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Facility Name: Hatch and 1 and 2

Inspection Conducted: January 10 through February 25, 1994

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SUMMARY

A special, announced team inspection was conducted on January 10 through February 25, 1994, in the area of service water system operational performance and in accordance with NRC Temporary Instruction 2515/118.

RESULTS

Safety issues management system item TI 2515/118 was closed. Three cited violations, two unresolved items and four inspector follow-up items were identified. The designs of the residual heat removal service water and plant service water systems were excellent. Design control, operation, maintenance and corrective actions at the plant were effective. Improved performance from the mid-1980s, due to substantial material condition upgrades, was apparent. Strengths were noted in instrument setpoint control, the non in-service test vibration monitoring program, check valve inspections, and the personnel expertise involved in ultrasonic testing. Housekeeping was excellent in all but two safety-related areas. A repetitive weakness was identified, associated with slow corrective action initiation by corporate engineering. Weaknesses were identified in numerous types of inspections including PSW and RHRSW heat exchanger visual examinations, certain aspects of the silt, clam and mussel intake structure inspections, and pipe corrosion radiographic testing program. There were weaknesses in some of the technical support activities. Also, audits of the SWS activities were ineffective in identifying apparent weaknesses in the testing and inspection of safety-related heat exchangers. Additionally, a weakness was identified with respect to the licensee's hydraulic model of the plant service water system.

REPORT DETAILS

1. Inspection Scope and Objectives

Numerous problems identified at various operating plants in the country have called into question the ability of the SWSs to perform their design function. These problems have included the following: inadequate heat removal capability, biofouling, silting, single failure concerns, erosion, corrosion, insufficient original design margin, lapses in configuration control or improper 10 CFR 50.59 safety evaluations, and inadequate testing. NRC management concluded that an in-depth examination of SWSs was warranted based on the identified deficiencies.

The inspection team focused on the mechanical design, operational control, maintenance, and surveillance of the SWS and evaluated aspects of the quality assurance and corrective action programs related to the SWS. The inspection's primary objectives were to:

* assess SWS performance through an in-depth review of the system's mechanical functional design and thermal-hydraulic performance including the content and implementation of SWS operating, maintenance, and surveillance procedures, and operator training on the SWS,

* verify that the SWS functional design and operational controls could meet the thermal and hydraulic performance requirements, and that SWS components were operated in a manner consistent with their design bases,

* assess the licensee's planned and completed actions in response to Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," July 1989, and

* assess SWS unavailability resulting from planned maintenance, surveillance, and component failures.

The areas reviewed and the concerns identified are described in Sections 3 through 9 of this report. Personnel contacted and those who attended exits on February 11 and 25, 1994, are identified in Appendix A. Details pertaining to GL 89-13 action items are attached as Appendix B.

2. System Description

The SWSs at the facility are RHRSW and PSW. The RHRSW system provides a reliable supply of cooling water for decay heat removal from the RHR system under normal and post-accident conditions as well as for maintaining torus water temperature within allowable limits. The PSW system provides a reliable supply of cooling water to turbine and power conversion auxiliaries during normal operations and to the necessary systems and equipment during post-accident conditions.

RHRSW water for equipment cooling is taken from the Altamaha River via the intake structure by four pumps. The four pumps are arranged into two divisions of two pumps each. Each division is composed of the two pumps, a common discharge pipe to the tube side of an RHR heat exchanger and a discharge pipe with a pressure control valve downstream of the heat exchanger. The pressure control valve maintains RHRSW pressure at least 20 pounds above RHR system pressure. This assures any heat exchanger tube leaks will not allow radioactively contaminated water to be discharged to the river. Each division's discharge pipe connects into one common discharge line to the circulating water flume. Additionally, the system serves as a standby coolant supply system with the capability to inject makeup water from the river to the RHR system to keep the core covered during an extreme emergency. The two divisions have the capability to be cross-connected via a normally closed valve.

PSW water for equipment cooling is taken from the Altamaha River via the intake structure by four, one-third capacity pumps. The four pumps are arranged into two divisions of two pumps each. Each division supplies water to its respective safety-related diesel generator and safety-related auxiliary building loads via its own header. The two supply headers connect to form one supply for the non safety-related turbine building loads. PSW safety-related loads include the emergency diesel generators, safety-related room coolers in the auxiliary building and the control room ventilation system. After passing through the PSW loads, the water is discharged through common underground piping to the circulating water flume or the river. Under certain conditions, the turbine building loads are automatically isolated by redundant motor operated butterfly valves in each divisional supply. An automatic transfer scheme is provided between the divisional supplies based upon low flow conditions to the control room ventilation cooling condensers. Normal flow demands are approximately 25,000 gpm, whereas accident demands on safety-related equipment are approximately 1/10 of the normal demand. The system can also be used for emergency spent fuel pool makeup, fire protection, and radwaste dilution.

The cooling water for the 1B EDG is normally supplied via its own dedicated standby PSW pump. The pump receives its power from a 600V MCC that can be fed from either the 1F or 2F 4160V emergency buses. An alternate cooling supply for the 1B EDG is available from either division of Unit 1 PSW.

3. <u>Generic Letter 89-13 Implementation</u>

The NRC issued GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment," requesting licensees take certain actions related to their SWS. These actions included establishing biofouling surveillance and control techniques, monitoring safety-related heat exchanger performance, establishing a routine inspection and maintenance program, reviewing the design to assure intended safety functions could be accomplished and training personnel in the operation, maintenance, and testing of the SWS.

The licensee's actions to GL 89-13 were generally adequate, but there were deficiencies in action items I and II. The most significant deficiencies dealt with heat exchanger performance monitoring (action item II). The method used for testing the RHRSW and PSW pump motor coolers was inappropriate, and the acceptance criteria for testing room coolers had not been adequately established. The procedures for visual examination of the EDG and CR HVAC heat exchangers were inadequate and only one RHR heat exchanger had been visually examined. Effective biofouling measures had been established through water chemical treatment. However, some implementation weaknesses were noted in the biofouling (clam/mussel) inspections and in implementing corrective actions to silt inspection results (action item I).

4. <u>Mechanical Design Review</u>

The team reviewed the mechanical designs of the SWSs, including the design bases, functional requirements, design assumptions, calculations, boundary conditions, analyses, and models to determine if the designs met licensing commitments and regulatory requirements. The SWSs capability to meet the thermal and hydraulic performance specifications during accident and abnormal conditions were also reviewed. From February 22-25, 1994, the team witnessed re-benchmarking efforts of the licensee's computerized PSW system hydraulic model. This included witnessing the preparation, data gathering, and data reduction for the test. Select stress calculations supporting seismic qualification and SWSs modifications were evaluated, and single and common mode failure vulnerabilities, flooding mitigation characteristics and the ability of the Altamaha River to function as the ultimate heat sink were assessed. Also, the proper reflection of the SWS design in plant operations, testing, and maintenance procedures was reviewed. The inspection results were as follows:

a. The licensee's computer based analytical model of the PSW system had a number of limitations and had not been properly benchmarked by technical support personnel. The computer model used standard analytical methodology for establishing a steady state model of PSW pressures and flows. No plant records could be produced to show that the model agreed to within 10 percent of actual plant flows during the original benchmarking of the model. Several cases were run during the course of the team's inspection and for various reasons the model was never able to produce results that were within 10 percent of actual field data. The flow measuring devices that were used during the benchmark test did not always agree within 10 percent when used to measure the same flow. This was due in part to different technologies used to measure the flow that included clamp-on ultrasonic flow detectors (Controlotrons), installed orifice plates, and self averaging pitot tubes (Annubars). The model did not include the 1B diesel generator SW flow, the CR HVAC SWS, or a pipe break in the turbine building. Also, the model only calculated steady state flow and pressures and could not calculate system dynamic changes, such as pressure spikes.

b. Due to the concerns discussed in paragraph 4.a, the licensee attempted to re-benchmark the model. The re-benchmarking effort could not produce results meeting the acceptance criteria and had a number of implementation weaknesses.

