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

Report No.: 50-413/85-36

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

Docket No.: 50-413 License No.: NPF-35

Facility Name: Catawba Unit 2

Inspection Conducted: August 5-9, 1985

Inspector: [signature] 8/26/85
for W. J. Ross Date Signed

Approved by: [signature] 8/26/85
J. J. Blake, Section Chief Date Signed
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope: This routine, unannounced inspection involved 36 inspector-hours on site in the areas of plant chemistry and inservice inspection of pumps and valves.

Results: No violations or deviations were identified.

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REPORT DETAILS

1. Persons Contacted

   Licensee Employees

   *J. W. Hampton, Station Manager
   *J. W. Cox, Technical Services Superintendent
   *R. H. Charest, Station Chemist
   C. Bolin, Chemistry Supervisor
   L. Evans, Power Chemistry Coordinator
   E. Heck, Staff Chemist
   M. Kowalewski, Staff Chemist
   B. McNeill, Staff Chemist
   *Z. Taylor, Test Engineer
   C. Therrien, Chemistry Supervisor

   Other licensee employees contacted included chemistry technicians.

   NRC Resident Inspectors

   *P. H. Skinner
   P. K. VanDoorn

   *Attended exit interview

2. Exit Interview

   The inspection scope and findings were summarized on August 9, 1985, with those persons indicated in paragraph 1 above. The inspector described the areas inspected and discussed the inspection findings. No dissenting comments were received from the licensee.

   (Closed) Inspector Followup Item 50-413/84-48-01, Review of Water Chemistry Program (Paragraph 5.b(4)).

   (Closed) Inspector Followup Item 50-413/85-11-09, Inservice Testing (IST) Scheduling Procedure (Paragraph 6.c)

   (Closed) Inspector Followup Item 50-413/85-11-10, IST Summary Station List (Paragraph 6.d).

   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 the inspection.

5. Plant Chemistry (79501 and 79502)

   As a result of its continuing concern for steam generator tube integrity, the NRC staff has recently issued recommended actions and review guidelines that are 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 Generators 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."
   >
   > <u>Reference</u>
   >
   > 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 met during previous inspections of Catawba Unit 1 (see Inspection Reports 84-48 and 84-101, dated May 23, 1984, November 19, 1984). However, at the time of these earlier inspections Unit 1 had not become operational, and the licensee had not fully developed the capability to implement all requirements of the water chemistry program. This situation was designated for further evaluation as Inspection Followup Item 50-413/84-48-01, Review of Water Chemistry Program.

This followup inspection consisted of a reassessment of the licensee's activities during startup of Unit 1 with special emphasis on those problems in plant design and chemistry control that had previously been identified.

a. Plant Design and Operation

(1) General

Unit 1 achieved criticality in January 1985 and began commercial operation on June 29, 1985. Subsequently, this unit has been operating at full power except during a one-day steam-dump test on July 11 and during a three-day outage (July 28-31) caused by failure of condenser tubes. The inspector observed that chemistry control parameters were out of limits periodically during the power ascension tests in March 1985; however, the quality of the secondary coolant has been consistently high, except during the July outage, since final power tests were begun on June 12.

(2) Main Condenser

The condenser tube leaks on July 28 and July 31 highlighted both the principal pathway of potentially corrosive contaminants into the secondary water cycle and the licensee's capability to protect the primary coolant pressure boundary (i.e., the steam generator tubes) from corrosive attack by these contaminants. The first leak was attributed to a rapid rupture of a condenser tube as the result of mechanical failure or missile damage, and the second leak is thought to have been the result of fatigue cracking. Contamination of the secondary water system during the first incident was magnified because the leak occurred while the quality of the closed-cycle condenser cooling water was degraded because the cooling-tower blowdown system was inoperable. The quality of the cooling water had been restored to the equivalence of Lake Wylie makeup water before the second tube leak occurred. However, the quality of Lake Wylie water is considered to be poor relative to the condenser cooling water used at other inland nuclear power plants in this area of the country.

Because of the design of the three sections of the Unit 1 hotwells (i.e., Sections B and C drain into Section A and then into a common discharge header) the licensee did not immediately identify the first failed tube. Inleakage was stopped by isolating the

cooling water line (one of two) from the cooling tower sump that supplied the affected condenser. The second failure occurred in the same condenser. Subsequently, the licensee plugged a total of 427 condenser tubes in the vicinity of the two failed tubes as a preventive measure until the condenser can be inspected.

