TVA

SERVICE WATER SYSTEM
OPERATIONAL PERFORMANCE INSPECTION (SWSOPI)

BROWNS FERRY NUCLEAR PLANT

Prepared for:

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EXECUTIVE SUMMARY

On April 17, 1995, the Tennessee Valley Authority (TVA), assisted by Ogden Environmental and Energy Services Co., Inc. (Ogden), began onsite activities related to performing a Service Water System Operational Performance Inspection (SWSOPI) of the safety-related Emergency Equipment Cooling Water (EECW) and Residual Heat Removal Service Water (RHRSW) systems at Browns Ferry Nuclear Plant (BFN). TVA elected to perform a self-assessment of the BFN service water systems in lieu of the Nuclear Regulatory Commission (NRC) performing a SWSOPI. The self-assessment plan was preapproved by the NRC in accordance with Inspection Procedure 40501, "Licensee Self-Assessments Related to Area of Emphasis Inspections."

The self-initiated inspection of the EECW, RHRSW, and interfacing systems used selective sampling and vertical-slice inspection techniques. Document reviews, walkdowns, and personnel interviews were used to identify weaknesses or missing information in the design basis, operating, or design output documents. The inspection was performed in accordance with guidance contained in NRC Temporary Instruction 2515/118, Service Water System Operational Performance Inspection, Revision 1. An inspection plan was prepared to provide additional guidance to the reviewers.

The SWSOPI team consisted of four Ogden inspectors, one TVA/BFN inspector, and a team leader (the Ogden team leader also served as an electrical reviewer). Over a 5-week period, the team examined plant activities in the areas of mechanical and electrical systems design, operations, maintenance, surveillance and testing, and quality assurance. During the inspection, a total of 64 Action Items documenting requests for additional information were issued by the inspection team. Copies of all Action Items issued during the inspection are available in separately prepared binders.

Overall, the team found that the service water system was capable of performing its safety functions on demand.

However, weaknesses were identified in documentation and in some plant practices. Overall, 22 observations were written during the inspection and are attached to this report. From the observations, weaknesses identified were characterized into six areas:

- Heat Exchanger and Piping Inspections - BFN has elected to inspect and clean heat exchangers in lieu of thermal performance testing. An exception to regular and periodic cleaning of heat exchangers was the case of the air sides of room coolers. The air side of five out of six coolers was found to require cleaning. In addition, documentation of as-found conditions during heat exchanger and piping inspections is not always completed, and some individuals performing internal inspections are not formally trained. These weaknesses suggest a need for increased management attention to assure that all program elements are accomplished.

- Check Valve Testing - Check valves between the EECW and the chemical treatment system are not in the in-service testing (IST) program and are required to function as a boundary between Class 3 and non-Class systems.

- Weakness in Design Analyses - Non-conservative assumptions were used in HVAC design analyses. For example, a calculation for the core spray pump room cooler assumed two coolers, whereas there is only one cooler in the room.

- Operations/Engineering Interface - Examples were found where EECW alarms are viewed as system performance based, but supporting engineering documentation indicates the alarms are component based. For example, an EECW header low flow alarm may annunciate during an accident based on the setpoint for the new flow transmitters currently being installed.

- Response to External Flood - The procedure used to implement the site response to a flood is weak. For example, the Unit 3 Diesel Building Drain check valves cannot be verified closed in a timely manner because a welded grating prevents access to the check valve for inspection.

- Transient Material Control - Transient materials that were stored improperly were found, for example, oil soak rags in the Unit 3 diesel fuel transfer pump room without permits, unchocked Genie lift truck wheels, and unsecured scaffolding and ladders.

Strengths were also identified during the team's effort. The team found that the plant design is extensively documented through design criteria documents, systems requirements calculations, and numerous design calculations. The installation of the Calgon chemical treatment system and the stainless steel piping upgrades were viewed as strengths. The plant operators were found to be knowledgeable in systems operation, and plant material condition was considered good.

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SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

1.0 BACKGROUND

As part of a program to improve the reliability of service water systems at nuclear reactors, and because of a large number of previously identified problems at nuclear power plants which questioned the ability of service water systems to perform their design function, the U.S. Nuclear Regulatory Commission (NRC) developed and is implementing Service Water System Operational Performance Inspections (SWSOPIs). Tennessee Valley Authority (TVA) elected to perform a self-assessment of the Browns Ferry Nuclear Plant (BFN) service water systems in lieu of the NRC performing a SWSOPI. The self-assessment plan was preapproved by NRC in accordance with Inspection Procedure 40501, "Licensee Self-Assessments Related to Area of Emphasis Inspections." The self-assessment of the BFN safety-related Emergency Equipment Cooling Water (EECW) and Residual Heat Removal Service Water (RHRSW) systems was performed from April 10, 1995 through May 12, 1995. The self-initiated SWSOPI used vertical-slice performance-based review techniques.

2.0 METHODOLOGY AND SCOPE

2.1 METHODOLOGY

A SWSOPI is an interactive inspection in which a team of highly qualified and experienced inspectors focus on the functional capability and reliability of a system or group of systems. The team of five Ogden inspectors and one TVA inspector examined plant activities in the areas of mechanical and electrical systems design, operations, maintenance, surveillance and testing, and quality assurance/corrective actions. The inspection methodology relied upon two basic principles:

1. Through the daily interaction of a relatively small number of senior, experienced inspectors, deficiencies can be identified which otherwise may remain undetected.

2. By conducting a detailed review of selected systems (also called deep vertical-slice reviews), conclusions can be drawn as to the overall plant design process, operations, and management controls.

The inspection consisted of an audit-level review of the BFN service water systems (EECW and RHRSW) design bases, using document reviews to ensure consistent application of the design bases down through the BFN design output and operating documents. The inspection used selective sampling vertical-slice (SSFI type) reviews of the service water system (including walkdowns and personnel interviews) to identify weaknesses in the design bases, operating, or design output documents.

The inspection was performed in accordance with guidance contained in the NRC Temporary Instruction (TI) 2515/118, Service Water Systems Operational Performance Inspection, Revision 1. In accordance with TI 2515/118, the inspection:

- Assessed planned or completed actions in response to Generic Letter (GL) 89-13, Service Water System Problems Affecting Safety-Related Equipment.

- Verified that the service water system is capable of fulfilling its thermal and hydraulic performance requirements and is operated consistent with its design bases.

- Assessed the service water system operational controls, maintenance, surveillance and other testing, and personnel training to ensure the system is operated and maintained so as to perform its safety-related functions.

In addition to the above, the inspection placed an emphasis on a review of recent modifications and other changes that could affect the reliability of the service water systems.

Prior to the start of the inspection, an inspection plan and checklist was prepared (Attachment 1). The plan was provided as guidance to the reviewers, not as a rigid checklist, but as a starting point for the various directions that the inspection might take. Where weaknesses were identified, the inspection was intensified in the areas of weakness to determine the extent of potential weakness. In addition, the review was not limited to the licensing basis of the plant, but was often extended beyond the original licensing basis in order to determine the functionality and reliability of the systems.

The inspection plan was supplemented by the SWSOPI Critical Attributes Matrix (CAM). This matrix provided guidance to each inspector for the topical areas and priorities under their responsibility. The CAM also provided a reference to topics that have become issues or concerns at other plants during previously conducted SWSOPIs. A completed copy of the CAM is included within the plan (Attachment 1).

2.2 SCOPE OF REVIEW

The inspection was performed for Unit 2 and included those portions of the EECW and RHRSW in Units 1 and 3 that are necessary for operation of Unit 2. The inspection also included assessment of Unit 3 EECW and RHRSW systems to the extent possible. Due to the recovery status of Unit 3, all systems are not currently in service. However, the system requirements for multi-unit (Units 2 and 3) operation were assessed. For example, the following areas of review for Unit 3 were performed:

- Implementation of heat exchanger inspection and cleaning, which is directly applicable to Unit 3 operation as these heat exchangers become operational.

- Surveillance testing of EECW and RHRSW pumps and testing of RHRSW pump room sump pumps that are common to Units 2 and 3.

- Completeness of the IST program for pumps and valves as the Unit 3 valves become operational.

- Walkdowns and engineering assessments of RHR and core spray (CS) pump room coolers were performed.

- Unit 2 maintenance practices.

- Design analysis demonstrating EECW flow during Units 2 and 3 operations.

- Material condition reviews.

- The consequences of external phenomena and internal flooding.

Based on the reviews performed, the activities and programs to return Unit 3 to service should be adequate.

3.0 TEAM COMPOSITION

The inspection team was composed of the following Ogden and TVA members:

Position	Inspector
SWSOPI Technical Team Leader (and Electrical Reviewer)	Stanley F. Kobylarz, Ogden
Mechanical Design Reviewer	Stuart M. Klein, Ogden
Operations Reviewer	Redford Norman, Ogden
Maintenance Reviewer	John M. Hilditch, Ogden
Surveillance and Testing Reviewer	Gary J. Overbeck, Ogden
Quality Assurance/Corrective Actions Reviewer	Charles Jansing, TVA

The response team was composed of the following TVA members:

Position	Response Team Member
Engr/Response Team Leader	Howard Crisler
Corporate Licensing	Charlie Davis
Operations	Johnny Dollar
Tech Support/Sect XI	Charlie Driskill
Chemistry	Jay Grafton
Corp Maint & Tech Supt	Tom Golston
Work Control	Paul Harris
Tech Support/Sys Engr	Ed Kirby
Engineering/Mechanical	Frank Lascalzo

Maintenance	Gary McConnell
Engineering/Civil	Jon E. McCord
BOP Supervisor	Jim Shaw
Engineering/Electrical	Jackie Wright
BOP Support/System Engineer	John Woodward
Escort	Eric Predmore
Escort	Jody Black
Escort	Vicki Bauer
Escort	Clay Whitworth
Escort	Ron Robinson
Escort	Travis Shults

4.0 SCHEDULE OF ACTIVITIES

The schedule of activities included 5 weeks of actual inspection, including 3 weeks of onsite inspection at the Browns Ferry Nuclear Plant in Athens, Alabama, and several weeks of final evaluation and report writing. The actual schedule follows:

Week 1 April 10, 1995 through April 14, 1995

Preparation of an Inspection Plan and SWSOPI Critical Attributes Matrix.

Initial reviews in Ogden offices.

Week 2 April 17, 1995 through April 21, 1995

SWSOPI Entrance Meeting (April 17, 1995).

Team members begin review of design documentation at BFN, walk down the service water systems, and are badged.

Week 3 April 24, 1995 through April 28, 1995

Team continues review at BFN with daily team meetings.

Week 4 May 1, 1995 through May 5, 1995

Ogden team members continue review at Ogden offices.

TVA team members continue review at BFN.

Week 5 May 8, 1995 through May 12, 1995

Team members continue/conclude review activities at BFN with daily team meetings.

Exit meeting to summarize results of inspection for BFN management and staff on May 12, 1995.

Weeks 6 and 7 May 15, 1995 through May 26, 1995

Team members prepare draft inspection report.

Draft inspection report submitted to TVA for review (May 26, 1995).

Weeks 8 and 9 May 30, 1995 through June 9, 1995

Draft report reviewed by TVA.

Weeks 10 and 11 June 12, 1995 through June 23, 1995

Incorporate TVA comments and submit final inspection report on June 23, 1995.

5.0 GENERAL CONCLUSIONS

The inspection involved a substantial review of design, operations, maintenance, surveillance, and quality assurance related documents; walkdowns of the system and interfacing equipment such as HVAC; and interviews with engineering, licensing, operations, testing, and maintenance personnel. When questions arose or weaknesses were perceived, inspection observations were prepared, using an inspection observation form. As additional information was developed relative to a specific observation, the observation was revised. The final inspection observations are included in Attachment 2.

Based on inspection observations, as set forth in this report, and the specific discipline area summaries of Section 6.0, the team found that the service water system is capable of performing its safety functions on demand. References to specific inspection observations contained in Attachment 2 appear in parentheses in the text. Strengths or positive observations were not documented on observation forms. The strengths presented in this section were formulated from the overall team effort.

In total, 22 observations were written throughout the inspection. The scope of the inspection plan was accomplished by the team and the TI-2515/118 objectives were met as follows:

1. Implementation of Generic Letter 89-13

The team found that planned or completed actions in response to recommended actions, Tasks I through V of GL 89-13, were adequate and that the service water systems are functional in accordance with design requirements. General observations are discussed below with applicable weaknesses identified.

Task I - Implement and Maintain an Ongoing Program of Surveillance and Control Techniques

The inspectors found that intake inspections are being performed, and chemical injections are also performed on EECW and RHRSW. The installed Calgon system is considered a strength. The team understands that the high pressure fire protection (HPFP) system will have chemical injection in the future.

Flushing of all EECW and RHRSW dead legs is not done at BFN. For example, the RHRSW to residual heat removal (RHR) system cross-connect piping near valve 2-FCV-23-57 is not flushed. The team expected that if a dead leg cannot be flushed, the piping would be examined by radiographic test/ultrasonic test (RT/UT) or boroscope. In addition, instrument lines are not flushed during calibration tasks. At other power plants, it has been found that silt accumulation has caused instrument lines to become clogged.

Although TVA is aware of the potential for silt accumulation in instrument lines, there is no history of such accumulation at BFN. The team was informed that if TVA's trending program identified such accumulations, a preventive maintenance task or modification would be installed to correct the condition.

The layup program was not assessed (no equipment is in layup in Unit 2), but there are known deficiencies in its implementation. These deficiencies are now being corrected in Unit 3.

The BFN response to GL 89-13 states that a quarterly flow test is used to verify the design flow requirements to safety-related components through EECW piping as part of the Section XI pump testing. However, minimum required design flows supplied to safety-related components by EECW are confirmed by a combination of testing and analysis. Similarly, the BFN response to GL 89-13 indicated that the annual Section XI test on RHRSW pump is performed to verify design flow (4500 gpm) through normally assigned flow paths. However, this test also does not demonstrate that minimum design flow is supplied to safety-related components.

Task II - Conduct a Test Program to Verify Heat Transfer Capability

Currently, BFN inspects and cleans heat exchangers to meet this requirement. The team understands that RHR heat exchanger testing will be implemented in the future.

Task III - Establish a Routine Inspection and Monitoring Program

The inspectors found that a suitable inspection and maintenance program for open cycle water systems is implemented through Site Standard Procedure SSP 13.5. The team considers this a good initiative, and it has all the elements of a good program. BFN could be more aggressive with RT/UT inspection on the system. RT/UT could be used more frequently as a diagnostic tool, as the team has observed at many other nuclear plants. The team also noted that corrosion rates have been monitored.

Improvements are necessary in the documentation of the condition of the system internals when the system is opened and the heat exchangers are inspected. For example, the as-found condition of GL 89-13 heat exchangers is not consistently documented and maintained. This documentation is necessary to trend conditions over time as required by GL 89-13 (TEST-02).

Task IV - Confirm the Service Water Systems Licensing Basis and Capability to Withstand Single Failure

TVA's development of design criteria documents, system requirements calculations (SRCs), generation of numerous design calculations, and previous walkdowns is consistent with GL 89-13, Action IV requirements for design basis reviews. The inspectors were informed that extensive single failure studies have been performed in the past, but documentation of these evaluations was not available. However, during the inspection, the team was unable to identify the failure of a single active component that would prevent the EECW or RHRSW systems from performing their safety function (MECH-03).

Task V - Confirm Maintenance Practices, Operating and Emergency Procedures, and Training are Adequate

The team concluded that the EECW and RHRSW systems are maintained to perform when required. Operations, procedures, and training are consistent with the expectations of GL 89-13. However, improvements in the alarm response for EECW header low flow and low pressure, strainer and traveling screen high differential pressure, and flood response are recommended (MAINT-04, OPS-02, OPS-03, and OPS-04).

The inspectors also found that personnel performing visual inspections of service water systems' internal piping and components were not formally trained (MAINT-02). However, other training for operations and maintenance personnel was adequate.

2. Thermal Hydraulic Performance of EECW and RHRSW Systems/Design Bases

The team reviewed design analyses and calculations related to the hydraulic and thermal performance of the EECW and RHRSW systems, including in-depth reviews of the EZFLOW models and analyses for both systems. Although some weaknesses were

identified in these and related analyses, the team concluded that sufficient conservatism exists in the analyses to assure that design requirements are satisfied.

3. Impact of Plant Activities on Safety-Related Functions

The team assessed the service water systems' operational controls, maintenance, surveillance and other testing, and personnel training to ensure that the EECW and RHRSW systems are operated and maintained to perform their safety-related functions. This area of review was found to be adequate. However, some inconsistencies between the engineering and the operations personnel's understanding of the functions of the non-safety-related EECW system alarms were identified (MECH-05).

4. Quality Assurance and Corrective Actions, Operability, and Safety Evaluations

Overall, the team found that issues identified during assessments were documented on Problem Evaluation Reports (PERs) and tracked. The interface between engineering, technical support, and operations was good.

5.1 STRENGTHS OBSERVED

The following strengths were identified during the inspection:

- The plant is well documented, with many design calculations. This is viewed as a positive element of the restart programs for the units.

- The large number of RHRSW pumps is considered a strength because they provide operational flexibility.

- The level of knowledge of operations personnel, especially the younger members of the BFN operations staff, was found to be high. This suggests that senior BFN operations staff takes the time to transfer their experience to the junior level operators.

- The color-coded valve tag convention provides a positive indication of desired valve position and is a configuration control strength.

- The plant material condition is good (and, in particular, the RHRSW pumphouse condition has improved significantly).

The following items are considered noteworthy system improvements:

- Installation of the Calgon treatment system.

- Stainless steel piping upgrades of the EECW system.

- The program and features of Site Standard Practice SSP 13.5.

5.2 WEAKNESSES OBSERVED

Specific weaknesses were identified in the area of heat exchanger inspections and the translation of design information into operations requirements and procedures, and in some plant practices. Overall, 22 observations were written during the inspection. From the observations, the identified weaknesses were characterized into six areas:

Heat Exchanger Inspections

In response to GL 89-13, BFN chose to inspect and clean heat exchangers rather than to perform thermal performance testing. Thermal performance testing of the RHR heat exchangers was initiated in late 1994. With one exception, the inspectors found that heat exchangers are regularly and periodically cleaned. Maintaining a heat exchanger in a clean condition promotes confidence that the heat exchanger will perform well when required. The one exception found where heat exchangers were not cleaned regularly was the air sides of room coolers (TEST-06). In fact, the air sides of these coolers were found to be dirty. BFN's inspection of the coolers confirmed the team's finding that the air sides of five out of six coolers should be cleaned.

Nonetheless, inspection and the ability to trend the results of the heat exchanger inspection are critical to assuring that the cleaning frequency is adequate or that biofouling controls are effective between cleanings. The team found that heat exchangers are being inspected as required, but the documentation describing the condition found is not always completed and/or maintained (TEST-02). Therefore, the ability to trend and monitor conditions is limited.

Contributing to this weakness is the lack of formal training for those individuals expected to perform the condition assessments when system components are opened (MAINT-02). Although significant knowledge and experience can reside in a few individuals, confidence in the quality of the inspection program is reduced by the qualifications of the most inexperienced individuals performing the condition assessment. The ability to trend and monitor changing conditions is an expectation of GL 89-13. Although BFN is satisfying this expectation, there is not a full auditable trail to demonstrate that this expectation is satisfied.

Check Valves Testing (IST)

Check valves between the EECW and the chemical injection system are not in the IST program. These check valves are required to function as a boundary between Class 3 and non-Class systems. The team was informed that these valves will be added to the IST program. The interim actions taken to test the valves in the reverse flow direction are both appropriate and prompt (TEST-04).

Weaknesses in Design Analyses

Non-conservative assumptions were used in HVAC design analyses, for example:

- The calculation for the core spray pump room assumed two coolers, whereas there is only one cooler in the room (MECH-04).

- The same calculation assumes shutting down one train of RHR and core spray at 30 minutes into the accident. However, this action is not reflected in operating procedures. This is an unverified assumption (MECH-06).

- The air flow acceptance criteria for air side tests permits air flow rates below the values analyzed in the heat transfer calculations, which is non-conservative (TEST-03).

Consequently, calculated temperatures could be higher than those calculated for the conditions analyzed. However, during the inspection, TVA performed additional preliminary analyses to demonstrate that sufficient conservatism exists to assure that design temperatures will not be exceeded.

Operations/Engineering Interface

From an operations point of view, the EECW system alarms are system performance indicators. But, engineering documentation supporting the alarms is based on component requirements. For example, for the EECW header low flow alarm, a low flow alarm may annunciate during an accident scenario based on the setpoint for the new flow transmitters that are being installed (MECH-05). There appears to be a discrepancy in the understanding by engineering and operations of the functions for the alarms and indications; this should be reviewed and resolved by BFN.

Response to External Flood

The actions that are taken in response to external flood conditions, such as AOI-100-3, need to be reviewed and strengthened. For example, the Unit 3 diesel building drain check valves cannot be verified closed in a timely manner. A welded grating prevents access to the check valve for the inspection that is necessary to verify that the valve is closed and seated properly. In addition, EECW Alarm Response Procedures require an RHRSW pump room inspection upon receipt of an alarm. During a flood condition, access to the room is not addressed in the AOI (OPS-04).

Transient Material Control

On three occasions during the inspection, different transient materials were found stored improperly or without the necessary review.

- Oil soak rags were found in the Unit 3 diesel fuel transfer pump room without permits.

- Genie lift trucks were found without their wheels being chocked.

- Scaffolding and ladders were found not properly secured.

In all cases, the subject deficiencies were immediately addressed and correctly dispositioned.

6.0 DETAILED SUMMARY OF INSPECTION OBSERVATIONS BY DISCIPLINE

This section provides amplification and further details on the weaknesses identified for the safety-related EECW and RHRSW systems (and interfacing systems) at BFN.

6.1 MECHANICAL SYSTEMS DESIGN

6.1.1 Review and Approach

The team reviewed documentation related to the design of the EECW and RHRSW systems, including portions of the FSAR, engineering reports, specifications, drawings, design criteria documents, system requirements calculations, and design calculations. The BFN FSAR, design criteria documents, and other design documents were reviewed to identify licensing requirements, design criteria, and the general description of the systems. The review continued with design analyses, engineering studies, and drawings to determine how these requirements were implemented in the design of the EECW and RHRSW systems. The review focused on the capability of these systems to supply adequate flow to the safety-related equipment served and the capability of that equipment to transfer heat loads during accident conditions. The team also performed a walkdown of portions of the systems, including RHRSW pump rooms, diesel generator rooms, and several areas in the reactor building that house components supplied cooling water by the EECW and RHRSW systems. In general, the team found that documentation and analysis was extensive, detailed, and comprehensive. TVA's development of design criteria documents and system requirements calculations (SRCs) and numerous design calculations represents strong efforts in the area of design basis reconstitution.

6.1.2 Summary of Significant Observations

The team found that design analysis supporting the thermal and hydraulic performance of the EECW and RHRSW systems was detailed and comprehensive. For example, BFN has developed detailed hydraulic flow models for both the EECW and RHRSW systems. The model has been used to evaluate flow distribution (at the end of plant design life, 40 years) to safety-related components during accident and safe shutdown conditions. In addition, the model for the RHRSW system has been benchmarked against field test data. However, the team identified some weaknesses in design analyses performed to confirm that EECW can supply adequate flows to safety-related components and in HVAC calculations that evaluate reactor building temperatures and minimum room cooler flow rates during a design basis accident (DBA). A summary of the significant observations issued in the area of mechanical systems design is provided below.

Weaknesses in Design Analysis Performed to Determine Reactor Building Temperatures During Accident Conditions and in Analysis to Establish Minimum Flows Supplied to the RHR and CS Room Coolers (MECH-04 and MECH-06)

Calculation ND-Q2999-89026, Revision 3, dated 4/10/95, Reactor Building Design Basis Accident Loss of Coolant Accident Temperature Analysis, was performed to determine the transient and steady-state temperatures for the Unit 2 reactor zone spaces resulting from a design basis accident (DBA) loss of coolant accident (LOCA). The calculation uses the MITAS II computer code to predict both transient and steady-state temperatures for a 100-day DBA duration. The model developed for the reactor building rooms and areas included drywell and wetwell temperature response profiles, equipment, cable, and other heat loads. The team reviewed this calculation and identified several weaknesses, for example:

1. During the inspection, and in response to the team's questions related to the core spray and RHR pump room coolers, BFN noted that this calculation incorrectly assumes that the northeast and northwest reactor building corner rooms (core spray pump rooms) contain two room coolers per room, whereas they actually contain only one cooler. Therefore, the room temperatures may be higher than calculated.

   BFN prepared BFPER950476 to address the issue, analyzed the condition, and determined that sufficient capacity remained to satisfy required heat loads. BFN has stated that the calculation will be revised to correct this deficiency.

2. The calculation assumes that at 10 minutes into the event, the normally operating control rod drive (CRD) pump is shut down, and at 30 minutes into the event, two of the RHR and CS pumps are shut down because only one loop of each is required. The team was informed that this option is available to operators. However, the team found that procedures do not require this equipment to be shut down during accident conditions. Consequently, no credit can be taken for the absence of these heat loads in determining peak post-LOCA temperatures in the reactor building.

   The effect of these additional heat loads could increase temperatures calculated for the pump rooms and adjacent areas.

   In response to this concern, TVA has stated that the assumption will be reviewed with the operations staff and, if required, the calculation will be revised in the upcoming revision.

   The team concluded that design analysis should account for the potential presence of these heat loads because imposing constraints to shut down a train may remove operational flexibility during accident conditions. The team recommends that the calculation should be revised to address the above issues.

The team also reviewed Calculation MD-Q0067-930043, Revision 3, dated 4/10/95, RHR and Core Spray Room Cooler Analysis. This calculation determines minimum flow rates needed to remove the heat load from the RHR and CS rooms for various EECW inlet water temperatures

accounting for fouling and with no tube plugging. However, the calculation assumes zero air side fouling, which is not conservative, and implies that the cooler is maintained in a continuously clean condition.

In response to this issue, TVA does not agree that it is necessary to add an air side fouling factor to the coil analyses. TVA has stated that:

> "This assessment is based on the very limited influence of air side fouling to overall coil performance. Typical centrifugal fan performance curves have a fairly steep slope in the area where the system curves meet the fan curve (operating point). With this steep slope a small change in pressure will result in magnified change in air flow rates. Before significant air side fouling occurs (i.e., fouling that would influence performance) there would be a reduction in the air flow rate across the coil. Tests are periodically performed to assess the ability of these coils to pass the design flow rate. If unable to achieve design values, then the coils are inspected, and if fouled on the air side they would be cleaned."

The team concluded that this response appears to focus on (gross or macro) "fouling" (such as a plastic bag or other debris caught in the coils) that would significantly affect air flow. However, the air side fouling factor is included in the design of the cooler to account for degradation in thermal performance that might result from adverse environmental conditions, such as a light oil film or thin layer of dust accumulated on the coils. Neither of these small deposits would significantly degrade air flows and may not be observed during testing performed to assure design air flows are satisfied, but could adversely impact the heat transfer capability of the unit.

It is the team's experience that an air side fouling factor (greater than zero) is used to account for such deposit buildups during intervening cleaning periods. As noted in Inspection Observation TEST-06, the air side of the RHR and CS pump room coolers is not inspected and cleaned on a regular schedule to assure air side heat transfer capability. That observation contributes to the team's concern that assuming a zero air side fouling factor is not justified.

The team concluded that the calculation should be revised to incorporate an appropriate air side fouling factor. TVA has stated that they intend to include these coolers in the proposed heat exchanger test program. When the tests are conducted, both "as-found" and "as-left" performance data will be collected. This data will then be evaluated to determine the suitability of the fouling factors used in the calculation.

EECW System Alarm Setpoints Either Have No Documented Basis or Do Not Support System Level Performance Requirements (MECH-05)

Several EECW system alarm setpoints are based on individual component requirements, but no alarm setpoints have a documented basis in overall system performance. For example:

1. The EECW pump low flow alarm setpoint is 1800 ±524 gpm, decreasing. TVA has stated (Action Item #035) that the basis of the EECW low flow alarm is to alert the

operators that the pump is operating near its minimum flow point of 1125 gpm. However, Calculation MD-Q0067-930028 states that the RHRSW minimum pump flow is 1350 gpm. This value disagrees with the value provided in the BFN response to SWSOPI Action Item #035. Further, OI-67 Section 3.24 informs the operator that the EECW pump flow should not be less than 1350 gpm at any time.

2. BFN provided information (Action Item #005) indicating that the EECW remote discharge pressure and flow with four pumps running (on 4/19/95) for the B3 pump was 142 psig and 1500 gpm, respectively. It appears that if the EECW pumps start up automatically in response to an accident signal, the EECW system low flow alarm may annunciate on the EECW B pump discharge. The team did not expect to find that an alarm may annunciate as a result of an expected automatic change in the system operating configuration.

In response to these concerns, TVA has issued a PER to reevaluate the low flow alarm setpoint, its associated errors, and acceptance tolerances applied to the setpoint. The team recommends that operating procedures should clearly indicate the intent and basis for the low header flow alarm (e.g., minimum pump flow protection).

Weaknesses in Design Analyses Performed to Confirm that EECW Flows Measured During Surveillance Testing Satisfy Design Basis Requirements (MECH-01)

TVA does not perform periodic flow balance testing for the BFN EECW system to confirm that safety-related equipment is supplied minimum required design cooling water flow rates under worst-case conditions. Flow rates for individual components are measured during EECW check valve surveillance testing. Calculation MD-Q0067-940058, Revision 0, dated 12/19/94 (RIMS R14941219134), EECW Flow Balance, was performed to establish the technical basis for testing the EECW system and to demonstrate that the system continues to meet design basis conditions. The calculation makes use of pressures, differential pressures, and flows measured during EECW system testing.

The team reviewed this calculation and found that the methodology developed in the calculation consists of predicting the flow during worst-case conditions using an exponential relationship between flow and differential pressure, where the exponent X is 2.4. The relationship generally used in hydraulic analysis is the well-known "Darcy-Weisbach" formula where the exponent X = 2. The exponent, X, in this case 2.4, was obtained from Calculation MD-Q2067-880368, Revision 1, dated 9/21/90 (B22900925102), Evaluation of Restart Test Data and Analysis of EECW Capacity for Loss of Dam Operation. That calculation derives the value of the exponent using restart test data.

The team found that the derivation of the value of X = 2.4 did not account for instrument accuracy associated with the pressures and flows measured during restart testing. Instrument error could increase the value of the exponent, which could result in lower calculated flows supplied to safety-related equipment. The calculation did not account for instrument accuracy associated

with the pressures and flows measured during surveillance testing. These errors would also reduce the calculated flows supplied by EECW.

The calculation identifies several components that have flows that either are less than design minimum required flows or are marginally low flows, e.g., the control bay chillers (-10.2% and 0.3%), diesel generator (DG) 3A/B (1.5%), and several other DGs that have low flow margins. Accounting for instrument error may further reduce calculated flow rates and margins.

In summary, the team found that although the general approach used to confirm flows supplied to safety-related equipment is sound:

- The flow relationship and methodology used to determine flows supplied does not account for instrument error.
- The methodology evaluates flows for piping degradation to the end of a 40-year plant design life and does not permit evaluation of flows supplied by EECW to safety-related equipment in the event of a DBA or safe shutdown, should it occur today, considering worst-case conditions.

In response to the team's concerns, TVA provided the results of a preliminary unverified calculation using an exponent of 2 in the flow relationship and accounting for instrument errors applicable to the data obtained during surveillance testing. Results indicated that most flow margins were increased and some were reduced. The flow to control bay chiller 1A was still less than required at the end of the 40-year plant design life. TVA stated that EECW flow to the chiller can be assured by the amount of cooling water supplied to the adjacent emergency condensing unit, which achieved a flow margin of 7.7%.

The team found this response acceptable. However, the team recommends that the calculation should be revised to:

- Formally document the approach used in the preliminary calculation developed to establish the use of an exponent of 2.0 in the flow relationship and include the effects of instrument error.
- Provide a means of evaluating flows supplied by EECW to safety-related equipment in the event of a DBA or safe shutdown, should it occur today, considering worst-case conditions.

6.1.3 Conclusions

In addition to the extensive document reviews performed, the team had the benefit of discussions with BFN engineering personnel. Based on these reviews and the information provided by BFN, the team established the following conclusions:

1. TVA's development of design criteria documents, system requirements calculations (SRCs), generation of numerous design calculations, and previous walkdowns are consistent with GL 89-13, Action IV requirements for design basis reviews. There was no documentation of single failure evaluations performed by TVA. However, the team was unable to identify the failure of a single active component that would prevent the EECW or RHRSW systems from performing their safety function.

2. Some weaknesses exist in HVAC-related analyses of reactor building DBA temperatures, room cooler performance, and the determination of flows supplied to safety-related components by EECW and RHRSW. However, it appears that sufficient conservatism exists in these analyses to assure that design requirements are satisfied.

