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NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

SEABROOK 1

50-443

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CAUTION

The information in this report has been developed over an extended period of time based on a site visit, the Final Safety Analysis Report, system and layout drawings, and other published information. To the best of our knowledge, it accurately reflects the plant configuration at the time the information was obtained, however, the information in this document has not been independently verified by the licensee or the NRC.

NOTICE

This sourcebook will be periodically updated with new and/or replacement pages as appropriate to incorporate additional information on this reactor plant. Technical errors in this report should be brought to the attention of the following:

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Corrections and other recommended changes should be submitted in the form of marked up copies of the affected text, tables or figures. Supporting documentation or references should be included if possible.

SEABROOK 1
RECORD OF REVISIONS

REVISION	ISSUE	COMMENTS
0	08/90	Original report

SEABROOK 1 SYSTEM SOURCEBOOK

This sourcebook contains summary information on the Seabrook 1 nuclear power plant. Summary data on this plant are presented in Section 1, and similar nuclear power plants are identified in Section 2. Information on selected reactor plant systems is presented in Section 3, and the site and building layout is illustrated in Section 4. A bibliography of reports that describe features of this plant or site is presented in Section 5. Symbols used in the system and layout drawings are defined in Appendix A. Terms used in data tables are defined in Appendix B.

1. SUMMARY DATA ON PLANT

Basic information on the Seabrook 1 nuclear power plant is listed below:

- Docket number	50-443
- Operator	New Hampshire Yankee
- Location	Seabrook, New Hampshire
- Commercial operation date	5/90
- Reactor type	PWR
- NSSS vendor	Westinghouse
- Number of loops	4
- Power (MWt/MWe)	3411/1150
- Architect-engineer	United Engineers & Contractors, Inc.
- Containment type	Reinforced concrete cylinder with steel liner (primary containment) enclosed in a reinforced concrete secondary containment

2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

Seabrook 1 utilizes a Westinghouse PWR four-loop nuclear steam supply system (NSSS) in a large, dry containment. Other four-loop Westinghouse plants in the United States include:

- Braidwood 1 and 2
- Byron 1 and 2
- Callaway
- Catawba 1 and 2 (ice condenser containment)
- Comanche Peak 1 and 2
- Donald C. Cook 1 and 2 (ice condenser containment)
- Diablo Canyon 1 and 2
- Haddam Neck
- Indian Point 2 and 3
- McGuire 1 and 2 (ice condenser containment)
- Millstone 3 (subatmospheric containment)
- Salem 1 and 2
- Sequoyah 1 and 2 (ice condenser containment)
- South Texas 1 and 2
- Trojan
- Vogtle 1 and 2
- Watts Bar 1 and 2
- Wolf Creek
- Yankee Rowe
- Zion 1 and 2

3. SYSTEM INFORMATION

This section contains descriptions of selected systems at Seabrook 1 in terms of general function, operation, system success criteria, major components, and support system requirements. A summary of major systems at Seabrook 1 is presented in Table 3-1. In the "Report Section" column of this table, a section reference (i.e., 3.1, 3.2, etc.) is provided for all systems that are described in this report. An entry of "X" in this column means that the system is not described in this report. In the "FSAR Section Reference" column, a cross-reference is provided to the section of the Final Safety Analysis Report where additional information on each system can be found. Other sources of information on this plant are identified in the bibliography in Section 5.

Several cooling water systems are identified in Table 3-1. The functional relationships that exist among cooling water systems required for safe shutdown are shown in Figure 3-1. Details on the individual cooling water systems are provided in the report sections identified in Table 3-1.

Table 3-1. Summary of Seabrook 1 Systems Covered in this Report

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor Heat Removal Systems			
- Reactor Coolant System (RCS)	Same	3.1	5
- Auxiliary Feedwater (AFW) and Secondary Steam Relief (SSR) Systems	Emergency Feedwater System, Startup Feedwater System	3.2	6.8, 10.4.12
- Emergency Core Cooling Systems (ECCS)	Same		
- High-Pressure Injection & Recirculation	Safety Injection System, CVCS	3.3	6.3, 9.3.4
- Low-pressure Injection & Recirculation	Residual Heat Removal (RHR) System	3.3	6.3, 5.4.7
- Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System)	Residual Heat Removal (RHR) System	X	5.4.7, 6.3
- Main Steam and Power Conversion Systems	Main Steam Supply System Condensate and Feedwater Systems, Circulating Water System	X	10.3 10.4.7 10.4.5
- Other Heat Removal Systems	None identified	-	-
Reactor Coolant Inventory Control Systems			
- Chemical and Volume Control System (CVCS) (Charging System)	Same	3.4	9.3.4
- ECCS	See ECCS, above	-	-

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Table 3-1. Summary of Seabrook 1 Systems Covered in this Report (Continued)

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Containment Systems			
- Containment	Same	X	6.2.1
- Containment Heat Removal Systems	Same	-	-
- Containment Spray Systems	Containment Buiding Spray System	3.9	6.2.2
- Containment Fan Cooler System	Containment Structure Cooling System	3.9	9.4.5
- Containment Normal Ventilation Systems	Containment Enclosure Area Cooling and Ventilation System	3.9	9.4.6
- Combustible Gas Control Systems	Same	X	6.2.5
Reactor and Reactivity Control Systems			
- Reactor Core	Same	X	4
- Control Rod System	Control Rod Drive System	X	4.6
- Boration Systems	See CVCS, above	-	-
Instrumentation & Control (I&C) Systems			
- Reactor Protection System (RPS)	Reactor Trip System	3.5	7.2
- Engineered Safety Feature Actuation System (ESFAS)	Same	3.5	7.3
- Remote Shutdown System	Remote Safe Shutdown (RSS) Panels	3.5	7.4.2, 7.4.3
- Other I&C Systems	Various systems	X	7.5, 7.6, 7.7

Table 3-1. Summary of Seabrook 1 Systems Covered in this Report (Continued)

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Support Systems			
- Class 1E Electric Power System	Same	3.6	8.1.3, 8.3.1, 8.3.2
- Non-Class 1E Electric Power System	Same	X	8.1.1, 8.1.2, 8.2
- Diesel Generator Auxiliary Systems	Same	3.6	9.5.4 thru 9.5.8
- Component Cooling Water (CCW) System	Primary Component Cooling Cooling Water System	3.7	9.2.2
- Service Water System (SWS)	Same	3.8	9.2.1
- Other Cooling Water Systems	None Identified	-	-
- Fire Protection Systems	Same	X	9.5.1
- Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems	Same	X	9.4.1 thru 9.4.15
- Instrument and Service Air Systems	Compressed Air Systems	X	9.3.1
- Refueling and Spent Fuel Systems	Spent Fuel Pool Cooling and Cleanup System, Fuel Handling System	X	9.1.3, 9.1.4
- Radioactive Waste Systems	Radioactive Waste Management Systems	X	11
- Radiation Protection Systems	Same	X	12

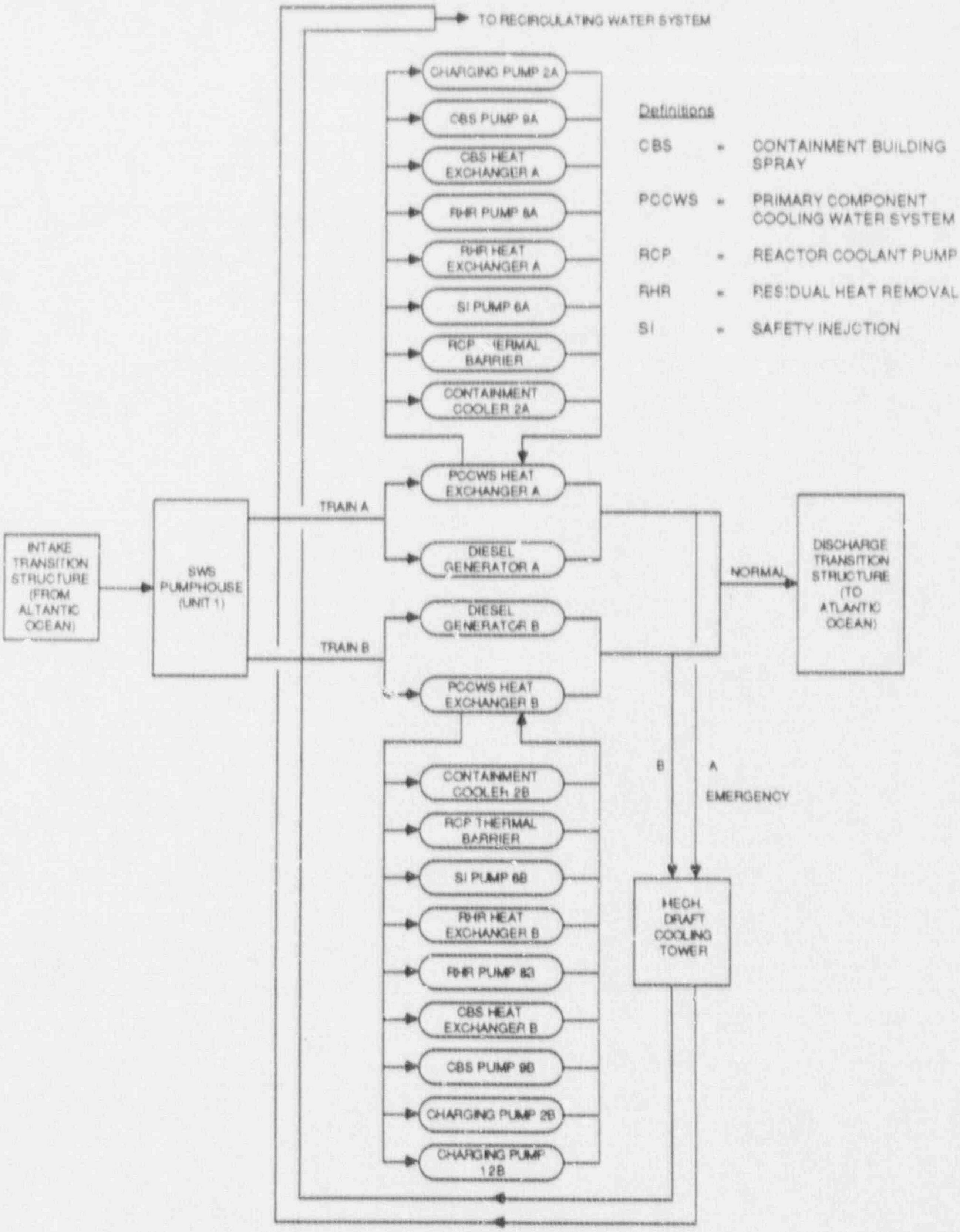


Figure 3-1. Cooling Water Systems Functional Diagram for Seabrook 1

3.1 REACTOR COOLANT SYSTEM (RCS)

3.1.1 System Function

The RCS transfers heat from the reactor core to the secondary coolant system via the steam generators. The RCS pressure boundary also establishes a boundary against the uncontrolled release of radioactive material from the reactor core and primary coolant.

3.1.2 System Definition

The RCS includes: (a) the reactor vessel, (b) four parallel reactor coolant loops, (c) reactor coolant pumps, (d) the primary side of the steam generators, (e) a pressurizer, and (f) connected piping out to a suitable isolation valve boundary. An isometric drawing of a four-loop Westinghouse RCS is shown in Figure 3.1-1. Simplified diagrams of the RCS and important system interfaces are shown in Figures 3.1-2 and 3.1-3. A summary of data on selected RCS components is presented in Table 3.1-1.

3.1.3 System Operation

During power operation, circulation in the RCS is maintained by one reactor coolant pump in each of the four reactor coolant loops. RCS pressure is maintained within a prescribed band by the combined action of pressurizer heaters and pressurizer spray. RCS coolant inventory is measured by pressurizer water level which is maintained within a prescribed band by the chemical and volume control system (CVCS).

At power, core heat is transferred to secondary coolant (feedwater) in the steam generators. The heat transfer path to the ultimate heat sink is completed by the main steam and power conversion system and the circulating water system.

Following a transient or small LOCA (if RCS coolant inventory is maintained), reactor core heat is still transferred to secondary coolant in the steam generators. Flow in the RCS is maintained by the reactor coolant pumps or by natural circulation. The heat transfer path to the ultimate heat sink can be established by using the secondary steam relief system to vent main steam to atmosphere when the power conversion and circulating water systems are not available. If reactor core heat removal by this alternate path is not adequate, the RCS pressure will increase and a heat balance will be established in the RCS by venting steam or reactor coolant to the quench tank through the pressurizer relief valves. There are two power-operated relief valves (each in series with a motor-operated block valve) and three safety valves on the pressurizer. A continued inability to establish adequate heat transfer to the steam generators will result in a LOCA-like condition (i.e., continuing loss of reactor coolant through the pressurizer relief valves). Repeated cycling of these relief valves has resulted in valve failure (i.e., relief valve stuck open).

Following a large LOCA, reactor core heat is dumped to the containment as reactor coolant and ECCS makeup water spills from the break. For a short period, the containment can act as a heat sink; however, the containment cooling systems must operate in order to complete a heat transfer path to the ultimate heat sink.

3.1.4 System Success Criteria

The RCS "success" criteria can be represented in terms of LOCA and transient mitigation, as follows:

- An unmitigatable LOCA is not initiated.
- If a mitigatable LOCA is initiated, then LOCA mitigating systems are successful.
- If a transient is initiated, then either:

- RCS integrity is maintained and transient mitigating systems are successful, or
- RCS integrity is not maintained, leading to a LOCA-like condition (i.e. stuck-open safety or relief valve, reactor coolant pump seal failure), and LOCA mitigating systems are successful.

3.1.5 Component Information

A. RCS
   1. Total system volume, including pressurizer: 12,265 ft^3
   2. Normal operating pressure: 2235 psig

B. Pressurizer
   1. Internal volume, full power: 1800 ft^3
   2. Design pressure: 2485 psig

C. Reactor Coolant Pumps (4)
   1. Rated flow: 100,600 gpm @ 288 ft. head (124.8 psid)
   2. Type: Vertical, single-stage, centrifugal

D. Power-Operated Relief Valves (2)
   1. Set pressure: 2485 psig
   2. Relief capacity: 210,000 lb/hr (each) @ 2385 psig

E. Safety Valves (3)
   1. Set pressure: 2485 psig
   2. Relief capacity: 420,000 lb/hr (each)

F. Steam Generators (4)
   1. Type: Vertical shell and U-tube
   2. Model: F
   3. Steam flow: 3.78 x 10^6 lb/hr

3.1.6 Support Systems and Interfaces

A. Motive Power
   1. The reactor coolant pumps are supplied from Non-Class 1E switchgear.
   2. There are four banks of pressurizer heaters. Two banks are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.6. The remaining two banks are Non-Class 1E AC loads that are powered from 480 VAC buses 11 and 12.

