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BGE

May 16, 1997

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit No. 1; Docket No. 50-317
License Amendment Request: Service Water Heat Exchangers Replacement

REFERENCES:

(a) Letter from Mr. R. E. Denton (BGE) to NRC Document Control Desk, dated June 30, 1994, Final Response to Generic Letter 89-13, Service Water System Problems Affecting Safety-Related Equipment (TAC Nos. M73978 and M73979)

(b) Letter from Mr. C. H. Cruse (BGE) to NRC Document Control Desk, dated December 29, 1993, Licensee Event Report 93-007, Performance Tests Indicate Possibility of SRW Heat Exchanger Inoperability

1/1 A065

Pursuant to 10 CFR 50.90, Baltimore Gas and Electric Company hereby requests an amendment to Operating License No. DPR-53 to implement a modification which constitutes an unreviewed safety question as described in 10 CFR 50.59. The modification involves replacing the service water (SRW) heat exchangers with new plate and frame heat exchangers having increased thermal performance capability. The saltwater and SRW piping configuration will be modified as necessary to allow proper fit-up to the new components. A flow control scheme to throttle saltwater flow to the heat exchangers and the associated bypass lines will be added. Saltwater strainers with an automatic flushing arrangement will be added upstream of each heat exchanger. The majority of the physical work associated with this modification is restricted to the SRW pump room.

The following two reasons provided the impetus for the proposed activity:

- In response to Generic Letter 89-13 (Reference a), Baltimore Gas and Electric Company performed baseline thermal performance tests on the SRW heat exchangers in the fall of 1993. Evaluation of the test results revealed that the available heat duty (the amount of heat the heat exchangers can remove at a given set of conditions) was less than expected (Reference b). The system design basis was revised to reflect these results. Strict cleaning and bulleting requirements have been imposed on the heat exchangers. Flow controllers were installed on the containment air coolers SRW inlet valves to throttle SRW flow during a loss-of-coolant accident to reduce the SRW System heat load. Despite the modification, operation at higher Chesapeake Bay water (ultimate heat sink) temperatures has required frequent heat exchanger cleaning, which restricts operational flexibility.

- The existing heat exchangers are susceptible to erosion/corrosion at their normal operating conditions. During the spring 1994 Unit 1 refueling outage, 140 plugged tubes were replaced in the No. 11 SRW Heat Exchanger. These tubes had been previously plugged due to leakage. During the replacement, it was discovered that there was severe tube wall thinning in the first three to four inches of the inlet end of the tubes. Tube damage was apparently caused by erosion/corrosion on the tube side. Further inspection indicated that similar damage is widespread in both the No. 11 and 21 SRW Heat Exchangers. This problem was temporarily addressed by installing sleeves in the inlet end of the tubes.

UNREVIEWED SAFETY QUESTION

We have concluded that the addition of new active components by the proposed activity introduces the possibility of new malfunctions that could affect either train of the SRW System. The proposed activity will add a strainer and a number of control valves which will introduce a potential for malfunctions of a different type from previously evaluated in the Updated Final Safety Analysis Report. In spite of the possibility for the introduction of new malfunctions, the proposed activity is a significant improvement in the method of performing the function of the Saltwater and SRW Systems. Additional information concerning this determination is contained in Attachment (1). Upon approval of this request and completion of the modification, the Updated Final Safety Analysis Report will be revised to reflect the new configuration.

SCHEDULE

We are planning to replace the SRW heat exchangers during the 1998 Unit 1 refueling outage, which is scheduled to begin on March 13, 1998. To help us prepare for the replacement outage in a timely fashion, we request that you review and approve our application by October 31, 1997. The required modification for Unit 2 replacement is conceptually identical to Unit 1; however, this request for a license amendment is limited to the Unit 1 SRW heat exchanger replacement only. A similar safety evaluation will be performed for Unit 2 replacement, in accordance with the provisions of 10 CFR 50.59.

ASSESSMENT AND REVIEW

We have evaluated the significant hazards considerations associated with this proposed modification, as required by 10 CFR 50.92, and have determined that there are none (see Attachment 2 for a complete discussion). We have also determined that operation with the proposed modification will not result in any significant change in the types or significant increases in the amounts of any effluents that may be released offsite, and no significant increases in individual or cumulative occupational radiation exposure. Therefore, the proposed amendment is eligible for categorical exclusion as set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment is needed in connection with the approval of the proposed modification. The Plant

Operations and Safety Review Committee and the Offsite Safety Review Committee have reviewed this proposed modification and concur that operation with the proposed modification will not result in an undue risk to the health and safety of the public.

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

[signature]

STATE OF MARYLAND :
: TO WIT:
COUNTY OF CALVERT :

I, Charles H. Cruse, being duly sworn, state that I am Vice President, Nuclear Energy Division, Baltimore Gas and Electric Company (BGE), and that I am duly authorized to execute and file this License Amendment Request on behalf of BGE. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other BGE employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

[signature]

Subscribed and sworn before me, a Notary Public in and for the State of Maryland and County of Calvert, this 16 day of May, 1997.

WITNESS my Hand and Notarial Seal: Michelle D. Hall
Notary Public

My Commission Expires: February 2, 1998
Date

CHC/GT/bjd

Attachments: (1) Summary Description and Safety Analysis
(2) Determination of Significant Hazards

cc: R. S. Fleishman, Esquire
J. E. Silberg, Esquire
A. W. Dromerick, NRC
Director, Project Directorate I-1, NRC
H. J. Miller, NRC
Resident Inspector, NRC
R. I. McLean, DNR
J. H. Walter, PSC

ATTACHMENT (1)

SUMMARY DESCRIPTION AND SAFETY ANALYSIS

Baltimore Gas & Electric Company
Docket No. 50-317
May 16, 1997

ATTACHMENT (1)

SUMMARY DESCRIPTION AND SAFETY ANALYSIS

BACKGROUND

On July 18, 1989, the Nuclear Regulatory Commission issued Generic Letter 89-13 to require licensees and applicants to supply information about their respective service water (SRW) systems to assure the Commission of compliance with the General Design Criteria and quality assurance requirements, and to confirm that the safety functions of their respective SRW systems are being met.

In response to Generic Letter 89-13 (Reference 1), Baltimore Gas and Electric Company performed baseline thermal performance tests on the SRW heat exchangers in the fall of 1993. Evaluation of the test results revealed that the available heat duty (the amount of heat that heat exchangers can remove at a given set of conditions) was less than expected (Reference 2). The system design basis was revised to reflect these results. Strict cleaning and bulleting requirements have been imposed on the heat exchangers. Flow controllers were installed on the containment air coolers (CACs) SRW inlet valves to throttle SRW flow during a loss-of-coolant accident (LOCA) to reduce the SRW System heat load. Despite the modification, operation at higher Chesapeake Bay water (ultimate heat sink) temperatures has required frequent heat exchanger cleaning, which restricts operational flexibility.

In addition to the problem with the available heat duty, the existing heat exchangers are susceptible to erosion/corrosion at their normal operating conditions. During the spring 1994 Unit 1 refueling outage, 140 plugged tubes were replaced in the No. 11 SRW Heat Exchanger. These tubes had been previously plugged due to leakage. During the replacement, it was discovered that there was severe tube wall thinning in the first three to four inches of the inlet end of the tubes. Tube damage was apparently caused by erosion/corrosion on the tube side. Further inspection indicated that similar damage is widespread in both the No. 11 and 21 SRW Heat Exchangers. This problem was temporarily addressed by installing sleeves in the inlet end of the tubes.

To alleviate these problems, Baltimore Gas and Electric Company initiated a project to replace the existing shell and tube SRW heat exchangers with new plate and frame heat exchangers (PHEs).

DESCRIPTION OF EXISTING CONFIGURATION

A. SERVICE WATER SYSTEM

The SRW System is a closed loop system which uses plant demineralized water treated with a corrosion inhibitor. The system removes heat from various turbine plant components, a blowdown recovery heat exchanger, CACs , a spent fuel pool cooling heat exchanger, and diesel generator (DG) heat exchangers.

