APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-313/89-46
50-368/89-46

Operating Licenses: DPR-51
NPF-6

Dockets: 50-313
50-368

Licensee: Arkansas Power & Light Company (AP&L)
P.O. Box 551
Little Rock, Arkansas 72203

Facility Name: Arkansas Nuclear One (ANO), Units 1 and 2

Inspection At: ANO, Russellville, Arkansas

Inspection Conducted: December 4 through 8, 1989

Inspector: Claude E. Johnson — 1-9-90
C. E. Johnson, Reactor Inspector, Plant Systems Section, Division of Reactor Safety — Date

Approved: T. F. Stetka — 1/9/90
T. F. Stetka, Chief, Plant Systems Section
Division of Reactor Safety — Date

Inspection Summary

Inspection Conducted December 4 through 8, 1989 (Report 50-313/89-46; 50-368/89-46)

Areas Inspected: Routine, unannounced inspection of licensee action on licensee event reports (LERs), previous inspection findings, and testing of safety-related pipe supports conducted during the Unit 1 mid-cycle outage.

Results: Management attention is evident in the area of closure and corrective actions on previous inspection findings such as violations or deviations. The inspector had no difficulty with the inspection in this area.

In the area of LER closures, licensee program improvement is needed. The inspector had difficulty in LER closure because of insufficient documentation in the closure packages presented for review. Licensing management indicated that they are aware of these shortcomings, and that program improvements have been considered.

Management attention in the testing of pipe supports (snubbers) in the Unit 1 mid-outage was evident. The program appeared to be functioning properly.

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DETAILS

1. Persons Contacted

AP&L

J. L. Taylor-Brown, Quality Control (QC)/Quality Engineering (QE) Superintendent
R. Brumfield, Project Engineer
M. Durst, Project Engineering Superintendent
T. Earle, Project Engineer
J. J. Fisicaro, Licensing Manager
*L. W. Humphrey, General Manager, Nuclear Quality
*J. D. Jacks, Nuclear Safety and Licensing Specialist
*R. J. King, Acting Supervisor-Licensing
L. Taylor, Licensing Engineer
A. Todd, Project Engineer
G. D. Provencher, Quality Assurance (QA), Manager

NRC

*R. C. Haag, Resident Inspector

*Denotes those attending the exit interview conducted on December 8, 1989.

2. Followup of Licensee Event Reports and Previously Identified Findings (92700, 92701, 92702)

a. (Closed) Violation (313/8910-02): Failure to properly implement a procedure for the calibration of a decay heat removal flow transmitter. The wrong flow transmitter was isolated for calibration. This resulted in a loss of decay heat flow indication and the subsequent securing of the decay heat removal pump.

A contributing cause was an error in the maintenance surveillance procedure which specified the location of Instrument PDT-1401 as the "B" decay heat vault. The correct location was the "A" decay heat vault.

The surveillance procedure has been corrected to show the location of PDT-1401 as the "A" decay heat vault. Additionally, maintenance supervisors were advised of the circumstances of the event and were requested to review the event with their groups, stressing attention to detail. This item is closed.

b. (Closed) Violation (313/8930-01): Failure to include instructions for the use of external cooling during the "run-in" of the service water pump packing.

The licensee has added appropriate instructions to the procedure used. This additional instruction should prevent recurrence. The inspector verified the changes to the procedure. This item is closed.

c. (Closed) Violation (313/8928-01): A fire door between Units 1 and 2 auxiliary buildings had been intentionally propped open, and compensatory measures had not been taken.

The licensee has initiated the following corrective actions:

- Issuance of a Director of Nuclear Operations memorandum identifying to site personnel the Technical Specification fire protection requirements. The memorandum also emphasizes mandatory compliance with these requirements.

- Annual retraining is given to all site personnel on the requirements to maintain the integrity of fire barriers.

This item is closed.

d. (Open) Violation (313/8918-01): Failure to follow maintenance procedures in applying grease required to lubricate the gear case to a pump coupling on High Pressure Injection Pump P36A.