B. Reactor Coolant Pump Seal Injection Water System
   The charging system (see Section 3.4) supplies seal water to cool the reactor coolant pump shaft seals and to maintain a controlled in leakage of seal water into the RCS. Loss of seal water flow may result in RCS leakage through the pump shaft seals which will resemble a small LOCA. If loss of seal injection flow should occur, the thermal barrier heat exchanger, which is cooled by the primary component cooling water system (see Section 3.8), cools the reactor

coolant to an acceptable level before it enters the pump bearing and the shaft seal area (Ref. 1).

3.1.7 Section 3.1 References

1. Seabrook 1 FSAR, Section 5.

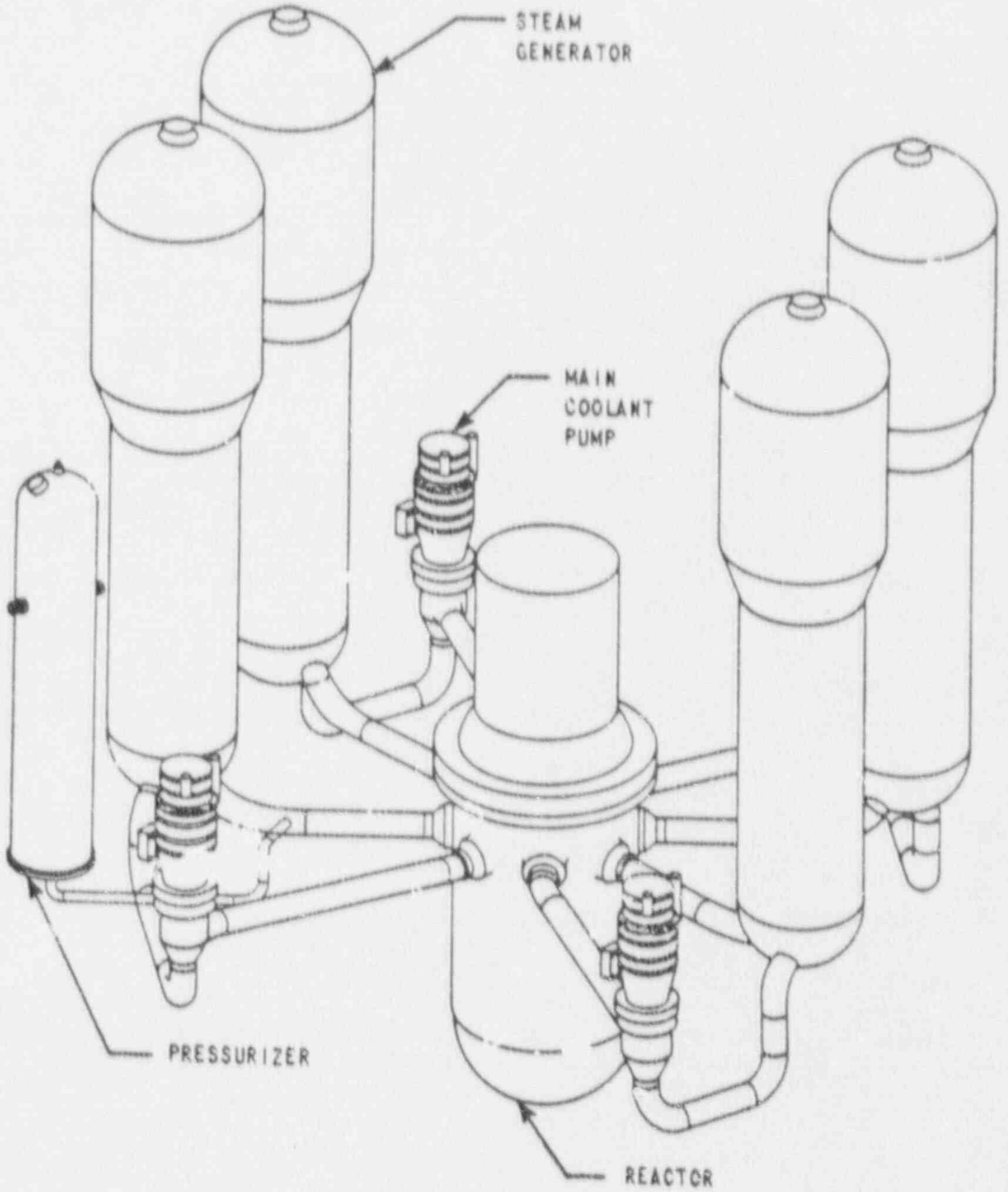


Figure 3.1-1. Isometric View of a 4-Loop Westinghouse RCS.

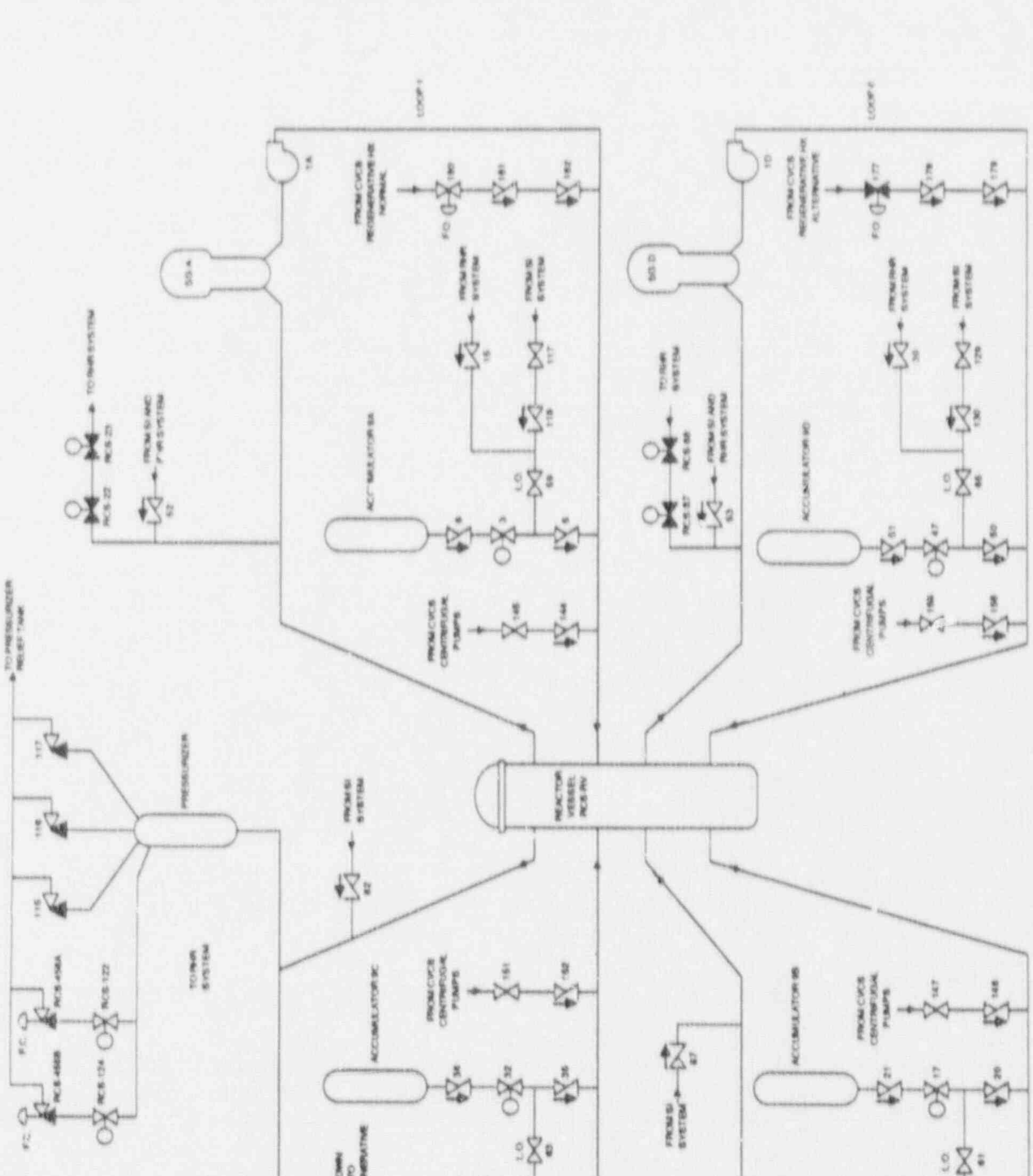


Figure 3.1-2. Seabrook 1 Reactor Coolant System

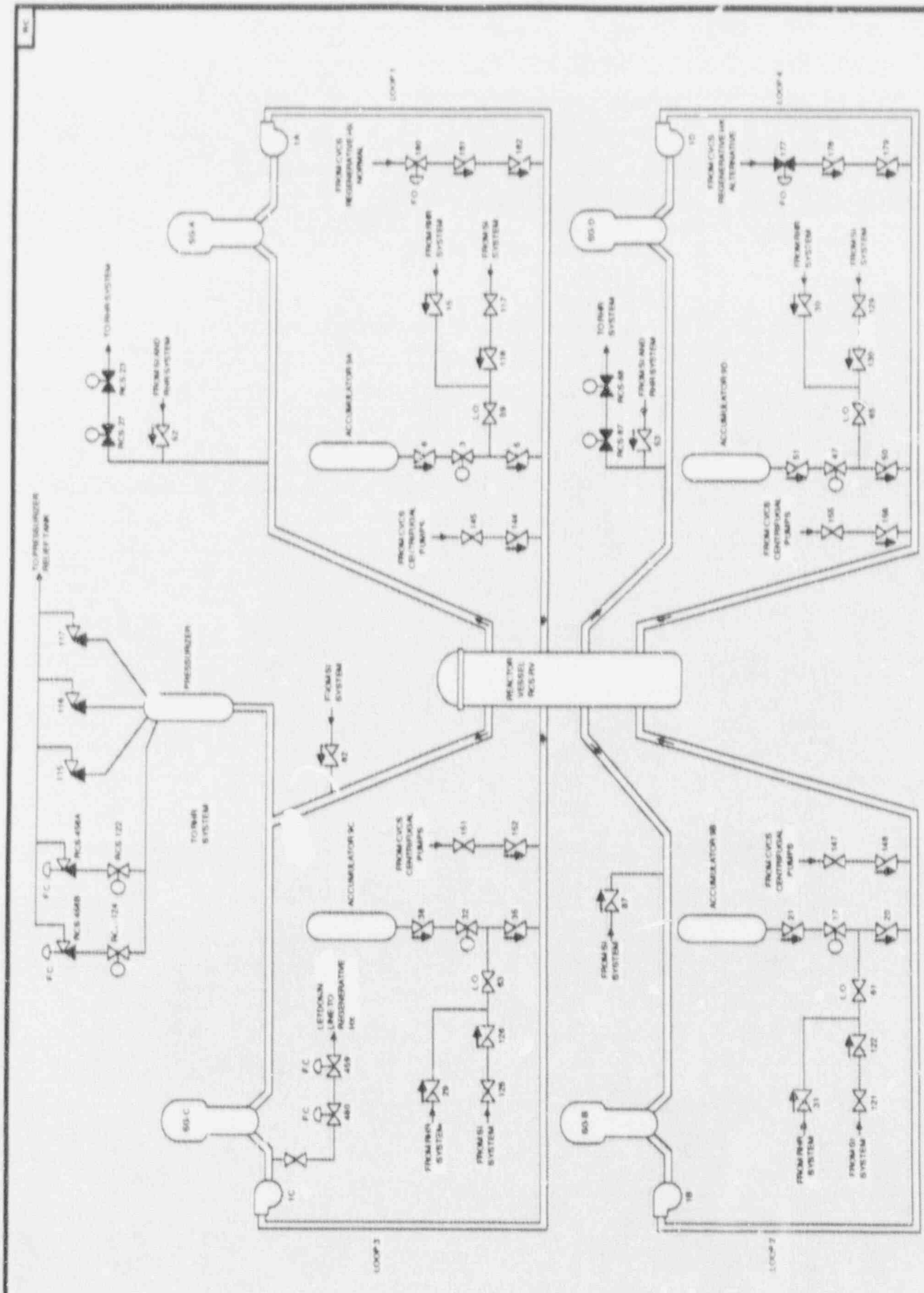


Figure 3.1-3. Seabrook 1 Reactor Coolant System Showing Component Locations

Table 3.1-1. Seabrook 1 Reactor Coolant System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RCS-122	MOV	RC	EP-MCC-521	480	SWGRMA	AC/A
RCS-124	MOV	RC	EP-MCC-621	480	SWGRMB	AC/B
RCS-22	MOV	RC	EP-MCC-621	480	SWGRMB	AC/B
RCS-23	MOV	RC	EP-MCC-521	480	SWGRMA	AC/A
RCS-456A	NV	RC	EP-BS-11A	125	SWGRMA	DC/A
RCS-456B	NV	RC	EP-BS-11B	125	SWGRMB	DC/B
RCS-87	MOV	RC	EP-MCC-621	480	SWGRMB	AC/B
RCS-88	MOV	RC	EP-MCC-521	480	SWGRMA	AC/A
RCS-RV	RV	RC				

3.2 EMERGENCY FEEDWATER SYSTEM (EFWS) AND SECONDARY STEAM RELIEF SYSTEM (SSRS)

3.2.1 System Func

The EFWS provides a source of feedwater to the steam generators to remove heat from the reactor coolant system (RCS) when: (a) the main feedwater system is not available, and (b) RCS pressure is too high to permit heat removal by the residual heat removal (RHR) system. The Secondary Steam Relief System (SSRS) provides a steam vent path from the steam generators to the atmosphere, thereby completing the heat transfer path to an ultimate heat sink when the main steam and power conversion systems are not available. Together, the EFWS and SSRS constitute an open-loop fluid system that provides for heat transfer from the RCS following transients and small-break LOCAs.

3.2.2 System Definition

The Seabrook 1 Emergency Feedwater System, also known as the Auxiliary Feedwater System, is a safety-class system consisting of two pumps (one motor-driven and one steam turbine-driven), valves, and associated piping. The EFWS is augmented by a nonsafety-class system, the Startup Feed Pump System (SUFPS), which consists of one motor-driven pump, valves, and associated piping.