The system is divided into two subsystems in the Auxiliary Building to provide adequate redundancy in the design basis accidents. The non-safety-related portion of the system, located in the Turbine Building, is divided into two separate supply headers, but combine downstream of the Turbine Building loads into a common return header. The SRW Turbine Building piping is automatically isolated during a LOCA. While in normal operation, both subsystems are usually in service and are independent to the degree necessary to assure the safe operation and shutdown of the plant, assuming a single failure. The SRW supply temperature is maintained at or below 95°F. During shutdown, operation of the SRW System is essentially the same as during normal operation, except that the heat loads are reduced, as is the saltwater (SW) flow required to remove the heat from the system. During a LOCA, each subsystem supplies two CACs, and the No. 12 SRW

Subsystem cools No. 1B DG. During this event, the SRW System design temperature initially increases to 115°F, and subsequently decreases below 105°F within 35 minutes. The SRW System supply temperature is maintained at or below 105°F for the remainder of the event.

The design safety function of the SRW System is to supply cooling water to the CACs to support cooldown of containment, and to No. 1B DG to ensure continued reliable operation of the DG as an emergency power supply.

B. SALTWATER SYSTEM

The SW System consists of two subsystems. Each subsystem provides SW to heat exchangers cooling the SRW System, Component Cooling (CC) System and the Emergency Core Cooling System (ECCS) pump room. These heat exchangers transfer heat from the associated systems to the Chesapeake Bay. The SW System has three pumps. The pumps provide the driving head to move SW from the intake structure, through the system, and back to the circulating water discharge conduits.

During normal operation, both subsystems are in operation with one pump running on each header, and a third pump in standby. If needed, the standby pump can be lined-up to either supply header. The SW flow through the SRW and CC heat exchangers is throttled to provide sufficient cooling to the heat exchangers, while maintaining total subsystem flow below a maximum value to prevent pump runout.

Operation following a LOCA has two phases - pre-and post-Recirculation Actuation Signal (RAS). One subsystem can satisfy the design heat removal requirements during both phases of the accident. After a LOCA and before a RAS, each SW subsystem is automatically reconfigured to provide full flow to the SRW heat exchangers. During this phase, the ECCS pump room air coolers may also be cooled by SW if the ECCS pump room temperature exceeds its preset limit. Saltwater flow to the CC heat exchangers is automatically isolated on a Safety Injection Actuation Signal (SIAS). Upon initiation of RAS, the SW isolation valves on the CC heat exchanger return to their pre-accident positions and the operator can throttle flow to maintain CC temperatures. The SRW heat exchangers and the ECCS pump room air coolers continue to operate during this phase. In the existing system, the SRW heat exchanger SW outlet valves (1-CV-5210 and 1-CV-5212, Figure 9.8 in Reference 3) will fully open on a SIAS and return to their pre-accident position on RAS. The CC and SRW heat exchanger SW outlet valves are throttled by the operator post-RAS to maintain system design temperatures.

Should a rupture or blockage occur in the common SW discharge piping downstream of the heat exchangers and air coolers, an alternate flow path may be employed so that the function of the components on the No. 12 SW Subsystem will not be impaired. This alternate flow path may also be used to support maintenance during Modes 5 (Cold Shutdown), 6 (Refueling), and defueled.

C. ENGINEERED SAFETY FEATURES ACTUATION SYSTEM

The Engineered Safety Features Actuation System (ESFAS) consist of those sensors, logic, and controls used to initiate the operation of equipment which protects the public and plant personnel from the accidental release of radioactive fission products in the unlikely event of various Updated Safety Analysis Report (UFSAR) Chapter 14 analyzed accidents (e.g., LOCA, main steam line break, or loss of feedwater incident). The safety features function to localize, control, mitigate, and terminate such incidents in order to minimize radiation exposure levels for the general public. Safety injection actuation signal and RAS, which are part of the ESFAS system, are currently used to operate the SRW heat exchanger SW outlet control valves. These control valves (1-CV-5210 and 1-CV-5212) go to the fully open position upon receipt of SIAS, and return to their pre-accident throttled position upon receipt of the RAS. Engineered Safety Features Actuation System operation of the SRW heat exchanger SW outlet control valves will be removed under this modification.

D. INSTRUMENT AIR SYSTEM

The instrument air system is designed to provide a reliable supply of dry and oil-free air for the pneumatic instruments and controls and pneumatically-operated valves. The Instrument Air System provides a continuous supply of air to hold various pneumatically-operated valve actuators in the positions necessary for all operating conditions.

The SW air compressor air system is a safety-related subsystem of the Instrument Air System. The SW System air compressors provide a source of air to various accumulators, receivers, and safety-related control valves. The SW air compressors start automatically upon receipt of a SIAS and supply air to various safety-related loads, including controls for the SRW heat exchangers.

DESCRIPTION OF PROPOSED MODIFICATION

The two existing shell and tube SRW heat exchangers will be replaced with four new PHEs (see Figure 1) having increased thermal performance capability. The materials chosen for the new PHEs (Titanium for the plates and EPDM for the gaskets) and the method by which the PHEs are assembled provide deterrence to the erosion/corrosion problem that has damaged the existing heat exchangers. The SW and SRW piping configurations will be modified as necessary to allow proper fit-up to the new components. A flow control scheme to throttle SW flow to the heat exchangers and the associated bypass lines will be added. Saltwater strainers with an automatic flushing arrangement will be added upstream of each heat exchanger (see Figure 2). The majority of the physical work associated with this modification is restricted to the SRW pump room. Figures 3 and 4 depict the proposed changes to the SW and SRW Systems that will be incorporated in Figures 9.8 and 9.9 of Reference 3, respectively, following the implementation of the proposed modification. Figures 5 and 6 show affected areas for the existing configuration. A more detailed description of the proposed modification is provided below:

1. Each SRW heat exchanger will be replaced with two PHEs operating in parallel.
   - Two PHEs, i.e., one train of SW System, will be capable of supporting continued plant operation under all expected operating conditions. The PHEs are sized such that two units can remove the expected accident heat load from two CACs and the DG at SW supply temperatures up to 90°F while maintaining SRW within its design limits.
   - Plate and frame heat exchanger plates will be titanium with EPDM [Ethylene Propylene Diene Monomer] gaskets. All other major subcomponents will be carbon steel. In no case is carbon steel directly exposed to SW.
   - The PHE frames are sized to allow expansion of the heat exchanger, if needed, at a later date.

2. A SW strainer will be installed upstream of each PHE to remove debris and minimize macrofouling in the heat exchanger.

   - The strainers have an automatic flushing capability. Automatic flushing is carried out at regular intervals without interrupting the straining process. Initially the strainers will be flushed every 60 minutes, and this interval will be adjusted based on operating experience with the new system. The automatic flushing arrangement is composed of a flushing valve and a flow diverter, which are regulated by a control assembly. During normal operation, the liquid enters the strainer basket. The flow diverter is open and the flushing valve is closed. The SW passes through the inlet section where it is forced through the screen basket before passing out through the outlet. Regeneration (strainer flushing) takes place in two stages. Initially, the flushing valve opens to commence the regeneration cycle. With the flushing valve open, total flow through the filter increases. This loosens the debris on the pipe walls and the inside of the strainer basket. The debris is then washed via the flushing valve to the SW discharge header downstream of the heat exchangers. During the second portion of the regeneration phase, the flow diverter closes while the flushing valve remains open. The flow is then forced through the strainer basket in the inlet section. The majority of the flow leaves the strainer through the main outlet, but some is diverted from the exterior to the interior of the debris collection section. This provides a backflushing effect on this section of the strainer element. Dislodged remnants are discharged through the flushing valve. The flushing cycle takes approximately 80 seconds.

   - The strainers for each subsystem are interlocked such that the regeneration cycle can only take place for one strainer at a time, i.e., the control circuit is designed such that a strainer flush is permitted only if the flushing valve for the other strainer, on the same subsystem, is in the fully closed position.

   - The strainers will also flush on high differential pressure, providing protection against rapid build-up of debris or failure of the time initiated flush sequence.

   - A full port ball valve is used for the flushing valve to provide minimal obstruction to removal of debris from the strainer. The flushing line bypasses the PHE and connects to the SW return header downstream of the flow elements. Flushing discharge piping is sized and positioned to minimize the potential for clogging.