The test involved the use of clamp-on, ultrasonic flow measurement devices at the following locations:

- Common Supply Line HPCI Room Coolers (T41-B005-A, -B)
- RHR Pump Cooler (1E11-C002-B, -C) Supply
- Corner Room Cooler (T41-B003-A) Supply
- Corner Room Cooler (T41-B003-B) Supply
- Common Supply Line CRD Room Coolers (T41-B001-A, -B)
- CR HVAC Division II - Supply
- Turbine Building Supply
- Division II Reactor Building Supply
- D/G 1C - Supply

During performance of the SWS confirmatory test, the hydraulic model was aligned to match the plant configuration. The test acceptance criteria was a ± 10 percent agreement between the flow measured and the flow predicted by the model at each selected point. Seven of nine points did not agree to within ten percent.

There were several reasons for these discrepancies. These included: the model alignment included flow to both divisions of CR HVAC coolers which should have been isolated (about 250 gpm), the wrong model points were read for turbine building flow (about 4900 gpm), the model showed flow through the mini-flow line of the idle SW pump (about 500 gpm), the instrumentation was adjusted for two local flow readings because the initial flow results were not in the expected range. The licensee performed an additional test of the flow model with the CR isolation valves closed (eliminating one of the test points). The results of the additional test on the model more closely correlated with the actual data initially taken at the test points; however, the results still indicated that 4 of the 8 valid test points had an error of greater than 10 percent. A table of the test results is included in Appendix D.

Also, initial data collected on the common supply to the Unit 1 HPCI room coolers indicated a total flow of 3.5 gpm. This data was collected with flow to all the other room coolers supplied by Division II. At approximately 5:30 PM on February 23, 1994, the licensee declared HPCI inoperable due to low service water flow rate through the HPCI coolers. After troubleshooting, the licensee determined that the clamp-on flowmeter had been located too close to a transition in the piping. The flowmeter was relocated further from the transition and the new data showed that the flow was between 18 and 20 gpm. The acceptable flow was 15.1 gpm. The licensee declared the HPCI operable on February 24 1994.

The team concluded, and the licensee concurred, that the SWS model needed further modifications before it could be used as the basis for operability determinations or other safety-related purposes. Further licensee initiatives to improve model accuracy are identified as IFI 50-321,366/94-01-01, "PSW System Flow Model Verification."

c. The team could not fully determine that the SWSs within the containment were adequately protected from a high energy line break. The PSW system provided cooling water to the containment coolers in Unit 1. Since this system penetrated primary containment and was intended to be a closed system inside containment, it was designed to the requirements of 10 CFR 50, Appendix A, Criterion 57, "Closed System Isolation Valves." For such systems, only one isolation valve is required outside containment, the first barrier being the piping and components inside containment. In order for both of these barriers to remain intact post-accident, they must be protected against the effects of a high energy line break (HELB).

   When the licensee was asked to provide evidence that the PSW piping inside the drywell was protected against HELB an informal analysis addressing the piping in two quadrants of the drywell was provided. Of 78 break locations reviewed, one recirculation line break caused an interaction between the resulting jet of water/steam and drywell cooler 1T47-B009B (1.7 feet between the break location and the cooler). The licensee judged this would be no threat to the PSW piping or the cooler. The team disagreed with this judgement, calculating that the jet would produce a force on the cooler's sheet metal exterior of approximately 425 tons which could have substantial impact on the integrity of the cooler.

   Analysis of two other systems of similar configuration, i.e., closed non safety-related systems inside the containment with non-automatic containment isolation valves were requested. These were the reactor building closed cooling water system that supplied cooling water for the reactor recirculation pumps, and the drywell chilled water system that supplied cooling water for the Unit 2 drywell coolers. The licensee indicated that the architect engineer maintained that information and that severe storms at their offices significantly impaired retrieval of the requested information. Consequently, the team was unable to review these results during the course of the inspection. This is UNR 50-321,366/94-01-02, HELB Protection for SWSs within the Containment.

d. The design basis temperature for the PSW motor coolers was 90°F. However, the design basis temperature for the PSW system (which supplies the motor cooling) was 95°F. The licensee contacted the vendor of the pump motors and received confirmation that the pumpmotors would not experience degraded performance or service life reduction with a cooling water inlet temperature of 95°F. The licensee stated that the design basis of the PSW pump motor coolers would be updated to reflect the new information.

e. There was disagreement between the FSAR and the NRC SER as to whether a radiation monitor was to be installed on the RHRSW discharge piping. The Unit 1 Safety Evaluation Report dated May 11, 1973, Section 9.2.1, "Residual Heat Removal Service Water System," stated, "Monitoring for radioactive leakage into the RHR service water system is provided by a scintillation counter with the same calibration criteria as used for the liquid monitors in the radwaste system." Also, P&ID H-16329, Rev 40, August 2, 1993, Note 5, stated, "Discharge lines for cooling water [RHR service water] to be routed upstream of service water radiation monitors." Conversely, the FSAR did not mention the existence of this radiation monitor and none had ever been installed on the discharge line. The system was designed to preclude leakage into the RHRSW system by maintaining the service water pressure 20 psig higher than the RHR system pressure. This assured that any leakage would be into rather that out of the RHR system. The licensee maintained that the differential pressure feature was sufficient to preclude leakage; therefore, radiation monitoring was unnecessary. Also, the licensee indicated that this was an editorial mistake in the NRC SER and that the system referenced with the radiation monitor should have been the PSW system. Pending further NRC review, this is UNR 50-321,366/94-01-03, "Necessity for an RHRSW Radiation Monitor."

f. The facility was susceptible to the conditions discussed in NRC Information Notice No. 93-83, "Potential Loss of Spent Fuel Pool Cooling Following a Loss of Coolant Accident (LOCA)." The ability for manual emergency makeup to the spent fuel pool prior to cooling water boil off was prohibitive under the postulated accident radiation levels of Regulatory Guide 1.3. This concern has been considered by the NRC as a generic issue and will be resolved accordingly.

g. There was common discharge piping for SWS (RHRSW and PSW) trains. Also, there were two manual locked valves in each of the unit's common PSW return lines from the reactor building and from the control room HVAC units. Passive failure of any of these valves or piping sections during an accident could prevent both divisions of the SWS from performing their design safety functions. Additionally, during normal operation, failure of any of these valves could hinder shutdown of the plant.

   However, these common mode failure points had been allowed under the licensing basis of the facility. The common piping had been evaluated through a seismic monitoring program by the licensee for failure during an earthquake, and the conclusion was reached that such a failure was not credible. Due to the timeframe in which Hatch was licensed, consideration for passive SWS valve failures was not applicable. Nevertheless, the licensee had evaluated through a PRA analysis, the plant's vulnerability to a passive SWS valve failure. The analysis concluded that such a failure was of very low probability. The team confirmed the PRA rational used for these valves was consistent with standard industry practice.

h. In a letter dated May 10, 1989, the manufacturer of the PSW and RHRSW pumps provided a minimum PSW flow recommendation of at least 4250 gpm. However, the expected PSW system loads after Turbine Building isolation generally were less than half the 4250 gpm required. The letter prompted an engineering study of this situation. The team requested a report from the licensee as to what actions were being taken on this matter. The licensee responded that the design minimum flows were still adequate to preclude pump damage for at least six hours based on information which they had received in a letter from the manufacturer on May 10, 1989. Also, per the abnormal operating procedures (34AB-P41-001-1S and 34AB-P41-001-2S) the operators would re-establish PSW flow to the non safety-related portions of the system, controlling the header pressure to > 80 psig. Therefore, long term PSW flow after an accident would be much higher than the minimum needed to support long term operation of the PSW pumps. The team contacted the manufacturer and was assured that 4250 gpm was conservative, and it was industry practice to specify a flow for long term operation that was half the design flow. The team concluded that the current plant procedural guidance was adequate to cope with this issue.

i. The team identified a number of minor errors associated with the SWS drawings. The licensee acknowledged these deficiencies and indicated that the drawings would be corrected.

