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

Report No.: 50-395/83-37

Licensee: South Carolina Electric and Gas Company
Columbia, SC 29218

Docket No.: 50-395

License No.: NPF-12

Facility Name: Summer

Inspection at Summer site near Jenkinsville, South Carolina

Inspector: W J Ross 1/9/84
W. J. Ross Date Signed

Approved by: J Blake 1/9/84
J. J. Blake, Section Chief Date Signed
Engineering Program Branch
Division of Engineering and Operational Programs

SUMMARY

Inspection on December 12-16, 1983

Areas Inspected

This routine, unannounced inspection involved 44 inspector-hours on site in the areas of plant water chemistry and inservice testing of pumps and valves.

Results

Of the two areas inspected, no violations or deviations were identified.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*O. S. Bradham, Director, Nuclear Plant Operations
*J. G. Connelly, Deputy Plant Manager
*A. R. Koon, Associate Manager - Regulatory Compliance
*F. S. McKinnon, Associate Manager - Quality Control
*M. N. Browne, Manager - Technical Services
*W. F. Bacon, Associate Manager/Chemistry
*L. C. New, Quality Assurance
*H. I. Donnelly, Senior Licensing Engineer
*P. E. Troy, Independent Safety Engineering Group
A. J. Cribb, Plant Chemist
R. H. Burch, Chemistry Supervisor
L. F. Faltus, Chemistry Supervisor
J. Turkett, Maintenance Engineer

Other licensee employees contacted included six chemistry specialists.

NRC Resident Inspector

C. W. Hehl

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on December 16, 1983, with those persons indicated in paragraph 1 above. The licensee acknowledged the inspection results with no dissenting comments.

Inspector Followup Item 50-395/83-37-01: "Incorrect References to Procedures and to Deleted Attachments in Chemistry Procedures- 602, 603, 612, and 614.

3. Licensee Action on Previous Enforcement Matters

a. (Closed) Inspector Followup Item 395/83-14-01: "Loose or Missing Nuts and Screws"

The inspector verified that by means of Maintenance Work Request Nos. 57144, 57145, 57146, 57147, 57148, 57161, and 90860 the licensee initiated repair for the seven faulty components noted in this Followup Item. These repairs were accepted on: April 15, 1983, (Nos. 57144 through 57147); April 19, 1983, (No. 57148); May 5, 1983, (No. 57161); and April 25, 1983, (90860). The inspector considers this Followup Item to be resolved and closed.

b. (Closed) Inspector Followup Item 395/83-23-01: "Process Equipment Instrumentation Calibration"

The inspector verified that Station Administrative Procedure SAP-141 "Control and Calibration of Measuring and Test Equipment" had been revised (April 22, 1983) to read as follows: "Process instrumentation controlled by their respective procedures do not require calibration tags". Inasmuch as there is no regulatory requirement to the contrary, this revision to SAP-141 is acceptable. This Followup Item is, therefore, considered closed.

c. (Closed) Inspector Followup Item 395/83-23-02 "Results of MT Inspection"

The inspector verified that the licensee had taken the following steps in response to perceived incomplete documentation of MT examination results:

- Magnetic Particle Inspection Report #VCSM-153 was corrected and a copy placed in the MWR package (20152-0002) in accordance with plant procedures.
- A review of all NDE reports generated from 3/1/83 until the present time was reviewed for completeness. No additional omissions were discovered.
- All NDE inspectors were counseled on the importance of "attention to detail" when completing inspection reports. A copy of the attendance record to this meeting is on file in the personnel records.

The licensee's actions are considered to be sufficient, and this Followup Item is closed.

4. Unresolved Items

Unresolved items were not identified during this inspection.