   - An 8-inch handhole has been added to the cover of each strainer to facilitate clearing any large items that might impact strainer operation.

   - Provisions are made for local operation/override of the regeneration controller. A local control station is provided for strainer control, indication, and annunciation.

3. Saltwater and SRW instrumentation will be provided to support system operation and heat exchanger testing.

4. Saltwater piping, tubing, and supports have been redesigned to allow the installation of the four PHEs and strainers.

   - All of the existing SW pipe in the SRW pump room will be removed up to the three spools embedded in the K-line concrete wall.

5. A manual SW isolation valve will be provided upstream of each strainer (four total) to allow isolation of any selected strainer/PHE combination. In addition, manual valves will be installed in each subsystem, as close as possible to the common discharge header to support future maintenance on any SW component without the need for a dual SW header outage.

6. Service water piping and supports are modified only to the extent necessary to accommodate the installation of two parallel PHEs on each subsystem. Eight new SRW manual isolation valves will be added to the system.

7. Instrument air piping and tubing is modified to support the new and repositioned air-operated valves. The increased number of air-operated valves will necessitate a larger safety-related air supply. This increased demand is within the capacity of the replacement SW air compressors which are being installed under a separate modification package.

8. Engineered Safety Features Actuation System signals currently are provided to the SRW heat exchanger SW outlet valves, 1-CV-5210 and 1-CV-5212. After implementation of this modification, ESFAS signals will not be required for any SW valve in the SRW pump room.

9. The PHEs are designed to operate at a lower total SW flow (4500 gpm nominal to each PHE) than the existing shell and tube heat exchanger (minimum required flow 16,830 gpm). To ensure the SW pumps operate at an efficient flow rate, a SW bypass line has been added around the PHEs. Flow indicating controllers (FIC) will automatically throttle the control valves on the discharge of each PHE to maintain a constant SW flow. The position of the SW bypass control valve for each SW subsystem will be automatically controlled by a pressure indicating controller (PIC). The PIC will maintain SW header pressure in a pre-established band selected to meet the range of conditions that might exist during normal operation or after initiation of an accident.

10. Control Room annunciation and indication will be maintained to warn the operator of high SRW heat exchanger SRW outlet temperature. In addition, a SRW heat exchanger trouble alarm will be provided to alarm on high PHE SW differential pressure (dP), high strainer dP, abnormal strainer flushing cycle, low SW flow, or strainer mode control in manual. This will alert the operator of a problem with the strainer and/or heat exchanger. Local indication will allow identification of the specific problem.

11. Electrical schemes for all affected control valves in the SRW room will be modified as required.

12. To accommodate the replacement of the two existing shell and tube heat exchangers with the new PHEs, a number of structural modifications will be required. These will include modifications to the 14'-9" elevation steel floor, removal of interferences, modification of stairs and platforms, and addition of drip pans.

DESCRIPTION OF SYSTEM OPERATION AFTER THE MODIFICATION

A. GENERAL DESCRIPTION

The PHE SW outlet control valves usually will be controlled by a FIC to maintain SW flow to each PHE at about 4500 gpm (exceptions are discussed below). This setpoint is based on the loop uncertainty of the FIC and the minimum and maximum flow requirements of the PHE. The PHEs are designed for a minimum SW flow of 4300 gpm. At this flow rate they can remove the accident heat load at SW inlet temperatures up to 90°F. The maximum flow is 4750 gpm. At this value, the total flow to the two SRW PHEs on each subsystem is 9500 gpm (same as the existing post-RAS SW flow) ensuring sufficient flow to the CC heat exchangers post-RAS. Automatically maintaining the flow between the two values will eliminate the need for ESFAS signals for SW valves in the SRW pump room. In addition, the minimum flow requirement maintains sufficient turbulence in the PHE flow passages to minimize microfouling on the plates.

During periods of high bay temperatures, the operator will have the option to increase SW flow to the PHEs to help maintain SRW supply temperature within its design values. This will be accomplished by placing the PHE SW outlet valve hand switches in "open," which will place the valves in their full open position. Placing the hand switch in open will also automatically defeat the high PHE SW dP and high strainer dP inputs to the common alarm, and override the high strainer dP flush signal. The strainer will continue to automatically flush at a preset frequency. The common alarm will only indicate heat exchanger low flow, strainer improper valve position, strainer mode out of auto, and strainer power failure when the PHE SW outlet valves are full open in this manner. If a LOCA occurs while operating in this manner, the operator will be required to place the hand switch in auto after a RAS. This will throttle flow to the PHE to insure sufficient flow is available for the CC heat exchangers. This action will replace the current post-RAS action in Emergency Operating Procedure (EOP)-5 requiring the operator to throttle 1-CV-5210 and 1-CV-5212 to maintain SRW temperature.

The SW pumps were designed for a nominal flow of 20,000 gpm with a minimum flow requirement of 10,000 gpm. To allow system operation with only the SRW PHEs operating on a subsystem, a SW bypass line was added around the PHEs. The position of the SW bypass control valve for each SW subsystem will be automatically controlled by a PIC. The PIC will maintain SW header pressure in a pre-established band selected to meet the range of conditions that might exist during normal operation or after initiation of an accident. The minimum pressure limit will prevent pump runout, even when the strainers automatically flush, while allowing operation at high pump efficiencies. The maximum pressure limit will insure that pump minimum flow requirements are met.

B. NORMAL OPERATION WITH TWO PHEs OPERATING ON EACH SW SUBSYSTEM

Normally, SW flow to each SRW PHE will be maintained by a FIC at the pre-established setpoint. The SW strainers will flush automatically at the selected frequency or if an abnormally high strainer dP is experienced prior to the normal flush. Operation of the SW pumps, the ECCS pump room air coolers, and the CC heat exchangers will be unchanged from the current system. The new SW bypass lines will be throttled by PICs to help maintain SW header pressure within the prescribed band.

At higher SW temperatures, additional SW cooling flow can be achieved by fully opening the PHE SW outlet valves. The valves can be fully opened by moving the associated handswitch (1-HS-5209, 5210, 5211, or 5212) from auto to open. This mode will support plant operation with SW temperatures up to 90°F.

C. NORMAL OPERATIONS WITH ONE SW SUBSYSTEM SECURED, TWO PHEs ON THE OPERATING SUBSYSTEM

Either SW subsystem can be secured for maintenance by cross-connecting the SRW System to the remaining pair of PHEs. At higher bay temperatures, the operator may fully open the PHE SW outlet valves to provide additional cooling. The two operating PHEs can remove the heat load during normal operations or a design basis accident with SW temperatures up to 90°F. This mode of operation is similar in concept to the existing procedures used in support of heat exchanger or subsystem maintenance.

D. NORMAL OPERATIONS WITH ONE PHE SECURED

Valves are provided in the system to allow isolation of a single strainer-PHE combination while continuing to operate the other PHE, the CC heat exchanger, and the ECCS pump room air cooler on the affected SW subsystem. Under most conditions, a single PHE cannot remove the entire LOCA heat load while maintaining SRW temperature within its design limits. However, if one CAC is removed from operation, the single PHE can handle the remaining accident heat load on that subsystem. This would allow the DG (No. 12 SRW Subsystem only), the remaining CAC, the CC heat exchanger, and the ECCS pump room cooler on the affected subsystem to remain operable while the one PHE is out-of-service. The other SW and SRW subsystems would still have two operable PHEs and would satisfy the assumptions in the accident analysis.

The heat loads during normal operations differ significantly from those experienced during the accident, and are not equally divided between the two subsystems. Either PHE on the No. 11 SW Subsystem can remove the full expected heat load during normal operations at SW temperatures up to 90°F. At higher bay temperatures, the operator may fully open the PHE SW outlet valves to improve cooling. The normal heat load on the No. 12 SRW Subsystem is considerably larger. One PHE may not be able to remove the full No. 12 SRW Subsystem normal operation heat load at SW temperatures above 80°F. As SW temperature approaches 80°F, the operator may need to fully open the SW outlet valve on the Nos. 12A or 12B PHE, whichever is operating.

