



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

MAR 21 1986

Report Nos.: 50-269/86-09, 50-270/86-09, and 50-287/86-09

Licensee: Duke Power Company
422 South Church Street
Charlotte, NC 28242

Docket Nos.: 50-269, 50-270, and 50-287

License Nos.: DPR-38, DPR-47, and
DPR-55

Facility Name: Oconee 1, 2, and 3

Inspection Conducted: March 6, 1986

Inspector:

W. J. Ross
W. J. Ross

3/19/86

Date Signed

Approved by:

Douglas M. Collins

P. G. Stoddart, Acting Section Chief
Division of Radiation Safety and Safeguards

3/20/86

Date Signed

SUMMARY

Scope: This special announced inspection entailed eight inspector-hours onsite in the areas of steam generator cleaning and maintenance related to the secondary water cycle.

Results: No violations or deviations were identified.

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REPORT DETAILS

1. Persons Contacted

Licensee Employees

T. S. Barr, Superintendent of Technical Services
*E. L. Jackson, Project Engineer
B. K. Jones, Project Shift Manager
D. P. Rochester, Project Chemical Engineer

Other Organizations

S. J. Weems, MPR Associates, Inc.
D. L. Tate, Babcock and Wilcox

NRC Resident Inspectors

J. Bryant, Senior Resident Inspector
K. Sasser, Resident Inspector

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on March 6, 1986, with those persons indicated in Paragraph 1 above.

3. Licensee Action on Previous Enforcement Matters

This subject was not addressed in the inspection.

4. Unresolved Items

Unresolved items were not identified during the inspection.

5. Monitoring of Licensee Maintenance Activities Related to the Secondary Water System (79701)

The primary purpose of this special inspection was to monitor activities related to cleaning of the once-through steam generators (OTSG) in Unit 1 and to review the results of similar cleaning of the OTSGs in Units 2 and 3 (see Inspection Report Nos. 50-269/270/287/85-16 dated July 8, 1985). A secondary purpose was to monitor other maintenance activities related to the inspection and modification of components in the secondary water cycle.

At the time of this inspection Unit 1 was in its Cycle 9 refueling outage while Units 2 and 3 were operating.

a. Steam Generator Cleaning

As the result of sludge (solid oxides of iron) buildup in the tube bundle and on the lower tube sheet of the two OTSGs of each of the three Oconee Units, the flow of the feedwater/steam mixture through the tube bundles was retarded to the extent that the maximum achievable power levels of the three units were jeopardized. In 1985, the licensee used a combination of cleaning and sludge removal processes on Units 2 and 3 to improve the flow of water through the steam generator tube bundles. At that time, both of these processes were still in the development stage, and the results of the cleaning and the sludge removal steps did not meet the licensee's expectations. However, both Units 2 and 3 were able to achieve and maintain maximum design power levels following the steam generators cleaning. Although the maximum power level of Unit 1 was not yet degraded by increased pressure differential through the OTSGs, the licensee chose to perform a similar cleaning operation of the two OTSGs in Unit 1 during the 1986 refueling outage.

(1) Slap-Cleaning Process

Based on experience with Oconee Units 2 and 3, as well as at two other nuclear plants designed by Babcock and Wilcox, the reduced flow through the OTSG tube bundles was attributed to blockage of the broached tube-holes in the lower tube support sheets. The reduction of flow through these holes was thought to result from the deposition of iron oxide through several mechanisms; e.g., gradual buildup of oxide on the sides of the tubes and the tube support plates through deposition from the water/steam mixture as it rises and is further heated to supersaturated steam, or by transfer of crystalline or amorphous oxide residues from other parts of the tube and tube support plates.

The licensee, in association with other utilities and MPR Associates, Inc. was developing a "water-slap" process for removing solid material from the broached holes and from other surfaces within the tube bundle and transferring this sludge to the lower tube sheet where it could be removed from the steam generator. A brief description of this proprietary process and a review of the safety analyses performed by MPR Associates, as well as by Babcock and Wilcox, were included in Inspection Reports Nos. 50-269/270/287/85-16.

The inspector was informed that the "slap-cleaning" procedure had been further refined to achieve higher levels of energy in the "slap" process while, at the same time, the stress levels placed on components of the steam generator had been decreased. The modified procedure was tested in cooperation with Babcock and Wilcox, on an OTSG mockup in January 1986, and the results were found to be consistent with the safety evaluation. The inspector briefly reviewed the proprietary safety evaluation of the modified

procedure in an effort to comprehend the bases of the improvements. The inspector did not identify any unreviewed safety issues.

The inspector established that the licensee had developed a written procedure (TT/1/A/425/02) for performing the "water-slap" cleaning process. The procedure was being followed in the same manner as discussed in Inspection Report 85-16 with the activities within the containment building being directed and monitored from a control station outside of the containment building. The cleaning procedure was being coordinated with the sludge lancing efforts described as follows: the sludge that was observed on the tube sheet after Unit 1 shutdown was removed to the extent possible by sludge lancing; the steam generator was then cleaned by the "water-slap" process; and then the tube sheet was sludge lanced again. During the period the inspector was on site, Steam Generator "B" was sludge lanced once and was being cleaned, while Steam Generator "A" was being sludge lanced for the second time. The "water-slap" process was performed in the same manner as during the mockup tests. The written procedure was followed and it was the inspector's perception that no significant problems were encountered.

(2) Sludge Lancing

Previous efforts to remove sludge from OTSGs by lancing procedures were not encouraging. However, Babcock and Wilcox recently developed improved lances for flushing solids from the tube lanes to the annulus region where the solids could be removed by suction. The improved lances were evaluated with the same mockup OTSG used for the "water-slap" process and were used to reduce the mass of solids in OTSG "A" and "B" to the greatest extent possible before the "water-slap" process was initiated. Approximately 175 pounds of iron oxide sludge was removed from each OTSG; however, the design of the annulus region reduced the mobility of the "bundle" lance that was used in conjunction with a "lane" lance. Consequently, approximately 50% of the sludge remained on the lower tube sheet at the conclusion of the lancing. It was hoped that a more complete removal of sludge would be achieved during the second phase of lancing (after the cleaning process was complete).

In order to improve the capability to inspect the interior of the tube bundle and to monitor the effectiveness of both the cleaning and lancing processes, an additional 4-3/4" hand hold was drilled in each OTSG between the fifth and sixth tube support plates.

The inspector will assess the success of the lancing process at a later date after the second-stage lancing has been completed. It was the licensee's position that the degree to which the holes in the tube support plates were clogged was not related to the mass

of sludge on the lower tube sheet; however, the in-flow of feedwater would be affected if a large mass of sludge covered the lower tube sheet.

c. Inspection of Low-Pressure Turbines

While Unit 1 was shutdown, the licensee inspected the blades of the wheels on the low-pressure turbines. The inspector was informed that crack indications were observed by ultrasonic tests in some of the pins that connect the blades to the wheels. At the time of the inspection, these cracks had not been completely analyzed and evaluated; therefore, it was not known if there was any correlation to the licensee's control of secondary water chemistry. This matter was designated Inspector Followup Item 86-09-01.

d. Water Cleanup System

The inspector was informed that components of a new design were being installed in the filter/demineralizer units of the water cleanup system. This action was being taken in an effort to eliminate "throw" or "leakage" of fragments of ion-exchange resin beads into the feedwater.