5. <u>Operations</u>

The team observed licensed operator performance during routine and abnormal situations using the plant-specific simulator. Where simulator limitations prohibited direct observation, operator performance was assessed by walkthroughs, interviews, and control room observations. Plant walkdowns were conducted to assess present operating configurations, housekeeping, and material conditions. Additionally, the plant operating procedures were reviewed for adequacy. The inspection results were as follows:

a. Licensed operators demonstrated adequate knowledge of the PSW and RHRSW systems and the effects of abnormal operations. During simulator scenarios, the operators used the appropriate plant procedures and showed sufficient knowledge regarding the PSW and RHRSW systems' capabilities and limitations.

b. Procedures

(1) System Operating Procedure 34SO-G41-003-2S, "Fuel Pool Cooling and Cleanup System," contained two errors. These were:

- Valve 2G41-F040 was designated as being open on the valve lineup sheet Attachment 2 page 9 of 10. The valve was shown as locked closed on the P&ID, H-26039. Field investigation revealed the valve was locked closed. Further investigations by the team and the licensee revealed that this portion of the procedure had been rewritten, and although it had been approved in this manner, this was probably a typographical error. The most recent valve line-up, conducted by a previous procedure revision, showed this valve to be in the correct position.

- Valve 2G41-F001 was designated as being locked closed on the valve lineup sheet Attachment 2 page 9 of 10. The valve was shown as being only closed on the P&ID. Field investigation revealed the valve was in fact closed but not locked.

This is an example of VIO 50-321,366/94-01-04A, "Failure to Follow Procedures or Inadequate Procedures."

(2) There were inconsistencies as to what controls were present to maintain valve 2P41-F073 in its required position. The valve was shown as locked closed in procedure 34SO-P41-001-2S. The valve was shown as only closed in procedure 23GO-OPS-024-2S. The actual position of the valve was locked closed. The licensee indicated that this was probably a typographical error and that procedure 23GO-OPS-024-2S would be revised.

(3) Abnormal Operating Procedures 34AB-P41-001-1S/2S, "Loss of Plant Service Water," provided guidance for responding to malfunctions in the PSW system. During one of the simulator scenarios, the plant experienced a degraded PSW situation in which only one PSW pump was available to supply plant cooling water requirements. The procedure provided the operators the flexibility to supply turbine building loads in the event that the abnormal PSW flow rates were not a result of a turbine building PSW rupture by overriding a turbine building isolation signal and throttling open the turbine building isolation valves. However, the guidance provided was weak since the turbine building isolation valves were large butterfly valves and not easily throttled. Additionally, no guidance was provided concerning the limitations on the maximum flow rate allowable under single pump operation. These factors increased the susceptibility to pump runout conditions during single pump operations.

(3) Annunciator Response Procedure 34AR-601-230-1S, "RHR Hx B Diff Press Low," described the operator actions in response to a low differential pressure alarm on the 1B RHR heat exchanger. Procedures 34AR-601-304-1S, 215-2S, and 313-2S were the corresponding procedures for the 1A, 2B, and 2A heat exchangers respectively. All of these procedures except for the 1B heat exchanger procedure contained a step to shift RHR system operation to the opposite loop if the heat exchanger outlet conductivity monitor indicated more than 9.5 micromhos. The licensee indicated the 1B heat exchanger alarm response procedure would be revised to be made consistent with the other procedures.

c. System Walkdowns

(1) Housekeeping was superior in the reactor and diesel generator buildings. However, housekeeping in the vicinity of the CR HVAC condensers and the lower level of the SWS intake structure was inadequate. Numerous pieces of lagging and debris were on the

floor by the condensers. The lower level of the intake structure showed heavy corrosion on most of the metal surfaces. The 1D RHRSW pump column had large slabs (several feet long) of rust peeling away. Handrails were rusted through in spots with the water below the only place for the scale to land. The water in the intake pit contained debris. Also, the lighting was provided by an extension cord. The licensee bagged the HVAC lagging during the inspection and indicated that plans were being implemented to improve the condition of the lower intake structure. Administrative control procedure 20AC-BLD-001-OS, "Plant Housekeeping and Cleanness Control," section 8, required work areas be cleaned; materials and debris safely placed. This is an example of VIO 50-321,366/94-01-04B, "Failure to Follow Procedures or Inadequate Procedures."

(2) Numerous piping and flanged connections in the PSW piping did not have proper stud to nut engagement. General maintenance procedure 51GM-MNT-033-OS, "Torquing Procedure," step 7.3.3.1, required studs to be at least flush with the nut head. However, numerous connections in the PSW piping had studs below the top of the nut. The licensee indicated that this condition had been a recurring problem. This is an example of VIO 50-321,366/94-01-04C, "Failure to Follow Procedures or Inadequate Procedures."

6. Maintenance and Inspections

The team reviewed maintenance history on selected PSW and RHRSW equipment, maintenance procedures, completed work packages, the preventive maintenance schedule, preventive maintenance procedures, and LERs. Select completed work requests were reviewed in detail. The availability of spare parts was evaluated by reviewing the licensee's stocking records. Personnel were interviewed and their qualification records were reviewed to determine their expertise in accomplishing selected inspections and maintenance tasks. Whenever possible, the team witnessed the inspections and maintenance activities actually being performed. The inspection results were as follows:

a. Machinery History Results

(1) The required maintenance activities had drastically decreased due to major equipment modifications which were completed in the mid 1980s. As a result, the pump run times between required rebuilds had drastically increased. All the PSW and RHRSW pumps had been upgraded to stainless steel motor oil coolers and pump internals. Both of these items had required extensive maintenance activities prior to the modifications.

(2) The outlet valves for the RHRSW heat exchangers (F068A/B) had experienced cavitation problems. To remedy this deficiency, the licensee had performed a modification on the unit 1 valves to replace them with a different type of valve design. A similar modification was planned for the Unit 2 valves. The licensee

installed drag valves that eliminated the problems with cavitation, but introduced a new problem associated with valve clogging. The valves were located at the outlet of the RHRSW HX which is located downstream of the RHRSW system strainers. In the past, the licensee had experienced strainer failures that had allowed an excessive amount of debris to pass through the strainers and into the remainder of the RHRSW system. Due to its unique design, the drag valves were somewhat susceptible to clogging, thus, the excessive debris had resulted in valve failure. The design of the RHRSW system was such that during certain operating configurations, pump starts could momentarily overpressurize the strainers. Over a period of time, these abnormal stresses led to strainer failures. During periods of high river level, large amounts of debris have been observed in the intake to the PSW and RHRSW systems. The combination of these factors contributed to the clogging observed in the F068A/B valves. The licensee had planned further system modifications to limit the pressure surges experienced by the RHRSW strainers. The team determined that the licensee's efforts to eliminate the pressure surges to the RHRSW strainers to be of sufficient importance to justify inspection follow-up activities. Final resolution of the effectiveness of the licensee's modifications to the RHRSW system to limit pressure surges, strainer overpressurization, and outlet valve clogging are included into previously opened IFI 50-321,366/92-15-03, "Resolution of RHRSW Air Release Valve Issues."

