U. S. NUCLEAR REGULATORY COMMISSION
REGION 1

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LICENSEE:	Baltimore Gas and Electric Company
FACILITY:	Calvert Cliffs Nuclear Power Plant, Units 1 and 2 Baltimore, Maryland 21203
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EXECUTIVE SUMMARY

The objective of this inspection was to perform a limited scope service water system operational performance inspection and assess the licensee's planned and completed actions taken in response to Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment." The inspectors performed a detailed inspection of the service water system design area. The other NRC functional areas of operations, maintenance, testing and surveillance, and quality assurance and corrective actions received a lesser review. The inspectors used the inspection guidance provided in Temporary Instruction 2515/118, "Service Water System Operational Performance Inspection." Prior to this inspection, the licensee had performed two service water self-assessments using this inspection guidance. The inspectors thoroughly reviewed the licensee actions taken in response to these self-assessments.

The inspectors concluded that the service water systems at Calvert Cliffs were satisfactorily designed and capable of performing their safety functions. To assure the proper design of their service water systems, the licensee has made significant resource commitments. For example, major modifications involving the replacement of the cement lined salt water piping with carbon steel, rubber-lined piping have been installed. Several unresolved design issues were identified. For example, regarding the service water heat exchanger operability margin issue, the licensee had not completed a new transient analysis being performed to support an increase of the current 78°F Chesapeake Bay water temperature limit. The inspectors also identified several design-control process issues that were considered to be of minor safety significance. However, no new major safety-significant issues were identified regarding the design of the service water systems. The inspectors concluded that this was a positive indication that the licensee had taken aggressive actions at Calvert Cliffs regarding the industry-wide problem involving the design of safety-related cooling water systems well in advance of the issuance of Generic Letter 89-13.

In the other functional areas reviewed, the inspectors concluded that the operations aspects concerning the service water systems at Calvert Cliffs were satisfactory. Although several weaknesses were identified concerning the lack of periodic maintenance for instrument lines and automatic vents, the inspectors observed that the licensee was accomplishing effective maintenance on service water system components. The licensee had performed extensive testing to evaluate heat exchanger capability and establish appropriate corrective actions. The inspectors noted the lack of a formal (continuing) heat exchanger test program, and the licensee agreed to establish one by June 30, 1994. The licensee had established a comprehensive corrective action program to track the resolution of all findings developed during the prior service water self-assessments. The inspectors considered that this corrective action program afforded good administrative tracking of all open issues.

The inspectors considered that licensee self-assessments were thorough and covered all areas comparable to a full NRC service water system operational performance inspection. Although several unresolved items related to service water issues were identified during this inspection, the inspectors had no concerns regarding the licensee's actions taken in response to Generic Letter 89-13. The inspectors concluded that the licensee's service water self-assessments should be considered as an appropriate alternative to a full NRC service water system operational performance inspection.

The following unresolved items were identified:

(1) Reanalysis of bay water temperature limit (Section 3.2);

(2) Preventive maintenance for horizontal instrument lines susceptible to fouling, and safety-related automatic air vents (Section 5.2);

(3) Formal periodic test program for safety-related heat exchangers (Section 6.1); and

(4) Bases for excluding manual and air-operated valves from IST program (Section 6.2).

DETAILS

1.0 INTRODUCTION AND INSPECTION SCOPE

Numerous problems identified at various operating plants have caused concerns regarding the ability of service water systems (SWS) to perform their design function. These problems have included: inadequate heat removal capability, biofouling, silting, single failure concerns, erosion, corrosion, insufficient original design margin, lapses in configuration control or improper 10 CFR 50.59 safety evaluations, and inadequate testing. The NRC issued Generic Letter (GL) 89-13, "Service Water System Problems Affecting Safety-Related Equipment," requesting that licensees take certain actions related to their SWS. These actions included establishing the appropriate frequencies for testing and inspecting safety-related heat exchangers over three operating cycles to ensure the operability of SWS that are credited for cooling safety-related equipment. The NRC also issued Temporary Instruction 2515/118, "Service Water System Operational Performance Inspection" (SWSOPI), to assess the licensee's planned or completed actions in response to GL 89-13.

Baltimore Gas and Electric (BG&E) performed two separate SWS self-assessments in June/July and August/September 1993, respectively. Each self-assessment was comprised of personnel from all the engineering disciplines. On August 5, 1993, BG&E made a presentation to the NRC in Region I wherein they requested the NRC to consider their upcoming SWS self-assessment as an alternative to a full NRC SWSOPI. The NRC denied this request on August 12, 1993, stating that the licensee's proposed self-assessment did not meet all the requirements for the NRC's program for the acceptance of such requests. The NRC informed the licensee that a full NRC SWSOPI was scheduled for February/ March 1994. The licensee performed their second SWS self-assessment in August/ September 1993 and presented these results together with the prior self-assessment during a meeting in Region I on February 1, 1994. BG&E requested the NRC to reconsider its prior decision regarding the conduct of a full NRC SWSOPI. Based on this information, the NRC informed the licensee that a limited scope SWSOPI would be performed where the NRC would focus its inspection in the SWS design area.

The inspectors performed a comprehensive inspection of the mechanical design area comparable to that expected during a full SWSOPI. The other inspection areas of operations, maintenance, surveillance/testing, and quality assurance/corrective actions received a lesser review. The inspectors also thoroughly reviewed how the licensee was resolving the various findings from its prior SWS self-assessments. The results of these inspection activities are described below.

2.0 SYSTEM DESCRIPTIONS

The safety-related cooling water systems at Calvert Cliffs are comprised of the salt water (SW), service water (SRW), and component cooling water (CCW) systems for which the following information is applicable to either Unit 1 or 2. The SW system is a raw water system that supplies cooling water to the heat exchangers (HXs) in the closed loop SRW and

CCW systems. Figures 1, 2, and 3 are enclosed and provide simplified schematics of the SW, SRW, and CCW systems respectively. These schematics are notated to illustrate the surveillance test procedures (STPs) conducted by the licensee.

2.1 Salt Water System

The SW system is a once-through system that supplies cooling water to the following major safety-related components:

- CCW heat exchanger (HX) tube side that provides heat removal from the CCW system,

- SRW HX tube side that provides heat removal from the SRW system, and

- emergency core cooling system (ECCS) room coolers that provide heat removal from the equipment and piping housed in the ECCS rooms.

The SW system also provides cooling water for two small nonsafety-related loads, namely the circulating water pump seals and the condenser tube "bulleting" system that forces a wire brush (bullet) through the tubes to clean them. There were no interconnections between the SW systems for each unit. The ultimate heat sink (UHS) for the SW system is the Chesapeake Bay. The SW system consists of two subsystems with one subsystem needed to provide all safety-related services. There are three SW pumps, each rated for 15,500 gpm at 82 ft. discharge head. Only one pump per subsystem is required; the third pump can be manually aligned to either subsystem. Each subsystem provides cooling to one set of the HXs listed above and is designed to remove the accident heat loads. During normal system operation, both subsystems may be required to operate with flow being throttled to the CCW and SRW HXs based on the heat loads.

The alignment of the SW system during a loss-of-coolant accident (LOCA) is different prior to a recirculation actuation signal (RAS) and after a RAS. The SW system's alignment prior to a RAS requires the closure of the CCW HX inlet and outlet valves in order to maximize the SW flow to the SRW HX. Upon initiation of a RAS, SW flow to the CCW HX is restored that reduces flow to the SRW HX. The safety-related SW air compressors provide air for air-operated valve operation that is required for the system alignment changes.

If a pipe rupture were to occur making the normal overboard line unavailable during the post-accident recirculation phase, the SW system can be manually realigned in an emergency overboard alignment. This flowpath utilizes the supply piping to one of the subsystems as an alternate discharge path to the UHS.

2.2 Service Water System

The SRW system is a closed loop system that provides cooling water to the following major safety-related components:

- SRW HX shell side that provides the heat transfer to the SW system;
- emergency diesel generators (EDG) combustion air, jacket water and lube oil coolers;
- containment air coolers (CAC) that provides containment heat removal; and
- spent fuel pool (SFP) cooling HXs.