6.2 OPERATIONS

6.2.1 Review and Approach

The objective of the operations area review was to evaluate the processes and procedures established at BFN to ensure the EECW and RHRSW systems are being operated in accordance with appropriate guidelines and the systems' design bases. The team assessed plant operations, procedures, training, and modifications for adequacy and impact on the service water system's ability to perform its safety-related functions.

During the inspection, the team reviewed numerous documents related to plant operations, conducted several walkdown inspections with equipment operators, and interviewed or had conversations with a number of licensed and non-licensed operators. The team performed these efforts to gain a comprehensive insight into the conduct of operations of these systems and the capabilities and overall knowledge of the plant operators.

In addition, the team conducted walkdowns of the EECW and RHRSW systems to assess the system configuration relative to drawings and procedures and to assess the material condition of equipment and plant areas. Flow and pressure instrumentation that is relied upon in an emergency situation was evaluated for access by operators, the location of instruments in the system, and whether the instruments would be available to monitor systems during a postulated accident. Walkthroughs were conducted in the control room and the simulator with licensed and non-licensed operators. Walkthroughs were also conducted with non-licensed operators at the intake pumping station, emergency diesel fire pumping station, and the auxiliary raw water station. The team also reviewed the adequacy of controls used to ensure proper valve positions and assessed operational controls for the intake structure and traveling screens.

In conducting the operations review, the team used TI 2515/118 for guidance. Each of the areas identified by the Inspection Plan was reviewed to ensure the completeness of the audit.

6.2.2 Summary of Significant Observations

In general, the team found that the material condition of Unit 2 was satisfactory, operating instructions contained sufficient information and allowed the operator to accomplish necessary actions, and operators were generally knowledgeable of system operation. However, some weaknesses were identified in procedural guidance and, in some cases, procedures were not always consistent with design documentation. A summary of significant observations identified in the area of operations is provided below.

BFN's Response Procedures to a High Lake Elevation (Flood) Are Weak or Incomplete (OPS-04)

The probable maximum flood level for the BFN site is 572.5 feet. This flood level results in the intake structure being completely surrounded by water up to 7.5 feet deep. Some procedures directing BFN's response to a high lake elevation condition (flood) are weak or incomplete. For example:

1. Flood Above Elevation 565' Procedure (0-AOI-100-3)

   - The procedure (4.2.3) requires all units to be placed in cold shutdown at an elevation of 565' (top of CCW pump deck). However, when water spills over the CCW pump deck, the traveling screens may no longer be functional, and debris may enter the forebay unimpeded, potentially fouling the RHRSW pump impeller strainer and the EECW pump discharge strainers. No guidance is provided to operators for responding to this possibility.

   - The procedure does not provide guidance for responding to an RHRSW system alarm that requires RHRSW pump room inspection during a flood.

   - The procedure does not provide guidance for the possibility that water spilling over the CCW pump deck and the fire diesel pump structure could disable the fire diesel pump.

   - The procedure (4.2.5) directs that all water-tight doors, bulkheads, manholes, and equipment hatches below El. 578' be verified closed or sealed. However, the team was informed (Action Item #011) that there are no sealing requirements for the diesel building drain check valves because they are designed to open at a cracking pressure of 1 psi. During walkdowns, the team observed (and confirmed through interviews with AUOs) that the Unit 3 diesel building drain pipe check valve is difficult to "verify closed and sealed" in a timely manner. Tack welded grating prevents easy access to the check valves for visual inspection.

   - The procedure does not address possible interactions between raw cooling water (RCW), control air, and RHRSW systems when directing operators to secure the RCW pumps and control air compressors during a flood, e.g., starting remaining RHRSW pumps on low RCW system pressure.

2. Lake Elevation High Alarm, LA-23-75, Window 9 (1-ARP-9-20A)

- This alarm annunciates in Unit 1 only. The ARP does not direct the Unit 1 operators to inform the other units of the problem.

- The ARP appears to prompt operator action at a lake elevation of 558', but the alarm setpoint is El. 564'. The team was informed (Action Item #050) that the Unit 1 operator verifies lake level less than El. 558' once per shift in accordance with 0-GOI-300-1, Attachment 2. The GOI prompts the Unit 1 operator to have the doors and hatches listed in 0-AOI-300, Attachments 1 and 2 "verified closed and sealed." However, there is no operator prompt to enter the ARP or the remainder of the AOI until the 564-foot alarm annunciates. Also, the GOI does not direct the Unit 1 operators to inform the other units of the situation.

In response, TVA has stated that procedures 0-AOI-100-3, 1-XA-55-20C-9, and 0-GOI-300-1 will be revised to address the above concerns. For example, additional instructions and guidance will be provided in the procedures to permit verification that the Unit 3 diesel generator building drain pipe check valve is closed and sealed by removal of the grating. The Unit 1/2 diesel generator building drain pipe check valves have a design that is verifiable from the grade elevation.

Several EECW System Alarm Response Procedures Are Weak or Incomplete (OPS-02)

The team identified several examples where the EECW system alarm response procedures are weak or incomplete. For example:

1. EECW North Header Level Low Alarm, LA-67-52 (1-ARP-9-20A)

   This alarm annunciates in Unit 1 only. The sensor is located on the EECW north header in Unit 3. The ARP does not direct the Unit 1 operators to inform the other units of the problem.

2. Traveling Screen Differential High Alarm, PDA-27-1A, et al.

   The ARP does not direct the operators to determine if debris is being carried over into the forebay by the traveling screens. The team was informed that the traveling screens are operated in the manual mode because of past experience of river debris being carried over into the CW pump forebay. If debris gets into the forebay, the debris can get into the RHRSW pump pit. The ARP does not suggest that the operators monitor the EECW strainer d/p more closely when the traveling screens are having troubles.

3. EECW Supply Strainer Differential Pressure High Alarm, PDA-67-1, et al.

   The ARP lists a dirty or clogged strainer to strainer malfunction as a cause. The ARP does not suggest that the strainer could be clogged due to material inside the strainer that it is not designed to remove (i.e., soft plastic, grass, soft fish flesh, etc.). In this

condition, the strainer still rotates and the backflush is open as long as the RHRSW pump flow is greater than about 150 gpm.

The ARP does not direct the control room operator to verify EECW header flows or pressures. Instead, the ARP directs the operator only to check which EECW pumps are on.

4. EECW Flow Low Alarm, FA-67-3A

The ARP makes no distinction between the different low flow setpoints for the old GE flow transmitters (1300 gpm) on the C and D pump discharge lines and the new Rosemount flow transmitters (1800 gpm) on the A and B pump discharge lines.

Based on the elementary drawings, the EECW low flow alarm will annunciate whenever either RHRSW pump #1 (swing) or #3 (EECW) motor breaker is closed <u>and</u> there is a low flow condition in the associated EECW header. The ARP does not address an EECW low flow alarm that could occur when the associated #1 (swing) RHRSW pump is operating to supply water to the RHRSW system while the #3 (EECW) RHRSW pump is secured.

TVA has stated that the appropriate procedures will be revised to address these deficiencies.

6.2.3 <u>Conclusions</u>

Based on documentation reviews, walkdowns, and interviews with operations personnel, the team determined that operators were generally knowledgeable of EECW and RHRSW system operation, and that procedures provided sufficient guidance to operators during emergency conditions. However, weaknesses were identified in some procedures related to flood conditions and in responding to alarms.

6.3 MAINTENANCE

6.3.1 <u>Review and Approach</u>

The team reviewed extensive documentation related to the maintenance and maintenance activities for the EECW and RHRSW systems, including maintenance procedures, instrument calibrations, vendor manuals, work order lists, and completed work orders, as well as design drawings and documents, e.g., flow diagrams and portions of the BFN FSAR. Specific maintenance activities and practices were reviewed using the guidance provided in TI 2515/118. In addition, the team performed complete system walkdowns, had the benefit of conversations with maintenance personnel, and interviewed craft personnel.

6.3.2 Summary of Significant Observations

Although no significant service water maintenance was performed during the onsite portion of the inspection, the team found that maintenance procedures were generally accurate, complete, and reflected current industry practice. Material condition of the equipment, piping, and spaces inspected during walkdowns was good. However, some weaknesses were noted in the lack of training for internal inspections and implementation of fouling and corrosion control procedures. A summary of significant observations identified in the maintenance area is provided below.

Maintenance and Tech Support Personnel Are Not Formally Trained for Internal Inspections of the EECW and RHRSW Systems (MAINT-02)

BFN relies upon visual inspection and cleaning in lieu of testing for most GL 89-13 heat exchangers and coolers. SSP 13.5 requires the maintenance personnel to notify the system engineer when systems affected by fouling and corrosion are opened. The team found that for raw water system components, the work procedures do call out the need for the system engineer to inspect the component internals prior to the component being cleaned. However, in many instances, documented training for those performing the internal system inspection was incomplete or did not exist. As a result, the inspection results are generally poorly documented. The team also noted that the system engineer does not record his own inspection results. The poor documentation of the inspections makes future assessments of the degradation of the service water system based on inspection reports difficult.

The team recognizes that the system engineer cannot personally inspect every raw water system opening; thus, others must perform the actual inspection. However, the person who performs the inspection must have knowledge of what to look for, how to obtain microbiologically induced corrosion (MIC) samples and how to adequately document the inspection for future evaluation by the system engineer and/or others.

BFN relies heavily on the on-the-job training (OJT) knowledge of the Technical Support Group to perform the internal component inspections in raw water systems. This OJT knowledge base is very perishable due to normal personnel attrition, and thus can be easily lost.

This observation contributes to the team's concern about the adequacy of the inspect and clean program for the service water systems in lieu of testing.

In response to the team's concerns, TVA has stated that the Raw Water System Group has three engineers who perform all raw water evaluations. This number assures that all expertise will not be lost nor will any one individual be overworked relative to these evaluations. Although some raw water expertise has been lost due to attrition, Technical Support has always maintained a minimum of three system engineers, qualified by experience, industry contact, and OJT, to perform raw water evaluations. When attrition of experience has occurred, neither the program nor the quality of evaluation has been diluted. In addition, these engineers provide a focal point for all individuals who may be performing raw water inspections.

Technical Support believes that the current contingent of system engineers - who have 17, 15, and 11 years of experience, participate in raw water task force efforts and programs, and work closely with the site corrosion specialist - has been adequate to ensure quality evaluations of raw water fouling and corrosion in support of GL 89-13 commitments.

The team noted that the intent of a formal training program is to assure that there is uniformity in reporting similar conditions during inspections that will enhance trending of these conditions.

Site Procedure SSP 13.5, "Raw Water Fouling and Corrosion Control Program," Is Not Being Fully Implemented at BFN (MAINT-03)

The BFN procedure for raw water fouling and corrosion control, SSP 13.5, was reviewed, and the team identified several weaknesses in its implementation. For example:

- Inspections were not documented by any site organization on SSP-254 and SSP-255 forms.

- Although selected RT inspections are scheduled, UT inspections are done on a case-by-case basis. SSP 13.5, Step 3.4.2, Detection and Monitoring, states that these RT and UT inspections "should" be made.

- System flow rate, residual biocide or total residual oxidant (TRO), corrosion rates, product injection rates, inspection findings, river water temperatures, MIC water samples, etc., are not recorded, or data maintained to permit proper trending as required by SSP 13.5.

In response to these issues, TVA has stated that:

- Corrosion monitoring sample transmittals are performed on an as-needed basis per SSP 13.5, Section 3.4.2.2. Section 3.2.C of the procedure allows the system engineer to submit samples as needed.

- RT of selected welds is scheduled to be performed prior to each outage. This information is retained in a history file and these welds are radiographed during each refueling outage. The new RT results are then compared to the previous outage results and evaluated for potential crack growth and MIC development.

- All of the site chemistry requirements contained in SSP 13.5 to ensure that the relevant parameters are within the required specifications are implemented. Corrosion rates are monitored by use of coupons on raw water systems (HPFP, EECW, RHRSW), and results are evaluated and trended by Site Engineering. MIC samples are also collected and analyzed, and the results transmitted to Site Engineering for evaluation and trending on raw water systems. River temperatures/clam counts to determine the optimum times for treatment are captured in CI-137, which is based on a 5-year study performed by personnel from the onsite Toxicity Testing Laboratory (TTL) (RIMS memo R46 940531-813).

Not only are SSP 13.5 requirements implemented, but all Generic Letter 89-13 commitments are met. Other parameters, although not required by SSP 13.5 (i.e., system flow rates, product injection rates), are maintained.

The team noted that no corrosion data for the EECW and RHRSW system was taken prior to January 1994. Consequently, there is no documentation demonstrating that monitoring the EECW and RHRSW systems was performed until that time. Documentation of raw water system inspections is required to establish trends, effectiveness of the program, and to document compliance with BFN GL 89-13 commitments.

6.3.3 Conclusions

Based on the results of the team's reviews, walkdowns, and information provided by BFN personnel, the following conclusions were established:

- The EECW and RHRSW systems are maintained to perform when required.
- The plant material condition is good.
- The program and features of Site Standard Procedure SSP 13.5 are considered a strength.
- Some weakness exists in the area of training for personnel performing internal inspections of piping and components.

6.4 SURVEILLANCE AND TESTING

6.4.1 Review and Approach

The technical adequacy and accuracy of the Technical Specification surveillance and IST procedures performed for the EECW and RHRSW systems were reviewed and evaluated. The IST records for pumps and valves in the EECW and RHRSW systems were also reviewed. Special emphasis was placed upon reviewing the technical adequacy of the IST program. For safety-related components outside of the ASME Code boundaries, the team examined alternative testing performed to assure that these components will function upon demand. The technical adequacy of test procedures and trending of test results were examined. A complete set of surveillance test procedures was reviewed to determine if the procedures comprehensively address required EECW and RHRSW systems responses. Restart testing results were examined to determine whether the EECW and RHRSW systems capabilities and limitations were appropriately demonstrated. Valve stroke time testing was reviewed to verify compliance with Technical Specification operability requirements.

With the mechanical system design inspector, a review was conducted to ensure design assumptions on system performance are satisfactorily demonstrated by the test methodology. As part of this review, the design and licensing basis of the EECW and RHRSW systems were identified, and test acceptance criteria verified to be consistent with the design basis to ensure that

testing of the EECW and RHRSW systems adequately demonstrates that the EECW and RHRSW systems will operate as designed.

Testing to support GL 89-13 Action Item II was also examined. Procedures for periodic testing of safety-related heat exchangers were reviewed to ensure that heat transfer capability is maintained and that trending is performed. Techniques used to detect flow blockage from biofouling or siltation were examined. This included alternate flow paths, low flow areas (<3 ft/sec), or any other lines that use the same source of water as the EECW and RHRSW systems (GL 89-13, Action I). Testing of air-to-water heat exchangers served by the EECW system was reviewed to ensure proper heat transfer, including air side fouling.

6.4.2 Summary of Significant Observations

The surveillance test and IST programs used to assure readiness of the EECW and RHRSW systems were generally found to be complete with few weaknesses observed. That portion of the IST Program associated with pumps was found to be strong with no weaknesses observed. In addition, the team observed an effective pump trending program. A summary of the significant observations issued in the area of surveillance and testing is provided below.

The EECW Chemical Injection Check Valves Required to Function as a Boundary Between Class 3 and Non-Class Systems Are Not Included in the In-Service Test Program (TEST-04)

A systematic review of the IST program for valves identified a weakness at the interface of the EECW and RHRSW systems with the chemical injection system. BFN concluded that these boundary valves were originally excluded because design calculations determined that flow losses from a line break at the injection point would be limited by the flow restricting orifice. The flow loss was found to be acceptable for one unit operation. In 1994, the design calculation was revised to state that the orifice and check valve had been seismically qualified and there was no need to include the losses through a chemical injection line pipe break in the EECW flow and pressure drop analysis calculations. Based on this information, BFN no longer included losses through a failed injection line in determining acceptability of EECW system flow rates to essential components. Because the design analyses took credit for the proper functioning of the boundary check valves, the IST Program should have been revised to include testing of the check valves. Problem Evaluation Report BFPER950531 was initiated during the inspection to address the lack of testing or inspection of these check valves. BFN clarified that there would be sufficient flow margin to allow a chemical injection line pipe break to occur on all four lines without threatening the EECW safety-related flow demands.

Boundary Valves Between Class 3 and Non-Class Systems Are Not Included in the In-Service Test Program (TEST-05)

In reviewing the RHRSW chemical injection lines, the team found that check valves identified on In-Service Inspection (ISI) drawings as the boundary between Class 3 RHRSW system and the non-Class chemical injection system are not included in the IST Program. Specifically, check valves 0-CKV-50-521, 522, 555, 556, 563, 565, 580, 581, 614, 615, 646, 647, 684, 685, 690, and

691 are identified as valves within the ISI boundary, but are not included in the IST Program. Likewise, potential manual isolation valves, 0-SHV-23-528, 539, 548, 558, 567, 577, 599, and 600, are shown on Drawing 1-47E858-1 as normally open and are also not included in the IST Program as Category B, active valves requiring manual stroke testing. As a consequence, the safety-related boundaries between the safety-related RHRSW and the non-safety-related chemical injection system are not assured by the IST Program. BFN confirmed that the manual isolation valves are normally closed and only opened during the quarterly operability Surveillance Instructions (SI) for the RHRSW pumps and headers and to support quarterly SIs for RCIC and HPCI. At all other times, manual isolation valves (0-SHV-23-528, 539, 548, 558, 567, 577, 599, and 600) are closed. In response to this issue, BFN initiated a Potential Drawing Discrepancy (PDD) to correct the drawing to show the manual isolation valves are normally closed, and the manual isolation valves at the injection line connection to the RHRSW piping (0-SHV-23-528, 539, 548, 558, 567, 577, 599, and 600) will be added to the IST Program as normally closed passive valves. This deviation was also included in Problem Evaluation Report BFPER950531.

In reviewing the completeness of the IST Program with respect to pumps and valves, the team identified other pumps and valves required to perform a safety-related function and confirmed that these components were tested in a manner commensurate with their importance to the operation of the EECW or RHRSW systems. For example, the testing of the following components was examined.

- Two-inch check valves at the EECW discharge from the diesel generator coolers installed to break the vacuum and prevent siphoning of EECW water from the diesel coolers.

- RHRSW intake structure sump pumps required to de-water the intake structure during storm or line break scenarios.

- The EECW/RHRSW pump discharge piping air release valves (0-23-501A, 505A, 587A, 521A, 525A, 590A, 545A, 541A, 593A, 564A, 560A, 596A) installed to vent the pumps upon startup and break the vacuum upon pump shutdown.

- The EECW system piping vacuum breakers (1-67-554, 1-67-597 reference 1-47E859-1; 2-67-554, 2-67-597 reference 2-47E859-1; 3-67-554, 3-67-597 reference 3-47E859-1) installed to maintain the EECW effluent headers at atmospheric conditions.

For each of these components, the team determined that adequate testing or inspection was performed on some periodicity to assure that they functioned upon demand. This result contributed to the team's conclusion that BFN's testing program has as a basis a broad scope, broader than the combined scopes of the IST and surveillance testing programs required by ASME Code and Technical Specifications.

Heat Exchangers Are Inspected as Required, But Documentation Describing What Conditions Are Found Is Not Always Completed and/or Maintained (TEST-02)

In response to GL 89-13, BFN chose to inspect and clean their heat exchangers in lieu of thermal performance testing. Thermal performance testing of the RHR heat exchangers was initiated in late 1994. The team found that BFN is cleaning its heat exchangers, and maintaining a heat exchanger in a clean condition promotes confidence that the heat exchanger will perform well. Nonetheless, inspection and the ability to trend what was found during the inspection are critical to assuring that the heat exchanger frequency of cleaning is adequate or that biofouling controls are effective between cleaning. The team found *that heat exchangers are being inspected as required, but the documentation describing what condition are found is not always completed and/or maintained.* Therefore, the ability to trend and monitor conditions is limited. Contributing to this weakness is *the lack of formal training for those individuals expected to perform the condition assessments when system components are opened (see Section 6.3.2 for a discussion of MAINT-02).* Although significant knowledge and experience can reside in a few individuals, confidence in the quality of the inspection program is reduced by the qualifications of the most inexperienced individuals performing the condition assessment.

The ability to trend and monitor changing conditions is an expectation of GL 89-13. Although BFN may be satisfying this expectation, there is not an auditable trail to demonstrate this expectation is satisfied.

Inspections of GL 89-13 heat exchangers are performed in accordance with SSP 13.5. Section 3.4.2 of SSP 13.5 states, in part, that the system engineer shall perform and document visual examinations of internal surfaces of components for the presence of biofilms, deposits, and nodules in accordance with Section 3.2. This latter section requires that visual evaluations be documented using Form SSP-253, Visual Evaluation Record, and the results of visual examinations maintained by the system engineer. The team determined that visual examinations are performed, but the condition assessments are not always documented and/or maintained as required. For example, biennial inspections of the diesel generator coolers are required by Appendix C of SSP 13.5. All diesel coolers were inspected and documented in the associated Work Orders. However, three Form SSP 253s could not be located. The team's review of the system engineer's Form SSP 253 documentation indicates that this weakness exists for other GL 89-13 heat exchangers. In response to this condition for the short term, Problem Evaluation Report BFPER950488 was written to emphasize to all system engineers that Form SSP 253 shall be filled out for every visual inspection conducted on a raw water system, and forwarded to the BOP raw water system lead engineer. This was reinforced with a memorandum from the Technical Support Manager to each system engineer.

Documentation of visual inspections in accordance with GL 89-13 was not the only activity that had weak traceability. Section 3.4.2 of SSP 13.5 also requires that when deposits and/or nodules are present, the corrosion specialist (or system engineer) shall take samples and transmit them to an approved laboratory using Form SSP-254 for analysis. Another form, SSP-255, is used to document the corrosion deposit/product analysis. The corrosion specialist is to transmit periodically Forms SSP-254, 255, and any 35 mm negatives or videos to the Records and

Information Management System (RIMS). Through interviews, the team found no record of completed Forms SSP-254 or 255. The lack of documentation indicates either periodical sampling and analysis is not being performed or the records are not being maintained. From interviews, the team was informed that only one sample was taken per SSP 13.5 and transmitted by Form SSP 254, but the sample was allowed to dry out, so no analysis results could be obtained.

If samples are being analyzed, the documentation trail prescribed by SSP 13.5 is not being implemented. If the lack of documentation demonstrates that no sampling is being accomplished, then BFN's ability to determine the presence of MIC or to trend the adequacy of chemical treatment is significantly reduced. The team expected to observe some periodic chemical analysis to confirm visual inspections. Instead the team found none.

Although BFN has not committed to perform testing of any GL 89-13 heat exchangers in its response to the NRC, a thermal performance test was conducted on RHR heat exchanger '2C' (Test 2-TI-322, during the most recent shutdown). In Problem Evaluation Report BFPER940325, BFN acknowledges the lack of any thermal performance testing and states, under Corrective Action, that procedures for testing the heat transfer ability for heat exchangers referenced in GL 89-13 will be developed using as a guideline, EPRI NP-7552, "Heat Exchanger Performance Monitoring Guidelines." The team was informed that procedures for testing the heat transfer capabilities for one RHR heat exchanger per refuel cycle will be in place and performed by restart after the Unit 2 C8 outage. Plans exist to test both the RHR and CS room coolers. However, the determination to include these room coolers in the testing program will be based on the validity of data obtained during preliminary testing. The remainder of the GL 89-13 heat exchangers will continue to be cleaned and inspected only.

The Air Sides of the RHR and CS Pump Room Coolers Are Not Inspected and Cleaned on Some Periodicity to Assure Air Side Heat Transfer Capability Is Maintained (TEST-06)

During the team's walkdown of Unit 1, 2, and 3 RHR and CS pump room coolers, the team noted dirt on the air intakes and dust accumulation on the visible fin surfaces (i.e., fin surface fouling). Air flow rate tests are performed periodically; if the required air flow is not obtained, work orders are prepared to clean the heat exchangers. Nonetheless, having the required air flow is only one factor in assuring heat transfer. Assuring that the fin surfaces are clean and devoid (to the extent practicable) of film fouling is also important. The team did not find any preventive maintenance activity to clean the air side on some periodicity.

The lack of inspection and cleaning of the air sides of these air to water heat exchangers is contrary to the intent of BFN's commitment to inspect and clean GL 89-13 heat exchangers and inconsistent with the assumption used in heat transfer analysis (i.e., zero air side fouling; see MECH-06). In response to this concern, BFN stated that action will be undertaken to expand the scope of the existing preventive maintenance action, which performs chemical flushing of the cooling water side, to also include requirements for cleaning of the air side. This results in the cleaning of the air side on a once per refueling cycle basis.

The Air Flow Rate Acceptance Criteria for RHR and Core Spray Pump Room Cooler Air Side Tests Permits Air Flow Rates Below the Values Analyzed in Heat Transfer Calculations (EST-03)

TVA Calculation MD-Q0067-930043, RHR and Core Spray Room Cooler Analysis, states that the purpose of the "calculation was to determine the minimum flow rate needed to remove the heat load from the RHR and CS rooms for various EECW inlet water temperatures accounting for fouling and with no tube plugging." Review of this calculation indicates that the design input for the air side flow rate was 10,000 cfm and 12,000 cfm, depending upon the size coil. Review of Technical Instruction 2-TI-134, Core Spray and Residual Heat Removal Room Coolers Air Flow Verification, Rev. 1 indicates that the following test acceptance criteria ranges for total cfm.

Cooler	Acceptance Range
Core Spray "A" and "C" Room Cooler	11430 - 13970 cfm
Core Spray "B" and "D" Room Cooler	9000 - 11000 cfm
RHR Pump "A" Room Cooler	9000 - 11000 cfm
RHR Pump "B" Room Cooler	9000 - 11000 cfm
RHR Pump "C" Room Cooler	9000 - 11000 cfm
RHR Pump "D" Room Cooler	9000 - 11000 cfm

Although ASHRAE may permit an acceptance range of ±10% of rated flow, BFN's heat transfer calculations do not include margin for the lower limit of the range.

In response to this concern and because of some errors and inconsistencies in other HVAC calculations (see MECH-04 and MECH-06), the affected calculations will be revised to reflect the 90% air flow rate.

6.4.3 Conclusions

In summary, the team found an effective component test program with minor exceptions. This component test program included elements of the surveillances required by Technical Specification, IST required by Section XI of ASME Code, and augmented component testing and inspection such as BFN's check valve maintenance program.

The team found SSP 13.5, Raw Water Fouling and Corrosion Control Program, to be a thorough and effective program document. However, weaknesses were identified with its implementation. The team found no formal training was provided to individuals required to perform heat exchanger or piping inspections. The documentation of inspections prior to cleaning heat exchangers is not routinely accomplished. The actions required and/or suggested by SSP 13.5 are not always implemented. In some instances, an alternate action is implemented, but its applicability to SSP 13.5 is not explicitly documented. These weaknesses suggest a need for increased management attention to assure that all program elements are accomplished.

The EECW and RHRSW systems are comprehensively tested with respect to flow, and test acceptance criteria are consistent with design bases. Some weakness was observed with the air flow rate acceptance criterion for safety-related coolers.

The GL 89-13 heat exchangers are maintained in a state of readiness by cleaning as an alternative to testing. A weakness was observed with the cleanliness of the RHR and CS pump room coolers. The lack of periodic inspection and cleaning of the air side is inconsistent with the intent of GL 89-13.

6.5 QUALITY ASSURANCE/CORRECTIVE ACTIONS

6.5.1 Review and Approach

This portion of the inspection focused on the BFN corrective action program and its function to correct deficiencies in the plant's service water systems. The role of the onsite (PORC) and offsite review committees (NSRB) was also reviewed to determine their effectiveness on decisions related to the plant service water systems. The team evaluated the interface between Engineering, Technical Support, and Operations to ensure that the service water systems are being operated with their design parameters and that problems are being addressed by the appropriate site organizations.

6.5.2 Summary of Significant Observations

Three observations were issued in the Quality Assurance and Corrective Actions area. Two of these observations, QA/CA-01 and QA/CA-03, were of minor significance and were quickly corrected. Observation QA/CA-02 identified an instance where a previous TVA assessment had noted a concern regarding the MIC program in 1993; the present SWSOPI also identified concerns for documentation and trending of inspections (see MAINT-03 discussion in Section 6.3.2).

6.5.3 Conclusions

In general, the team found that BFN has documented the identified problems and that corrective actions are carried out. Issues found during this and previous assessments and documented on PERs are tracked in TROI (Tracking and Reporting of Open Items). The team also found that:

- The role of the onsite (PORC) and offsite review committees (NSRB) has been effective in the review and approval of critical activities at BFN.

- The interface between Engineering, Technical Support, and Operations is good.

6.6 ELECTRICAL SYSTEMS DESIGN

6.6.1 Review and Approach

The team reviewed documentation related to the electrical design of the EECW and RHRSW systems, including portions of the FSAR, design calculations, specifications, drawings, safety assessments for design change notices (DCNs), and design criteria documents. The review focused on the RHRSW pump motor protective device (breaker) trip setpoint and the thermal overload protection selected for the EECW strainer motors. Safety assessments on selected DCNs were also reviewed for technical scope and adequacy. Electrical component (conduit) design features that assure the integrity of the RHRSW pump rooms from external flood conditions were reviewed from both a design and installation perspective. Those features were also physically inspected, to the extent practical, to provide assurance that the as-designed features were installed as required.

6.6.2 Summary of Significant Observations

The team found that the design analyses for the selection of the trip setpoints for RHRSW pump motor breaker and for the selection of the thermal overload devices for the EECW strainer motors were detailed, and were completed and verified in accordance with ANSI N45.2.11.

The design features to seal conduits at the RHRSW pump room for external flood conditions were found to be properly developed for the maximum flood condition, and appropriate testing was performed to assure the flood-proof integrity of the sealing design for conduits that enter the pump room. The team found on inspection that appropriate conduit seals (EYS fittings) were installed where required.

The safety assessments reviewed on DCN W17803A Revision 3, DCN W17702A Revision 3, and DCN W17702A/A35839A were found to be very detailed and well documented. The format of the safety assessment, which included the use of a detailed assessment checklist that formed the basis for the applicable justifications, was viewed to be a clear and effective method for the assessment.

6.6.2 Conclusions

The electrical design was found to be adequately documented for the aforementioned components. The active components, the RHRSW pumps and EECW strainers, were selected due to their importance as the more critical components in these systems. The passive design feature, RHRSW pump room sealing, was also selected due to the importance of preserving the flood integrity of the pump room. No anomalies were noted during this review.

7.0 LIST OF ACRONYMS

ARP	Alarm Response Procedure
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
AUO	Assistant Unit Operator
BFN	Browns Ferry Nuclear Plant
CAM	Critical Attributes Matrix
CCW	Condenser Cooling Water
CRD	Control Rod Drive
CS	Core Spray
DBA	Design Basis Accident
DCN	Design Change Notice
DG	Diesel Generator
EECW	Emergency Equipment Cooling Water
EPRI	Electric Power Research Institute
FCV	Flow Control Valve
FSAR	Final Safety Analysis Report
GL	Generic Letter
HPCI	High Pressure Coolant Injection
HPFP	High Pressure Fire Protection
HVAC	Heating, Ventilating and Air-Conditioning
ISI	In-Service Inspection
IST	In-Service Testing
LOCA	Loss of Coolant Accident
MIC	Microbiologically Induced Corrosion
NRC	Nuclear Regulatory Commission
OJT	On-the-Job Training
PDD	Potential Drawing Discrepancy
PER	Problem Evaluation Report
RCIC	Reactor Coolant Isolation Condenser
RCW	Raw Cooling Water
RHR	Residual Heat Removal
RHRSW	Residual Heat Removal Service Water
RT	Radiographic Test
SSFI	Safety Systems Functional Inspection
SSP	Site Standard Procedure
SWSOPI	Service Water System Operational Performance Inspection
SRC	System Requirements Calculation
TI	Temporary Instruction
TRO	Total Residual Oxidant
TROI	Tracking and Reporting of Open Items
TTL	Toxicity Testing Laboratory
TVA	Tennessee Valley Authority
UT	Ultrasonic Test

ATTACHMENT 1

INSPECTION PLAN AND CRITICAL ATTRIBUTES MATRIX

ATTACHMENT 1

INSPECTION PLAN AND CRITICAL ATTRIBUTES MATRIX

ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3

PROPOSED INSPECTION PLAN AND CHECKLIST
FOR
THE SERVICE WATER SYSTEMS OPERATIONAL PERFORMANCE
INSPECTION (SWSOPI)

1.0 PURPOSE

The purpose of this inspection plan is to provide guidance to reviewers for the review of plant design documentation and the conduct of walkdowns and personal interviews during the inspection of the BFN Service Water Systems (SWSs). The inspection satisfies the guidance established in NRC Temporary Instruction (TI) 2515/118, "Service Water System Operational Performance Inspection, Revision 1." The inspection plan is intended to supplement the TI. The plan is not intended to be a rigid format for the inspection. As such, the plan is intended to serve as a starting point for the various directions that the inspection may take. However, if any given area of the investigation results in the identification of potential weaknesses, efforts may be intensified in this area. The inspection will be performed for Unit 2 and include those portions of the SWSs on Units 1 and 3 which are necessary for operation of Unit 2. The inspection will also include assessment of Unit 3 SWSs to the extent possible. Due to the recovery status of Unit 3 all systems are not currently in service. However, the system requirements for multi-unit (Units 2 and 3) operation will be assessed.

