



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

Report Nos.: 50-269/87-40, 50-270/87-40, and 50-287/87-40

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 Nuclear Station

Inspection Conducted: October 1, 1987

Inspector:

W. J. Boss
W. J. Boss

10/9/87
Date Signed

Approved by:

J. B. Kahle
J. B. Kahle, Section Chief
Division of Radiation Safety and Safeguards

10/9/87
Date Signed

SUMMARY

Scope: This special, announced inspection was performed to observe the licensee's activities related to chemical cleaning of the steam generators in Oconee Unit 1.

Results: No violations or deviations were identified.

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REPORT DETAILS

1. Persons Contacted

Licensee Employees

*J. Davis, Superintendent of Technical Services
W. A. Haller, Manager, Corporate Technical Services
R. Eaker, Supervisor, Corporate Nuclear Chemistry
D. P. Rochester, Project Engineer, Corporate Nuclear Chemistry

Nuclear Regulatory Commission

*J. Bryant, Senior Resident Inspector
P. Skinner, Senior Resident Inspector
L. Wert, Resident Inspector

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on October 1, 1987, with Mr. J. Davis. The inspector described the areas inspected and discussed the inspection findings. No dissenting comments were received from the licensee. The licensee stressed that all data and material provided to or reviewed by the inspector during this inspection should be considered as being preliminary and subject to revision.

3. Licensee Action on Previous Enforcement Matters

This subject was not addressed in the inspection.

4. Steam Generator Cleaning

This inspection was performed to monitor actions being taken by the licensee to (a) chemically remove iron oxide sludge from the secondary side of the two once-through steam generators (OTSG) in Oconee Unit 1 and (b) prevent chemical attack of the OTSG structural materials and welds. The chemical cleaning process was based on in-house developmental work as well as on work sponsored by the Electric Power Research Institute, the Steam Generator Owners' Group, and Babcock and Wilcox Co. A description of the generic process has been described in EPRI Report NP-4954 Chemical Cleaning Waste Disposal published in November 1986. The licensee discussed the details of the process to be used at Oconee with NRC representatives on July 22, 1987.

In brief, the chemical cleaning process consisted of repeatedly filling, soaking, and draining the secondary side of each of the two OTSGs with a solvent that had been selected for its high specificity for iron, especially for iron in the ferrous (Fe⁺²) state. The aqueous solvent

contained 15 percent (weight/volume) ethylenediamine tetraacetic acid (EDTA, the solubilizing agent), one percent hydrazine (added to reduce iron to the ferrous state), and one percent CCI-80/1 (a proprietary corrosion inhibitor). The solution was neutralized (to pH 7) by the addition of ammonia.

The licensee's procedure called for the initial two soaking periods to last 75 minutes each, the next four soaks to last 240 minutes, and the final two soaks to last 300, for a total of 30 hours. During the soaks the solvent would be maintained at 200°F. The OTSGs were to be rinsed, before and after the soaks, with an aqueous solution that contained 300 ppm of hydrazine (added to ensure the absence of dissolved oxygen in the rinse water) and which had a pH of 10.2. The final step was to be a rinse at 200°F to re-form a passivating film of magnetite (Fe_3O_4) on the surfaces of all steel components of the secondary side of the OTSG.

The licensee based the composition of the solvent on the expected removal of 2,300 to 5,800 pounds of magnetite from OTSG 1A. This estimate had been derived from partial examinations of the secondary side by the use of fiber optics. In addition to blockage of tube-tube support plate crevices, magnetite powder and flakes had been observed on the OTSG tubes and tube support plates.

In a corollary activity the licensee was planning to monitor the corrosivity of the solvent and rinse solutions and the formation of galvanic couples between the inconel tubes and steel structural components during the cleaning process. Five representative types of test OTSG material had been selected for these tests; i.e., two types of steel, 1015 and 515, used in rods and plates, and three types of weld material (specimen of welds prepared by shielded manual arc methods and perpendicular and parallel cuts from weld material representative of the vertical seam on the OTSG shroud).

Heatup for the preliminary rinse of OTSG 1A began on September 30, 1987, and the initial fill, soak, and drain cycle followed as planned. On the basis of the very low rate of chemical attack observed during the initial 75-minute soak, the second and third soak times had been increased to 105 minutes. During these cycles the OTSG had been filled only to the seventh tube support plate (i.e., the OTSG was approximately 37% filled) in order to prevent carryover of solvent foam into the feedwater nozzle and other regions of the OTSG that would not be cleaned by the final rinses. By this action the licensee reduced the possibility that localized corrosive environments would result from residual EDTA and the sulfur-containing CCI-80/1 corrosion inhibitor. During the fourth and subsequent soak cycles the solvent level was maintained at the ninth tube support plate (i.e., the OTSG was approximately 48% filled).

Through discussions with licensee personnel and a review of preliminary data obtained through the fourth soak cycle, a tentative conclusion was reached that the process was being carried out as planned without any indication of significant corrosion of OTSG materials. The inspector

was informed that approximately 1,900 pounds of magnetite had been removed during the initial four soaks, and the indicated rate of galvanic attack was less than 0.5 mil/year.

The inspector's assessment was updated by means of a telephone conference with the licensee on October 6, 1987, during which the inspector was informed that the chemical cleaning of OTSG 1A had been completed, and approximately 3,374 pounds of magnetite had been removed. The licensee's preliminary review of the corrosion study results indicated that the maximum loss of structural or weld metal had been 1.1 mils. The amount of magnetite removed corresponded very closely to the licensee's prediction of 3,300 pounds. The extent to which the magnetite in the broached holes was eliminated cannot be established until the unit is restarted and flow through the holes can be determined.

The results of the corrosion study are to be reviewed and evaluated; however, preliminary data indicated that the cleaning process had been performed while maintaining general and galvanic corrosion within a tolerable range and within criteria established for the test; i.e., 3 mils for Type 515 metal and 10 mils for Type 1015 metal and the weld material.

Prior to the chemical cleaning of OTSGs 1A and 1B the licensee had established baseline data related to the integrity of the OTSG tubes by eddy current testing a representative number of tubes (approximately 35 percent in OTSG 1A and 55 percent in OTSG 1B). The inspector was informed that eddy current tests (probably on a lesser number of tubes) would be repeated to determine if the tube integrity had been degraded.

No violations or deviations were identified.

5. Followup on Inspector Followup Items (92701)

(Closed) IFI 50-270/84-23-01 Chemical Cleaning of Ocone Unit 2 Steam Generators. The inspector was informed that the OTSGs in Unit 2 will be chemically cleaned during the next refueling outage, by the same process used for Unit 1. Therefore, this IFI is closed.