Entergy
Operations

Entergy Operations, Inc.
Route 3 Box 137G
Russellville, AR 72801
Tel 501 964 3100

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SUBJECT: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Licensee Event Report No. 50-368/90-024-00

Gentlemen:

In accordance with 10CFR50.73(a)(2)(ii)(B), attached is the subject report concerning an inadequate preventive maintenance program for the steam turbine driven emergency feedwater pump which resulted in a degraded turbine governor system and subsequent overspeed trips of the turbine.

Very truly yours,

James J. Fisicaro

James J. Fisicaro
Manager, Licensing

JJF/LAT/mmg
Attachment
cc: Regional Administrator
Region IV
U. S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

INPO Records Center
Suite 1500
1100 Circle, 75 Parkway
Atlanta, GA 30339-3064

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NRC Form 366 U.S. Nuclear Regulatory Commission
(6-89)

Approved OMB No. 3150-0104
Expires: 4/30/92

LICENSEE EVENT REPORT (LER)

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TITLE (4) Inadequate Preventive Maintenance Program For Steam Turbine Driven Emergency Feedwater Pump Results In Degraded Turbine Governor System And Subsequent Overspeed Trips Of Turbine.

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 5 0 0 0
1 2	0 5	9 0	9 0	-- 0 2 4	-- 0 0	0 1	0 4	9 1		0 5 0 0 0

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	1 0 0	20.402(b)	20.405(c)	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 Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

Name	Telephone Number
Larry Taylor, Nuclear Safety and Licensing Specialist	Area Code 5 0 1 9 6 4 - 5 0 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
Yes (If yes, complete Expected Submission Date) X No				

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

On December 5, 1990 based on evaluations of two previous events involving overspeed trips of the steam turbine driven emergency feedwater pump, it was concluded that the cause of the trips had been water slugging of the turbine on startup due to condensate accumulation in the steam supply line to the turbine. Following another overspeed trip on December 6, 1990, the actual cause for the turbine trips was found to be sluggish response of the turbine governor valve due to a contaminated control oil system. The root cause was considered to be inadequacies in the preventive maintenance program. The program did not appropriately address and minimize the potential effects of oil contamination and degradation of governor components over time. Following the last overspeed trip, the oil and oil filter assembly were changed, a hydraulic actuator was replaced and a remote servo valve and control oil tubing were cleaned. The turbine is being tested on an increased frequency and the oil quality is being monitored to ensure it is not degrading. Long term actions include procedure revisions to include periodic cleaning and/or replacement of control oil system components. Additionally, the turbine oil system will be cleaned to remove varnish and hardened oil deposits during the next refueling outage.

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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 100% power in Mode 1 (Power Operation). Reactor Coolant System (RCS) [AB] temperature was approximately 580 degrees Fahrenheit and RCS pressure was about 2250 psia.

B. Event Description

On November 13, 1990 at 1054 hours while attempting to start the steam turbine driven Emergency Feedwater (EFW) pump (2P7A) [BA-P] following a maintenance activity, the turbine tripped on overspeed. Following the trip, the pump alignment was verified, the turbine steam supply line steam traps were blown down, the pump was re-vented and refilled and a second start was attempted. The pump started and ran normally. The pump was stopped and restarted again approximately thirty minutes later. The pump again responded normally. The redundant EFW Pump (2P7B), which is motor driven, was operable during this period.

Investigations indicated that the likely cause of the overspeed trip was the failure to remove all of the air from the pump casing during the post-maintenance filling and venting operation. At this time, it was thought that the presence of air in the pump casing resulted in a condition of very low pump resistance during the initial start resulting in the subsequent overspeed trip. The two successful starts after refilling and venting the pump appeared to confirm that the problem had been properly identified and corrected. The pump was declared operable and returned to service.

On November 29, 1990 at 1032 hours an overspeed trip of EFW pump 2P7A occurred again while attempting to run the pump for post-maintenance testing. Investigations into the cause of this event indicated that the problem might have been accumulation of condensate in the turbine steam supply line, leading to water slugging of the turbine on startup. A review of plant records indicated that previously on November 5, 1990, steam traps on the steam supply line had been isolated because they were not functioning properly. Operations personnel had been manually opening a bypass valve around the traps once every four hours in order to remove any condensate which might have accumulated in the line while the traps were isolated. Subsequent testing and evaluations conducted after the November 29, 1990, overspeed trip led personnel to conclude that manually blowing down the steam line every four hours was not sufficient to prevent the possibility of an overspeed trip due to condensate accumulation in the steam line. On December 5, 1990, it was concluded that the steam driven EFW pump might have been susceptible to an overspeed trip due to water slugging of the turbine for intermittent periods since the initial isolation of the steam traps on November 5, 1990. Because the redundant motor driven EFW pump had been removed from service for a short period of time on at least two occasions during the time period while the steam traps were isolated, it was assumed that ANO-2 might have unknowingly operated with both EFW pumps in an inoperable condition. This potential condition was reported to the NRC on December 5, 1990, in accordance with 10CFR50.72(b)(1)(ii)(B).

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The steam traps were placed back in service to provide for continuous removal of condensate from the steam supply line. The frequency of testing for the pump was increased to ensure that the cause of the overspeed trips had been properly and identified and corrected.