2.0 SCOPE

2.1 The inspection will consist of an audit level review of the BFN Emergency Equipment Cooling Water (EECW) and the Residual Heat Removal Service Water (RHRSW) systems design bases. The inspection consists of document reviews to ensure consistent application of the design bases throughout the licensing bases documents, such as the Updated Final Safety Analysis Report (UFSAR), Technical Specifications (TS), applicable plant drawings, operating and emergency procedures, test procedures, American Society Mechanical Engineers (ASME) Section XI and Environmental Qualification programs.

2.2 The inspection will utilize "educated" selective sampling vertical slice inspection (SWSOPI/SSFI type) level review of the BFN SWSs (including document reviews, walkdowns and personnel interviews) to identify weaknesses or missing information in the design bases, operating, or design output documents. The inspection will:

- Assess planned or completed actions in response to Generic Letter (GL) 89-13, "Service Water Systems Problems Affecting Safety- Related Equipment, July 18, 1989."

- Verify that the SWSs are capable of fulfilling their thermal and hydraulic performance requirements and are operated in a manner consistent with their design bases.

- Assess the SWSs operational controls, maintenance, surveillance and other testing, and personnel training to ensure the SWSs are operated and maintained so as to perform required safety-related functions.

2.3 As stated above, the inspection will place a heavy emphasis on a review of BFN's response to and implementation of GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment," as well as the review of recent modifications. The inspection will include:

- EECW

- RHRSW

- Ultimate Heat Sink

- Specific SWSs Component Electrical Requirements

- Heating Ventilation and Air Conditioning (HVAC) Systems served by and Equipment Cooled by the SWSs

- Service Water System Interfaces (e.g. raw cooling water)

In addition, a review of how the assumptions made in BFN's 10 CFR 50.59 Safety Evaluation process have been translated into procedures, instructions, etc., will be conducted (i.e., the validity of 50.59 conclusions may depend on implementing assumptions made). In addition, 50.59 evaluations will be reviewed to determine the adequacy of "unreviewed safety question" conclusions and that the approval process is appropriate.

2.4 The original design basis criteria, requirements, and commitments will be established for the design of these systems. Inspection and review will be intensified as appropriate to identify any weaknesses that may exist in the baseline design bases for these systems or in the design documentation developed to substantiate modifications performed. UFSAR statements related to the design of the SWSs will be verified and design basis documents reviewed.

2.5 NRC Information Notices, Bulletins, GL, NUREGs, and Regulatory Guides, will be reviewed to identify operating restrictions (e.g., operator actions, maintenance requirements, testing limitations, etc.), Additionally, topical reports (e.g., Regulatory Guide 1.97, Appendix R, compliance reports, GE Topical Reports, etc.), reports on SWSOPIs conducted at other utilities, and TVA responses to Institute of Nuclear Power Operations Significant Event Reports and Significant Operating Experience Reports will be reviewed to verify consistency with design requirements, design bases documents and incorporation into operating documents.

2.6 Refinements to the above scope may be made subsequent to the initial review of the SWSs design to include additional scope details if appropriate.

3.0 <u>MECHANICAL SYSTEMS ENGINEERING DESIGN AND CONFIGURATION CONTROL</u>

3.1 Initial Review

In addition to the criteria in this section, the review of the mechanical systems aspects of SWSs will follow the specific criteria in Section 03.01, Mechanical Systems Engineering Design Review and Configuration Control, of TI 2515/118. Following is additional guidance for the mechanical inspector.

3.1.1 Review original and UFSAR, Nuclear Steam Supply System design and interface requirements and criteria, and other documentation provided to identify regulatory commitments and design requirements for the SWSs. The review will include criteria and commitments for interfacing systems such as the HVAC System.

3.1.2 Review design documentation such as system design descriptions, applicable plant drawings, component specifications and other SWSs configuration drawings to establish how commitments and requirements were incorporated into the design documents.

3.1.3 Verify the proper identification of SWSs boundaries and interfaces.

3.1.4 Review SWSs calculations and analyses to verify consistency of design assumptions or assumed operator actions and acceptability of available margins. Additionally, review the calculation index to identify calculations related to compliance with design requirements and criteria (e.g., flow distribution in the SWS, minimum flow requirements, maximum flow and run-out, other hydraulic calculations). The capability to satisfy Regulatory Guide 1.27 requirements related to shutdown with maximum anticipated temperatures will also be reviewed.

3.1.5 Determine methods used to comply with design and regulatory guidance in the following areas:

- The type of cooling water supply

- The ability to dissipate the total essential station heat load.

- The effect of environmental conditions on the capability of the SWSs to furnish the required quantities of cooling water, at appropriate temperatures for extended times after shutdown.

- The effect of earthquakes, tornadoes, missiles, floods, and hurricane winds on the availability of the cooling water. The SWSs will also be reviewed to assure that adverse environmental conditions including freezing will not preclude the fulfillment of the safety function of the systems.

- The sharing of cooling water sources between units.

- The applicable design requirements such as the high-water and low-water levels of the source SWSs water determine their compatibility with the SWSs.

- The effects of the failure of non-seismic Category I equipment, structures, or components on safety-related portions of the SWSs are taken into account during SWSs design.

3.1.6 Confirm that service water GL 89-13 design and licensing requirements (e.g., review of SWS single failures, biofouling, and silting controls) have been adequately addressed and implemented.

3.2 Review of Modifications

3.2.1 Review plant design changes for assumptions/restrictions, consistency with equipment specifications, drawings, vendor manuals and, equipment databases. Individual modification packages are to be reviewed to determine the effect of modifications performed on the capability of the SWSs and interfacing systems to meet established commitments and design requirements.

3.2.2 Review field changes and temporary alterations to assure that system capability has not been degraded below established criteria and requirements.

3.2.3 Review calculations related to each modification package to assure that changes are adequately substantiated and documented.

Confirm that calculations are completed and verified in accordance with the requirements of American National Standards Institute (ANSI) N45.2.11.

3.2.4 Review changes made to applicable plant drawings to assure that appropriate nonsafety-related portions of the system have been adequately isolated from safety-related portions of the system where required. Confirm that nonseismic portions of the system and interfacing systems are designed such that the SWSs can perform their safety function under all modes of operation.

3.2.5 Perform a walkdown of accessible portions of the service water, and component cooling systems comparing the as-installed and as-built configuration with that reflected on the design drawings.

3.2.6 Review modifications to assure that provisions have been made to perform post-modification testing of those changes that affect the capability of the system to perform its safety function. Review appropriate operating procedures to assure that changes in procedures are properly incorporated where modifications affect system operational requirements. Confirm that the modified design can be operated as originally intended and that assumptions made in related analyses concerning operator actions and response times are accurately incorporated into appropriate procedures.

3.2.7 Where necessary, review maintenance procedures to assure that special maintenance requirements established as a result of modifications made are properly documented.

3.2.8 Review 10 CFR 50.59 Safety Evaluations associated with modifications to assure that the modified design has been correctly evaluated for the identification of all safety issues and potential reductions in design margins.

3.2.9 Confirm that the modified design of the SWSs and interfacing systems are consistent with requirements specified in TSs.

3.3 Supplementary Reviews

3.3.1 Review the Q-List to confirm that entries are being accurately recorded. Confirm that safety-related and nonsafety-related, Q and non-Q, components are correctly designated for modifications made to the SWS.

3.3.2 Review the basis for establishing motor-operated valve design parameters and their relationship to torque switch settings. Confirm that opening and closing settings are appropriately related to worst-case differential pressure for any mode of operation. Review the basis for maximum differential pressure to assure that all modes of plant operation have been adequately accommodated.

3.3.3 Review modified designs to assure that established setpoints have been appropriately revised to reflect any changes in the system functional design. Confirm that the bases for these setpoints have been adequately substantiated by documented analyses.

3.3.4 Review modified designs to assure that special considerations, e.g., seismic II/I and internally (or externally) generated missiles, have been adequately evaluated and documented.

4.0 OPERATIONS

4.1 Initial Review

In addition to the criteria contained in this section, the review of the operation aspects of the SWSs the operations review will follow the specific criteria contained in section 03.02, Operations, of TI 2515/118. Following is additional guidance for the operations inspector.

4.1.1 Review UFSAR sections, system design descriptions, and one-lines related to the service water and interfacing systems, (e.g., Residual Heat Removal System) for correlation of system design with operating procedures.

4.1.2 Review GL 89-13 commitments with regard to confirming the adequacy of the SWSs operating and emergency procedures.

4.1.3 Review TS to identify operational requirements related to the safe operation of the service water systems.

4.1.4 Review the procedures for normal and emergency operations of the SWSs and their interfacing systems to identify any areas of operational concern, such as inadequate procedural guidance or weaknesses.

4.1.5 Review selected modification packages to assure that changes which affect the service water and interfacing systems operations have been adequately addressed in operating procedures.

4.1.6 Verify that the SWSs are maintained in a state ready to respond to system demands with appropriate valve, breaker, and control lineups. Verify that the procedures are sufficient for the proper operation and maintenance of the system.

4.2 Interaction with Plant Operations Personnel

4.2.1 Using the results of the above reviews as a basis, interview plant operations personnel to determine:

- the effectiveness of the operating procedures in providing adequate guidance to personnel for the operation of the SWSs (and interfacing systems) in performing their safety functions;
- the adequacy of operator familiarity with SWSs, normal and emergency procedures;
- whether actions required by operator and specified response times for these actions are reasonable for postulated accident conditions; and
- whether adequate information is available through existing safety-related instrumentation to execute actions required by operating procedures.

4.2.2 During the interviews with operations staff, assess control of work and operations, and routine system status verification. Assess the qualifications and capability of the operations staff based on their experience, education, and training.

4.2.3 Through interaction with other inspection team members, assist in the assessment of the operations staff and procedures used relative to the design intent for the original service water systems design bases.

4.2.4 Walk through operating procedures identified during the initial review with licensed operators, when available, to identify any areas of weakness in the procedures. Concurrently, interview operating personnel to determine their opinions and input on these procedures relative to ease of performance and suggested changes that would improve weak areas.

4.2.5 During a walkdown of the SWSs and interfacing systems, determine if components are labeled and accessible to verify the components can be operated locally/manually.

4.2.6 Determine if as tested system lineups duplicate the required lineups for specific accident scenarios; or, that a change in system lineup is required and provided for in operating procedures.

4.3 Supplementary Reviews

4.3.1 Confirm that human factors considerations are adequately addressed in the implementation of operating procedures. To assure that required actions can be executed using available instrumentation, controls, and accessible components specified by the procedures.

4.3.2 Review the operational experience of the service water and interfacing systems, including Licensee Event Reports, Nuclear Plant Reliability Data Systems, enforcement actions, nonconformance reports, and maintenance work requests.

5.0 SURVEILLANCE AND TESTING

5.1 Initial Review

In addition to the criteria contained in this section, the review of operation aspects of the SWSs will follow the specific criteria contained in Section 03.04, Surveillance and Testing, of TI 2515/118. The following are additional guidance for the review:

5.1.1 Review UFSAR sections, design basis documents, TSs for service water and interfacing systems to identify requirements for surveillance and testing.

5.1.2 Review GL 89-13 commitments with regard to verifying the capability of SWS heat exchangers. Additionally, review the plant's commitments for the controlling of biofouling.

5.1.3 Review surveillance procedures for SWSs and interfacing systems to assure that surveillance requirements are adequately implemented. Verify the procedures reflect actual system and components function and design intent.

5.1.4 Review surveillance procedures for service water and interfacing systems to confirm that these systems and components are tested to demonstrate that they will perform their intended safety functions for all design bases conditions. For example, testing should demonstrate:

- capability of automatically supplying cooling water to equipment that must operate during an emergency shutdown;
- capability of automatically supplying cooling water to equipment required for normal plant operation in the case of a failure of the primary source of cooling water;
- automatic initiation of SWSs pumps on receipt of an actuation signal.

5.1.5 Review trending completed by the plant staff on surveillance data to determine if methods ensure that degradation will not result in components operating outside their design bases prior to next scheduled surveillance testing.

5.1.6 Identify selected modifications to the SWSs and interfacing systems for review to assure that appropriate surveillance and post-modification testing has been incorporated as required.

5.2 Plant Staff Interactions

5.2.1 Walk through surveillance and test procedures with surveillance and test personnel, if available, to identify any procedural weaknesses or procedures that may not be consistent with the design basis intent.

5.2.2 Interview surveillance personnel in conjunction with review of surveillance tending data to determine whether the root causes of failures have been aggressively pursued, identified, and corrected.

5.3 Supplementary Reviews

5.3.1 Review selected modification packages to confirm that post-modification testing, where necessary, has been provided to demonstrate that the modified design can perform its safety functions as required by the design bases.

5.3.2 Review actual in-service evaluation and testing data logs to confirm that data is being correctly logged and accurately documented in accordance with applicable procedures.

5.3.3 Review post-modification test procedures and actual post-modification testing data for testing conducted on the modified designs to confirm that:

- accurate and appropriate acceptance criteria based on design bases documentation have been established and met;

- procedures are technically adequate and reflect the design basis intent to assure the modified design can perform intended safety functions; and

- data is accurately and correctly logged as required by test procedures.

5.3.4 Review modifications to identify SWSs surveillance inspection and test requirements to be implemented on modified design. Confirm that provisions have been made to incorporate these requirements into appropriate procedure, scheduled surveillance testing, and Inservice Inspections.

5.3.5 Review surveillance procedures to determine the adequacy of inservice testing of SWSs pumps and valves in accordance with ASME Section XI requirements. Confirm that adequate acceptance criteria are specified and that they are consistent with design bases requirements (review in conjunction with mechanical portion of inspection).

6.0 <u>MAINTENANCE</u>

6.1 Initial Review

In addition to the criteria contained in this section, the review of the maintenance aspects of the SWSs will follow the specific criteria contained in Section 03.03, Maintenance, of TI 2515/118. Following is additional guidance for the maintenance inspector(s).

6.1.1 Review UFSAR sections, design basis documents, and maintenance program documentation provided to identify maintenance commitments for the service water and interfacing systems.

6.1.2 Identify maintenance-related documentation to be reviewed, (e.g., maintenance procedures, work requests, and post-maintenance test procedures).

6.2 Plant Staff Interactions

6.2.1 Review selected SWSs maintenance and maintenance test procedures with maintenance staff personnel to identify weaknesses and inconsistencies with the design intent for the component or system function.

6.2.2 Interview maintenance staff personnel to determine technical adequacy of maintenance instructions provided by maintenance procedures. Identify extent of maintenance instructions left to technician's capability in "skill of craft."

6.3 Supplementary Reviews

6.3.1 Review selected modifications to the SWSs for maintenance-related requirements, post-maintenance testing, etc. Confirm that provisions have been made to incorporate these requirements into appropriate maintenance procedures and periodic maintenance test schedules.

6.3.2 Review SWSs maintenance work requests and maintenance records to determine whether required maintenance was properly executed as specified in maintenance procedures.

6.3.3 Review maintenance records to confirm that required post-maintenance testing was conducted as specified in maintenance test procedures and that the test adequately demonstrated that the system and components tested will perform their intended safety functions as defined in the design bases.

6.3.4 Review maintenance records to determine whether repeated maintenance problems with the same components are adequately tracked and the root cause of the problems resolved.

6.3.5 Review maintenance records to identify any portions of the system that were inoperable or found substantially degraded for long periods of time. Determine if adequate root cause analyses were performed and if appropriate corrective actions were taken.

7.0 MANAGEMENT

7.1 Reviews

7.1.1 Review the interface between Operations, Nuclear Engineering and Technical Support to determine that adequate support is provided to Operations.

7.1.2 Identify the degree of root cause analyses and component trending.

7.1.3 Select modifications to be reviewed to identify weaknesses in configuration control.

7.1.4 Review modifications to confirm that changes made to the service water and interfacing systems have been accurately reflected in timely revisions to the UFSAR, drawings, operating and maintenance procedures, calculations, Q-List, and training documents where required. Evaluate errors and inconsistencies identified, including those identified by other reviewers, to determine if a generic weakness exists.

7.1.5 Review the procedures for temporary alterations.

7.1.6 Review training of engineering personnel.

7.2 Quality Assurance (QA) and Corrective Actions Activity

Initial Review - In addition to the criteria contained in this Section, the QA and Corrective Actions review will follow the specific criteria contained in Section 03.05, Quality Assurance and Corrective Actions of TI 2515/118. Following is additional guidance for the QA and Corrective Actions reviewers.

7.2.1 Review audit reports issued in the past 24 months involving corrective processes, plant maintenance, operations, surveillance and testing, and design activities to evaluate the effectiveness of corrective measures for issues identified in SWSs.

7.2.2 Review surveillance reports issued in the past 24 months involving SWSOPI concerns. Assess the timeliness and effectiveness of the corrective actions taken for identified issues.

7.2.3 Evaluate the timeliness and effectiveness of the corrective action processes for identified concerns raised during the recent SWSOPI Project activities.

7.2.4 Review any self-assessment activities performed in SWS areas by individual line organizations. Assess the timeliness and effectiveness of identified concerns.

7.2.5 Review the Licensing database for addressing NRC and any other commitments concerning SWS areas. Assess whether the commitments are being effectively met.

8.0 <u>ELECTRICAL SYSTEMS SUPPORTING SERVICE WATER SYSTEMS</u>

8.1 Initial Review

8.1.1 Review original and updated FSAR sections, design basis documents, Technical Specifications, and interface requirements and criteria to identify regulatory and design requirements for electrical power systems which support service water systems.

8.1.2 Review the index of modification design changes to the electrical systems and interfacing systems and interfacing systems during recent outages to identify packages that impact specific SWS components and should be inspected in detail.

8.2 Review of Modifications to the Electrical Systems

8.2.1 Review individual modification packages selected for inspection to determine effect of modifications performed on the capability of electrical systems and interfacing systems to meet established SWS commitments and design requirements.

8.2.2 Review selected modification packages or electrical design changes to assure that SWS capability has not been degraded relative to established criteria and requirements.

8.2.3 Review documentation substaining modifications to the service water systems to confirm that analyses are verified and completed in accordance with the requirements of ANSI N45.2.11.

8.3 Supplementary Reviews

8.3.1 Review the selection of SWS power sources, including separation requirements and availability.

8.3.2 Review SWS equipment control design.

8.3.3 Review the analyses for selected SWS motors and components, substaining the selected motor overcurrent and overload protection.

8.3.4 Review load sequencing, timing, and alignment of electrical power supplies that support the SWS.

OGDEN'S SWSOPI CRITICAL ATTRIBUTES MATRIX			
MECHANICAL DESIGN REVIEW	NRC ISSUE	SWSOPI INSPECTION	
		PRIORITY	REVIEWED
Hydraulic Analysis		1	
Hydraulic Model/Calculations	NYA,CEC,GNP,	1	X
	GPC		
Worst-Case Accident Scenarios		2	X
Abnormal Conditions/System Alignments		2	X
Design Flows	GNP,PGE,ONP	1	X
Component/Piping Resistances		1	X
Component Design - SW Pumps/Strainers		2	
Calculations	CEC	1	X
Maximum Allowable Degradation	SNO	2	X
NPSH	ONP	2	X
Runout Protection		2	X
Alarm Setpoints		3	X
Component Design - Heat Exchangers/Coolers		1	
Sizing Calculations	NYA,CEC,GNP,	1	X
	PGE,NSP		
Fouling Factors	PGE	1	X
Design Temperatures	NSP	2	X
Heat Loads		1	X
Design Pressures		2	X
Specifications/Codes		2	X
Modifications		2	
10CFR50.59 Safety Evaluations	NYA,ONP	1	X
Preservation of Design Basis/Licensing Basis		1	X
Seismic Qualification		2	X
Safety Classification	GNP,NYA,ONP	2	X
Temporary/Field Changes	IP3	3	
Other Mechanical Design Aspects		2	
Single Failure Analysis	NYA,GNP,WNP,	1	X
	CPL, DNP,CEC,		
	FPL		
Flooding/Pipe Break (HELB)	FPL,GPC	2	X
Freeze Protection	IP3	2	
Seismic Design	ONP	2	X
Water Hammer	SNO,ONP	2	X
Cathodic Protection	WNP	2	
Engineering/Safety Evaluations	CEC,HLP,WNP,	2	X
	ONP		
Environmental/Equipment Qualification	CEC,FPL	2	X
Equipment Separation/Missile Protection		2	X
Interfacing Systems (i.e., HVAC, Instrument Air)		3	X

OGDEN'S SWSOPI CRITICAL ATTRIBUTES MATRIX			
GENERIC LETTER 89-13	NRC ISSUES	SWSOPI INSPECTION	
		PRIORITY	REVIEWED
Biofouling Control		2	
Biofouling Micro/Macrofouling	APS		X
Intake Structure Inspections	CEC,NYA	3	X
Chemical/Heat Treatment, Chlorination		2	X
System Flushing/Flow Testing	GNP,CEC,ONP	3	X
Surveillance Testing/Control Techniques		2	
HX Heat Transfer Capability Testing	PGE,DNP,NYA	1	X
Test Instrumentation	APS,NYA,IP3	3	X
Trending	APS,PGE	2	X
HX Operability Review Based on Test Data	APS,PGE	2	
Acceptance Criteria (i.e., fouling, dp)	HLP,CEC,FPL	2	X
	CPL		
Adequacy of HX Inspection Frequency	GNP,CEC,FPL	2	X
	ONP		
On-Line Monitoring		2	
Routine Inspection and Maintenance Program		2	
GL 89-13 Program (Action III)	CEC	1	X
Adequate Inspection Population	GNP	2	X
Corrosion/Erosion Program	HLP,IP3,GPC	2	X
Protective Coatings/Piping Inspections	APS	2	X
Underground Piping Inspections	SNO	2	X
Silting/Biofouling Criteria	SNO,DNP	2	X
Silting of Instrument Lines	NYA,DNP,BGE	2	X
Licensing Basis Review		2	
System Functional Review	PGE	3	X
Design Basis Review	FPL,GNP,ONP	2	X
Single Failure Analysis	See Mech	1	X
System Walkdown	CEC	3	X
Operation/Procedures		2	
Maintenance Procedures	GPC	1	X
Normal Operating Procedures		2	X
Emergency Operating Procedures	FPL	1	X
Training	HLP,FPL,GNP,	3	X
	ONP		
No Formalized Program/Procedures	WNP,NYA,BGE	2	

OGDEN'S SWSOPI CRITICAL ATTRIBUTES MATRIX

OPERATIONS	NRC ISSUES	SWSOPI INSPECTION PRIORITY	SWSOPI INSPECTION REVIEWED
Plant Operation		3	
Operator Knowledge		3	X
Licensee Event Reports (LER/PREs)	WNP,NYA,IP3,	2	X
	GPC		
Proper Valve Line-ups	WNP,CEC,NYA,	2	X
	CPL,GPC		
Valve Accessibility	IP3	3	X
Operational Limits	PGE	2	X
Control Room Conduct		3	X
Procedures		2	
Normal Operating Procedures	HLP,WNP,CEC,	2	X
	CPL		
Abnormal Operating Procedures	CPL	2	X
Emergency Procedures	FPL,ONP	2	X
Alarm Response Cards		3	X
GL 89-13 Procedure Review		1	
Walkthrough with Licensed Operators		1	X
Training		3	
Training Manuals	See GL 89-13	3	
Lesson Plans		3	X
Up-to-Date Operator Knowledge		3	X
Modification		2	
Procedural Impact		2	X
Training Impact		3	

OGDEN'S SWSOPI CRITICAL ATTRIBUTES MATRIX			
QUALITY ASSURANCE/CORRECTIVE ACTIONS REVIEW	NRC ISSUES	SWSOPI INSPECTION	
		PRIORITY	REVIEWED
Document/Calculation Control		3.	
Document Control/Design Control	GNP,IP3,ONP,	1	
	CPL		
Design Calculation Control	FPL,PGE,ONP,	2	
	CPL		
Modification Packages	ONP	2	
Design Reports		3	
P&ID Accuracy		3	
Training		3	
Training Manuals		3	
Lesson Plans		4	
Up-to-Date Operator Knowledge		4	
Quality Assurance/Corrective Actions		2	
Audit Reports Review (Past 24 months)		2	X
Surveillance Reports Review (Past 24 months)		2	
Corrective Actions	ONP,GPC	2	X
Line Organization Self-Assessments	ONP	2	X
Commitment Assessment		2	
OSSRC/POSRC OIs on SWS Issues		2	X
Operational History		2	
Quality Verification Activities	APS	2	X
Interface of Engineering/Systems/Operations		2	X

OGDEN'S SWSOPI CRITICAL ATTRIBUTES MATRIX			
SURVEILLANCE AND TESTING REVIEW	NRC ISSUES	SWSOPI INSPECTION PRIORITY	REVIEWED
Pre-Operational Testing	FPL	3	
Minimum Flows		3	
Test Procedure		3	
Component Performance		2	
Test Configuration	GNP,ONP	3	
Surveillance Testing		1	
Pump Performance	NSP,CEC,DNP,		X
	ONP,CPL		
HX Performance Testing (Eddy Current)	NYA		X
Flow Balance/Verification	HLP,NSP,FPL,	1	
	NYA		
System Configuration	FPL		X
Technical Specifications	GNP	1	X
Procedures	PGE,GPC	2	X
Trending	See GL 89-13	2	X
Instrument Error/Calibration	HLP,SNO,WNP,	2	X
	NYA,FPL		
Design Basis Flows		1	X
ISI/IST Program		2	
ISI/IST Program	NSP,GNP	1	X
Completeness of IST Program	HLP,SNO,NSP,	1	X
	DNP,FPL,NYA,		
	ONP,BGE		
IST Failure Evaluations	NSP,CEC,NYA	1	
Corrosion/Erosion Inspections		2	X
Intake Structure Inspections		1	X
Protective Coatings		3	
Silting Biofouling Criteria	APS	1	X
MOV Inspection Program	APS,SNO	2	

OGDEN'S SWSOPI CRITICAL ATTRIBUTES MATRIX			
MAINTENANCE REVIEW	**NRC ISSUES**	**SWSOPI INSPECTION**	
		PRIORITY	**REVIEWED**
Preventive Maintenance Program		1	
Corrosion/Erosion Program	WNP,CEC	2	X
Preventive Maintenance Program Completeness		2	
Corrective Maintenance Program		1	
Root Cause Analyses	WNP,FPL	2	
Maintenance Work Orders	ONP	2	X
Trending/Maintenance Histories		2	X
	CEC		
Vendor Recommendations		4	X
GL 89-13 Requirements (Action III)		1	X
	See GL 89-13		
Procedures/Training		3	X
	See GL 89-13		
Industry Experience		2	X
System Walkdown for Material Condition		1	
System Walkdown	IP3	1	X
Material Condition (Scaffolding, Labeling, etc.)	WNP,NYA,FPL	2	X

OGDEN'S SWSOPI CRITICAL ATTRIBUTES MATRIX			
ELECTRICAL DESIGN REVIEW	NRC ISSUE	SWSOPI INSPECTION	
		PRIORITY	REVIEWED
Electrical Maintenance		2	
Maintenance Adequacy		2	
Procedures		2	X
Trending		3	
Electrical Calculations/Studies		2	
Voltage Study		1	
Short Circuit		2	X
Coordination		2	X
EDG Loading		1	
Licensing Basis		1	X
MOV Protection	NYA	2	
Electrical Modifications		2	
10CFR50.59 Safety Evaluations		2	X
Design Basis		2	
Other Electrical Requirements		2	
Separation		2	
Single Failure Analysis	NYA	2	X
Availability		3	
IST Evaluations	NYA	2	

OGDEN'S SWSOPI CRITICAL ATTRIBUTES MATRIX

INSTRUMENTATION AND CONTROLS REVIEW	NRC ISSUES	SWSOPI INSPECTION PRIORITY	REVIEWED
I&C Maintenance		2	
Maintenance Adequacy		2	
Instrument Out-of-Calibration Reviews	SNO,CPL	1	X
Trending		2	
Procedures		2	X
I&C Calculations/Study		2	
Loop Accuracy		2	X
Logic/Testability		3	
Calibration	NYA	3	
Design Basis of Setpoint	PGE,GNP,IP3	2	X
Modifications		3	
Design Basis		3	
10CFR50.59 Safety Evaluations		3	

OGDEN'S SWSOPI CRITICAL ATTRIBUTES MATRIX

Legend

APS - Arizona Public Service Company (Palo Verde)
BGE - Baltimore Gas & Electric Company (Calvert Cliffs)
CEC - Commonwealth Edison Company (Quad Cities)
CPL - Carolina Power and Light Company (Robinson)
DNP - Commonwealth Edison Company (Dresdon)
GNP - Rochester Gas and Electric Corporation (Ginna)
GPC - Georgia Power Company (Hutch)
FPL - Florida Power and Light Company (St.Lucie)
HLP - Houston Light and Power Company (South Texas)
IP3 - New York Power Authority (Indian Point 3)
NSP - Northern States Power (Monticello)
NYA - New York Power Authority (FitzPatrick)
ONP - Duke Power Company (Oconee)
PGE - Pacific Gas & Electric Company (Diablo Canyon)
SNO - Southern Nuclear Operating Company (Farley)
WPS - Washington Public Power Supply System (Washington)

TOPIC	PLANT	ISSUE	CATEGORY
Hydraulic Model/Calculations	NYA	The hydraulic model did not consider the appropriate strainer dps. The alarm setpoint was higher in the field than that used in the ESW model.	Follow-up Item
Hydraulic Model/Calculations	CEC	The hydraulic model had not been benchmarked against plant data. The team identified a list of unverified assumptions incorporated into the model. In addition, the effect of fouling has not been incorporated in these models.	Observation
Hydraulic Model/Calculations	GNP	Reassessment of SWS hydraulic model. The major limitation associated with the model was the limited amount of actual plant data used to verify the flow resistance.	Unresolved Item
Hydraulic Model/Calculations	GPC	The licensee attempted to re-benchmark the flow model. However, the re-benchmarking effort could not produce results meeting the acceptance criteria and had a number of implementation weaknessess.	Follow-up Item
Design Flows	GNP	A reanalysis to determine that the containment pressure integrity would not be impaired by diverted flow to the containment air cooler fan motors which was not listed by the FSAR. This reanalysis indicated that the containment would be subjected to a slightly longer and higher temperature transient than originally determined. Because the containment temperature profile changed in comparison with the original profile, the team advised the licensee to include consideration of this change as part of an updated containment analysis to the NRC.	Observation
Design Flows	GNP	Inaccurate FSAR information, for example, neglected flows to the CAC fan motors, no cross-connects when in fact there was, and system is designed to isolate non-safety related loads on an accident yet it did not. See related Database entries for more details.	Deficiency
Design Flows	PGE	Test results showed that the ASW system flow was reduced by much more than was concluded by the licensee calculations for the condition where system flow was aligned through the pump cross-tie.	
Design Flows	ONP	No procedural controls existed to assure the Low Pressure SW pump flows inputted	Violation

TOPIC	PLANT	ISSUE	CATEGORY
		into the hydraulic computer model for the LP SWS remained valid during quarterly testing of the pumps. In other words, maximum pump degradation allowed by testing was not used in the hydraulic analysis.	
SW Pump Design Calc	CEC	The test acceptance criteria was met for the 5800 gpm flow. However, the methodology used for the higher flow may not be applicable for the accident mode with only one RHRSW pump operating at approximately 3500 gpm.	Observation
Max Allowable Degradation	SNO	Maximum allowable pump degradation was determined by multiplying the degraded pump flow rate by a factor of 1.1 to obtain a minimum acceptable baseline for a two pump combination. The degraded flow rate should have been divided by a factor of 0.9. This value was used in the IST program and the flow model.	Non-cited Violation
NPSH	ONP	The NPSH of the Low Pressure Service Water pumps was not adequately considered as a design input. During certain operating conditions involving loss of instrument air where flow demand was greater than design, there was insufficient NPSH. An evaluation stated that the condition was acceptable based on the manufacturer's best judgement that no significant pump degration would occur during and following the inadequate NPSH condition. Neither the licensee nor the pump manufacturer performed any testing validating this judgement.	Violation
Sizing/HX Capacity Calc	NYA	A SE assumed that the crescent area unit cooler would only be 50% effective due to a 12 foot high flood wall. No calculation backed this assumption. In addition one cooler can be removed from service, therefore only 3 1/2 coolers remain available. The TS require four to be operable.	Unresolved Item
Sizing/HX Capacity Calc	CEC	The following weaknesses were noted in the HX routine inspection and maintenance: The licensee did not establish specific fouling/clogging acceptance criteria for the HX that were inspected. An evaluation was not completed to determine if any of the heat exchangers or room coolers were marginal and deserved special consideration. An evaluation was not completed to assess the actual system heat transfer fouling factor based on observed conditions to ensure that existing heat transfer margins were not being	