The SRW system also provides cooling water to various nonsafety-related loads in the turbine building. The SRW system is comprised of the common piping network, with the essential components separated into two subsystems with only one subsystem needed to provide all safety-related services. The nonsafety-related loads and SFP cooling are automatically isolated during a safety injection actuation signal (SIAS). There are three SRW pumps with each pump rated for 7,050 gpm at 180 ft. discharge head. Only one pump per subsystem is required; the third pump can be manually aligned to either subsystem. During an accident, each subsystem can provide cooling water to two CACs and one EDG. One EDG (EDG 12) can be cooled by the SRW system from either unit.

2.3 Component Cooling Water System

The CCW system is a closed loop system that provides cooling water to the following major safety-related components:

- CCW HX shell side that provides the heat transfer to the SW system;
- shutdown cooling heat exchanger (SDCHX) that provides for decay heat removal; and
- seal cooling and lubrication heat removal for the low pressure and high pressure safety injection (LPSI and HPSI) pumps.

The CCW system also provides cooling water to various nonsafety-related loads. The nonsafety-related loads are automatically isolated during a SIAS. Unlike SRW, the CCW system essential components are not separated into two subsystems, but into two redundant interconnected headers. There are three CCW pumps, each rated for 5,000 gpm at 100 ft. discharge head. Only one pump is required to provide all safety-related services following a LOCA. Since the system is comprised of a common piping network, any operating pump will provide recirculation through both interconnected headers that contain the HXs listed above. Consequently, CCW will be circulated through the HXs with and without heat removal duty. The third pump can be manually aligned to receive power from either EDG.

3.0 MECHANICAL DESIGN REVIEW

The mechanical design review of the SW, SRW, and CCW systems at Calvert Cliffs included a determination of whether the systems' design bases, design assumptions, calculations, analyses, boundary conditions, and models met regulatory requirements and licensing commitments. This review also included an assessment of the single failure impact on the systems' ability to perform their required safety functions. The inspectors reviewed selected modification packages. Also reviewed were the SW, SRW, and CCW systems' capability to meet the thermal and hydraulic performance specifications during accident or abnormal conditions. The inspectors also reviewed the systems' seismic qualification, design vulnerabilities, and flooding mitigation characteristics.

3.1 Review of Modifications, Calculations, and Safety Evaluations

During this inspection, the licensee was completing the last phase of an extensive modification involving the replacement of the cement lined SW piping with the carbon steel, rubber-lined piping and arranging this new piping to eliminate the undesirable dead legs, which were present in the original SW piping design. These SW system design changes should serve to minimize the silting or biofouling of the SW system. The inspectors observed that the engineering and technical support organization personnel responsible for these modifications were well qualified. The inspectors also concluded that these changes were a positive indication that the licensee had taken proactive measures in the safety-related cooling water systems well in advance of the issuance of GL 89-13. The licensee had included these SW system changes in the flow model but the calibration of the model had not yet been performed. The inspectors considered that the licensee should perform this calibration in a timely manner.

The inspectors reviewed several modification packages, including facility change request (FCR) 93-207, which will modify the controls for the CAC inlet valve closure. The inspectors determined that modifications performed on the SW, SRW, and CCW systems were thorough and contained appropriate safety analyses. The calculations were of good quality and showed in-depth understanding of the problems. The format was very good, with clear problem statements, assumptions, results, and references. Also, the reviewed safety evaluations were of good quality and provided the necessary depth to facilitate the understanding of the issues.

3.2 SRW Heat Exchanger Operability Margin

The licensee performed extensive testing of the heat exchangers (HXs) in the SW, SRW, and the CCW systems, including calculations and evaluation of the uncertainties of test data. A significant example of the results of these efforts included the SRW HXs where the test results and calculations formed the basis for HX operability limits, which were illustrated as a nomogram in the SW System Operating Instruction (OI) 29. This nomogram was derived, based on an assumed (maximum) fixed value for the SRW HX microfouling (layer of deposits inside the tubes) and by using the observed differential pressure (d/p) across the tube side of the HX as an indication of the macrofouling (blockage of the tube sheet). This nomogram enabled plant operators to determine the SRW HX operability as a function of three SW system variables: d/p, flow rate, and bay water temperature. Except as discussed below, the NRC inspectors found application of this nomogram to be conservative.

Evaluation of the uncertainties of test data and findings of the BG&E's service water system self-assessments demonstrated that this nomogram lacked conservatism in two following areas:

- Maximum assumed value of the SRW HX (microfouling), and
- Maximum assumed value of the SRW HX heat load.

The licensee voluntarily reported this information in Licensee Event Report 93-007 since it indicated possible SRW HX inoperability and the information could be beneficial to other licensees.

The following discussion provides the background, current status and proposed actions related to these items. Some of this information was identified in BG&E's service water system self-assessments and is repeated here for full understanding of the items.

The nomogram provided in OI-29 was developed by Calculation M-91-16, Rev. 2 (11/91). Some of the critical assumptions used to develop this nomogram are listed below.

A. The SRW HX fouling factor is 0.0005.
B. CACs are "dirty" and SRW flow rate is at design-basis minimum value.
C. Initial SRW temperature to the CACs is 105°F (steady state).
D. Containment air temperature is a constant value (275°F).

The licensee's uncertainty analysis of the SRW HX test results documented in Calculation M-93-147, Rev. 0 (11/93), revealed that the test uncertainty of the fouling value was 0.00065 for "clean" HXs. Additionally, the licensee obtained independent reviews of their HX testing program by Holtec and input from Dr. Toborek (expert consultant) on the microfouling assumptions. Also, BG&E's self-assessment identified that assumptions B., C., & D. above were not conservative, since they did not maximize heat rejection rate (from containment to SRW HXs) and used a containment air temperature value lower than the predicted peak value.

The licensee revised the nomogram in late October 1993 and established the current 78°F bay water temperature restriction for plant operation. This change was based on the following change to the fouling factor assumption stated above (and no changes to assumptions B., C., & D.). The SRW HX fouling factor was increased from 0.0005 to 0.0012, which was derived as follows: $0.00065 + 0.0005 \approx 0.0012$, where 0.0005 represented the expected change in fouling from clean to dirty between HX cleanings.

The licensee evaluated the impact of the nonconservative assumptions B., C., & D. (used in Calculation M-91-16) in Calculation M-94-13. This calculation was performed for a bay water temperature of 87°F and the following assumptions.

- SRW HX fouling factor was assumed to be 0.0012;
- containment air coolers (CACs) are "clean," i.e., 0.0 fouling;
- initial SRW temperature to the CACs is 95°F, with final temperature of 105°F and a peak transient value slightly in excess of 105°F; and
- containment air temperature was modeled as a transient input from the UFSAR Chapter 14 curve.

The results of this calculation indicated, that the SRW temperature was predicted to peak at approximately 115°F and the duration for which the SRW temperature exceeds 105°F was about 20 minutes. The licensee stated that the SRW system can sustain a transient temperature increase above the limit imposed by the EDG. This position was based on the following information:

- The EDG vendor's (Fairbanks Morse) engineering department evaluated the SRW temperature increase to 115°F for approximately 30 minutes, with a subsequent return to 105°F. This evaluation determined that there was no negative impact on the EDG performance.
- The EDG vendor has allowed operation at 120°F for a similar EDG at another nuclear facility.

The licensee continues to address the low temperature/low margin issue for the SRW HXs. One of the solutions being pursued is FCR 93-207. This modification will limit the flow to the CACs during a LOCA prior to RAS actuation and restore full flow rate after RAS.

During additional discussions concerning the micro/macrofouling issue, the licensee noted that they were pursuing a new transient analysis in order to increase the current 78°F bay water temperature limit. This new analysis will utilize assumptions similar to those in Calculation M-94-13 and also model the reduced flow rates to the CACs to be afforded by FCR 93-207. The licensee indicated that the new analysis may provide for an additional margin. If such margin is realized, the licensee would consider applying it to an increase of the macrofouling allowance, which could result in lowering the frequency of the tube sheet cleaning and, thus, increase the SW header availability.

