UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30303

Report No.: 50-364/85-12

Licensee: Alabama Power Company
600 North 18th Street
Birmingham, AL 35291

Docket No.: 50-364 License No.: NPF-8

Facility Name: Farley 2

Inspection Conducted: February 26-28, 1985

Inspection at Farley site near Dothan, Alabama

Inspector: Frank Jape 3/12/85
for J. J. Lenahan Date Signed

Accompanying Personnel: J. Macdonald

Approved by: Frank Jape 3/14/85
F. Jape, Section Chief Date Signed
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope: This routine, unannounced inspection involved 40 inspector-hours on site in the area of reviewing and witnessing repair of the Unit 2 containment building post-tensioning system.

Results: No violations or deviations were identified.

## REPORT DETAILS

1. Persons Contacted

   Licensee Employees

   *J. D. Woodard, Plant Manager
   R. G. Berryhill, System Performance and Planning Superintendent
   W. D. Shipman, Assistant Plant Manager
   *W. G. Ware, Safety Audit and Engineering Review

   Other Organization

   D. Waitkus, Quality Assurance Supervisor, INRYCO

   NRC Resident Inspectors

   *W. H. Bradford
   W. H. Ruland

   *Attended exit interview

2. Exit Interview

   The inspection scope and findings were summarized on February 28, 1985, with those persons indicated in paragraph 1 above. The inspector described the areas inspected and discussed in detail the inspection findings. No dissenting comments were received from the licensee. Subsequent to the inspection the inspector attended a meeting on March 1, 1985, in the NRC offices in Bethesda, Maryland to discuss the licensee's program for inspection and repair of the tendon anchor heads. The meeting was attended by representatives of the NRC offices of Nuclear Reactor Regulation; Inspection and Enforcement, and Region II; and the licensee and the contractors, including INRYCO, the tendon manufacturer; Bechtel, the architect-engineer; the Inland Steel Company Laboratory; and Battelle Laboratories.

   The licensee did not identify as proprietary any of the material provided to or reviewed by the inspector during this inspection.

3. Licensee Action on Previous Enforcement Matters

   This subject was not addressed in the inspection.

4. Unresolved Items

   Unresolved item were not identified during the inspection.

5. Repairs to Unit 2 Containment Building Post-Tensioning System

a. Background

On January 28, 1985, while conducting a preintegrated leak rate test walkdown of the exterior of the Unit 2 containment building, a licensee employee noticed that a grease can (cap) covering the top of a vertical tendon was deformed. Inspection of the lower grease can on the same tendon, number V-17, disclosed that the lower grease can was damaged also. Removal of the lower grease can disclosed that the field anchor head had broken into seven pieces. Inspection of another tendon, number V-21, disclosed that the field anchor head on this tendon was cracked and separated into two pieces. Review of the tendon fabrication and installation records disclosed that the field anchor heads from both of these tendons had the same fabrication lot control number, lot control number HV. Further review of the installation records disclosed that 47 other Unit 2 tendons had field anchor heads from lot control number HV. (There are no anchor heads from lot control number HV on any Unit 1 tendons). Based on manufacturing records, INRYCO, the tendon manufacturer, concluded that there are no other anchor heads from lot control number HV installed at ar other post-tensioned nuclear facility. In order to determine the cause of this problem, the licensee implemented an extensive inspection and testing program. The inspection and testing program included the following:

(1) Visual inspection of all remaining 47 HV field anchor heads. No other problems were identified.

(2) Replacement of all HV anchor heads.

(3) Visual inspection of 55 randomly selected field anchor heads from the non-HV lots. No additional failures were identified in the 55 inspected.

(4) Performance of extensive laboratory testing on the two failed anchor heads and four other HV anchor heads. These tests included chemical and physical properties, scanning electron microscopy, as well as load testing.

(5) Chemical analysis of grease samples which were obtained from around the field anchor heads.

Based on the laboratory test results, the licensee concluded that the problem was not related to a specific lot control number and that hydrogen stress cracking caused the failures. The cause of the hydrogen stress cracking was attributed to the presence of moisture around the anchor heads. As a result, the licensee modified and expanded the inspection program to inspect all vertical tendons and all below-ground horizontal tendons for failed field anchor heads and evidence of moisture. In addition, the licensee decided to perform

magnetic particle (MP) testing on the 24 HV anchor heads that had been removed during the replacement process. The removal and replacement of the additional HV anchor heads was suspended pending results of the expanded inspection program and MP testing.

b. Observation of Tendon Inspection Activities

Visual inspection of the remaining anchor heads was conducted in accordance with INRYCO procedure number SQG.1, Inspect Field Anchors. The inspector witnessed removal of the grease cans, grease sampling, and visual inspections by INRYCO QC inspectors of the field anchor heads or tendon numbers V-62, V-71, V-124, and V-125. The inspector also examined the field anchor heads on tendon number V-51, V-52, V-54, V-55, V-95, V-121, V-122, and V-123. The above anchor heads were from lot control numbers HP or HU. No visual defects were noted on any of these anchor heads. As of completion of the inspection, the field anchor heads had been inspected on 125 of 130 vertical tendons. One additional failed anchor was identified during this inspection. This anchor head was on tendon number V-31, from lot control number HP. The inspector witnessed detensioning of tendon V-31 and examined the tendon after detensioning was completed. The button heads had broken off numerous wires when the anchor head failed and deformed. Based on the liftoff force recorded during detensioning, the tendon was estimated to be carrying approximately 55 percent of its predicted prestress force. The inspector examined the field anchor head after it had been removed from the tendon. The anchor head had broken into five pieces.

The inspector witnessed performance of the MP testing as the HV field anchor heads which had been removed from tendon numbers V-16 and V-59. The anchor head from tendon V-16 had six ligament cracks while the other anchor head was found to be acceptable. As of the inspection date, the licensee had completed performance of the MP test on 19 of the HV field anchor head. A total of seven were found to have at least one ligament crack.

c. Summary of Meeting Between NRC and Licensee to Discuss Tendon Anchor Head Problem

As stated in paragraph 2 above, a meeting was held on March 1, 1985, in the NRC offices in Bethesda, Maryland, to discuss the licensee's program for inspection and repair of the tendons. The licensee summarized the results of their investigations and stated the cause of the failed anchor heads. Based on the results of extensive laboratory testing, the licensee concluded that the anchor heads failed as a result of hydrogen stress cracking. The licensee plans to do the following to correct the problem on Unit 2:

(1) Regrease the vertical HV anchor heads which had been replaced using a new greasing procedure

(2) Perform a visual inspection for moisture and cracks on a random sample of dome and horizontal tendon anchor heads to establish a 95 percent probability with a 95 percent confidence level for no cracked anchors in each group.

(3) Remove and perform a MP test on all remaining vertical anchor heads and on field anchors on any horizontal and dome tendons which have significant moisture present.

For Unit 1, the licensee plans to inspect the field anchor heads on all vertical and on a random sample of horizontal and dome tendons for presence of moisture and cracks. Based on results of this inspection, the licensee will formulate an expanded inspection program, if necessary, similar to the Unit 2 inspection program.

Within the areas inspected, no violations or deviations were identified.