TOPIC	PLANT	ISSUE	CATEGORY
		significantly degrades. The program did not have in place a specific requirement to evaluate the adequacy of existing heat exchanger inspection frequencies upon completion of each inspection.	
Sizing/HX Capacity Calc	CEC	The licensee failed to recognize that no additional margin was added to the minimum allowable flow rates to account for instrument uncertainty, variations in intake water level, pump degradation allowed by the IST program requirements, dynamic effects that may occur when operating both the RHRSW and the DGSW systems simultaneously, and routine fouling effects that can accumulate during plant operation.	
Sizing/HX Capacity Calc	GNP	The team identified that at normal flow rates through its shell side, the component cooling water heat exchangers were susceptible to flow-induced vibration which could result in tube deterioration due to fretting. The licensee had not determined the maximum flow rates nor assessed whether a greater potential for flow-induced vibration exists.	Observation
Sizing/HX Capacity Calc	PGE	A computer model predicted the CCWHX's heat transfer performance to ensure that it would remove the design basis heat load. The test data showed the heat exchanger capacity to be at 98.7%. It also did not account for the maximum allowed differential pressure across the HX.	Unresolved Item
Sizing/HX Capacity Calc	NSP	Calculation of heat loads for the RHR/CS pumps rooms showed that the cooler heat removal capability exceed the total heat load by 1.3%. This analysis was based on design coolant flow whereas operating data indicated that a flow rate of less than design flow was more realistic.	
Fouling Factors/Macrofouling Calc	PGE	No analysis of calcification on the inner diameter of the CCWHX tube sheets had the potential of undetected tube plugging.	Follow-up Item
Design Temperatures	NSP	The minimum threshold overall heat transfer coefficient for the RHR heat exchanger was in error. The RHR minimum threshold overall heat transfer coefficient available from the manufacturer's data sheet with a coolant temperature of 85°F in lieu of 90°F.	Follow-up Item

TOPIC	PLANT	ISSUE	CATEGORY
Safety Evaluations (50.59)	NYA	A safety evaluation, which downgraded the control room chiller condensers from safety-related to non-safety related did not provide an adequate basis for the determination that the change does not involve an unreviewed safety question. Flooding was not evaluated in the safety evaluation. In addition, the heat generation in the control room used in the SE was outdated.	Violation
Safety Evaluations (50.59)	CNP	10CFR50.59 Screening Checklists require completion of a safety evaluation when the answer to any of the questions is yes. The question "Does the evaluation item affect structures, systems, or components that are addressed in the FSAR in a significant manner?" was answered incorrectly.	Violation
Safety Evaluations (50.59)	TEC	The change in the alignment of the isolation valves for the standby containment air cooler, as described in the Updated Safety Analysis Report, did not receive a written safety evaluation and was not documented as a change in the facility.	Violation
Safety Classification	GNP	The licensee installed a second spent fuel pool heat exchanger and in doing so relegated A to serving a backup function. However, this heat exchanger was classification and be subject to applicable code and inspection requirements. The licensee stated control room indication of crescent room area temperatures and existing plant procedures would provide adequate guidance to respond to	Unresolved Item
Safety Classification	NYA	The licensee stated control room indication of crescent room area temperatures and existing plant procedures would provide adequate guidance to respond to the postulated failure of one train of ESW to the crescent area unit coolers; however, the temperature indication for the east crescent area is non-safety related. This particular component was being considered in a SFA to determined its required function in an accident.	Unresolved Item
Safety Classification	NPP	In an effort color-code essential and non-essential service water system valves, some essential valves were mis-classified as non-essential.	Weakness
Safety Classification	ONP	The active components associated with CCW pumps were not classified as safety-related. However, the licensee credited CCW pump operation 1/2 hour after	Unresolved Item

TOPIC	PLANT	ISSUE	CATEGORY
		accident occurrence to provide the suction supply to the LPSW system. Therefore,	
		the pumps were improperly classified. In addition, the HPSW system was not	
		classified, constructed, tested or maintained commensurate with its importance to	
		safety.	
Safety Classification	ONP	The CCW pump components necessary to support siphon operation to the LPSW	Non-cited Violation
		system (the first siphon) performed a safety related function but were not classified	
		as pump casing and the CCW piping must be leaktight, and the pump mountings	
		must be safety related. For the first siphon to operate, the physical interface	
		between the capable of withstanding an earthquake without allowing air inleakage.	
Temporary/Field Changes	IP3	NYPA was implementing a special area temperature monitoring program is areas	Commitment
		of the SWS susceptible of freezing due to problems with the existing heat tracing	
		system. Temporary 15 KW heaters were found plugged into wall outlets in the Zurn	
		strainer room and had been in place for approximately one year. The heaters are	
		neither mounted nor grounded and present both fire and personnel safety hazards.	
Single Failure Analysis	NYA	The licensee did not verify that a single failure of a valve in the open position	Follow-up Item
		would not adversely affect emergency service water flow rates to other safety-	
		related heat exchangers. The valve was normally throttled.	
Single Failure Analysis	NYA	The licensee stated control room indication of crescent room area temperatures	Unresolved Item
		and existing plant procedures would provide adequate guidance to respond to	
		the postulated failure of one train of ESW to the crescent area unit coolers;	
		however, the temperature indication for the east crescent area is non-safety	
		related. This particular component was being considered in a SFA to	
		determined its required function in an accident.	
Single Failure Analysis	NYA	Electric bay and cable tunnel ESW return valve and crescent area unit cooler	
		ESW return valve could affect both safety trains of area cooling equipment if a	
		single failure is postulated.	
Single Failue Analysis	GNP	The SWS has been operated in a cross-connected configuration. If the	Unresolved Item
		discharge check valve for one of the SW pumps failed to close upon system	

TOPIC	PLANT	ISSUE	CATEGORY
		realignment such that if the associated pump was not operating, water could be pumped in the opposite direction through the check valve into the SW intake bay. This scenario was identified but not appropriately analyzed, in a single failure report.	
Single Failure Analysis	GNP	Inadequate SFA of - non-critical loads which are automatically isolated following an SIS (did not include isolation of the CCWHXs) concurrent with undervoltage and normal system alignment did not permit a single active or passive failure to result in the loss of service water flow to redundant critical loads.	Observation
Single Failure Analysis	WNP	The licensee did not address failure of the loop isolation valve. The concern was that uncertainties with this valve's operation could cause a loss of redundant SW trains.	Deficiency
Single Failure Analysis	DNP	A vulnerability existed in the CCSW supply that could potentially disable the safety related cooling capability for the common Unit 2/3 control room. Unit 2 CCSW provide the only cooling water to the safety related train B HVAC unit for the common Unit 2/3 control room. Should Unit 2 CCSW be out of service there would be no safety related cooling water supply for the refrigeration condenser.	
Single Failure Analysis	CEC	Single failure vulnerabilities were not fully evaluated by the licensee: Non-safety-related RHRSW and DGCW system piping downstream of these safety-related HX could rupture or clog, the effects of which could render safety-related service water system equipment inoperable. The reliance upon non-environmentally-qualified RHRSW heat exchanger flow reversal valves, that allowed the operators to reverse flow through the RHR heat exchangers during accident conditions if the heat transfer capability of the RHRSW heat exchangers was degraded. Common mode failures that could result from maintenance or operator errors.	Deficiency
Single Failure Analysis	FPL	The lubricating water supply to the ICW pumps was susceptible to a common mode failure because the two trains of lube water joined in a common header.	Observation

TOPIC	PLANT	ISSUE	CATEGORY
		For example, a pipe break or a bearing failure could have prevented the flow of lube water to all ICW pumps.	
Single Failure Analysis	CPL	AOP procedure, "Loss of SW", would not provide fire suppression system water as backup supply to the control room HVAC coolers following a single failure of the north service water header at a pressure below the design pressure rating of the HX.	Violation
Single Failure Analysis	TEC	Two independent pressure switches, which in turn control the capability to switch the SW discharge to the seismically qualified portion of the intake structure, could be isolated by the failiure of a common root valve.	Unresolved Item
Flooding/Pipe Break (HELB)	NYA	A safety evaluation, which downgraded the control room chiller condensers from safety-related to non-safety related did not provide an adequate basis for the determination that the change does not involve an unreviewed safety question. Flooding was not evaluated in the safety evaluation. In addition, the heat generation in the control room used in the SE was outdated.	Violation
Flooding/Pipe Break (HELB)	FPL	The nonessential heater isolation valves were located below the flood level but were not qualified for submersible operation.	Observation
Flooding/Pipe Break (HELB)	GPC	The licensee was asked to provide evidence that the PSW piping inside the drywell was protected against an HELB, an informal analysis was provided. One recirc line break caused an interaction between the resulting jet of water/steam and drywell cooler. The licensee judged this would be no threat to the PSW piping or cooler. The team disagreed.	Unresolved Item
Freeze Protection	IP3	NYPA was implementing a special area temperature monitoring program is areas of the SWS susceptible of freezing due to problems with the existing heat tracing system. Temporary 15 KW heaters were found plugged into wall outlets in the Zurn strainer room and had been in place for approximately one year. The heaters are neither mounted nor grounded and present both fire and personnel safety hazards.	Commitment

TOPIC	PLANT	ISSUE	CATEGORY
Seismic Design	ONP	Measures had not been established to assure that conditions adverse to quality had been corrected. The evaluation to detemrine corrective actions concerning the postulated response of the High Pressure Service Water System to the maximum hypothetical earthquake did not include the consequences of spurious fire protection component activations. The violation was for inadequate corrective actions.	Violation
Seismic Design	ONP	The licensee had performed calculations to determine the effect an earthquake would have on the LPSW systems. In the case of a non-seismically supported turbine building line failure without turbine isolation, the calculation indicated the LPSW system would not be able to supply adequate cooling to the required safety related loads. The licensee stated that failure of a seismic/non-seismic interface valve was outside the licensing basis for the facility. The team disagreed.	Unresolved Item
Seismic Design	TEC	Design analyses for the containment and emergency core cooling assumed constant SW temperature. This is only true if connections between the Lake and the seismic class I intake structure were intact. These interconnections were not classified as seismic class I. Also, the use of non-seismic interconnection conflicted with USAR statements.	Unresolved Item
Water Hammer	SNO	An initiating event in the licensee's waterhammer analysis was LOSP coincident with LOCA. Certian analysis assumptions asociated with intial SW temperature, time to energize SW pumps following a LOSP, heat input into the SWS and SWS backpressure control appeared to be non-conservative and could adversely affect the results.	Unresolved Item
Water Hammer	ONP	Measures had not been established to assure that conditions adverse to quality had been corrected. The evaluation for a postulated water hammer within the Low Pressure Service Water piping downstream of the reactor building cooling units, did not address the water hammer effects on the structural integrity of the piping. The violation was for inadequate corrective actions.	Violation
Cathodic Protection	WNP	Procedures allowed operators to operate the flow reversing valves of the RHR heat exchangers during an event to enhance heat transfer capability. the valves	Deficiency

TOPIC	PLANT	ISSUE	CATEGORY
		were not environmentally qualified. The concern was that unqualified valves could fail in some intermediate position and render the RHRSW HX inoperable during an accident mitigating activity.	
Environmental/EQ	CEC	Procedures allowed operators to operate the flow reversing valves of the RHR heat exchangers during an event to enhance heat transfer capability. the valves were not environmentally qualified. The concern was that unqualified valves could fail in some intermediate position and render the RHRSW HX inoperable during an accident mitigating activity.	Deficiency
Environmental/EQ	FPL	The nonessential heater isolation valves were located below the flood level but were not qualified for submersible operation.	Observation
Engineering/Safety Evaluations	CEC	A study of the RHR heat exchanger room coolers determined that they were not required to mitigate the consequences of an accident. Natural ventilation was assumed in the study, however, field verification identified no natural ventilation pathway. Corrective actions to address degraded RHR HX room coolers that were identified was not taken to inspect and evaluate the operability of the other unit's room cooler. The second cooler was inoperable for approximately one year.	Deficiency
Engineering/Safety Evaluations	CEC	Follow-up on reliability-centered engineering studies' recommendations did not appear to exist in all cases.	Observation
Engineering/Safety Evaluations	HLP	The licensee concluded that tube fin separation had degraded the effectiveness of heat transfer across the tubes. However, the team noted that the licensee's evaluation addressed only the heat transfer requirements for the intercoolers, but did not address structural integrity requirement for the tube fins, potential failure modes, and 10CFR 21 reporting requirements.	
Engineering/Safety Evaluations	WNP	The operational status of the active cathodic protection system had been identified as indeterminate during an SSFI. The resolution to the finding was that the system was unnecessary. The non-conservative initial disposition and	Deficiency

TOPIC	PLANT	ISSUE	CATEGORY
		untimely engineering evaluation of the SSFI finding was considered a	
		deficiency.	
Engineering/Safety Evaluations	ONP	A condition adverse to quality report associated with a broken coupling on the	
		hydroelectric station's turbine guide bearings oil cooler was neither processed as	
		an upper tier adverse quality report nor did it rceive a written operability evaluation.	

TOPIC	PLANT	ISSUE	CATEGORY
Biofouling, Micro/Macrofouling	APS	Although biocide programs were in place, there was algae growth in	
		the service water spray ponds of all three units. The programs in place	
		were not effective in fully preventing algae growth.	
Intake Structure Inspections	CEC	The intake structure inspection scope was too narrowly focused on RHRSW	
		and did not include an inspection of the complete intake structure, did not	
		specifically address biofouling concerns such as the presence of mussels and	
		clams, and the growth of river grass. Specific qualifications and training were	
		not required for the diver who performed the intake structure inspections.	
Intake Structure Inspections	NYA	Specific guidance was not provided for future service water intake structure	
		inspections and the scope of future inspections was not defined. The	
		inspections did not include such evaluations as extent of silting and debris	
		accumulation, biofouling, and structural condition.	
Intake Structure Inspections	NPP	Inspections of the intake structure were not complete, in that one of the Service	Unresolved Item
		Water Bays could not be isolated to permit diver inspection inside the travelling	
		screen, nor dewatered to permit cleanup.	
Chemical/Heat Treatment	CNP	The "biofouling Control and Surveillance Techniques" were sub-optimal due to	Weakness
Chlorination		ommissions in the stagnant line flush program and no chemical treatment of the	
		SWS.	
System Flushing/Flow Testing	GNP	Action I - Appropriate actions were not defined in the licensee's SWS	Observation
		reliability optimization program to ensure that infrequently used loops and	
		stagnant areas, such as the alternate discharge to Deer Creek, the SWS	
		supplies to the auxiliary feedwater and standby auxiliary feedwater systems,	
		the SWS supply to the DG cooling Water expansion tank, and isolated header	
		piping, would not become clogged.	
System Flushing/Flow Testing	CEC	Isolated lines/system interconnections were not included in the GL program	
		scope. These lines included the SWS supply to the standby coolant supply	
		system, the fire water and SWS supply to the safe shutdown makeup system,	
		the service water/fire water system supply to the safe shutdown makeup system	

TOPIC	PLANT	ISSUE	CATEGORY
		room cooler, and the fire water system supply to the RHR system.	
System Flushing/Flow Testing	ONP	The post-construction flushing procedure for the Safe Shutdown Facility's discharge lines to all the steam generators did ot contain flush velocities or acceptance criteria based upon filter, turbidimetric or chemical analyses.	Violation
System Flushing/Flow Testing	ONP	All raw water systems were not reviewed for stagnant or intermittent flow locations. The licensee did not include the Keowee service water cooled systems were not included.	Deviation
HX Heat Transfer Capability Testing	PGE	Initial baseline testing of the heat exchangers did not take into consideration the amount of microfouling or macrofouling. The differential pressure was not recorded. The failure to record differential pressure precluded the use of the test data as an assessment of the adequacy of the operator's differential pressure limits. The water level in the outlet water box. This varies with the tide and adds additional variables which effect the measurement differential pressure across the HX.	
HX Heat Transfer Capability Testing	NPP	REC heat exchanger testing did not demonstrate that the heat exchangers would function as required in the limiting conditions. The licensee planned to evaluate the technical basis for the heat exchanger testing.	Unresolved Item
HX Heat Transfer Capability Testing	DNP	The team considered Dresden's initial response and certain aspects of the initial program to be weak in addressing the concerns of GL 89-13. In some cases, Dresden's actions did not meet the GL's intent. Examples included: testing was not performed as committed to in the GL response, inadequate CCSW and HPCI room cooler testing methodology, and not including instrument lines in the flush and clean program.	
HX Heat Transfer Capability Testing	DNP	The team concluded that LPCI/CCSW heat exchanger testing was necessary to develop baseline performance parameters that would confirm the heat exchangers capability for each proposed flow reduction scenario. Finally, the test would provide the LPCI/CCSW HX with site specific tube side fouling	Follow-up Item

TOPIC	PLANT	ISSUE	CATEGORY
		factors, which may or may not be the same as those recommended by the TEMA standards.	
HX Heat Transfer Capability Testing	NYA	Heat transfer testing of the ESW heat exchangers did not include an uncertainty band for the measured heat transfer rate and margins of uncertainty were not factored into the acceptance criteria. The existence of sufficient margin between the design conditions and the test results regarding the crescent area unit coolers has not been demonstrated.	Unresolved Item
Test Instrumentation	APS	Heat exchanger testing used assumed flows rather than measured due to the lack of flow instrument. Flow devices used to measure flow rates of individual heat exchangers were broken for two years. Consequently, the flow rates were not being recorded.	Follow-up Item
Test Instrumentation	NYA	The strainers do not presently have a local dp indication to provide a positive means to verify the condition of the ESW basket strainer. The team determined that this modification was necessary to provide the operators with information regarding the condition of the ESW strainers.	Commitment
Test Instrumentation	IP3	The EDG jacket water and lube oil cooler thermal performance test was inconclusive because a surface-mounted temperature sensing element was installed on the lube oil line beyond the outlet of the discharge joint. The purpose of the element was to monitor diesel outlet service water temperature.	Commitment
Trending	APS	Heat exchanger data trended by the system engineer only recorded certain pressures, specifically, the pump discharge pressures and pressures at the ECW HX and the spray pond nozzles. This was not sufficient to detect flow blockage. Erratic readings were not usually followed up to determine their cause.	
Trending	PGE	No trending was performed for the amount of macrofouling found in each CCW heat exchanger and the consequent amount of tube plugging.	
HX Operability Review Based	APS	Thermal performance data for certain heat exchangers was not	Follow-up Item

TOPIC	PLANT	ISSUE	CATEGORY
on Test Data		reviewed. The licensee committed to include an operability review for	
		all the heat exchangers.	
HX Operability Review Based	PGE	The effect of a CCWHX failing to meet its acceptance criteria had not	Unresolved Item
on Test Data		been analyzed on ASW system operability for almost three years.	
HX Operability Review Based	PGE	Despite assurances of ASW system design margin, the NRC determined that CCW	Violation, Level III
on Test Data		heat exchanger 1-2 failed to demonstrate ability to remove the design basis heat load	
		during a heat exchanger capacity test performed in February 1991. The NRC also	
		determined that PG&E had failed to properly identify the cause or to take timely corrective	
		action following the February 1991 CCW heat exchanger test failure, but PG&E engineering	
		personnel again failed to promptly respond to identified problems, this time by failing to	
		properly evaluate or reslve the QA findings, and QA did not force the issue. PG&E's	
		inadequate follow-up on the QA findings represents an additional, significant missed	
		opportunity to have identified and corrected the violation which is now being cited.	
Acceptance Criteria	HLP	During the heat transfer testing, the heat load was normally less than	Deficiency
		the design basis value. This decreased heat load would in turn decrease	
		the temperature difference between the process fluid and essential cooling	
		water. Given this situation, a substantially fouled HX could still meet the	
		established acceptance criteria. Since HX capability is not necessarily	
		demonstrated using the current methodology, the team found the derived	
		acceptance criteria unacceptable.	
Acceptance Criteria	CEC	rogram to monitor heat exchanger Dp was not fully developed in that	
		um and maximum acceptance criteria were not established, and the	
		dures did not specify what the proper cooler inlet conditions should be	
		the Dp was being monitored.	
Acceptance Criteria	FPL	Operability criteria based on test results showing worst-case fouling conditions	Observation
		and heat exchanger differential pressure had not been established.	
Acceptance Criteria	CPL	The work requests that implemented the inspection and cleaing of safety-related	Non-Cited Violation
		HX did not define the as found conditions in sufficient detail to enable the team to	Follow-up Item

TOPIC	PLANT	ISSUE	CATEGORY
		determine the conditions of the HVHs. The instructions for the inspection of the HX and the requirement for documentation of the results were inadequate. Additional HX inspections were scheduled to be performed during the upcoming refueling outage using the revised procedures.	
Acceptance Criteria	FPC	Tests were routinely accepted when an additional heat exchanger had to be placed into service for the SW/RW pumps to achieve design flow.	Unresolved Item
Acceptance Criteria	TEC	The team identified the lack of acceptance criteria for inspection PMs for various heat exchangers and other components.	
Adequacy-HX Inspection Freq	CEC	The following weaknesses were noted in the HX routine inspection and maintenance: The licensee did not establish specific fouling/clogging acceptance criteria for the HX that were inspected. An evaluation was not completed to determine if any of the heat exchangers or room coolers were marginal and deserved special consideration. An evaluation was not completed to assess the actual system heat transfer fouling factor based on observed conditions to ensure that existing heat transfer margins were not being significantly degrades. The program did not have in place a specific requirement to evaluate the adequacy of existing heat exchanger inspection frequencies upon completion of each inspection.	
Adequacy-HX Inspection Freq	GNP	Action II - The licensee had not established a sound basis for the preventive maintenance frequencies for heat exchanger open and inspect frequencies.	Observation
Adequacy-HX Inspection Freq	FPL	HX test results, given instrument inaccuracies and the required extrapolation inherent with the test methodology, showed that the heat transfer capability of the CCWHX was marginal. The heat exchanger test frequency may not be adequate.	Observation
Adequacy-HX Inspection Freq	ONP	A periodic testing program had not been established for the testable Keowee Service Water System heat exchangers or the standby shutdown facility's testable emergency diesel generator heat exchangers.	Deviation

TOPIC	PLANT	ISSUE	CATEGORY
Adequacy-HX Inspection Freq	FPC	In the case of heat exchanger plugging with shells, a tech spec action statement	Unresolved Item
		was entered for the division while the heat exchanger was being cleaned. Upon	
		completion of the cleaning, that division would be restored to service and	
		successfully tested. The the same process was repeated for the opposite division.	
		No consideration was given to the indeterminate period of timeprior to the first	
		attempt, when both divisions of the system would not have been capable of	
		performing their safety function if called upon.	
GL 89-13 Program (Action III)	CEC	Valves and components that are periodically disassembled and inspected were	
		not identified and included in the GL 89-13 program.	
GL 89-13 Program (Action III)	CEC	Specific guidance for performing as-found inspections and evaluations during	
		PM and corrective maintenance activities was not established and implemented	
		to address GL 89-13 concerns. Evaluations were not completed to ensure that	
		critical sections of small bore piping and tubing would not become clogged	
		with silt and debris. The program did not include non-safety-related service	
		water piping downstream of the safety-related HX.	
Adequate Inspection Population	GNP	Action III - Measures were not taken to ensure that the population of	Observation
		components being inspected was complete and that the frequency of the	
		inspections were adequate. The licensee had not included in its program any	
		periodic inspection requirements or other measures to ensure that internal	
		piping areas and instrument lines were not degraded.	
Corrosion/Erosion Program	HLP	Quarterly ultrasonic subsurface crack length evaluation which may not	Observation
		appropriately factor in actual experience with the subsurface growth	
		rate. In addition, the procedure accounts for safe shutdown earthquake	
		bending stress, but not those due to water hammer.	
Corrosion/Erosion Program	IP3	RC team concluded that corrosion induced pipe and component leakage	Unresolved Item
		ad a notable occurrence throughout the SWS over the past several years.	
		quently, the team requested that NYPA develop and implement an action	
		to identify and inspect SWS piping susceptible to corrosion and leakage in	

TOPIC	PLANT	ISSUE	CATEGORY
Corrosion/Erosion Program	GPC	The RT program offered good insights into the material condition of the pipe	Follow-up Item
		through RT testing of selected locations. However, program implementation was	
		hampered by the lack of strict diretion and control of pipe loactionfor taking	
		consecutive reading. This reduced the ability to accurately trend corrosion rates.	
Corrosion/Erosion Program	GPC	Structural calculations for all the RHRSW and PSW pump columns did not include	Follow-up Item
		an allowance for corrosion. Also, periodic inspections of these pumps did not	
		include inspection for corrosion deterioration.	
Protective Coatings/Piping	APS	The inspector concluded that the licensee did not have a routine	
Inspections		program for the inspection of coated service water piping. In addition,	
		the inspector noted that the failure to meet the GL 89-13 commitment	
		to have a routine program of pipe inspection should have been	
		identified by the quality monitoring report and was not.	
Underground Piping Inspection	SNO	The indicated location of underground piping in the procedure did not	Violation
		correlate to the actual location, because one of the landmarks for the	
		inspection was a construction road that had been significantly rerouted	
		between the plant and the SWIS.	
Silting/Biofouling Criteria	SNO	Valve maintenance and test records indicated that certain SWS valves	Follow-up Item
		and small bore piping were repeatedly clogged with silt and rust.	
		Specifically lube and cooling lines for SWS pumps.	
Silting/Biofouling Criteria	DNP	The GL 89-13 program did not require documentation of silting evaluations,	
		no acceptance criteria was available for allowable silting amounts. Low flow	
		areas were incorporated into the Erosion/Corrosion Program, However, no	
		acceptance criteria was established.	
Silting of Instrument Lines	DNP	The team considered Dresden's initial response and certain aspects of the	
		initial program to be weak in addressing the concerns of GL 89-13. In some	
		cases, Dresden's actions did not meet the GL's intent. Examples included:	
		testing was not performed as committed to in the GL response, inadequate	
		CCSW and HPCI room cooler testing methodology, and not including	

TOPIC	PLANT	ISSUE	CATEGORY
		instrument lines in the flush and clean program.	
Silting of Instrument Lines	NYA	The licensee had not completed a formal review and evaluation to ensure that all susceptible areas had been identified. For example, instrument lines may deserve further consideration.	
Silting of Instrument Lines	DNP	SWS instrument lines susceptible to fouling were cleaned on a reactive rather than proactive basis. The licensee identified critical instrument lines that may be susceptible to fouling and agreed to revise procedures to clean instrument lines on a periodic basis.	
Silting of Instrument Lines	BGE	No periodic maintenance requirements had not been established for certain safety-related equipment. The licensee had not fully evaluated the susceptibility of SW instrument line fouling. No specific flushing requirements had been implemented. The periodicity for insturment line flushing was based only on the insturment calibration frequency.	Unresolved Item
System Functional Review	PGE	The licensee's review of their design basis to verify that the ASW system would perform its intended design function did not identify several important design basis issues. Specifically, the design basis of the CCW HX Dp limit, QA findings suggested that engineering controls on operational configurations were not sufficient to preclude pump runout conditions in certain situations.	Follow-up Item
Design Basis Flows	FPL	Many (8) FSAR discrepancies were noted. While, taken individually, the items were not of major safety significance, collectively these discrepancies indicated a failure to properly represent plant configuration in the FSAR. The licencee's review of design basis documentation as recommended by Action VI of the GL 89-13 did not identify any of the FSAR discrepancies.	Deficiency
Design Basis Review	GNP	Action IV - Inadequate design basis review: SFA, FSAR discrepancies, flow model discrepancies, operability calculation discrepancies.	Observation
Design Basis Review	ONP	The design basis of different systems was not adequately translated into design	Violation

TOPIC	PLANT	ISSUE	CATEGORY
		documents. The calculations supporting Emergency Circulating Cooling Water	
		decay heat removal did not include numerous aspects that would reduce the	
		system's decay heat removal capacity. The capability of the Circ Cooling Water	
		system ot withstand a loss of Lake Keowee was not translated into any design	
		document. The design basis of the Low Pressure SWS's capability to function on	
		loss of Condenser circulating water Intake Canal/Dam failure was not translated into	
		any design document.	
System Walkdown	CEC	P&IDs and other design drawings were not detailed or entirely accurate.	Observation
		Discrepancies noted during the walkdowns of the service water system were to be	
		corrected by the licensee. Drawing and material condition deficiency corrections	
		were in progress.	
Maintenance Procedure	GPC	Numerous SWS flanged pipe connections in the intake structure had studs less	Violation
		than flush with the nut.	
Maintenance Procedure	CNP	Maintenance procedure for providing the direction on how to flush service water	Violation
		motor coolers was not use correctly to accomplish task.	
Maintenance Procedure	NPP	Preventive Maintenance Items were weak in that they did not provide direction or	Weakness
		guidelines to the diversin terms of what to look for, where to inspect, and how to	
		collect samples for analysis by others.	
Emergency Ops Procedures	FPL	Action V recommended licensees to confirm that operating and emergency	Observation
		procedures that involve the SWS are adequate to ensure that safety-related	
		equipment that is cooled by service water will function as intended. In its	
		review of procedures, the licensee did not identify those discrepancies	
		identified by the NRC team.	
Training	HLP	The licensee did not implement operations and maintenance training	Observation
		program that incorporated all elements addressed in the generic letter.	
		In addition, the licensee had not identified the different groups that	
		should have been targeted for training in response to Action V.	