The NRC inspectors' independent review concurred with the self-assessment findings regarding the low temperature/low margin issue for the SRW HXs. However, the inspectors noted that this issue was significantly impacted by the fact that the value assumed for the

SRW HX tube microfouling (original - 0.0005 and current - 0.0012) had not been verified by a successful as-found test. The inspectors were concerned that the relatively low value of the microfouling assumption leads not only to questionable ability of the SRW HXs to reject the worst case accident loads, but also to a relatively high frequency of the tube cleaning that, in turn, leads to a decrease of the SW header availability.

In conjunction with the licensee's ongoing analyses concerning an increase of the current bay water temperature limit (78°F), the inspectors requested the licensee to consider the following items:

1. These analyses should consider a review of the aggregated impact (frequency of the occurrence and duration) of the service water header unavailability as a function of the assumed macro and microfouling, especially if an as-found test will not been performed to verify the assumed microfouling value. This review should also take into consideration the accuracy of SW d/p readings, given the oscillating nature of indication of the individual pressure gauges used for d/p determination across the SRW HX.

2. Near-term and ongoing work concerning SRW HX operating limits prior to revision of OI-29.

3. Basis of the OI-29 revision should be communicated in a timely manner to allow for review before the bay temperature approaches its current operability limit (78°F).

Pending the licensee's completed analyses discussed above with any associated corrective actions and subsequent review by the NRC, this issue is an unresolved item **(50-317/94-80-01 and 50-318/94-80-01)**.

3.3 Design Control Interface

The inspectors noted the following design control interface process issues regarding actions taken by design engineering and plant personnel during the resolution of plant problems.

The revision of OI-29 to reduce the allowable bay temperature to 78°F was performed without an independent review of the engineering documents used to provide the basis for this revision. Discussions with the licensee indicated that the revision to OI-29 was a temporary and not a permanent change. The intent, as supported by various documents, was to finalize a permanent change with all required calculations well in advance of the onset of the warm bay water temperatures in 1994. The NRC inspectors were satisfied with this response. However, the inspectors considered not obtaining an independent review of the engineering documents prior to incorporation of their results into plant procedures (either permanent or temporary) to be an instance of poor engineering practice, which should not be in general use when transferring engineering information into plant procedures, especially for such changes with significant impact on overall plant operation.

The SRW HX operability margin issue review also revealed that the nomogram derived in the original Calculation M-93-16 and in Plant Deficiency Report (PDR) 93113 did not account for the instrument accuracy of the gauges used for d/p determination. The output from the calculation was adjusted by 0.7 psid ($\{[0.5]^2 + [0.5]^2\}^{1/2}$) prior to incorporation into OI-29. There was no documentation that the results of the calculation had received an appropriate independent review. The inspectors noted that the licensee initiated Issue Report (IRO) IRO-0166-453 for corrective action to be taken.

During the review of design-basis Calculation M-92-15 and the IST Procedure STP-0-73A-1, the team observed that the low action level limit for SW pump 12 used in the calculation marginally exceeded the limit used in the STP. This discrepancy, although minor, was in the nonconservative direction. The licensee's subsequent review discovered several other similar small discrepancies that were all in a conservative direction. A similar observation had been expressed previously by BG&E's self-assessments. In response to the inspectors' concern regarding the need for consistent use of the same design information when used by different groups, the licensee initiated IRO-034-046 for corrective action.

3.4 Other Design-Related Observations

During the NRC inspectors' detailed review of the design area, several items developed that had not been identified previously by BG&E's self-assessments. These items were satisfactorily resolved by the licensee and they are discussed separately below.

3.4.1 Net Positive Suction Head

During the review of the licensee's SW calculations, the inspectors observed that no analysis had been performed for the limiting net positive suction head available ($NPSH_A$) case. The bounding case for the SW $NPSH_A$ determination is a seismic event with the loss of offsite power (LOOP). For the LOOP scenario, the EDG is sequenced to auto start the plant instrument air compressor (and not the salt water air compressor, which would have been started on a "LOCA" signal). Since the plant instrument air system is not seismically qualified, it could not be credited to be available for this case. The fail open, air-operated SW valves would go to a full open position, resulting in a maximum SW flow rate until manual starting of the salt water air compressor provides air for SW valve control.

Based on the results of the licensee's preliminary review of this case, $NPSH_A$ was slightly greater than NPSH-required ($NPSH_R$). Furthermore, even if the final analysis would show that the $NPSH_A$ margin was somewhat lower, the SW pumps would not be expected to sustain any appreciable damage due to the short duration of this event. The inspectors verified with the licensee that operating procedures were in place for which operator actions would be reasonably expected to promptly correct the adverse NPSH condition. The licensee initiated Issue Report IRO-0168-336 to update the affected calculations. The inspectors considered these actions to be adequate.

3.4.2 Potential Loss of CCW

During the review of the in-containment CCW piping, the inspectors identified a containment integrity concern under certain postulated conditions. The postulated scenario assumed that a high energy line break of primary system, such as a LOCA, could lead to a loss of pressure integrity of the adjacent CCW small bore line due to mechanistic effects, such as pipe whip or jet impingement. The consequential failure of the CCW pressure boundary in containment coupled with a single active failure of the CCW containment isolation valve could lead to a loss of containment integrity during a LOCA. The CCW containment penetration is a Type III containment penetration, and it credits a closed system inside containment as one of the containment isolation boundaries. The inspectors expanded this concern to all Type III containment penetrations.

The licensee responded to this concern by noting that the potential for this scenario is unique to CCW system only. All other systems with Type III penetrations are protected by the shield wall inside containment where only the CCW system penetrates the shield wall. If such a break were postulated in the CCW system, it would require that the containment pressure be in excess of the CCW pressure for a containment release to occur. If this situation occurred, the radiation monitors in the CCW system would alert the operator to the source of the breach to enable prompt isolation with the appropriate CCW system isolation valves. The inspectors considered this licensee response to be adequate.

3.4.3 Potential Water Hammer

The inspectors identified a potential water hammer under certain conditions in the SW system that could challenge the system's integrity during a LOCA condition. Prior to a RAS, both outlet and inlet SW isolation valves for the CCW HX are isolated in accordance with plant procedures. These valves are later reopened upon actuation of a RAS. The CCW HX is a high point for the SW system. Depending on the type of event, it could be hours before the actuation of a RAS, which could create the possibility for voiding the HX by draining it through vents, drains, air vents, etc. Under these postulated voided conditions, reopening of the SW isolation valves for the CCW HX could result in the water hamm[illegible]

The licensee responded by indicating that the salt water leakage in the CCW HX rooms is closely monitored to prevent the salt water entering the radioactive drain system. Also, if minor external leakage from the CCW HX was a preexisting condition, it would be compensated for by the internal inleakage through the isolation valves. The inspectors considered this licensee response to be adequate.

3.5 Conclusions

Although an unresolved design issue was identified and the licensee has initiated IROs for corrective actions to be taken for several issues, the inspectors concluded that the SW, SRW, and the CCW system[illegible] [illegible]lvert Cliffs were satisfactorily designed and capable of performing their safety functions. The inspectors also concluded that the absence of significant findings was a positive indication that the licensee had taken aggressive actions regarding industry-wide problems involving the design of safety-related cooling water systems, well in advance of the issuance of GL 89-13.

4.0 OPERATIONS

The inspectors reviewed plant operations to assess operator knowledge and the accuracy and completeness of the SWS operating procedures and training. These reviews were accomplished during plant walkdowns by document reviews and during discussions with plant personnel.

4.1 Operating Procedures

The inspectors performed a review and partial walkthrough of Operating Instructions (OI) OI-29, "Saltwater System," OI-15, "Service Water System," and OI-14, "Circulating Water."