These two leaks were not considered to have been caused by chemical corrosion. However, the licensee has already replaced the 304 stainless steel tubes in the Unit 2 condensers with 316 stainless steel tubes. This action was taken after degradation of seam welds had been observed and attributed to microbiologically induced corrosion of these welds in sections of 304 stainless steel pipes that held stagnant condenser cooling water.

The inspector also noted that air inleakage into the condenser hotwell had been high (50-60 SCFM) during the first month of commercial operation. Inasmuch as the concentration of dissolved oxygen in the condensate water remained <5 ppb during this period, it is evident that the air leaks are above the water line. The licensee informed the inspector that, to date, lack of resources has prevented a thorough leak detection program from being initiated. However, the licensee is aware of the possible correlation between air inleakage and stress corrosion cracking of low-pressure turbine disks and blades.

(3) Condensate Cleanup System

The licensee has continued to have problems with the DeLaval filter/dimineralizer system that provides condensate polishing and protection from condenser coolant inleakage. Leakage of resin through the filter cells continues even though all cells were 'bubble-tested' to ensure the integrity of the steel mesh and weld seams. Likewise, there has been leakage of resin through the resin catcher (downstream of the filter/demineralizers) as the result of loss of integrity of the wire mesh screen in the resin catcher.

In an effort to minimize or prevent transport of ion exchange resin to the steam generator, and subsequent formation of free sulfate ions through thermal decomposition of the resin, two actions have been taken. First, two different types of filter/demineralizer tubes are being investigated as a substitute for the DeLaval tubes. Both of these new tubes are considered to provide greater integrity and reduced potential for the formation of holes in the wire mesh. One complete bundle of new tubes is currently in use. Inasmuch as the quality of feedwater, during commercial operation, has significantly exceeded the licensee's criteria, the licensee had begun bypassing some of the filter/demineralizer cells while passing full flow (~4000 gpm) through the remaining bundles. There has not been any measurable degradation in the quality of feedwater.

The two condenser tube leaks afforded an opportunity to evaluate the degree of protection these filter demineralizers afford against rapid and slow ingress of corrosive ions and as a cleanup system to restore the desired quality of feedwater. A review of the recorder traces in the licensee's secondary chemistry laboratory revealed that the cation conductivity of the steam generator water was >10 umhos/cm fifteen minutes after the first tube ruptured. This parameter peaked at ~75 umhos/cm (sodium was >400 ppb and chloride >100 ppb). Even though the leak was isolated and the filter/demineralizers were precoated or overlayed as rapidly as possible, the cation conductivity of the feedwater steadily increased to >10 umhos/cm approximately four hours after the rupture. These data indicate that the filter/demineralizers were quickly loaded after the rupture occurred. Through continual replacement of the saturated resin bundles and use of maximum steam generator blowdown (~135 gpm), the conductivity of the feedwater was decreased to 0.8 umho/cm within 16 hours and the cation conductivity of the steam generator water to less than the action Level I limit (0.8 umho/cm) in about 24 hours. In comparison, the second tube failure caused the cation conductivity in the steam generator blowdown to increase only to 2.6 umho/cm (sodium increased to 300 ppb). These relatively low valves apparently were maintained because the demineralizers were not saturated until six hours after the leak occurred, and the licensee was able to rapidly recover the desired purity through blowdown and recoating of the filter/demineralizers. Also the concentrations of impurities in the condenser cooling water during the second tube leak were only ~10 percent of those during the first tube leak.

(4) Steam Generator Blowdown System

The blowdown system for Unit 1 was designed for a maximum capacity of ~160 gpm. In order to accommodate the limits of the blowdown recovery system the licensee restricts the blowdown to ~135 gpm. This system has been used effectively to supplement the cyclic startup cleanup procedure (blowdown is wasted until specified levels for silicon and cation conductivity in the generator water are achieved) and, subsequently, to maintain the desired quality of steam generator water. The rapidity with which recovery from the two condenser tube leaks was achieved is indicative of the cleanup attained by such a high blowdown rate.

The licensee's capability to purify and recover blowdown water greatly minimizes the need for condensate makeup and, thereby, reduces further the probability that the feedwater will be contaminated.