The elements of the SUFPS are located in the turbine building. The SUFPS pump takes a suction from the Condensate Storage Tank (CST) and discharges to the main feedwater pump discharge header, the make-up header from the CST, the steam generator recirculation pump discharge header, and the EFWS pump discharge header. Simplified drawings of the SUFPS are shown in Figures 3.2-1 and 3.2-2.

The elements of the EWFS are located in the emergency feedwater pump building. The system's pumps are each capable of providing 100% of the required cooling flow. One pump is motor-driven, and the second pump is steam turbine-driven with steam supplied from either steam generator A or B. Both pumps take suction from the CST. Simplified drawings of the EFWS are shown in Figures 3.2-3 and 3.2-4.

The SSRS consists of five safety valves and one hydraulically operated atmospheric relief valve on each of the four main steam lines, as shown in Figures 3.2-3 and 3.2-4.

3.2.3 System Operation

During normal operation, both the SUFPS and EFWS are in standby. The SUFPS pump starts automatically upon loss of both main turbine-driven feedwater pumps unless a safety injection, loss of offsite power, or high-high steam generator level signal also occurs. Given a safety injection, steam generator low-low water level, or loss of offsite power signal, the EFWS will take over. That is, the turbine-driven EFWS pump steam admission valves will open and the motor-driven EFWS pump will automatically start. Both EFWS pumps discharge into a common supply header which supplies four individual lines, one to each of the four steam generator main feedwater lines.

Coolant is supplied to the pumps by the CST. The capacity of the CST is 400,000 gallons, half of which is reserved for use by the EFWS. The EFWS has access to all 400,000 gallons since its connections are at the base of the CST, and the SUFPS has access to 200,000 gallons since its connections are located half-way up the CST.

3.2.4 System Success Criteria

For the decay heat removal function to be successful, both the EFWS and the SSRS must operate successfully (Refs. 1, 2 and 3). The EFWS success criteria are the following:

- Makeup to two of the four steam generators provides adequate decay heat removal from the Reactor Coolant System.
- The turbine-driven EFWS pump or the motor-driven EFWS pump can provide adequate flow. If only the turbine-driven pump is used, it must receive steam from either steam generator A or B, and it must feed the same steam generator that is supplying steam to the turbine.
- If available, the SUFPS pump can provide adequate flow.

3.2.5 Component Information

A. Motor-driven EFWS pump 37B
   1. Rated flow: 710 gpm @ 3050 ft. head (1320 psig)
   2. Rated capacity: 100%
   3. Type: Horizontal, centrifugal

B. Turbine-driven EFWS pump 37A
   1. Rated flow: 710 gpm @ 3050 ft. head (1320 psig)
   2. Rated capacity: 100%
   3. Type: Horizontal, centrifugal

C. Motor-driven SUFPS Pump 113
   1. Rated flow: 1500 gpm @ 3000 ft. head (1300 psig)
   2. Rated capacity: 200%
   3. Type: Horizontal, centrifugal

D. Condensate Storage Tank
   1. Capacity: 400,000 gallons
   2. Reserved capacity: 200,000 gallons

E. Safety Valves (20 total, 5 per main steam line)
   1. Set pressure: 1185 to 1255 psig
   2. Relief capacity: 893,200 to 945,300 lb/hr (per valve)

F. Atmospheric Relief Valves (4 total, 1 per main steam line)
   1. Set pressure: 1135 psia
   2. Relief capacity: 400,000 lb/hr (each) @1135 psia

3.2.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. The EFWS is automatically actuated on either a low-low level in any steam generator, a safety injection signal, or a complete loss of electrical power.
      b. The SUFPS is automatically actuated upon loss of both turbine-driven feedwater main pumps. The SUFPS automatic actuation signal is inhibited by a safety injection, loss of offsite power, or high-high steam generator level signal.
   2. Remote manual
      The turbine-driven EFWS pump steam admission valves can be operated from the main control board (MCB) and the remote safe shutdown (RSS) panel. The motor-driven EFWS pump can be operated from the MCB and the switchgear room.

B. Motive Power
1. The motor-driven EFWS pump and motor-operated valves are Class 1E loads that can be supplied from the standby diesel generators as described in Section 3.6.
2. The turbine-driven EFWS pump is supplied with steam from the main steam lines of either steam generator A or B upstream of the main steam line isolation valves. The power and controls for the steam supply valves are supplied from the Class 1E DC system.
3. The motor-driven SUFPS pump is a non-class 1E load (4160 VAC bus 4).

C. Other
1. Cooling water required for the pumps is supplied locally by the pump discharge.
2. Lubrication is assumed to be provided locally for the EFWS pumps.
3. Lubrication of the SUFPS pump is provided by a motor-driven auxiliary lube oil pump.
4. Systems for SUFPS and EFWS pump room cooling have not been identified.

3.2.7 Section 3.2 References

1. Seabrook 1 Final Safety Analysis Report, Sections 6.8 and 10.3.
2. NUREG/CR-3531, "Review of the Seabrook Units 1 and 2 Auxiliary Feedwater System Reliability Analysis," Brookhaven National Laboratory, February 1984.
3. Seabrook Station Probabilistic Safety Assessment, Section 7.9.