OI-29 was reviewed regarding the abnormal operation of gagging the SW system emergency overboard discharge valve, SW-5149-CV, in the open position. This review included: (1) verifying that the procedures can be performed and that components and equipment are accessible; (2) determining if special equipment required to perform procedures was available and in good condition; and (3) verifying operators knowledge of equipment location and operation. During a walkdown of the OI-29 instructions for gagging SW-5149-CV open, the team observed that some of the special equipment required was not stored in the location specified by the procedure. The inspectors noted that BG&E's self-assessments had identified and documented in Issue Report IRO-0166-554 two similar occasions where tools and equipment necessary to accomplish safety-related activities were improperly stored. The licensee has proposed corrective actions to: (1) identify all tools and equipment required for emergency use on safety-related systems; (2) establish adequate storage for the tool and equipment; (3) establish a program to periodically verify that the tools and equipment are properly stored; and (4) develop and provide continuing training on the location and use of the emergency use tools and equipment, for completion by July 30, 1994. The inspectors concluded that the proposed corrective actions would be comprehensive, if completed. The inspectors discussed the frequency for testing the regulator and calibrating the regulator gages used for gagging open SW-5149. Testing and calibration of the regulators was not being performed. It was also identified that OI-29 specified operating SW-5149-CV with a gas pressure of between 65 and 100 psi, while the maximum working pressure rating for the actuator was 90 psi. The licensee's initial review determined that the operator would not catastrophically fail and would satisfactorily operate at the higher pressure. Additionally, Issue Report IRO-168-313 was initiated to fully review and resolve these issues.

OI-15 was reviewed regarding the abnormal operations of filling SRW head tanks with water from the fire main (FM) and saltwater (SW) systems. The inspectors observed that the

OI-15 instructions for providing FM and SW makeup to the SRW system could be performed. The equipment needed for these operations was accessible, available, and in good condition.

The team reviewed OI-14 and the alarm procedures associated with actions expected in response to fouling of the traveling screens. An alarm is provided to alert the control room operator when excessive d/p exists across the traveling screens, which is sufficient to cause screen rotation. Guidance is provided for directing the operator to stop the circulating water pumps if the screen d/p exceeds predetermined limits. If extreme salt water flow problems were experienced, Abnormal Operating Procedure 7A, "Loss of Saltwater Cooling," provides suitable alternatives for restoring flow. The inspectors concluded that adequate guidance for the operator was included in OI-14 and the control room alarm response procedures.

4.2 Operator Logs

The Unit 1 and 2 turbine building and outside operator logs were reviewed to determine the adequacy of temperature, flow, and differential pressure monitoring to maintain the service water (SRW) system within its design basis.

The turbine building logs are used to record the saltwater system differential pressure, flow, and inlet temperature through the SRW heat exchangers every six hours. These SRW heat exchangers flows and inlet temperatures are used to determine an allowable maximum differential pressure within the design envelope from curves in Operating Instruction OI-29, "Saltwater System." The log requires that the measured value of differential pressure be compared to the maximum allowable differential pressure, which is also recorded in the log for comparison. The inspectors concluded that this was an adequate method for maintaining the SRW system within the currently identified design basis. The inspectors also observed that the log identified that the maximum allowable SRW heat exchanger inlet temperature was identified as 88°F. The inspectors noted that this value was outside the current design envelope and could be confusing. Discussion with operations personnel determined that this was an old maximum temperature value that had not been revised because the maximum allowable value had changed several times during the design-basis reconstitution. The licensee stated that this value would be changed once their initiative to develop a design-basis document for logs, including maximum and minimum values for all log readings, was completed.

The inspectors concluded that the current operator logs were adequate to ensure that the SRW system was operated within its current design basis. The licensee's plan to enhance their operator logs by developing a basis document for the logs with allowable operating limits was considered a good initiative.

4.3 Conclusions

The inspectors concluded that the licensee was taking comprehensive corrective action to assure that the proper tools and equipment would be available for supporting the emergency overboard alignment procedure.

5.0 MAINTENANCE

The inspectors performed detailed system walkdowns to review the material condition of the as-configured systems. The inspectors also reviewed several maintenance procedures for technical adequacy.

5.1 System Walkdown and Pipe Inspections

The inspectors walked down portions of the SW, SRW, and CCW systems, including the intake structure containing the SW pumps and the rooms containing the CCW and SRW pumps/HXs and the ECCS pumps/coolers.

The Unit 2 systems appeared to be in excellent material condition. Discrepancies observed had been previously identified, and discrepancy tags were in place identifying the deficiency. The inspectors sampled several deficiencies and noted that each deficiency identified by a discrepancy tag had been entered into the licensee's tracking system and maintenance work orders had been initiated where appropriate.

The Unit 1 systems were also found to be in very good condition. Unit 1 was in a refueling outage that included the replacement of the above-ground, cement-lined SW system piping with rubber-lined piping. A sampling of existing Unit 1 rubber-lined piping sections opened for inspection were found to be clean in high flow areas. Only small amounts of marine growth were noted in lower flow areas. Maintenance personnel were involved with cleaning and eddy current testing of the SRW HXs. The inspectors also observed the intake bays prior to their cleaning and noted that relatively small amounts of marine growth were attached to the exposed surfaces. The inspectors noted that the intake bays have been routinely inspected and cleaned as part of the preventive maintenance program since 1990. The licensee recognized this action to be a high priority in order to eliminate marine growth at the SW system source and reduce the frequency for cleaning the SRW and CCW HXs.

The underground cement lined piping is cleaned, inspected and repaired during each refueling outage. The inspectors reviewed a videotape of ongoing inspections of this Unit 1 piping. The inspectors observed that the system engineers perform hand-over-hand inspections of the underground cement-lined piping to identify deficiencies requiring repair and to verify the integrity of previously accomplished repairs. Each identified deficiency and repair is logged for the material history and for use during future inspections. Based on the walkdown inspections and the review of the videotape, the inspectors considered these inspections appropriate to maintain the performance, integrity, and reliability of the underground cement-lined SW system piping.

5.2 Review of Maintenance Procedures

The inspectors reviewed the preventive maintenance procedures for the SW system pump and the pump discharge expansion joints. The method for scheduling the preventive maintenance was also reviewed. This equipment was observed during the system walk down to determine its material condition. The inspectors also reviewed the maintenance requirements for the instrument lines and the auto vents in the SW system.

When comparing the preventive maintenance (PM) requirements for the SW system pump against the vendor technical manual, the inspectors found that the vendor PM recommendations were generally incorporated into the PM procedures. One discrepancy identified the amount and frequency of lubricating the pump bearings. The inspectors found that the licensee self-assessment had also identified a similar discrepancy noting that BG&E had used the lubricating of the pump bearings in accordance with manufacturer's instructions on a regular PM schedule as the basis for relief from the ASME Section XI pump testing requirements for measuring bearing temperatures. The inspectors' review of the proposed corrective actions found that the licensee had obtained information to clarify the manufacturer's lubrication instructions and has planned to test these instructions on the Unit 1 SW system pumps prior to returning them to an operable status at the end of the current outage. The inspectors considered these proposed corrective actions appropriate.

From a comparison of the SW system pump expansion joint PM checklist against the technical manual requirements, the inspectors found that the vendor specified inspection attributes had been satisfactorily identified in the PM checklist. The inspectors observed that the maintenance standard, MS-XJ-1, developed for these expansion joints included: critical characteristics, failure history and modes, corrective and repetitive maintenance tasks, and the source and basis for the specified inspection attributes. The inspectors concluded that this maintenance standard was a good procedure.

The inspectors observed two instances where periodic maintenance requirements had not been established for certain safety-related equipment. The inspectors determined that the licensee had not fully evaluated the susceptibility of SW instrument line fouling. No specific flushing requirements had been implemented. The periodicity for instrument line flushing was based on the instrument calibration frequency. Walkdowns of SW pump discharge lines found that the instrument lines to the safety-related pressure switches had long stagnant horizontal runs that were susceptible to fouling. The inspectors learned that these instrument lines in Unit 1 had been clogged several months ago necessitating corrective maintenance. These lines are not checked by periodic maintenance or surveillance. The inspectors noted that this was not consistent with the intent of GL 89-13, which recommended that licensees establish routine maintenance of SW piping and components to ensure that silting and biofouling could not degrade system performance. The inspectors requested the licensee to establish the basis for excluding these and other instrument lines from periodic maintenance or surveillance.