The licensee's operating procedures do not include a chemistry hold on power ascension during startup to assure that the feedwater remains within the limits set for >5 percent power level. However, limits have been set for several control parameters in the steam generator blowdown for both heat-up (Modes 2, 3, and 4) and power operation. Similarly, these procedures do not, as yet, call for a chemistry hold during cooldown to allow solubilized 'hideout return' to be removed from the steam generator by means of blowdown. However, the inspector was informed that the value of chemistry holds will be reviewed further when the capability for monitoring sulfate is improved with an ion-chromatograph.

(5) Moisture Separator Reheater (MSR)

The tubes in the MSR are the only components in the secondary water system that are fabricated from a copper alloy. Consequently, copper transport is monitored on a weekly schedule in the following systems: polisher effluent, feedwater, C heater drains, and blowdown demineralizer influent and effluent.

(6) Summary

During the first weeks of commercial operation the main condenser and the condensate cleanup system have been sources of contamination of feedwater and steam generator water. As long as the quality of condenser cooling water remains relatively poor and the integrity of the tubes in the main condenser remains subject to serious and rapid degradation the licensee is dependent primarily on the large capacity blowdown to provide protection to the steam generator. In the absence of water inleakage, the secondary coolant has been brought to, and maintained at, a quality significantly better than specified in the licensee's water chemistry program. Although the inleakage of air is excessive, no detrimental effect has been observed to date; however, the potential for initiating stress corrosion cracks in the low-pressure turbine is considered by the turbine vendor to be much greater than in the absence of air inleakage.

b. Water Chemistry Control and Surveillance

(1) Primary Water Control

The licensee has developed a program to meet the requirements of the Catawba Technical Specifications relative to control of chemistry in the reactor coolant. The inspector evaluated this program through discussions with cognizant chemistry personnel, observation of chemical analysis and radiochemical counting of primary water samples, and through review of the following procedures:

CP/0/A/8700/01 - Chemistry Procedure for Sampling Local Primary Sample Points

CP/0/A/6200/11 - Operating Procedure for the Primary Sampling System

CP/0/A/8800/05 - Chemistry Procedure for Recording and Management of Data

The inspector also audited the results of analyses that were performed since commercial operation began. All parameters were within the limits specified in the Technical Specifications.

(2) Environmental Chemistry

The inspector audited the official log for the quality of water in the cooling tower blowdown and found that, except during July 26-27, 1985, the specifications in Enclosure 6.13 of Procedure CP/0/A/8800/05 were met. During this period the impurities in the closed cycle cooling water increased approximately twelve fold (i.e., calcium concentration increased above the allowable limit of 100 ppm and specific conductivity increased to >1200 umhos/cm) as the result of isolation of blowdown of the cooling tower sump.

These values dropped to ~15 ppm and 175 umhos/cm on July 29 after blowdown had been restored and water from Lake Wylie again was being used to makeup water lost through steam and blowdown.

(3) Secondary Water Control

As reported previously, (Inspection Report 84-48) the licensee has endorsed the recommendations of the Steam Generator Owners Group (SGOG) and the Electric Power Research Institute (EPRI) for controlling the chemistry of Pressurized Water Reactors. The inspector reassessed the degree to which the administrative and technical guidelines developed by SGOG/EPRI were being implemented by the licensee.

All of the secondary chemistry procedures have been written to be consisted with the SGOG/EPRI guidelines. The inspector was informed that parts of some procedures (e.g., action statements) were being revised on the basis of lessons learned during the condenser tube failure incidents in July.

Staff turnover has been minimal since the last inspection; consequently, the on-the-job training program had been successfully continued in an effort to achieve a full level of qualification for all technicians. Considerable 'hands on' experience with

the condensate polishers had been achieved, so that the technicians are now more comfortable with this duty. The licensee has developed a program for rotating technicians through responsibilities in the primary, secondary, and environmental laboratories; however, this program has not been initiated. A new supervisor of the primary laboratory was assuming her new position during this inspection period. The licensee was continuing to delegate chemists from the chemistry support staff to the major problem areas (e.g., condensate polishing, instrument maintenance, post-accident sampling, secondary laboratory annex) as well as to responsibilities associated with hot functional tests for Unit 2.