E. LOSS-OF-COOLANT ACCIDENT (Pre-RAS)

There will be no ESFAS signals associated with any SW equipment in the SRW pump room as a result of this modification. Safety injection actuation signal and RAS controls to the SRW heat exchanger SW outlet control valves will be eliminated. Upon receipt of a SIAS, SW flow to the CC heat exchangers will be isolated and the SW pumps will be started, if necessary. No other system changes will be automatically initiated. The FICs will continue to maintain the preset flow to the PHEs if the PHE SW outlet valves are in automatic. If the PHE SW valves are fully open, they will remain in that position. The strainers will continue to automatically flush. The PIC will adjust the bypass valve positions, if necessary, to maintain the SW header pressure within the established limits. No immediate operator actions are required during this phase of the accident.

F. LOSS-OF-COOLANT ACCIDENT (Post-RAS)

Upon a RAS, the CC heat exchanger throttle valves will return to their pre-LOCA position. Their operation post-RAS will be identical to that described in the current EOP, i.e., the operator will be required to throttle 1-CV-5206 and 5208 (Reference 3), as necessary, to maintain CC outlet temperature. The RAS will cause no automatic changes to the operation of the SRW heat exchangers. If the PHE SW outlet valves are in auto, the FICs will continue to maintain SW flow to each heat exchanger at the preset value (~ 4500 gpm). If the PHE SW outlet valves are fully open, the operator will be required to return them to auto after a RAS. The existing EOP-5 requires the operator to throttle SW flow to the SRW heat exchanger post-RAS to maintain SRW temperatures. The need for the operator to control the throttle position will be eliminated. Therefore, requiring the operator to place the valve position switch in auto will not impose additional demands on the operator. The strainers will continue to cycle at the pre-established frequency or, once the PHE SW outlet valves are returned to auto, on high strainer dP.

G. ALTERNATE FLOW PATH

In the event of a break in the common SW piping downstream of the SRW heat exchangers, the system can be reconfigured to the alternate flow path (via 1-CV-5149) in the same manner as in the existing system. The only significant difference to operation on the alternate flow path is that the No. 12A and 12B PHE SW outlet control valves and FICs will remain in operation. The FIC will continue to maintain flow to the No. 12A and 12B PHEs at the pre-established setpoint (~ 4500 gpm). The current system provides no throttling capability when using the alternate flow path. After the implementation of this modification, the new No. 12A and 12B PHE SW bypass line will remain in operation and the PIC will adjust the control valve position, as necessary, to maintain SW header pressure between the pre-established limits. Operation of the CC heat exchanger or ECCS pump room air cooler on the alternate flow path will be unchanged.

Some system components cannot be isolated from the common discharge header to facilitate maintenance without removing both SW headers from service. As an alternative, these items can be isolated by using the alternate flow path to keep No. 12 SW Header in operation. While this line-up was originally designed as an alternate accident line-up, it has been used for maintenance in Modes 5, 6, and defueled. While in this line-up, the SRW PHE throttling capability is maintained, ensuring that both the SRW PHEs and the CC heat exchangers, can achieve their design flows and remove the required heat loads.

UNREVIEWED SAFETY QUESTION

We have concluded that the addition of a number of active components by the proposed activity introduces the possibility of new malfunctions that could affect either train of the SRW System. The proposed activity will add a strainer and a number of control valves which will introduce a potential for malfunctions of a different type from previously evaluated in the UFSAR. In spite of the possibility for the introduction of new malfunctions, the proposed activity is a significant improvement in the method of performing the functions of the SW and SRW Systems. The safety significance of the new components is addressed in detail in the following section.

SAFETY ANALYSIS

The design, procurement, installation, and testing of the equipment associated with this activity are consistent with the applicable codes and standards governing the original systems, structures, and components. No new common-mode failures are introduced by this activity. Redundancy and separation are maintained. The redundant cooling capacity of the SW and SRW Systems has not been altered. No single active failure at any time, nor any single passive failure after recirculation from the containment sump, will prevent the safety feature systems from fulfilling their design function.

However, the addition of new components to the system introduces the potential for malfunctions which were not previously considered in the UFSAR. The malfunctions discussed below assume no operator action is taken; however, actions made available to the operator, inherent in the proposed design, are stated where applicable. The new system components are discussed below:

A. STRAINER

The strainer has four potential failure modes: failure of the pressure boundary, clogging of the strainer, failure of the flushing valve, and failure of the diverter valve.

- Failure of the pressure boundary - The strainer is designed and manufactured to the same codes and standards as the other system pressure boundary components. Therefore, the probability of a failure of the pressure boundary is no different from the portions of the system already evaluated in the UFSAR.

- Clogging of the strainer - The strainer is designed to flush automatically on a preset timing cycle and, as a back-up (when the PHE outlet valve is controlled by the FIC), on high strainer dP. Furthermore, the operator has the option to initiate a flushing cycle manually. Should clogging occur, despite the automatic flush capability, the affected strainer will eventually reach its dP limit and alarm setpoint. Initially, the associated PHE SW outlet control valve will open further to compensate for the macrofouling in the strainer. Eventually the SW low flow alarm setpoint would be reached (note that this is another input to the common alarm). This scenario is generally a slow developing process which will provide the operator with sufficient time to investigate and implement corrective actions. A handhole has been provided on the strainer cover plate to allow quick inspection and manual cleaning. Ultimately, if the strainer clogs sufficiently to adversely affect subsystem operation, the operator can take action as described in *Note 1* below.

- Flushing valve remains open - The flushing valve is designed to fail shut on loss of power or air. However, if the flushing valve should fail to shut, the affected strainer would continue to flush and remain relatively clean. The abnormal strainer flushing cycle would provide the operator with an alarm, prompting investigation. Without operator action, the interlock between the two strainers within the subsystem, will prevent flushing of the unaffected strainer. This may eventually cause the unaffected strainer to reach its dP limit and alarm setpoint. As the strainer clogs, the PHE SW outlet control valve will open further to compensate for the macrofouling in the strainer. Eventually the SW low flow alarm setpoint and/or strainer high dP alarm setpoint would be reached. Both PHEs will continue to remove their design basis heat load until the heat exchanger low flow setpoint is reached due to the gradual clogging of the strainer. The PHE will remain functional with reduced flow rate; however, depending on bay temperature and/or accident condition, the heat exchanger may not be capable of removing the design basis heat load. This scenario is a slow developing process which will provide the operator with sufficient time to investigate and implement corrective actions *(see Note 1)*.

- Flushing valve remains shut - The flushing valve is designed to fail shut on loss of power or instrument air. If the flushing valve fails to open when required, the abnormal strainer flushing cycle would provide the operator with an alarm, prompting investigation. This may eventually cause the affected strainer to reach its dP limit and alarm setpoint. Initially, the affected side PHE outlet SW control valve will open further to compensate for the macrofouling in the strainer. Eventually the SW low flow alarm setpoint and/or strainer dP alarm setpoint would be reached. The flushing circuit on the unaffected strainer would continue to function. Both PHEs will continue to remove their design basis heat load until the heat exchanger low flow setpoint is reached on the affected side (recall that this is a common alarm). The PHE will remain functional with reduced flow rate; however, depending on bay temperature and/or accident condition, the heat exchanger may not be capable of removing the design basis heat load. This scenario is a slow developing process which will provide the operator with sufficient time to investigate and implement corrective actions *(see Note 1)*.

- Diverter fails open - The diverter valve is designed to fail open on loss of power or air. If the diverter fails to shut during the regeneration cycle, the abnormal strainer flushing cycle would provide the operator with an alarm, prompting investigation. This failure would lead to less effective flushes, probably resulting in an increased number of automatically-initiated flushes on high strainer dP. This would eventually have the same effect as a flushing valve failing closed; however, this event would be slower in reaching the PHE low flow alarm setpoint *(see Note 1)*.

- Diverter fails shut - The diverter valve is designed to fail open on loss of power or air. If the diverter fails to fully reopen during the flush cycle, the abnormal strainer flushing cycle would provide the operator with an alarm, prompting investigation. The number of automatic strainer flushes initiated by high dP would increase. Eventually this would have the same effect as a flushing valve failing closed. However, since the effective strainer area is reduced by this event, the PHE low flow setpoint may be reached sooner than in other events *(see Note 1)*.