5. Plant Water Chemistry (92706)

This inspector reviewed the "as-built" design of the Summer secondary water cycle against the description provided in the Final Safety Analysis Report (FSAR) (especially Section 10.4) and assessed the effectiveness of the designed secondary cycle, and the licensee's water chemistry program, in preventing degradation of both the main turbines and the primary coolant boundary (in the steam generators). This review consisted of three interrelated inspection efforts: an assessment of the design and operation of the major components of the secondary cycle; an evaluation of the adequacy of the Summer water chemistry program; and verification that the requirements of the Summer Technical Specifications and water chemistry program are being implemented.

a. Assessment of the Design and Operation of the Summer Secondary Cooling System

This inspection was performed during a period when Summer was returning to power after a scheduled outage to inspect the three steam generators. The plant is operating in its first fuel cycle and has operated approximately six months since significant modifications were made on the unit's model D-3 steam generators. Although a final steam-generator inspection report had not been completed, the NRC inspector was informed by the licensee that very little, if any, tube degradation had occurred to date, and only relatively very small amounts of solids (sludge) had been observed and removed from the three steam generator's tubesheets. These results compare favorably with those obtained during the March 1983 shutdown, when the total volume of sludge in all three steam generators, before lancing, was determined to be 25 gallons.

The inspector "walked down" the secondary cycle and discussed with cognizant licensee personnel the operational experience of each component during the initial year of plant operation. This part of the inspection is summarized as follows:

(1) Main Condenser

The Summer plant transfers waste heat energy to once-through cooling water from the Monticello Reservoir by means of a main condenser and three auxiliary condensers. The inspector verified that the quality of this cooling water is monitored on a monthly schedule as part of the licensee's "Summer/Fairfield Environmental Monitoring Program". The stainless steel condenser tubes are cleaned with an Amertap system and are further protected by periodic chlorination of the cooling water. Although Asiatic clams have been observed in the intake bay, there has been neither degradation due to chemicals or biota, nor inleakage of lake water through these tubes.

The condenser hotwells are compartmented into four sections and are valved to facilitate location of inleakage. The inspector verified that the condensate is continuously monitored at the discharge of the condensate pumps for chlorine, sodium, and oxygen as well as changes in cation conductivity (Chemistry Procedure 602).

(2) Condensate Makeup Water System

Demineralized water for various uses in the plant, including water for reactor-makeup and condensate-makeup is acquired by purifying water from Monticello Reservoir. The licensee's chemistry program places limits on 12 parameters related to the purity of this water. Makeup for the 500,000 Condensate Water Storage Tank (CWST) is routed, from the equally large Demineralized Water

Storage Tank, through the condenser for deaeration when the plant is operating. Provision is made to bypass the condenser when the plant is shutdown. The water in the CWST has limits on seven parameters (chloride, sodium, silica, solids, pH, conductivity and oxygen) that are monitored on a weekly basis (Chemical Procedure 602). The inspector agrees that an acceptable level of purity of the makup water can be achieved by monitoring and controlling these parameters.

The licensee has experienced some air inleakage to the condensate from sources yet unidentified. The amount of oxygen that has thereby been introduced has not been of great concern because it has not been significantly greater than the 10ppb allowable limit and is subsequently reduced to an acceptable level as the condensate undergoes further deaeration downstream. The licensee also believes that the condensate makeup water is the source of trace amounts of organic compounds that have caused the cation conductivity of the condensate and feedwater to periodically fluctuate (0.8-1.1μmhos) around the administrative limit of 1.0 μmho.

(3) Condensate Polishers

Although the "as-built" condensate cleanup system is as described in the Summer FSAR, this system was not in the original design of the plant and is currently designed to operate (100% flow) only when the plant is below 50% maximum power. The licensee's system is a Powdex (Ecodex) system manufactured by the Graver Water Division of Ecodyne. Each of the three demineralizer vessels holds 492 filter/demineralizer tubes that are precoated by Operations personnel as directed by Chemistry supervision. As mentioned above, this system is used only during startup until the plant reaches 50% power because of limitations in the pressure drop of the condensate pumps. The licensee is currently designing an internal loop that will permit a portion of the condensate to be passed through the polishers and cycled back to the hotwell so that cleanup may be partially continued after the plant has exceeded the 50% power level. During the initial year of plant operation the licensee experienced three problems with this Graver system: the Powdex formulation of resin and fiber did not yield a uniform coating on the tubes when added separately to the precoat mixer and was replaced by the Ecodex formulation of resin and fiber as an intimate mixture; considerable "throw off" contamination occurred as the result of faulty tube construction that allowed part of the condensate to pass through the top of the tubes without coming into contact with the resin; and degradation of the resin with production of free chloride occurred when the concentration of hydrazine in the condensate water was too high. All of these problems have now been resolved. The inspector observed the precoating of tubes in Demineralizer Tank B by

operations personnel and verified that the prescribed procedure (SOP-3) was followed. The inspector also observed that Demineralizer Tanks A and C were being operated while the plant was being restarted and cation conductivity and sodium were being monitored in the demineralizer effluent as required by Chemistry Procedure 602.

