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

Report No.: 50-413/84-48

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

Docket No.: 50-413 License No.: CPPR-116

Facility Name: Catawba Unit 1

Inspection Date: April 30 - May 4, 1984

Inspection at Catawba site near Rock Hill, South Carolina

Inspector: J. P. Blake for W. J. Ross — 5/17/84 Date Signed

Approved by: J. P. Blake — 5/17/84 Date Signed
J. P. Blake, Section Chief
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope: This routine, unannounced inspection involved 42 inspector-hours on site in the areas of plant chemistry and IE Bulletin Closeout.

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

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*J. W. Cox, Technical Services Superintendent
*R. H. Charest, Plant Chemist
A. Nietering, Staff Chemist
T. Jackson, Staff Chemist
L. Evans, Power Chemistry Coordinator
D. Bain, Primary Chemistry Supervisor
J. Canfield, Secondary Chemistry Supervisor
W. Scruggs, Operations Staff Support Engineer
C. Wray, Operations
*P. Leroy, Licensing Engineer

Other licensee employees contact included four technicians and two operators.

Other Organization

W. Hicks, Westinghouse

*Attended exit interview.

2. Exit Interview

The inspection scope and findings were summarized on May 4, 1984, with those persons indicated in paragraph 1 above. The licensee acknowledged the inspection results with no dissenting comments.

Inspector Followup Item 50-413/84-48-01, "Review of Water Chemistry Program" (Section 5.b).

Inspector Followup Item 50-413/84-48-02, "Display of Chemical Parameters on the Control Board" (Section 5.b).

3. Licensee Action on Previous Enforcement Matters

Not Inspected.

4. Unresolved Items

Unresolved items were not identified during this inspection.

5. Plant Water Chemistry (92706)

This inspection consisted of the following interrelated efforts:

- Assessment of the capability of the major components of the secondary water cycle to protect the primary pressure boundary by ensuring the absence of corrosive environments in the steam generator,
- Assessment of the adequacy of the licensee's water chemistry program to monitor the quality of water in the primary and secondary water systems, and
- Assessment of the ability of the licensee to control the quality of water in the plant through implementation of the water chemistry program.

a. Assessment of the Design of Components in the Secondary Water System

At the time of this inspection, the licensee had completed the hot functional tests on Unit 1 and was anticipating loading fuel within a few weeks and being operational in approximately one year. During this interim period, the four steam generators are in wet lay-up, the condensate-feedwater pipes are drained, and the condenser hotwell is partially filled with water. The inspector compared the "as-built" secondary water system with the description that is in the Final Safety Analysis Report (FSAR), especially Section 10.3 "Main Steam Supply System," and interviewed cognizant plant personnel to determine what efforts had been made to maximize the effectiveness of the following components of the secondary water system:

(1) Main Condenser

Catawba Unit 1 will transfer waste heat energy through a condenser to a closed-cycle cooling system that uses water from the Catawba River (Lake Wylie) to replace water lost through evaporation from three mechanical-draft cooling towers. Historically, the main condenser has been the principal path of air and water inleakage and contamination of the condensate of feedwater, and thereby, the source of impurities that form corrosive environments in the steam generator and in the low pressure turbines. The inspector established that the concentrations of cations (especially sodium) and anions (especially chloride and sulfate) in the water from Lake Wylie are relatively high in comparison to the cooling water used at other Duke stations and are concentrated further in the closed-cycle system. This water also contains asiatic clams which are known to foul systems that contain raw cooling water.

The licensee is protecting the integrity of the condenser tubes (304 stainless steel) by adding sulfuric acid (continuously) and sodium hypochlorite (periodically to chlorinate bio-organisms) and also by the use of an Amertap cleaning system. Additional protection is provided to safety-related systems, and certain sampling systems, that are cooled by lake water by placing a closed-cycle cooling system between the raw cooling water and the heat exchangers of the systems to be protected. The quality of the demineralized water in the closed-cycle loops is monitored and controlled as part of the licensee's water chemistry program.