Note 1: The operator has the option to deenergize the controls for the failed strainer and initiate manual flushes of the unaffected strainer, or allow the unaffected strainer to resume its automatic flushing sequence (**exception**: not available if the flushing valve is stuck open).

The operator also has the ability to isolate any strainer-PHE combination and could thus remove the affected component and one associated CAC from service. This would maintain the remainder of the associated SW, SRW, and CC subsystems operable. Failure to take any corrective action might eventually result in the loss of the associated SRW subsystem. However, the other SW and SRW subsystems would be unaffected and capable of removing the full design accident heat load.

B. CONTROL VALVES

This modification adds a number of control valves to the SW System. The failure modes of these valves are discussed below:

The existing No. 11 and 12 SRW heat exchanger outlet SW control valves are being replaced by control valves in each subsystem at the outlet of each PHE and in the bypass line. However, as discussed previously, these valves will no longer receive a SIAS or RAS.

For the PHE SW outlet control valves, a flow controller is used to modulate the valve at the predetermined flow setting. This is accomplished by using a flow element, a FIC, a valve positioner, and solenoid and instrument air valves. The PHE bypass line control valves utilize some of the same type of valve position controls; however, the position of the SW bypass control valve for each SW subsystem will be automatically controlled by a PIC. The PIC will maintain SW header pressure in a pre-established band selected to meet the range of conditions that might exist during normal operation or after accident conditions. Again, no automatically-generated safety signal alters the positions of any of these new control valves during a design bases event. The positions of the control valves are determined by the FIC flow setting or PIC pressure setting.

Should the control valves fail, they are designed to fail in a fail-safe position. The heat exchanger SW outlet control valves will fail open upon loss of power or instrument air to ensure continued flow to the heat exchanger. To prevent pump runout and ensure adequate flow to the PHEs, the heat exchanger bypass valves are designed to fail shut upon loss of power or instrument air.

Should a bypass valve fail closed, the PHE SW outlet control valves will maintain the flow through the PHEs at the setpoint provided for the FICs. The safety-related functions of the SW and SRW Systems would not be immediately impacted. If this occurs prior to a RAS, the total SW flow will drop below the minimum required for the SW pump (10,000 gpm). This will not lead to immediate pump failure, however, it must be corrected for continued pump reliability. The operator can raise flow by remotely opening the PHE SW outlet valves until RAS. If the failure exists post-RAS, continued pump operation is possible with the SRW PHE FICs operating at their normal setpoint and the CC heat exchanger on line. Post-RAS, minimum flow is ensured by the operator maintaining SW header pressure within the prescribed limits. Failure to restore minimum pump flow could eventually lead to failure of the SW pump and loss of the associated subsystem. The other SW subsystem would be unaffected and capable of removing the full design accident heat load.

Should either one of the PHE SW outlet control valves fail open, SW flow to the associated PHE will be increased, improving the components' heat removal capability. The other PHE on the subsystem would continue to operate. Total system flow (SW header pressure) can still be automatically adjusted by the bypass line control valves. For this scenario, the SW or SRW safety-related loads will function as designed. Post-RAS, the operator may need to reduce flow through the bypass line in order to achieve the minimum required flow to the CC heat exchanger. This can be done by raising the set pressure on the associated PIC or by shutting the bypass valve. The other SW subsystem would be unaffected by this failure and remain capable of removing the full design accident heat load

In the event that all three valves on one train fail simultaneously; i.e., PHE SW outlet control valves fail open and the bypass line control valve fails close, the heat exchangers' heat removal capacity will increase. All pre-RAS design functions will continue to be performed. Post-RAS this may result in insufficient SW flow to the CC heat exchangers. However, the CC system is designed to perform its function with the failure of a CC heat exchanger. Also, with the new design, the operator has the option to isolate one PHE and its associated CAC. The remaining PHE will have the capacity to support the operation of one CAC and a DG (no DG on No. 11 subsystem) at most expected SW temperatures. The loss of one heat exchanger in the existing system would result in the loss of its associated CACs and DG. With the one PHE secured, the SW subsystem has the capacity to support operation of the CC heat exchanger and the ECCS cooler. The other SW subsystem would be unaffected and capable of removing the full design accident heat load.

The failure of any control valve into a position other than its fail safe position is highly unlikely. This would require operator error or equipment malfunction, along with instrument air forcing the valve operator to hold the control valve out of position. In any event, this failure would not affect the other SW subsystem, which would remain capable of removing the full design accident heat load.

CONCLUSION

The proposed modification has been determined to constitute an unreviewed safety question as defined in 10 CFR 50.59. We are adding a strainer and a number of control valves which will introduce a potential for malfunctions of a different type from previously evaluated in the UFSAR. In spite of the possibility for the introduction of new malfunctions, the proposed activity is a significant improvement in the method of performing the functions of the SW and SRW Systems. Therefore, per 10 CFR 50.59(2)(c), we request the NRC review and approve the proposed modification through an amendment to our Unit 1 Operating License.

REFERENCES:

(1) Letter from Mr. R. E. Denton (BGE) to NRC Document Control Desk, dated June 30, 1994, Final Response to Generic Letter 89-13, Service Water System Problems Affecting Safety-Related Equipment (TAC Nos. M73978 and M73979)

(2) Letter from Mr. C. H. Cruse (BGE) to NRC Document Control Desk, dated December 29, 1993, Licensee Event Report 93-007, Performance Tests Indicate Possibility of SRW Heat Exchanger Inoperability

(3) Calvert Cliffs Nuclear Power Plant, Units 1 & 2, Updated Safety Analysis Report, Sections 9.5.2.2, "Service Water System" and 9.5.2.3, "Saltwater System," Revision 20