(3) The maintenance department was responsive to maintenance work requests and the backlog of MWOs was reasonable. It was noted that a majority of the MWOs had been identified due to a recent walkdown of the systems by the licensee.

b. Preventive and Predictive Maintenance

(1) The preventive maintenance associated with the RHRSW system was comprehensive. The RHRSW pumps and motors were overhauled on a five-year basis. However, due to the smooth running nature of the pumps, these overhauls were frequently deferred.

(2) The maintenance engineering organization had established a predictive maintenance program to monitor plant equipment. One aspect of this program was a vibration monitoring program (outside of the scope of normal ASME Section XI testing). The vibration monitoring program used state-of-the-art equipment and analytical techniques to monitor plant equipment for degradation and preventive maintenance. Although no direct benefits of this program had been observed in the maintenance of the PSW and RHRSW pumps and motors, several other instances of positive benefits in other plant systems were observed. This program was a positive benefit to overall plant maintenance activities.

c. Inspections

(1) Heat Exchangers

a. Preventative Maintenance Procedure 52PM-E11-009-OS, Rev 1, August 12 1992, "RHR Heat Exchanger Preventative Maintenance," was the licensee's procedure for visual inspection of these heat exchangers. The inspectors noted that various aspects of this procedure contained inadequate guidance. The specific procedural inadequacies were:

- Page 5 contained references to the "upper" and "lower" sections of the tubes. When asked to explain, the licensee responded that it appeared that the writer had thought the RHR heat exchangers were horizontal U-tube devices; therefore, "upper" and "lower" would have referred to the inlet and outlet ends of the tubes. The heat exchangers were vertical U-tube devices, and the "upper" and "lower" terms were incorrect. As a result of this error, "upper" could have been interpreted to mean the upper portion of the tube bundle, in which case, if the procedure had been followed verbatim, only that portion of the bundle would have been cleaned.

- Step 7.3.11.1 required cleaning of the tubes by blowing air through the tubes. However, the procedure did not specify the pressure, volume, quality, source, etc. of the air to be used. Additionally, no acceptance criteria for this activity had been identified.

- Step 7.4.2 contained a QC hold point to perform a visual inspection of the "as-found" condition of the heat exchanger internals. However, this step occurred after the tube cleaning step. Therefore, the "as-found" condition could not actually be verified. Additionally, this procedure provided no QC hold point to verify the cleanliness of the heat exchanger in the "as-left" condition before it was reassembled.

b. Preventative Maintenance Procedure 52PM-E11-009-OS, referenced Inspection Procedure 42IT-TET-012-1S(2S), Rev 0, July 19, 1991, "Plant Service Water and RHR Service Water Piping Inspection Procedure" for "as-found" visual inspection guidance. However, Procedure 42IT-TET-012-1S(2S) provided no guidance or direction for inspecting heat transfer surfaces.

c. "Diesel, Alternator and Accessories Inspection," 52SV-R43-001-OS, Rev. 4 contained one page that had a place for comments for the jacket cooler, oil cooler, and air cooler for the diesel inspected. In most cases, the comments state "good" or "good no apparent problems." This was inadequate guidance for inspection and documentation of the as-found and as-left conditions.

d. Twelve-month preventive maintenance procedure, "Control Room Air Conditioning System Maintenance," 52 PM-Z41-002-1S, Rev. 9, had one step that stated the condenser tubes were clean or had been cleaned with a signature block next to it. This was inadequate guidance for inspection and documentation of the as-found and as-left conditions.

These inadequate procedures are examples of VIO 50-321,366/94-01-04D, "Failure to Follow Procedures or Inadequate Procedures" (Further discussion of the heat exchanger inspection program is provided in action item II of Appendix B).

(2) Silt

Periodically, the licensee sent scuba divers into the forebay to measure the silt accumulation per Preventive Maintenance Procedure, 52PM-MME-006-0S, "Intake Structure Pit Inspection." The acceptance criterion for the silt accumulation was a sediment level less than 12 inches. The most recent inspection results of November 1993, documented 7 of the 10 samples above the acceptable sediment depth. However, 10 months previously all sample points met the acceptance criterion. Although there was a work order issued to remove the sediment, the work was not scheduled for approximately six months after the condition was discovered.

The lack of timeliness for the corrective actions associated with the most current inspection results was not seen in earlier inspections of the same type. After the inspection in early 1993, the responsibility for the sediment inspection program was transferred to another department. This reflected a weakness in the transition of responsibilities between departments. Failure to promptly correct this sediment deficiency, a condition adverse to quality, is an example of VIO 50-321,366/94-01-05, "Inadequate Condition Adverse to Quality Actions."

(3) Clams/Mussels

This procedural guidance associated with the clam/mussel program was adequate; however, the licensee did not document corrective actions for unsatisfactory test results. The deficient results, as reported by the chemical vendor, included improper sampling to detect clam larva and zebra mussels and insufficient sediment sample supernatant volumes to provide complete analyses. Future licensee actions to enhance the clam/mussel inspection program is IFI 50-321,366/94-01-06, "Clam/Mussel Inspection Initiatives." Licensee actions in this area are more thoroughly discussed in Appendix B, action item I.

(4) Pipe Corrosion

The licensee used both UT and RT techniques in the corrosion monitoring program for SWS piping. The UT technicians and their supervisor were knowledgeable of their duties as well as all applicable standards and regulations. They had a complete and through understanding of their tasks and were knowledgeable of their task's interface with other plant programs. The level of expertise of these technicians and their direct supervision was a strength. The licensee's RT program was still in the development stage. Conceptually, the program offered good insights into the material condition of the pipe through the radiographic testing of selected locations. However, program implementation was hampered by the lack of strict direction and control of pipe location for taking consecutive readings. This reduced the ability to accurately trend corrosion rates. Also, there were some weaknesses in the acceptance criteria selected. Continued licensee development of the RT portion of the corrosion monitoring program for SWS piping is IFI 50-321,366/94-01-07, "RT Program Continued Development." The RT initiative is more thoroughly discussed in Appendix B, action item III.

(5) Pump Columns

As previously mentioned, there was heavy corrosion on the 1D RHRSW pump column. The structural calculations for all the RHRSW pumps and the Unit 1 PSW pumps did not include an allowance for corrosion (only the Unit 2 PSW pump calculations included such an allowance). However, the pump columns for the Unit 1 PSW and RHRSW pumps were nominally only 3/8" thick compared to the Unit 2 pumps that were 3/4" thick. Also, periodic inspections of these pumps (Preventative Maintenance Procedure 52PM-E11-005-0S, Rev 3, July 2, 1993, "RHR Service Water Pump and Motor Maintenance") did not include inspection for corrosion deterioration.

In response to the team's concerns, the licensee performed ultrasonic inspections of the 1D RHRSW pump column and determined that the thinnest measured wall thickness was 0.30". An analysis was performed by the licensee that showed that the minimum allowable wall thickness was 0.25". Therefore, the structural integrity of the pump was acceptable. Future licensee efforts to periodically evaluate pump column integrity is IFI 50-321,366/94-01-08, "Pump Column Periodic Integrity Evaluations."

(6) Check Valves

Procedure 42SV-SUV-040-1(2)S, "Check Valve Internals Inspection" provided adequate procedures for disassembly and inspection of check valves. The program included routine inspections of safety-related check valves and also provided guidance for expanding the inspection to include similar valves upon a failed inspection. Through a review of check valve deficiency cards, the team noted that during routine inspections several valves were found unable to fully seat due to silt buildup. The component engineer was aware of the situation and indicated any changes to the current inspection frequency would not occur until results of the new chemical addition program could be determined.

The licensee effectively used the information from the program to improve system availability. The licensee had evaluated several safety-related valves with recurring problems and removed the internals. Also, the licensee had added valves 1P41-F552 A and C to the program. Subsequently, these valves had significant corrosion. Although continued routine maintenance inspections would be adequate, the licensee was in the process of upgrading these valves.