On December 6, 1990 at 1320 hours, during testing another overspeed trip of 2P7A occurred. Following this trip the turbine was reset and started successfully several times with normal response. Investigations conducted following this overspeed event led to the identification of a degraded condition of the turbine governor valve control system as the cause of the trip.

ANO has two EFW pumps, one motor driven and one steam turbine driven pump. Upon initiation of a start signal to the turbine driven pump, a bypass valve around a normally closed main steam isolation valve in the steam supply line to the turbine opens and the turbine accelerates to a minimum idle speed. Following a preset time delay the main steam supply isolation valve opens and the turbine governor valve opens to accelerate the turbine to the rated speed. The governor valve is positioned by an EG-R hydraulic actuator in conjunction with a remote servo. The EG-R is supplied an electrical speed demand signal which is converted by an electro-hydraulic transducer to a hydraulic signal which is sent to the servo to adjust governor valve position. Filtered oil from the turbine lube oil system is used as the hydraulic medium for the EG-R actuator.

After the December 6, 1990 overspeed trip, an authorized field representative of the Woodward Governor Company was brought on site to help determine the cause of the continuing overspeed trips. After observing sluggish governor valve response, the control oil system was opened and inspected. The condition of the control oil was examined and found to be dirty and gritty. The oil filter was also found to be dirty. A thick gelatin-like coating of hardened oil was observed in some components. The turbine oil was subsequently changed and the oil filter was replaced. The EG-R actuator was replaced, and the remote servo and control tubing were cleaned. The governor system was tuned for good system response and the turbine was tested for several hours with quick starts to 100 percent speed and with step changes both up and down from minimum to maximum demand. The EFW pump was declared operable and returned to service on December 9, 1990 at 0245 hours.

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C. Root Cause

The overspeed trips that occurred on November 13, November 29 and December 6, 1990, were a result of sluggish governor response to quick start demands. A preventive maintenance (PM) task included in the ANO PM program provided for sampling the EFW turbine lube oil on a monthly basis. The ANO PM program also included requirements to change the lube oil and filter on a six month frequency. Maintenance records indicate that the oil and filter had last been changed in accordance with the PM program on September 2, 1990. Periodic inspections to determine the cleanliness of the oil sump and other components of the hydraulic system, however, were not addressed by any current PM procedure. It is believed that the buildup of oil contaminates over time in the oil sump and in other governor system components caused the oil and filter change to be ineffective. Therefore, the root cause of these events was determined to be inadequacies of the PM program. The program did not appropriately address and minimize the potential effects of oil contamination and degradation of governor components over a long period of time.

D. Corrective Actions

As a result of this event several interim actions have been implemented to ensure the turbine driven EFW pump remains operable and to reduce the susceptibility of the turbine to overspeed trips.

The turbine is being run on an increased frequency until acceptable reliability has been demonstrated. The turbine control system is being monitored during pump runs for proper governor response by observing control valve motion and turbine speed. The control oil quality is being monitored each time the oil filter or oil are changed. The oil and filter were replaced on December 8, 1990 and oil was flushed through the turbine bearing caps. Additionally, the oil filter was replaced on December 9th and 12th. The samples taken during oil and filter changes will verify that the oil quality is improving and not degrading.

Long term actions which will be implemented to prevent recurrence of a similar event include:

- Continuation of the PM to change the oil and filter on a regular basis.
- The EGR actuator and remote servo will be added to the PM program. Procedures will be revised by May 1, 1991 to include periodic cleaning and/or replacement of these components.

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- An oil flush of the 2P7A turbine oil system to remove varnish and hardened oil deposits will be performed during the next refueling outage.

E. Safety Significance

At the time of the overspeed trips of the turbine driven EFW pump, the motor driven EFW pump was available to provide feedwater to the Steam Generators (SGs) to maintain SG water levels for decay heat removal. After the overspeed trips on November 13, 1990 and November 29, 1990, successful completion of the required surveillance tests indicated that the turbine driven pump had been restored to operable status. Due to the sporadic nature of the effects of the dirty control oil on the turbine governor valve response, the true root cause was not diagnosed until after the third overspeed trip on December 6, 1990. During the period between the initial overspeed trip and the third overspeed trip, the reliability of the turbine driven EFW pump could be questionable. Even though the normal surveillance tests required to prove pump operability had been successfully completed, the probability of an overspeed trip was possible due to the condition of the control oil and governor system components. During the period between the first and third overspeed trips, the motor driven EFW pump 2P7B was taken out of service for brief time periods to perform valve stroke testing. The safety significance of this event is considered to be minimal since the motor driven EFW pump was operable for most of the time period during which the turbine driven pump was more susceptible to an overspeed trip. The periods of time when the motor driven EFW pump was not available were short, and the motor driven pump could have been started manually by operators, if needed. Additionally, the turbine driven pump could have been manually reset and started under manual control if needed to supply feedwater to the steam generators.

F. Basis For Reportability

These events were determined to constitute operation of the plant in a condition outside the design basis of the plant and therefore, reportable per 10CFR50.73(a)(2)(ii)(B).

G. Additional Information

There have been no previous events reported involving overspeed trips of the turbine driven EFW pump caused by contaminated lube oil.

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