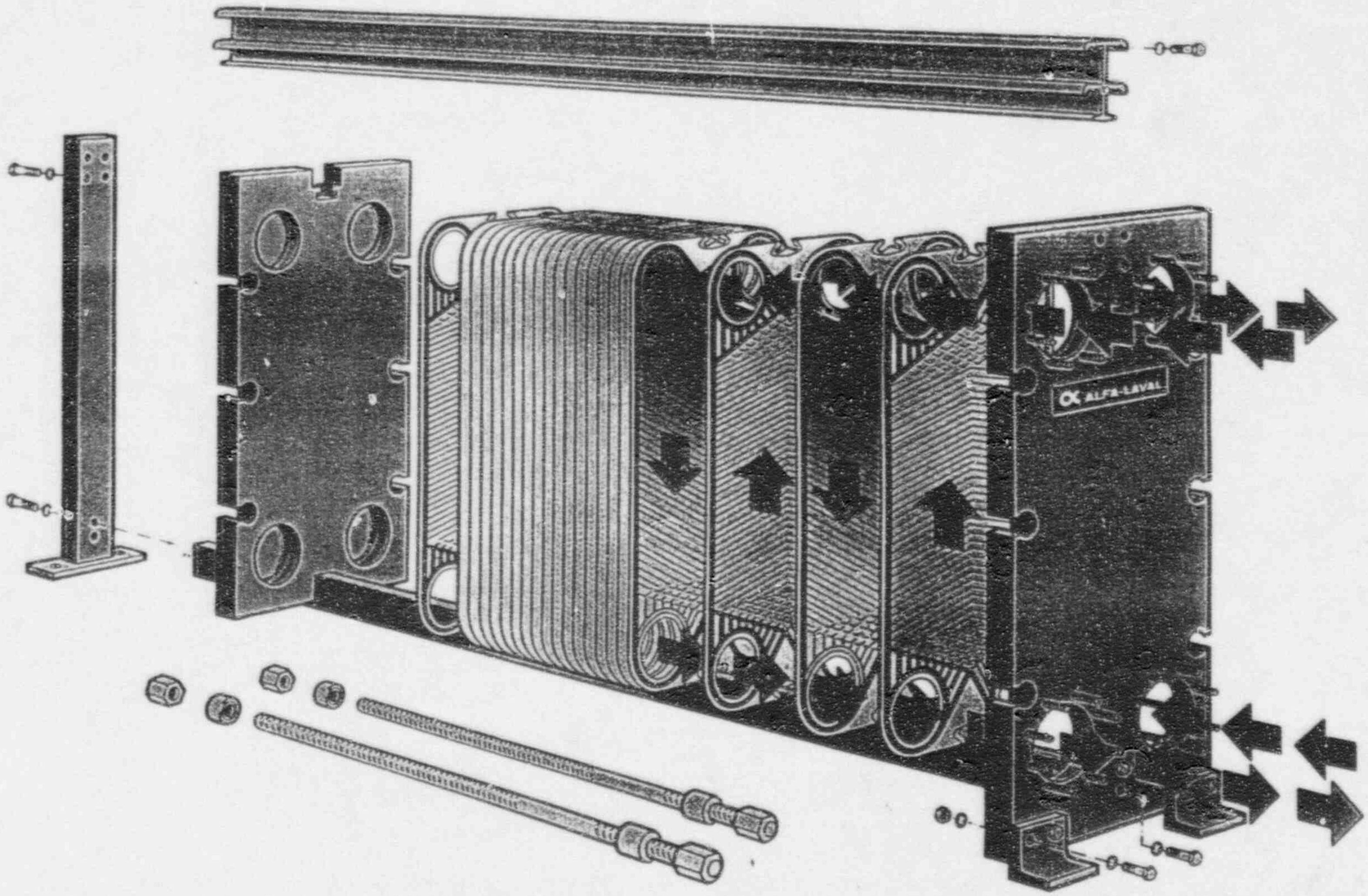

Figure 1
Plate and Frame Heat Exchanger

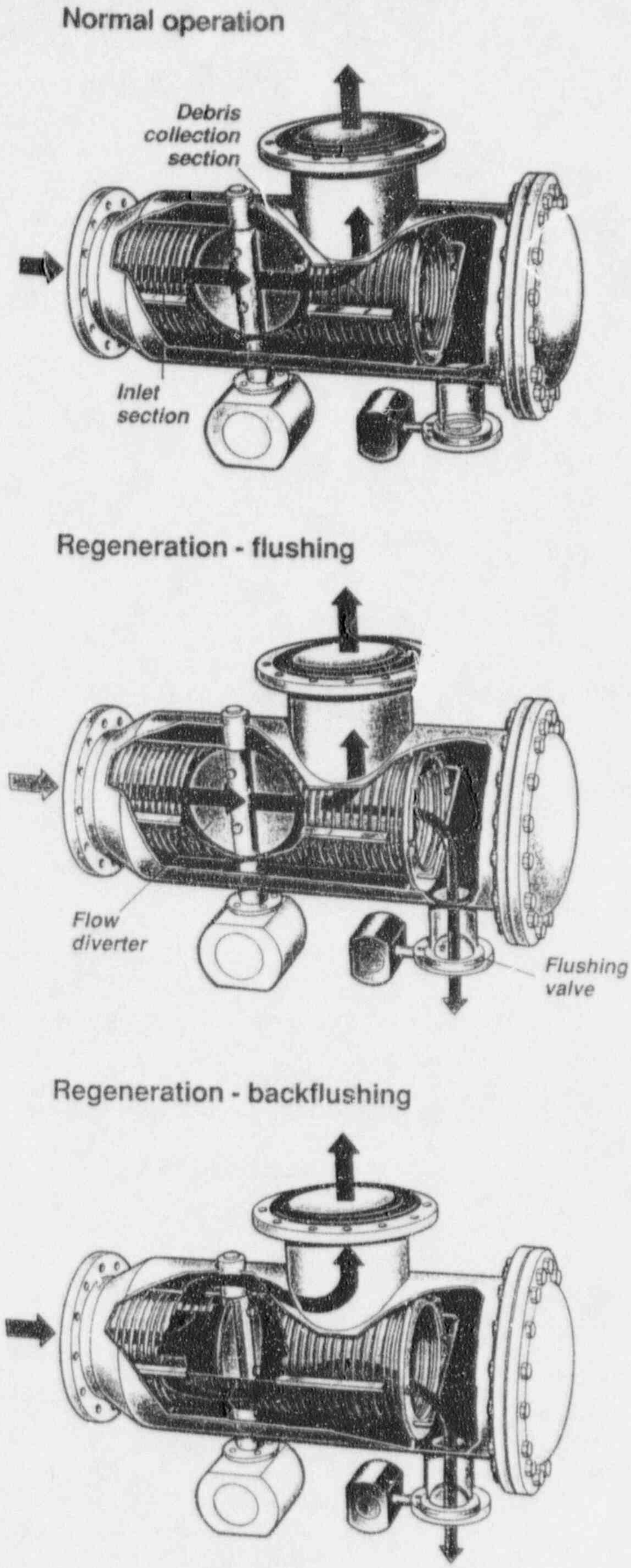

Figure 2
Automatic Flushing Strainer

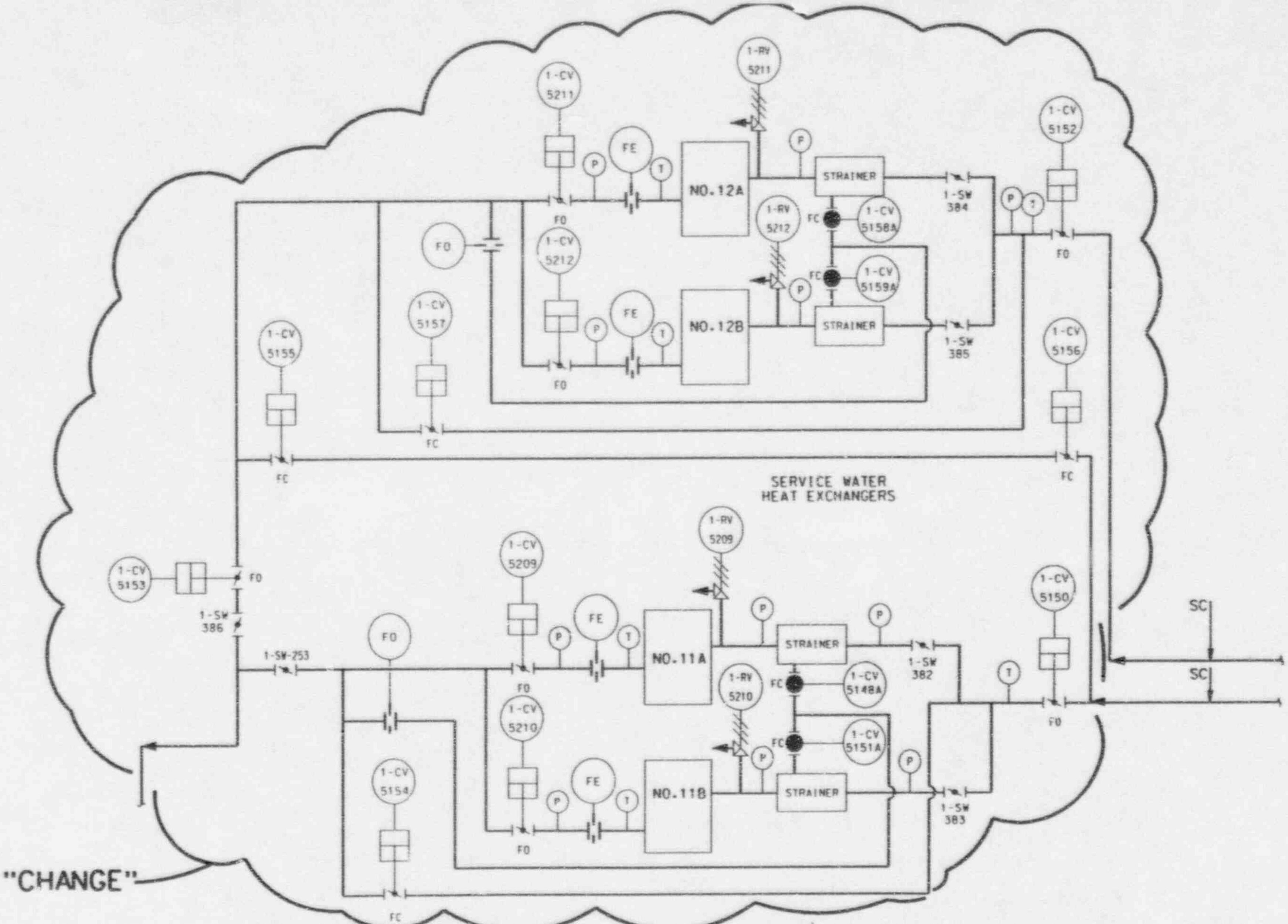

Figure 3
Proposed Change to the Saltwater System

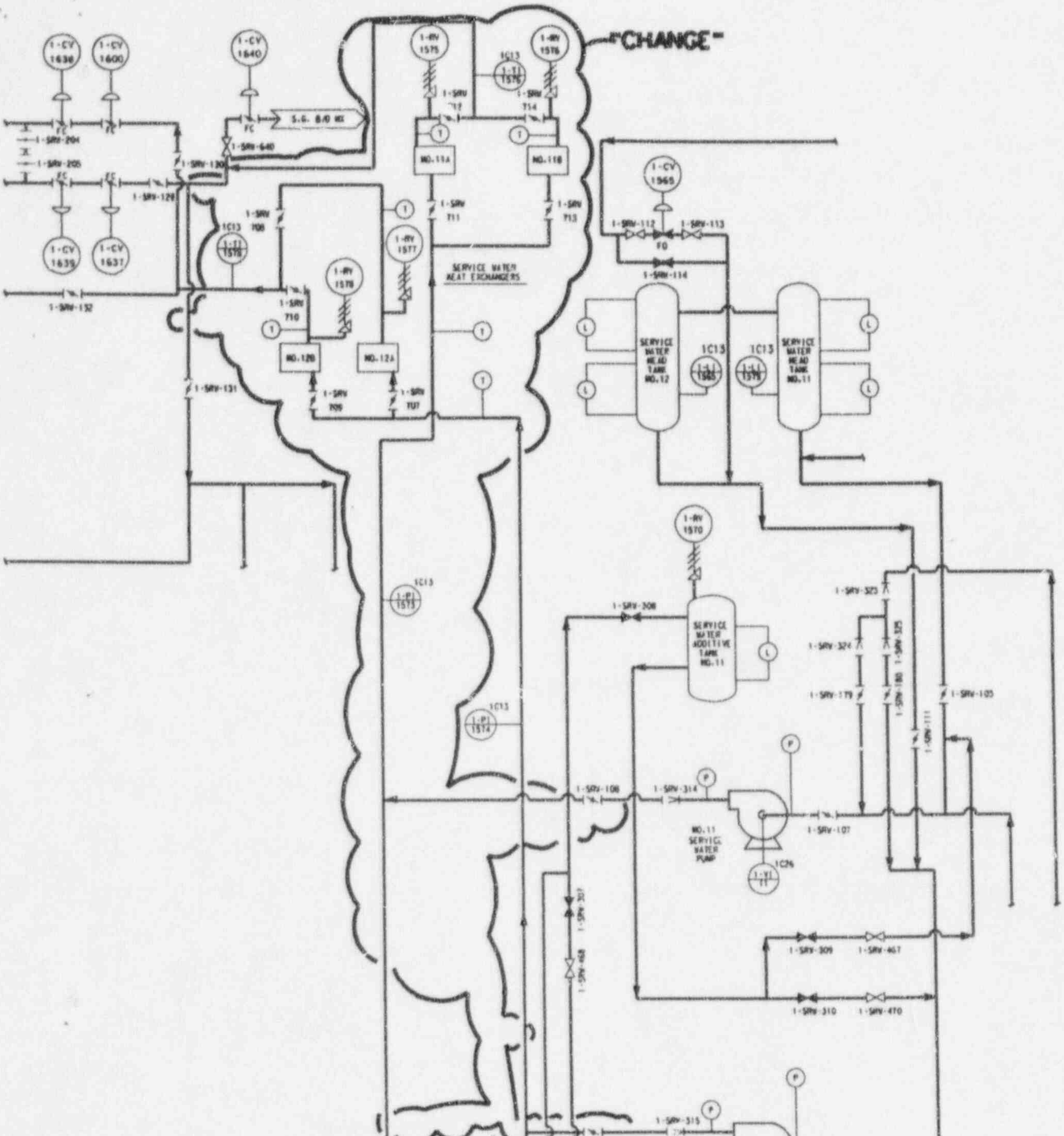

Figure 4
Proposed Change to the Service Water System

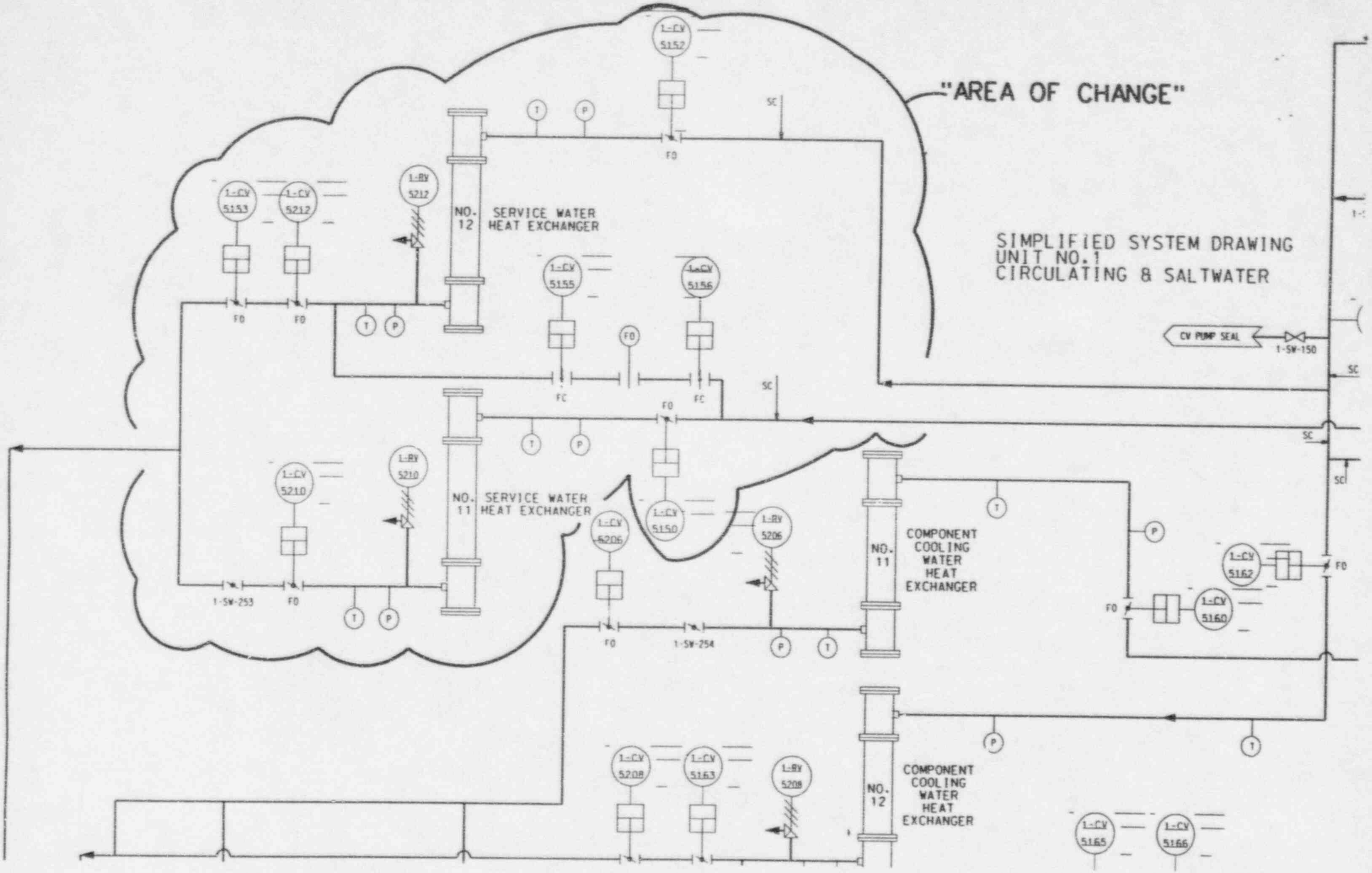

Figure 5
Existing Configuration
Saltwater System

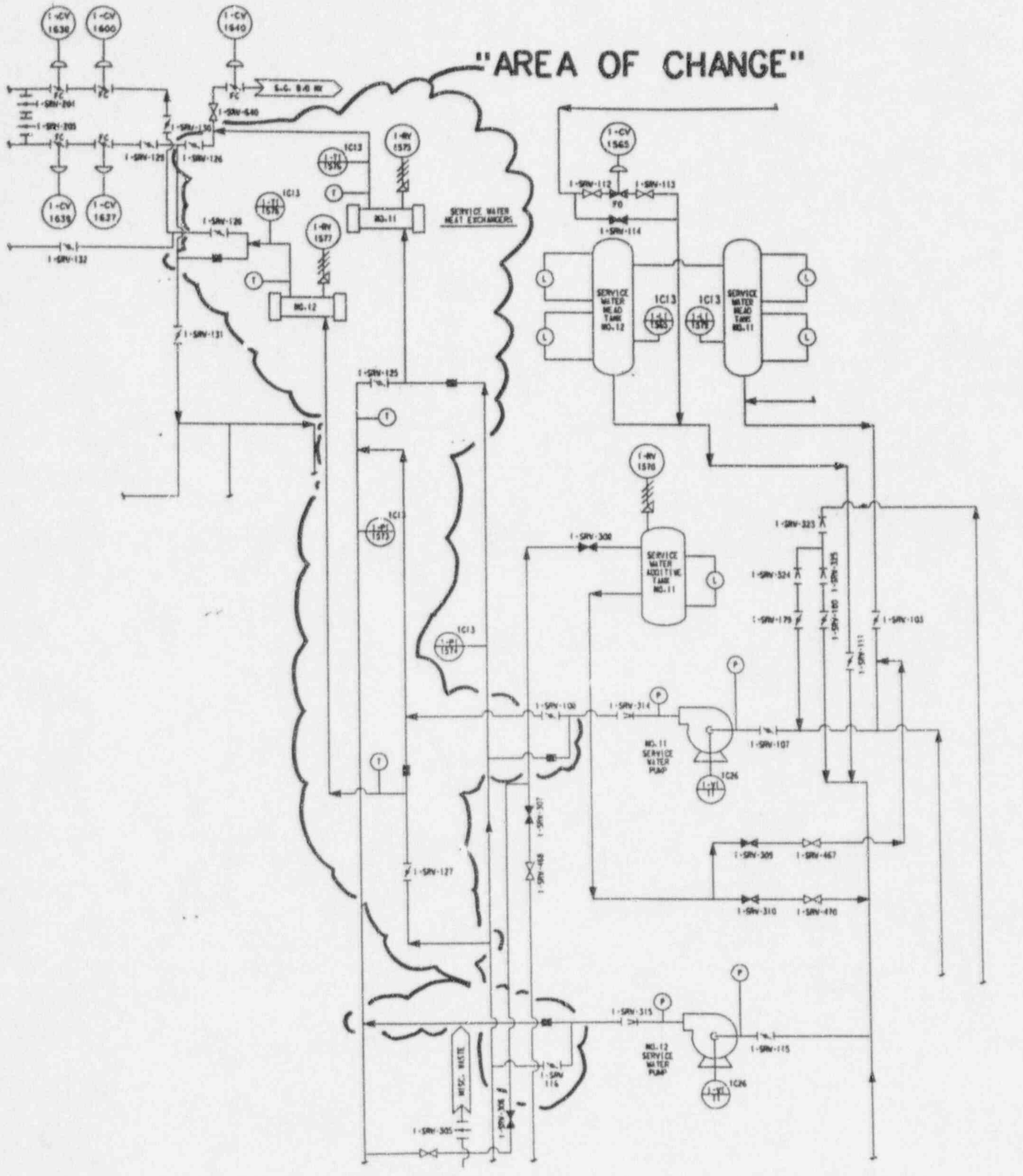

Figure 6
Existing Configuration
Service Water System

ATTACHMENT (2)

DETERMINATION OF SIGNIFICANT HAZARDS

Baltimore Gas & Electric Company
Docket No. 50-317
May 16, 1997

ATTACHMENT (2)

DETERMINATION OF SIGNIFICANT HAZARDS

The proposed modification will replace the existing Service Water (SRW) heat exchangers with new plate and frame heat exchangers having increased thermal performance capability. The Saltwater (SW) and SRW piping configuration will be modified as necessary to allow proper fit-up to the new components. A flow control scheme to throttle SW flow to the heat exchangers and the associated bypass lines will be added. Saltwater strainers with an automatic flushing arrangement will be added upstream of each heat exchanger. The majority of the physical work associated with this modification is restricted to the SRW pump room.

The safety function of the SW and SRW Systems is to provide cooling to the containment air coolers and emergency diesel generators following a design basis accident. With this proposed modification in place, the SW and SRW Systems will continue to meet their safety functions. All of the failure mechanisms for this proposed modification have previously been evaluated and were found acceptable. However, because the proposed modification introduces malfunctions of a different type from any previously evaluated in the Updated Final Safety Analysis Report (UFSAR), this proposed modification has been determined to be an unreviewed safety question.

The proposed change has been evaluated against the standards in 10 CFR 50.92 and has been determined to not involve a significant hazards consideration, in that operation of the facility in accordance with the proposed amendments:

