APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-313/89-44 Operating Licenses: DPR-51
50-368/89-44 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, Units 1 and 2

Inspection At: Russellville, Arkansas

Inspection Conducted: November 27 - December 1, and December 12-14, 1989

Inspector: H. F. Bundy 12/28/89
for D. L. Kelley, Reactor Inspector, Test Programs Section, Division of Reactor Safety Date

Accompanied By: A. N. Massey, General Engineer - Intern (November 29 - December 1, 1989) Nuclear Reactor Regulation
W. C. Lyon, Plant Systems, Nuclear Reactor Regulation (November 29 - December 1, 1989)
W. C. Seidle, Chief, Test Programs Section, Division of Reactor Safety (November 30 - December 1, 1989)

Approved: for T. F. Laudon 12/28/89
W. C. Seidle, Chief, Test Programs Section Division of Reactor Safety Date

Inspection Summary

Inspection Conducted November 27 - December 1, and December 12-14, 1989 (Report 50-313/89-44 and 50-368/89-44)

Areas Inspected: Announced inspection of two modifications and the associated postmodification testing involving the high pressure injection venturi for Unit 1 and the core protection calculator upgrade for Unit 2, and the control rod drive mechanism leakage on Unit 1.

Results: The tests associated with the two modifications were found to have acceptance criteria, test controls, and plant safety controls to provide results that would envelope the design parameters while maintaining the plant in a safe condition.

The corrective actions taken by the licensee on the high pressure injection venturi problem and the control rod drive mechanism problem were found to be comprehensive and performed in a satisfactory manner.

DETAILS

1. Persons Contacted

Arkansas Power & Light Company (AP&L)

**N. S. Carns, Director, Nuclear Operations
**J. J. Fisicaro, Manager, Licensing
*B. A. Baker, Manager, Modifications
*J. L. Taylor-Brown, Quality Control/Quality Engineering Manager
*J. D. Jacks, Nuclear Safety & Licensing Specialist
*C. T. Jones, General Manager, Engineering
**R. King, Acting Supervisor, Licensing
*G. D. Proviencher, Quality Assurance Manager
L. Humphrey, General Manager, Nuclear Quality
S. Smith, Instrument Supervisor
M. Durst, Project Engineer
J. Richardson, Design Engineer
J. Muke, Project Engineer
J. Veglia, Startup Engineer
J. Conners, Startup Engineer
G. Higgs, Project Engineer
**R. Lane, Manager, Engineering
**J. D. Vandergrift, Plant Manager, Unit 1

NRC

*R. Haag, Resident Inspector

*Denotes those attending the exit interview on December 1, 1989.
**Denotes those attending the exit interview on December 14, 1989.

During the inspection, the inspectors also contacted other licensee personnel.

2. Inspection of Design Modification Testing (72701)

The purpose of this inspection was to review the postmodification testing associated with design change packages (DCP) 89-1012 and 85-2075D. These packages dealt with the installation of cavitating venturis in the high pressure injection (HPI) lines on Unit 1, and the core protection calculator (CPC) upgrade on Unit 2. The inspection findings for the two modifications are discussed in the paragraphs below.

a. HPI Venturi Modification DCP 89-1012

The inspector concluded from the review of the proposed test procedure and other documents that the test sufficiently identifies the acceptance criteria and contains the necessary controls for performance and the maintenance of plant safety.

During a review of the HPI system on Unit 1, the licensee had discovered a previously unanalyzed type accident concerning a small break loss of coolant accident (SBLOCA) of one of the four HPI lines. To ensure that the required injection flow from the three intact lines would reach the reactor core if this accident were to occur (assuming that the flow of the severed injection line flows to the building floor) the licensee proposed the installation of flow restricting devices (i.e., cavitating venturis).

This inspection dealt primarily with the postinstallation testing of the four venturis. The licensee's test objectives were to: (1) show that for back pressures from the reactor cooling system, (approximately 600 psig or below) the venturi would restrict the flow through the severed line; and (2) demonstrate that the total flow reaching the reactor core through the three intact lines was sufficient to meet the core cooling requirements.

The test procedure (see attachment) was the Makeup and Purification System Check and Control Valve Stroke Test (Procedure OP 1104.02); it included a temporary procedure change so that the modification test could be performed as part of the surveillance test. The test pressure and flow criteria were taken from the evaluation model results for the SBLOCA. The inspector concluded that the methodology for determining the specific flow rates was reasonable for this application. It was also noted in the test review that the licensee had taken into consideration alternative pump lineups to ensure that the Technical Specifications (TS) decay heat removal requirements were maintained. In addition to the examination of the modification test and design evaluation, the inspector examined the four safety injection pipes to assess the impact of the installation of the venturis on other piping and components and the influence of components on the venturis. The inspector concluded that the venturis would be located far enough from pipe elbows and valves to preclude interaction.

b. <u>CPC Upgrade DCP 85-2075D</u>

The inspector concluded that the postmodification testing was comprehensive enough to have detected any major problems, if they had arisen, and demonstrated that the CPC and its associated components would operate as designed.

The licensee had recently completed an upgrade of the CPC on Unit 2. The upgrade comprised a replacement of the six central processing units (CPUs) - four CPCs and two control element assembly calculators (CEAC). This inspection consisted of a review of the completed testing performed after completion of the installation.

The testing included calibration, manufacturer's software diagnostics checks of the computer hardware, terminal board to terminal board checks, and string checks from the sensor to the final actuation

device. The test procedure contained six supplements, one for each of the CPUs.

The inspector reviewed several of the completed supplements and the test log. Several test changes were also reviewed. These changes appeared complete, were clearly stated, contained necessary engineering, and reflected completion of the required reviews.