All technicians work twelve-hour shifts, and their reactions to this schedule were mixed. The most frequent positive response was that such a schedule entails less time in travel and less days at work than does an eight-hour shift. The most frequent response on the negative side was that fatigue was greater. The inspector discussed this matter with plant management and was told that the licensee has had considerable experience with twelve-hour shifts and does not consider these longer shifts to be detrimental because 'days of rest' are more frequent. The inspector considers chemical technicians to be "key personnel" as described in the Catawba Technical Specifications in that they are responsible for identifying abnormal chemistry conditions and recommending appropriate and timely corrective action (as they did late on a Saturday night when the first condenser tube leak occurred). For this reason and because twelve-hour shifts are not commonly used in Region II, so that the human factor implications are not fully understood, the inspector believes that the technicians, especially in the secondary chemistry laboratory, should be frequently observed to ensure excessive fatigue does not occur, especially when these people assume additional field responsibilities related to Unit 2.

The licensee is currently constructing an annex to the secondary chemistry laboratory which will increase the capability for monitoring with inline instrumentation the main steam system, steam generator blowdown cleanup system, and the moisture separator reheater drain tanks.

Finally, through an audit of data logs, the inspector observed that key control chemical parameters in the secondary cycle had been maintained at levels significantly below the limits recommended by SGOG/EPRI and adopted as limits in Enclosure 6.10 of Procedure CP/0/A/8800/05. Inasmuch as the licensee has not yet installed an ion chromatograph, analyses for trace concentrations of diagnostic parameters, such as chloride and sulfate, are periodically performed in a corporate central laboratory. These analyses have indicated that ion-exchange resin beads leak into

the feedwater every time a freshly pre-coated polisher bundle is placed in operation. Results of these analyses also have indicated the presence of ppb concentrations of phosphate, nitrite, and bromide in the feedwater. The presence of these ions, as well as the periodic presence of copper, can not be explained by the licensee.

(4) Summary

The inspector considers that the licensee is effectively implementing the control and surveillance measures required to ensure protection of the primary and secondary water systems. The licensee's capabilities will be enhanced as training and experience are obtained with an operating plant and when additional laboratory facilities and analytical instrumentation become available. No violations or deviations related to regulatory requirements were identified during this part of the inspection.

On the basis of this inspection Inspector Followup Item 50-413/84-48-01, Review of Water Chemistry Program, is considered closed.

6. Inservice Testing (IST) of Pumps and Valves

The inspector addressed the following four Inspector Followup Items that had been opened during Inspection Number 50-413/85-11, March 26-29, 1985.

413/85-11-07, IST Code of Record
413/85-11-08, IST Plan Control
413/85-11-09, IST Scheduling Procedure
413/85-11-10, Summary Status List

These items relate to the licensee's program for implementing the requirements of Section XI of the ASME Code pertaining to inservice testing of pumps and valves.

a. Item 413/85-11-07 - The licensee had indicated that the Catawba IST program would be amended to reflect the required edition of the ASME Code (i.e., 80W81 edition). This action has not yet been taken. The inspector advised the licensee that this change should be made before the NRC review of the program and associated requests for relief from Code requirements has been completed and a Safety Evaluation Report issued on the basis of the 80W80 edition of the code.

b. Item 413/85-11-08 - The licensee had indicated earlier that a review of Revision 9 of the Catawba IST program would be made to determine if this document should have a listing of effective pages. The inspector was informed that such a listing would be incorporated in this document. Until this change is made this item remains open.

c. Item 413/85-95-11-09 - The licensee had previously indicated that a program for scheduling pump and valve tests was under development and would be completely operational before the start of commercial operation for Catawba Unit 1. The inspector observed that a computerized 'Weekly Operating Schedule' had been developed for all plant surveillance tests and was in use. It is the responsibility of the Performance Engineer to identify those tests that are to be performed by the Performance Group and ensure that the designated schedule is met. The schedule identifies the test by procedure, specific valve or pump, and the day for performing the test. Since the tests are then made by personnel in the Performance Group, this administrative procedure is considered acceptable and this item is closed.

d. Item 413/85-11-10 - Since the previous inspection the licensee has developed a computer-base listing that is being used to implement the Code requirement (IWP-6210 and IWV-6210) for maintaining Summary Status Lists. These lists identify each pump or valve, the procedure used for each test, and dates for previous tests and the next test. Finally, the listing identifies the status of the component. This listing is considered to fulfill the Code requirement and this item is closed.