This item will be followed up by the resident inspector during his review of the licensee's maintenance program for lubrication of pump couplings.

This item remains open.

e. (Closed) Open Item (313/8919-01; 368/8919-01): The fire alarm system for Units 1 and 2 does not annunciate subsequent trouble alarms (reflash) after an initial alarm is silenced in accordance with National Fire Protection Association (NFPA) Standard 72D, 1975.

The licensee has issued Design Change Packages (DCPs) 85-1085 for Unit 1 and 87-2068 for Unit 2. These DCPs will bring the fire alarm system for both units in agreement with NFPA Standard 72D, 1975. Interim compensatory measures are in place that require increased surveillance of the fire alarm panels in both control rooms when a trouble alarm condition exists.

The item was opened pending completion of the DCPs. The DCPs have since been completed. This item is closed.

f. (Closed) LER (368/89-011-00): A 3-hour rated fire door was propped open without a fire watch established in the area. Immediately upon notification that the fire door was open, personnel were dispatched to close the door. Periodic training emphasizes to ANO personnel the requirement that fire doors are to be closed at all times, unless a

fire watch is established. A memorandum from the plant manager to all site personnel was issued reiterating the requirements imposed on both units by Technical Specification to close fire doors. This event is also covered in Violation 313/8928-001 which is closed in this report. This item is closed.

g. (Closed) LER (313/86-007-01): Pressurizer Code Safety Valve PSV-1001 was found to have a set pressure approximately 22 psig lower than allowed.

The licensee has corrected the set points and are now checking both valves at each refueling outage. The inspector reviewed the test data to verify that the valves were tested. Several QC hold points were added to further ensure that the maintenance and testing are performed on the correct valve, that critical internal settings (adjusting ring positions) are achieved, pressure bolting is properly torqued, and that critical tolerances are achieved. This item is closed.

h. (Closed) LER (313/89-032-00): On September 6, 1989, it was discovered that the monthly functional test for the reactor building area radiation monitors was not performed as required by Technical Specifications. A new procedure for the testing of these monitors had been written and the monitors had been deleted from the original test procedure.

The licensee completed the surveillance requirements on September 6, 1989, declared the monitors operable, and returned them to service. Additionally, a change to the procedure revision request form had been initiated. This form is required to accompany each procedure submitted to the Plant Safety Committee (PSC) for approval. Procedural guidance is given in Station Administration Procedure 1000.006, "Procedure Review, Approval and Revision Control." The inspector verified the procedure change. This item is closed.

i. (Closed) LER (313/88-025-00): The inadequate procedure utilized to develop the purge gaseous release permit did not specify the reactor building (RB) purge system flow rate value that should be used in the calculation.

As a result of this event, an evaluation of the design of the flow instrumentation for RB purge exhaust was performed. Additionally, the procedure governing the RB purge release in permit will be revised to ensure that the correct system flow rate is used in the development of the release permit. This item is closed.

j. (Closed) LER (368/89-014-00): Failure to recognize the maximum expected temperatures to which portions of the reactor coolant makeup system piping and auxiliary spray piping may be exposed. This resulted in system operation outside the plant design basis.

After discovering that the piping analysis was inadequate for the maximum possible temperatures, a visual inspection of the piping and supports was performed by engineering personnel. No structural damage was identified. Additionally, administrative controls were established to provide guidance to operations personnel in the event the auxiliary spray line was required to be used when charging water temperatures were greater than 120°F. In April 1988, engineering personnel documented that for the worst expected temperature of 479°F, piping stresses were calculated to be within ASME code allowables. The supports, however, could not be shown to be qualified for loadings under this condition.

During refueling outage 2R6 modifications were made to several supports to qualify the supports to 479°F. In addition, operations procedures were revised to include guidance to ensure that an engineering evaluation of the piping was performed in the event the temperature of the water through the piping exceeded 120°F.