7. Surveillance and Testing

The team reviewed preoperational test procedures, surveillance procedures, and the licensee's IST program and implementing procedures to determine if sufficient testing had been conducted to confirm system design requirements and system operability. Also reviewed were the licensee's procedures, controls, and other activities associated with the calibration of instrumentation in the SWSs. The results of those reviews were as follows:

a. In-service Testing

(1) The licensee's methodology for vibration testing of the PSW and RHRSW pumps was inconsistent. The instrument used to monitor pump vibration was equipped to accommodate two different types of probes. The different probes produce different vibration response spectra; thus, the use of different probes in the same monitoring location would make it difficult to establish consistent, trendable data. The licensee had not specified the particular probe to be used for each vibration point, and the test personnel had been using different probes during the tests based on their own personal preferences. This type of inconsistent testing methodology made it difficult to compare data between any two given pump tests since the particular probe used was not annotated in the test results.

(2) The licensee had been granted relief from the normal vibration testing as specified in ASME Section XI pump testing requirements. In lieu of the requirements of ISTB 4.6.4, vibration measurements were to be taken on vertical line shaft pumps in three orthogonal directions, one of which was in the axial direction.

Engineering was to establish base line data for axial vibration during required pump testing. However, the locations that technical support personnel had previously designated would not accommodate the vibration probe. Therefore, during two pump tests witnessed by the team, one for RHRSW and one for PSW, it was necessary to establish new locations for vibration readings. This delayed the testing and processing of the test procedures.

(3) The pump portion of the IST program was of adequate scope. Degraded pump conditions could be identified, and maintenance activities were being conducted based upon equipment performance trending. Also, other routine checks, such as oil sampling, were being conducted on a routine basis.

(4) The valve portion of the IST program was of appropriate scope and adequately implemented.

b. There were surveillance procedures for testing service water valves that switchover automatically except for the PSW CR HVAC valves. Originally, procedure 52SV-P41-001-1S directed testing of these valves. The maintenance department was originally responsible for the test procedure, but in the late 1980s, the responsibility for the procedure was changed to I&C in order to add instrument calibrations. The procedure was sent back to the sponsor on January 13, 1989, for resolution of validation comments. It was returned from the sponsor to the writer on January 16, 1989. It was again returned to the sponsor due to further review comments. The procedure was then changed to a 42SV engineering procedure, and neither the licensee or the team could find objective evidence as to whether it was approved. As a result, testing has not been done on the PSW service water isolation valves, however, there was no safety significance in testing the valves due to the redundancy between divisions. The B HVAC unit is the only one of the three HVAC units that can be supplied from either division. The team concluded that this reflected a weakness in the transition of responsibilities between departments.

c. Technical Specification surveillance procedures for the SWSs contained the correct information and acceptance criteria. Also, the tests were performed within the frequencies prescribed by the TS.

d. The functional test, calibration procedures, and instrument setpoint documentation for 38 SWS instruments were reviewed and found to be correct. Instrument setpoints were in accordance with the setpoint index documents, and when required, were also in accordance with the Technical Specifications.

8. Equipment Availability

The team reviewed the availability records of the PSW and RHRSW systems for the past two years. This data was compared to that used as input to the IPE report. The team determined that the recent availability data compared favorably to that used in the IPE submittal.

9. Quality Verification and Corrective Actions

The team reviewed the licensee's self-assessments and selected corrective action documents associated with the SWS. Additionally, the team reviewed the minutes of on-site committee meetings. Results of these reviews were as follows:

a. Three audits of the SWS and the GL had been performed since 1991. These audits identified problems with licensee actions including the lack of performance monitoring of the PSW and RHRSW motor coolers. However, the audits did not identify the inadequacies in the heat exchanger inspection effort or the inappropriate use of the temperature monitoring method on the coolers for the PSW and RHRSW motors.

b. Condition adverse to quality reports were properly issued and resolved by the plant's staff. Examples included:

(1) In spring, 1993, personnel identified solenoid operated valve failures on air operated valves. The licensee aggressively replaced the solenoids with a different type under the condition adverse to quality program.

(2) Prior to the inspection, the licensee identified cracked grout under a Unit 1 PSW strainer and a Unit 2 RHRSW strainer. Condition adverse to quality reports were properly initiated and issued. Both conditions were evaluated by the licensee and determined to be acceptable, and the team concurred with the licensee's conclusion. However, a calculation, SCNH-94-007, initiated to support operability of the PSW strainer pad was incomplete. The calculation had been abandoned when operability could be supported through field observations. The calculation should have been voided to avoid inappropriate uses of the document in future applications. The licensee indicated that the calculation would be superseded.

c. A condition adverse to quality report was issued by corporate engineering in an untimely manner. During the week of December 6, 1993, the corporate MOV coordinator reviewed required torque information from the vendor of the turbine building isolation valves. This information indicated that the valves on Unit 1 would not close under all necessary conditions. From that time until January 20, 1994, conservatisms in the thrust calculations were reduced in an attempt to justify the motor operated valves' capability. However, no condition adverse to quality report was initiated until January 20,

1994. After the CAQ report was initiated, licensee representatives met, established an appropriate course of action, and began an operability evaluation. The operability evaluation was completed on January 26, 1994, and indicated that the valves could still perform their safety functions. The operability evaluation was based upon successful testing of the valves during simulated LOOP/LOCA conditions and also upon consideration that adequate flow to safety-related equipment could be achieved even with the valves partially open. The operability evaluation appeared to be satisfactory and consistent with NRC guidance on operability determinations. The licensee indicated that the valve motors would eventually be replaced with higher thrust-rated motors. However, the failure to promptly identify and correct a condition adverse to quality is considered an example of VIO 50-321,366/94-01-05, "Inadequate Condition Adverse to Quality Actions." Other examples of similar untimely or inadequate corrective actions have been identified by the NRC.

d. In the mid-1980s, the licensee failed to issue a required LER associated with the Unit 2 RHRSW system. As previously discussed, in order to assure that no contamination in the RHR system leaks into the environment through the RHR heat exchanger, the RHRSW system was designed to maintain the pressure on the RHRSW side (tube side) of the heat exchanger at least 20 psi higher than the pressure on the RHR side (shell side). This assured that any leakage was into, rather than out of, the RHR system.

To demonstrate the operability of this function, TS 4.7.1.1 required that once per 92 days, the pumps be verified to be capable of the performance required to maintain this differential pressure under the worst case design conditions. The basis for the TS numerical values was Bechtel Calculation # 500, Rev 0, April 22, 1985, "RHR to RHRSW Delta P w/ Flow Control (Unit 2)." This calculation concluded that with the then existent TS surveillance requirement for pump performance ($\geq$ 300 psig discharge pressure at a flow of $\geq$ 4,000 gpm), not only could the required 20 psid not be maintained for all design conditions, but that with this level of performance, the differential pressure could be as much as 94 psid in the wrong direction. The calculation's conclusion was that the TS was not acceptable.

More than a year after this discrepancy was originally discovered, after investigation by Southern Company Services (letter from William F. Garner to P. R. Bemis, log no. REA-6-6-602, dated June 19, 1986), Deficiency Report No. 2-86-298 was written. After further investigation, the licensee discovered that in five separate instances, the pumps had not met the correct performance requirements which, per the above referenced letter, were actually 800 feet TDH at 4,000 gpm. This deficiency report also concluded that the fact that the pumps were not meeting the required performance criterion, was reportable under 10 CFR 50.73 as an LER. However, in a subsequent Plant Review Board Meeting Minutes (meeting 86-183, dated August 7 1986), the board concluded that this was not reportable. The minutes state, "From the information currently available there is no positive indication that the tech. spec. discharge pressure requirement would prevent RHRSW from maintaining a positive differential pressure with respect to its associated RHR system. Based on this information presented by S. B. Tipps, this DR was made not reportable." It is not clear from the minutes what "currently available" information (other than the letter cited above which had led to the opposite conclusion) led to this determination. In a later memorandum from NSLD Hatch to S. B. Tipps, log no. SL-1685, dated December 11, 1986, it was also concluded that not meeting the correct performance requirements was not reportable because nothing could be found in the FSAR that specifically, ". . . state[s] that one of the functional requirements of the system is to provide a barrier to radioactive materials." Based on the above described documents, the licensee closed the discrepancy report on December 29, 1986, with no further action taken with respect to reportability.

