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

OCT 21 1986

Report Nos.: 50-280/86-25 and 50-281/86-25

Licensee: Virginia Electric and Power Company
Richmond, VA 23261

Docket Nos.: 50-280 and 50-281 License Nos.: DPR-32 and DPR-37

Facility Name: Surry 1 and 2

Inspection Conducted: September 8-12, 1986

Inspector: Douglas M. Collins for W. J. Ross — 10-18-86 Date Signed

Accompanying Personnel: J. D. Buchanan
NRC Office of Inspection and Enforcement

Approved by: Douglas M. Collins — 10-18-86 Date Signed
D. M. Collins, Chief
Emergency Preparedness and
Radiological Protection Branch
Division of Radiation Safety and Safeguards

SUMMARY

Scope: This routine, unannounced inspection was performed in the area of plant chemistry.

Results: No violations or deviations were identified.

REPORT DETAILS

1. Persons Contacted

   Licensee Employees

   *R. F. Saunders, Station Manager
   *H. L. Miller, Assistant Station Manager
   *E. S. Grecheck, Superintendent, Technical Services
   *E. T. Swindell, Supervisor Chemistry
   R. Blount, Supervisor, Performance Engineering
   D. Bostick, Chemist
   A. Davis, Laboratory Supervisor Chemistry
   W. Hagon, Supervisor Water Management
   R. Solan, Laboratory Supervisor Chemistry

   Other licensee employees contacted included chemistry technicians.

   NRC Resident Inspectors

   *W. E. Holland
   *L. E. Nicholson

   *Attended exit interview.

2. Exit Interview

   The inspection scope and findings were summarized on September 12, 1986, with those persons indicated in Paragraph 1 above. The inspector described the areas inspected and discussed in detail, the results of the inspection. 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. Plant Chemistry (79502, 79701)

   This site visit represented the inspector's third inspection and assessment of the licensee's capability to maintain control of secondary water chemistry in a manner that will ensure the integrity of the primary - coolant pressure boundary, as represented by the steam generator tubes. As before, this review and assessment addressed three areas: the effect of plant design and plant operation on chemistry control; the adequacy of the licensee's water chemistry program, including staffing, physical facilities, and analytical capability; and the degree to which Technical Specifications related to the reactor coolant system had been implemented.

As shown in the following sections, the control of chemistry during the thirteen intervening months since the inspector's last inspection, in July 1985, had benefitted from both continued upgrading of the secondary water cycle and through the licensee's adherence to the control criteria recommended by the Steam Generator Owners Group (SGOG). In addition, the licensee was installing two state-of-the-art, in-line analytical systems that were expected to significantly increase the level of control and diagnosis of both the primary and secondary coolants.

a. Effect of Plant design and Operation of Chemistry Control

At the time of this inspection Surry Unit 1 was operating at full power in the third month of a scheduled 18-month fuel cycle. Unit 2 was also at full power but was scheduled to shut down for refueling on October 3, 1986. In addition to its 54-day refueling outage in May-July 1986, Unit 1 also had been shut down in February 1986 for ten days for snubber inspection and had five other brief shutdowns in the last 14 months. During the remainder of this period this unit operated under stable conditions. Unit 2 had undergone three outages longer than 10 days, had experienced one trip, and had operated in a "load following" mode during part of the year.

The combination of relatively good operating stability and the high integrity of the condensers of both units (i.e., no tube leaks and low air inleakage) had permitted the licensee to maintain high quality water in the condenser hotwells during the past year. Improvements in the efficiency of the water treatment system (especially after the flash evaporator had been retubed) facilitated the production of high quality makeup water that was used to supplement water recovered from steam-generator blowdown. (However, licensee had experienced ingress of organic contaminations through the water treatment plant pathways for a brief period in September 1985.)

The inspector was informed that the deep-bed demineralizers that constitute the condensate cleanup system had been the source of less sodium and sulfate contaminants in the feedwater during the last year because of improvements in the process for regenerating these beds. Each bed continued to be regenerated once per two weeks to keep ammonia loading to less than 50 percent of the resin's capacity and, therefore, to ensure that the bed provided an adequate barrier against massive inleakage of contaminants if a condenser tube rupture occurred. The licensee also continued its policy of replacing the ion-exchange resin in each bed once every two years.

During the refueling outage for Unit 1 the copper-alloy tubes in the fifth and sixth feedwater heater had been replaced with tubes fabricated from 304 stainless steel. Tubes in the same feedwater heaters in Unit 2 were to be replaced during the upcoming refueling outage. Plans were being made to change out all the remaining copper-containing feedwater heater tubes during the next refueling outage for each unit.

As the result of these actions the transport of soluble and solid species of copper to the steam generators will no longer occur, and the detrimental, corrosive action of copper can be eliminated. However, until the copper that is presently in the steam generators (10 to 15 ppb) is eliminated the role of copper in corrosion mechanisms cannot be ignored.

