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

MAY 01 1986

Report Nos.: 50-369/86-10 and 50-370/86-10

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

Docket Nos.: 50-369 and 50-370 License Nos.: NPF-9 and NPF-17

Facility Name: McGuire 1 and 2

Inspection Conducted: April 7-11, 1986

Inspector: W. J. Ross 4/25/86
W. J. Ross Date Signed

Approved by: P. Stoddart 4/29/86
P. Stoddart, Acting Section Chief Date Signed
Emergency Preparedness and Radiological
Protection Branch
Division of Radiation Safety and Safeguards

SUMMARY

Scope: This routine, unannounced inspection concerned the area of plant chemistry.

Results: No violations or deviations were identified.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*T. L. McConnell, Station Manager
*B. Hamilton, Superintendent of Technical Support
*R. P. Michael, Station Chemist
A. Baxter, Chemistry Supervisor
M. Bridges, Chemistry Supervisor
P. Dunlap, Chemistry Supervisor
T. Hendrickson, Chemistry Supervisor
M. Hollis, Chemistry Support Coordinator
*L. Kimray, Power Chemistry Coordinator

Other licensee employees contacted included chemists, chemical engineers, and chemistry technicians.

NRC Resident Inspector

*W. Orders, Senior Resident Inspector

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on April 11, 1986, 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. The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspector during this inspection.

3. Licensee Action on Previous Enforcement Matters

(Closed) Unresolved Item 50-369/85-04-01, Valve Stroke Times. This item is discussed in Inspection Report 50-369/86-11.

4. Plant Chemistry (79502 and 79701)

As a result of its continuing concern for steam generator tube integrity, the NRC staff has recently issued recommended actions and review guidelines directed toward the resolution of unresolved safety issues regarding this subject (see Generic Letter 85-02 dated April 17, 1985). One recommended action is as follows:

> "Licensees and applicants should have a secondary water chemistry program (SWCP) to minimize steam generator tube degradation. The

specific plant program should incorporate the secondary water chemistry guidelines in the Steam Generator Owners Group (SGOG) and Electric Power Research Institute (EPRI) Special Report EPRI-NP-2704, "PWR Secondary Water Chemistry Guidelines," October 1982, and should address measures taken to minimize steam generator corrosion, including materials selection, chemistry limits, and control methods. In addition, the specific plant procedures should include progressively more stringent corrective actions for out-of-specification water chemistry conditions. These corrective actions should include power reductions and shutdowns, as appropriate, when excessively corrosive conditions exist. Specific functional individuals should be identified as having the responsibility/authority to interpret plant water chemistry information and initiate appropriate plant actions to adjust chemistry, as necessary.

The reference guidelines were prepared by the Steam Generator Owners Group Water Chemistry Guidelines Committee and represented a consensus opinion of a significant portion of the industry for state-of-the-art secondary water chemistry control."

Reference

Section 2.5 of NUREG-0844

In parallel action, the NRC Office of Inspection and Enforcement has developed two new Inspection Procedures to verify that the design of a plant provides conditions that ensure long term integrity of the reactor-coolant pressure boundary and to determine a licensee's capability to control the chemical quality of plant process water in order to minimize corrosion and occupational radiation exposure.

The objectives of these new procedures were partially fulfilled during previous inspections (see Inspection Reports 50-369;370/84-01 and 50-369;370/85-04 dated February 15, 1984 and March 1, 1985). This followup inspection was a further assessment of the degree to which the integrity of the steam generator (and low-pressure turbine) had been maintained during the last year. The inspector reviewed the effectiveness of both the secondary system and the licensee's chemistry control program in minimizing ingress of corrosive species and formation of localized corrosive environments that would jeopardize the primary coolant pressure boundary.

a. Plant Design and Operation

During this inspection, McGuire Unit 1 was operating at full power in its third fuel cycle that began in May 1985 and which is scheduled to end in May 1986. McGuire Unit 2 was in a refueling outage at the end of its second fuel cycle that began in April 1985. Consequently, both units had essentially completed a full fuel cycle since the inspector's last site visit.

Through a review of operational data from the Chemistry Group's computerized data base, the inspector established that during the current fuel cycle, Unit 1 had experienced four brief power outages and five significant power reductions that impacted the control of the chemistry of the secondary coolant. Likewise, Unit 2 had five outages of short duration, two outages that lasted several days, and seven power reductions during its second fuel cycle. None of these power transients resulted in an Action Level, as defined in plant procedures, being exceeded.