The leak-tightness of the condenser, hotwell, and hotwell pumps is established by continuously monitoring the condensate for pH, specific conductivity, dissolved oxygen and sodium and by determining silica on a weekly frequency during power operation.

The inspector verified that the licensee was aware of the relatively poor quality of the circulating cooling water and the potential for loading the condensate polishers and subsequently, corroding the steam generator tubes if ingress of this water is not maintained essentially at zero level. The use of condenser tubes that are fabricated from stainless steel rather than from copper alloys should decrease the possibility of tube leaks as well as eliminate the presence of copper in the condensate and eventually, in steam generator sludge. The inspector informed the licensee that inleakage of air through the hotwell pumps and turbine gland seals had been observed in other PWRs and these paths should be considered as potential sources of inleakage at Catawba also.

The inspector considered the design of the condenser and the licensee's proposed monitoring program to be acceptable protection against contamination of the condensate.

(2) Condensate Makeup Water

A second potential source of contamination of the condensate is the water added to the condensate as makeup. At Catawba, the source of this makeup water is also Lake Wylie. The lake water is first chlorinated (with chloride gas) and then purified in a water treatment plant by passage through a sand filter, an activated carbon bed, and a mixed-bed demineralizer. The product is either transferred to the plant drinking water supply, to the condensate makeup system, or is deaerated and transferred to the reactor water makeup tank. The water treatment plant will produce 475 gpm and its efficiency is monitored after each step. The demineralized water produced for the secondary system is pumped to either one of four tanks in the turbine building for use as condensate makeup or as the source of auxiliary feedwater. All water that is used for

condensate makeup is pumped from the Upper Dome Storage Tank and undergoes deaeration as it is transferred to the condenser hotwell. Likewise, water to be used for auxiliary feedwater is pumped to a 15,000 gallon tank on the roof where it is deaerated continuously.

The inspector observed that the proposed specifications for water in the Condensate Storage Tank (in Chemical Procedure CP.O.B/8800/05, Encl. 6.3) differ numerically from those listed for "makeup water" in Section 10.3.5.2 of the FSAR and are more stringent than the FSAR values. The inspector concluded that the licensee's makeup water system will provide acceptable safeguards against contamination of the condensate feedwater.

(3) Condensate Polisher Demineralizers

The licensee has committed (in FSAR Section 10.3.5.2.3) to use blowdown and polishers to meet (as a minimum) the criteria for feedwater and steam generator water that have been developed by the Steam Generator Owners Group and the Electric Power Research Institute (SGOG/EPRI) for plants with recirculating steam generators. Catawba Unit 1 has a full-flow condensate polishing system, manufactured by the DeLaval Corporation, that consists of five cells, a precoat system, and two tanks for processing used resin. Actually, 100% flow cleanup is considered possible with only four cells, thereby allowing one cell to be held ready as a replacement for a cell that becomes spent, as determined from measurement of the cation conductively of the effluent or the differential pressure of the cell. A mixture of cation (hydrogen or ammonium form) resin and anion (hydroxyl) resin is used to coat the cell units and the licensee plans to allow a new coat to age for at least 24 hours so that a firm filter/demineralizer coat will be established before the cell is put on line. The licensee advised the inspector that several problems with these polishers had been identified, i.e., leaking cells, large holes in the stainless steel mesh of some units, inefficient resin strainers and strainer back-wash process, and useful cell lives of less than one week. The licensee plans to monitor the effectiveness of the polishing system by continuously measuring the conductivity of the ineffluent and effluent for each cell and for the total system as well as continuously determining sodium in the system effluent and measuring silica once a shift and

solids once a day. This monitoring program is considered acceptable for determining the efficiency of the demineralizer resins. The licensee is also aware of the potential for corrosive environments in the system generator if resin particles leak through the resin traps. Consequently, samples of feedwater will be analyzed periodically at the corporate training site for sulfate by means of an ion chromatograph to establish if breakthrough and leakage of resin is occurring.

(4) Chemical Treatment of Condensate/Feedwater

The inspector established that the licensee is adding hydrazine and ammonia to the effluent of the demineralizers to control dissolved oxygen and pH during plant operation as described in Section 10.3.5.2 of the FSAR. These chemicals are also added when the plant is in wet lay-up.