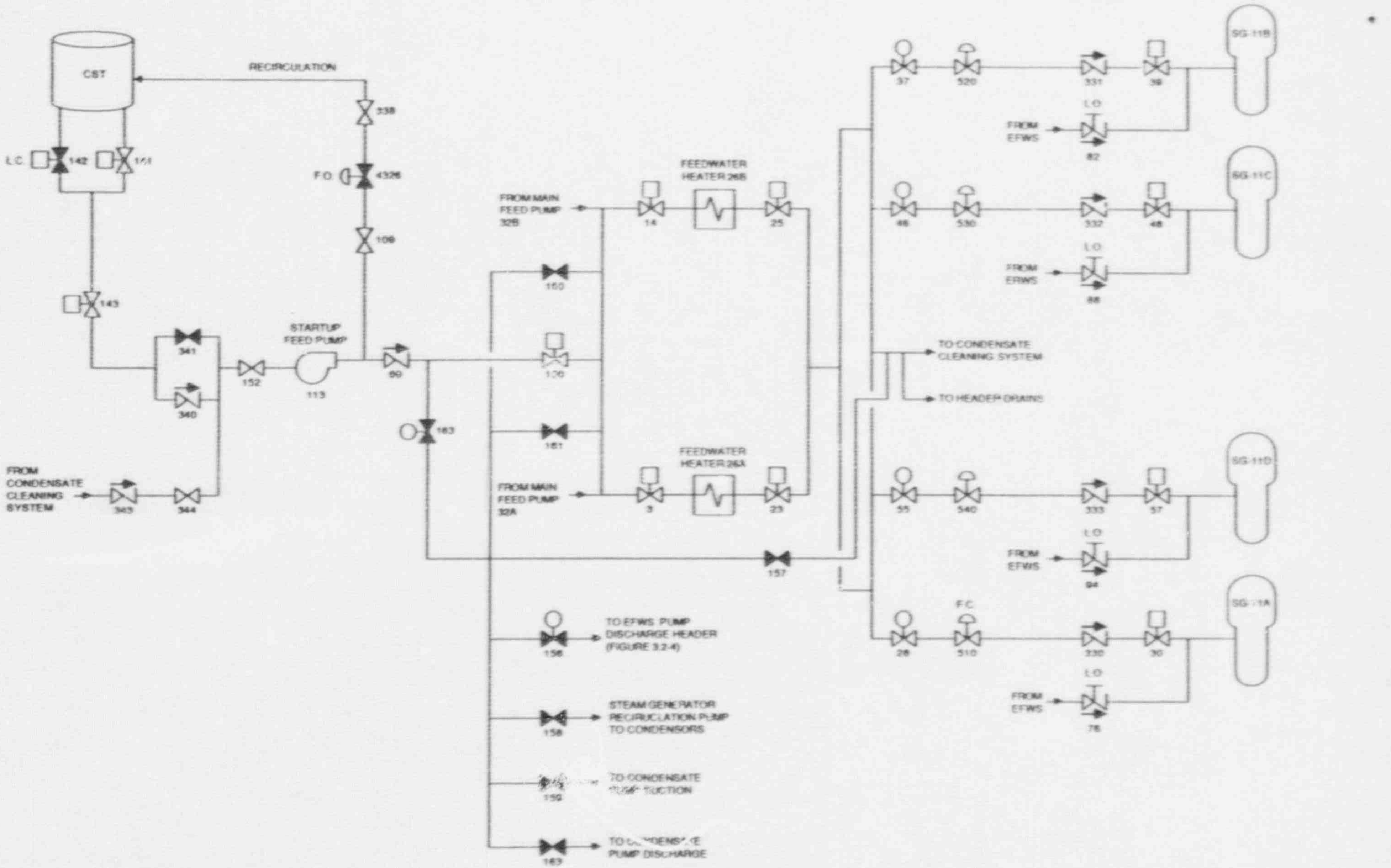


Figure 3.2-1. Seabrook 1 Startup Feed Pump System

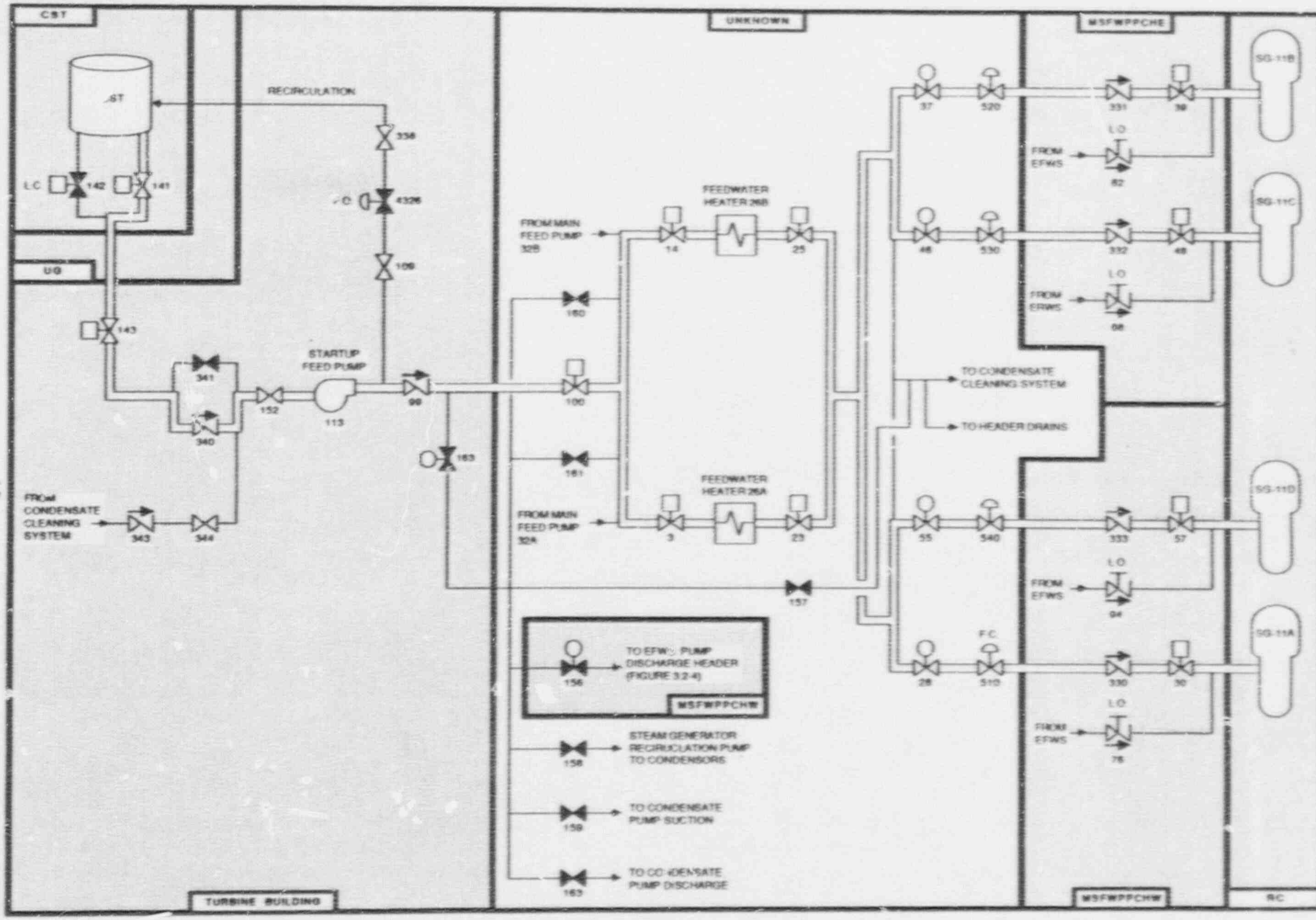


Figure 3.2-2. Seabrook 1 Startup Feed Pump System Showimg Component Locations

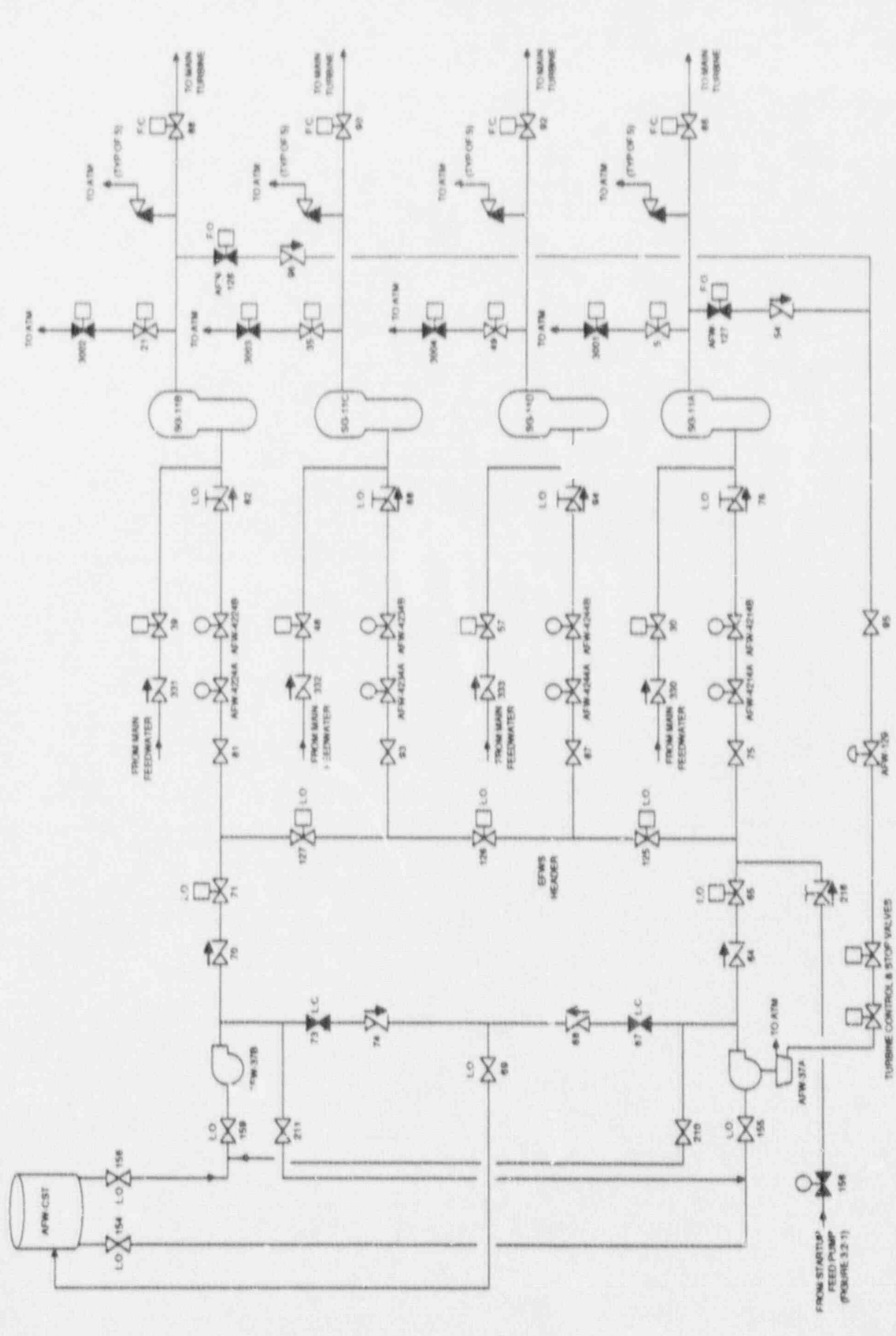


Figure 3.2-3. Seabrook 1 Emergency Feedwater System

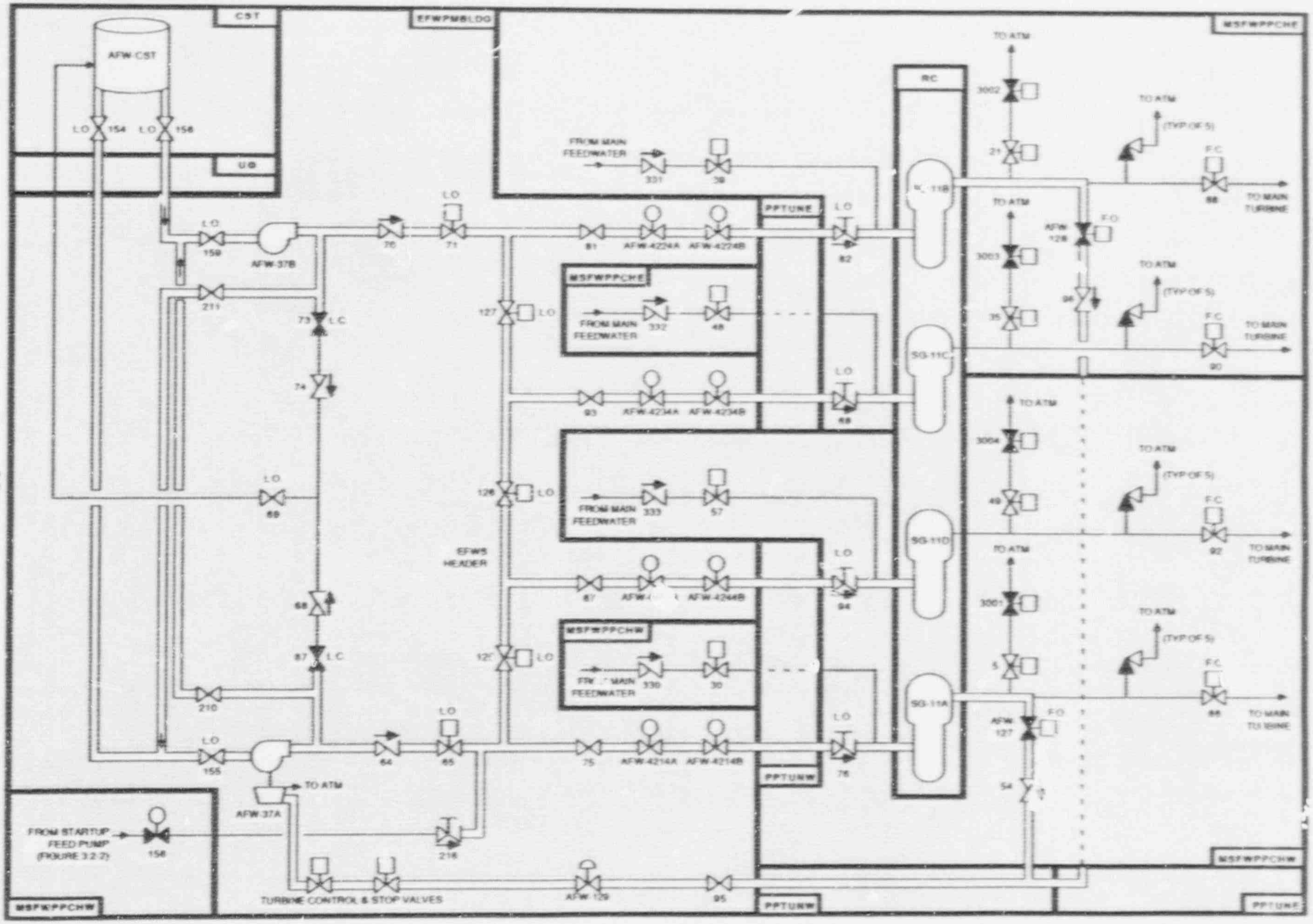


Figure 3.?-4. Seabrook 1 Emergency Feedwater System Showing Component Locations

3.3 EMERGENCY CORE COOLING SYSTEM (ECCS)

3.3.1 System Function

The ECCS, or Safety Injection System (SIS), is an integrated set of subsystems that perform emergency coolant injection and recirculation functions to maintain reactor core coolant inventory and adequate decay heat removal following a LOCA. The coolant injection function is performed during a relatively short-term period after LOCA initiation, followed by realignment to a recirculation mode of operation to maintain long-term, post-LOCA core cooling. Heat from the reactor core is transferred to the containment. The heat transfer path to the ultimate heat sink is completed by the Residual Heat Removal (RHR) system heat exchangers and containment heat removal systems.

3.3.2 System Definition

The emergency coolant injection (ECI) function is performed by the following subsystems:

- Charging System (CVCS, see Section 3.4)
- Safety Injection System
- Accumulators
- Residual Heat Removal System

These systems operate at different pressures from high to low, in the order listed above.

The portion of the CVCS system required for emergency core cooling system (ECCS) function consists of two separate centrifugal charging pump trains, 2A and 2B, whose suction source during injection is the refueling water storage tank (RWST) and during recirculation (in conjunction with the RHR pumps) water is drawn from the containment recirculation sumps. Both centrifugal charging pumps discharge into a common header and subsequently into the four RCS cold legs.

The safety injection (SI) system consists of two separate trains whose suction source during injection is the RWST and during recirculation (in conjunction with the RHR pumps) water is drawn from the containment recirculation sumps. Both SI pumps discharge into a common header which supplies the four RCS cold legs. In addition, the SI pumps can be aligned to supply two headers that deliver water to the four RCS hot legs. The four accumulators of the SI system function independently to discharge water into separate RCS cold legs at a pressure lower than the SI pump shutoff head.

The Residual Heat Removal (RHR) system consists of two separate trains whose suction source during injection is the RWST and during recirculation water is drawn from the containment recirculation sumps. During the injection mode of operation, both RHR pumps discharge into a common header which supplies the four RCS cold legs. If RCS pressure remains high, a recirculation flow path from the containment source is established with the RHR pumps and the SI and/or centrifugal charging pumps operating in tandem. At low RCS pressure, the RHR pumps recirculate water from the sumps directly to the RCS. The RHR system also performs the shutdown cooling function.

Simplified drawings of the safety injection system are shown in Figures 3.3-1 to 3.3-3. The RHR system is shown in Figures 3.3-4 and 3.3-7. The charging system (CVCS) is discussed in Section 3.4. A summary of data on selected ECCS components is presented in Table 3.3-1.

3.3.3 System Operation

During normal operation, most of the ECCS components are in standby mode, except that the CVCS is maintaining primary coolant inventory and boron concentration and is supplying reactor coolant pump seal water. The ECCS is automatically actuated by a Safety Injection "S" signal, which is generated on any of the following conditions:

- Low pressurizer pressure
- High containment pressure
- High steam flow in two of four lines in coincidence with either low T_{avg} or low steam line pressure
- Manual actuation

The accumulators constitute a passive injection system, discharging their contents automatically when RCS pressure drops below the tank pressure. Sufficient borated water is supplied in the four tanks to rapidly fill the volume outside of the core barrel below the nozzles, the bottom plenum, and a portion of the core with the contents of one tank assumed to be lost through the break.

Upon receipt of an SI "S" signal, all pumps start and the CVCS injection valves open. At this time, RCS pressure is decreasing and the charging pumps begin injecting borated RWST water into the RCS. When the pressure decreases below the SI pump shutoff pressure, the SI pumps will start injecting borated water from the RWST into the RCS cold legs. Once the pressure decreases sufficiently, RHR flow is injected into the RCS cold legs.

Transfer of the ECCS from the injection mode to the recirculation mode is initiated automatically in response to coincident RWST "low-low" level signals and an SI signal. At this time, the RHR pumps take suction from the containment recirculation sumps and discharges to the RCS cold legs (assuming RCS pressure has dropped below the shutoff head of the RHR pumps). The SI and CVCS pumps have no direct suction path from the containment recirculation sumps and must be manually aligned in series with the RHR pumps when needed to establish a high-pressure recirculation flow path. In the high-pressure recirculation mode, the train A RHR pump is aligned to discharge to the two centrifugal charging pumps and SI pump 6A, and the train B RHR pump discharges to SI pump 6B. Recirculation can also occur using the hot legs by manually transferring the flow path from the four RCS cold legs to two RCS hot legs. RCS heat removal via an RHR heat exchanger is required during the recirculation phase.

3.3.4 System Success Criteria

LOCA mitigation requires both the emergency coolant injection (ECI) and emergency coolant recirculation (ECR) functions. The four accumulators, two centrifugal charging pumps, two safety injection pumps, and two residual heat removal pumps are all utilized to respond to both large and small LOCAs, with the accumulators and RHR pumps more important for large LOCAs and the charging and safety injection pumps more important for small LOCAs. The ECCS is designed to be successful with a single active failure and one RCS loop assumed to be out of service due to the break.

The RWST is required for system success during the injection phase. Success criteria for the various functions are (Ref. 2):

- Small LOCA: one of two SI or one of two centrifugal charging pumps injecting to two of four RCS cold legs.
- Large LOCA: one of two RHR pumps injecting to two of four RCS cold legs.

High pressure recirculation requires the successful establishment of at least one tandem pumping path from a containment sump to an RHR pump, to one of four SI and centrifugal charging pumps, and finally to two of four RCS cold legs. During the low pressure recirculation phase, one of two RHR pumps taking suction from a containment sump and injecting to two of four RCS cold legs is required. RCS heat removal via an RHR heat exchanger is required during recirculation.

3.3.5 Component Information

A. Safety Injection pumps 6A, 6B
   1. Rated flow: 425 gpm @ 2700 ft. head (1170 psid)
   2. Maximum flow: 660 gpm @ 1700 ft. head (737 psid)
   3. Shutoff head: 3545 ft. head (1540 psid)
   4. Type: Horizontal, multistage, centrifugal

B. Residual Heat Removal pumps 8A, 8B
   1. Rated flow: 3000 gpm @ 375 ft. head (163 psid)
   2. Maximum flow: 5150 gpm @ 275 ft. head (120 psid)
   3. Shutoff head: 460 ft. head (200 psid)
   4. Type: Vertical, single stage, centrifugal

C. Centrifugal charging pumps 2A, 2B
   1. Rated flow: 150 gpm @ 5800 ft. head (2514 psid)
   2. Maximum flow: 550 gpm @ 1400 ft. head (607 psid)
   3. Type: Horizontal, multistage, centrifugal

D. Accumulators (4)
   1. Volume, total: 1350 ft^3 each
   2. Nominal water volume: 850 ft^3 each
   3. Normal operating pressure: 650 psig

E. Refueling Water Storage Tank
   1. Capacity: 475,000 gallons
   2. Operating pressure: atmospheric

F. RHR Heat Exchangers (2)
   1. Type: shell and U-tube
   2. Heat removal capacity: 35.1 x 10^6 Btu/hr

3.3.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. The ECCS subsystems are automatically actuated on any of the following safety injection signals:
         - Low pressurizer pressure
         - High containment pressure
         - High steam flow in two of four lines in coincidence with either low T_{avg} or low steam line pressure
         - Manual actuation

      b. The Safety Injection "S" Signal automatically initiates the following actions:
         - reactor trip
         - starts the diesel generators
         - starts the charging, safety injection, and RHR pumps
         - opens the RWST pump suction and CVCS injection valves

c. Switchover from the injection mode to recirculation is initiated on RWST "low-low" level signals in conjunction with a safety injection signal. This causes the suction valves from the containment sump to open and the RWST isolation valves to close.

2. Remote manual
   a. A safety injection signal can be initiated by remote manual means from the control room. ECCS operation can be initiated by remote manual means.
   b. The control room operator must manually align the RHR pump discharges to supply the SI and/or centrifugal charging pump suctions when a high-pressure recirculation flow path is required.

B. Motive Power
   1. All ECCS motor-driven pumps and motor-operated valves are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.6.

C. Other
   1. Cooling for the charging, safety injection, and RHR pumps is provided by the Primary Component Cooling Water System (see Section 3.8).
   2. Pump lubrication is assumed to be provided locally.
   3. The RHR heat exchangers are cooled by the Primary Component Cooling Water System (see Section 3.8).
   4. Room cooling for the ECCS pump rooms is provided by the containment enclosure cooling system.

3.3.7 Section 3.3 References

1. Seabrook 1 Final Safety Analysis Report, Section 6.3.
2. Seabrook Station Probabilistic Safety Assessment, Section 7.8.

