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

Report No.: 50-261/88-24

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

Docket No.: 50-261 License No.: DPR-23

Facility Name: H. B. Robinson

Inspection Conducted: July 25-29, 1988

Inspector: R. H. Bernhard 9/1/88 Date Signed

Approved by: F. Jape, Chief 9/7/88 Date Signed
Test Programs Section
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope: This routine, announced inspection was in the areas of service water design verification and survey of current service water initiatives. Current system configuration and operation was compared to the design basis as described in the UFSAR. Plant programs to insure system operability were reviewed. A walkdown was performed to verify equipment condition. Interviews were held with plant personnel to discuss system history, current, and future plans.

Results: The plant has a high level of awareness of the possible problems associated with their service water system. A recent study and recommendations made in regard to chlorination discuss the history of H. R. Robinson's problems, the current technologies available to resolve the issues, and the measures necessary to implement the program.

The plant recently to assigned on-site engineers the responsibility for particular systems. This system engineer concept has worked well for service water. The system has been receiving a level of attention that would not have been present if items were worked only in response to trouble tickets.

The inspector identified potential deficiencies in the service water system with respect to the UFSAR design. One unresolved item (Reference: Section 3.0) was opened to examine the results of the timing of the closure signal to the turbine building service water isolation

8810040314 880920
PDR ADOCK 05000261
Q PDC

valves. When these valves remain open they would reduce the availability of water to safety-related loads for periods of time that exceed those currently in UFSAR. A second unresolved item (Reference: Section 4.0) was opened to assess the impact of the current throttle valve alignment and the controls for maintaining the alignment. The last system flow balance was performed over ten years ago and no direction has been given to operations on limits for controlling system throttle valves. An oral commitment was made with respect to this issue.

Three Inspector Followup Items (IFIs) were identified (Reference: Section 3.0). One identified an alarm setpoint in the control room for low flow to the containment air coolers at a value lower than the UFSAR value for design flow. Another is to verify that the new diesel loading study includes power values for containment air coolers, service water pumps and booster pumps that consider the higher than normal power requirements during accident conditions or due to the changing of throttle valve positions. The last inspector followup item is to verify operating limitations for low flow and runout operation of the service water and service after booster pumps are incorporated in analysis and procedures.

H. B. Robinson has a well developed program for identifying service water potential and actual problems. The study mentioned above was one of the most complete the inspector had seen on any previous inspection. The plants' response to problems once they are identified is average. The utility was very responsive to the inspectors questions and concerns. The future plans for the service water system include piping replacement and a chlorination system. If system monitoring is maintained at the current levels, a flow and heat balance is performed for the system, and the future plans actually implemented, the major service water concerns found currently in power plants will be addressed.

REPORT DETAILS

1. Persons Contacted

   Licensee Employees

   *R. D. Crook, Senior Specialist, Regulatory Compliance
   *J. A. Eddy, Jr., Environmental and Chemistry Supervisor
   *S. W. Farmer, System Engineer
   *W. J. Flanagan, Manager, Modifications Implementation
   *S. A. Griggs, Regulatory Compliance
   *E. M. Harris, Jr., Director, Onsite Nuclear Safety
   *R. E. Morgan, General Manager
   *R. M. Smith, Manager, Environmental and Radiation Control
   *H. S. Young, Director, QA and QC

   Other licensee employees contacted during this inspection included engineers, operators, security force members, technicians, and administrative personnel.

   NRC Resident Inspector

   *L. W. Garner

   *Attended exit interview

2. System Description And Inspection Overview

   The Service Water System at H. B. Robinson consists of four main service water pumps, two service water booster pumps and the associated system piping, valves and heat exchangers. The system's water source is Lake Robinson. The water is taken up by a combination of several of the four main pumps and delivered to a common header. The common header feeds two independent supply headers that go to the system loads. Isolation valves are available to split the common header and isolate flows to the independent loops.

