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

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Report Nos.: 50-325/85-37 and 50-324/85-37

Licensee: Carolina Power and Light Company
P. O. Box 1551
Raleigh, NC 27602

Docket Nos.: 50-325 and 50-324 License Nos.: DPR-71 and DPR-62

Facility Name: Brunswick 1 and 2

Inspection Conducted: November 4-8, 1985

Inspector: W J Ross 11/27/85
W. J. Ross Date Signed

Approved by: W E Cline 11/29/85
W. E. Cline, Section Chief Date Signed
Emergency Preparedness and Radiological
Protection Branch
Division of Radiation Safety and Safeguards

SUMMARY

Scope: This routine, unannounced inspection entailed 37 inspector-hours onsite in the area of plant chemistry.

Results: No violations or deviations were identified.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*C. R. Dietz, General Manager
*A. G. Cheatham, Manager, Environmental Radiological Control (E&RC)
*C. E. Robertson, Chemistry Supervisor, E&RC
T. Caldwell, Systems Engineer
*J. Davis, Project Specialist, E&RC
W. Nurnberger, Chemistry Foreman, E&RC
L. Sellers, Radwaste Supervisor, Operations
S. Smith, Systems Engineer

Other licensee employees contacted included chemistry staff personnel.

NRC Resident Inspector

W. Ruland

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on November 8, 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. 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

This subject was not addressed in the inspection.

4. Unresolved Items

Unresolved items were not identified during this inspection.

5. Plant Chemistry (79501 and 79502)

In a recent action the NRC Office of Inspection and Enforcement has developed two new Inspection Procedures to verify that the design of a nuclear power plant provides conditions that ensure long-term integrity of the reactor coolant pressure boundary and to establish the extent to which a licensee is able to control plant chemistry so that corrosion and occupational radiation exposure are minimized. The objectives of these new procedures were partially fulfilled during a previous inspection of the

Brunswick plant (see Inspection Report Nos. 50-325/84-23 and 50-324/84-23, August 30, 1984). This followup inspection consisted of a review of plant operating experience since the previous inspection and an assessment of the protection that had been provided through chemistry surveillance and control.

a. Plant Operation

At the time of this inspection Unit 1 was restarting, in its third fuel cycle, after an eight month outage during which major maintenance and repairs were performed, including repair of intergranular stress corrosion cracks (IGSCC) in the recirculating water lines. Unit 2 was in the last month of its seventh fuel cycle that began in October 1984. An outage of approximately seven months is planned for Unit 2 to allow similar major repairs to be made. During their periods of operation since the last inspection, in July 1984, both units experienced a number of problems that resulted in unstable operation or shutdowns. None of these problems were attributed to control of chemistry. However, besides the IGSCC degradation of the recirculating lines the licensee has also observed stress corrosion cracks in the low-pressure turbine wheels and has replaced one rotor in Unit 1 and plans to replace one in Unit 2 as soon as a replacement is available.

Once Unit 2 began operating in a stable condition during the past year (~ April 1985) the licensee was able to maintain both chemistry control and diagnostic parameters within the limits recommended by the BWR Owners Group (BWROG) for corrosion control. This favorable condition is attributed to the integrity of the condenser and other components of the reactor coolant system (i.e., no inleakage of air or condenser cooling water) as well as to the capability of the dual condensate cleanup system to remove impurities from the condensate makeup as well as to filter out solid oxidation products of iron that form on the inner surfaces of both the low-pressure and high-pressure components of the reactor coolant system during plant outages. The licensee has been able to maintain a high level of cleanliness within the reactor coolant system as shown by the fact that the filter/demineralizers usually have been precoated only once per three or four weeks and calculations indicate the deep-bed demineralizers will not be depleted for several (two to six) years under normal conditions.