The inspector was informed that the amounts of metal oxides that were removed from the condensate/feedwater lines during the pre-startup cleanup of Unit 1, at the end of the recent refueling outage, were considerably less than previously observed. This indicated that greater protection against oxidation was being provided to the low- and high-pressure water and steam lines by adhesive, protective layers of stable iron oxide (magnetite) on the inner surfaces of these pipes. This assumption was confirmed by the relatively small (<100 pounds) amount of metal oxide sludge that was found in each steam generator of both units during their last refueling outage.

Through an audit of chemistry data that had been acquired during the past year, the inspector established that the level of contaminants in the steam generator water had been maintained at levels significantly below the maximum limits recommended by the SGOG (e.g., cation conductivity of 0.10-0.15 umho/cm vs the SGOG limit of 0.8 umho/cm). While both units were at power, the concentrations of such corrosive ions as sulfate and chloride were normally less than the detectable limits of the licensee's state-of-the-art analytical methods. However, during both planned and unplanned power reductions, when the Tavg dropped below 500°F, the concentrations of sulfate, chloride, silica, and sodium increased significantly (e.g., sulfate increased to 800 ppb). Such a level of hideout return indicated that considerable buildup of these potentially corrosive species had occurred since the steam generators were replaced 5 to 6 years ago, and that these contaminants had not been removed when the steam generators had been sludge lanced during each refueling outage. (The inspector was informed that in October 1985 a problem with the blowdown polishers had resulted in ~0.75 liter of ion-exchange resin being transported to each of the Unit 1 steam generators where the resin was thermally degraded to ionic sulfate species.)

The inspector discussed with the licensee, means for reducing the level of hideout return. During the past year operating procedures had been revised to provide for a "chemistry hold" of 12 hours at the optimum temperatures (~350°F during planned unit cooldowns to maximize removal of hideout return through blowdown of the steam generators. Such procedures appeared to the inspector to offer the best means of reducing the total amount of corrosive species in the steam generators to a level that would both expedite startup of a unit (Unit 1 was forced into a power ascension hold for 19 hours in January 1986, and for 8 hours in May 1986, because of high sulfate levels) as well as provide long-term protection against corrosion within the steam generator. The blowdown cleanup systems for both units have the capacity for blowdown rates of 60-70 gpm; consequently, the licensee can use maximum flow rate to remove ionic species that are solubilized during cooldown.

Eddy current inspection of the steam generator tubes during the Unit 1 refueling outage showed that several tubes had crack indications 40% through-wall. However, further investigation revealed that most of these indications were false. Accordingly, only two tubes were plugged in two of the three steam generators. The false indications were attributed to the presence of the ion oxide scale on some on the inconel 600 tubes.

On steam generator tube in Unit 2 experienced a through-wall leak in June 1986. This leak was attributed to mechanical abrasion of the tube by a small metal object that may have remained in the steam generator after welding activities had been completed during the previous refueling outage in 1985.

Summary

On the basis of an audit of chemistry data taken during the last year the inspector considered that the licensee had maintained good control of secondary water chemistry. Likewise, the most recent inspection of steam generators in both units had shown that the integrity of the tubes (i.e., the primary coolant pressure boundary) had not been degraded. Finally, the amount of sludge taken from each steam generator during sludge lancing had continued to decrease; thus indicating oxidation of the carbon steel pipe, especially in the steam lines, had been reduced. The steam generators still were contaminated with sulfate and chloride, as revealed from hideout return; however, the licensee had revised its operating procedures to facilitate reduction of the concentrations of these contaminants by means of blowdown.

b. Adequacy of the Licensee's Water Chemistry Program

During this inspection the inspector focused on three elements of the licensee's chemistry program: staffing and training; installation of new inline analytical instrumentation; and the licensee's efforts to upgrade its quality assurance program.

(1) Staffing and Training

The Surry chemistry staff consisted of 20 people headed by a supervisor and two laboratory foremen. (The inspector was informed that ~8 additional personnel were to be added during the next year.) Twelve chemistry technicians, divided into six two-person shifts were manning the primary and secondary laboratories around the clock. Two staff chemists were providing support, particularly in relation to the operation and maintenance of instrumentation.

The inspector was informed that a new corporate training program had gone into effect on September 2, 1986, and would increase the amount of classroom training and retraining. A total of 117 job performance modules (JPMs) had been designed for chemistry technicians, and a two-year period for qualification of all technicians in these JPMs had been established.

The inspector interviewed several experienced technicians as well as several technicians who had less than one-year experience, other than academic training. The "buddy" system was being used to maximize on-the-job-training during each two-person shift while additional training was being provided when the less experienced technician was acting as a day shift supernumeray.