(5) Feedwater Lines

The purified effluent from the condensate polishers is pumped through the low-pressure and high-pressure feedwater heaters before it enters the steam generators. The inspector established that the licensee was taking steps to prevent contamination of the feedwater during this stage by performing pre-operational cleanups of the main feedwater lines, the steam lines that carry extraction steam to the feedwater heaters, and the drain lines from the high-pressure feedwater heaters (and moisture separator reheaters) that feed back into the feedwater line. This action complements the "short cycle" cleanup of the condensate lines from the hotwell to the low-pressure feedwater heaters and assures that the desired quality of feedwater is achieved before feedwater is pumped into the steam generators when the plant is returning to power after an outage.

During power operation, the feedwater is continuously analyzed for pH, specific and cation conductively, dissolved oxygen and hydrazine; silica is determined each shift; and iron, copper, and ammonia are monitored weekly. (Copper is monitored because the moisture separator reheater has tubes fabricated from 90/10 Cu-Ni alloy and could be the source of soluble copper or copper oxide that might be transported to the steam generators by means of the heater drain.)

(6) Steam Generators

Catawba Unit 1 is equipped with four Model D-3 steam generators that have been modified to improve flow characteristics of the feedwater and to increase the blowdown capability. (The licensee informed the inspector that the steam generators being installed in Catawba Unit 2 had been modified further through use of more corrosive resistant structural material and with quadrafoil openings in the tube support plates to improve flow through the tube bundles and to minimize deposition of sludge against the tubes.) The hot functional tests that were completed during November-December 1983 were extended so that an acceptable film of corrosion resistant iron oxide (black magnetite) could be formed on the interior carbon steel surfaces of the steam generators.

The licensee plans to operate all steam generators with continual blowdown close to the maximum rate of approximately 60,000 lbs/hr/generator to control the purity of water in the steam generators. Blowdown will be cycled through a cleanup system (filter and demineralizer bed) back to the hotwell. The quality of this water will be monitored as it is discharged from the steam generators and in the influent and effluent of the cleanup demineralizer to ensure that it will not contaminate the water in the hotwell.

(7) Moisture Separator Reheaters

As discussed above, these heaters are the only components of the secondary water system that contain copper. To insure that copper is not transported to the steam generator through heater drains, the Catawba Water Chemistry Program places a limit of <2 parts per billion (2 ppb) on the copper concentration in the feedwater and <5 ppb in the heater drain tank.

(8) Turbine

Catawba Unit 1 uses main turbines that were built by General Electric Corporation. The inspector verified that the licensee was aware that the vendors of low-pressure turbines are currently investigating the causes of stress corrosion cracks that have been observed in the keyway and bore regions of these turbines. Although neither the initiation nor propagation of this type of crack has been attributed to chemical causes, the vendors emphasize the necessity for maintaining the quality of steam and condensate at a high level. The inspector observed that the licensee plans to monitor the steam from each steam generator for pH, specific conductivity, sodium, and ammonia on a weekly frequency.

(9) Summary

The licensee has used knowledge gained from the design and operation of the two McGuire units to design Catawba Unit 1. The inspector also used the results of his inspection of the McGuire units (Reports 50-369/84-01 and 50-370/84-01) to assess the capability of the licensee to maintain high quality water in the steam generator of Catawba Unit 1. The most significant differences between the two stations appear to be:

(1) The quality of the circulating cooling water at Catawba is poorer than at McGuire; consequently, water inleakage at Catawba will be a greater load on the condensate polishers.

(2) Catawba recycles blowdown to the hotwell while McGuire rejects blowdown as waste. The recycled blowdown water at Catawba is cleaned up by means of a filter and demineralizer bed, so that the quality of water in the hotwell is not reduced.

(3) Catawba will use four condensate polishers for 100% flow while McGuire uses 2 or 3 or this purpose.