Upon identification of this matter to licensee representatives, they indicated that corporate management had made the final decision on not reporting this situation versus the original conclusion drawn by plant personnel in DR 2-86-298. The licensee's final reportability conclusion on this situation was incorrect. Unit 2 FSAR Section 9.2.7.3 described this function. Also, FSAR section 9.2.7.1.2 under the power generation design bases stated the RHRSW system pressure would be higher than the RHR system pressure to preclude radioactive leakage. FSAR section 14A.23 required preoperational testing of the modulating valve that should maintain the pressure differential (If pump performance has the necessary capability). Additionally, the ability of the RHRSW system to limit radioactive discharge to the environment was clearly reflected in major features of the design (high pressure pumps, piping, and other components, and the throttle valve at the heat exchanger discharge). Also, this was a standard design feature established by General Electric for this system on other BWR 4s similar to Hatch. 10 CFR 50.73 requires licensees report within 30 days "Any event or condition that resulted in the condition of the nuclear power plant, including its principle safety barriers, being seriously degraded, or that resulted in the nuclear power plant being: . . . In a condition that was outside the design basis of the plant . . ." Contrary to this requirement, as described above, the licensee in 1986 discovered that on five separate occasions the RHRSW pumps had been in a condition that was outside their design basis, and no LER was issued to the NRC. This is violation 50-366/94-01-09, "Failure to Issue an LER associated with the RHRSW System." The team verified that under the current licensee reporting procedures, such issues would be reported as required.

e. Although immediate corrective actions to the situation discussed in paragraph 9.d. were timely and adequate, long term corrective actions lacked the same level of timeliness and thoroughness.

The actual surveillance test procedure, Document Number 34SV-E11-004-2S, "RHR Service Water Pump Operability," was immediately revised to reflect higher, correct performance requirements (Revision 3, dated September 28, 1986). Since that revision, all subsequent revisions of the procedure also reflected the appropriate pump performance requirements. Also, since 1986 there was only one occasion where a pump did not meet the correct acceptance criteria, and in that case, the licensee took the appropriate corrective action.

However, the TS had yet to be changed and the licensed operators had not been formally informed of the incorrect TS. In addition to having the incorrect numerical value for the RHRSW performance, the TS value was stated incorrectly. The TS stated that the pumps were to be demonstrated operable by verifying that each pump ". . . develops a discharge pressure of $\geq$ 300 psig at a flow of $\geq$ 4000 gpm." This statement represented the minimum required discharge pressure at the minimum river level. However, as stated, this requirement was only valid if the test were done when the river was actually at the minimum level. For all higher river levels, the actual discharge pressure would increase because the water would require less lift from the river to the pump discharge. Therefore, the required discharge pressure should have been increased accordingly to assure that the pump performance remained adequate for the minimum river level. The surveillance procedure did account for this with a graph of acceptable discharge pressure versus river level, but the TS did not. (It should be noted that the commonly accepted method for stating pump performance requirements is TDH at the required flow, since TDH is a pure performance parameter independent of river level. This is how the Unit 1 RHRSW TS 4.5.C.b. was written.)

Upon inquiry by the team, the licensee indicated that the TS was to be corrected as part of the TS upgrade program. The tentative NRC approval date for using the new TS was June 1994. Also, as an interim measure, the licensee issued a TS clarification to the operating crews on February 10, 1994.

f. The onsite review committee met at the required frequency, and reviewed the appropriate material with an adequate quorum.

10. Exit Interview

The team conducted an interim exit meeting on February 11, 1994, at the Hatch Nuclear Power Station to discuss the major areas reviewed during the inspection, the strengths and weaknesses observed, and the inspection results. Licensee representatives and NRC personnel attending at this exit meeting are documented in Appendix A of this report. The team also discussed the likely informational content of the inspection report. The licensee did not identify any documents or processes as proprietary. There was one dissenting comment at the meeting regarding a potential violation associated with PSW hydraulic model input controls. After the interim exit, the licensee provided additional information regarding limitations on when the model would be used and how the model would be updated with the most current plant data prior to the use of the model. Subsequently, the team considered the information adequate to resolve the concern of using outdated inputs in the hydraulic model.

The team conducted a final exit meeting on February 25, 1994, at the Hatch Nuclear Power Station to discuss the strengths and weaknesses observed and the inspection results associated with the PSW re-benchmarking effort. Licensee representatives and NRC personnel attending at this exit meeting are documented in Appendix A of this report. The team also discussed the likely informational content of the inspection report applicable to hydraulic model benchmarking. The licensee did not identify any documents or processes as proprietary. There were no dissenting comments at the meeting.

ITEM NUMBER	STATUS	PARAGRAPH	DESCRIPTION
94-01-01	Open	4.b	IFI - PSW System Flow Model Verification
94-01-02	Open	4.c	UNR - HELB Protection for SWSs within the Containment
94-01-03	Open	4.e	UNR - Necessity for an RHRSW Radiation Monitor
94-01-04	Open	5.b.1, 5.c.1, 5.c.2, 6.c.1	VIO - Failure to Follow Procedures or Inadequate Procedures
94-01-05	Open	6.c.2, 9.c	VIO - Inadequate Condition Adverse to Quality Actions
94-01-06	Open	6.c.3	IFI - Clam/Mussel Inspection Initiatives
94-01-07	Open	6.c.4	IFI - RT Program Continued Development
94-01-08	Open	6.c.5	IFI - Pump Column Periodic Integrity Evaluations
94-01-09	Open	9.d	VIO - Failure to Issue an LER associated with the RHRSW System
92-15-03	Open	6.a.2	IFI - Resolution of RHRSW Air Release Valve Issues

APPENDIX A

HATCH NUCLEAR POWER PLANT

Persons Contacted

* E. Burchett, Supervisor Engineering Support
* R. Davis, Acting SEAR Site Supervisor
* K. Cumbie, System Engineer
* D. Desmukes, Bechtel
* H. Dougherty, Co-owner Representative
* T. Elton, Acting NS&C Manager
\+ J. Gilmer, Bechtel
* G. Goode, Engineering Support Manager
* M. Gourge, Outage Planning Manager
* S. Grantham, Training & E.P.
* J. Hammonds, Regulatory Compliance Supervisor
*+ T. Long, Project Engineer
* B. Manning, Plant Chemist
\+ B. Miller, Bechtel
* C. Moore, Assistant General Manager - Operations
*+ D. Read, Assistant Site Manager for Plant Support
* K. Robuck, Manager PM&MS
\+ L. Sumner, General Manager
* D. Swann, Engineer
* J. Thompson, Security Manager
*+ S. Tipps, Manager, Nuclear Safety and Compliance
* P. Wells, Operations Manager
*+ D. Willyard, Engineer
*+ P. Zaloum, Engineer

U.S. NUCLEAR REGULATORY COMMISSION

*+ L. Mellen, Reactor Inspector
* D. Prevatt, PowerDyne Corporation
*+ L. King, Reactor Inspector
* W. Rogers, Team Leader
* J. Shackelford, Reactor Inspector
* R. Holbrook, Hatch Resident Inspector
* D. Tamai, Intern
*+ L. Wert, Senior Resident Inspector
* P. Skinner, Division of Reactor Projects Section Chief

* Indicates those present at the exit meeting on February 11, 1994
\+ Indicates those present at the exit meeting on February 25, 1994

APPENDIX B

Generic Letter 89-13 Action Items

I. Biofouling Control and Surveillance Techniques

Action I of GL 89-13 requested licensees implement and maintain an ongoing program of surveillance and control techniques to significantly reduce the incidence of flow blockage problems as a result of biofouling. The actions requested included intake structure inspections, periodic SWS flushing/flow testing and chemical treatment of the SWS.