The inspectors also determined that licensee had not established a periodic maintenance or surveillance program for the safety-related automatic air vents. This issue was not identified by the BG&E's self-assessment. Since these components are active devices and perform a safety-related pressure boundary function, the inspectors requested the licensee to establish the basis for excluding these devices from periodic maintenance or surveillance.

Pending the licensee's corrective actions and the NRC's review of the basis for horizontal instrument line maintenance and excluding automatic vents from periodic surveillance/ maintenance, this issue is an unresolved item **(50-317/94-80-02 and 50-318/94-80-02)**.

5.3 Conclusions

The inspectors concluded that the licensee was accomplishing effective maintenance for service water system components. Several minor weaknesses were identified concerning the lack of periodic maintenance for instrument lines and auto vents.

6.0 SURVEILLANCE AND TESTING

The inspectors reviewed certain licensee heat exchanger, surveillance, and in-service testing activities. This included a review of the in-service test (IST) program and its implementation, several test procedures, and the licensee's use of test data for trending.

6.1 Heat Exchanger Performance Testing

The inspectors reviewed the licensee's procedures for periodic testing of safety-related heat exchangers. This review also included discussions with the licensee regarding their actions taken to meet commitments made in response to GL 89-13.

The inspectors determined that initial or baseline testing of the CCW heat exchangers was completed in February 1994 for Unit 1 and January 1993 for Unit 2. This testing was completed between August and October 1993 for the SRW heat exchangers. The licensee completed similar testing of the ECCS Room Coolers during the spring and summer months of 1992 for Unit 1 and 1993 for Unit 2. As noted in Section 3.2, the inspectors considered this HX testing and evaluation of the test results to be extensive. However, the inspectors observed that the licensee had not yet established a formal periodic test program for their safety-related HXs as recommended by GL 89-13. The licensee stated that the development of a continuing HX test program document was scheduled for completion by June 30, 1994. This was confirmed in a licensee position paper, "GL 89-13 Task II Status," dated March 10, 1994. Pending the development of this program and its implementation and review by the NRC, this issue is an unresolved item **(50-317/94-80-03 and 50-318/ 94-80-03)**.

6.2 In-Service Test Program

The inspectors reviewed the surveillance test procedures (STPs), STP-73A-1 and STP-0-65E-1, for the Unit 1 SW system pumps and discharge check valves to verify that the IST program requirements were adequately implemented and the acceptance criteria were consistent with the design basis. The inspectors found that the flow criteria used for the ASME Section XI in-service pump testing did not correspond with the design flow. Discussions with licensee personnel indicated that the IST reference values and action levels for each pump are provided to design engineering so that the corresponding degraded pump curve can be used in the system flow model calculation to determine the system design basis. Using this methodology, the SW pump IST action levels correspond to points on the design-basis degraded pump curve. The inspectors compared the STP-0-73A-1 action levels against the existing flow model calculation. The inspectors found that the 11 and 13 SW pump action levels were properly included in the flow model calculations. However, as noted in Section 3.3, the inspectors also found that the 12 SW pump had been recently changed and the new reference and action level values had not been properly included in the flow model calculations. As noted in Section 3.3, the inspectors determined that the flow criteria used for the ASME Section XI in-service testing for 12 SW pump did not correspond with the design flow. Specifically, the inspectors found that the 12 SW pump had been recently replaced and the new reference values and action levels had not been properly included in the flow model calculations. When reviewing these STPs for demonstrating SW pump discharge check valve operability in the open and closed directions, the inspectors concluded that these STPs were adequate. For example, the inspectors verified that STP-0-65E-1 adequately demonstrates seating of these check valves on reverse flow by the use of appropriate pressure instrumentation.

During this review of surveillance procedures, the inspectors observed that the licensee had established a good initiative for an IST program basis document. The inspectors reviewed Draft C of this basis document, "Calvert Cliffs Nuclear Plant Units 1 & 2 Basis ASME In-Service Testing (IST) Program," dated June 26, 1992, and noted that a licensee internal action item (AI #1H9400068) was opened in January 1994 to reconcile this basis document in light of draft NUREG-1482, "Guidelines for In-Service Testing at Nuclear Power Plants." The licensee has made substantial progress during the past 6 months in reconciling the basis document against the IST program and in addressing the concerns identified by the self-assessments. The inspectors considered that some of this progress can be attributed to corrective action taken in response to the licensee's first service water self-assessment. However, upon reviewing the SW system valves included in the scope of the IST program, the inspectors observed several valves that were excluded. Specifically, SW system manual valves 112, 113, 114, 115, and air-operated (AO) valves 5150, 5153, and 5174 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. The AO valves are normally open/fail open valves. The emergency overboard alignment is a licensing basis requirement that provides the capability to withstand a single, passive failure following the initiation of a RAS. Based on these observations, the inspectors requested the licensee to establish their basis for excluding these valves from the scope of the IST program. This item is unresolved pending the NRC's review of this requested licensee response (50-317/94-80-04 and 50-318/94-80-04).

6.3 Pump Testing and Test Instrumentation

The inspectors witnessed portions of the performance of a surveillance test of the 21 SRW pump being performed in accordance with STP-0-73B-2, "Service Water Pump Quarterly Test." During a pretest briefing, applicable portions of the procedure were reviewed, potential problem areas were identified and discussed, and the means for coordinating actions were identified. Plant personnel collected the test data in the service water pump room appropriately. The inspectors concluded that the surveillance testing of the 21 SRW pump was well conducted and appropriately controlled.

The inspectors discussed with plant personnel how the ultrasonic flow instrumentation manufactured by Controlotron was used to support testing. The licensee has been using the Controlotron Model 990 instrumentation for several years. In general, this instrumentation is installed temporarily to support an individual test. However, the Controlotron Model 990 instrumentation is installed permanently for on-line monitoring of SW flow through the SRW HXs. The inspectors verified that performance testing personnel install and remove this equipment in accordance with detailed procedures that are consistent with the Controlotron instruction manual. It was apparent that the performance test personnel responsible for this instrumentation were knowledgeable concerning its limitations and use. The licensee takes credit for $\pm 3\%$ accuracy when using this instrumentation. This tolerance is consistent with the vendor's stated accuracy of at least $\pm 2\%$. The inspectors concluded that the licensee was exercising good controls concerning the use of this instrumentation to support testing.

6.4 Trending

The inspectors reviewed the performance trending of the service water equipment being tested. The inspectors found that administrative guidelines were in place that required the IST engineer to trend IST test data. This was being done manually through the use of an IST trend logbook. Surveillance test and IST data were also being trended through the use of a computer database. Discussions with licensee personnel indicated that this database was not user friendly and was not frequently used. Therefore, system engineers performed informal trending of this information to ensure satisfactory system performance.

Additionally, other site groups, such as maintenance and reliability engineering, perform trending; however, trending of this information was not integrated. The system engineer may not be informed of adverse trends until they become a problem, so the trended information was being used in a reactive manner in lieu of a proactive manner. Further, the licensee's service water self-assessments identified weaknesses in formal trending of system and equipment performance in plant activities including, preventive maintenance associated with instrumentation, heat exchanger cleaning, and performance trending of pumps. The licensee responded to these inspectors observations and documented their ongoing initiatives to address them in a position paper, "System and Equipment Trending," dated March 10, 1994. The licensee's corrective actions include upgrading existing trending-related procedures and developing new trending procedures. The licensee stated that the performance of a pilot program for an integrated and automated trending data base was being evaluated for acceptance as a formal and proceduralized program. The inspectors had no further comments.

6.5 Conclusions

The inspectors concluded that the licensee had performed extensive testing to evaluate HX capability and establish appropriate corrective actions. The licensee was performing good pump and valve testing. A possible weakness was identified concerning several SW system manual and AO valves that had not been included in the IST program. The inspectors observed the lack of a formal continuing HX test program and the licensee agreed to establish one by June 30, 1994.

7.0 QUALITY ASSURANCE AND CORRECTIVE ACTIONS

The inspectors reviewed the licensee responses to GL 89-13 and their specific corrective actions taken regarding the findings from the prior service water self-assessments. The inspectors also reviewed root cause analyses performed for several service water component failures.