The inspector also established, through interviews of cognizant plant personnel, that the licensee had taken the following steps to prevent the formation of unstable iron oxide on carbon steel surfaces that might subsequently be transported to the steam generators and form corrosive sludge environments on the steam generator tubes:

(a) The condensate/feedwater pipe had been cleaned with hot alkaline solution, washed with demineralized water, and flushed with hot demineralized water in order to minimize the formation of red iron oxide (hematite) while a passifying film of black iron oxide (magnetite) was being formed on the interior surfaces of these pipes.

(b) Subsequent wet lay-ups were performed with excessive concentrations of hydrazine in the lay-up water to prevent further oxidation processes.

(c) An atmosphere of nitrogen is maintained over the water in the steam generator during wet lay-ups.

(d) The steam generators have been lanced to remove very small amounts of debris, and the steam generator tubes have been verified to have a metallic luster with no evidence of iron oxide sludge.

The inspector considers that the licensee has taken appropriate action through design of the secondary system and preoperational preparation and tests to maintain a high quality of water in the four steam generators. The inspector did not observe any discrepancies between the "as-built" plant and the description in the FSAR.

b. Water Chemistry Program

Technical Specifications (TS) 3/4 4.7, 4.1.2.5 and 4.1.2.6 for Catawba Unit 1 set specifications on allowable concentrations of chloride, fluoride, oxygen, and boron in the primary (reactor) coolant and also specify the frequency for monitoring these chemical parameters. Section 6.3.4.c of these TS requires the licensee to implement a Secondary Water Chemistry Program as follows:

"A program for monitoring of secondary water chemistry to inhibit steam generator tube degradation. This program shall include:

1) Identification of a sampling schedule for the critical variables and control points for these variables,

2) Identification of the procedures used to measure the values of the critical variables,

3) Identification of process sampling points, which shall include monitoring the discharge of the condensate pumps for evidence of condenser in-leakage,

4) Procedures for the recording and management of data,

5) Procedures defining corrective actions for all off-control point chemistry conditions, and

6) A procedure identifying: (a) the authority responsible for the interpretation of the data, and (b) the sequence and timing of administrative events required to initiate corrective action."

The inspector observed that the development of a Water Chemistry Program that will meet the TS requirements and will provide the necessary surveillance and control of the secondary water system had not been completed at the time of this inspection. The licensee confirmed that the Catawba Water Chemistry Program would based on the SGOG/EPRI guidelines and on the water chemistry programs used at other Duke nuclear power plants. A preliminary assessment of the licensee's efforts to date is provided below.

(1) The equivalent of a "Chemistry Manual" has been developed in the form of eleven series of Chemistry Procedures that encompass actions related to Power Chemistry, Radiochemistry, and Radwaste Management. The 8800 Series is titled "Miscellaneous Chemical Procedures" and, among other guidance, provides specific information for the following actions that are required by the TS:

- Establishes key parameters and sample points to be monitored when the plant is in wet lay-up, hot standby, and power operation modes
- Establishes sampling frequencies for these key parameters
- Provides for calibrations and quality control
- Provides guidance for recording and managing data
- Provides guidance for corrective action to be taken when a limit is exceeded. This guidance is based on the action levels in the SGOG/EPRI guidelines.

The 8100 Series is composed of 56 specific procedures for determining key chemical variables by various analytical chemistry techniques. The 8700 Series, as well as specific procedures, in the series of chemistry operating procedures, provides instructions for taking grab samples from process streams in the primary and secondary water systems.

These procedures were developed for use during the hot functional tests in 1983 and are now being reviewed and revised for use during plant operation. The inspector did not identify documentation of guidance or instructions for developing new chemical procedures or revising procedures after plant operation has begun. Also, the inspector did not identify guidelines for training and retraining analysts and technicians.

(2) The licensee has established a Chemistry Section under the direction of a Station Chemist. All activities related to the primary and secondary water systems are performed under the supervision of the Power Chemistry Coordinator and either the Primary or Secondary Supervisor. The inspector reviewed the qualifications for a Chemistry Specialist and for three levels of Chemistry Technicians as defined by Task Inventories that are to be fulfilled in an on-the-job training program that follows a general six months indoctrination program at the Duke Training Center. The inspector did not confirm if the licensee has established minimum qualifications for chemistry technicians or for supervisory personnel.