The licensee is attempting to improve the quality of makeup water by switching from well water to domestic (county) water as the input to the water treatment plant and, thereby, eliminating fouling of the cation and anion resin beds. Also, the limiting conductivity of the product of the water treatment plant has been decreased from 1.0 umho/cm to 0.1 umho/cm, thereby ensuring that the product water is essentially free of all potentially corrosive species. This product water is still being stored in the Condensate Storage Tank (CST) where it is exposed to air, thereby saturating the water with dissolved oxygen. During the last outage for Unit 1 the design of the reactor coolant cycle was modified so that suction for control-rod-drive (CRD) water no longer is taken from the CST but rather from the discharge of

the condensate cleanup system. Consequently, the quality of the CRD water, that eventually mixes with the reactor coolant, has been improved and ensures that the reactor coolant will not be degraded. However, in Unit 2 CRD water is still taken directly from the CST without benefit of further polishing or air removal. By preventing ingress of impurities into the feedwater the licensee has been maintaining essentially the purity of demineralized water, i.e., conductivity of 0.054 umho/cm and silica less than 1 ppb. This purity translates into high quality reactor coolant, i.e., conductivity of 0.16 to 0.28 umhos/cm, chloride <5 ppb, silica 50-200 ppb. The licensee's capability to provide continual cleaning of the reactor water, by means of the Reactor Water Cleanup System (RWCU) has been variable. The inspector observed that the RWCU, when operable, was able to produce water with a conductivity of 0.07-0.08 umho/cm. However, the effluent of the RWCU periodically has been contaminated with "fines" from the filter/demineralizer resin columns. These small resin fragments leak through the DeLaval septums and are subsequently thermally degraded into acidic sulfate species that can form corrosive environments that enhance IGSCC. All of the septums in Unit 1 were replaced during the recent outage in an effort to reduce resin leakage. The inspector was also informed that a different design of septum is under investigation and may be substituted for the DeLaval tubes.

Summary

The inspector's audit of analyses performed on the reactor coolant revealed that whenever Unit 2 was operating in a stable condition, the chemistry variables that are controlled to prevent IGSCC were within the limits recommended by the BWROG, unless there was resin leakage in the RWCU. When the power level was fluctuating the conductivity of the reactor water often exceeded the 0.3 umho/cm limit established by the BWROG and, therefore, was less conducive to corrosion control. The licensee does not attempt to control the concentration of oxygen in the reactor water, other than by maintaining the oxygen content of the condensate and feedwater as low as achievable (20-30 ppb) by means of condenser vacuum and the dearation achieved in the high pressure feedwater heaters. The licensee has made no commitment to initiating hydrogen water chemistry control of dissolved oxygen in the reactor coolant. Unit 2 operated under stable conditions for a record (for Brunswick) period between April and August 1985; however, there were several periods before and afterwards when chemistry control was not optimum because of power changes and periodic power outages.

The inspector was informed that no evidence of chemical induced degradation of fuel elements had been observed in either Brunswick unit.

b. Chemistry Program

As during the previous inspection, the inspector used the water chemistry guidelines that have been prepared by the BWR Owners Groups (BWROG) as a yardstick to evaluate the scope and adequacy of the licensee's water chemistry program. From discussions with plant management and chemistry supervisory personnel the inspector established that the licensee was familiar with both the philosophical and technical recommendations developed by the BWROG; however, there was no indication that any of the specific guidelines had been incorporated into management directives or plant procedures. Although the BWROG guidelines have not yet been endorsed by the NRC, as have the guidelines developed by the industry for PWRs, the guidelines represent the consensus of current understanding of stress corrosion cracking and fuel degradation in BWRs and their prevention. Consequently, throughout this inspection, emphasis was placed on those parts of the licensee's water chemistry program that did not appear to be consistent with the BWROG guidelines. Two areas specifically were of concern. First, the inspector perceived a need for a formal commitment by corporate and plant management to corrosion control and a policy for controlling water chemistry to prevent corrosion. Second, there is a need to make the chemistry and operating procedures more specific and consistent relative to allowable limits for chemistry control parameters during all modes of plant operation as well as to the actions to be taken when these limits are exceeded. The inspector was informed that new directives are being developed by the corporate chemistry staff that will address these areas of concern.

The inspector evaluated the licensee's capability to maintain appropriate water chemistry conditions in the two Brunswick units through the following means: auditing chemistry control data that had been acquired for Unit 2 during its current fuel cycle; interviewing cognizant personnel in the Chemistry and Radwaste staffs; observing activities performed in the chemistry laboratory; and reviewing the licensee's program for quality control and quality assessment of data required by Procedures E&RC-1001 Sampling and Analysis Schedule for Radioactive and Non-Radioactive Non-Technical Specifications Related Chemistry and E&RC-1700 Verification of Analytical Performance.