As discussed below, the chemistry staff will soon perform most of the analyses required for chemistry control, as well as for diagnosis of abnormal or unusual events or trends, by means of inline, computer-controlled, highly sensitive, analytical instrumentation. Until recently the chemistry staff had minimal experience with most of the new inline monitors or with the inline ion chromatographic system. Consequently, the inspector considered that a significant amount of training and qualification would be required to convert the current chemistry control program to a surveillance program that will be based on the new instrumentation.

The inspector observed that one of the staff chemists was devoting most of his time to the installation of the first of two new inline ion chromatographs and the associated computerized control and data management systems. Since the inspector's last site visit other members of the chemistry staff had been qualified on similar "bench-top" ion & chromatographs that were being used to analyze "grab samples" for several key chemistry variables.

(2) Inline analytical instrumentations.

As noted above, the licensee was installing two type of inline analytical instrumentation. One system consisted of inline analyzers for seven key chemistry parameters in the secondary water chemistry cycle (namely, specific conductivity, cation conductivity, dissolved oxygen, pH, hydrazine, sodium, and chloride). This system was being installed as part of a new steam generator protection maintenance program which has resulted in increased involvement of Westinghouse resources and personnel with chemistry control at Surry. New lines from six sampling points had been installed in Unit 1 during the last refueling outage of this unit, and the associated sampling panel will be installed within the next year. Similarly, installation of sample lines for Unit 2 is scheduled for the upcoming refueling outage.

Although other chemistry parameters (such as ammonia, sulfate, total organic carbon, copper, iron, calcium, and magnesium) would continue to be monitored by means of grab samples, the inline, continuous monitoring of the principal chemical species, required for control purposes, should significantly enhance the licensee's capability to prevent corrosion of the steam generator. The inline monitors will have readout displays at six locations in the plant, and instrumentation for the most important parameters will have alarms for expediting corrective actions if their pre-set limits are exceeded.

In addition to the inline instrumentation that was being installed for control purposes, the licensee had also installed the first of two inline, computer-controlled ion chromatographs to enhance the capability to diagnose or predict abnormal chemistry conditions. This ion chromatograph was connected to new sampling lines that had already been installed in Unit 1 (and will also be connected to similar lines in Unit 2). The other ion chromatograph will be connected to the primary coolant systems in both units.

By means of the inline chromatograph certain chemical species (at present only anions and monovalent cations are being investigated) were being detected at levels (~0.01 ppb) even lower than achievable with the bench-top ion chromatographs that have been in use at Surry for the last two years. Consequently, the licensee was using the new instrument to analyze the effluents of the condensate polishers in an effort to established, very accurately, the efficiency of the polishers and the purity of the feedwater. The inspector questioned licensee personnel as to the reliability of this system and the degree of quality control that could be established. The response was that until these matters had been studied in greater detail, the data that were being acquired by the inline ion chromatograph would be used for diagnostic and trending purposes only rather than being considered as absolute concentrations.

Considerable work (including the construction of new laboratories) and testing still needed to be completed before these two inline analytical systems would be considered operable. However, these activities had already progressed to the extent that the inspector recognized that the licensee was moving to a much higher level of analytical capability than has been available at nuclear power plants. As a consequence, the inspector discussed with chemistry supervision and plant management the need for further review of, and possible changes in, such elements of the chemistry program as staffing, training, data interpretation and application, and quality control. During these discussions the licensee raised several possibilities for using the enhanced capabilities of the new instrumentation for extending the goals of the SGOG guideline and for achieving greater comprehension of corrosion phenomena. The inspector will follow the installation and utilization of these inline systems.

(3) Quality Control

The inspector reviewed the licensee's quality control program that had been upgraded during the past year. Through discussions and an audit of control charts the inspector established that an adequate level of control was being maintained through calibration of chemistry instruments and verification of analytical results. In addition to an in-house control program using standards and "spiked" samples, the Surry QA program involved the analysis of samples that were prepared by the corporate laboratory and also participation in "round-robin" analyses with the North Anna laboratory.

(4) Audit of Chemistry Control

Through an audit of the licensee's chemistry logs and graphical presentations the inspector established that the surveillances required by Technical Specifications had been performed and all requirements and limits had been met. Similarly, the two units had been operated consistently within the limits that have been recommended by the SGOG and endorsed in the licensee's chemistry procedures. Appropriate corrective actions had been taken whenever chemistry action levels had been exceeded and when proposed power changes were not consistent with the quality of feedwater of steam generator water.

The inspector reviewed several reports that were being provided to the licensee on a monthly frequency by Westinghouse. These reports consisted of evaluations of data that had been provided by the licensee and served as an independent assessment of chemistry communication between the licensee and Westinghouse had been initiated as part of the cooperative steam generator protective maintenance program.

During this inspection no violations or deviations were identified.