Attachment A includes the inspectors' overall assessment of the licensee's response to the five requested actions presented by the NRC in GL 89-13. Although several unresolved items regarding service water issues were identified during this inspection, the inspectors had no significant problems with the licensee's actions in response to GL 89-13. However, due to: (1) the many licensee actions taken regarding service water issues, (2) the several licensee letters submitted to the NRC concerning their commitments to GL 89-13, (3) the elapsed time since the issuance of GL 89-13, and (4) the combination of these factors, the inspectors requested the licensee to make a formal submittal to the NRC consolidating, updating, and clarifying, as necessary, their prior commitments made regarding GL 89-13. The licensee indicated that they had discussed their intentions to provide such a submittal previously with the NRR project manager. The licensee stated that this submittal would be made to the NRC by June 30, 1994.

The licensee had established a comprehensive, corrective action program to track the resolution of all findings developed during the prior service water self-assessments. This corrective action program is separate from the normal plant corrective action process. The inspectors considered that this corrective action program afforded good administrative tracking for all open issues. Also, generally good, corrective actions were being taken with the inspectors identifying only several exceptions. These exceptions involved a timeliness weakness regarding the root cause analysis of the SW-1067 failure and the premature closeout and lack of effective feedback regarding two single failure issues.

The inspectors acknowledged the plant manager's corrective action program initiative, which had been started in 1993 and was addressing corrective action program weaknesses identified by the NRC in Inspection Report 50-317/93-31 and 50-318/93-31. Major parts of this ongoing initiative have been to improve the quality of root cause analyses (RCAs) and the timeliness in the completion of RCAs. The inspectors selected a random sample of RCAs that had been performed to address SW, SRW, and CCW component failures during the last 2 years. Several of these RCAs involved problems with the 12 SW pump, which had also been reviewed by the licensee's service water self-assessments. The inspectors concluded that the licensee had taken appropriate corrective actions concerning these problems to obtain the root causes and prevent recurring failures of the 12 SW pump. The inspectors also evaluated the licensee RCA efforts regarding the September 1993 failure of SW-1067, which is a manual valve associated with a flow port/annubar connection for the SW header serving the 21 SRW HX. The failure consisted of a pipe rupture at the carbon steel nipple connecting SW-1067 to a boss on the SW header. This event resulted in flooding the lower level of the Unit 2 SRW HX room with 4 inches of water, necessitating immediate isolation of the 21 SW header. The nipple failure was caused by accelerated galvanic corrosion due to dissimilar metals installed. The licensee had incorrectly installed a carbon steel in lieu of a stainless steel nipple. The licensee had not yet determined the root causes for the installation of the incorrect carbon steel nipple. Program deficiency report (PDR) 93119 had been issued in September 1993 to complete this task and the estimated completion date was September 1994. The inspectors noted that the licensee had taken prompt action in September 1993 to verify that proper materials were installed for all other SW flow ports. However, considering the safety-significance of this failure in that the flooding could have disabled all equipment in the SRW HX room, the inspectors concluded that the licensee had not promptly completed this RCA. The licensee agreed to include this RCA timeliness weakness in the ongoing actions associated with the plant manager's corrective action program initiative.

The licensee's prior service water self-assessments identified two separate issues related to single failure in the CCW system. The first self-assessment questioned the basis for the statement in the UFSAR Section 9.5.2.2, which implied that CACs are fully redundant with the CCW for post-accident containment cooling. The licensee issued PDR 92294 for corrective action. PDR 92294 is still open. The second self-assessment identified a discrepancy related to a reliability engineering unit (REU) report. The conclusions of the REU report were inconsistent with the UFSAR Section 9.5.5 statement that states no single passive failure after recirculation from the containment sump will prevent the safety feature systems from fulfilling their design function. The licensee issued action item tracking (AIT) item 2M9300022 to track this issue to closure. AIT 2M9300022 was recently closed, and the inspectors considered this action to be premature. One of the justifications used to closeout this item was the statement in the UFSAR Section 9.5.2.2, which was still unresolved and the subject of open PDR 92294.

The NRC issued Information Notice (IN) 93-92 to alert licensees regarding the potential for CCW system failures to be a high contributor to core melt frequency. IN 93-92 described this vulnerability by discussing the CCW system common piping network and its potential exposure to a complete loss of function due to a single failure. The licensee's screening review of IN 93-92 did not identify for Calvert Cliffs any CCW system common piping network similarities and consequently the licensee did not perform a detailed evaluation. A potential link with the PDR 92294 issue discussed above was also not realized. Subsequent to the screening review for IN 93-92, the licensee's REU had determined that a loss of the CCW inventory was one of the largest contributors to core melt frequency for Calvert Cliffs. However, the IN 93-92 was not subsequently reviewed for applicability.

The licensee agreed to include these CCW single failure corrective action deficiencies in conjunction with the actions being taken to implement the plant manager's corrective action program initiative. The inspectors also considered these deficiencies to be another example of the design-control interface issues discussed in Section 3.3.

7.1 Conclusions

The inspectors concluded that the licensee's actions in response to GL 89-13 were satisfactory. The licensee had established a comprehensive, corrective action program to track the resolution of all findings developed during their prior service water self-assessments, and this program afforded good administrative tracking of all open issues.

8.0 REVIEW OF LICENSEE SERVICE WATER SELF-ASSESSMENTS

As the inspectors performed independent reviews of the individual functional areas and developed various issues, the licensee responded to these specific issues and also informed the inspectors regarding how these issues had or had not been addressed by their prior service water self-assessments. Consequently, as the inspection progressed, the inspectors gained an ongoing perspective of the licensee's self-assessments. The inspectors reviewed both licensee self-assessment reports and considered that the self-assessments were thorough and covered all areas comparable to a full NRC service water system operational performance inspection (SWSOPI). The number and significance of the self-assessment findings indicated an excellent level of detailed review.

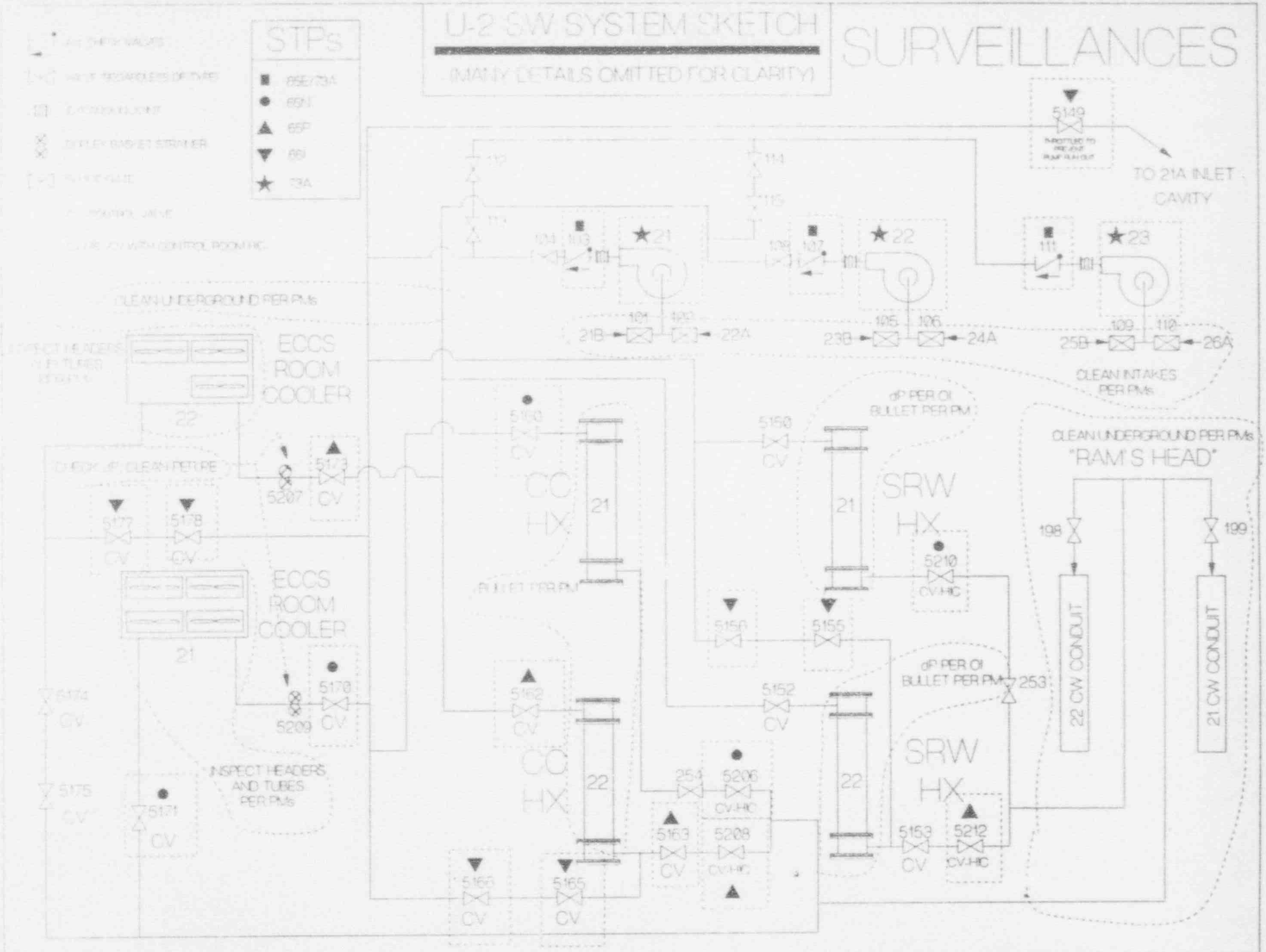
The inspectors sampled the licensee's corrective actions being taken in response to the self-assessment findings and found the licensee's actions, in general, to be appropriate. The inspectors developed additional findings, which had not been identified by either self-assessment. Most of these findings were in the design area. The inspectors considered that these new findings did not detract from the licensee's excellent service water self-assessment efforts.