(4) AVT Chemicals Injection

The licensee injects hydrazine and ammonia into the condensate downstream from the condensate polishers.

(5) Deaerator

The Summer plant is somewhat unique in that its design includes a deaerator and a large (75,000 gallons) deaerator storage tank in the secondary water cycle between the condensate polishers and the feedwater booster pumps. The deaerator uses steam sparging to reduce the concentration of dissolved oxygen in the condensate to less than detectable limits (<0.005 ppm).

(6) Steam Generators

After the Summer plant had been operating for approximately 6 months, and upon the recommendation of the steam generator vendor (Westinghouse), the licensee modified the three Model D-3 steam generators to improve the flow characteristics of the feedwater and to minimize mechanical damage to the generators' interior components. The purpose of the current plant outage was to assess the effects of these modifications. Initial results of eddy current testing (16% of all tubes) indicate that there has been no degradation of the steam generator tubes. The licensee also examined the interior of the three generators for sludge and found very little. During this examination, however, the licensee found two small metallic objects (a wedge and a knife) in Steam Generator A and part of a pair of eye glasses in Steam Generator B. During startup from this outage the licensee also observed some sulfate and chloride in hideout return even though there was very little solid material (sludge) on the tubes or tubesheet. The licensee's initial evaluation is that sulfate and chloride probably entered the steam generator as the result of a transient in makeup water. Another chemical change that is being attributed to the steam generator modifications is that the ratio of concentrations of ammonia in the steam generator blowdown and in the feedwater has changed from 1:2 to 1:4. This increased loss of ammonia is of interest because of its effects on the pH and concentration of corrosive hydroxyl ions in the steam generator.

The Summer plant has the capability for continuous steam generator blowdown to improve the purity of the water in the steam generators. This blowdown system was designed to permit blowdown equivalent to 1% of steam flow (~ 85 gpm); however, the maximum achievable flow is ~ 40 gpm because of control problems at the blowdown heat exchanger and a restricted flow path through the radiation monitors. Consequently, the licensee's capability to control steam generator water chemistry by blowdown has been limited.

(7) Components in the Steam Cycle

The inspector assessed the components in the steam cycle as potential sources of impurities that might impact the chemistry of the secondary water cycle. The major source of corrosion products in a PWR is from formation of hematite ($Fe_2 O_3$) on the carbon steel surfaces of steam lines when the plant is shutdown. The licensee informed the inspector that the Summer plant originally had strainers in the main steam lines but after one year of operation there was very little indication of corrosion and the strainers are no longer used. During the restart from the December 1983 outage there was <1 ppm solids on the condensate polishers. These observations indicate that the resistant magnetite film that forms on the interior surfaces of carbon steel lines must be retaining its integrity.

The inspector was informed that the only component of the secondary cycle that contains copper are the heaters in the moisture separators. Even though copper that may be eroded or corroded from these heater should be removed from the condensate by the polishers, the licensee has placed a limit of 0.005 ppm on copper in the condensate and feedwater and also monitors steam generator blowdown samples for copper.

The design of the Summer plant includes vacuum pumps to achieve removal of non-condensible gases from the condenser; thereby, assisting in the elimination of oxygen in the secondary cycle.