The inspector was informed, however, that both units experienced difficulty in achieving control of secondary water chemistry during startup of their new fuel cycles in the Spring of 1985. In Unit 1, inleakage of condenser cooling water was determined to be the cause of the problem. This leak was thought to have been caused by welding activities within the condenser during the second refueling outage. No condenser leaks have been experienced as the result of chemical attack. The secondary side of Unit 2 was contaminated during the first refueling outage when insulation material (in the form of small particles) was allowed to enter the shells of the moisture separator reheaters while the MSR tube bundles were being replaced. Much of this solid material was subsequently transported to the steam generators through drain lines that bypassed the condensate polishers during the startup of this unit and was identified through elevated concentrations of calcium, magnesium, sulfate, and silica in the steam generator water.

The inspector was informed that the only other identified chemistry control problem that could be attributed to the design or operation of the two units had been air inleakage through the condenser and through other components that operate at sub-atmospheric pressure. Data from the licensee's computerized information system indicated that the rate of inleakage of air reflected the stability of unit operation. However, only when the unit was in cold shutdown did the concentration of dissolved oxygen in the hotwell and condensate exceed 5 ppb. During unit operation, this parameter remained $\leq$3 ppb.

The inspector was informed that several modifications to the secondary water system had been made during the refueling outages in 1985 or were planned for the refueling outages in 1986. These changes are summarized below and were designed to upgrade the licensee's capabilities to monitor and/or control secondary water chemistry.

- Additional sampling pumps had been installed in the condenser, so that each segment of the hotwell could be sampled separately and thus expedite the location of a leak in the condenser tube bundle.

- Beginning with Unit 2 during the second refueling outage, the DeLaval filter/demineralizer tubes in the condensate polishers would be replaced with sintered metal tubes purchased from Paul Trinity Co. By this action, the licensee is attempting to

reduce leakage of ion-exchange resins into the feedwater and subsequently, to eliminate contamination of the steam generator with acidic sulfate species that initiate corrosive environments. The inspector was informed that if leakage of resin can be stopped, the licensee's policy of using minimal polishing during plant operation would be reviewed and full-flow polishing might be initiated.

- The copper alloy tubes in the original moisture separators had been replaced with stainless steel. This action eliminated the only source of copper that could have been transported to the steam generator and therefore removed the detrimental effort of copper as a corrodant.

In addition to these actions, the licensee was also making plans for additional plant modifications during future refueling outages.

- Deep-bed ion-exchange resin systems would be installed in the steam generator blowdown lines. Through the use of these resin beds, in the hydrogen and hydroxyl forms, the blowdown water could be more effectively cleaned before it is cycled to the condensate and the purity of the feedwater could be enhanced.

- Low-pressure turbine rotors of a new design would be installed to reduce the possibility of keyway and bore cracks. These new rotors have the first three disks machined as integral parts of the shaft of the rotor, thereby eliminating crevices and similar sites that are considered vulnerable to stress corrosion cracking.

Finally, the licensee was planning to shot-peen the steam generator tubes in both McGuire units to eliminate stress levels in the inner portions of these tubes. By this means, the licensee hoped to prevent the initiation of the type of primary-side, stress-induced, chemical attack and cracking that has been observed in the lower tube sheet region of pressurized water reactors with steam generators of similar design to those at McGuire. In a further effort to eliminate primary to secondary leaks (both units had experienced small tube leaks), the licensee was planning to plug all Row 1 steam generator tubes.

In summary, it was the inspector's conclusion that the design of the secondary water system had been effective in preventing ingress of air and potentially corrosive chemical species. However, the condensate polishers in both McGuire units had continued to be a source of acidic sulfate species in the steam generator. Based on the relatively small amount of sludge found in the steam generators (approximately 30 to 40 lbs. each) during the 198[illegible] refueling outages and the low level of hideout return observed dur.ng cooldown, the inspector considered that the secondary cycle of both units were adequately protected from chemical attack during the initial fuel cycles.