8.1 Conclusions

The inspectors concluded that the licensee's self-assessment efforts were thorough and extensive. The inspectors, therefore, concluded that the licensee's service water self-assessments should be considered as an acceptable alternative to a full NRC SWSOPI.

9.0 EXIT MEETING

The inspectors met with those denoted in Attachment B on March 25, 1994, to discuss the preliminary inspection findings that are detailed in this report.



U-2 SW SYSTEM SKETCH
(MANY DETAILS OMITTED FOR CLARITY)
SURVEILLANCES
STPs
65E/73A
65N
65P
65I
73A
TO 21A INLET CAVITY
CLEAN UNDERGROUND PER PMs
ECCS ROOM COOLER
CLEAN INTAKES PER PMs
dP PER OI BULLET PER PM
CLEAN UNDERGROUND PER PMs
"RAM'S HEAD"
CC HX
SRW HX
22 CW CONDUIT
21 CW CONDUIT
INSPECT HEADERS AND TUBES PER PMs

FIGURE 1

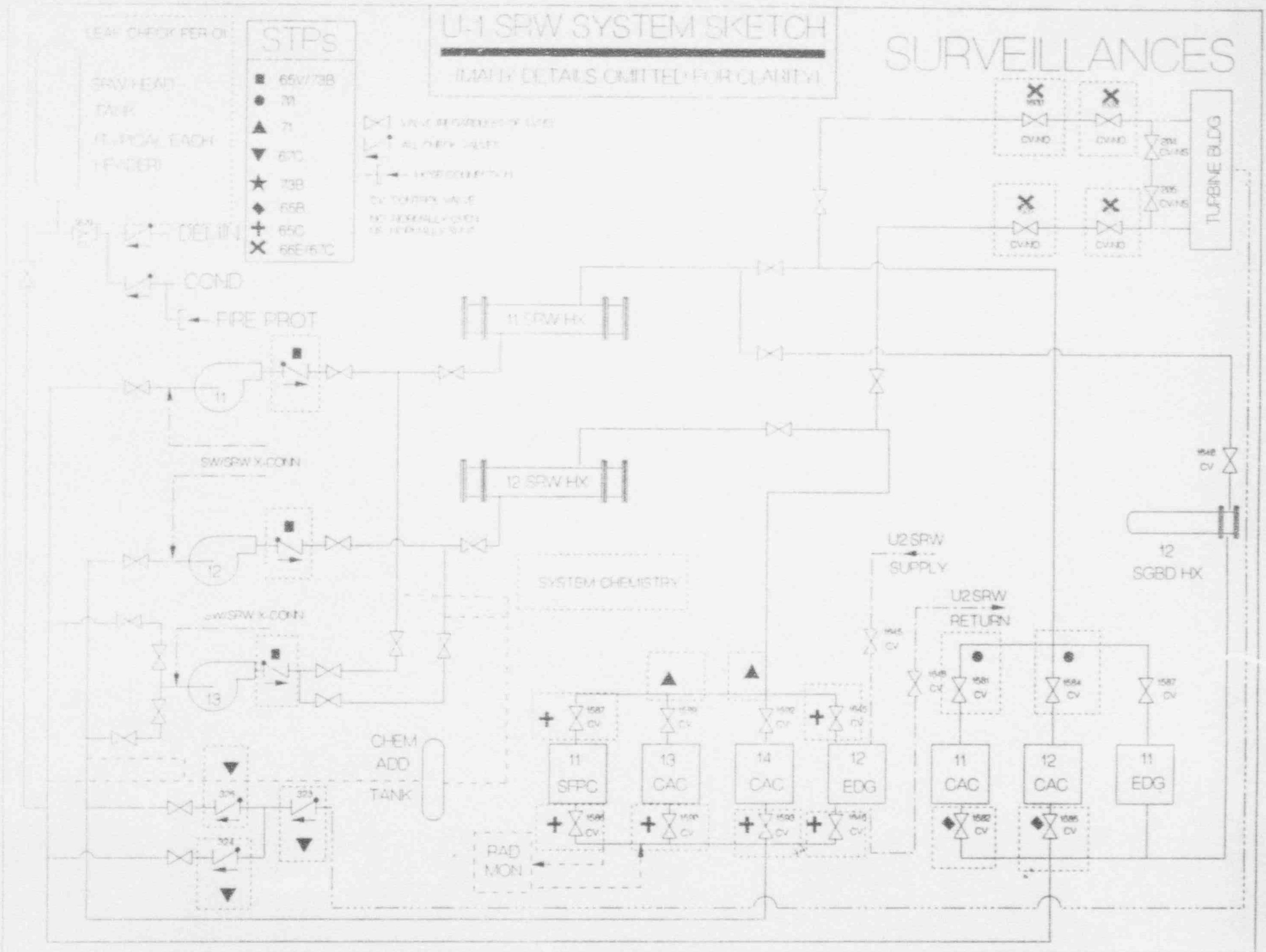

U-1 SRW SYSTEM SKETCH
SURVEILLANCES
STPs
65V/73B
70
71
67C
73B
65B
65C
65E/67C
LEAK CHECK PER OI
SRW HEAD TANK
DEL IN
COND
FIRE PROT
11 SRW HX
12 SRW HX
SW/SRW X-CONN
SYSTEM CHEMISTRY
CHEM ADD TANK
RAD MON
11 SFPC
13 CAC
14 CAC
12 EDG
11 CAC
12 CAC
11 EDG
U2 SRW SUPPLY
U2 SRW RETURN
12 SGBD HX
TURBINE BLDG
CV
CV-NO
CV-NS