   Both safety-related and nonsafety-related loads are cooled by service water. Isolation of the nonsafety-related loads is provided by the V6-16A, B, and C valves which close upon a Safety Injection (SI) signal with an accompanying bus undervoltage. Under accident conditions, with the nonsafety-related loads shed, service water is supplied to the Service Water Booster Pumps, which supply cooling water for the containment air recirculation (HVH1-4) coolers, the component cooling water heat exchanger, the auxiliary feedwater pump bearing coolers, the air compressor coolers, the auxiliary building heating and ventilation coolers, the emergency diesel generator coolers, and is available to supply water to the auxiliary feedwater pump as an emergency supply. The service water is discharged to a return header and eventually to the plant discharge canal, which returns after a several mile long journey back to Lake Robinson.

This inspection compared the existing system to the design requirements of the UFSAR. Past test results were reviewed, the most recent flow balance was reviewed, and current operating practices were examined. Interviews were conducted with the system engineer, an operations representative, and a chemistry representative. Past history, the current state, and future plans for the system were discussed. The system was walked down to determine equipment condition. A complete system walkdown had been performed within a month of this inspection by Resident Inspector. Details of the walkdown are available in NRC Inspection Report Number 50-261/88-16.

Microbiologically Influenced Corrosion (MIC) problems in the stainless steel piping inside containment were not examined during this inspection. This problem has been examined in Inspection Report Nos: 50-261/84-45, 84-48, 85-12, 85-22, 86-12, 87-03, 87-35, 88-03, and 88-12. Current plans include replacement of the effected piping inside containment.

The documents reviewed during this inspection are listed in Section 6.0 of this report.

3. Design Review

The system was compared to the UFSAR description and to the requirements of the sections of the UFSAR that described service water as a support system.

Section 6.2.2.2.2 of the UFSAR described the Containment Air Recirculation Cooling System. The HVH1-4 coolers are supplied service water on the tube side of the heat exchanger, and air flows across the other side. The service water has a design maximum cooling water temperature of 95°F for the UFSAR DBA analysis.

The inspector determined records of service water temperature were not maintained prior to the inspection. Condenser circulating water temperatures are recorded daily. The service water, Unit 2 circulating water and Unit 1 circulating water intakes are located near each other on the lake. Circulating water for Unit 2, due to the large water flows, receives a mix of water from the surface and subsurface of the lake. Examination of the 1986 annual environmental report showed temperature stratification in the vicinity of the intake. The temperature at the bottom of the lake can be up to 5-6°C (9°F) lower than the lake's surface temperature. Therefore, since service water receives most of its water from lower lake elevations, the circulating water temperature should bound service water temperature.

Initial indications were that circulating water temperature had exceeded 95°F in 1986. Followup evaluations performed by the licensee indicated that the maximum circulating water temperature recorded by the performance monitoring group at the plant was 93.8°F in 1986. Nineteen eighty-six was a year in which the plant encountered a low lake level, high solar heat input, and a severe drought. The years 1981-1987 were examined to verify margin existed to the 95°F limit. Four of the seven years recorded a maximum temperature of 91°F or greater. The licensee, during the inspection, agreed to include service water temperature as a parameter the operations staff will check and record at least daily.

For the HVH coolers to remove the design heat, adequate airflow must exist, and fouling on both the airside and water side of the coolers must be within the design parameters. Results from EST-026 testing verify no excessive fouling on the airside of the tubes, and that airflow exceeds 85,000 cfm. Results from the April 1987 tests were: HVH1-97,983 cfm, HVH2-91,474 cfm, HVH3-91,055 cfm, and HVH4-101,682 cfm. HVH1 and HVH4 have flows 15-20% higher than required. This is conservative with respect to heat removal, but can place additional load requirements on the emergency busses and emergency diesel generators.