TOPIC	PLANT	ISSUE	CATEGORY
Training	FPL	Though the framework for establishing and maintaining correct course content was well established, the failure to properly implement this process had resulted in incorrect training material.	Deficiency
Training	GNP	Action V - Program elements were not established and training was not provided to ensure that zebra mussels would be identified during routine maintenance and operating activities, and that follow-up actions would be taken upon discovery of zebra mussel debris.	Observation
Training	ONP	The training and procedures review programs established for service water systems were not adequate. The reviews never identified that there were no flow indicators in the Auxiliary Service Water discharge lines to the steam generators, no emergency procedure addressed inadequate Low Pressure Service Water flow and there were no operating procedures for Keowee SWS.	Deviation
No Program/Procedures	WNP	The licensee indicated they had inspected the spray ponds once per refueling outage, and no fouling accumulation had been found in the safety-related SSW system. However, this inspection and a biofouling monitoring program had not been proceduralized.	Observation
No Program/Procedures	NYA	The licensee did not have a well documented program to address the generic letter action items. While it was clear that actions were being taken to maintain the emergency service water system, specific definition of programmatic requirements and actions being credited to satisfy the generic letter request were not documented. The team was concerned that the lack of such documentation would make it difficult for the licensee to audit and maintain its GL 89-13 program over the life of the plant. The licensee committed to establish a program.	
No Program/Procedures	BGE	The licensee had not yet established a formal periodic test program for their safety-related HXs as recommended by GL 89-13.	Unresolved Item

TOPIC	PLANT	ISSUE	CATEGORY
Pre-Operational Testing	FPL	In its review of the pre-operational tests of the intake cooling water system, the team identified several test anomalies which did not appear to have been evaluated by the licensee at the time of the test.	Follow-up Item
Pre-Operational Test Config	GNP	Pre-operational testing did not fully verify the capability of the system. Non-safety related loads were isolated during testing they are not during an SIS. Pre-op testing used three pumps to perform a system flow balance. Two pumps were required to supply all loads yet testing used three. Pump run-out conditions were not evaluated or considered.	
Pre-Operational Test Config	ONP	The preoperational test program was inadequate in that the flow control capabilitie to the steam generators and the flow distributions among the three service water pumps (Auziliary Service Water; Heating, Air Conditioning and Ventilation; Emergency Diesel Generator Cooling Water) when operating simultaneously as assumed in numerous design calculations was not performed.	Violation
Surveillance Testing	FPL	Isolation valves were required to shut during a SIAS initiation; However, these valves were shut prior to testing. As such the integrated ESF test on Unit 1 did not fully test the ICW system response during SIAS actuation which could allow such problems as water-hammer or pressure fluctuations to go undetected.	Observation
Surveillance Testing	FPL	The integrated ESF test did not adequately test operation of the C pump. The C pump could be aligned to either the A or B trains when the A or B pump is inoperable. The 1C pump was normally aligned electrically and mechanically to the B train, this configuration did not test the train A power logic and circuit interlock features for the pump and failed to test the train B SIAS contact.	Deficiency
Pump Performance	NSP	The licensee had not taken timely corrective actions to perform pump testing in accordance with the code based on the timeframe from when the issue was originally identified, the OM-6 code committee response letter, and this inspection. OM-6 did not allow the use of pump curves referenced in IST procedures.	Violation

TOPIC	PLANT	ISSUE	CATEGORY
Pump Performance	CEC	The DGCW pump flows were higher than the design flow. The licensee did not provide the team with any assessment of the effect of higher flow on the pumps, including vibration, erosion, and the adequacy of the pump motor.	Deficiency
Pump Performance	DNP	Acceptance limits for the SWS pump flow were expanded beyond those allowed by the Code without adequate justification. ASME Code Table IWP-3100-2 stated the high values for flow were 1.02 and 1.03 times the reference value for the alert and required action range, respectively. The licensee's test acceptance limits were 1.05 and 1.07 times the reference valve.	Follow-up Item
Pump Performance	ONP	The Periodic Safe Shutdown Facility Auxiliary Service Water pump operability test was not performed under suitable environmental conditions. The pump was preconditioned by venting the pump just prior to its being started masking any air entrapment that may affect pump performance.	Violation
Pump Performance	CPL	Relief requested from the normal pump vibration testing requirements of IWP-450 of ASME Section XI and proposed to satisfy vibration requirements by performing ASME OMa-1988, Part 6. The licensee's relie request specified that the acceptance criteria would be the most limiting of 2.5V or 0.325 in/sec [alert range] and the most limiting of 6V or 0.7 in/sec [action range]. Contrary to this, the acceptance criteria was based on 0.325 and 0.7 in/sec instead of 2.5 and 6V, which would have been the more limiting.	Violation
HX Performance Testing	NYA	Eddy current testing used for the ESW HX check only for local tube wall thinning. The absolute method which scans for general wall thickness was not performed.	
HX Performance Testing	NPP	The utility committed to performing eddy current testing of the REC heat exchange where before they had not performed eddy current testing.	Commitment
Flow Balance/Verification	HLP	The procedures establishing flow balancing of the ECWS adequately demonstrate minimum required flow to critical components. However, the individual SDG HX flows were not verified. Instrument inaccuracies were not considered.	Observation

TOPIC	PLANT	ISSUE	CATEGORY
Flow Balance/Verification	NSP	System flow balancing could not be verified, through actual testing, that reactor building components were supplied with adequate service water flow.	Unresolved Item
Flow Balance/Verification	FPL	No current program had been established to provide the appropriate criteria for monitoring degradation and determining operability of the CCWHX during the operating cycle.	Observation
Flow Balance/Verification	NYA	The licensee stated that the Barton flow instrumentation for the EDG was not accurate and typically indicated low due to installation problems. Given this condition, the team questioned why the licensee did not periodically confirm that the emergency service water flow rate to each EDG was acceptable, when the emergency service water injection valves were closed and the test by-pass valves were open.	Follow-up Item
Technical Specifications	GNP	The tech specs required that two service water pumps are operable for post-accident heat removal during the recirculation phase of the accident. However, the TS requirements, given a single failure of a pump or DG, are not sufficient to ensure that two pumps would be available during recirculation.	Deficiency
Technical Specifications	CNP	The tech specs state that the Nuclear Safety Review Board shall be responsible fo the review of safety evaluations. The NSRB did not review a safety evaluation for replacingt the lower pump bearing with a rubber cutlass-type bearing, removing the lower injection tube which surrounded the pump shaft, and removing the lower rings of packing from the packing gland and replacing them with lantern rings for the 1A safet-relaed service water pump.	Violation
Technical Specifications	CNP	The tech specs state that written procedures be established, implemented and maintained for activities referenced in App. A of Reg. Guide 1.33, including procedures for startup, operation, and shutdown of the service water system. Operating procedure for the service water system requires certain valve positions which were not properly implemented.	Violation

TOPIC	PLANT	ISSUE	CATEGORY
Surveillance Test Procedures	PGE	The inspection found that the licensee had not established a routine inspection program or procedures to inspect the ASW piping. The utility had commited to a program and procedures to inspect and maintain the ASW piping.	Unresolved Item
Surveillance Test Procedures	NPP	The diesel generator heat exchanger performance test procedures did not specify the load of the diesel generator to be used in testing.	Commitment
Surveillance Test Procedures	GPC	The procedures used to determine the ability of the RHR, EDG, and Control Room HVAC HXs to perform their safety-related, heat transfer function provided inadequate guidance for inpsection and documentation of the as-found and as-left conditions. The procedure to inpsect the RHR HX was for a horizontal instead of a vertically mounted HX. The procedure to clean the RHR HX tubes with air did not specify the pressure, volume, quality, or source of the air. The QC hold point to visually inspect the "as found" condition of the tubes occurred after the tubes were cleaned.	Violation
Surveillance Test Procedures	GPC	The 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.	Follow-up Item
Surveillance Test Procedures	CNP	A periodic test for Heat Exchanger Heat Capacity states that that "The heat exhanger under test will have shell side and tube side flow set up as close to design flow as possible. Inlet and outlet temperatures will be taken at both sides of the heat exchanger. From this data a tube side fouling factor will be obatined." The design flow was not achieved during the test (1400 GPM - test, 900 GPM - design).	Violation
Instrument Error/Calibration	HLP	The accuracy of flow element installation for the component cooling water HX was insufficient to meet the requirements of ASME Code Section XI and that a request for relief from these requirements was necessary.	Deficiency

TOPIC	PLANT	ISSUE	CATEGORY
Instrument Error/Calibration	NPP	See I&C ISSUES - Accuracy	
Instrument Error/Calibration	SNO	There was a large error band associated with HX test results due to the significant thermocouple inaccuracy for the small temperature differentials being measured. Other weaknesses in the method included not considering the moisture content of the air even through high humidity was present in the rooms, and not modifying the LMTD correction factor to compensate for the test flowrates when they varied from design flowrates. The test results were used to determine when heat exchanger cleaning would be performed and not to determine operability.	Follow-up Item
Instrument Error/Calibration	WNP	The required flow values specified in the SSW system valve position verification procedures did not include an allowance for instrument error. Based on a review of the documents forming the bases for the required flow values, the team determined that sufficient margin exist to compensate for the effect on heat exchanger performance of a small reduction in SSW flow rate resulting form instrument inaccuracy. However, no formal evaluation of the acceptability had been performed.	Observation
Instrument Error/Calibration	NYA	The acceptance criteria for balancing the emergency service water system flows did not include allowances for instrument inaccuracy or variations in lake level.	Follow-up Item
Instrument Error/Calibration	SNO	The requirements was to verify adequate cooling water flow rate to each containing cooling fan cooler group every 31 days. However, the procedure's acceptance criteria did not take into account instrument inaccuracy.	Non-cited Violation
Instrument Error/Calibration	FPL	HX test results, given instrument inaccuracies and the required extrapolation inherent with the test methodology, showed that the heat transfer capability of the CCWHX was marginal. The heat exchanger test frequency may not be adequate.	Observation

TOPIC	PLANT	ISSUE	CATEGORY
Instrument Error/Calbration	NYA	The licensee stated that the Barton flow instrumentation for the EDG was not accurate and typically indicated low due to installation problems. Given this condition, the team questioned why the licensee did not periodically confirm that the emergency service water flow rate to each EDG was acceptable, when the emergency service water injection valves were closed and the test by-pass valves were open.	Follow-up Item
ISI/IST Program	NSP	The licensee had not implemented their 10 year IST program which should have started	Violation
ISI/IST Program	GNP	The licensee did not enter LCOs during IST since it did not consider the equipment being tested to be out of service. Not entering an LCO allowed the licensee to take redundant equipment out of service simultaneously with IST.	Unresolved Item
Completeness of IST Program	HLP	The team determined that certain valves in the emergency backwash flow path from the self-cleaning strainer were required to change position in order to mitigate a potential common mode failure mechanism of multiple ECW trains. However, they were not included in the IST program.	Defieciency
Completeness of IST Program	SNO	There was no qualified check valve in the return piping from the turbine building to prevent reverse flow, and operator action was required to close the turbine building return isolation valves in the event of rupture of the non-seismic/non-safety related SW piping in the turbine building. These valves were not incorporated into the inservice test program.	Violation
Completeness of IST Program	NSP	Valves required to operate to perform a specific function in shutting down a reactor to the cold shutdown condition or in mitigating the consequences of an accident should be tested. Several valves were not for example: RHR pump cooling water discharge valves, bypass valve on each pump strainer, and manual cross connect piping valves.	Violation
Completeness of IST Program	DNP	CCSW Flow control valves were not included in the IST program even	

TOPIC	PLANT	ISSUE	CATEGORY
		h they are normally closed and required to open to provide CCSW flow e LPCI HX.	
Completeness of IST Program	DNP	Control room HVAC valves position indication on the B train control room HVAC panel was not tested as required by Section XI. The valves were included in the IST program to be full stroke exercised and stroke timed. While the valves received some IST type testing, the two year PIT was not performed to verify valve position matched the position indication.	
Completeness of IST Program	DNP	The CCSW pump discharge check valves have a closed safety function to prevent backflow through an idle pump. This function was not identified in the IST program; however, the valves were test quarterly in the closed direction.	
Completeness of IST Program	DNP	Control Room HVAC valve was not fail safe tested as stated in the utilities IST program. Section XI required valves with a fail safe function be teed on a quarterly basis. [Violation of 10CFR50.55a(f)(4)]	Violation
Completeness of IST Program	DNP	Control Room HVAC check valve was not exercised on a quarterly basis to the required open position to fulfill its safety function as stated in Dresden's IST program. Section XI required check valves to be exercised on a quarterly basis to the position required to fulfill their safety function. [Violation of 10CFR50.55a(f)(4)]	Violation
Completeness of IST Program	FPL	The IST program, as submitted to the NRC, was not being adhered to in two areas. Manual valves in the program had subsequently been removed; and, the scope of a second valve had been changed. The licensee failed to notify the NRC of its changes to the IST program.	Deficiency
Completeness of IST Program	NYA	Manually operated valves were not included in the IST program. These valves were normally open and formed the boundary between the safety-related and non-safety related piping. The violation was not cited because the criteria specified in Section V.A of the Enforcement Policy were satisfied.	

TOPIC	PLANT	ISSUE	CATEGORY
Completeness of IST Program	NYA	Isolation valves for the non-safety related control rod drive pump cooler isolate a potential path for diversion of ESW flow during an accident; however, closure of the valves is not credited in any accident analyses, since the reactor building would be inaccessible. The need for these valves to be in the IST was under review.	Unresolved Item
Completeness of IST Program	ONP	Certain check valves within the LPSW system which must close to establish HPI flow were not tested in the closed direction per the IST program. The lack of reverse flow check valve testing had been previously identified by the licensee. Corrective actions were in progress to revies the IST program and develop testing procedures for the valves.	Non-Cited Violation
Completeness of IST Program	BGE	SW system manual valves and air-operated valves were not included in the IST program even though some of these valves must change from their normally open to closed position for the emergency overboard alignment. This alignment is a licensing basis requirement that provide the capability to withstand a single, passive failure following the intiation of a RAS.	Unresolved Item
Completeness of IST Program	TEC	The IST program did not contain a closed safety function for the SW pump straine blowdown valves; even though, flow could be reduced to safety related components if the valves failed open.	Weakness
Completeness of IST Program	TEC	Certain SW to CCW cross-connect valves were not included in the IST program even though SW provided the only seismic backup water supply to the CCW system.	Weakness
IST Failure Evaluation	NSP	Unacceptable test results for valves were not documented and evaluated as required by the licensee's IST program.	Violation
IST Failure Evaluation	NSP	Failure to adequately document and evaluate test deficiencies for the EDG pump as required by the IST program and in accordance with the code.	Violation
IST Failure Evaluations	CEC	Several attempts to determine the flow characteristics of the DGCW pumps	Unresolved Item

TOPIC	PLANT	ISSUE	CATEGORY
		and to assess the adequacy of the flow to the individual safety-related ECCS pump room coolers and to the Diesel generator jacket water coolers were made. The testing showed that in some cases excessive flow rates existed and others inadequate flow rates existed. No corrective actions were initiated to address the flow distribution of the pumps following the testing.	
IST Failure Evaluations	NYA	Flow rates to individual crescent area unit coolers were not adjusted to greater than the minimum value of 24 gpm. Testing showed flow rates of 21, 21, and 22.8 gpm and no subsequent actions were performed.	Deviation
IST Failure Evaluations	CEC	The DGCW pump flows were higher than the design flow. The licensee did not provide the team with any assessment of the effect of higher flow on the pumps, including vibration, erosion, and the adequacy of the pump motor.	Deficiency
Missed Testing	TEC	The team identified examples of missed inservice testing for certain stop check valves, which were not exercies on a quarterly basis to the full open position.	Weakness

TOPIC	PLANT	ISSUE	CATEGORY
Corrosion/Erosion Program	WNP	The majority of piping runs in the reactor building were unpainted and had experienced light corrosion. The corrosion at flange fasteners was more severe but had not yet produced significant stud wastage. Without attention, the condition could eventually become significant.	Observation
Corrosion/Erosion Program	CEC	The Service water design review report credited the ability to operate certain valves to satisfy or mitigate single-failure scenarios, but actions were not taken to ensure that these valves would be functional. The Service water design review report stated the assumption that surveillance test, inspections, and normal process and equipment monitoring features effectively detect all significant failure modes, so that no undetectable failures will exist in combination with a single failure. This assumption was not validated by in-depth review and evaluation and establishment of an appropriate PM program.	Deficiency
Corrective Maintenance Progra	GNP	The licensee performed the majority of maintenance during power operation, including removing a single pump for long-term maintenance. This policy was considered unconservative in view of its findings regarding the need for more than two pumps to be operable.	Observation
Root-Cause Analysis	WNP	Due to apparent relaxation of the spring pack in the Limitorque actuator after closing, the torque switch (which normally opens to stop motor operation at valve closure) can again close. Because of the ever-present close demand signal, the actuator restarts unexpectedly and attempts to further close the already closed valve. The results in a short stroke hammering of the valve disk into the seat. The licensee's lack of corrective actions to preclude recurrence of hammering is a deficiency.	Deficiency
Root Cause Analysis	FPL	The root-cause analysis program's usefulness was limited because it could not search for failures involving other similar components and the failure criteria of 4 times in 12 months was set at too high a threshold to identify all failure trends of interest.	Observation

TOPIC	PLANT	ISSUE	CATEGORY
Maintenance Work Orders	ONP	A safety related work order for performing the triennial inspection of the hydro-electric station's turbine guide bearings oil cooler specified an inproper housekeeping zone. This was a violation due to several other improper activities affecting quality.	Violation
Trending/Maintenance Histories	CEC	Review of GSRV, TJM, NPRDS, and QAP forms was not performed to provide a complete history on each component and to ensure adequate trending. With several groups performing the actual maintenance work, there did not appear to be a single point of contact to ensure adequate trending occurred.	Observation
System Walkdown	IP3	Because of the NRC's team concern that a number of deficiencies had not been identified by NYPA, operations personnel performed a walkdown of the material condition of the skid where the backup service water pumps are mounted. Additional discrepancies were identified by plant personnel.	
System Walkdown	NPP	The following minor walkdown issues were raised: A small pinhole leak was fou Missing labels. Poor painting practices in SWS pump room. Numerous bolted connections which appeared to have inadequate thread engagement.	Weakness
Scaffolding	WNP	Scaffolding was installed in both RHR heat exchanger rooms on an apparently permanent basis. Scaffolding is ordinarily a temporary installation for a short duration job. The team noted that the need for continuing operator access usually is met be providing permanent ladders and platforms through a design change.	Observation
Material Condition	FPL	Walkdown discrepancies noted included material condition (i.e., rust) of components located outside, collection of rain water on certain components, and collection of rain water in rotary strainer gearboxes.	Observation

TOPIC	PLANT	ISSUE	CATEGORY
Labeling	NYA	During the system walkdown the valve and equipment labeling was noted as being weak. In addition, no access was readily available to close valves used to isolate the non-safety related component from safety-related components. The valves were 15 feet off of the floor.	

TOPIC	PLANT	ISSUE	CATEGORY
LER/PER adequacy	WNP	Due to biofouling problems which existed, an excessive amount of Bulab 6003, which contains sulfur, was added to the spray ponds was added to the spray ponds. Consequently, the sulfur concentration went above the licensee's control limit. The licensee did not issue a Problem Evaluation Request to evaluate exceeding the sulfur limit.	Deficiency
LER/PER adequacy	NYA	The failure to provide complete and accurate information is an apparent violation of NRC requirements. The examples cited were: 1) Test data was not used when performing the maximum pump degradation allowable. If the test data had been used, the calculation's results would have been that the ESW pumps could not provide adequate flow to safety-related components. 2) The GL response stated that the DG cooling system was a glycol closed-loop system and not subject to fouling. This statement was untrue the DG cooling system is actually cooled by lake water. 3) An LER analysis failed to recognize degraded system conditions that existed at the time of the event and determined that the coolers would have been capable of performing their safety function when in fact they would not have. 4) The chiller condenser room air handling unit supply line A had become plugged with silt. The LER stated that it was still supplied by the B line but did not recognize the failure of the B train 5) An analysis of a failure check valve to the crescent area coolers to close would most probably not have had a significant adverse impact on plant safety in the event of the accident postulated in the FSAR. In addition, it stated that the valves accessibility could be hindered by a post-LOCA environment. The NRC did not agree with the utilities response.	Violation
LER/PRE Adequacy	IP3	LER, which indicated that prior to maintenance on SWS main header isolation valve, the position of the valve could not be verified as full open. Engineering determined that the valve was required to be a minimum of 50% open to ensure adequate flow. Due to the difficulty in verifying the valve's position during past plant operation, and the significant damage in the valve operator, the team considered the actual valve position during reactor operation to be unverified.	Unresolved Item

TOPIC	PLANT	ISSUE	CATEGORY
Licensee Event Reports	GPC	The FSAR requires the tube side of the RHR HX be maintained above the shell sid inlet, thereby preventing reactor water leakage into the river water in the event of a tube leak. The licensee failed to report within 30 days that on five occasions, the pressure on the tube side could not be maintained above the pressure on the shell side for the full regime of required design conditions.	Violation
Proper Valve Line-ups	WNP	The failure to perform valve lineups of small vent valve, both of which were underwater in the ponds as required by procedures was identified.	Deficiency
Proper Valve Line-ups	CEC	Throttle valve setpoints were not established based on the most limiting system configurations. System lineups such as the back-flow alignment of the diesel generator jacket water coolers and the RHR HX was not considered.	
Proper Valve Line-ups	NYA	Throttle valves were being throttled very nearly to the closed position to establish flow balance. Throttle valves nearly closed could result in silt accumulation in the valve body and undesirable flow reduction.	Follow-up Item
Proper Valve Line-ups	CPL	Containment penetration cooler valves were identified as throttled on the P&IDs, normally were throttled , and currently were throttled but were not designated as throttled in the procedure. This is identified as a failure to establish appropriate design control of throttle valves.	Violation
Proper Valve Line-ups	CPL	Operating procedures did not specify minimum positions for the CCWHX outlet valves. This could have allowed the non-safety related turbine building loads to remain un- isolated, reducing cooling to safety related loads such that they could not fulfill their safety-related function in response to a LOCA.	Violation
Proper Valve Line-ups	GPC	Operating Procedure line-up sheet incorrectly indicated that a valve was open and second valve was loced closed. The design documentation indicated that the valves were closed and unlocked closed repectively. The actual positions were inconsistent with the design documents.	Violation
Valve Accessibility	IP3	Since containment isolation valves are located at the 55 ft elevation, the	Unresolved Item

TOPIC	PLANT	ISSUE	CATEGORY
		penetration area may be inaccessible in the post-accident period due to high radiation from nearby residual heat removal piping. Unresolved pending a NYPA evaluation of the need for accessibility of these isolation valves in a post-accident environment.	
Operational Limits	PGE	Lack of operational limits for protecting the system from high flow rates under 1 pump and 2 heat exchanger configurations.	
Normal Operating Procedures	HLP	The SOP did not provide any implementing instructions nor was there an operations department policy for establishing when the filling and venting of an ECW train would be required and the fill and vent section of the procedure failed to provide corrective actions in the case of inadequate ECW flow to the standby diesel generators.	Observation
Normal Operating Procedures	HLP	The procedure for the ECW train testing required independant verification. The verifier should not have observed the actions of the first. However, the NRC observed the RPO repeating the other's actions he had just observed.	Observation
Normal Operating Procedures	WNP	None of the licensee's operating procedures provided guidance to the operators on pond icing. The inspectors requested the licensee to consider the need for clear operator guidance on what degree of icing was acceptable, and what actions should be taken if that icing limit was approached.	Observation
Normal Operating Procedures	CEC	If the SWS was declared "out of service", there was no readily available reference to be used to return throttle valves back to their proper position when the system was returned back to service.	Observation
Normal Operating Procedures	NPP	Procedures relied on operator's detailed system knowledge.	Weakness
Normal Operating Procedures	NPP	Service Water System was operated inconsistenly with its design basis as reflected the USAR and the SWS DCD to maintain system pressure greater than RHR system pressure in the shutdown cooling mode of operation.	Weakness

TOPIC	PLANT	ISSUE	CATEGORY
Normal Operating Procedures	NPP	The importance of the SWS pump discharge strainers and their function was not reflected in system operating procedures.	Weakness
Normal Operating Procedures	NPP	No procedural guidance existed to direct the operators' actions when river water temperature approached the design basis maximum temperature. Also, operating procedures did not address the automatic operation of certain SWS RHR heat exchanger outlet isolation and throttle valves.	Weakness
Normal Operating Procedures	CPL	The most recent completed valve lineups had valves, which were signed off withou exception, that were in a throttle position even though the procedure indicated they should be full open. Failure of the operators to requirest and obtain a change to the applicable proedure before continuing the valve line-up is considered a violation.	Non-Cited Violation
Abnormal Operating Procedure	CPL	AOP procedure, "Loss of SW", would not provide fire suppression system water as backup supply to the control room HVAC coolers following a single failure of the north service water header at a pressure below the design pressure rating of the HX. The same procedure would not provide the required primary water stroage tank backup cooling water to the SI pump thrust bearing with sufficient pressure to perform it's intended safety function.	Violation
Emergency Ops Procedures	ONP	No flow instruments existed to confirm 200 gpm was being provided to each steam generator or 400 gpm was being provided to an un-isolated steam generator by the ASW pump as directed by an EOP.	Violation
Emergency Ops Procedures	ONP	With one operating LPSW pump supplying both units, the LPI cooler flows required the emergency procedure could not be achieved. None of the licensee's procedures were applicable to this situation. The operators used their judgement and secured LPSW flow to the LPI coolers, isolated cooling to the control room, and isolated non-essential loads.	Follow-up Item
Lesson Plans	TEC	Discrepancies in the training lesson plans indicated that when the effort to match the P&IDs and operations checklists lapsed, upkeep of training documents suffered. Examples of deficiencies included: valve lineups, valves incorrectyl indentifying	

TOPIC	PLANT	ISSUE	CATEGORY
		positions, wrong pressures for pumps.	

TOPIC	PLANT	ISSUE	CATEGORY
MOV Protection	NYA	The safety-related motor-operated valves presently have thermal overload relays with high settings. The thermal overloads will not operate before the valve motor is damage.	
EE Evaluations	NYA	The power supply voltage for certain control room annunciator relays were reviewed. The output of the ac/dc power supply was 135 Vdc, whereas the output of the dc supply is shown as 125 Vdc. During a walkdown of the relay panel the licensee noted that the uniterruptible power supply voltage was 165 Vdc. A work request was written to investigate and correct the high voltage.	

TOPIC	PLANT	ISSUE	CATEGORY
Instrument Out-of-Cal Revie	SNO	Investigation determined that no administrative controls existed to direct	Violation
		analysis and corrective action of instruments found out-of-tolerance	
		when beginning calibration checks. The lack of an established program	
		to identify, evaluate and correct conditions adverse to quality, such as	
		instrumentation found out-of-tolerance was a violation.	
Instrument Out-of-Cal Revie	CPL	A maintenance procedure specifies that if a component is found out-of-tolerance	Violation
		during calibration, a technical review sahll be performed evaluating the effect of the	
		out-of- tolerance parameter on plant safety and address the corrective action. This	
		review shall be documented. Contrary to this, on numerous occasions the required	
		reviews to evaluate the effects of out-of-tolerance parameters on plant safety were not	
		performed, documented or filed.	
Procedures	CNP	See DESIGN CALCULATION CONTROL issue.	Violation
Accuracy	CNP	Verification that the acceptable water level and maximum average water temperature	Violation
		for the standby nuclear service water pond was not assured in that the acceptance	
		criteria for the periodic test procedure did not account for instrument inaccuracies.	
Accuracy	NPP	Heat exchanger performance test procedures did not specify test instrument	Weakness
		calibration, test instrument accuracy, nor explicit acceptance criteria.	
Calibration	NYA	The EDG ESW flow indicators were calibrated on a two year interval with a	Commitment
		25% allowable time extension. During the past two calibrations the device	
		was out of calibration. The licensee committed to increasing the frequency to	
		two years.	
Design Basis of Setpoints	PGE	The CCW HX was monitored for differential pressure as an indicator	Violation
		to clean the heat exchangers. There was no basis for the differential	
		pressure setpoint. The maximum allowable number of tubes plugged	
		was 24; however, a HX that was cleaned, at a DP less than the limit,	
		had 28 tubes plugged. Test failures did not imediately generate an	

TOPIC	PLANT	ISSUE	CATEGORY
		investigation by the utility. QA questioned the setpoint but did not elicit a studied response from the engineering organization.	
Design Basis of Setpoints	GNP	There was no engineering basis for the SWS low header pressure setpoint.	Unresolved Ite
Design Basis of Setpoints	IP3	The licensee lost design control for instrument air supplied to air-operated service water flow control valves in the EDG system. Solenoid valves of dual flow control valves were over-pressurized by instrument air. System drawings of the instrument air-service water interface were found to be inaccurate. No setpoint control program for air regulators was identified.	Violation
Procedures	CNP	Instrument standards, installation and field practices require continuous downward slope from instrument taps to the instrument, a continuous downward slope from the vent to the instrument line and S-type expansion loops for service water strainer and motor cooling instruments. The high pressure side instrument lines for service water pump strainers were not S-type or continuously sloped down from the instrument tap to the instrument and the instrument line for the service water pump motor cooler flow element was not continuously sloped downward from the vent to the instrument.	Violation

TOPIC	PLANT	ISSUE	CATEGORY
Document/Design Control	GNP	Inadequate design document control and verification. The licensee was not properly controlling, verifying, and accepting design reports, calculations, or analyses.	Deficiency
Document/Design Control	IP3	The licensee lost design control for instrument air supplied to air-operated service water flow control valves in the EDG system. Solenoid valves of dual flow control valves were over-pressurized by instrument air. System drawings of the instrument air-service water interface were found to be inaccurate. No setpoint control program for air regulators was identified.	Violation
Document/Design Control	ONP	The NPSH of the Low Pressure Service Water pumps was not adequately consider as a design input. During certain operating conditions involving loss of instrument air where flow demand was greater than design, there was insufficient NPSH. An evaluation stated that the condition was acceptable based on the manufacturer's best judgement that no significant pump degration would occur during and following the inadequate NPSH condition. Neither the licensee nor the pump manufacturer performed any testing validating this judgement.	Violation
Document/Design Control	ONP	The design basis of different systems was not adequately translated into design documents. The calculations supporting Emergency Circulating Cooling Water decay heat removal did not include numerous aspects that would reduce the system's decay heat removal capacity. The capability of the Circ Cooling Water system ot withstand a loss of Lake Keowee was not translated into any design document. The design basis of the Low Pressure SWS's capability to function on loss of Condenser circulating water Intake Canal/Dam failure was not translated into any design document.	Violation
Document/Design Control	ONP	Belzona was used to plug leaking tubes in the RBCUs. When selecting Belzona fo this application the licensee did not consider the thermal and hydraulic changes Belzona would experience due to accident conditions. Failure of the material would affect containment integrity.	Violation
Document/Design Control	ONP	No procedural controls existed to assure the Low Pressure SW pump flows inputte into the hydraulic computer model for the LP SWS remained valid during quarterly testing of the pumps. In other words, maximum pump degradation allowed by testing	Violation

TOPIC	PLANT	ISSUE	CATEGORY
		was not used in the hydraulic analysis.	
Document/Design Control	ONP	System drawings did not indicate: the existence of an additional valve, a supply line that was interconnected, a pipe specification change, and a consistent piping class break for both units.	Violation
Document/Design Control	CPL	Containment penetration cooler valves were identified as throttled on the P&IDs, normally were throttled , and currently wer throttled but were not designated as throttled in the procedure. This is identified as a failure to establish appropriate design control of throttle valves.	Violation
Document/Design Control	CPL	The QA program requires that design changes to the facility be accomplished in accordance with written, approved procedures and that there is an adequate review of the suitability of material, parts, equipment, and prcesses which are essential to the safety-related functions of SSC's. However, the licensee had modified the pressure boundary of three Safety related HX with a proprietary epoxy based material (Belzona) without evaluating the suitability of the application.	Violation
Document/Design Control	CPL	Minor errors were noted in the UFSAR and the SWS drawings during the design review and the detailed system walkdown. Several older, non-critical drawings were of inferior quality and illegible in certain areas. The more recent and critical drawings provided acceptable informations. The licensee indicated the specifice deficiencies would be appropriately dispostioned.	Follow-up Item
Document/Design Control	CNP	Revisions to design document did not designate a change to the low flow setpoint alarm response procedure or emergency procedure, such that normal containment spray heat exchanger flow was less than those indicated in the alarm response procedure or the emergency procedure.	Observation
Document/Design Control	NPP	The USAR was not updated to include the effects of two safety evaluations. One safety evaluation changed the design basis service water temperature. The other safet evalaution was performed in support of conclusions that the change to not operate the service water booster pumps in shutdown cooling, and consequently not maintain service water system pressure higher than RHR system pressure, did not	Violation

TOPIC	PLANT	ISSUE	CATEGORY
		involve an unreviewed safety question.	
Document/Design Control	NPP	Established measures did not assure that the change in service water design basis temperature was correcty translated into calculations, drawings, and procedures.	
Document/Design Control	NPP	Established measures did not assure that the design basis, as specified in the the general design criteria document for internal flooding, to qualify fire protection system piping in the service water system pump room to Class I (seismic) standards, was correctly translated into specs and drawings.	
Design Calculation Control	FPL	The CCWHX accident heat load was inconsistently reported in different documents. A realistic approach utilizing a time-history study with proper sequencing of the fan coolers and shutdown cooling heat was performed, yet the results not incorporated into plant documentation.	Violation
Design Calculation Control	ONP	No procedural time limit existed to establish a definitive length of time for revising calculations following design changes; thus, several calcs were not updated for years after design changes, which affected those calculations, were implemented.	Follow-up Item
Design Calculation Control	ONP	The calculation of the air side fouling factor was highly sensitive to variations in the flow distribution. The computer code was benchmarked by a vendor; however, a subsequent airflow test indicated airflow was substantially less than expected. When questioned about the results, the licensee stated this test was invalid due to significant air side fouling. No further testing was performed.	Non-Cited Violation
Design Calculation Control	CPL	The design organization had not established appropriate controls to assure SWS calculation model assumptions and inputs remained valid. No formal controls existed when SWS pump head characteristics changed either through refurbishment activities or service degradation.	Unresolved Item
Design Calculation Control	PGE	Failure to use a validated computer code for CCWHX capacity tests.	Violation
Design Calculation Control	CNP	The ultimate heat sink analysis did not consider pump heat, inventory loss via seepage or fire protection, auxiliary feedwater, component cooling water and fuel pool	Violation

TOPIC	PLANT	ISSUE	CATEGORY
		makeup systems, level and instrument inaccuracies causing the theortical peak	
		temperature of 100 degrees F to be exceeded by 0.5 degrees F.	
Design Calculation Control	CNP	Calculation did not use a piping resistance factor consistent with the pipe's service	Violation
		environment.	
Design Calculation Control	CNP	Calculation did not validate heat load assumptions, use the maximum allowable inl	Violation
		temperature for the component cooling water heat exchangers, size the EDG starting	
		air aftercooler and component cooling water heat exchanger relief valves such that	
		their relieving capacity would keep system pressure less than or equal to system	
		design pressure, or use FSAR auxiliary feedwater flows of 900 GPM.	
Modification Packages	ONP	Belzona was used to plug leaking tubes in the RBCUs. When selecting Belzona fo	Violation
		this application the licensee did not consider the thermal and hydraulic changes	
		Belzona would experience due to accident conditions. Failure of the material would	
		affect containment integrity.	
Modification Packages	TEC	The modification process allowed the closure of modification packages without the	
		appropriate changes to drawings and procedures.	
Corrective Actions	ONP	Measures had not been established to assure that conditions adverse to quality ha	Follow-up Item
		been corrected. The evaluation for a postulated water hammer within the Low	
		Pressure Service Water piping downstream of the reactor building cooling units, did	
		not address the water hammer effects on the structural integrity of the piping. The	
		violation was for inadequate corrective actions.	
Corrective Actions	GPC	Licensee personnel had information indicating that the turbine isolation valves woul	Deviation
		not have enough motive force to fully close and did not initiate a condition adverse to	
		quality report. intake structure sediment inspections documented sample were above	
		the acceptable sediment depth of 12 inches, and the sediment was not scheduled to	
		be removed until approximately 6 months after the condition was identified.	
Corrective Actions	GPC	Drag valves located downstream of the RHRSW HX ssystem strainers. In the past,	
		the licensee had experienced strainer failures that had allowed an excessive amount	

TOPIC	PLANT	ISSUE	CATEGORY
		of debris to pass. Due to its unique design, the drag valves were somewhat	
		susceptible to clogging. The licensee had planned further system modifications to limit	
		the pressure surges experienced by the RHRSW strainer.	
Line Org. Self-Assessments	ONP	Numerous SWS were omitted for the Self Initiated Technical Audit including the	
		Auxiliary SWS, the Standby Shutdown Facility's SWS, the Keowee SWS, the	
		condenser cooling mode of the Circulating Cooling Water System (CCWS), and the	
		recirculation mode of the CCWS.	
Line Org. Self-Assessments	ONP	The licensee's organization did not appear to have the appropriate sensitivity to	Unresolved Item
		findings or conditions that clearly indicated questionable operability.	
Quality Verification Activitie	APS	The commitments made to the NRC regarding GL 89-13 involved two	
		separate letters to the NRC both verifying that actions were in place	
		actually were not. A lack of adequate management review was noted	Unresolved Item
		by the inspector.	