Also during refueling outage 2R6, nondestructive evaluations on high stress points of the piping and additional piping walkdowns to inspect the supports were performed. These walkdowns did not identify any visible piping or support damage. Evaluations have been performed to qualify all sections of the auxiliary spray piping to the maximum expected temperatures to which these sections of piping have been exposed. This item is closed.

k. (Open) LER (313/89-022-00): Failure of a support designer to use the correct load during the initial support design.

A DCP was initiated to install a new support to replace the existing undersized support on the emergency feedwater (EFW) system. The new support had been installed and the DCP was completed. During Refueling Outage 1R7, the licensee reviewed additional EFW support calculations. This LER will remain open pending further NRC review of concerns related to hangers and supports at ANO Units 1 and 2.

l. (Open) LER (313/89-015-00): On December 9, 1986, during Refueling Outage 1R7, a technician performing a calibration of reactor protection system (RPS) Channel "A" noted that a Loop "B" reactor coolant system (RCS) flow transmitter sensing line was not properly supported. Unistrut supports for the line were installed, but there were no tubing clips holding the line to the supports.

Review of maintenance records by the inspector indicated that the clips were subsequently installed. Discussions with the licensee indicated that similar sensing lines were reviewed and found to have proper support. This LER will remain open pending further NRC review of concerns related to hangers and supports at ANO Units 1 and 2.

m. (Closed) LER (368/89-007-00): Failure to reinstall a snubber on the pressurizer spray line following maintenance work due to inadequate work controls.

Review of the maintenance records by the inspector indicated that the snubber was replaced and other snubbers on the same line were reinspected.

As a result of this event, procedure changes have been implemented addressing work control improvements. This item is closed.

n. (Open) LER (313/89-019): Portions of the High Pressure Safety Injection (HPSI) system, including supports, were not installed in accordance with the design installation drawings during construction.

The licensee has replaced the section of piping including the vent stack and two piping elbows. The licensee has a program for reconciling safety-related piping isometric and hanger drawings with the as-built condition. This program started in late 1987. This LER will remain open pending further NRC review of concerns related to hangers and supports of ANO Units 1 and 2.

o. The inspector reviewed the following LERs. This review could not be completed because of insufficient documentation in the closure packages presented for review:

- LER (368/88-011): A nonisolatable RCS leak caused by a vibration induced fatigue failure of a reactor coolant pump seal cavity pressure sensing instrumentation line.
- LER (368/88-015): HPSI system manual actuation and injection into the RCS.
- LER (313/89-018): Reactor trip due to a turbine trip which was inadvertently caused by personnel-induced vibration of an inadequately supported turbine control panel.
- LER (313/88-017): Service water pump bay sluice gate leakage caused by failure to perform periodic maintenance resulting in the potential loss of emergency cooling pond water level below Technical Specification limits.
- LER (368/88-001): Plant modification design deficiencies resulting in incorrect installation of solenoid operated valves and degradation of containment isolation capability.

3. Reactor Coolant Pump (RCP) Pipe Supports (70370)

During this mid-cycle outage of Unit 1, the licensee performed a 100 percent visual inspection of all safety-related snubbers. During this inspection, the licensee identified three RCP Paul-Munroe hydraulic snubbers leaking hydraulic fluid. The hydraulic fluid level in one reservoir was below specified requirements. There are a total of eight RCP snubbers (two per RCP).

The three that showed visual signs of leakage were functionally tested and failed. A fourth snubber did not show signs of leakage, until functionally tested. It then leaked at the static seal head. All four supports were rebuilt during this mid-cycle outage.

An engineering evaluation was performed by the licensee with input from the manufacturer, Paul-Munroe. Listed below are the licensee's description, root cause, and corrective action recommendations:

Description of the Failure Mode

The basic failure mechanism is fluid leakage through the seals located on the piston rod or tail rod end of the snubber body. The sealing surface is being damaged by abrasion from an area where the chrome plated finish has been destroyed. The destruction of the rod finish is caused by both pitting of the chrome and the deposition of bronze from the rod bushing. The pitting is suspected to be a direct result of the passage of small electrical currents. The bronze deposits are suspected to be a direct result of electrolysis which is dramatically increased or directly caused by these same electrical currents.