The design for the HVH1-4 coolers assumed at least 800 gpm of service water would be available to each cooler. HVH flow is available, but remote indication is not provided in the control room for use by the operators in the event of an emergency to verify operability of the HVH coolers. An alarm, which indicates an outlet flow of less than 700 gpm, is available in the control room. The licensee, in response to questions on the basis of the alarm setpoint, showed in a preliminary analysis that the 700 gpm setpoint may be lower than the minimum required flow for full cooler operability. IFI 50-261/88-24-01, Setpoint Basis for HVH Cooler Low Water Flow Alarm, will track resolution of this issue.

The HVH coolers are supplied water through use of two service water booster pumps. Each pump's discharge, through a valving arrangement, can supply all four HVH coolers. The arrangement is such that if a booster pump outlet check valve stuck open, a running pump could backflow through the nonrunning pump with the stuck check valve and starve the coolers for flow. Operator indication would be low water flow alarms for all HVH coolers. Diverted water flow through a stuck open check valve or through a piping break was not included as a possible cause in the alarm response procedure. The licensee added diverted flow to the list of possible causes in the alarm procedure. This is not a design problem, because, as both booster pumps get an auto start signal on a SI, a double failure would be required during an SI. It could be encountered when changing from an operating booster pump to a standby pump during normal operations.

Flow through the safety-related components would be effected by closure of the turbine building isolation valves (16, A, B, C) which isolates the nonsafety-related loads. The UFSAR Section 6.2.2.3.2 states that minimum required cooling water flow will be available to the HVH coolers within 46 seconds after an SI signal. OST-301 tests Service Water System components each refueling. In OST-301, the UV/SW E1 and UV/SW E2 relays are set up to operate at 60± 3 seconds. The 16A, B, C valves close upon UV/SW E1 or UV/SW E2 actuation. Data from past valve operation shows the 16A, B, C valves stroke times vary from 14 to 25 seconds. This would indicate full flow would not be available to the HVH coolers until up to 90 seconds after an SI signal, due to diversion of service water flow to non safety-related loads. This impacts the current safety analysis as reflected in the UFSAR. During the inspection, the licensee was not able to determine the effect of partial flow to the HVH coolers for the first 90 seconds of SI. This item will be tracked as an Unresolved Item (URI) 50-261/88-24-02, UV/SW Relay Timing and the Impact on Cooling Water Flows During an SI.

This changeover also impacts the service water and service water booster pumps In the event of a loss of offsite power with a coincident SI, all four service water pumps and both booster pumps would start. After isolation of the turbine building, each pump would be supplying about 3750 gpm.

The pump manufacturer does not recommend the pumps be operated continuously at flows of less than 5600 gpm. Current operation procedures do not recommend taking pumps off line when flows are less that 5600 gpm. An inspector followup item, IFI 50-261/88-24-04, Incorporation of Manufacturer's Operating Limitations on Service Water Systems Pumps Into Procedures, will be opened to track this item. One system weakness that makes it difficult for operators to monitor whether pump operation is within recommended ranges is the lack of system total flow indication in the control room.

In the event one emergency diesel generator does not provide power to one safety-related bus, two service water pumps would be supplying 23,000 gpm of load until the 16A, B, or C valves were closed. The pumps would be in a runout condition. In addition, inadequate suction head would probably be present at the booster pumps. These conditions could impact power requirements for the pumps until flows are stabilized. The high power requirements for the three pumps in runout/cavitation should be considered, along with the high power requirements of the HVH fans, mentioned earlier, when the new EDG loading study is finalized. IFI 50-261/88-24-03, EDG Load Study Impact from Service Water Pumps Runout Condition and HVH Fans High Air Flow Condition, will track these matters.