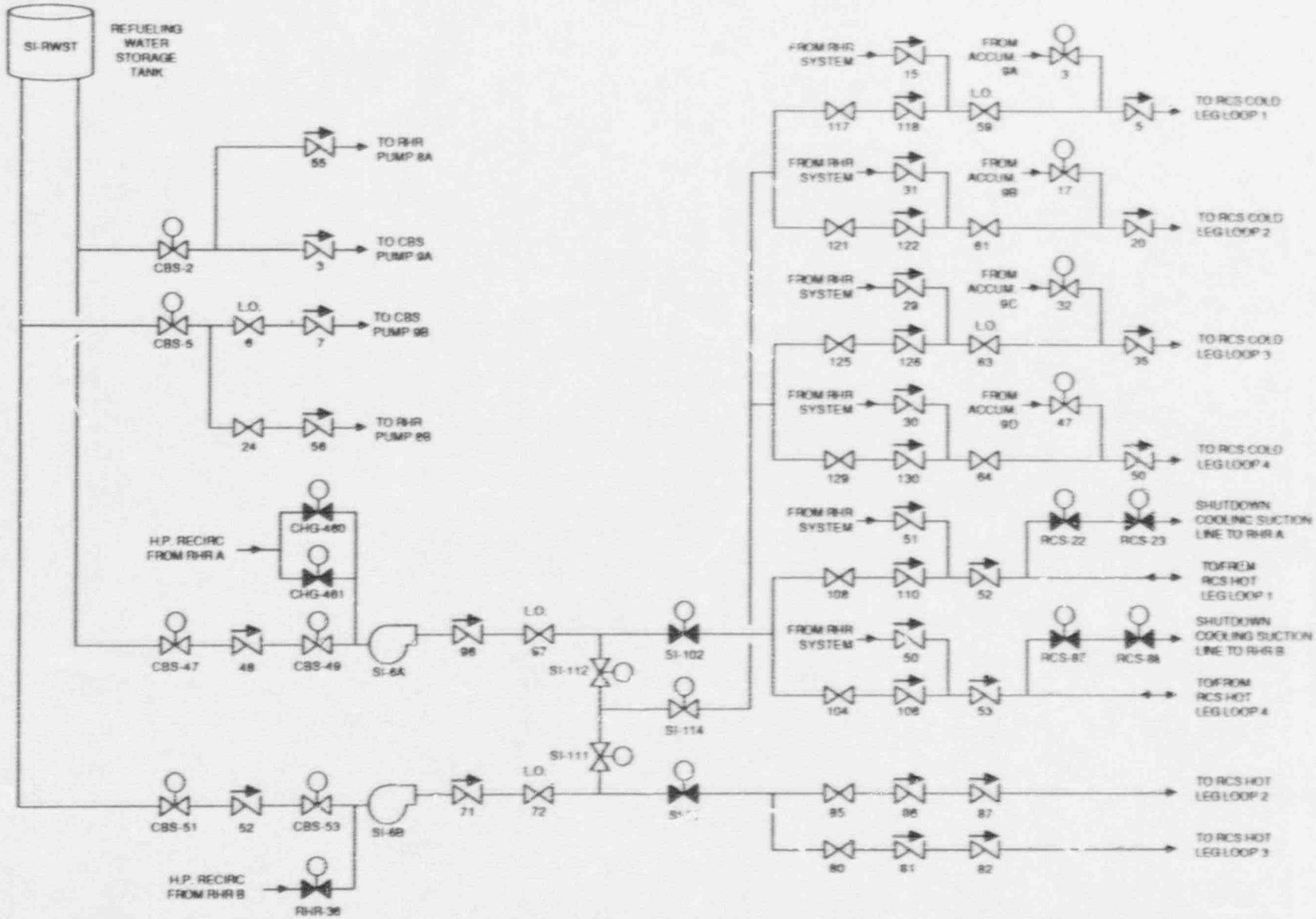


Figure 3.3-1. Seabrook 1 Safety Injection System

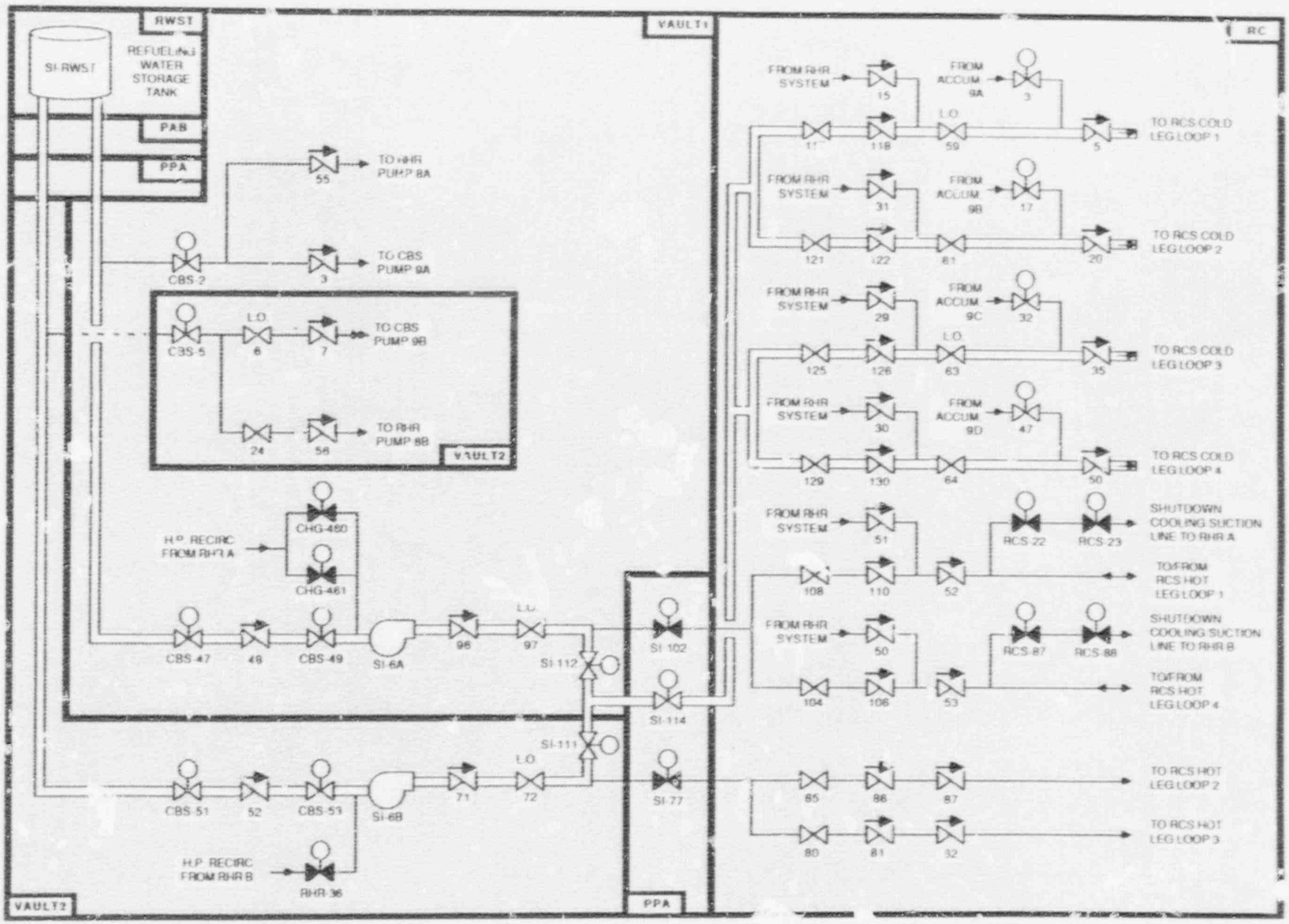


Figure 3.3-2. Seabrock 1 Safety Injection System (Inject... Mode) Showing Component Locations

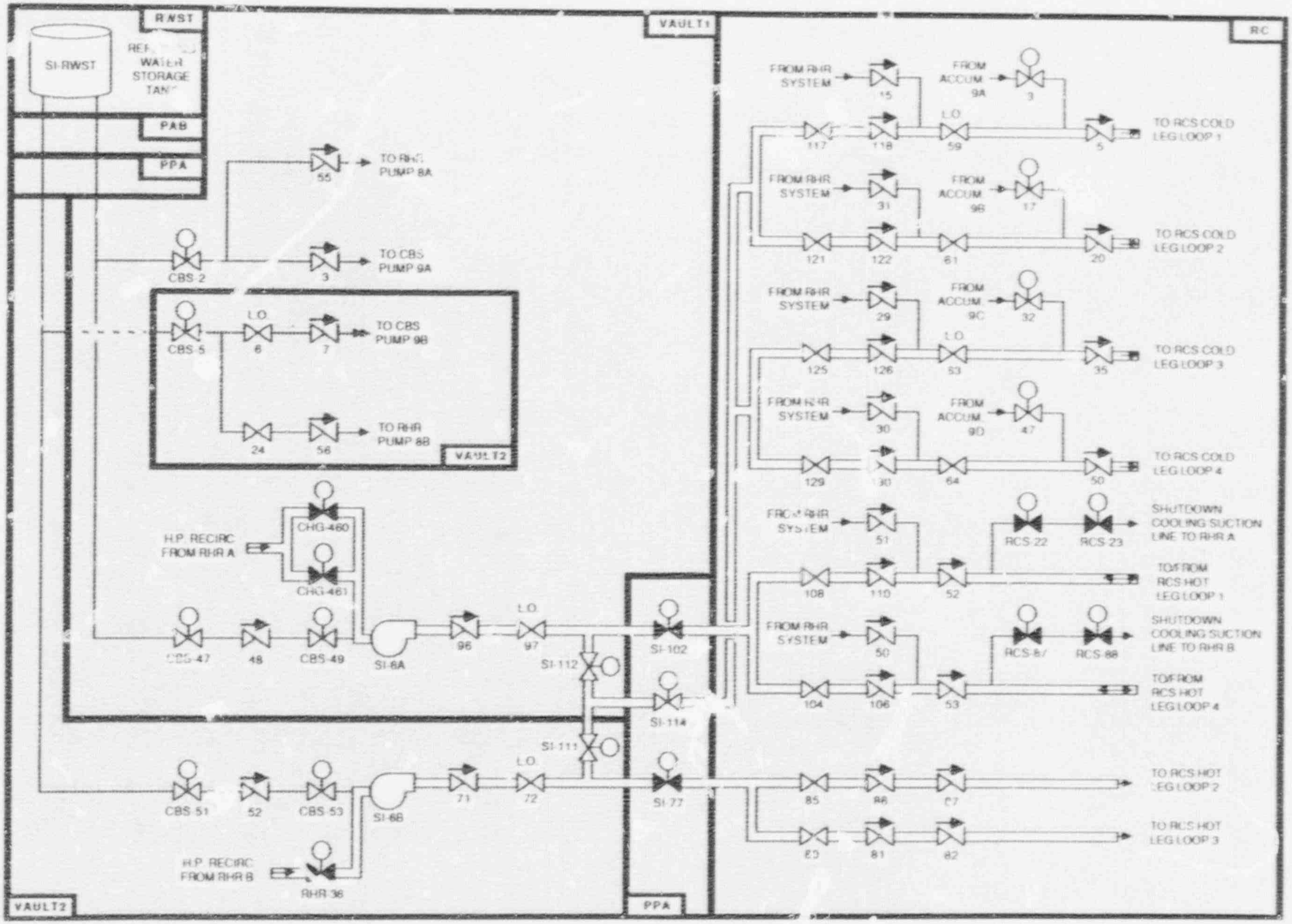


Figure 3.3-3. Seabrock 1 Safety Injection System (High Pressure Recirculation Mode) Showing Component Locations