SWS Intake Structure Biofouling Inspections - The licensee inspected the wetted surfaces of the intake suction pit per Preventive Maintenance Procedure, 52PM-MME-006-0S, Intake Structure Pit Inspection. (This monitored for macroscopic biological fouling organisms and sediment)

The team reviewed the results of the last three performances of this procedure, and selected portions of the procedure were walked down. The procedural guidance which was provided was adequate; however, the licensee did not document corrective actions for unsatisfactory test results. The deficient results, as reported by the chemical vendor, included improper sampling to detect clam larva and zebra mussels and insufficient sediment sample supernatant volumes to provide complete analyses. The team discussed these actions with the plant chemical staff and determined that they believed there was no Asiatic clam problem in the service water system. This belief was based, in part, on the fact there was no record of equipment failure, either in plant records or corporate memory, which was related to biofouling. Adult Asiatic clams had been detected in the intake forebay and in the cooling tower flume (the SWS common discharge point) but they have not been detected in the SWS piping or heat exchangers.

During the inspection, the licensee elected to re-sample the intake wet pit sediment for biological fouling. The samples were gross filtered and the clams which were collected were examined. The team verified there were no adult zebra mussels in the sediment samples. The sediment was not analyzed for fouling organism larva, at least in part, because it was not spawning season.

Based on records reviewed and interviews, zebra mussels have not been detected. The team concluded this is because their migration has apparently not reached this portion of Georgia and not due to improper zebra mussel sampling techniques.

Sediment Inspections and Corrective Actions in the Intake Wet Pit (Forebay) - The licensee used three methods to prevent the accumulation of sediment in the intake. These included the addition of flocculent to the SWS to prevent the suspended solids from coming out of solution in the SWS, digging a large hole in the river bed in front of the intake structure to allow the sediment the suspended solids to drop out of solution and settle in this hole, and inspecting in the wetted surfaces of the intake suction pit per Preventive Maintenance Procedure, 52PM-MME-006-0S, "Intake Structure Pit Inspection."

The team determined the flocculent program was still in the development stage and that there were no analytical results to prove that a smaller amount of sediment would actually settle in the SWS as a result of this effort. Based on interviews, the team determined that the licensee was not increasing the inspection frequency on some silted components due to the belief that the flocculent would minimize the accumulation. There was no objective evidence for this course of action. The location of the hole outside the intake structure was determined by the Hydrology Group in Atlanta. While the plant personnel were convinced this approach had positive effects, there was no objective evidence that it was effective. The team determined that the licensee did not adjust the intake pit structure inspection frequency to ensure the pit sediment level was below the accumulation acceptance criteria of 12 inches or take timely corrective actions when the acceptance criterion was not met. The most recent inspection results of November 1993 documented 7 of the 10 samples above the acceptable sediment depth. The inspection which had been conducted 10 months previously, showed all of the sample points within the acceptance criteria. Although there was a work order issued to correct this problem, the work was not scheduled for approximately six months after the condition was discovered. The team concluded that the inspection program was acceptable; however, the corrective actions were not timely.

<u>Infrequently Used Heat Exchangers and Piping Dead Legs</u> - General Operating Procedures 34GO-OPS-024-1S and 34GO-OPS-024-2S, "Equipment Rotation and Flushing of PSW and RHRSW Piping Deadlegs," provided instructions for alternating and flushing the piping supplying SW to infrequently operated components.

The team reviewed the program and determined that the scope of the flushing program was adequate. The results of the last three deadleg flushes were well documented and no problems were noted.

<u>SWS Chemical Treatment</u> - Microbiological control was attained by simultaneous injection of sodium hypochlorite and sodium bromide at the plant intake. The treatment method was to inject low levels of oxidizing biocides for long periods of time. [This was a change from the Georgia Power Company's May 1992 Generic Letter 89-13, "Initial Action Summary Report," which stated the chlorination was 30 minutes per day when needed.] The SWSs were aligned to completely discharge to the flume during any period of oxidizing biocide addition. The flume was allowed to fill and then overflow to the plant discharge during chemical addition. Also, the licensee indicated that service water loops were not placed in wet layup. Therefore, the loops were not filled with chlorinated or equivalently treated water before layup.

The team reviewed the licensee's program and it appeared effective since there was no evidence of microbiological fouling in the SWS piping or components. The diluted chemicals were well below EPA limits because of the dilution methodology employed. Also, the team found no evidence of systems that should have been left in wet layup. The water at the inlet of the plant indicated a corrosive, rather than a scaling environment.

The water quality indicated that there was very little runoff from industry, farms or sewage treatment upstream of the plant. The monitored parameters remained relatively constant, and the water quality was similar to that of ground water.

II. Monitoring Safety-Related Heat Exchanger Performance

Action II of GL 89-13 requested licensees implement a test program to periodically verify the heat transfer capability of all safety-related heat exchangers cooled by the SWS. The test program was to consist of an initial test program and periodic retesting.

In response, the licensee committed to test the safety-related heat exchangers in accordance with Electric Power Research Institute Report, "Heat Exchanger Performance Guidelines for Service Water Systems." The three methods used for performance monitoring of heat exchangers were the temperature effectiveness method, temperature monitoring method, and periodic maintenance.

The temperature effectiveness method was used to determine operability of the corner room heat exchangers. These rooms house the core spray pumps, RHR pumps, RCIC pump, HPCI, and control rod drive pumps. The results of this method would have exceeded the established acceptance criteria in several instances if instrument accuracy were considered. However, the allowable temperatures were set conservatively and compensated for the instrument accuracy with respect to the allowable environmental requirements for the areas affected.

The temperature monitoring method was used to determine the operability of the coolers for the PSW and RHRSW motor coolers; however, the method was incorrectly applied. In order to use the temperature monitoring method, it is required that the limiting flow conditions be attained or simulated. Since establishment of this condition was not possible, this method could not be used to determine operability. The licensee agreed with the team's assessment and contacted the manufacturer. The vendor of the motors forwarded a letter stating that under postulated accident conditions of 95°F service water and 122°F ambient temperatures, a margin of approximately 20°F will be available to assure proper operation of the PSW and RHRSW pump motor bearings and motor (assuming that normal maintenance has been performed and that the motors are operated within specified criteria defined on the motor outline drawings). The team found this an acceptable response based on the difficulty of testing these coolers and the fact that they have been changed to stainless steel and are equipped with a high temperature alarm that should give adequate warning of problems.

The periodic maintenance method was used to determine the ability of the CR HVAC, RHR, and the EDG heat exchangers to meet their safety-related requirements. As previously discussed in paragraph 6.c, the guidance that was provided was inadequate. The EPRI manual states that the thickness of many biofilm layers is significantly reduced when they are in a dry condition and can appear as deceptively thin layers during an inspection. These layers may be significantly thicker in their normal wet condition. Therefore, inspectors should be trained to look for more than just gross fouling or blockage. Some of the EPRI guidelines were contained in Procedure 42EN-ENG-026-0S, Rev. 1, December 17, 1993, "Service Water Systems Heat Exchanger Testing." However, this procedure was not referenced to the applicable preventative maintenance procedures.