ATTACHMENT 2

OBSERVATIONS

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

ASSESSMENT OBSERVATION

OBSERVATION NUMBER: MECH-01

REVISION: 1

DATE: May 12, 1995

ASSESSMENT AREA: Mechanical Systems Design

INSPECTOR: S. M. Klein

ISSUE:

Weaknesses in design analyses performed to confirm that EECW flows measured during surveillance testing satisfy design basis requirements.

REQUIREMENT:

BFN FSAR Section 10.10.2 states that the EECW system shall be capable of supplying sufficient cooling water to all essential users.

DISCUSSION:

TVA does not perform periodic flow balance testing for the BFN EECW system to confirm that safety-related equipment is supplied minimum required design cooling water flow rates under worst-case conditions. Flow rates for individual components are measured during EECW check valve surveillance testing. Calculation MD-Q0067-940058, Revision 0, dated 12/19/94 (RIMS R14941219134), EECW flow balance was performed to establish the technical basis for testing the EECW system and to demonstrate that the system continues to meet design basis conditions. The calculation makes use of pressures, differential pressures, and flows measured during EECW system testing.

The team reviewed this calculation and identified several weaknesses:

1. The methodology developed in the calculation consists of predicting the flow during worst-case conditions using the following (differential) pressure-flow relationship:

$$P_2/P_1 = (Q_2/Q_1)^X$$

where:

P_2 = header pressure calculated for worst-case conditions (e.g., lowest anticipated river level, pump degradation) in a referenced (EZFLOW) flow distribution calculation

P_1 = header pressure measured during surveillance testing

Q_2 = predicted flow during worst-case conditions

Q_1 = flow supplied to component measured during surveillance testing

X = exponent

The relationship generally used in hydraulic analysis is the well-known "Darcy-Weisbach" formula where the exponent $X = 2$. In some cases, the empirical Hazen-Williams formula is used, in which case the exponent $X = 1.85$. The exponent, X, in this case 2.4, was obtained from Calculation MD-Q2067-880368, Revision 1, dated 9/21/90 (B22900925102), Evaluation of Restart Test Data and Analysis of EECW Capacity for Loss of Dam Operation. That calculation derives the value of the exponent using restart test data.

The team found that the derivation of the value of $X = 2.4$ did not account for instrument accuracy associated with the pressures and flows measured during restart testing. Instrument error could increase the value of the exponent, which could result in lower calculated flows supplied to safety-related equipment. The calculation did not account for instrument accuracy associated with the pressures and flows measured during surveillance testing. These errors would also reduce the calculated flows supplied by EECW.

The calculation identifies several components that have flows that either are less than design minimum required flows or are marginally low flows, e.g., the control bay chillers (-10.2% and 0.3%), diesel generator (DG) 3A/B (1.5%), and several other DGs that have low flow margins. Accounting for instrument error may further reduce calculated flow rates and margins.

Because the calculated flows are referenced to a pressure determined using degraded piping conditions at a 40-year plant life, there probably is no immediate concern. However, the calculation does not provide a means of evaluating the flows measured during surveillance testing against worst-case conditions in the event of a design basis accident, or to assure safe plant shutdown considering current piping condition (i.e., current degradation).

The team recommends that the methodology should be modified to facilitate evaluation of these component flows considering worst-case conditions during a design basis accident that might occur for the existing plant conditions.

2. The calculation concludes that the negative margin for control bay chiller 1A (-10%) was due to the normal operation of the temperature control valve (TCV). In addition, the calculation noted that the adjacent emergency condensing unit was supplied substantially more flow through a smaller piping network. The calculation determined that the chiller would have been supplied adequate flow based on the flow supplied to the emergency condenser. In addition, Engineering Design informed the team that the surveillance test results obtained for the chiller may have been suspect because previous testing indicated higher flows were supplied to the chiller.

   The team concluded that the results obtained for flow supplied to control bay chiller 1A is indeterminate since the TCV was not wide open during surveillance testing.

In summary, the team found that although the general approach used to confirm flows supplied to safety-related equipment is sound:

- The flow relationship and methodology used to determine flows supplied does not account for instrument error.

- The methodology used does not permit evaluation of flows supplied by EECW to safety-related equipment in the event of a design basis accident or safe shutdown, should it occur today, considering worst-case conditions.

- Results obtained for flow supplied to control bay chiller 1A are inconclusive because the TCV was not wide open during testing.

CONTACTS: F. Loscalzo

BFN RESPONSE:

In response to the team's concerns, TVA provided the results of a preliminary unverified calculation using an exponent of 2 in the flow relationship and accounting for instrument errors applicable to the data obtained during surveillance testing. Results indicated that most flow margins were increased and some were reduced. The flow to control bay chiller 1A was still less than required at the end of the 40-year plant design life. TVA stated that EECW flow to the chiller can be assured by the amount of cooling water supplied to the adjacent emergency condensing unit, which achieved a flow margin of 7.7%.

TVA also stated that a complete flow balance was performed for Unit 2 prior to restart in 1991, and an additional flow balance will be performed before Unit 3 EECW is declared operable.

EVALUATION OF BFN RESPONSE:

The response is acceptable. However, the team recommends that the calculation should be revised to:

- Formally document the approach used in the preliminary calculation developed to establish the use of an exponent of 2.0 in the flow relationship and include the effects of instrument error.

- Provide a more formal documented basis for the conclusion that the emergency condensing unit has a smaller piping network (higher resistance path).

- Provide a means of evaluating flows supplied by EECW to safety-related equipment in the event of a design basis accident or safe shutdown, should it occur today, considering worst-case conditions.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: MECH-02

REVISION: 1

DATE: May 15, 1995

INSPECTION AREA: Mechanical Systems Design

INSPECTOR: S. M. Klein

ISSUE:

Weaknesses in design analyses performed to confirm that EECW and RHRSW are capable of supplying minimum required design cooling water flow rates to safety-related components during worst-case accident conditions.

REQUIREMENT:

BFN FSAR Section 10.10.2 states that the EECW system shall be capable of supplying sufficient cooling water to all essential users.

Section 3.1.1.1 of BFN-50-7023, Residual Heat Removal Service Water System - Units 2 & 3, requires that the RHRSW system shall be able to cool the suppression pool water after a design basis event.

DISCUSSION:

Calculation MD-Q0067-930028, Revision 0, dated 6/28/94 (RIMS R14940629107), EECW System Pressure Drop - EZFLOW, was performed to determine hydraulic losses throughout the EECW piping system for Units 1, 2, and 3 using the TVA computer software EZFLOW. The analysis evaluates flows supplied by EECW to safety-related components for Unit 2 operation, Unit 3 operation, and simultaneous Unit 2 and Unit 3 operation during shutdown loading and Appendix R conditions. The calculation predicts flows supplied by EECW to safety-related components during these worst-case conditions based on pipe degradation equivalent to the 40-year plant life.

The results of the calculation are used as input to Calculation MD-Q0067-940058 to support surveillance testing confirming that adequate EECW flow is supplied to safety-related

components during worst-case accident conditions (see Inspection Observation MECH-01 for weaknesses identified in that calculation).

The team reviewed this calculation in detail and identified a number of weaknesses. For example:

1. The calculation determines flow rates to safety-related components assuming estimated reduction in pipe diameter equivalent to 40 years of corrosion product buildup. The calculation concludes that required flow for 40-year life cannot be obtained for the core spray pump room coolers (3A and 3B), RHR pump room coolers 3A and 3C, Unit 3 shutdown boardroom chillers 3A-1, 3A-2, 3B-1, and 3B-2. Although this condition is predicted for the end of the plant's (design) life, it is not clear what flow margins, if any, currently exist for these components. In addition, in most cases analyzed, the large flow users have been throttled to receive their required design minimum flow rates in order to satisfy the demands of the smaller (flow deficient) users. It has been the team's experience that these small users, which represent relatively higher resistance paths, sometimes require a substantial reduction in resistance to satisfy minimum required flow demands.

2. The team was informed that the computer model used for the analysis has not been benchmarked against any field test data. Consequently, there is no assurance that the model used represents actual system performance and can conservatively predict pressures and flows that might be expected during worst-case accident conditions considering the current piping degradation.

   The team recommends that:

   - The model should be revised to predict flows supplied to safety-related components with no reduction in pipe diameter due to corrosion product buildup.

   - The model should be benchmarked against actual field test data and adjusted as required to account for actual piping degradation due to corrosion product buildup and reflect current system hydraulic performance.

   The team was informed that TVA intends to perform benchmark testing during restart testing for Unit 3. However, there is no documented formal commitment to perform this testing. The team recommends that this commitment be formalized and implemented.

3. The calculation uses an EECW pump discharge strainer pressure drop of 1.2 psid at 4500 gpm. This corresponds to the manufacturer estimated pressure drop through the

strainer when it is clean. However, the team was informed that strainer differential pressures of 2 to 3 psig have been observed. The team found that using the clean strainer pressure drop is not conservative, and the higher pressure drops observed may result in lower than calculated flows. The team recommends that a conservative value of strainer differential pressure should be incorporated into the model.

4. In some cases, the pressures at some piping nodes are at vacuum levels. For example, Appendix I, page 266 indicates a pressure of -14.3 psig at nodes 3DSB3A1 and 3DSB3B1, which corresponds to a saturation pressure of 73°F. Because this temperature exceeds the 70°F input temperature used in the analysis, the computer generated "VAPOR" flag was not printed out at these nodes. The potential for flashing to vapor exists at these locations (for the case analyzed) at temperatures greater than 73°F. Because the design maximum river water temperature supplied to the RHRSW pumps is 95°F, flashing may occur. Consequently, the results obtained may not be valid because they are based on single phase (water) flow calculations.

5. Sheet 16 states that losses through the hypochlorite system due to a line break were not required to be modeled because seismically qualified check valves exist upstream of the north and south header leading to the hypochlorite system. However, the team found that these check valves are not tested in reverse flow to assure that they seat properly. Consequently, no credit can be taken for their function to prevent this loss of flow. Because the valves are not tested, their failure to seat is considered an "undetected" failure rather than (and in addition to) any postulated single failure.

The team also reviewed Calculation MD-Q0023-920133, Revision 1, dated 3/29/95 (RIMS R14950329114), Total RHRSW System Head vs. Flow Rate for RHR Heat Exchanger Service. The calculation was performed to determine the RHRSW flow and pressure drops for Unit 2 and Unit 3 operation. This calculation also uses the EZFLOW computer program to model the RHRSW system.

The team identified the following weaknesses:

1. This calculation also determines RHRSW flow supplied to the RHR heat exchanger assuming estimated reduction in pipe diameter equivalent to 40 years of corrosion product buildup. The team found that it is not clear what flow margin, if any, currently exists for satisfying RHRSW flow requirements for the RHR heat exchangers.

2. The calculation indicates (Sheet 14) that the 12-inch Unit 3 throttling valves in the RHR heat exchanger discharge may experience cavitation for the accident conditions evaluated in Attachment 4. The team was informed that DCN T35994A replaces these valves with better performing valves that have lower pressure drops. The team

reviewed the safety assessment (SABFMDCN95036, Revision 0) for this DCN and found no explicit indication that this calculation (MD-Q0023-9200133) will be revised to assess the impact of the design change. Attachment 4 to the calculation indicates that flashing may occur in the downstream discharge piping as well as at the valves themselves. It is not obvious that the valve and piping changes will eliminate the potential for flashing to vapor in the RHR heat exchanger discharge piping. In addition, because the analysis was performed to evaluate flows supplied at the end of plant life, it is not clear that this potential for flashing to vapor does not exist for current levels of piping degradation.

The model should be revised to reflect the modified piping and valves, and analysis should be performed to assure the potential for flashing is eliminated.

3. The abstract on Sheet 1 of the calculation states that at the end of 40-year life, if one unit is in operation (Unit 2 or 3), the RHRSW system may not be adequate to meet the design basis requirement that each RHRSW pump be capable of supplying the cooling water required by one RHR heat exchanger. However, the team was informed that the calculation does not include analysis for Unit 2 or Unit 3 operation (The abstract is incorrect). There is no analysis to confirm that sufficient flow is supplied to the RHR HXs for either Unit 2 or Unit 3 operation alone. Considering the potential for flashing in the Unit 3 RHR heat exchanger discharge piping, an evaluation should be performed for Unit 3 operation alone with the modified piping and valves (See Item 2 above).

4. Attachment 2 of the calculation provides results of analysis performed to "benchmark" the model developed against measured flows and pressures obtained from field test data for Unit 2. The adjusted model was used as a basis for further analysis in Attachment 4, which evaluated accident conditions in Unit 2 and simultaneous shutdown of Unit 3. However, the team was informed that the Unit 3 portion of the model has not been benchmarked against field test data.

   The team recommends that the Unit 3 portion of the model should be benchmarked against field test data.

5. Attachment 4 determines flows supplied to the RHR heat exchangers during a postulated accident in Unit 2 with the simultaneous safe shutdown of Unit 3. The calculation uses a flow requirement of 1000 gpm for each of the two RHR heat exchangers supplied in the non-accident unit for safe shutdown (Attachment 4 results). No basis is provided for this flow requirement. The team was informed that the 1000 gpm (per RHR heat exchanger) flow requirement was based on flow measurements during a plant cooldown in which less than 2000 gpm total was supplied to the RHR

heat exchangers. However, cooling water temperatures during this cooldown were probably less than the maximum design temperature of 95°F.

Attachment 1 of the calculation evaluates flows supplied by RHRSW to the RHR heat exchangers during the simultaneous safe shutdown of Units 2 and 3. The 1000 gpm flow requirement is also used in evaluating flows supplied to the RHR heat exchangers for this case (safe shutdown of both units). For both of these cooldown cases, lower flows supplied will result in extended cooldown times. In addition, the 1000 gpm flow is substantially less than the 4500 gpm design flow for the RHR heat exchanger. The team determined that at 1000 gpm, RHRSW flow through the RHR heat exchanger may be in the transition zone (i.e., not fully turbulent), and may affect the heat transfer capability of the heat exchanger.

The team recommends that the calculation should be revised to provide the technical basis for these flow requirements for the cooldown units.

6. The calculation uses a pressure drop of 6 psi at a flow of 4500 gpm for the RHR heat exchanger. However, this does not account for the additional resistance due to tube plugging. Although the team was informed that current tube plugging for these heat exchangers is less than 2% (which would have a small impact on pressure drop), additional tube plugging could increase the pressure drop.

In summary, the team concluded that:

- It is not clear what flow margins actually exist for components supplied by EECW and RHRSW. Although testing demonstrates sufficient flow to safety-related components, the testing for EECW uses the EECW EZFLOW analysis to establish margins at the end of plant life, and for RHRSW testing does not address worst-case conditions.

- The potential for flashing exists at some locations in both RHRSW and EECW system piping under some conditions. This potential, and its effects on flows supplied to safety-related components, has not been fully evaluated for EECW during Appendix R shutdown conditions and planned modifications for some RHRSW piping and valves.

- Other weaknesses exist in the analyses performed to confirm the capability of RHRSW and EECW to supply design basis flows to safety-related components.

However, the team found that sufficient conservatism exists in the analysis performed to assure that there is no immediate concern. The analysis conservatively assumes piping degradation to the end of plant design life. In addition, analyses performed for the accident

case assumed lowest anticipated water levels associated with the failure of Wheeler Dam. A postulated design basis accident with a coincident dam failure is extremely remote.

CONTACTS: F. Loscalzo

BFN RESPONSE:

The TVA responses to these issues are summarized below:

Calculation MD-Q0067-930028, Revision 0

1. The coolers that are receiving less than adequate flow in Unit 3 were analyzed with carbon steel piping because the piping modification ECN L1970 was not fully implemented at the time that the calculation was prepared. An effort is currently under way that will document the change in pipe material for the core spray and RHR pump room coolers.

   The EECW supply and discharge to the Unit 3 shutdown board room coolers is mostly imbedded and was not changed out to stainless steel. This piping is tested quarterly and flow rates are above the acceptance values.

2. It is TVA policy to perform its pressure drop calculations for raw water systems based on a 40-year plant life. This is done in order to minimize piping replacement and associated costs over the projected life of a generating facility.

   The EZFLOW model will be benchmarked to actual EECW conditions when the data is obtained from the performance of the BTRD.

3. The strainer differential pressure will be changed to a more conservative pressure (drop) for the next revision of the calculation.

4. The flow at some locations is fixed at 0 gpm to model a high point vent without allowing flow into the system. This is an accepted mechanism for modeling provided by the EZFLOW software.

5. Failures in addition to the loss of Wheeler Dam and the emergency supply to fuel pool makeup are not warranted.

Calculation MD-Q0023-920133, Revision 1

1. The calculation performed an analysis of the RHRSW system piping based on data taken from 0-TI-63. This analysis indicated that the Unit 2 RHRSW piping has a

capability to perform its safety-related function for an extended period of time. An analysis was performed for two unit operation (Units 2 and 3) and included in the calculation as Attachment 4. Combined flows at an expected pipe degradation (C = 63) would ensure that adequate flow is supplied to Unit 2 (accident conditions) and Unit 3 (shutdown cooling). This combined unit operation is bounding for a single unit operation.

2. DCN T35994A replaces the existing valves in Unit 3 with a model that has a higher C_v. This will ensure that the pressure drop through the RHRSW discharge valves will be less than the existing configuration. The existing valves have a C_v of 770 versus a minimum C_v of 2040 for the replacement valves. The EZFLOW model will be revised and all potential flashing conditions evaluated after the Unit 2/3 restart test.

3. Attachment 2 of the calculation evaluates a single unit operation (Unit 2) based on plant data, and there was a measured flow of 4150 gpm and 4225 gpm for flow through two heat exchangers with a combined discharge outlet. Therefore, Unit 2 meets its design basis. Unit 3 will be evaluated for single unit operation after its restart test; however, the worst-case condition was evaluated in Attachment 4.

4. The benchmarking of Unit 3 will be performed after the collection of data from the restart test.

5. A minimal amount of RHRSW flow is used to bring the non-accident unit to cold shutdown for these conditions. The 1000 gpm flow will be verified by referencing a valid design input document in the next revision of the calculation.

EVALUATION OF BFN RESPONSE:

<u>Calculation MD-Q0067-930028, Revision 0</u>

1. The response is acceptable. The team recommends that the model and calculation should be revised to reflect the as-installed pipe material.

2. The response is acceptable.

3. The response is acceptable.

4. The response is acceptable.

5. The response is acceptable.

<u>Calculation MD-Q0023-920133, Revision 1</u>

1. The team agrees that the analysis performed based on the data from 0-TI-63 for Unit 2 RHRSW piping indicates satisfactory performance for an extended period (i.e., to end of plant design life). However, this testing was not performed during (and Attachment 2 does not reflect) worst-case conditions, e.g., lowest anticipated water level and degraded pumps. Attachment 2 reflects the results of analysis for a model that was adjusted to suit the conditions existing during the testing performed (with a lake level at El. 553' rather than El. 529' and fixed measured pressures rather than pump curves). This adjusted model was then used to perform analysis related to combined Unit 2 and Unit 3 operation, and the results were presented in Attachment 4 for that case. It is not obvious from the calculation that the combined unit operation of Attachment 4 bounds single unit operation.

   Because it is TVA's stated policy (see TVA response to Item 2, Calculation MD-Q0067-930028 above) to perform these analyses based on a 40-year life, the team has no further questions on these issues.

2. The response is acceptable.

3. See Item 1 above. The team recommends that the calculation should be revised to address single unit operation.

4. The response is acceptable.

5. The response is acceptable.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: MECH-03

REVISION: 1

DATE: May 15, 1995

INSPECTION AREA: Mechanical Systems Design

INSPECTOR: S. M. Klein

ISSUE:

There is no documented review of the RHRSW and EECW system capability to perform required safety functions in the event of the failure of a single active component.

REQUIREMENT:

Action IV of Generic Letter 89-13 requires licensees to review the capability of the service water system to perform required safety functions in the event of the failure of a single active component.

DISCUSSION:

Action IV of Generic Letter 89-13 requires licensees to review the capability of the service water system to perform required safety functions in the event of the failure of a single active component. In response to this requirement, TVA has stated (letter to NRC dated March 16, 1990, L44900316801) that the "system capability to perform these functions is demonstrated through the restart test program. In a letter to TVA (April 23, 1990), the NRC stated that TVA should document and retain the details associated with implementation of actions in GL 89-13.

The team requested TVA to provide either:

- The documented single failure review performed for the residual heat removal service water and emergency equipment cooling water systems, or
- The documentation that demonstrates how the restart test program confirms that the residual heat removal service water and emergency equipment cooling water systems

> can perform their safety functions in the event of the failure of any single active component.

In response to this request, TVA has stated that:

> "The EECW and RHRSW systems are designed, installed and operated in such a manner that there is complete redundancy for both systems.
>
> > With the EECW system, there are two headers fed from separate pumps (3 pumps per compartment with 4 compartments), powered by diesels and shutdown boards which are independent of each other. Double check valves assure that the supply headers are independent when they connect immediately upstream of the coolers.
> >
> > The RHRSW system has 4 heat exchangers per unit with one RHRSW pump supplying one heat exchanger the required amount of water to meet the Design Basis. Any one pair of heat exchangers with separate and independent supply headers to provide redundancy. This alignment is such that a RHR heat exchanger takes a supply from a corresponding set of pumps (i.e., HX 2A receives water from the A2 pump). Each unit has a separate path from the reactor building to the Tennessee River. This configuration is verified by the Design Criteria (BFN-50-7023/7067) and CCDs.
>
> The restart test program for the EECW and RHRSW systems (BTRD-009 & 026) verified that the systems meet the design basis. The results of these tests are available for your review. There was no analysis of the test results to assure that each individual component meets "single failure criteria," however, the systems are redundant and all design basis functions were tested and meet the acceptance criteria as defined in the BTRDs."

It has been the team's experience that the GL 89-13 requirement for a single failure review is generally satisfied by a documented review of identified failure modes for components in the service water system(s) and an evaluation of the consequences of each of these postulated failures, considering worst-case accident conditions and safe plant shutdown. Although the design of both the RHRSW and EECW systems may satisfy the requirements of General Design Criterion 44 (Appendix A to 10CFR50) for "suitable redundancy," the design alone does not meet the intent of GL 89-13 for performance of a single failure review. Similarly, the team agrees that the intent of the restart test program was to verify the systems' design basis. However, there was no specific testing performed, or analysis of results obtained, to confirm that the system could perform required safety functions in the event of the failure of any single active component.

The team was informed that earlier in the design evolution for these systems, single failure reviews had been performed. However, documentation of these reviews no longer exists.

Consequently, the team concluded that the RHRSW and EECW systems' capability to perform these functions, assuming the single failure of an active component, has not been documented and may not be fully evaluated in accordance with GL 89-13, Action IV.

CONTACTS: F. Loscalzo

BFN RESPONSE:

The RHRSW and EECW systems have been designed to supply the required cooling water loads following a single active failure. One of the criteria for system evaluations performed by the Design Baseline Verification Program (DBVP) at Browns Ferry was to confirm that the system met applicable single failure criteria. During the DBVP system evaluations for RHRSW and EECW, no single active failure was identified which would prevent either system from meeting the design basis requirements (e.g., single active failure). TVA believes this satisfies the requirements of GL 89-13 and its approach is consistent with the guidance given in GL 89-13, Supplement 1, question V.F.

EVALUATION OF BFN RESPONSE:

Based on the information provided to the team as outlined in this Inspection Observation and the above TVA response, it appears that the TVA position is consistent with their response to the NRC for Action IV of Generic Letter 89-13.

It is the team's experience that such single failure reviews are documented. However, the team also noted that no single failure of an active component was identified during this inspection which would prevent either the EECW or RHRSW from performing its safety function.

REVIEWED BY: ____________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: MECH-04

REVISION: 1

DATE: May 15, 1995

INSPECTION AREA: Mechanical Systems Design

INSPECTOR: G. Overbeck

ISSUE:

Safety-related HVAC calculations for the core spray pump rooms incorrectly assume two coolers are installed in each room when only one is provided.

REQUIREMENT:

ANSI N45.2.11 requires, in part, that design analyses should be verified to ensure that design inputs and assumptions reflect the as-installed configuration.

DISCUSSION:

While reviewing HVAC design calculations in response to a team concern, BFN noted that Unit 2 calculation ND-Q2999-890026 R3 and Unit 3 calculation ND-Q3000-920059 R1 incorrectly assume the northeast and northwest reactor building corner rooms (core spray pump rooms) contain two room coolers per room. These rooms contain only one cooler; therefore, the results, as analyzed, are not conservative.

Upon discovering the error, BFN prepared BFPER950476, analyzed the condition, and determined that sufficient heat removal capacity remained to satisfy heat removal needs.

CONTACTS: G. Silver
T. Golston

BFN RESPONSE:

As noted, TVA identified a problem with the referenced calculation and documented this deficiency by BFPER950476. One of the corrective actions associated with resolving the

deficiency will require revision to the referenced calculation. The corrective action plan is scheduled to be submitted 5/25/95.

EVALUATION OF BFN RESPONSE:

The response is acceptable.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: MECH-05

REVISION: 1

DATE: May 22, 1995

INSPECTION AREA: Mechanical Systems Design

INSPECTOR: J. Hilditch

ISSUE:

EECW system alarm setpoints either have no documented basis or do not support system level performance requirements.

REQUIREMENT:

1. ANSI N45.2.11 requires, in part, that assumptions should be reasonable, adequately justified and documented, and that the methodology used is appropriate and rational for the analysis performed and that methods shall provide for relating the final design back to the source of design input.

2. Procedural guidance and requirements should be consistent with system design.

DISCUSSION:

Several EECW system alarm setpoints are based on individual component requirements, but no alarm setpoints have a documented basis in overall system performance.

Examples:

1. The control room EECW pump flow indication and low flow alarms come from flow elements located downstream of the strainers. The low flow alarm setpoint is 1800 ±524 gpm, decreasing. The BFN response to SWSOPI Action Item #035 stated that the basis of the EECW low flow alarm is to alert the operators that the pump is operating near its minimum flow point of 1125 gpm.

The team has noted that Calculation MD-Q0067-930028 states that the RHRSW minimum required pump flow is 1350 gpm. This value disagrees with the value provided in the BFN response to SWSOPI Action Item 035.

The team also noted that OI-67 Section 3.24 informs the operator that the EECW pump flow should not be less than 1350 gpm at any time.

The team also noted that 0-SIMI-67B, BFNP Scaling and Setpoint Document for the EECW Flow, shows the following:

EECW Flow from:	Indication Loop	Flow Switch Loop	Setpoint
Pump A - North	±555 gpm	±524 gpm	1800 dec
Pump B - South	±555 gpm	±524 gpm	1800 dec
Pump C - North	±200 gpm	±105 gpm	1300 dec
Pump D - South	±200 gpm	±105 gpm	1300 dec

The BFN response to SWSOPI Action Item 035 stated that the difference in setpoints is due to the ongoing replacement of the old GE transmitters (set at 1300 gpm) with new Rosemount transmitters (set at 1800 gpm). However, the alarm response procedures for EECW flow low make no distinction in the low flow setpoint (<1800 gpm, 5 sec after pump breaker closes).

Normal EECW pump flow with one pump running on each header is about 3000 gpm per pump. This means that it is possible for the pump flow to decrease from 3000 to (1800-524=) 1276 gpm for Pumps A and B, and from 3000 to (1300-105=) 1195 gpm for Pumps C and D with no alarm in the control room. The resulting total EECW flow is 4942 gpm, which is less than the required total EECW system design flow for single-unit operation (5499 gpm).

2. BFN's response to SWSOPI Action Item 005 stated that the EECW remote discharge pressures and flows with four pumps running on 4/19/95 were:

Pump No.	psig	gpm
A3	149	1800
B3	142	1500
C3	149	1500
D3	142	1600

It appears to the team that if the EECW pumps start up automatically in response to an accident signal, the EECW system low flow alarm may annunciate on the EECW B pump discharge.

The team did not expect to find that an alarm may annunciate as a result of an expected automatic change in the system operating configuration.

3. The EECW system pressure indicators and low pressure alarms come off of eight different points on the system. BFN's response to SWSOPI Action Item 036 states that the alarm setpoints were established during the original design of the plant by TVA and that no detailed calculation exists documenting the basis of the setpoints.

   The north header low pressure setpoints are set at 37 psig, the south header is set at 48 psig, and the DG building header section is set at 53 psig. The BFN response to SWSOPI Action Item 036 stated that this arrangement ensures that all the alarms will not come on at the same time. The team has not seen any analysis or system test to substantiate this statement.

   Based on an initial team analysis, it appears that the differences in the EECW header low pressure alarm setpoints account for the EECW north and south header elevation difference of 25 feet. The team expects that all EECW low pressure alarms may annunciate nearly simultaneously on a loss of EECW pumps.

4. The EECW strainer high differential pressure (DP) alarm setpoint is set at 6 ± 0.08 psid. The BFN response to SWSOPI Action Item 023 stated that the EECW strainer high DP alarm "is an operator support function only." The response further states that "the limiting factor associated with the EECW strainers is not a high differential pressure causing damage to the strainers but, EECW flow restriction, with respect to EECW providing cooling water to safety related equipment." There is no documented basis for the alarm setpoint with respect to the EECW system performance. The team has noted that the EECW flow analysis assumes a 1.2 psi pressure drop across the strainer.

   The BFN response to SWSOPI Action Item 023 also states that the operators are provided flow indication and annunciation. However, as discussed above in example 1, the low flow alarm is based on the RHRSW pump minimum flow requirements, which is not related to any system design requirements. Furthermore, there is no documented basis for the EECW system low pressure alarm setpoints.

   The EECW system can operate with a strainer DP up to 6 psid without operator action. Moreover, based on current conditions, the EECW B strainer could operate with a DP greater than 6 psid for many hours before it is noted by an AUO because

the control room alarm input is disabled. There have been no additional operator compensatory actions to monitor the EECW B strainer more frequently since the control room alarm was disabled.

CONTACTS: Ed Kirby
Johnny Dollar
W. Weaver

BFN RESPONSE:

Response to requirement statement and questions on alarms:

1. BFNP was not originally built to ANSI N45.2, but later committed to 10CFR50, appendix B for new work (see General design criteria BFN-50-736, section 3.0). As part of the design basis and verification program (DBVP) critical attributes were verified to ensure operation of essential systems for accident mitigation. Alarms and basis for alarm settings were not necessarily a key attribute for the DBVP program. Analysis and testing of systems for ensuring systems met their design limits (i.e., adequate system flow to all essential components) was verified, but alarm settings and the analysis to support those settings was not established.

Response to examples:

1. The major system parameter is to verify flow and system pressure using the flow indication and pressure indicators in the Main Control Rooms (the flow instrument loops are Post Accident Monitoring, category 2 per RG 1.97). The operator is going to verify the system flow and pressure, but alarms such as low flow or header pressure are intended for gross indication of loss of flow or system misalignments, etc. The EECW flow limit alarm is based on minimum flow of 1350 GPM for pump protection (the scaling and setpoint calculation originally used 1125 GPM, the calc will be used to reflect the correct limit of 1350). A PER (copy attached) has been issued to document the different limit for low flow conditions and the different setpoint values for low flow (1300 GPM vs 1800 GPM). The calculation was reviewed and it was determined that the minimum flow alarm lower limit (due to instrument errors) is approximately 1400 GPM (based on reevaluating very conservative errors in the calculation). Also, the errors in the scaling and setpoint calculation for low flow alarm are random errors and as such cannot and will not be all negative or all positive errors. Finally in the scaling and setpoint calculation, the indicated errors are calculated at the low flow setpoint, not the required system flow. The calculated errors are much higher at the low end of the flow curve than at the normal system flow. The calculation is very conservative when it determines that the indicator errors are ±555 GPM (worse case, at low flow) since these are calculated

for the low end of the flow curve (e.g., Q = √(pressure difference across orifice plate). Recalculating the indicator errors at 4500 GPM gives an indictor error of approximately ±320 GPM.