(3) The licensee has state-of-the-art sampling and laboratory facilities. A closed-cycle cooling system has been installed in a "Hot Laboratory" and is dedicated to cooling only samples from the primary coolant so that the Component Cooling Water System may be used for other purposes. There are sampling taps in the Hot Laboratory for liquids and gases from approximately 30 sampling points in the Reactor Coolant System, Volume Control System, and the Spent Fuel Pool as well as tapse for samples from the upper shell and blowdown of all four steam generators. Other points in the primary side can be sampled locally. Operating Procedure OP/0/A/6200-11 has been developed to provide instructions for sampling systems inside or outside containment which require notification of the Operations Department. Primary samples are analyzed in separate "wet chemistry" or instrument laboratories. All radioactive samples are counted in a separate counting room by Health Physics technicians.

Sample lines from all of the key points of the secondary water system are routed to the Secondary Laboratory and connected, either directly or through a patch panel, to grab sample taps and to inline analytical and display instrumentation. This system also includes extensions of sample lines from the steam generator that are isolated and sampled in the Hot Laboratory in case of a primary to secondary leak that makes these samples radioactive.

The inspector was informed that the Secondary Laboratory is to be expanded so that additional sampling panels and in-line instrumentation can be installed to monitor the main steam lines and the steam generator blowdown cleanup system.

Summary

Inasmuch as the licensee has not completely developed all of the elements of the Catawba Water Chemistry Program, an assessment of this program will be deferred until a later inspection and is designated as Inspector Followup Item 50-413/84-48-01, "Review of Water Chemistry Program." The inspector's initial impression is that the licensee is taking advantage of guidance from several sources to develop an effective program for the surveillance and control of the chemistry involved in the primary and secondary coolant systems. Through the use of a relatively large member of sample points and in-line analysis and display systems, the Chemistry Section will have the capability to quickly identify off-normal chemistry conditions and to take the actions to be defined in Chemistry Procedure CP/0/B/8800/04 "Chemistry Procedure for Corrective Action." The inspector was informed that the control room operators will depend on the Secondary Chemist to identify parameters as being "Out of Specification." Subsequently, the control room operators will take actions to "identify AND correct the cause of any Out of Specification Secondary Parameters AND to minimize steam generator corrosion" as specified in proposed procedure AP/0/A/5500/34 "Secondary Chemistry Out of Specification." The inspector observed that the only direct indication available in the control room that a chemistry parameter is out of specification is an alarm panel that activates when there is an unspecified "problem associated with the condenser polisher."

The inspector discussed the application of these corrective actions which personnel from both the Chemistry Section and Operations Division and emphasized the responsibility of Chemistry personnel, especially those on back shifts, to alert the control room in a timely manner to initiate the appropriate level of action required by procedure AP/0/A/5500/34.

The inspector also established that the Control Board for Unit 1 has a display capability for a computerized data base of chemical parameters. This data base can be updated whenever new information is provided by the Chemistry Section and used to call up the most current values of selected parameters. The inspector did not establish how the licensee planned to use this capability or what procedures would be used to insure that the data are current. Pending completion of pre-licensing activities, the inspector will defer further review of this data base and designate this action as Inspector Followup Item 50-413/84-48-02 "Display of Chemical Parameters on the Control Board."

The inspector considers that all actions being taken by the licensee are contributing to the development of an effective surveillance and control program. The final product will be evaluated in greater depth during a future inspection.

6. IE Bulletin Closeout

By letter dated May 13, 1983, the NRC Office of Inspection and Enforcement issued Bulletin No. 83-05 to the licensee. This Bulletin apprised the licensee of allegations related to certain pumps being manufactured by the Hayward Tyler Pump Company and requested that the licensee take action to resolve this issue.

In its response letter dated July 29, 1983, the licensee declared that there are no Hayward Tyler pumps or spare parts at Catawba. Consequently, since this Bulletin is not applicable to Catawba, it is hereby closed.