Conversations with cognizant Arkansas Nuclear One (ANO) and manufacturer personnel indicate consistent defects in the snubbers. Bronze material from the bushing is being deposited on the rod shaft near the hydraulic seal. Chrome pitting is evident on the shaft and on the interior of the snubber where the shaft or internal piston are in close proximity to the bushing or cylinder wall. The pitting is much worse on the shaft with minor damage occurring at the cylinder wall and piston interface. In addition to the chrome pitting and bronze deposition, the electrical current discolors the hydraulic fluid and is apparently causing various metallic powders to form and remain suspended. This metallic powder is thought to accelerate the deterioration of the seal surfaces.

The snubber manufacturer stated that a sample of the black material found inside of a snubber was analyzed. The analysis identified constituent elements of steel, bronze, and chromium alloys. All of these materials are present in the snubbers and in contact with the silicon based hydraulic fluid (GE FE1154).

Licensee Identified Root Cause

The root cause of the snubber failures on the RCPs is electrolytic corrosion. This corrosion is directly related to the time and magnitude of the electrical current. These failures proceed down a predictable sequence of degradation of critical parts until a sudden breakdown of the seals occur. When the seals breakdown, the snubber begins to leak hydraulic fluid emptying the reservoir. When the reservoir is empty, the snubber can no longer perform its safety function and becomes inoperable.

Licensee Corrective Action Recommendations

It is necessary to eliminate or substantially reduce the circulating ground current flowing through the snubbers. Elimination can only be achieved by insulating one end of the snubber from ground. This effectively breaks the stray ground path. This added electrical insulation must not interfere with the ability of the snubber to withstand the forces impressed by a seismic event. The insulating material should have an electrical resistance in excess of 20,000 ohms and be able to withstand normal drag loads of the snubber. Currently, no material meeting these requirements could be found and it may be impractical to custom manufacture available material into the desired configuration.

This leaves reducing the currents as the only reasonable corrective action. There are three actions recommended to substantially reduce the circulating currents:

a. Improve existing grounding of the RCP to minimize resistance to ground. Particular attention should be paid to improving the grounding on the "A" reactor coolant pump, since both of its snubbers failed in 1R7 and 1M89. A poor ground is the probable cause.

b. Provide a parallel path around the snubber to split the current.

c. Increase the resistance from the snubber base plate to ground by removing the ground connections to the snubber base plates.

The combined effect of these three actions will reduce the current passing through the snubbers and extend the time between failures.

Additional Licensee Recommendations

It is also recommended that a consistent welding policy be developed to require grounding of the negative lead on the same piece of equipment as is being welded. Reliance on the electrical ground mat and structural steel as a welding return path should be minimized.

It is recommended that the criteria for passing a visual inspection be further restricted to require disassembly, cleaning, and refurbishment if the presence of black stain or discolored hydraulic fluid is observed. Apparently, the blackish stains or minor leaks of a black discolored fluid is an indicator of an ongoing electrolysis process. Based upon the limited failure data, after the detection of this degraded hydraulic fluid, the snubber develops significant leakage during the next cycle and has difficulty passing a functional test.

Summary

The licensee is addressing this issue. The corrective actions are documented in condition reports CR-1-89-0590 through CR-1-89-0593, dated December 4, 1989.

Unit 2 had the same snubber problem as identified on November 6, 1989. Eight snubbers had deteriorated, but all were determined by the licensee to be operable. The licensee's corrective actions were similar and are covered in condition reports CR-2-89-623 through CR-2-89-630.

The inspector will continue to review the licensee's program for these pipe supports during a subsequent inspection. This review will include the effectiveness of the licensee's proposed corrective actions.

4. Exit Interview

The inspector met with licensee representatives (denoted in paragraph 1) on December 8, 1989, and summarized the scope and findings of this inspection. No information was identified as proprietary.