2. The critical parameter is verification of four (4) pump starts and verification of system flow and pressure, not the low flow alarm. The scaling and setpoint accuracies are the expected worse case errors for low flow at the end of an 18 month calibration frequency. It is not expected that the errors would be this low for all pumps at the same time; therefore, it is unlikely that the low flow alarms would come in at the same time. The low flow alarm for two of the instruments is too low (1300 gpm); however, it is probably too high (1800 gpm) for the other two instrument loops. This will be evaluated as part of the PER to determine if it needs to change.

3. From a search of the instrument tabulations, the setpoints of 37 psig, 48 psig, and 53 psig have been maintained since BFN started commercial operation. The setpoints appear to be compensated for by elevational differences between the headers. From the Alarm Response Procedure (ARP), the probable cause for header pressure loss is either strainer problems, valve alignment, pump malfunction, or sensor malfunction. The operator is directed to check the flow from the Main Control Room indicators on panel 9-20 (RG 1.97, category 2).

4. No setpoint and scaling calculation exists for the strainer DP switches. As stated in BFN response to SWSOPI Action Item 023, the setpoint of 6 psid has been maintained since BFN started commercial operation. The vendor manual notes that during normal operation with the continuous backwash in service, the differential pressure (DP) ranges from 2-3 psid. Probable cause of a high DP pressure is either strainer malfunction (clogging), loss of power to the strainer, or sensor malfunction. The original bases for the 6 psid in the calculation cannot be determined. However, the 6 psid setpoint has existed since commercial operation.

EVALUATION OF BFN RESPONSE:

The team has no issue with the TVA response to the requirement statement in the observation.

Evaluations of responses to examples:

1. The team found that a low flow alarm that is "intended for gross indication of loss of flow" is inconsistent with a flow limit that "is based on minimum flow of 1350 gpm for pump protection."

The team was informed that the low flow alarm setpoint will be reevaluated to minimize the possibility of a spurious alarm during system operation.

2. The team agrees that the setpoint and applied tolerances should be evaluated to assure that this condition does not occur. The team found that the inaccuracies, although worst-case errors, have been established as errors associated with this setpoint. Because they could occur at the end of the calibration period, they should either be reevaluated or applied to the setpoint.

3. The team recommends that the elevational differences should be confirmed and documented.

4. The team has no further questions on this issue.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: MECH-06

REVISION: 1

DATE: 5/17/95

INSPECTION AREA: Mechanical Systems Design

INSPECTOR: S. M. Klein

ISSUE:

Weaknesses in design analyses performed to determine reactor building temperatures during accident conditions and in analyses to establish minimum flows supplied to the RHR and CS room coolers.

REQUIREMENT:

ANSI N45.2.11 requires that assumptions should be identified and verified and sufficiently documented to permit verification.

DISCUSSION:

Calculation ND-Q2999-89026, Revision 3, dated 4/10/95, Reactor Building Design Basis Accident Loss of Coolant Accident Temperature Analysis, was performed to determine the transient and steady-state temperatures for the Unit 2 reactor zone spaces resulting from a design basis accident (DBA) loss of coolant accident (LOCA). The calculation uses the MITAS II computer code to predict both transient and steady-state temperatures for a 100-day DBA duration. The model developed for the reactor building rooms and areas included drywell and wetwell temperature response profiles, equipment, cable, and other heat loads. The team reviewed this calculation and identified several weaknesses:

1. The calculation assumes (Sheet 9) that at 10 minutes into the event, the normally operating CRD pump is shut down, and at 30 minutes into the event, two of the RHR and CS pumps are shut down because only one loop of each is required. The team was informed that this option is available to operators. However, the team found that procedures do not require this equipment to be shut down during accident conditions. Consequently, no credit can be taken for the absence of these heat loads in determining peak post-LOCA temperatures in the reactor building.

The effect of these additional heat loads could increase temperatures calculated for the pump rooms and adjacent areas.

2. The calculation states (Sheet 9) that the "temperature of the boundary node representing the outside atmosphere was held constant at 82°F prior to and throughout the event. This value is consistent with the outside temperature used in the SQN DBA LOCA analysis for a continuous 100 day period in the summer." The calculation refers to Reference 11 to support this assumption. However, the reference section for Reference 11 states it is "not used" in this calculation. In addition, this assumption is not consistent with a related assumption on Sheet 8, which states that "all nodal temperatures were assumed to start at their normal maximum value as defined on the BFN environmental data drawings prior to the event. These are the maximum temperatures that would exist concurrent with the outside design maximum temperature of 97°F."

   The team was informed that the 82°F outside atmosphere temperature used in the model represented an average temperature based on diurnal variations because the true variation could not be accounted for in the model. The team found that the average temperature used is not conservative and may not be representative of conditions existing at BFN because it was based on Sequoyah Nuclear Plant temperature data. Further, because the temperatures inside building areas exposed to the effects of outside temperatures (such as through walls) will lag the outside temperature variation by some time constant, at some point the effect of the outside temperature will be observed in a peak inside temperature. The accident could occur during this time period when peak temperatures exist as a result of the high outside temperatures, despite the fact that the peak temperatures no longer exist outdoors.

   The team agrees that it may not be necessary to impose maximum outside temperatures over the full 100-day duration of the accident. However, the analysis should reflect the effect of peak outside temperatures in the early stages of the accident when the performance of safety-related components is critical.

3. The calculation states (Sheet 17) that the safety-related coolers in each corner room were modeled as boundary nodes at a constant temperature of 105°F. This is the maximum temperature of the air leaving the cooler coil with the maximum entering RHRSW water temperature of 95°F. This assumes that heat loads imposed on the coolers in the rooms are no more than the heat load associated with these temperatures, i.e., design capacity for the cooler. To confirm this assumption, the calculation includes Appendix 8, which addresses the issue. Appendix 8 includes computer output from runs of the MARLO Coil Selection and Rating Program that confirms that imposed heat loads from the results of the MITAS II analysis do not exceed the cooler capacity. However, these MARLO runs do not use any air side

fouling factor (i.e., FFI = 0). The team found that use of a zero air side fouling factor is not conservative.

In addition, the team found that there is no indication in this calculation that the assumed 105°F air exit temperature is unverified and requires the confirmatory analysis provided in Appendix 8. Consequently, future users of this computer model to determine peak temperatures for other scenarios may not be aware of the imposed limitations.

The team recommends that the calculation should be revised to address the above issues. See Inspection Observation MECH-04 for an additional weakness identified in this calculation.

The team also reviewed Calculation MD-Q0067-930043, Revision 3, dated 4/10/95, RHR and Core Spray Room Cooler Analysis. This calculation determines minimum flow rates needed to remove the heat load from the RHR and CS rooms for various EECW inlet water temperatures accounting for fouling and with no tube plugging. However, the calculation assumes zero air side fouling which is not conservative and implies that the cooler is maintained in a continuously clean condition.

This calculation should be revised to incorporate an appropriate air side fouling factor.

CONTACTS:

G. Silver
R. Sulfridge
L. Klaes

BFN RESPONSE:

1. TVA will review this assumption with the operations staff and based on the result of this discussion, the calc, if required, will be amended during the upcoming revision.

2. Calculation MDQ0031-890030 addresses the impact of utilizing the day/night temperature swings on heat flows in concrete structures of varying thickness. This calc seems to address the concern raised. This calc will be reviewed and, if appropriate, will be referenced in the upcoming revision of 890026.

3. TVA does not agree that it is necessary to add an air side fouling factor to the coil analyses. This assessment is based on the very limited influence of air side fouling to overall coil performance. Typical centrifugal fan performance curves have a fairly steep slope in the area where the system curves meets fan curve (operating point). With this steep slope a small change in pressure will result in magnified change in air

flow rates. Before significant air side fouling occurs (i.e., fouling that would influence performance) there would be a reduction in the air flow rate across the coil. Test are periodically performed to assess the ability of these coils to pass the design flow rate. If unable to achieve design values, then the coils are inspected, and if fouled on the air side they would be cleaned.

3.A. Appendix 8 added to Calculation 890026 shows that the use of a discharge temperature of 105°F from the corner room coolers is conservative. It would be incumbent upon individuals contemplating revision to the calc to review all assumptions and appendices before making any revisions. During the upcoming revision to this calculation TVA will evaluate this assumption and, if deemed necessary, clarify as required.

EVALUATION OF BFN RESPONSE:

1. The response is acceptable subject to revision of the calculation to reflect the additional heat loads of operating two trains of RHR and CS in the event that Operations does not elect to provide specific procedural instructions to shut down one train (and the CRD pump). It is the team's experience that Operations is usually reluctant to incorporate such specific constraints in procedures in order to preserve flexibility and reserve judgment in specific circumstances. Consequently, design analyses must account for the potential presence of these heat loads.

2. The response is acceptable subject to satisfactory incorporation of a rationale basis supporting the day/night temperature swing issue raised, e.g., Calculation MDQ0031-890030, in Calculation ND-Q2999-89026. However, the latter calculation should be reviewed to assure that the parameters used (e.g., heat loads, concrete thicknesses) are applicable to the BFN reactor building and the scenarios evaluated in Calculation ND-Q2999-89026.

3. The response appears to focus on (gross or macro) "fouling" (such as a plastic bag or other debris caught in the coils) that would significantly affect air flow. However, the air side fouling factor is included in the design of the cooler to account for degradation in thermal performance that might result from adverse environmental conditions, such as a light oil film or thin layer of dust accumulated on the coils. Neither of these small deposits would significantly degrade air flows, may not be observed during testing performed to assure design air flows are satisfied, but could adversely impact the heat transfer capability of the unit.

   It is the team's experience that an air side fouling factor (greater than zero) is used to account for such deposit buildups during intervening cleaning periods. As noted in Inspection Observation TEST-06, the air sides of the RHR and CS pump room

coolers are not inspected and cleaned on a regular schedule to assure air side heat transfer capability. That Observation contributes to the team's concern that assuming a zero air side fouling factor is not justified.

3.A. The response is acceptable.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: TEST-01

REVISION: 1

DATE: 5/17/95

INSPECTION AREA: Surveillance and Testing

INSPECTOR: G. Overbeck

ISSUE:

The annual performance tests of the RHRSW intake structure sump pumps are not trended.

REQUIREMENT:

Technical Instruction 0-TI-171, RHRSW Sump Pump Flow Rate Test, Rev. 3, 10/18/91, requires trending of sump pump performance results.

DISCUSSION:

DIM-BFN-50-7023-15, RIMS No. R14 941129 201, BFN - Design Input Memorandum (DIM) on the Residual Heat Removal Service Water (RHRSW) System - Design Criteria BFN-50-7023, Revision 6, 11/29/94 states that "the performance of each sump pump [RHRSW intake structure sump pumps] shall be tested periodically." The periodic RHRSW sump pumps are tested in accordance with Technical Instruction 0-TI-171. This instruction requires the resulting flow rate data be evaluated annually and trended to ensure each sump pump's performance is adequate to support the design.

Although annual performance testing has been accomplished, trending of the results was not performed. During the assessment, the results were trended and a copy provided to the assessment team, indicating that sump pump capacities have remained greater than the acceptance criterion of 300 gpm.

CONTACTS: E. Kirby

BFN RESPONSE:

Sump pump data was not intended to be trended by the system engineer as a formal trend. Since these pumps are outside ASME Section XI boundaries, no periodic testing is required. As part of an overall system health monitoring program, the system engineer specified an annual flow rate test to trend pump performance. The performance of this test is considered to be trending in itself. As such, these pumps are trended during each performance solely against their acceptance criteria of 300 gpm.

The system engineer actually performs this test with only minimal plant support versus typical testing which requires support from multiple plant organizations. This enables the system engineer to view results first hand and detect any pump degradation. A review of the historical data for these pumps was inconclusive with the exception that all pumps passed the test by a significant margin of 46 gpm (15%) or more. Based on the procedure intent, pump performance and historical data, the methodology for performance of this TI is considered adequate and in compliance.

The system engineer agrees that the auditor's preference to formally trend the sump pump results from O-TI-171 is a good practice and has already implemented this into his formal trending. The system engineer will also continue to formally trend this data.

EVALUATION OF BFN RESPONSE:

The team does not concur with BFN statement that because the RHRSW pump room sump pumps are outside the ASME Section XI boundaries no periodic testing is required. Inservice testing is a subset of the testing required to support and assure nuclear plant safety. Other testing may be required to assure that safety-related components perform as expected upon demand.

The team concurs that trending of sump pump performance is a good practice incorporated within the Technical Instruction and with BFN's intent to trend test results in the future.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: TEST-02

REVISION: 2

DATE: 5/17/95

INSPECTION AREA: Surveillance and Testing

INSPECTOR: G. Overbeck

ISSUE:

Although visual inspections are performed, records documenting the conditions observed are not always prepared and/or retained for future trend assessments

REQUIREMENT:

Site Standard Practice (SSP) 13.5, Raw Water Fouling and Corrosion Control Program, requires, in part, that visual examinations of internal surfaces of components be performed and documented using Form SSP-253, Visual Evaluation Record.

DISCUSSION:

In response to GL 89-13, BFN selected regular inspection and cleaning of heat exchangers to ensure their optimum performance over testing.. An assumption supporting inspection in lieu of testing is that the heat exchanger being inspected will perform its intended function if it is maintained within an acceptably clean condition. Inspections of GL 89-13 heat exchangers are performed in accordance with SSP 13.5. Section 3.4.2 of SSP 13.5 states, in part, that the system engineer shall perform and document visual examinations of internal surfaces of components for the presence of biofilms, deposits, and nodules in accordance with Section 3.2. This latter section requires that visual evaluations be documented using Form SSP-253, Visual Evaluation Record, and the results of visual examinations maintained by the system engineer.

The team determined that visual examinations are performed, but the condition assessments are not always documented and/or maintained as required. For example, biennial inspections of the diesel generator coolers are required by Appendix C of SSP 13.5. The following table identifies the documentation.

Diesel Cooler	Inspected Under Work Order	Condition Assessment Available (SSP-253)
0-HEX-082-000A1	WO-93-09850-00 (9/12/94)	No
0-HEX-082-000A2	WO-93-09851-00 (9/15/94)	No
0-HEX-082-000B1		Yes (8/15/94)
0-HEX-082-000B2		Yes (8/15/94)
0-HEX-082-000C1	WO-93-06852-00	Yes (7/1/94)
0-HEX-082-000C2	WO-94-12614-00 (8/30/94)	Yes (7/1/94)
0-HEX-082-000D1	WO 93-08521-00 (8/1/94)	No
0-HEX-082-000D2	WO-93-08522-00 (8/4/94)	No
3-HEX-082-000A1	WO-93-13069-00 and WO 93-13070-00	Yes (1/9 and 10/95)
3-HEX-082-000A2	WO-93-13069-00 and WO 93-13070-00	Yes (1/9 and 10/95)
3-HEX-082-000B1	WO-93-15046-06 and -07	Yes (1/15/94)
3-HEX-082-000B2	WO-93-15046-06 and -07	Yes (1/15/94)
3-HEX-082-000C1	WO-93-13197-01 (2/1/95)	No
3-HEX-082-000C2	WO-93-13198-00 (2/2/95) and WO-93-13198-01 (CR Status)	No
3-HEX-082-000D1	WO 93-11483-01 and -02	Yes (1/25/94)
3-HEX-082-000D2	WO 93-11483-01 and -02	Yes (1/25/94)
3-HEX-082-000D1	WO 94-06310-00	Yes (5/17/94)
3-HEX-082-000D2	WO 94-06310-01	Yes (5/17/94)

Based upon the team's review of other completed SSP 253 forms, similar conditions exist for GL 89-13 heat exchangers. The team is concerned that failure to consistently document the as-found condition and maintain it as a record reduces BFN's ability to trend heat exchanger conditions from inspection to inspection and lessens BFN's capacity to justify the current inspection frequencies.

In response to this concern, BFN has initiated Problem Evaluation Report (PER) No. BFPER 950488. Immediate action was taken to reinforce to all system engineers that Form SSP 253 is to be completed for any raw water visual inspection. A memorandum was issued to all affected Technical Support personnel to emphasize Form SSP 253 will be completed on any raw water visual inspection.

CONTACTS: E. Kirby

BFN RESPONSE:

All diesel coolers were inspected and documented in the associated Work Orders. However, three Form SSP 253's could not be located. In response to this condition for the short term, Problem Evaluation Report (PER) No. BFPER 950488 was written to emphasize to all system engineers that form SSP 253 shall be filled out for every visual inspection conducted on a raw water system, and forwarded to the BOP Raw Water system lead engineer. This was reinforced with a memo from the Technical Support Manager to each system engineer.

For long term control, it is the intention of Browns Ferry to incorporate the SSP 253 copy of record into the Work Order while the system engineer will retain an information only copy for convenience of trending.

EVALUATION OF BFN RESPONSE:

The team interprets that "any raw water visual inspection" includes the fire protection system, and concurs with BFN's actions to correct this deviation from SSP 13.5 requirements and to strength BFN's ability to trend heat exchanger conditions from inspection to inspection.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: TEST-03

REVISION: 1

DATE: 5/17/95

INSPECTION AREA: Surveillance and Testing

INSPECTOR: G. Overbeck

ISSUE:

The air flow rate acceptance criteria for RHR and Core Spray Pump Room Cooler air side tests permits air flow rates below the values analyzed in heat transfer calculations.

REQUIREMENT:

ANSI N45.2.11 requires, in part, that design inputs are correctly translated into procedures and that the final design relate back to the source of design input. ANS 3.2/N18.7 requires, in part, that testing required to demonstrate that an item will perform satisfactory have acceptance limits contained in applicable design documents.

DISCUSSION:

TVA Calculation MD-Q0067-930043, RHR and Core Spray Room Cooler Analysis, Rev. 2 [Accession Number R14 95 0322 120] states that the purpose of the "calculation was to determine the minimum flow rate needed to remove the heat load from the RHR and CS rooms for various EECW inlet water temperatures accounting for fouling and with no tube plugging." Review of this calculation indicates that the design input for the air side flow rate was 10,000 cfm and 12,000 cfm depending upon the size coil (i.e., 10,000 cfm for 5WF 6B-18T x 84 and 12,000 cfm for 5WF 6B - 20T x 93). Review of Technical Instruction 2-TI-134, Core Spray and Residual Heat Removal Room Coolers Air Flow Verification, Rev. 1 indicates that the following test acceptance criteria ranges for total cfm.

Cooler	Acceptance Range
Core Spray "A" and "C" Room Cooler	11430 - 13970 cfm
Core Spray "B" and "D" Room Cooler	9000 - 11000 cfm
RHR Pump "A" Room Cooler	9000 - 11000 cfm
RHR Pump "B" Room Cooler	9000 - 11000 cfm
RHR Pump "C" Room Cooler	9000 - 11000 cfm
RHR Pump "D" Room Cooler	9000 - 11000 cfm

Although ASHRAE may permit an acceptance range of ±10% of rated flow, BFN's heat transfer calculations do not include margin for the lower limit of the range.

The team was informed that it is general practice to use design air flow rates in design calculations. The basis for this practice is the conservative inputs typically used in [heating ventilating and air conditioning] calculations. Because of the conservative nature of these inputs, they would be more than adequate to account for the air flow tolerances specified.

Although the team acknowledges that very conservative inputs may be used in heat ventilation and air conditioning (HVAC) calculations, it is not valid for safety-related calculations to use non-conservative inputs to counteract for other conservative inputs. The use of design basis values instead of the lowest values permitted by test acceptance criteria is not consistent with the method for establishing the tube side water flow rates. Very conservative assumptions are used to arrive at the design flow; yet test acceptance criteria do not allow the flow rate to fall below the design value.

CONTACTS: G. Silver
T. Golston

BFN RESPONSE:

TVA has identified a problem with Calculation ND-Q2999-890026. This calculation provides input data used in the calculation referenced in the question (MD-Q0067-930043). The deficiency has been identified by BFPER 950476. The Corrective Action will require revision to Calculation 890026. Since the calculation has to be revised, TVA will utilize the 90% flow values in the revision. The revision will result in a change to the EQ temperatures and TVA anticipates, using the inputs noted, that the calculation results will demonstrate that there is still considerable margin in the heat removal capability of the equipment in question. Calculation 930043 (referenced in the question) will also be revised to reflect the new input data from 890026 and during this revision, the 90% air flow will likewise be utilized.

The Corrective Action (C/A) Plan is scheduled for submittal 5/25/95. A copy of the C/A will be forwarded to the inspection team to confirm the commitment noted above.

EVALUATION OF BFN RESPONSE:

The team concurs with BFN's action in response to this observation.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: TEST-04

REVISION: 1

DATE: 5/17/95

INSPECTION AREA: Surveillance and Testing

INSPECTOR: G. Overbeck

ISSUE:

The EECW chemical injection check valves required to function as a boundary between Class 3 and non-Class systems are not included in the Inservice Test (IST) Program.

REQUIREMENT:

SSP 8.6. ASME Section XI, Inservice Testing of Pumps and Valves, Rev. 8, 3/20/95, defines a valve that must perform a mechanical motion during the course of accomplishing a system safety function to be an active valve. SSP 8.6 further defines valves that are self-actuating in response to some system characteristic, such as pressure or flow direction, as Category C valves. Active Category C valves require exercise testing in accordance with IWV-3520.

DISCUSSION:

The EECW chemical injection lines use check valves to function as boundaries between the Class 3 EECW system and the non-Class chemical injection system to keep them from impacting the safety-related EECW system. The valves are 0-CKV-1017, -1018, -1019, -1020, -1021, -1022, -1023, and -1024 (Ref: DWG 0-47E839-5). The team's review of the IST Program determined that these valves were not included in the program nor in the Maintenance Check Valve Inspection Program.

In response to the team's concern, BFN determined that these valves were originally excluded because of NE Calculations MD-Q-0050-880285 and MD-Q2067-880346, which determined that the flow losses from a line break at the injection point would be limited by the flow restricting orifice in the line to 56 gpm per line (112 gpm per header). The loss was determined to be acceptable for one unit operation and added to the flow demand when evaluating flow adequacy to essential components. Because the loss of 112 gpm from the

hypochlorite injection line was determined to be acceptable and would not prevent the EECW system from performing its safety function, the check valves on the injection lines were judged not required to perform a specific function in shutting down a reactor or in mitigating the consequences of an accident. Based on this determination, these valves were excluded from the IST Program. In 1994, MD-Q0050-880285 was revised to state that the orifice and check valve had been seismically qualified and there was no need to include the losses through a chemical injection line pipe break in the EECW flow and pressure drop analysis calculations. Based on this, NE no longer included losses through a failed injection line in determining acceptability of EECW system flow rates to essential components. At this point, the official basis for excluding the valves from the IST Program was voided. The IST Program was not revised accordingly.

BFN clarified that the minimum required accident condition flow of the EECW system is 5499 gpm (one unit operation). Because each EECW pump provides 4500 gpm and there is a minimum of one EECW pump operating on each header, there should be a margin of 3501 gpm for one unit operation. This would allow a chemical injection line pipe break to occur on all four injection lines on either EECW header without threatening the available margin for ECCW safety-related flow requirements. Problem Report BFPER950531 has been initiated to address the lack of testing or inspection of these check valves.

CONTACTS: C. Driskell

BFN RESPONSE:

The observation is correct in stating that the EECW chemical injection line check valves (0-CKV-50-1017, 1018, 1019, 1020, 1021, 1022, 1023, and 1024) are not in the BFN IST Program. These valves are within the ASME Section XI Code Class equivalent 3 boundary shown on ISI boundary drawing 0-47E839-5-ISI. Because NE no longer includes the flow losses from an assumed chemical injection line pipe break in determining flow requirements for EECW operability, the previous justification for excluding these valves from the IST Program is no longer valid. These valves should therefore be included in the BFN IST Program.

BFPER950531 was initiated as a result of this problem. As an interim action, Technical Support verified the closing function of these valves by reverse flow testing. 0-CKV-50-1017, 1018, 1021, 1022, 1023, and 1024 were verified to close on 5/5/95. 0-CKV-50-1019 and 1020 were verified to close on 5/9/95. The corrective action for this PER will be to add the check valves to the BFN IST Program and test the valves on a quarterly basis as required by ASME Section XI. The closure verification will be performed by reverse flow testing.

EVALUATION OF BFN RESPONSE:

The team concurs with BFN's response and with the immediate actions to test the check valves in their reverse flow direction.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: TEST-05

REVISION: 1

DATE: 5/17/95

INSPECTION AREA: Surveillance and Testing

INSPECTOR: C. Jansing and G. Overbeck

ISSUE:

Boundary valves between Class 3 and non-Class systems are not included in the Inservice Test (IST) Program. In addition, check valves relied upon to meet the single failure criterion are not tested in the closed direction.

REQUIREMENT:

SSP 8.6, ASME Section XI, Inservice Testing of Pumps and Valves, Rev. 8, 3/20/95, defines a passive valve as a valve which does not perform a mechanical motion during the course of accomplishing a system safety function. SSP 8.6 further defines Category B valves as valves for which seat leakage in the closed position is inconsequential for fulfillment of their function. Passive Category B valves are not required to be tested; however, they are to be listed in Appendix J of SSP 8.6 as passive valves.

Design attributes, such as check valves, relied upon to meet the single failure criterion should be tested on some periodicity to confirm the active function can be accomplished.

DISCUSSION:

In reviewing the RHRSW chemical injection lines, the team found that check valves identified on ISI drawings as the boundary between Class 3 RHRSW system and the non-Class chemical injection system are not included in the IST Program. Specifically, check valves 0-CKV-50-521, 522, 555, 556, 563, 565, 580, 581, 614, 615, 646, 647, 684, 685, 690, and 691 are identified as valves within the ISI boundary, but are not included in the IST Program (i.e., SSP 8.6, ASME XI Inservice Testing of Pumps and Valves). Likewise, potential manual isolation valves, 0-SHV-23-528, 539, 548, 558, 567, 577, 599, and 600, are shown on Drawing 1-47E858-1 as normally open and are also not included in the IST Program as Category B active valves requiring manual stroke testing. As a consequence, the

safety-related boundaries between the safety-related RHRSW and the non-safety-related chemical injection system are not assured by the IST Program.

In response to this concern, BFN confirmed that ISI drawings show the ASME Section Code Class 3 boundary extending up to and including the outer check valve in each pair of check valves. Modification DCN W27000A added a new chemical treatment injection system for the RHRSW and EECW systems. However, the only time the injection lines to the RHRSW are open is during the quarterly operability SIs for the RHRSW pumps and headers and to support quarterly SIs for RCIC and HPCI. At all other times, manual isolation valves (0-SHV-23-528, 539, 548, 558, 567, 577, 599, and 600) are closed. Regulatory Guide 1.26 allows the ASME Section XI Code Class boundary to be extended to the first normally closed valve off of the process line (the manual isolation valve). The present drawing configuration shown on 1-47E858-1 for these valves (OPEN) is in error. and a Potential Drawing Discrepancy (PDD) has been initiated to correct the drawing (i.e., the manual isolation valves are normally closed). Therefore, the manual isolation valves at the injection line connection to the RHRSW piping (0-SHV-23-528, 539, 548, 558, 567, 577, 599, and 600) will be added to the IST Program as normally closed passive valves.

BFN also indicated that the first check valve in each injection line will be added to the BFN Maintenance Check Valve Inspection Program (86-03) or some other appropriate test/ inspection program to assure that the check valves will function on demand (i.e., the valve will seat on demand when the manual isolation valves are open).

Problem Evaluation Report BFPER950531 has been initiated to address the incorrect ISI boundaries and the failure to have the required manual isolation valves listed in Appendix J of the IST Program.

CONTACTS: C. Driskell

BFN RESPONSE:

The observation is correct in stating that the RHRSW chemical injection line check valves (0-CKV-50-521, 522, 555, 556, 563, 580, 581, 614, 615, 646, 647, 684, 690, and 691) and the chemical injection line manual isolation valves (0-SHV-23-528, 539, 548, 558, 567, 577, 599, and 600) are not in the BFN IST Program. These valves are within the ASME Section XI Code Class equivalent 3 boundary shown on the ISI boundary drawing 0-47E839-5-ISI. As discussed in Observation TEST-05, the normally closed isolation valves (0-SHV-23-528, 539, 548, 558, 567, 577, 599, and 600) should be the boundary for the ASME Section XI Code Class 3 equivalent portion of the RHRSW system. As the boundary valves for the ASME Section XI Code Class portion of the system, these valves should be included in the BFN IST Program.

BFPER950531 was initiated as a result of this problem. As an interim action, Technical Support verified the closing function of the first check valve on each injection line beyond the manual isolation valves (0-CKV-50-521, 555, 563, 580, 614, 646, 684, and 690) by reverse flow testing on 5/5/95. The corrective action for this PER will be to add the manual isolation valves to the BFN IST Program as Category B passive valves in Appendix J Passive Valve Listing of SSP-8.6. As normally closed Category B passive valves, there will be no testing requirements for these valves. Check valves 0-CKV-50-521, 555, 563, 580, 614, 646, 684, and 690 will be added to the BFN-86-03 Check Valve Inspection Program (defined in MSI-0-000-CKV001) and inspected on a random basis at least once every seven years. This will meet single failure criteria for the RHRSW Chemical Treatment injection lines.

EVALUATION OF BFN RESPONSE:

The team concurs with BFN's response and with the immediate action to test the check valves in the reverse flow direction.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: TEST-06

REVISION: 1

DATE: 5/17/95

INSPECTION AREA: Surveillance and Testing

INSPECTOR: G. Overbeck

ISSUE:

The air sides of the RHR and CS pump room coolers are not inspected and cleaned on some periodicity to assure air side heat transfer capability is maintained.

REQUIREMENT:

In response to GL 89-13, BFN selected regular inspection and cleaning of heat exchangers to ensure their optimum performance over testing.

DISCUSSION:

During the team's walkaround of the Units 1, 2, and 3 residual heat removal (RHR) and core spray (CS) pump room coolers, the team noted dirt on the air intakes (varying degree of accumulation but not significant individually; however, the worst was Unit 2 CS pump room cooler) and dust accumulation on the visible fin surfaces (i.e., fin surface fouling). Air flow rate tests are performed periodically; if the required air flow is not obtained, work orders are prepared to clean the heat exchangers. Nonetheless, having the required air flow is only one factor in assuring heat transfer. Assuring that the fin surfaces are clean and devoid (to the extent practicable) of film fouling is also important. The team did not find any preventive maintenance activity to clean the air side on some periodicity. This lack of periodic cleaning was evident during the team's walkaround.

The lack of inspection and cleaning of the air side of these air to water heat exchangers appears contrary to the intent of BFN's commitment to inspect and clean GL 89-13 heat exchangers and inconsistent with the assumption used in heat transfer analysis (i.e., zero air side fouling, see MECH-06).

In response to this concern, BFN stated that because there is currently no thermal performance data available to sufficiently verify the assumption of zero air side fouling, preventive

maintenance tasks are being established in the Preventive Maintenance Program that will require cleaning the air side of the coils once per year for each coil. For the immediate time period, five work requests have been generated to clean those coolers that exhibit a dirty condition. BFN is also planning to conduct a thermal performance test in the near future to determine if meaningful data can be obtained for verifying thermal performance of the room coolers. The test data, if found to be meaningful, will be used to determine if changes to the preventive maintenance schedule are warranted.

CONTACTS: T. Golston
G. Silver
P. Gilbert

BFN RESPONSE:

In reviewing the above discussion, there appears that information provided by BFN to Action Item #046 may need further clarification. The discussion alludes to the case that the thermal performance test data is meant to verify the assumption of zero air fouling. BFN's response was meant to be interpreted that the thermal performance test will collaborate the assumption that monitoring of the air flow rate and differential pressure across the coil is a sufficient indicator for determining when cleaning of the air side is warranted. The thermal performance test is intended to determine if a cooler can still demonstrate sufficient cooling capacity even if that cooler exhibits some accumulation of dirt on the air intake and/or duct accumulation on the visible fin surfaces. Hence the thermal performance test results will not be used in verifying zero air side fouling.

A correction to an item contained in the response to Action Item #046 should also be noted in this response. The Action Item #046 response stated that preventive maintenance tasks will be established in the Preventative Maintenance Program which will have the air side of the coils cleaned on an annual basis. The action that will be undertaken instead by BFN will be to expand the scope of the existing PMs which performs chemical flushing of the cooling eater side to also include requirements for cleaning of the air side. This results in the cleaning of the air side on a once per refueling cycle basis.

EVALUATION OF BFN RESPONSE:

The team concurs with BFN's response to expand the scope of existing repetitive tasking to clean the air side on a periodicity consistent with the tube side chemical cleaning.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: OPS-01

REVISION: 1

DATE: May 16, 1995

INSPECTION AREA: Operations

INSPECTOR: J. Hilditch/R. Norman

ISSUE:

The status of the EECW system strainer high DP alarm was not adequately maintained in the Units 1, 2, and 3 control rooms.