4. System Flow Balance

The last flow balance of the Service Water System was performed July-September of 1975. The testing was performed in response to heat exchanger tube failures that were being experienced at H. B. Robinson, Unit 2. The report of the flow balance, issued in October 1975, stated the original preoperational test verified that flows were present, but did not quantify the flows. The test engineer reconstructed flow requirements from heat exchanger information. The report stated the original design requirements were not available in the plant records or from Ebasco. The flow balance determined that the as-found flows, in most cases, differed greatly from the design flows. Recommendations were made as a result of the flow balance. Most recommendations have been followed, including the upgrading of the service water pumps. The service water pumps impellers have been replaced with larger impellers. Recommendations not yet adopted included one for installation of flow indication for each pump, one for a mathematical model of the system to be developed for estimating throttle valve positions for year round balancing, and one for establishment of low level throttle limits on flow through the component coolers to ensure adequate flows during emergencies.

The flow balance is over 15 years old. The system has changed since it was performed. New pump internals have been installed. Replacements or changes have been made to the following heat exchangers: HVH1-4, HVH6A,B, HVH7A,B, A and B Emergency Diesel Generator Heat Exchangers, Main Generator Hydrogen Coolers, Motor Driven AFW pump lube oil coolers. Evidence of fouling is present in the system's small bore carbon steel piping. In addition, new system discharge piping has been installed in a new configuration.

Currently operations does not have limitations on the throttling of service water to control system heat removal rates from secondary systems. Studies have not been performed to show that system flows during an emergency would be adequate with the current valve positions. Engineering had not, at the time of the inspection, provided restrictions to operations on limiting valve positions.

The normal system configuration provided some verification of adequate flows. EDG testing verifies adequate cooling is present during the running of the EDG. HVH1-4 flows are greater than their alarm setpoints. When the system changes from normal to emergency service, the load lost to the turbine building corresponds roughly to the flow lost due to tripping of one pump. However, during the summer months, the number of pumps normally in service is three. In an emergency only two may be available if one bus is lost. An evaluation of adequacy should be performed.

An Unresolved Item URI 50-261/88-24-05, Service Water Flow Analysis to Show Adequacy of Flows to Safety-Related Components, is opened to follow these concerns. In addition, the licensee has made an oral commitment to perform a system flow balance, if practical, or if not, a system analysis verifying adequate flow to safety-related components under emergency conditions. The balance or analysis is committed to be completed prior to power operation at the end of the next refueling outage, scheduled for end of 1988. The URI will also assess the guidance given operations on throttle valve positions to insure adequate flow is maintained.

The 1975 flow study also showed it was possible to estimate total system flow based upon pressure drop between the pumps and the auxiliary building due to piping resistance. This could be used to provide guidance to operations on pump configuration. In addition, by using different pump configuration at the same discharge pressure, subtracting system flows could give an indication of individual pump output. This could be used for ASME Section XI pump tests. The current method does not use individual flows.

5. System Studies

The inspector reviewed a study performed by CP&L on treatment methods for service water to minimize fouling and corrosion. Service Water System Chlorination and Chemical Treatment, Report of Study Results and Recommendations, was written by Tony Lewis of CP&L, who is also very actively involved with EPRI in their Service Water System Working Group.

The report was a very complete study of the current service water system's problems due to biological and chemical activity. It included discussions of the theory of MIC and fouling studies performed at H. B. Robinson, reports from chemical suppliers on the available biocides, pictures of damage at H. B. Robinson caused by biological activity, a good section of reprints of articles on the subject from various journals and conferences, and recommendations for future action at H. B. Robinson. In addition, the study discussed a non-biological but important problem, of manganese deposition in heat exchangers causing reduced heat transfer.

The study summarizes the past few years of studies performed at H. B. Robinson and recommends chlorination along with a biodipersant as a method of preventing future degradation to the service water system. Chemical cleaning is recommended for some parts of the system. The system engineer indicated current plans for the system included addition of a chlorination system.

The inspector talked to plant personnel about the presence of asiatic clams in Lake Robinson. Clams are present in several rivers in close proximity to the plant. Lake Robinson has not yet been found to have asiatic clams present. Annual environmental studies are performed on the lake. The clams are not listed among the animals found in the studies. The reason for the absence is not known. Licensee personnel speculated the very low pH of the lake water could impact the clams. Another factor may be the high peak summer water temperatures, as studies have shown high mortality rates in clams at temperatures of 90°F.

