SMB-4. Maintenance on the valve revealed that 2CV-1215 failed to close on demand due to the disengagement of the motor side pinion gear from the motor drive shaft internal to the valve operator. This disengagement was caused by loosening of a setscrew used to secure the pinion gear key in the motor shaft. Vibration then allowed the motor pinion gear key to slip out. Without the key, the gear was able to turn freely on the shaft, thus preventing valve movement.

A review of maintenance history records indicated that in November 1989, the motor pinion gear key was replaced with a key made of a different material due to a concern related to the potential for failure of keys in Limitorque actuators as discussed in IE Information Notice No. 81-08. During that activity the craft personnel appear to have obtained and installed a 3/16"-18x1/2" setscrew in the motor pinion gear. When tightened against the key, this size setscrew (i.e., too short) allowed a gap to exist between the head of the screw and a lockwire which was supposed to prevent movement of the setscrew. Additionally, staking of the end of the motor shaft keyway was not adequate to retain the key in the keyway of the motor shaft when vibration eventually loosened the set screw. The valve maintenance in November 1989 was performed using Electrical Maintenance Procedure 1403.040, Rev 2. This procedure did not contain adequate written instructions on the installation of the pinion gear, and relied solely on a drawing of the gear orientation for the different models of valve operators. Specific instructions for setscrew installation and guidance on staking of the shaft keyway were not included. Therefore, the root cause of the failure on September 28, 1990, was determined to be inadequate work instructions to craft personnel leading to the failure of craft to recognize the purpose of the lockwire and the necessity for an adequately sized setscrew.

A contributing factor to occurrence of this event was failure of the operator to properly follow the procedural instructions for securing 2P-3B. The pump handswitch manipulations specified in the procedure for securing the pump were not followed exactly as written. In this case, the result was a premature trip of the pump. Once the pump was stopped, an interlock requiring the discharge valve to be closed prevented restart of the pump. Had the proper handswitch manipulations been made the operator could have recognized that the discharge valve was not closing properly and pump operation could have been maintained.

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D. Corrective Actions

The motor pinion gear key for 2CV-1215 was replaced after drilling the key to allow a captive seat for the setscrew. An adequately sized setscrew was installed, properly lockwired in place and the motor shaft end was properly staked. The discharge valve for the other circulating water pump (2CV-1224) was inspected and was determined to have a different pinion gear locking arrangement not subject to the same type failure.

A search of maintenance history records on other Limotorque model SMB-4 and SB-4 valve operators showed that no previous failures of this type had occurred other than previous failures of the circulating water pump discharge valves (see Additional Information, Section G). This is most likely due to the level of vibration experienced by the circulating water pump discharge valve operators during pump operation.

Electrical Maintenance procedure 1403.40 had been revised subsequent to the maintenance activity in November 1989 which installed the short setscrew on the 2CV-1215 valve operator. The current procedure (1403.040 Revision 4) provides detailed instructions for motor pinion gear installation, including setscrew installation, staking of the motor shaft keyway, and installation of lockwire. However, the procedure will be evaluated by December 15, 1990, to determine if additional guidance concerning the selection of setscrews is warranted. Additionally, ANO will evaluate machining the rotor shaft of 2CV-1215 and installing a pinion gear locking arrangement similar to that currently used on 2CV-1224. This evaluation will be completed by December 15, 1990.

With regard to the operator error in manipulating the 2P-3B handswitch while securing the pump, the specific individual involved, and the Shift Operating Supervisor and the Shift Senior Reactor Operator have been counselled on proper operation of the handswitch. Operational concerns raised by this reactor trip are being discussed with all Unit 2 Operations crews. Additional training will be provided during a regularly scheduled requalification training cycle. These actions will be completed by December 3, 1990.

E. Safety Significance

A loss of main condenser vacuum is an anticipated operational transient. Upon receipt of the automatic turbine trip on high condenser pressure, Operations personnel promptly initiated a manual reactor trip to preclude challenging the automatic reactor trip on high RCS pressure. The EFW system responded properly to low steam generator water levels and restored and maintained proper steam generator levels. The Operations staff took timely action in initiating the manual reactor trip and responded appropriately to the trip. Condenser vacuum was restored promptly following the trip and the turbine bypass valves were used for decay heat removal. The S/G main steam safety valves did not lift during the transient. The actions of the Emergency Operating Procedure were completed in a timely manner. It was concluded that there was no actual safety concerns as a result of this event.

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F. Basis for Reportability

This event resulted in an unplanned manual actuation of the Reactor Protection System and an automatic actuation of the Emergency Feedwater System (an ESF system) and is therefore reportable per 10CFR50.73(a)(2)(iv). The event was reported per 10CFR50.72(B)(2)(ii) at 2230 hours on September 28, 1990.

G. Additional Information

A similar event occurred on October 19, 1985 and was reported in LER 50-368/85-023-00. As a result of that event, the current method used to secure the motor pinion gear to the motor shaft was implemented. However, the appropriate plant procedures were not adequately revised to ensure subsequent maintenance activities did not cause the problem to occur again. Therefore, when maintenance was performed on 2CV-1215 in November 1989, errors were made which subsequently led to the valve failure on September 27, 1990.

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