1. *Would not involve a significant increase in the probability or consequences of an accident previously evaluated.*

   None of the systems associated with the proposed modification are accident initiators. The SW and SRW Systems are used to mitigate the effects of accidents analyzed in the UFSAR. The SW and SRW Systems provide cooling to safety-related equipment following an accident. They support accident mitigation functions; therefore, the proposed modification does not increase the probability of an accident previously evaluated.

   The proposed modification will increase the heat removal capacity of the SRW System. The design provided under this activity ensures that the safety features provided by the SW and SRW are maintained, and in some instances enhanced; i.e., the availability of important-to-safety equipment required to mitigate the radiological consequences of an accident described in the UFSAR is enhanced by the flexibility and increased thermal margin provided with this design.

   The redundant cooling capacity of the SW and SRW Systems have not been altered. Furthermore, the proposed activity will not change, degrade, or prevent actions described or assumed in any accident described in the UFSAR. The proposed activity will not alter any assumptions previously made in evaluating the radiological consequences of any accident described in the UFSAR. Therefore, the consequences of an accident previously evaluated in the UFSAR have not increased.

   Therefore, the proposed modification does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. *Would not create the possibility of a new or different type of accident from any accident previously evaluated.*

The proposed activity involves modifying the SW and SRW System components necessary to support the installation of new SRW heat exchangers. None of the systems associated with this modification are identified as accident initiators in the UFSAR. The SW and SRW Systems are used to mitigate the effects of accidents analyzed in the UFSAR. None of the functions required of the SRW or SW System have been changed by this modification. This activity does not modify any system, structure, or component such that it could become accident initiator, as opposed to its current role as an accident mitigator.