Clams, at present, are not a problem at H. B. Robinson. The annual environmental reports should provide warning if clams infest the lake.

6. Documents Reviewed

The following documents were reviewed in this inspection:

a. Drawings

Service and Cooling Water System Flow Diagram, G-109199

(1) Sheet 1 of 12, Rev. 27
(2) Sheet 2 of 12, Rev. 24
(3) Sheet 3 of 12, Rev. 20
(4) Sheet 4 of 12, Rev. 28

(5) Sheet 5 of 13, Rev. 28
(6) Sheet 6 of 12, Rev. 24
(7) Sheet 7 of 12, Rev. 26
(8) Sheet 8 of 12, Rev. 22
(9) Sheet 9 of 12, Rev. 27
(10) Sheet 10 of 12, Rev. 24
(11) Sheet 11 of 12, Rev. 27
(12) Sheet 12 of 12, Rev. 27

b. Procedures

Engineering Surveillance Test Procedures

(1) EST-026, HVH-1, 2, 3, & 4 Containment Cooling Units (Once Each Operating Cycle), Rev. 4, 2-12-88
(2) EST-081, Inservice Inspection Pressure Testing of Service Water Inside Containment, To and From HVH Units 1 thru 4 (40 month interval), Rev. 1, 8-31-87
(3) EST-094, Inservice Inspection Pressure Testing of the Service Water System (40 month interval), Rev. 0, 10-22-87

Operations Surveillance Test
(5) OST-301, Service Water System (Refueling), Rev. 7, 7-16-87
(6) OST-302, Service Water System Component Test (Monthly), Rev. 21, 6-17-88
(7) OST-902, Containment Fan Coolers Component Test (Monthly) Rev. 7, 6-03-88

System Description Procedure
(8) SD-004, Service Water System, Revision 8, 6-22-88

c. Updated Final Safety Analysis Report
9.2.1, Service Water
6.2.2.2.2, Containment Air Recirculation Cooling System
6.2.2.3.2, Containment Air Recirculation Cooling System
Table 8.3.1-1, Emergency Diesel Generator Loads for A Loss of Coolant Accident

d. Master Project Index Report, Special Run for Service Water, 7-21-88

e. H. B. Robinson Steam Electric Plant 1986 Annual Environmental Monitoring Report, 7'87

f. Memorandum NED-R-2442, H. B. Robinson Steam Electric Plant - Unit No. 2, Control Room Habitability HVAC Cooling Requirements (Proposal to use Service Water to Cool the HVAC Chillers)

g. PCN86-0499/00, Service Water System Chlorination and Chemical Treatment, Report of Study Results and Recommendations, December 31, 1987

h. Final Report H. B. Robinson, Unit 2, Service Water System Flow Tests, October 1975

7. Exit Interview

The inspection scope and results were summarized on July 29, 1988, with those persons indicated in Paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results listed below. Proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

IFI 88-24-01, Setpoint Basis for HVH Cooler Low Water Flow Alarm, (Paragraph 3.0)

URI 88-24-02, UV/SW Relay Timing and the Impact On Cooling Water Flows During an SI, (Paragraph 3.0)

IFI 88-24-03, Emergency Diesel Generator Load Study Impact From Service Water Pump Runout Condition and HVH Fans High Air Flow Condition, (Paragraph 3.0)

IFI 88-24-04, Incorporation of Manufacturer's Operating Limitations on Service Water System Pumps Into Procedures, (Paragraph 3.0)

URI 88-24-05, Service Water Flow Analysis to Show Adequacy of Flows to Safety-Related Components, (Paragraph 4.0)

Oral commitment to perform a service water system flow balance prior operation following the next refueling outage, (Paragraph 4.0)