REQUIREMENT:

0-OI-55, Annunciator System, Step 8.1.10 requires that the disabling of an annunciator input be logged in the applicable Operator's Journal.

DISCUSSION:

During a walkdown in the RHRSW pump B room, the team observed that the wire from the EECW strainer B high DP switch to the control room annunciator circuit was lifted. The lead was tagged (IN USE Tag 12778 dated 3/29/95) and stated that "wire 785 is lifted to clear the control room alarm, the PDIS had a corroded terminal." (The team was informed that the "IN USE" Tag is not the proper way to mark a lifted lead.)

The team noted that the Unit 2 operators were aware that an input to the EECW strainer high DP alarm was disabled. The Units 1 and 3 operators were not aware of the disabled strainer B input until informed by the team. BFPER950474 was written in response to the questioning on the status of the EECW strainer high DP alarm in Units 1, 2, and 3. The PER requests a change to 0-OI-55, Annunciator System.

The PER states that an input to a control room alarm was disabled per 0-OI-55 on 4/13/95. However, the IN USE tag on the alarm lead is dated 3/29/95; this date was confirmed by the maintenance man involved with the job. It appears that this condition was not noted in any control room between 3/29/95 and 4/13/95.

CONTACTS: Ed Kirby
Paul Harris
Johnny Dollar
Gary McConnell

BFN RESPONSE:

On 3/29/95, the IMs lifted lead #785 while performing troubleshooting on 0-PDIS-067-0005. When the lead was lifted, the IMs notified the Unit 2 control room and discussed this with the Unit 2 ASOS. It was determined that the cause of the nuisance alarm was due to this switch and that a corroded terminal block would have to be replaced. The IMs, with the concurrence of the ASOS, lifted the lead to prevent the nuisance alarm source from masking the other alarms, and documented the lifted lead in their work package. The package was returned to planning for materials, expecting a quick turnaround. The WO was subsequently placed in MX status due to unavailability of material. The WO and the nuisance alarm were tracked daily in the POD during the time period of 3/29/95 to 4/13/95. On 4/13/95, it was decided to document the alarm being disabled in Operations OI-55 since the material issue date for the WO was 7/7/95. This was done to remove the alarm from the POD nuisance list and maintain tracking on the weekly POD disabled alarm list.

EVALUATION OF BFN RESPONSE:

The response is acceptable.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: OPS-02

REVISION: 2

DATE: May 16, 1995

INSPECTION AREA: Operations

INSPECTOR: J. Hilditch

ISSUE:

Several EECW system alarm response procedures (ARPs) are weak or incomplete.

REQUIREMENT:

Procedural guidance and requirements should be consistent with system design.

DISCUSSION:

1. EECW North Header Level Low Alarm, LA-67-52 (1-ARP-9-20A)

This alarm annunciates only in Unit 1. The sensor is located on the EECW north header in Unit 3. The ARP does not direct the Unit 1 operators to inform the other units of the problem.

2. Traveling Screen Differential High Alarm, PDA-27-1A, et al.

The ARP does not direct the operators to determine if debris is being carried over by the traveling screens. The team was informed that the traveling screens are operated in the manual mode because of past experience of river debris being carried over into the CW pump forebay. If debris gets into the forebay, the debris can get into the RHRSW pump pit. The ARP does not suggest that the operators monitor the EECW strainer DP more closely when the traveling screens are having troubles.

3. EECW Supply Strainer Differential Pressure High Alarm, PDA-67-1, et al.

The ARP lists a probable cause to be a dirty or clogged strainer to strainer malfunction. The ARP does not suggest that the strainer could be clogged due to material inside the strainer

that it is not designed to remove (i.e., soft plastic, grass, soft fish flesh, etc). In this condition, the strainer still rotates and the backflush is open as long as the RHRSW pump flow is greater than about 150 gpm.

The ARP does not direct the control room operator to verify EECW header flows and/or pressures. Instead, the ARP directs the operator to only check which EECW pumps are on.

4. EECW Flow Low Alarm, FA-67-3A

a. The ARP lists the alarm setpoint as <1800 gpm for all pumps. The BFN response to SWSOPI Action Item 035 stated that there is an ongoing replacement of the old GE flow transmitters with new Rosemount flow transmitters. The A and B pump discharge lines have the new flow transmitters; thus, the low flow setpoints are 1800 gpm. The C and D pump discharge lines have the old flow transmitters; thus, the low flow setpoints are 1300 gpm. The ARP makes no distinction in the different low flow setpoints.

b. Based on the elementary drawings, the EECW low flow alarm will annunciate whenever either RHRSW Pump 1 (swing) or 3 (EECW) motor breaker is closed <u>and</u> there is a low flow condition in the associated EECW header. The ARP does not discuss the situation where the EECW low flow alarm could occur when the associated 1 (swing) RHRSW pump is operating to supply water to the RHRSW system while the 3 (EECW) RHRSW pump is secured.

CONTACTS: Ed Kirby
Johnny Dollar

BFN RESPONSE:

We agree with these four observations and will revise the appropriate procedures to correct/ enhance the procedures to address these deficiencies.

EVALUATION OF BFN RESPONSE:

The response is acceptable.

REVIEWED BY: ____________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: OPS-03

REVISION: 1

DATE: May 18, 1995

INSPECTION AREA: Operations

INSPECTOR: J. Hilditch

ISSUE:

OI-23 does not discuss a design feature in which the RHRSW header low pressure alarm does not activate when only the 1 RHRSW (swing) pump is supplying water to a RHR system header.

REQUIREMENT:

Procedural guidance and requirements should be consistent with system design.

DISCUSSION:

Based on a review of elementary diagram 0-45E614-7, it appears that the RHRSW header low pressure alarm (2-PA-23-4, et al.) does not activate when only the 1 RHRSW (swing) pump is supplying water to the RHR system header and a low pressure condition occurs. OI-23 does not appear to address this design feature.

CONTACTS: Johnny Dollar

BFN RESPONSE:

OI-23 is being revised to inform the operator that the RHRSW Low Pressure Alarm will not activate when only the #1 RHRSW pump is supplying the system header. See attached procedure change request.

EVALUATION OF BFN RESPONSE:

The response is acceptable.

REVIEWED BY: ______________________

SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: OPS-04

REVISION: 1

DATE: May 26, 1995

INSPECTION AREA: Operations

INSPECTOR: J. Hilditch/R. Norman

ISSUE:

BFN's response procedures to a high lake elevation condition (flood) are weak or incomplete.

REQUIREMENT:

Procedural guidance and requirements should be consistent with system design.

DISCUSSION:

The probable maximum flood level for the BFNP site is 572.5 feet. This flood level results in the intake structure being completely surrounded by water up to 7.5 feet deep. Some procedures directing BFN's response to a high lake elevation condition (flood) are weak or incomplete. For example:

1. Flood Above Elevation 565' Procedure (0-AOI-100-3)

a. Step 4.2.3 directs that when water begins to run across the top of the CCW pump deck at Elev. 565, then all units are to be placed in cold shutdown. It is possible that when water spills over the CCW pump deck, the traveling screens may no longer be functional. As a result, debris from the river may enter the forebay unimpeded. The RHRSW/EECW pumps are required for cold shutdown; thus, the RHRSW pumps will be operating. Any debris in the forebay could foul the RHRSW pump impeller strainer and the EECW discharge strainers. The procedure does not discuss possible operator recourse.

b. The procedure does not discuss the means to respond to a RHRSW system alarm which requires an inspection of the RHRSW pump rooms during a flood condition.

c. The procedure does not discuss the possibility that the high pressure fire protection system may not be functional once the water spills over the CCW pump deck into the intake structure (this could disable the electric motor), and over the fire diesel pump structure (which could disable the fire diesel pump).

d. Step 4.2.5 directs that all water-tight doors, bulkheads, manholes, and equipment hatches below Elev. 578 ft be verified closed or sealed. According to BFN's response to SWSOPI Action Item 040, the BFN safe shutdown analysis assumes that the operators "verify closed and sealed" the diesel building drain check valves; therefore, the check valves are not considered a single failure point. BFN's response to SWSOPI Action Item 011 indicates that there are no sealing requirements associated with the check valve because they are designed to open with a cracking pressure of 1 psi. Based on the team's walkdown and interviews with AUOs, the Unit 3 diesel building drain pipe check valves are difficult to "verify closed and sealed" in a timely manner. Tack welded grating prevents easy access to the check valves for visual inspection.

e. The procedure does not discuss the possible interactions between the raw cooling water system, the control air system, and the RHRSW system when Steps 4.2.28 and 4.2.29 direct the operators to secure the RCW pumps and the control air compressors during a flood condition. For example, the remaining RHRSW pumps assigned to the EECW headers will automatically start on a RCW system low pressure signal; valves 2,3-FCV-67-50 automatically open to supply EECW to the RBCCW coolers on the loss of RCW header pressure only if control air pressure is available to the valves.

f. The AOI does not refer to the Emergency Plans Implementing Procedures until Step 4.2.33. The team would expect that the Emergency Plans would be implemented before the lake level is at 564 feet.

2. Lake Elevation High Alarm, LA-23-75, Window 9 (1-ARP-9-20A)

a. This alarm annunciates only in Unit 1. The ARP does not direct the Unit 1 operators to inform the other units of the problem.

b. Step 2.b. in the ARP appears to prompt operator action when the lake is at the 558 foot level, but the alarm setpoint is set at the 564 foot level. BFN's response to SWSOPI Action Item 050 shows that the Unit 1 operator verifies lake level <558 feet once per shift in accordance with 0-GOI-300-1, Attachment 2. The GOI prompts the Unit 1 operator to have the doors and hatches listed in 0-AOI-300, Attachment 1 and 2 "verified closed and sealed." However, there is no operator prompt to enter the ARP or the remainder of the AOI until the 564 foot alarm annunciates. Also, the GOI does not direct the Unit 1 operators to inform the other units of the situation.

CONTACTS: Johnny Dollar
Frank Loscalzo
Howard Crisler
Gary McConnell

BFN RESPONSE:

Response 1A: 0-AOI-100-3 is being revised to caution the operator to monitor RHRSW system parameters closely during flood conditions because of the potential for plugging of pump suction strainers. See attached Procedure Change Request.

Response 1B: 0-AOI-100-3 is being revised to add that during flood conditions, observation of the RHRSW pump rooms may be accomplished from the grating above the rooms, and if entry is required, Maintenance will request to remove the grating. See attached Procedure Change Request.

Response 1C: 0-AOI-100-3 is being revised to inform the operator that the diesel fire pump may be unavailable during flood conditions. See attached Procedure Change Request.

Response 1D: 0-AOI-100-3 is being revised to clarify that the Diesel Generator Building drain pipe check valves may be verified closed and sealed from inside the building. See attached Procedure Change Request.

Response 1E: 0-AOI-100-3 is being revised to allow the Assistant Unit Operators to inspect the Unit 3 Diesel Generator Building drain pipe check valves by removal of the grating to ensure they are closed. The Unit 1/2 Diesel Generator Building drain pipe check valves have a design which is verifiable from the grade elevation. These actions are initiated when Wheeler Lake elevation reaches Elevation 558.0 feet. This is 7 feet below the grade elevation at the valve pits.

Response 1F: 1-XA-55-20C-9 is being revised to reference the Emergency Plans Implementing Procedures. See attached Procedure Change Request.

Response 2A: 1-XA-55-20C-9 is being revised to add the requirement for the Unit 1 operators to notify the other unit operators. See attached Procedure Change Request.

Response 2B: 0-GOI-300-1 is being revised to require notification of the SOS and other unit operators. In addition, the last half of "Attachments 1 and 2 for affected equipment" is being deleted from Attachment 2 which directs the operator back into 0-AOI-100-3. See attached Procedure Change Request.

It is BFN's intent to enter the ARP only as the result of an alarm and specifically at the 564 foot alarm point.

EVALUATION OF BFN RESPONSE:

The responses are acceptable.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: QA/CA-01

REVISION: 1

DATE: May 18, 1995

INSPECTION AREA: Quality Assurance/Corrective Actions

INSPECTOR: C. Jansing

ISSUE:

Corrective Actions on PERs BFPER940247 and BFPER940337.

REQUIREMENT:

SSP 3.4 requires that conditions adverse to quality be documented and dispositioned on a PER.

DISCUSSION:

BFPER940247 was written to document issues on the ability of check valves 0-40-3, 0-40-519, and 0-40-520 to protect the diesel generator buildings from a design basis flood. These check valves are located on the common drain lines for each of the diesel generator buildings. The Engineering response to Apparent Cause and Corrective Action was referenced to be done under BFPER940337. It was found that BFPER940337 did not provide corrective action/disposition for the single failure concerns during a design basis flood as required by BFPER940247.

CONTACTS: T. M. Mingus

BFN RESPONSE:

BFPER940337 has been revised to incorporate the disposition for the condition found in BFPER940247.

EVALUATION OF BFN RESPONSE:

The response is acceptable.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: QA/CA-02

REVISION: 1

DATE: May 18, 1995

INSPECTION AREA: Quality Assurance/Corrective Actions

INSPECTOR: C. Jansing

ISSUE: Previous assessment findings were not adequately addressed.

REQUIREMENT:

BFN assessment and audit findings will be appropriately addressed by either implementing the required actions or providing justification for no action.

DISCUSSION:

The implementation of SSP 13.5 was reviewed by conducting interviews with site personnel responsible for SSP 13.5 actions. It was found that SSP 13.5 was not being fully implemented at BFN. The details on the level of implementation are addressed in SWSOPI Observation MAINT-003.

The fact that SSP 13.5 was not being fully implemented was previously identified in the May 18, 1993, "Corrosion Control Program Assessment Results for TVA Operating and Active Construction Nuclear Sites" (RIMS L29 930524 800). This report identified that BFN "has not completely fulfilled a commitment to NRC regarding the MIC program which states that 'retrievable corrosion coupons and monitors are planned for installation to evaluate MIC and control techniques' by February 28, 1990." The report also identified that only limited inspections have been performed in accordance with SSP 13.5.

CONTACTS:
Ed Kirby - Tech Support
Keith Niesmith - Site Chemistry
Frank Loscalzo Site - Engineering
T. M. Mingus - Corrosion Specialist

BFN RESPONSE:

Corporate Engineering generated a report that stated BFN had not met a NRC commitment; See attached report RIMS L29 930524 800 (Page 10). This was not generated by BFN Site Licensing and only reflects an opinion. The commitment in question states, "Retrievable corrosion coupons and monitors are planned for installation to evaluate MIC and the control techniques." The susceptible systems that were identified at that time were High Pressure Fire Protection Piping (HPFPP), Emergency Equipment Cooling Water (EECW), and Residual Heat Removal Service Water (RHRSW) systems. The HPFPP coupon monitoring system was installed under EDCN 9446a, EECW was installed under WDCN 17010a, and RHRSW was installed under WDCN 17046a, the cover sheets for each are attached. The NCO items are NCO880204002 and NCO880204008, and are attached. Included is some of the reports on the HPFPP system where coupons were installed. The results are dated August 1991 and October 1992, which reflects the installation of monitors. The remaining systems have coupon data starting in January 1994, which reflects the installation of the remaining monitors.

In summation, the original commitment was scheduled to be implemented in February 1990; however, it was extended to the U2C6 refueling outage (1993). The extension was performed utilizing the appropriate methods. The February 1990 date was self-imposed by BFN. Therefore, the commitment has been implemented and closed.

EVALUATION OF BFN RESPONSE:

In response to Inspection Observations MAINT-03 and QA/CA-02, BFN stated that the system engineer can submit inspection samples as needed. The team found that inspections should be documented to establish trends and verify program effectiveness. In addition, BFN's response to GL 89-13 committed to cleaning and inspection. Documentation of these inspections is required to demonstrate compliance.

The team concurs with the TVA response concerning the installation of corrosion coupons. However, no corrosion data for the EECW and RHRSW system was presented prior to January 1994. This indicates that the commitment for monitoring the EECW and RHRSW was not met until January 1994.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: QA/CA-03

REVISION: 1

DATE: May 22, 1995

INSPECTION AREA: Quality Assurance/Corrective Actions

INSPECTOR: C. Jansing

ISSUE:

Extent of Condition on PERs BFPER941156 and BFPER950286.

REQUIREMENT:

SSP 3.4 allows the Management Reviewer or the Management Review Committee (for level A and B PERs) to indicate if Generic Reviews at other TVA sites are required.

DISCUSSION:

The piping in two of the Unit 3 RHRSW loops had experienced excessive corrosion, causing a loss of piping wall thickness. This was documented and reworked under BFPER941156. BFPER941156 did not require offsite generic review or extent of condition evaluations to be done. SWSOPI Action Item #13 questioned why other BFN or TVA plants would not be affected.

The response was that BFPER950286 was written to address BFN Unit 1 and that the other TVA sites operating status did not lend themselves to this potential problem.

Because the other TVA sites (SQN, BLN, and WBN) either could be in, have been in, or are potentially in layup conditions, this condition could potentially apply to those units.

The team believes that other TVA sites and system engineers could learn from what happens when systems are not in proper layup for extended periods of time, regardless of whether the same conditions may exist at those facilities today.

CONTACTS: William Crouch, Site Engineering

BFN RESPONSE:

BFPER941156 has been revised to upgrade it to Level B and to include the requirement for offsite generic reviews. This action was completed 5/10/95. Please refer to the attached copy.

EVALUATION OF BFN RESPONSE:

The response is acceptable.

REVIEWED BY: ______________________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: MAINT-01

REVISION: 2

DATE: May 17, 1995

INSPECTION AREA: Maintenance

INSPECTOR: S. F. Kobylarz

ISSUE:

Control of Transient Materials in Safety-Related Areas

REQUIREMENT:

Site Standard Procedure SSP-12.7, Revision 7, Housekeeping/Temporary Equipment Control

DISCUSSION:

On April 19, 1995, scaffolding material, a scaffold, and a ladder were observed in the Unit 3 diesel generator (DG) A and B areas stored behind or adjacent to safety-related equipment.

In DG A, the scaffolding material found stacked next to 3-LPNL-925-0659A could tip and fall against the panel. In DG B, an unsecured scaffold was found between the protective relay cabinet and the electrical control cabinet, but no permit was hung. Also, scaffolding material was found adjacent to panel 3-LPNL-925-0659B, and an unsecured ladder was found stored behind the same panel.

SSP-12.7 provides requirements in Section 3.5 for the restraint of items that are unattended and required for intermittent ongoing work. However, the material in question, scaffolding and ladders, appears to be excluded in Section 3.3, which invokes procedure 0-TI-264, Temporary Instruction for Scaffolds and Temporary Platforms. 0-TI-264, Revision 7, does not provide instructions for the storage of unattended transient scaffolding materials or ladders that could impact safety-related equipment. Regardless of which procedure applies, transient scaffolding materials and ladders should be treated like other materials that may be unattended, and appropriately restrained so as not to impact surrounding equipment.

PER 95-0461 was written to evaluate the procedural requirements for unattended scaffolding components.

Scaffolding permits were found hung for scaffolds installed in the Unit 3 DG C and D areas. The scaffolds in those areas were found secured.

On April 26, 1995, Genie lifts were observed in Unit 1/2 DG room "A", approximately 3 feet from the generator neutral cabinet 0-LPNL-925-0659A, and in DG room "D", approximately 4.5 feet from cabinet 0-LPNL-925-0659D. In the "A" room, Genie Personnel Lift Model No. PL-18M was found with In Use Tag 82193 (11-2-94). In the "D" room, Genie Easy Up Model EU-15M was found with In Use Tag 82195 (11-2-94). The lifts were unattended and no work was observed in progress in either location. No wheels on either lift were found to be chocked. Two wheels minimum on each are required to be chocked by SSP-12.7, Section 3.3.3.B.

CONTACTS:

Eric Predmore
Jody Black
Gary McConnell

BFN RESPONSE:

BF PER 95-0461 (categorized Level C) was written to address the procedural controls for unattended scaffolding components. Initial review of the associated procedures indicates that unassembled scaffold components should be controlled by the housekeeping procedure until they are assembled. This would basically classify them as transient material, require proper storage with regard to adjacent safety-related equipment, and would require identification with In-Use tags when left unattended. The corrective action for the PER will be to clarify the Exception given in SSP-12.7.

Additionally, the exception in SSP-12.7 incorrectly notes that "The specific requirements for scaffolding and ladders are given in 0-TI-264." Ladders are not addressed by 0-TI-264, Scaffolding and Temporary Platforms, and were never actually exempted from the requirements of the housekeeping procedure. Proper use of ladders by plant employees is addressed by the Nuclear Power Health and Safety Manual, and Item 4 of the SSP-12.7 housekeeping checklist is for ladders to be properly stored. This deficiency was not initially noted in the problem description of the PER, but will be described in the proposed corrective action plan.

BF PER 95-0484 (categorized Level D) was written to address the personnel lifts found with unchocked wheels in the DG rooms. Immediate corrective action taken was to chock the wheels, and subsequently, remove the lifts.

EVALUATION OF BFN RESPONSE:

The response is acceptable.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: MAINT-02

REVISION: 1

DATE: May 22, 1995

INSPECTION AREA: Maintenance

INSPECTOR: J. Hilditch/G. Overbeck

ISSUE:

Maintenance and Tech Support personnel have not received adequate training on the proper techniques for documenting the results for internal inspections of the EECW and RHRSW systems.

REQUIREMENT:

Generic Letter 89-13, Action V requires, in part, that personnel involved with the inspection and maintenance of raw service water systems receive adequate training (GL 89-13, Action V).

DISCUSSION:

BFN relies upon visual inspection and cleaning in lieu of testing for most GL 89-13 heat exchangers and coolers. SSP 13.5 requires the Maintenance personnel to notify the system engineer when systems affected by fouling and corrosion are opened. The team found that for raw water system components, the work procedures do call out the need for the system engineer to inspect the component internals prior to the component being cleaned.

The team recognizes that the system engineer cannot personally inspect every raw water system opening; thus, others must perform the actual inspection. However, the person who performs the inspection must have knowledge of what to look for, how to obtain MIC samples, and how to adequately document the inspection for future evaluation by the system engineer and/or others.

The team expected to find a well documented training file, but none was found. The team found that, in many instances, the people performing the internal system inspection never had any formal training in raw water system corrosion. As a result, the inspection results are

generally poorly documented. The team also noted that the system engineer does not record his own inspection results. The poor documentation of the inspections makes future assessments of the degradation of the service water system based on inspection reports difficult.

The BFN response to Action Item 16 indicated that a formal training program was attempted at one time, but was discontinued to meet other priorities and never resumed. As a result, it appears to the team that formal training has never occurred for a wide spectrum of people. Consequently, BFN relies heavily on the Technical Support Group's OJT knowledge to perform the internal component inspections in raw water systems. This OJT knowledge base is very perishable due to normal personnel attrition, and thus can be easily lost.

This observation contributes to the team's concern of the adequacy of the inspection and cleaning program for the service water systems in lieu of testing.

CONTACTS: John Woodard
Gary McConnell

BFN RESPONSE:

NRC Recommended Action V to Generic Letter 89-13 stated:

> "Confirm that maintenance practices, operating and emergency procedures, and training that involves the service water system are adequate to ensure that safety-related equipment cooled by the service water system will function as intended and that operators of this equipment will perform effectively. This confirmation should include (within the past 2 years) reviews of practices, procedures, and training modules. The intent of this action is to reduce human errors in the operation, repair, and maintenance of the service water system. This confirmation should be completed before plant startup following the first refueling outage beginning 9 months or more after the date of this letter. Results should be documented and retained in appropriate plant records."

As stated, the intent of the training requirement is to reduce human errors in the operation, repair, and maintenance of the service water system. The chief concerns relative to MAINT-02 appear to be:

- Personnel performing raw water inspections have the knowledge of what to look for, how to obtain MIC samples, and how to adequately document the inspection for future evaluation by the system engineer and/or others.

- Personnel performing the internal inspection have incomplete or no formal training in raw water system corrosion and biofouling.

- It appears to the SWSOPI team that formal training has not yet been completed for a wide spectrum of personnel involved in GL 89-13 activities.

- OJT is relied on for internal inspection of water systems by Technical Support. This OJT knowledge can be lost due to normal attrition and OJT does not assure minimum expertise resides in each individual.

- Concern MAINT-02 contributes to the team's concern relative to BFN's inspection and cleaning program in lieu of testing.

The guidelines and requirements for raw water inspections, evaluations, MIC sampling requirements, and inspection documentations are contained in SSP-13.5 and are considered inclusive. Prior to the approval and implementation of SSP-13.5, the inspection and evaluation of raw water systems was performed by one of two corrosion specialists in the Nuclear Engineering (Design) group. To provide an "in-plant" contact for corrosion inspections, the lead engineer for raw water and fire protection systems was designated to study under the corrosion specialists and receive as much OJT as possible. This assignment continued for more than one year with the Technical Support engineer understudying the corrosion specialist. The corrosion specialists left BFN and the current corrosion specialists assumed programmatic responsibilities for BFN. Again, the Technical Support engineer and corrosion specialist worked closely to "baseline" the corrosion specialist's knowledge of BFN raw water problems. At the same time, a second Technical Support engineer was designated to begin understudying raw water system problems. This provided two individuals with extensive knowledge of BFN raw water systems, their specific nuances, and a historical perspective of the systems. In addition, with the corrosion specialist and two engineers providing corrosion inspections, the site was provided both quality and consistency of inspections.

The initial SSP 13.5 was prepared by Corporate, the two raw water system engineers and the corrosion specialist, and had a 6-month implementation delay for the purposes of training and familiarization by site personnel. During this period, another (the third) Technical Support engineer began OJT under the OJT-trained system engineers. Also, during this period, the originally trained raw water system engineers wrote the specifications and cost justification for the BFN raw water chemical treatment program. These specifications were later adopted by TVA for the chemical treatment program of all sites, which lends credibility to the engineer's training and background in raw water program issues.

As stated in the Technical Support answer to SWSOPI Action Item 016, the Raw Water System Group has three engineers who perform all raw water evaluations. This number

assures that all expertise will not be lost nor will any one individual be overworked relative to these evaluations. Although some raw water expertise has been lost due to attrition, Technical Support has always maintained a minimum of three system engineers qualified by experience, industry contact, and OJT to perform raw water evaluations. When attrition of experience has occurred, neither the program nor the quality of evaluation has been diluted. In addition, these engineers provide a focal point for all individuals who may be performing raw water inspections.

Technical Support believes the current contingent of system engineers who have 17, 15, and 11 years of experience; participate in raw water task force efforts and programs; and work closely with the site corrosion specialist has been adequate to ensure quality evaluations of raw water fouling and corrosion in support of GL 89-13 commitments.

The new raw chemical treatment program has a provision that will provide corrosion training by the vendor and be tailored to TVA needs. TVA elected to exercise the training option in 1993. This formal corrosion training program is expected to be complete by mid-June 1995 and ready for TVA review. If there are no comments, then formal training is expected to begin in August 1995. This would complete any formal corrosion training required by TVA.

EVALUATION OF BFN RESPONSE:

The TVA response is acceptable. However, the team notes that the intent of a formal training program is to assure that there is uniformity in reporting similar conditions during inspections that will enhance trending of these conditions.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER:	MAINT-03
REVISION:	1
DATE:	May 18, 1995
INSPECTION AREA:	Maintenance
INSPECTOR:	Charles Jansing

ISSUE:

Site procedure SSP 13.5 "Raw Water Fouling and Corrosion Control Program" is not being fully implemented at BFN.

REQUIREMENT: Implement procedure SSP 13.5.

DISCUSSION:

The level of implementation of SSP 13.5 was reviewed by conducting interviews with site personnel responsible for SSP 13.5 actions and reviewing the available trended data. It was found that SSP 13.5 was not being fully implemented, based on the following:

1. No site organization had documented inspections on SSP-254 and SSP-255 forms. Inspections that were done under a work plan were pass or fail, and then signed off in the work plan.

2. At present, UT and RT inspection techniques are done only on a case-by-case basis at BFN. At Sequoyah and other nuclear plant sites, scheduled RT or UT inspection techniques are performed as a diagnostic tool in determining pipe wall diameter reduction and MIC pitting. SSP 13.5, step 3.4.2, Detection and Monitoring, says that these RT and UT inspections "should" be made.

3. System flow rate, residual biocide or TRO, corrosion rates, product injection rates, inspection findings, river water temperatures, MIC water samples, etc. are not taken, recorded, and data maintained on a regimented basis to allow proper trending as required by SSP 13.5. Engineering personnel did not know if this raw water system data was available or not.

CONTACTS:	Ed Kirby	- Tech Support
	Keith Niesmith	- Site Chemistry
	Frank Loscalzo	- Site Engineering
	T. M. Mingus	- Corrosion Specialist
	Fred Friselleo	- Site Engineering

BFN RESPONSE:

Item 1

Site engineering performs corrosion monitoring sample transmittals on an as needed basis per SSP 13.5, Section 3.4.2.2. The raw systems are prone to have microbial activity and nodules, biofilm, and deposits are expected. Therefore, Section 3.2.C of the procedure allows the system engineer to submit samples as needed.

Item 2

RT of selected welds are scheduled to be performed prior to each outage, the results are attached. A population shall be examined prior to start of cycle eight refueling outage. the RT is used to determine MIC growth and the effectiveness of chemical treatment. RT can only be used to determine if there is some structural damage in austenitic stainless steel welds. In carbon steel piping only microbial activity can be detected, but not reduction in wall diameter. Since RT reads only shades of gray, a very qualitative remaining wall thickness can be obtained.

This information is retained in a history file and these welds are radiographer during each refueling outage. The new RT results are then compared to the previous outage results and evaluated for potential MIC growth and not utilized for wall loss.

Item 3

All the site chemistry requirements contained in SSP 13.5 to ensure the relevant parameters are within the required specifications are implemented. Previous treatment of raw water system (EECW, RCW, HPFP) was in accordance with TI-110, Emergency Equipment Cooling Water Chlorination and 0-SI-4.11.B.1.d, Biocide Addition to Raw Cooling Water System and High Pressure Fire Protection System (reference attached) EECW treatment, with the addition of Calgon as a chemical partner, is now in accordance with CI-137, which includes RHRSW.

Corrosion rates are monitored by use of coupons on raw water systems (HPFP, EECW, RHRSW) with results evaluated and trended by Site Engineering (referenced attached). MIC samples are also collected and analyzed with results transmitted to Site Engineering for

evaluation and trending on raw water systems (reference attached samples). River temperatures/clam counts to determine the optimum times for treatment are captured in CI-137 which is based on a five year study performed by personnel from the onsite Toxicity Testing Laboratory (TTL) (RIMS memo R46 940531-813).

Not only are SSP 13.5 requirements implemented, but all Generic Letter 89-13 commitments are met. Other parameters, although not required by SSP 13.5 (i.e., system flowrates, product injection rates), are maintained.

EVALUATION OF BFN RESPONSE:

The response is acceptable. However, the team noted that no corrosion data for the EECW and RHRSW system was taken prior to January 1994, which indicates that the commitment for monitoring the EECW and RHRSW systems was not met until that time. Documentation of raw water system inspections is required to establish trends, effectiveness of the program, and to document compliance with BFN GL 89-13 commitments.

REVIEWED BY: ______________________
SWSOPI Team Leader

BROWNS FERRY NUCLEAR PLANT

SERVICE WATER SYSTEM OPERATIONAL PERFORMANCE INSPECTION

INSPECTION OBSERVATION

OBSERVATION NUMBER: MAINT-04

REVISION: 1

DATE: May 16, 1995

INSPECTION AREA: Maintenance

INSPECTOR: J. Hilditch

ISSUE:

Two EECW header low pressure alarms are not being set in accordance with the BFNP scaling and setpoint document.

REQUIREMENT:

Procedural guidance and requirements should be consistent with system design.

DISCUSSION:

Pressure switch 0-PS-67-023(024) activates the EECW north (south) header pressure low alarms, 3-PA-67-23(24).

The BFNP scaling and setpoint documents for the "EECW North (South) Header Section Unit 2 to Unit 3 Pressure" instrument, 0-PS-67-23(24), require that the pressure switch be set at 37 (48) psi, dec. However, Maintenance Procedure LCI-0-P-67-023(024) sets these pressure switches to 40.5 psi, dec.

CONTACTS: Gary McConnell

BFN RESPONSE:

The setpoint for 0-PS-67-23 is correct when corrected for elevation. The setpoint for 0-PS-67-24 is incorrect in the non-conservative direction. The instrument was last calibrated on 7/20/94 with the current revision of the procedure being issued 7/19/94. Work Request (WR) C-186952 has been generated to re-calibrate the instrument. BFPER 950567 has been written to address the issue.

EVALUATION OF BFN RESPONSE:

The response is acceptable.

REVIEWED BY: ______________________
SWSOPI Team Leader