Therefore, the proposed change does not create the possibility of a new or different type of accident from any accident previously evaluated.

3. *Would not involve a significant reduction in a margin of safety.*

The safety design basis for the SW and SRW Systems is the availability of sufficient cooling capacity to ensure continued operation of equipment during normal and accident conditions. The redundant cooling capacity of these systems, assuming a single failure, is consistent with assumptions used in the accident analysis.

The design, procurement, installation, and testing of the equipment associated with the proposed modification are consistent with the applicable codes and standards governing the original systems, structures, and components. The design of instruments and associated cabling ensures that physical and electrical separation of the two subsystems is maintained. Common-mode failure is not introduced by this activity. The equipment is qualified for the service conditions stipulated for that environment. New cable and raceways for this design will be installed in accordance with seismic design requirements. The additional electrical load has been reviewed to ensure the load limits for the vital 1E buses are not exceeded. The circuits and components related to the control valves control loops are safety-related, and are similar to those used for the other safety-related flow control functions. The proposed modification will not have any adverse effects on the safety-related functions of the SW and SRW Systems.

For the above reasons, the existing safety bases have not been altered by the proposed modification. This activity will not reduce the margin of safety as it exists now. In fact, the margin of safety has been increased by this activity due to the increase in the thermal capacity of the dual train design and the increased availability of safety-related components.

Therefore, this proposed modification does not significantly reduce the margin of safety.