The additional modifications to the secondary system that are planned for the 1986 and 1987 refueling outages should increase the level of protection and insure the integrity of the steam generators and low pressure turbines.

b. Implementation of Water Chemistry Program

As discussed in Inspection Report 50-369;370/84-01, the licensee was active in the development of the SGOG/EPRI guidelines, and the McGuire water chemistry program has incorporated the technical recommendations developed by the SGOG/EPRI. The inspector was not able to review the licensee's response to Generic Letter 85-02 and identified this action as Inspector Followup Item 86-10-01, Response to Generic Letter 85-02.

During this inspection, the inspector reassessed the licensee's capability to control chemical variables associated with the primary, secondary, and auxiliary water systems in a manner that would ensure that all Technical Specifications were met and that the primary coolant pressure boundary was not degraded. The results of this reassessment are summarized as follows:

- Staff - The chemistry staff of 33 personnel remains divided into three groups based on responsibilities in the areas of primary chemistry, secondary chemistry, and environmental chemistry. Surveillance and control activities are performed by five shifts of three technicians who work 12-hour shifts seven days a week and a group of 18 support specialists and technicians who work eight-hour shifts five days a week. An additional group of support chemists and chemical engineers, who report to the Station Chemist, was available to both the Chemistry and Radwaste Groups and were being used to coordinate such activities as training and the application of computers to data management. As much as 50 percent of the technicians' responsibilities were directed toward operating equipment and systems (e.g., condensate polishers, water treatment plant) while the remainder of the technicians' efforts were directed toward monitoring inline instrumentation, performing analyses on grab samples, quality control activities, and training. The inspector considered the licensee to be meeting the responsibilities of a chemistry staff as defined in the SGOG/EPRI guidelines. The licensee informed the inspector that consideration was being given to providing additional supervisory personnel on the 12-hour backshift to ensure that the guidelines for timely corrective action could be implemented whenever an abnormal chemistry event occurred.

- Training - The inspector interviewed several Chemistry Technicians relative to their training and discussed the licensee's new five-year training program with laboratory supervisors. It was evident that a continual on-the-job training program was in effect; however, it appeared that the technicians on eight-hour shifts were receiving less attention than those on 12-hour shifts.

Chemistry supervision also was endeavoring to educate the staff in greater depth relative to specific chemistry theories, practices, and techniques as well as the understanding of nuclear power plant systems. As the result of his interviews and observations, the inspector concluded that the supervisory personnel in the Chemistry Group were very knowledgeable of current technology related to analytical chemistry and corrosion control and that the Chemistry Technicians were performing their responsibilities in a knowledgeable and professional manner.

- Quality Control - The inspector reviewed the program that was being implemented to assure the accuracy and precision of analytical results. Both inter- and intra-laboratory control programs were in effect. The inspector emphasized the need for the Chemistry Group to retain its credibility in a manner that is consistent with the increased responsibility placed on the Chemistry Group through the licensee's endorsement of the SGOG/EPRI guidelines.

- Facilities - The inspector visited all the licensee's laboratories, the water treatment plant, the AVT Chemical Injection Stations, and the condensate polishing system. All of these facilities were considered to be in good condition, well equipped for their designed purposes, and displaying exemplary housekeeping.

- Procedures - The licensee's Chemistry Manual was again reviewed to reassess the changes that had been implemented during the last year and to compare this guidance with the Chemistry Program as it was being implemented. The inspector was especially interested in the "chemistry holds" that were being used to minimize the introduction of contaminants, especially solid oxidation products, into the steam generator during plant warmup and startup. In addition, shutdown procedures provide for steam generator "soaks" to expedite the removal of solids and hideout return. The inspector reviewed summaries of the results of hot soak and sludge lancing activities during the cooldown and the subsequent second refueling outage for Unit 1. As discussed earlier, the amounts of impurities found during these cleaning activities were relatively small and were indicative of the efficiency of the startup and operational cleanup procedures.

Summary

During the inspection, the inspector verified that the Technical Specifications related to chemistry control of the reactor (Primary) coolant had been met during the past year. Data related to the control of the secondary coolant was also audited. It was evident that the licensee is knowledgeable of the corrosion problems that have been encountered throughout the industry and had dedicated the necessary resources to minimize or prevent degradation of the steam generator and low pressure

turbines. Although the licensee's response to Generic Letter 85-02 was not available to the inspector, it was evident that the licensee was committed to the philosophy of the SGOG/EPRI recommendations and was endeavoring to maintain a chemistry staff and program consistent with the stringent demands of the SGOG/EPRI technical guidelines.

No violations or deviations were identified