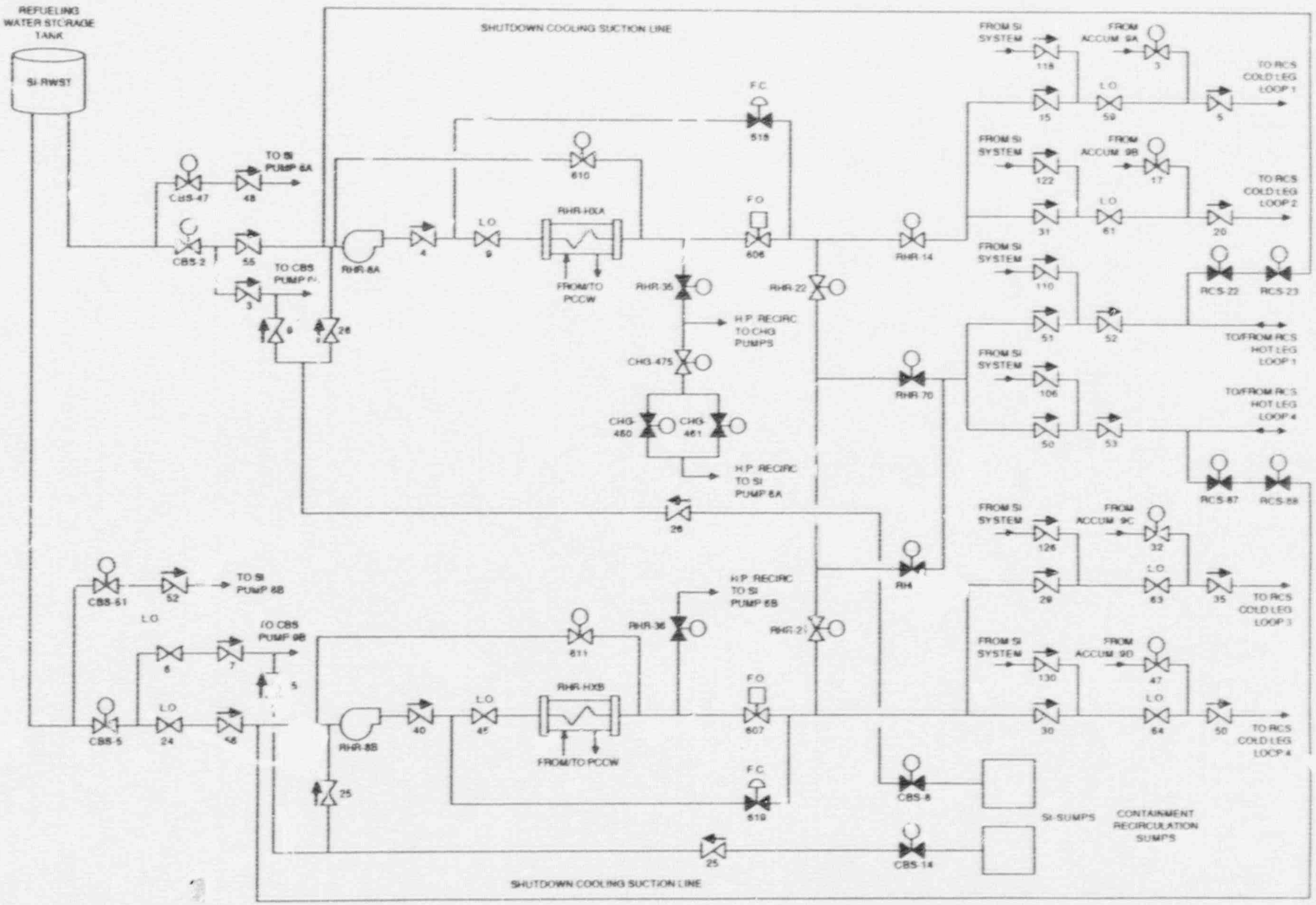


Figure 3.3-4. Seabrook 1 Residual Heat Removal System

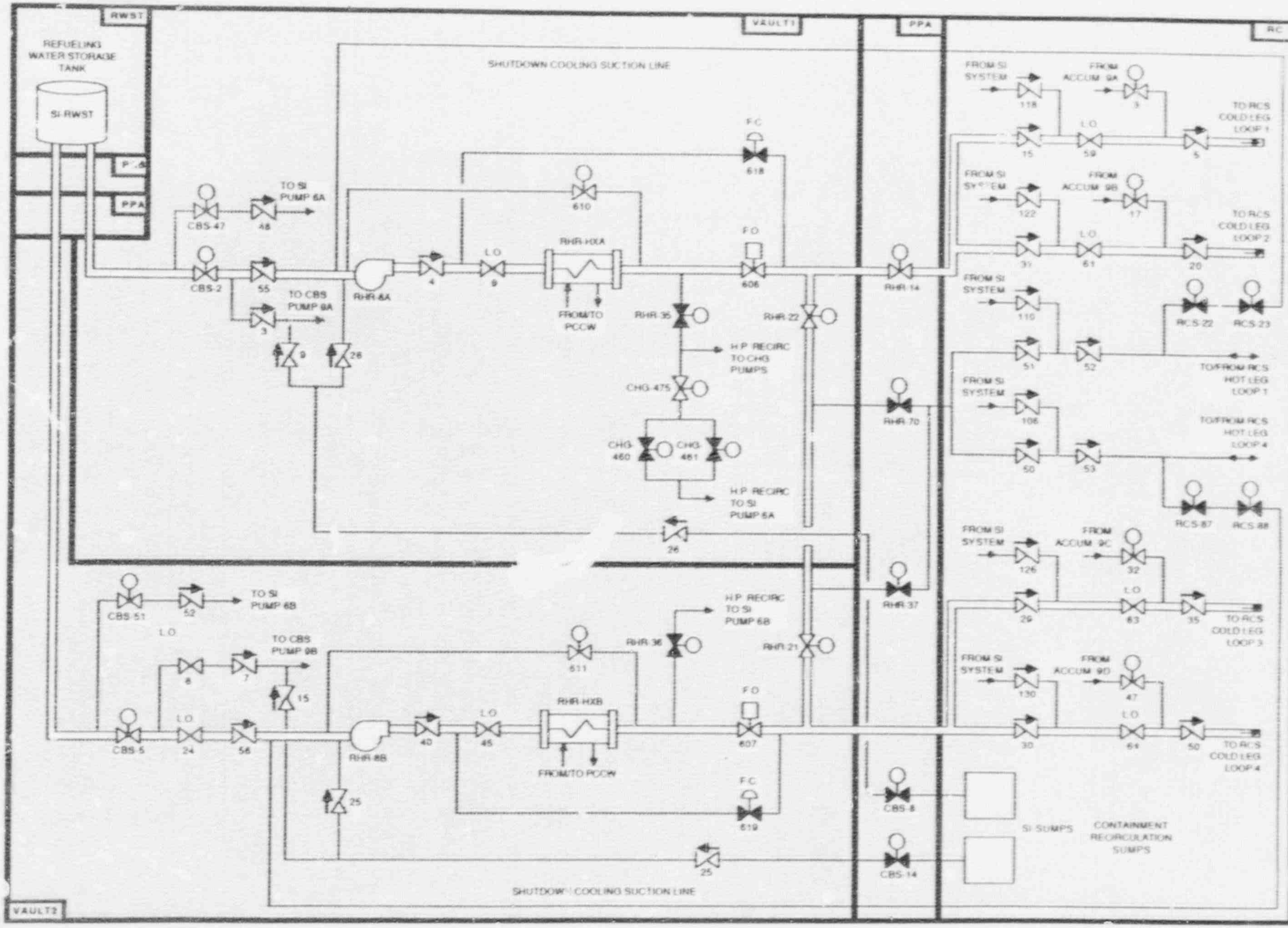


Figure 3.3-5. Seabrook 1 Residual Heat Removal System (Injection Mode) Showing Component Locations

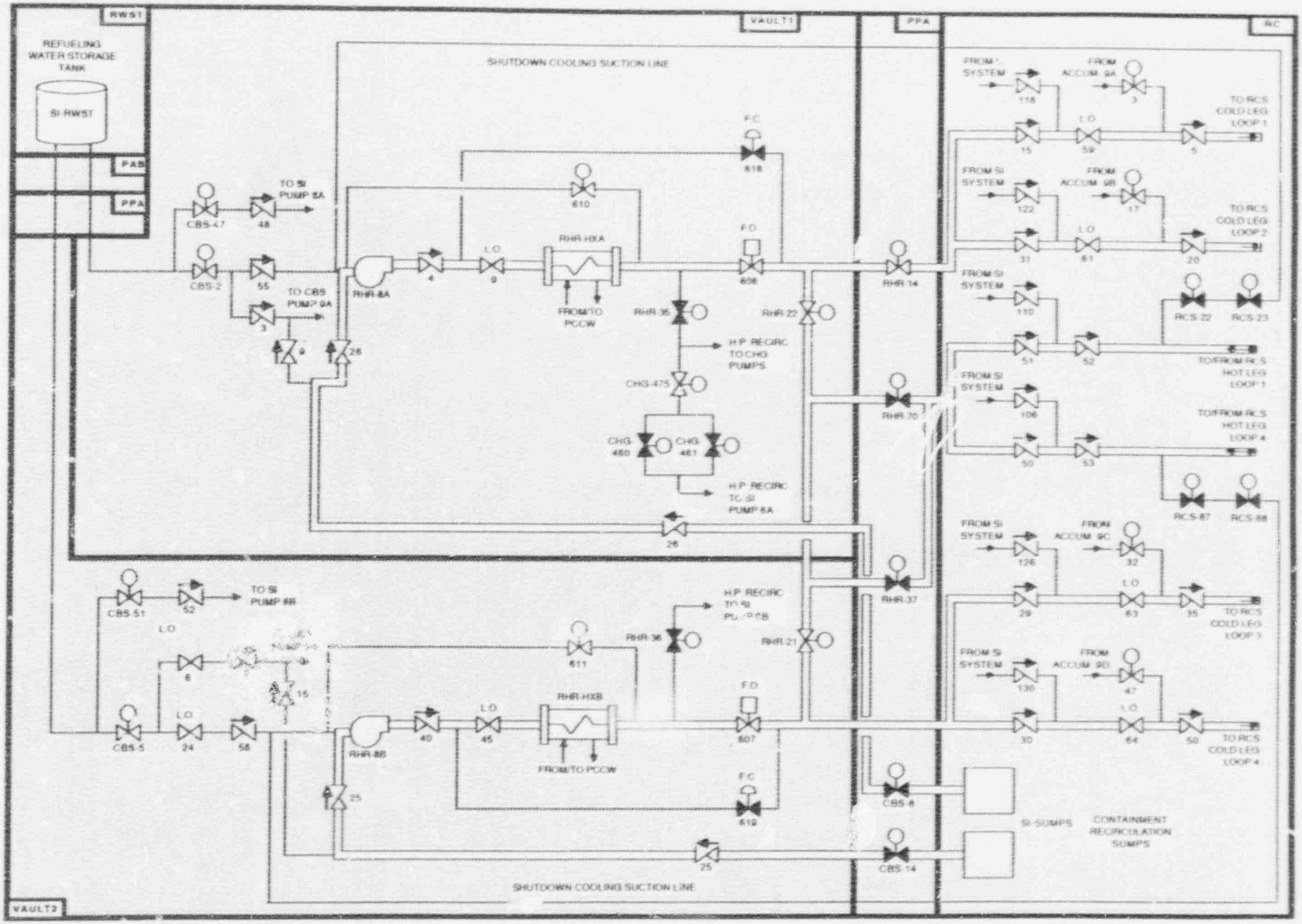


Figure 3.3-6. Seabrook 1 Residual Heat Removal System (Low-Pressure Recirculation Mode) Showing Component Locations

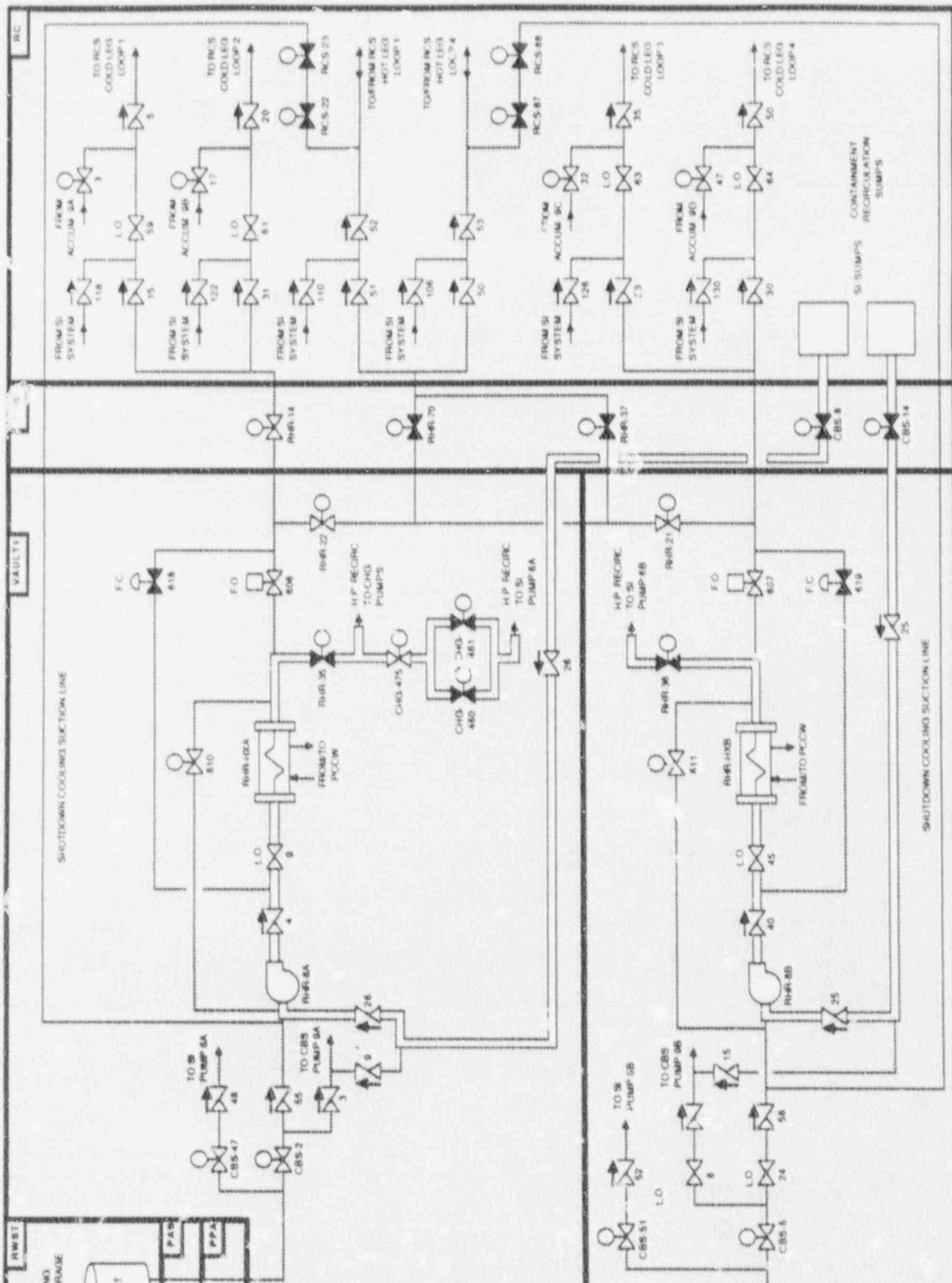


Figure 3.3-7. Seabrook 1 Residual Heat Removal System (High-Pressure Recirculation Mode) Showing Component Locations

Table 3.3-1. Seabrook 1 Emergency Core Cooling System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CBS-47	MOV	VAULT1	EP-MCC-521	480	SWGRMA	AC/A
CBS-49	MOV	VAULT1	EP-MCC-521	480	SWGRMA	AC/A
CBS-51	MOV	VAULT2	EP-MCC-621	480	SWGRMB	AC/B
CBS-53	MOV	VAULT2	EP-MCC-621	480	SWGRMB	AC/B
CHG-460	MOV	VAULT1	EP-MCC-512	480	SWGRMA	AC/A
CHG-461	MOV	VAULT1	EP-MCC-612	480	SWGRMB	AC/B
CHG-475	MOV	VAULT1	EP-MCC-612	480	SWGRMB	AC/B
RHR-35	MOV	VAULT1	EP-MCC-521	480	SWGRMA	AC/A
RHR-36	MOV	VAULT2	EP-MCC-621	480	SWGRMB	AC/B
RHR-8A	MDP	VAULT1	EP-BS-E5	4160	SWGRMA	AC/A
RHR-8B	MDP	VAULT2	EP-BS-E6	4160	SWGRMB	AC/B
RHR-HXA	HX	VAULT1				
RHR-HXB	HX	VAULT2				
SI-102	MOV	PPA	EP-MCC-522	480	SWGRMA	AC/A
SI-111	MOV	VAULT2	EP-MCC-621	480	SWGRMB	AC/B
SI-112	MOV	VAULT1	EP-MCC-521	480	SWGRMA	AC/A
SI-1[illegible]	MOV	PPA	EP-MCC-522	480	SWGRMA	AC/A
SI-6	MDP	VAULT1	EP-BS-E5	4160	SWGRMA	AC/A
SI-6B	MDP	VAULT2	EP-BS-E6	4160	SWGRMB	AC/B
SI-77	MOV	PPA	EP-MCC-622	480	SWGRMB	AC/B

3.4 CHEMICAL AND VOLUME CONTROL SYSTEM (CVCS)

3.4.1 System Function

The CVCS is responsible for maintaining the proper water inventory in the Reactor Coolant System, providing required seal water flow to the reactor coolant pump seals, and maintaining water purity and the proper concentration of neutron absorbing and corrosion inhibiting chemicals in the reactor coolant. The centrifugal charging pumps also are part of the emergency core cooling system (ECCS, see Section 3.3) and provide injection flow to the RCS following a LOCA. The makeup function of the CVCS (charging system) is required to maintain the plant in an extended hot shutdown condition following a transient.