The licensee had records for cleaning all heat exchangers on a periodic basis consistent with the guidance in the GL except for those in the RHR system. Only one inspection of one RHR heat exchanger had been performed. Also, section 2.2 of Procedure 52PM-E11-009-0S, "RHR Heat Exchanger Preventative Maintenance," stated, "The recommended performance frequency for this procedure is once every three refueling cycles." The procedure did not address the once per cycle guidance of the generic letter. This was justified by a letter to the NRC dated January 23, 1990, in which the licensee stated that these frequency requirements may not be met, but for cases where they were not met, justification would be developed. The licensee stated that this "justification" was a data trending program when the RHR heat exchangers were in normal service, and a letter from Bechtel to the licensee dated July 9, 1990, was presented describing this program. However, the licensee produced no evidence that this program had actually been implemented. Additionally, the frequency specified in the procedure was only "recommended," and not required.

Since the licensee's program for assessing the heat transfer capability of the RHR heat exchangers was considered to be inadequate, the present heat transfer capability of the heat exchangers was evaluated by the team. The team reviewed other design and testing information that provided strong indication that the heat exchangers were capable of performing their design function. The information which was reviewed included a comparison of the design fouling factor of the RHR heat exchangers, 0.002 BTU/hrft$^{2\circ}$F, with the design fouling factor of the PSW heat exchangers, 0.001 BTU/hrft$^{2\circ}$F. Testing of the PSW heat exchangers has consistently indicated actual fouling factors considerably less than design. Since the RHR heat exchanger was cooled by the same river water, its actual fouling factor was not likely to be significantly different from the PSW heat exchangers; thus, its heat transfer capability should have had a considerable margin above the design limits.

Although the instructions provided for the other heat exchangers were also inadequate, these were cleaned on a regular basis. This periodic cleaning, combined with good water quality and the PSW heat exchanger test results, indicated that adequate heat transfer capability existed.

III. Routine Inspection and Maintenance

Action III of GL 89-13 requested licensees implement a routine inspection and maintenance program for open-cycle SWS piping and components. This program was to ensure that corrosion, erosion, protective coating failure, silting, and biofouling would not degrade the performance of the safety-related systems supplied by the SWS.

<u>Piping</u> - Inspection of PSW and RHRSW piping was performed by Inspection and Test Procedure 42IT-TET-012-2S, "Plant Service Water and RHR Service Water Piping Inspection Program" (this monitored the piping walls for degradation due to corrosion, erosion and microbiologically induced corrosion). This procedure was adequate; however, the acceptance criterion did not identify an apparent 47 percent degradation of the 1B Diesel Generator PSW line in a 16-month period as requiring evaluation. If this corrosion rate had been correct, the wall thickness at the time of the NRC inspection would have been below minimum wall thickness. After questioning by the team, the licensee retested the 1B Diesel Generator PSW outlet piping using UT techniques. The results were similar to the previous results (Approximately +.017 over the previous reading.) This indicated that the previous reading may have been in error and the wall thickness was acceptable. The team noted the corrosion was the result of radiographing a pit in the piping and not overall wall thickness degradation.

Also, 10 of 25 points inspected had increased in size during a 16-month period. Although there was no mechanism to cause this phenomena, the licensee did not document evaluating these readings. Several values were above the nominal piping wall thickness, which were outside the procedural acceptance criteria. Piping of the type inspected with this procedure is manufactured with a ± 12 percent wall thickness accuracy. The procedure test acceptance criterion was less than or equal to the average wall thickness for this type of piping and not the upper end of the nominal wall thickness band. Consequently, any value that was above average wall thickness did not meet the acceptance criteria. The test engineer stated that although these values were outside of the written acceptance criteria, it was interpreted that the acceptance criteria should have included these points. While the team understood this position, there was no objective evidence to support this undocumented position on acceptance criteria.

The team concluded that the erratic RT results were caused by failing to precisely define the position of the RT source. Since RT examines only the wall thickness at a given cross sectional area, the movement of the source or the film by only a small amount changes the cross sectional area examined. This makes it difficult to precisely measure the changes between readings and establish a meaningful corrosion rate.

In November 1992, the licensee began the injection of a dispersing product. Once the concentration reached approximately 0.45 ppm, the licensee began to add zinc to reduce system corrosion. The concentration of zinc addition was gradually increased to 0.25 ppm. The current levels of these chemicals will be adjusted as experience warrants. The team could not ascertain that any conclusive benefits had resulted from the zinc addition program.

Pumps and Valves - Pumps and pump motors were refurbished or rebuilt and installed on a periodic and as needed basis. The maintenance schedules for the PSW and RHRSW pumps were satisfactory. Critical check valves and motor operated valves were periodically inspected with actions taken to identified discrepancies.

Heat Exchangers - Heat exchanger inspections were discussed under action item II.

IV. Design Function Verification and Single Failure Analysis

Action IV of GL 89-13 requested licensees confirm that the SWS would perform its intended function in accordance with the licensing basis for the plant. This confirmation was to include a review ensuring requisite safety functions were accomplished even with the failure of a single active component.

In response to this action item the licensee performed a design review for single and common mode failures.

The team reviewed the licensee's completed design review and found that it satisfied the requirements of the GL.

V. Training

Action V of GL 89-13 requested licensees confirm that maintenance practices, operating and emergency procedures, and training involving the SWS were adequate to ensure safety-related equipment cooled by the SWS would function as intended.

In response to this action item, the licensee performed a self-assessment of the SWS including a review of the applicable procedural guidance. The results of the review required various changes to plant operating and maintenance procedures.

The team evaluated the licensee's corrective actions to the procedural review as they related to this area and found them to be adequate. The licensee's performance reflected appropriate maintenance training. It was concluded that licensed operator training was adequate.

APPENDIX C

ACRONYMS AND ABBREVIATIONS

ASME - American Society of Mechanical Engineers
BWR - Boiling Water Reactor
CFR - Code of Federal Regulations
CRD - Control Rod Drive
EDG - Emergency Diesel Generator
EPRI - Electric Power Research Institute
FSAR - Final Safety Analysis Report
GL - Generic Letter
GPM - Gallons Per Minute
HELB - High Energy Line Break
HPCI - High Pressure Coolant Injection
HVAC - Heating Ventilation and Air Conditioning
IFI - Inspector Follow-up Item
IPE - Individual Plant Examination
IST - In-service Test
LER - Licensee Event Report
LOCA - Loss of Coolant Accident
CR - Control Room
MWO - Maintenance Work Orders
MOV - Motor Operated Valve
NSLD - Nuclear Services Licensing Department
PPM - Parts Per Million
PRA - Probabilistic Risk Analysis
PSID - Pounds per Square Inch Differential
PSIG - Pounds per Square Inch Gauge
PSW - Plant Service Water
RCIC - Reactor Core Isolation Cooling
RHR - Residual Heat Removal
RHRSW - Residual Heat Removal Service Water
RT - Radiographic Testing
SOV - Solenoid Operated Valve
SWS - Service Water System
SWSOPI - Service Water System Operational Performance Inspection
TDH - Total Developed Head
TS - Technical Specification
UNR - Unresolved Item
VIO - Violation

APPENDIX D

Test location	(T)test reading	(I)initial model prediction	T - I ---- X 100 T	corrected model prediction	final error
HPCI Room Coolers	3.5	30.5	771%	31	785%
RHR Pump Cooler	30	29.1	-3%	32.4	8%
(T41-B003-A)	169.5	192.7	13.7%	196	15.6%
(T41-B003-B)	131	186	42%	189	44.3%
CRD Room Coolers	105	115.1	9.6%	109	3.8%
CR HVAC Div. II	14	139	n/a	0	n/a
Div. II RX Bldg	440	725	64.8%	591	34%
Div. II TB Bldg	9975	13950	39.8%	9033	-9.4%
D/G 1C	915	952	4%	954	4.2%