The site acceptance test was a generic software, diagnostic test, supplied by the manufacturer and used to check out 3205 series computers. Plant specific software for the CPC was supplied by the NSSS vendor.

The inspector reviewed the test results of two CPC channels and one CEAC channel. The review included examination of the test procedure for completeness, the test engineer's daily log, and the test procedure changes. No problems were detected during the review and, where changes were required, all the required evaluations and reviews had been completed.

3. Cavitating Venturi Testing Results (93702)

On December 10, 1989, at approximately 9:50 p.m. (CST), the licensee established flow-through all four HPI lines to test the installed, cavitating venturis. The HPI (Pump P-36A) discharge pressure was 880 psi and the flow-through was 265 gpm through the B and C header and 260 gpm through the A and C header. Severe vibration and noise were noted in the north area of the reactor containment building (RCB), where three of the four venturis were installed. Loud noise was also noted on the 386-foot level of the auxiliary building (the D line venturi was installed outside the RCB). The licensee noted that the test differential pressure (d/p) gauges installed on the B and C line venturis had been damaged and were unreadable. The remaining d/p gauges were operable and indicated differential pressures in the expected range. At 10:10 p.m. (CST), it was decided to proceed to the hydrostatic test while the damaged d/p gauges were being repaired and recalibrated. The flow through the A, B, and D venturis was secured. Flow continued through the C venturi to control the hydrostatic test conditions. At 10:25 p.m. (CST), the operators reported gross leakage in the RCB north cavity. Also reported was an approximate one foot level loss in the reactor coolant system (RCS) hot leg. The A HPI pump was immediately secured. The investigation by the licensee revealed that the two angle globe valves in a vent line were open and a vent pipe cap was off; this apparently had been caused by the vibration. Several licensee personnel stated that they had observed the valve hand wheels rotating during the test. The resultant leakage allowed approximately 250 gallons of reactor coolant to discharge into the RCB sump. This occurrence was the subject of Preliminary Notification PNO-IV-89-69.

The licensee's followup action was to perform an in-depth damage study of the HPI system injection piping, components, and associated equipment and structures. The licensee also decided to remove the cavitating venturis

and return the HPI system to its original configuration. The scope of the damage assessment entailed examination of:

- Piping stress points
- Piping penetrations (including dye penetrant test of welds were indicated)
- Piping and pipe supports for evidence of movement
- Piping supports for changes in gap distances
- The internals of the check valves down stream of the venturis (as of December 15, 1989, three check valves had been inspected with no damage identified)
- HPI injection nozzles (volumetric inspection)

The inspection plan contained the caveat that, if conditions warrant, the scope of the plan would be expanded, as necessary.

The licensee's immediate actions and recovery plan appeared to be well thought out and well planned. The inspector had no further questions regarding this item. The progress of the restoration and return to power operations will be monitored by the NRC.

4. Control Rod Drive Mechanism Flange Leakage (93702)

The inspector followed up on the Unit 1 control rod drive mechanism (CRDM) leakage problem. The licensee had noted and reported to the NRC leakage from a CRDM seal. The licensee's investigation revealed that there were six CRDM seals which had leaked. One CRDM exhibited gross failure of the threaded area of the nut ring in two adjacent holes. The nut ring serves as the lower flange threaded area into which the CRDM closure studs are threaded. The CRDM flange sealing mechanism is comprised of an inner and outer flexitallic gasket between the flange faces and compresses by the CRDM closure studs. The licensee discovered evidence of steam cutting across the gasket to two adjacent stud holes of the grossly failed CRDM nut ring. Over a period of time, borated primary coolant apparently leaked into the stud holes to the carbon steel nut ring and corroded the threaded area to the point that there was insufficient thread remaining to effect engagement of the lower end of the two studs. The five other CRDMs did not exhibit nut ring corrosion failure, but did exhibit leakage across the gaskets between studs. The licensee replaced the corroded nut ring and the gaskets of all six leaking CRDM closures. In performing the repair, the licensee used a flexitallic gasket with a carbon compound filler instead of asbestos. An ultrasonic torquing method was used to install the studs.

In addition, the licensee inspected all suspected leakers and 50 percent of the weepers (i.e., those showing traces of boric acid crystals). No further problems were encountered. The remaining vessel head penetration uses a different sealing mechanism. The seal is constructed of two metal O-rings with spacers between them. Upon examination, the licensee determined that the seal design was inadequate. The seal was modified using the carbon filled flexitallic gasket and a compression ring.

The inspector reviewed the licensee's corrective action and reviewed a video tape of the licensee's examination of the failed nut ring. In addition to the above repairs, the licensee will inspect the vessel head penetrations for leakage during each refueling outage and, as subsequent CRDMs are disassembled, new gaskets will be installed and the studs torqued using the ultrasonic method. The inspector had no further questions regarding this item.

5. Exit Interview

The inspectors met with Mr. N. S. Carns and other members of the licensee's organization identified in paragraph 1 on December 1, 1989. A second exit meeting was held with Mr. N. S. Carns and other members of the licensee's organization on December 14, 1989. The inspectors summarized the scope of the inspection and presented the findings at each meeting. The licensee identified, as proprietary, several of the documents reviewed by the inspectors; however, no proprietary information was used in this inspection report.

ATTACHMENT

A. CPC Reference Material

- Special Work Plan 2409.153, Core Protection Calculator System (3205) Site Acceptance Test
- Special Work Plan 2409.164, 3205 Core Protection Calculator System Baseline Response Time Test
- Core Protection Calculator System (3205) String Checks
- Job Order Number 00789219, Reactor Protection System D Response Test

B. HPI Venturi Modification Material

- OP 1104.02, Makeup & Purification System Operation, Supplement 8
- HPI Venturi Installation, DCP 89-1012