The licensee's Chemistry staff remained essentially unchanged since the previous inspection. This stable condition was considered to be favorable because the licensee has initiated a formal training program, both at the corporate training center and onsite, for upgrading the training of all chemistry technicians and specialists. Most analyses required by Procedure E&RC-1001 (as well as under Procedure E&RC-1000 for analyses required by Technical Specifications) are performed on grab samples. Conductivity measurements are the principal exceptions. The licensee has acquired state-of-the-art analytical instrumentation and is training all chemistry technicians so that each will be

qualified on all radio-chemical as well as non-radiochemical procedures and instruments. A computerized program has been developed for tracking the training and qualification of each member of the chemistry staff. The chemistry specialists are being used effectively in support of the training activities as well as for resolving specific problems.

The inspector reviewed the chemistry quality control program and data acquired through routine calibrations and in-house verification procedures. Control charts are maintained for each instrumental procedure and are revised monthly on the basis of standard analyses performed by many of the 23 Chemistry Technicians. The licensee also participates in two inter-laboratory control programs. The CP&L corporate chemistry laboratory submits 'blind' samples to all power plant laboratories, however, the inspector believes that this program would be of greater value if the samples were prepared to be more representative of those encountered at Bruwnswick. In addition, the licensee has recently initiated a cross-check program with a commercial laboratory. An audit of the results of all of these quality control program revealed that a high level of assurance is being achieved for all key chemistry variables as well as for many diagnostic parameters such as sulfate and copper ions that exist in trace chemical levels in the reactor coolant.

The Chemistry Staff exhibited a high level of understanding of the potential mechanisms for corrosion in a BWR as well as a comprehension of the theory and techniques associated with state-of-the-art analytical instrumentation. All activities were being performed in a professional manner. The inspector emphasized the need to maintain an exceptionally clean laboratory environment while performing analyses of essentially pure water as well as to prevent spread of radioactive contamination.

Summary

During this part of the inspection, no violations or deviations were identified. The licensee's surveillance and control program, as defined in current procedures, is considered to provide an acceptable level of protection against IGSCC. The inspector believes, however, that this program does not incorporate two concepts that are considered by the NRC to be central to the current philosophy and guidelines for chemistry control that have been developed by the BWROG: (1) plant procedures should define allowable limits for chemical variables and progressively more stringent corrective actions that must be taken for out-of-specification chemistry conditions; and (2) written corporate goals and policies relating to water chemistry control and station operation should be developed and should show an understanding of the 'action level' concept and its possible impact as well as its possible benefits to the utility. It is the inspector's experience that utility commitment to these two concepts has provided the basis for the improvement in chemistry control that has been observed at nuclear plants in Region II during the last two years.

6. Closeout of Inspector Followup Items (IFI)

The following two IFIs were addressed during this inspection, and, on the basis of the information summarized below, both IFIs are hereby closed.

IFI 84-23-01 Implementation of Technical Specification 3.3.5.6 - Chloride Intrusion Monitor.

The inspector established that the licensee is meeting the requirement of Technical Specification 3.3.5.6 to have chloride intrusion monitors in the condenser hotwell outlet headers, in the condensate pump discharge, and in the inlets to both the condensate filter/demineralizer and the deep-bed demineralizer. In order to achieve greater reliability for chloride in different ranges (0-1 ppb, 0-10 ppb, and 0-100 ppb) conductivity meters have been substituted for in-line chloride detectors. In the absence of other impurities the measured conductivity can be converted to chloride concentration; however, the licensee uses the conductivity measurement as a direct method of monitoring the intrusion of all ionic impurities into the hotwell. The four conductivity meters on the condenser hotwell display in the Control Room and afford the first indication of condenser cooling water inleakage.

IFI 84-23-02 Role of Ionic Impurities in the Cracking of Valve G31-F042 in Unit 2

The licensee provided the inspector with additional information related to the earlier identification of IGSCC indications in a valve downstream of the filter demineralizers in the RWCU system. The basic cause of failure was hypersensitization of the 304 stainless steel valve seat when stellite was placed over the seat by application of local welding. The licensee believes that the valve would have probably failed without the aggravating effects of deposition of "fines" from the ion-exchange resins in the RWCU. No investigation was performed to determine if localized chemistry excursions would have accelerated the deterioration. The inspector does not consider that further research on this matter is warranted.