3.4.2 System Definition

The CVCS consists of several subsystems that perform the functions of maintaining RCS coolant inventory control, coolant chemistry and purity control, and reactivity control. The charging system consists of two centrifugal and one positive displacement charging pumps that, during normal operation, take a suction on the volume control tank (VCT) and return the purified reactor coolant to the RCS. The normal charging path is through the regenerative heat exchanger. The charging pumps also perform the high pressure safety injection function, as described in Section 3.3. In this mode, the charging pumps are aligned to take a suction on the refueling water storage tank (RWST) and inject through a common header into the RCS cold legs.

Simplified drawings of the CVCS, focusing on the charging function, are shown in Figures 3.4-1 and 3.4-2. A summary of data on selected CVCS components is presented in Table 3.4-1.

3.4.3 System Operation

During normal operation, a side-stream of reactor coolant flows through the letdown line to the purification system and is returned to the RCS by a single normally-operating charging pump. Letdown flow from RCS loop 3 cold leg flows through the shell side of the regenerative heat exchanger for an initial temperature reduction. The coolant then experiences a large pressure reduction as it passes through the letdown orifice. The cooled, low pressure water then undergoes a second temperature reduction in the tube side of the letdown heat exchanger, followed by a second pressure reduction by the low pressure letdown valve. Flow is then directed through various filters and ion exchangers before being sprayed into the volume control tank where it is returned to the RCS by the charging pumps.

Normal charging flow is handled by the positive displacement pump. This charging flow splits into two paths. The bulk of the charging flow is pumped back to the RCS cold leg through the tube side of the regenerative heat exchanger. A portion of the charging flow is filtered and injected into the reactor coolant pump seals (nominally 8 gpm per pump).

The centrifugal charging pumps serve as high-head safety injection pumps in the ECCS following a LOCA. The positive displacement pump, however, is supplied by Non-Class 1E power and is not available following a loss of offsite power. In the event of a LOCA, charging pump suction is switched from the VCT to the RWST.

3.4.4 System Success Criteria

The following success criterion is assumed for CVCS makeup following a transient:

- 1 of 3 charging pumps taking suction on the RWST is required for adequate post-transient makeup to the RCS.

The charging pump success criteria for LOCA mitigation is discussed with the ECCS in Section 3.3.

3.4.5 Component Information

A. Centrifugal charging pumps 2A, 2B
   1. Rated flow: 150 gpm @ 5800 ft. head (2514 psid)
   2. Maximum flow: 550 gpm @ 1400 ft. head (607 psid)
   3. Type: Horizontal, multistage, centrifugal

B. Positive displacement charging pump 128
   1. Rated flow: 98 gpm @ 5800 ft. head (2514 psid)
   2. Type: Positive displacement

C. Refueling Water Storage Tank
   1. Capacity: 475,000 gallons
   2. Operating pressure: atmospheric

D. Volume Control Tank
   1. Volume: 630 ft^3
   2. Design pressure: 75 psig

3.4.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. During normal operation, CVCS letdown flow and RCS makeup flow are controlled by the pressurizer level control system.
      b. A safety injection "S" signal automatically starts the two centrifugal charging pumps, closes the normal charging path valves, causes pump suction to change from the VCT to the RWST, and opens the centrifugal charging pump discharge valves SI-139 and SI-138.
   2. Remote manual
      The three charging pumps and associated motor-operated valves can be actuated by remote means from the control room. Moreover, the two centrifugal charging pumps can be controlled locally from the switchgear room.

B. Motive Power
   1. The centrifugal charging pumps and associated motor-operated valves of the CVCS are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.6. The positive displacement charging pump is a Non-Class 1E load (480 VAC bus 25).

C. Other
   1. Cooling water for the charging pumps is provided by the Primary Component Cooling Water System (see Section 3.8).
   2. Charging pump lubrication is assumed to be provided locally.
   3. Room cooling for the charging pump rooms is provided by the containment enclosure cooling system.

3.4.7 Section 3.4 References

1. Seabrook 1 Final Safety Analysis Report, Section 9.3.4.

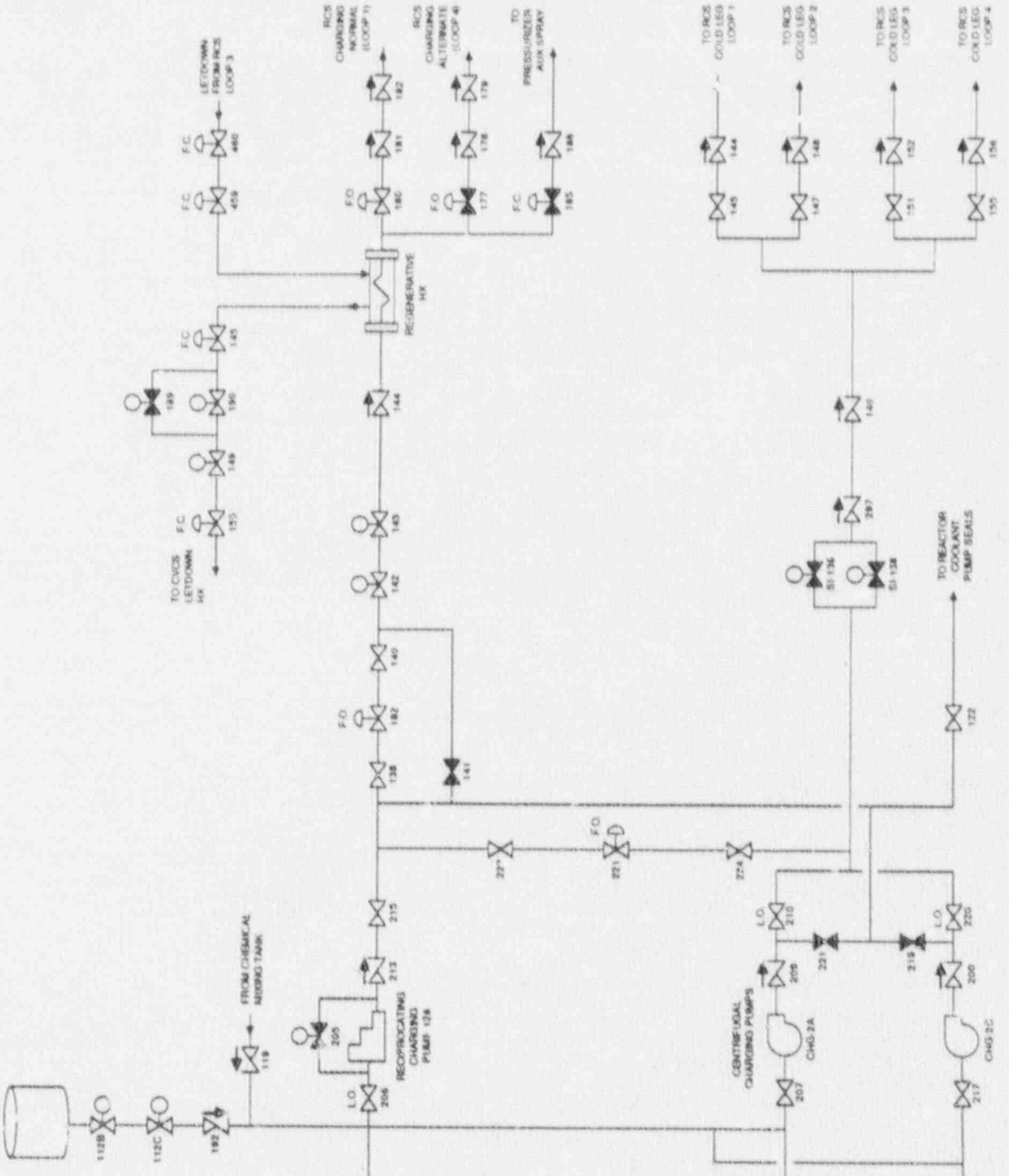


Figure 3.4-1. Seabrook 1 Charging System

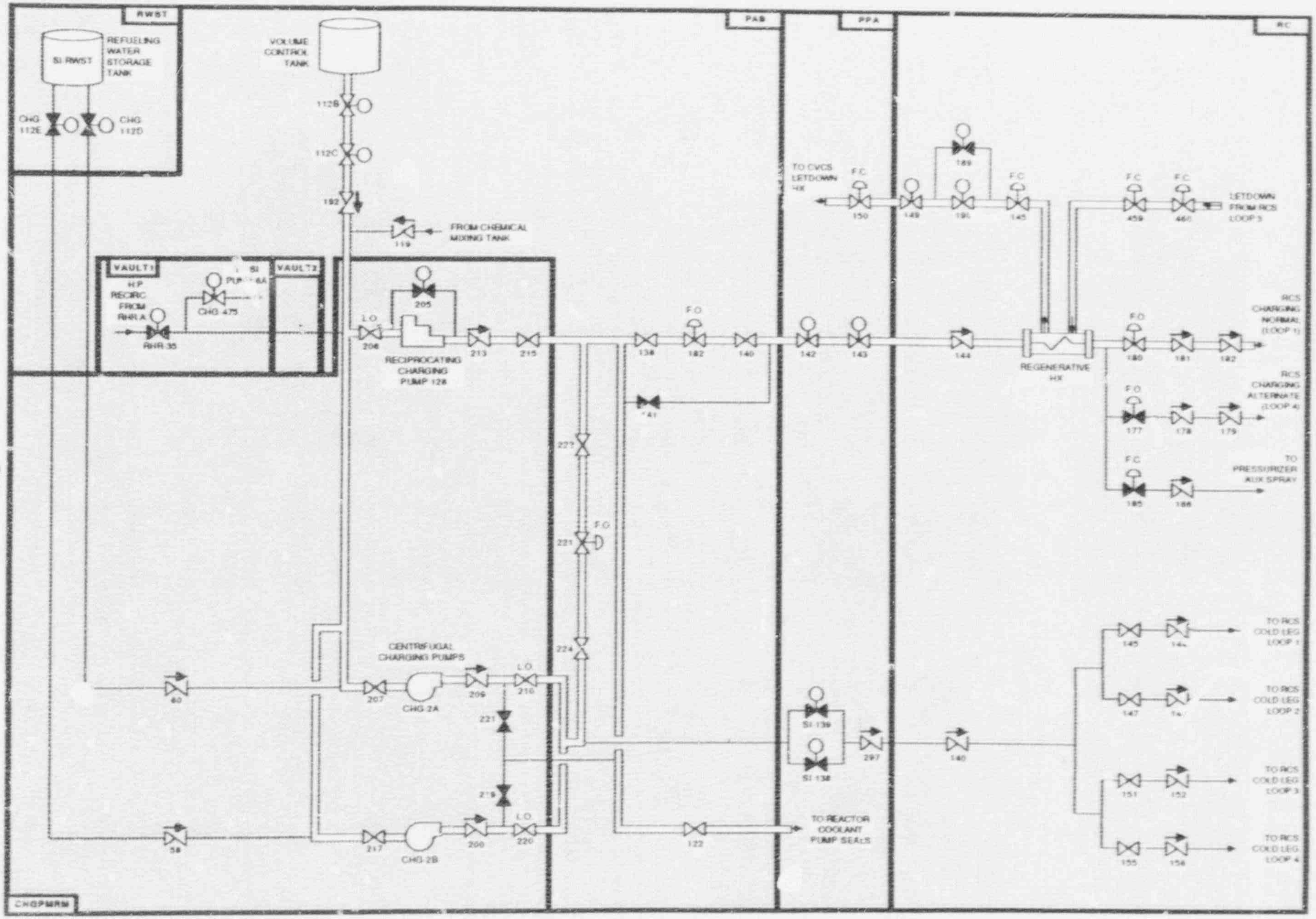


Figure 3.4-2. Seabrook 1 Charging System (CVCS Normal Charging Mode) Showing Component Locations

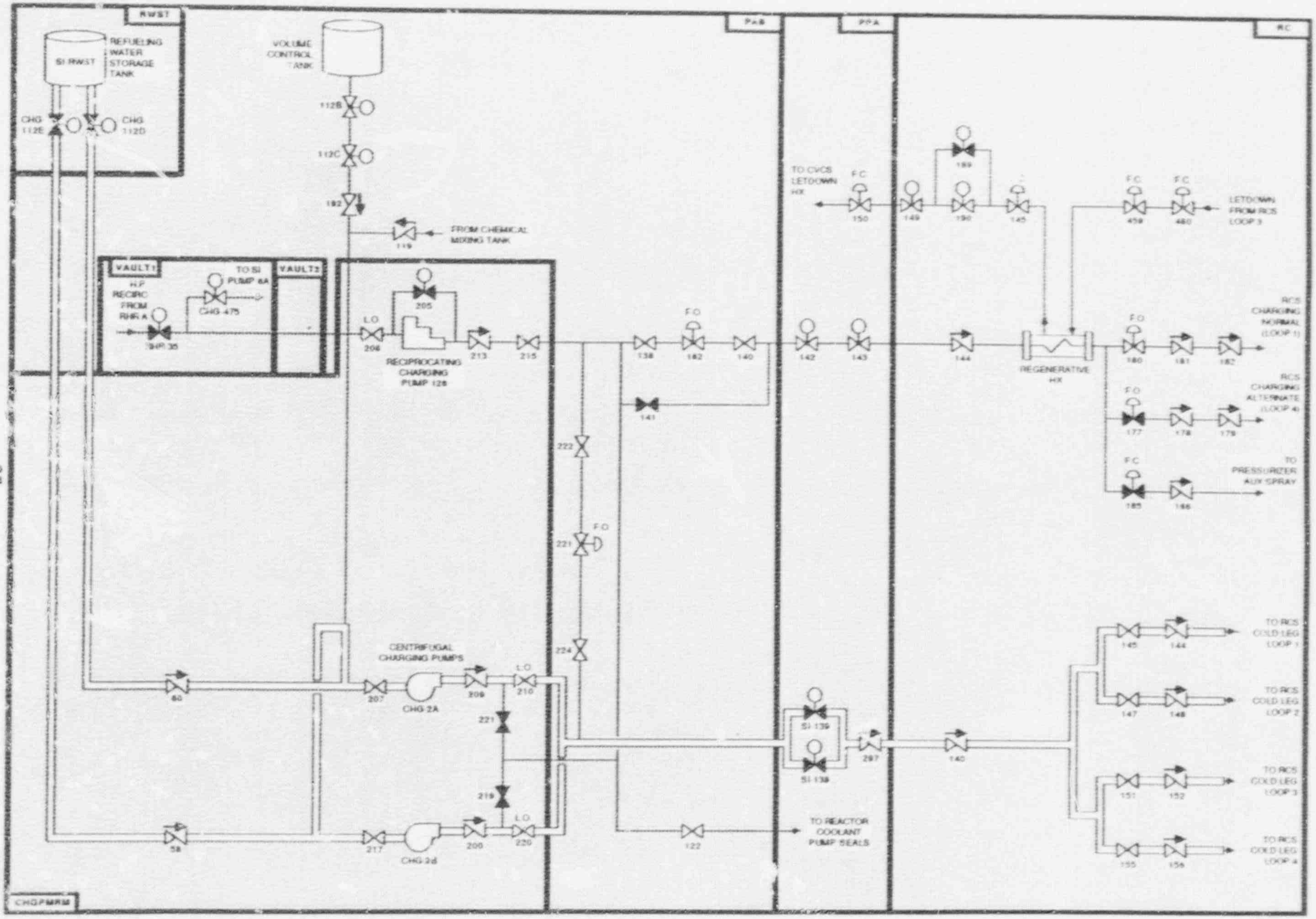


Figure 3.4-3. Seabrook 1 Charging System (ECCS Injection Mode) Showing Component Locations