FIGURE 2

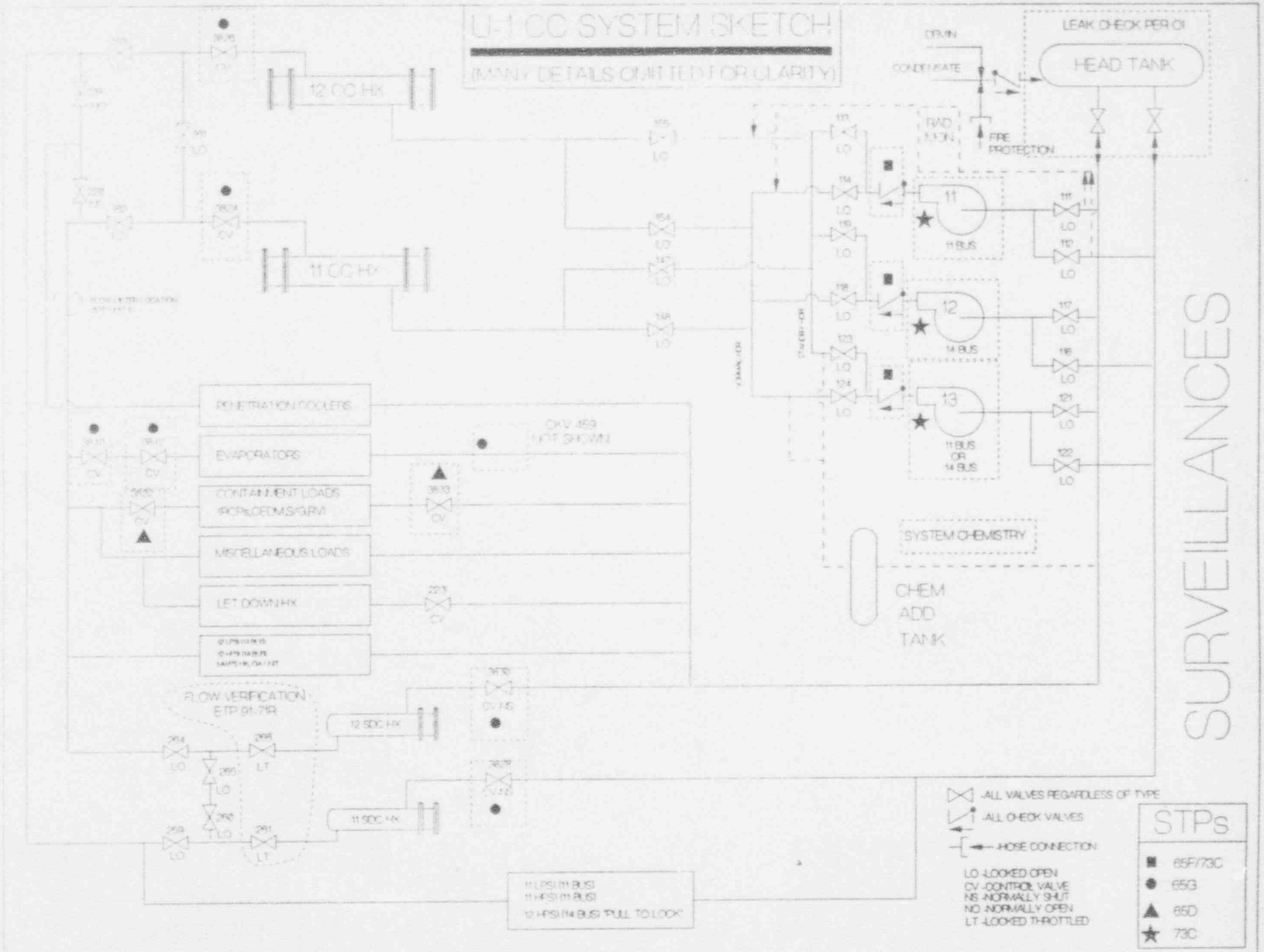

U-1 CC SYSTEM SKETCH
(MANY DETAILS OMITTED FOR CLARITY)
SURVEILLANCES
LEAK CHECK PER OI
HEAD TANK
DRAIN
CONDENSATE
FIRE PROTECTION
RAD MON
12 CC HX
11 CC HX
11 BUS
14 BUS
11 BUS OR 14 BUS
PENETRATION COOLERS
EVAPORATORS
CONTAINMENT LOADS (RCPs,CEDMS,G,RV)
MISCELLANEOUS LOADS
LET DOWN HX
CKV 459 NOT SHOWN
SYSTEM CHEMISTRY
CHEM ADD TANK
FLOW VERIFICATION ETP 91-71R
12 SDC HX
11 SDC HX
11 LPSI (11 BUS)
11 HPSI (11 BUS)
12 HPSI (14 BUS) "PULL TO LOCK"
-ALL VALVES REGARDLESS OF TYPE
-ALL CHECK VALVES
-HOSE CONNECTION
LO -LOCKED OPEN
CV -CONTROL VALVE
NS -NORMALLY SHUT
NO -NORMALLY OPEN
LT -LOCKED THROTTLED
STPs
65F/73C
65G
65D
73C

FIGURE 3

ATTACHMENT A

GENERIC LETTER 89-13 ACTION ITEMS

The licensee's first service water self-assessment inspectors provided a comprehensive review of the status of the licensee's commitments regarding the five requested actions included in GL 89-13. This review was documented as Attachment B, "Generic Letter 89-13 Assessment Report," to the self-assessment report. The inspectors reviewed this information in addition to their independent inspection observations to form an overall assessment of the licensee's responses to GL 89-13.

I. Biofouling Control and Surveillance Techniques

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

The inspectors concluded that the licensee was taking appropriate steps concerning this requested action except for the lack of periodic flushing of small SW system instrument lines. This weakness was identified as an unresolved item. The inspectors noted that the SW system intake bays were being routinely cleaned and inspected as part of the licensee's preventive maintenance program. The licensee's extensive SW system modifications have eliminated the undesirable dead legs that existed in the original design.

II. Monitoring Safety-Related Heat Exchanger Performance

Action II of GL 89-13 requested that licensees implement a program to periodically verify the heat transfer capability of safety-related heat exchangers (HXs) cooled by the SWSs. The test program should consist of an initial test program and a periodic retest program.

The licensee's HX test program consisted of both inspection and cleaning and/or performance testing of safety-related HXs. Performance testing was conducted on the SRW and CCW HXs. Inspection and cleaning was conducted on the SRW and CCW HXs plus the ECCS room coolers. In addition, monitoring tests were conducted for the containment air coolers and the ECCS room coolers.

The performance part of this program provided good information for the "clean" HX performance monitoring and compensatory maintenance activity. However, a successful as-found test has not been performed to this date. The inspectors identified a relatively low and unverified assumption being used for the SRW HX fouling factor. The licensee's self-assessments had a similar observation. This issue was identified as an unresolved item. The inspectors also identified the need for a formal continuing HX test program. The licensee agreed to establish this program by June 30, 1994. Also, the inspectors discussed the need for the licensee to provide a submittal to the NRC, which would consolidate, update, and clarify as necessary their prior commitments made in response to GL 89-13. The licensee stated that this submittal would be provided by June 30, 1994. With the exceptions of the fouling factor issue, the need for a formal continuing HX test program, and the updated GL 89-13 submittal, the inspectors concluded that the licensee's responses to this requested action were adequate to meet the intent of GL 89-13.

III. Routine Inspection and Maintenance

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

In general, the inspectors concluded that the licensee was taking appropriate actions in response to this requested action. The licensee was accomplishing effective maintenance on the SWS components. Several weaknesses were noted regarding the lack of periodic maintenance for instrument lines and auto vents. These issues were identified as unresolved items.

IV. Design-Function Verification and Single Failure Analysis

Action IV of GL 89-13 requested that licensees confirm that the SW, SRW, and CCW systems will perform their intended function in accordance with the licensing basis for the plant. This confirmation should include a review of the ability to perform required safety functions in the event of a single active component failure.

The inspectors reviewed the SW, SRW, and CCW systems' ability to perform their intended function in accordance with the licensing basis for the plant. The review included system configuration, flood and tornado protection, seismic design, emergency power supply, and functional logic evaluation. Specific consideration was given to identify failure of any single component that could potentially affect the performance of the SW, SRW, or the CCW system.

In general, the inspectors concluded that the SW, SRW, and CCW systems would perform their safety functions in accordance with the licensing basis for the plant. The inspectors noted that some single failure analysis issues were open pending the disposition of the PDR 92294.

V. Training

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

Based on the review of maintenance, operating, and emergency procedures and the training involving the SW, SRW, and CCW systems, the inspectors concluded that the licensee was adequately addressing this requested action.

ATTACHMENT B

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