Except for the modifications described above, the inspector did not observe any significant differences between the design of the "as-built" plant and the description of the secondary water cycle in the Summer FSAR. With the exception of minor inleakage of air in the first stages of the condensate system and the ingress of trace amounts of organic compounds, the Summer secondary cycle appears to be designed with the capability of maintaining the purity of feedwater at a very high level, thereby minimizing the formation of local corrosive environments in the steam generator or on the turbine disks and blades.

b. Water Chemistry Program

Section 10.3.5 of the Summer FSAR reads in part:

"The secondary water chemistry control program will include a comprehensive monitoring program. The aim of this program is the minimization of overall system corrosion. Special emphasis will be placed on the inhibition of steam generator tube degradation. In general, the program will be based on recommendations and criteria supplied by the NSSS Vendor. This program will consist of procedures covering the following areas:

(1) Identification of critical parameters, their specifications, and control measures.

(2) Written analytical procedures for determination of the specified parameters.

(3) Identification of process sampling points and the sampling schedule.

(4) Administrative and quality control of the generated data.

(5) Recommendations for response to off-normal conditions.

(6) Designation of authority and responsibility for the interpretation of data and implementation of corrective actions."

The inspector evaluated the adequacy of the licensee's program and means of implementing water-chemistry Technical Specifications through a review of administrative procedures - primarily Station Administrative Procedure-400 "Chemistry Operations Manual, Revision 2" dated September 22, 1983, and specific "Chemistry Procedures" that have been developed for each requirement.

By these means the inspector verified that responsibilities have been designated and guidance has been provided for the following activities:

- Establishing key parameters to monitor when the plant is in wet layup, hot shutdown/standby, and power operation
- Developing, reviewing, and updating procedures (SAP-400)
- Scheduling tests (CHP-602 "Chemistry Reporting Revision 4")
- Training Chemistry Technicians (CHP-603 "Chemistry Group Training Program, Revision 1")

- Performing chemical tests (Chemistry Procedures for specific parameters as well as CHP-613 "Steam Generator Chemistry Control, Revision 5", CHP-614 "Reactor Coolant Chemistry Control, Revision 4", and CHP-615 "Condensate and Feedwater Chemistry Control, Revision 4")

- Providing quality control and calibrations (Specific Chemistry Procedures)

- Documenting and reviewing test results (SAP-400)

- Taking required action on the basis of test results (CHP-612 "Out of Specification Handling and Reporting", Revision 2)."

The inspector verified that the licensee's Chemistry Program (specifically, CHP-614) includes means for implementing the Summer Technical Specifications for primary cooling water (Technical Specification 3.4.7, Table 3.4-1). In addition, the chemistry program encompasses auxiliary systems that have the potential for contaminating the primary or secondary water systems (i.e., industrial cooling water, spent fuel pool, and component cooling water).

On the basis of this review, the inspector concluded that the licensee's water chemistry program contains the necessary elements to meet the goals set forth in the FSAR and the objectives listed in SAP-400. The inspector recommended that increased emphasis be given to minimizing corrosion when the plant is shut down. The inspector subsequently evaluated, in a qualitative manner, the commitment and support given to the implementation of this program by the licensee's management. Through interviews of licensee personnel the inspector was informed that management of the plant and in corporate positions are aware of the need to anticipate off-normal chemistry and of the importance of having the capability to detect the magnitude and limit the duration of off-normal chemistry events. The inspector also verified that the plant's table of organization provides for the chain of responsibility and authority needed to implement the day-to-day chemistry control program.

During this part of the inspection, the inspector did not identify any violations or deviations; however, the inspector found several erroneous references in Chemistry Procedures CHP-602, 603, 612, and 614. These errors were confirmed by the licensee who immediately initiated actions for correction. The inspector will review these procedures again during a later inspection and designates this pending action as Inspector Followup Item 50-395/83-37-01 "Incorrect References to Procedures and to Deleted Attachments in Chemistry Procedures 602, 603, 612, and 614".

c. Implementation of the Summer Water Chemistry Program

The inspector assessed the degree to which the licensee is fulfilling the requirements of the Summer Technical Specifications and is implementing the water chemistry program that has been developed to meet the goals committed to in the FSAR. This assessment was based on discussions with plant personnel, review of written Chemistry Procedures and other internal documents, observation of the performance of chemistry tests, and audit of recent test results. This part of the inspection is summarized as follows:

(1) The chemistry program is implemented by personnel in the Plant Chemistry Section under the direction of the Associate Manager/ Chemistry as required by SAP-400. The Associate Manager has developed standard operating procedures for developing and revising Chemistry Procedures as needed.

(2) Chemistry control analyses are scheduled by the three Chemistry Supervisors who report to the Associate Manager. Each Chemistry Supervisor uses the report forms in CHP-602 as well as laboratory-specific forms and procedures for scheduling and tracking tests and for ensuring that shift turnover responsibilities are performed.

(3) Professional training is provided to chemical specialists in each of the three laboratories through periodic formal training courses and, primarily, through on-the-job instruction by senior specialists and supervisors.

(4) The inspector audited six specific Chemistry Procedures (for the determination of ammonia, fluoride, chloride, hydrazine, free hydroxide, and conductivity) and found them to be acceptable as to format, content, and clarity.

Most of the sample points in the secondary water system are equipped with continuous sampling lines that terminate in the secondary or primary chemistry laboratories. Similarly, three of the four steam-generator-critical parameters (cation conductivity, sodium, and pH), as well as oxygen, are analyzed continuously and the results are displayed on the sampling panel of the secondary laboratory. The licensee's laboratories are equipped with several state-of-the-art instruments, some of which are automatically and computer controlled.

(5) The inspector verified that instruments and chemical reagents are being calibrated as required by the associated Chemical Procedure.

(6) The inspector verified that the results of each analysis is being documented by the specialist who performed the test. The results of all analyses are reviewed daily by the appropriate Chemical Supervisor and are transmitted to key plant personnel daily by

means of special report forms or by a "Teleautograph" communication system.

(7) Each specialist and his/her supervisor interpret the test results, trend them, and provide both oral and written notification to Operations if a result is outside its specified limit. The inspector was informed by plant management that any actions recommended by the Chemistry Section related to out-of-specification events are to be given full consideration by Operations personnel who have the responsibility to correct the off-normal condition.

The inspector audited the log books and daily chemistry data sheets in the primary and secondary chemistry laboratories and observed that all audited results were either within specified limits or had been properly processed if out of limit. The inspector discussed selected out-of-limit results with licensee personnel to determine if the duration and magnitude of the discrepancy had been adequately analyzed and verified that such analyses had been performed.

(8) The inspector reviewed the status of the licensee's Post Accident Sampling System (PASS). This system is being designed and constructed by the licensee and uses the sampling system that is also used for normal sampling of the reactor cooling system. The PASS is not yet fully operational. The inspector informed the licensee that a comprehensive evaluation of the Summer PASS would probably be performed by NRC in the near future. During this part of the inspection, no deviations or violations were identified by the inspector.

d. Summary Assessment of the Summer Water Chemistry Program

The results of the licensee's second steam generator inspection indicate that very little corrosion has been experienced in the secondary cycle of the Summer plant during the initial year of operation and insignificant degradation of steam generator tube (primary coolant boundary) has occurred. The inspector considers that all aspects of the plant design and the secondary water chemistry program are contributing to this favorable situation. Even so, the inspector observed that the specifications of several key chemical parameters (e.g., cation conductivity, chloride, sodium, oxygen, and silica) in feedwater and steam generator specifications (CHP-615 and CHP-614) are higher, by a factor of 2 to 10, than the limits published as guidelines for PWRs with recirculating steam generators by the EPRI/Steam Generator Owners Group. Inasmuch as the inspector's audit of the secondary water chemistry log book indicated that the guideline concentrations could and were being achieved, the inspector recommended that the licensee review the secondary water specifications to determine if lower limits should be made mandatory and, thereby, augment the protection provided by the water chemistry program.

6. Inservice Testing of Pumps and Valves

The licensee has submitted a program for the inservice testing of pumps and valves to the NRC and has requested relief from specific requirements of the ASME Boiler and Pressure Vessel Code, Section XI. The program is applicable during the first 120-months of plant operation. Pending final review of this program, the NRC staff has given interim approval of program and the licensee is assuming that the relief requests will be approved. The inspector did not perform an audit of the IST program except to establish what administrative controls were being used to ensure that the program is being implemented.