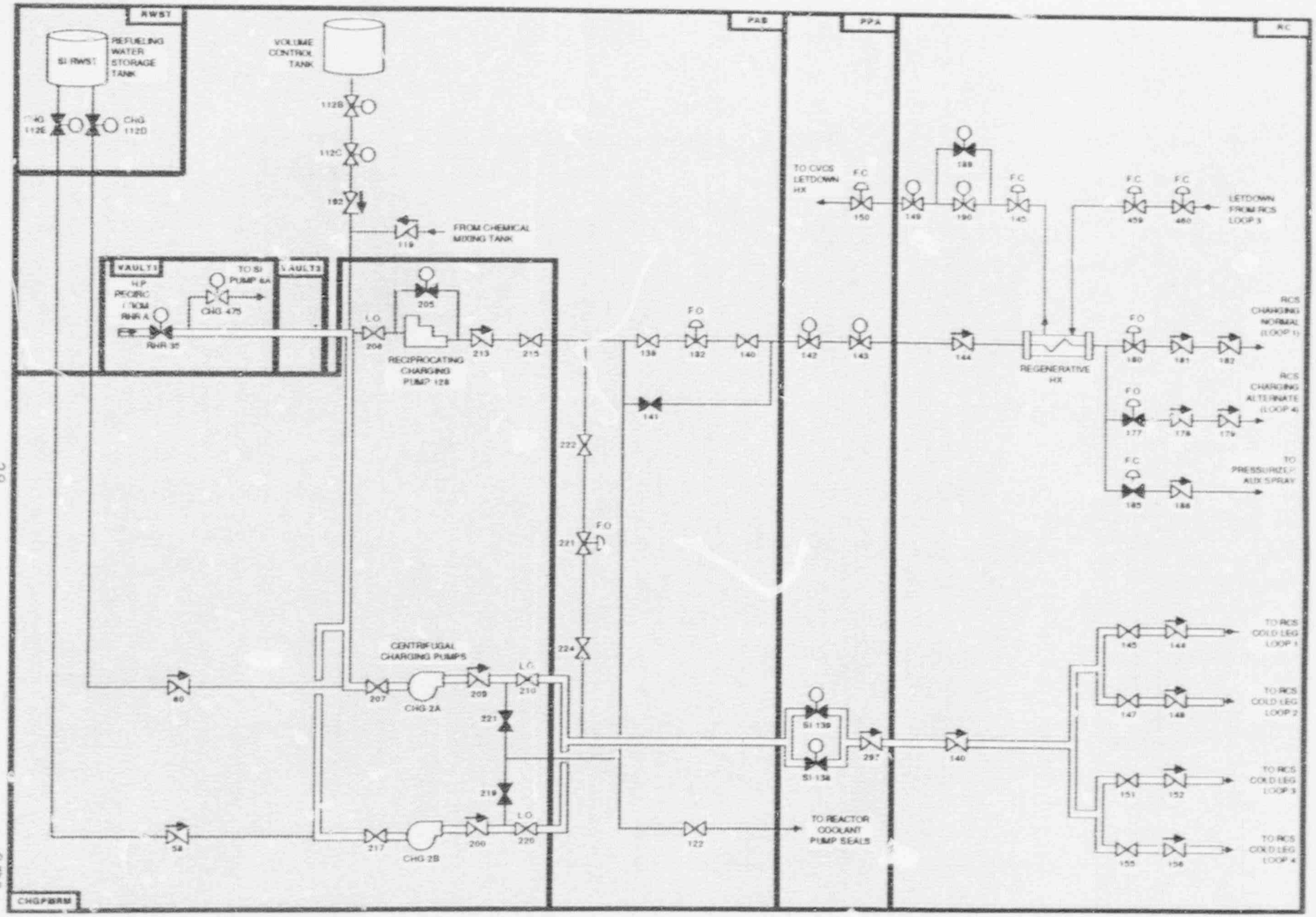


Figure 3.4-4. Seabrook 1 Charging System (ECCS High-Pressure Recirculation Mode) Showing Component Locations

Table 3.4-1. Seabrook 1 Chemical and Volume Control System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CHG-112D	MOV	RWST	EP-MCC-512	480	SWGRMA	AC/A
CHG-112E	MOV	RWST	EP-MCC-612	480	SWGRMB	AC/B
CHG-2A	MDP	CHGPMRM	EP-BS-E5	4[illegible]	SWGRMA	AC/A
CHG-2B	MDP	CHGPMRM	EP-BS-E6	4160	SWGRMB	AC/B
SI-138	MOV	PPA	EP-MCC-521	480	SWGRMA	AC/A
SI-139	MOV	PPA	EP-MCC-621	480	SWGRMB	AC/B
SI-RWST	TK	RWST				

3.5 INSTRUMENTATION AND CONTROL (I & C) SYSTEMS

3.5.1 System Function

The instrumentation and control systems consist of the Reactor Trip System (RTS), also known as the Reactor Protection System (RPS), the Engineered Safety Features Actuation System (ESFAS), and systems for the display of plant information to the operators. The RTS and the ESFAS monitor the reactor plant and alert the operator to take corrective action before specified limits are exceeded. The RTS will initiate an automatic reactor trip (scram) to rapidly shutdown the reactor when plant conditions exceed one or more specified limits. The ESFAS will automatically actuate selected safety systems based on the specific limits or combinations of limits that are exceeded. A remote shutdown capability is provided to ensure that the reactor can be placed in a safe condition in the event that the main control room must be evacuated.

3.5.2 System Definition

The RTS includes sensor and transmitter units, logic units, and output trip relays that generate a reactor trip signal. The reactor trip signal de-energizes the control rod magnetic latch mechanisms, allowing all control rod assemblies to drop into the core. The ESFAS includes independent sensor and transmitter units, logic units, and relays that interface with the control circuits for the many different sets of engineered safety features components that can be actuated. Operator instrumentation display systems consist of display panels in the control room and at local control stations that are powered by the 120 VAC electric power system (see Section 3.6)

A summary of data on selected I & C system components is presented in Table 3.5-1.

3.5.3 System Operation

A. RTS

The RTS has two to four redundant input instrument channels for each sensed parameter. Two reactor trip breakers are actuated by two separate RTS logic matrices. When either of the trip breakers opens, power is interrupted to the rod drive power supply, and the control and shutdown rods fall into the core. Bypass breakers are provided to permit testing of the trip breakers. Certain reactor trip channels are automatically bypassed at power levels where they are not required for safety. The following conditions result in reactor trip:

- High neutron flux (power range)
- Intermediate range high neutron flux
- Source range high neutron flux
- High positive neutron flux rate (power range)
- High negative neutron flux rate (power range)
- Overtemperature delta T
- Overpower delta T
- Low pressurizer pressure
- High pressurizer pressure
- High pressurizer water level
- Low reactor coolant flow
- Reactor coolant pump undervoltage
- Reactor coolant pump underfrequency
- Safety injection signal
- Turbine trip

- Low-low steam generator water level
- Manual

B. ESFAS

The ESFAS consists of two distinct portions of circuitry: (1) an analog portion consisting of three to four redundant channels per parameter, and (2) a digital portion consisting of two redundant logic trains which receive inputs from the analog channels and perform the logic needed to actuate the appropriate Engineered Safety Features (ESF). The following major systems have components which are actuated by the ESFAS:

- Safety Injection
- Residual Heat Removal
- Chemical and Volume Control
- Emergency Feedwater
- Containment Building Spray
- Main Steam
- Main Feedwater
- Service Water
- Primary Component Cooling
- Emergency Diesel Generators
- Containment Ventilation
- Containment Isolation

The ESFAS provides an actuation signal to each individual component in the required engineered safety features system.

C. Remote Shutdown

The main control room is the primary station for safe shutdown control of the plant. In the event that the main control room becomes uninhabitable, the plant may be brought to and maintained in a hot standby condition using alternate control provisions outside the main control room and subsequently attain cold shutdown. Safe shutdown, remote from the main control room, can be accomplished by taking control of the plant from the following remote safe shutdown (RSS) locations. These are the minimum number of centralized locations from which hot standby can be maintained on a unit basis:

- RSS Control Panels
- Diesel Generator Local Control Panels
- MCC's, distribution panels, and switchgear in Switchgear Room A and Switchgear Room B
- Disabling Panels
- In addition, a limited number of manual operations will be performed locally to achieve and maintain cold shutdown.

Upon arrival at the RSS locations, the operators will transfer control of safe shutdown equipment to the RSS locations by means of key-locked REMOTE-LOCAL selector switches. Access to the keys required for operation of the RSS location controls is administratively controlled and will be available when the main control room is evacuated.

3.5.4 System Success Criteria

A. RTS

The RTS uses hindrance logic (normal = 1, trip = 0) in both the input and output logic. Therefore, a channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e., the channel has a fail-safe failure mode). A reactor scram will occur upon loss of control power to the RTS. A reactor scram is implemented by the reactor trip breakers which must open in response to a scram signal. There are two series breakers in the power path to the scram rods. One of two circuit breakers must open to cause a scram. Each reactor trip breaker has an associated bypass breaker to permit testing of the trip breakers. Details of the scram system for Seabrook 1 have not been determined.

B. ESFAS

In general, the loss of instrument power to the sensors, instruments, or logic devices places that channel in the trip mode. Details of the ESFAS for Seabrook 1 have not been determined.

C. Manually-Initiated Protective Actions

When reasonable time is available, certain protective actions may be performed manually by plant personnel. The control room operators are capable of operating individual components using normal control circuitry, or operating groups of components by manually tripping the RTS or an ESFAS subsystem. The control room operators also may send qualified persons into the plant to operate components locally or from some other remote control location (i.e., a motor control center or RSS location). To make these judgments, data on key plant parameters must be available to the operators.

3.5.5 Support Systems and Interfaces

A. Control Power

Operator instrumentation displays are powered from the 120 VAC instrument buses (see Section 3.6).

3.5.6 Section 3.5 References

1. Seabrook 1 Final Safety Analysis Report, Section 7.

3.6 ELECTRIC POWER SYSTEM

3.6.1 System Function

The electric power system supplies power to various equipment and systems needed for normal operation and/or response to accidents. The onsite Class 1E electric power system supports the operation of safety class systems and instrumentation needed to establish and maintain a safe shutdown plant condition following an accident, when the normal electric power sources are not available.

3.6.2 System Definition

The Class 1E system is divided into two redundant trains (train A and train B), with either one of the trains capable of providing power to support systems needed to establish and maintain a safe shutdown condition. The engineered safety features for Seabrook 1 receive power from two 4160 VAC buses, designated E5 (train A) and E6 (train B), whose emergency sources of power are two diesel generators: diesel generator 1A feeds bus E5, and diesel generator 1B feeds bus E6. Each 4160 VAC bus feeds several emergency 480 VAC substations through transformers, and the 480 VAC substations in turn supply power to various motor control centers.

The essential (Class 1E) 125 VDC distribution system supplies control power to all the essential AC buses, diesel generators, and emergency power sequencers. There are four 125 VDC systems (designated 11A, 11B, 11C, and 11D), each consisting of a dedicated battery, a distribution bus, and a battery charger (rectifier).

The essential (Class 1E) 120 VAC distribution system supplies power to safeguards and protection instrumentation channels and to the balance of plant Class 1E instrumentation. Six vital uninterruptable power supply (UPS) units are provided to feed six electrically independent 120 VAC vital instrument panels. Four vital UPS units (1A, 1B, 1C, and 1D) are used to supply power to the four channels of the protection systems; the two additional vital UPS units (1E and 1F) provide redundant power supplies to the balance of plant Train A and Train B vital instrument panels. The system consists of panels, breakers, transformers, uninterruptable power supplies, and cables.

Simplified one-line diagrams of the station electric power system are shown in Figures 3.6-1 and 3.6-2. The 4160 and 480 VAC systems are shown in Figures 3.6-3 and 3.6-4, and the 125 VDC and 120 VAC systems are shown in Figures 3.6-5 and 3.6-6. A summary of data on selected electric power system components is presented in Table 3.6-1. Selected loads and components supplied by the Class 1E electric power system are listed in Table 3.6-2.

3.6.3 System Operation

During normal operation, the Class 1E electric power system is supplied from unit auxiliary transformers (UAT) ED-X-2A and ED-X-2B which also feed the 13.8 kV and 4160 V Non-Class 1E buses. The emergency sources of AC power are the diesel generators. The transfer from the preferred power source to the diesel generators is accomplished automatically by opening the normal source circuit breakers and then reenergizing the Class 1E portion of the electric power system from the diesel generators.

The DC power system normally is supplied through the battery chargers, with the batteries "floating" on the system, maintaining a full charge. Upon loss of AC power, the entire DC load draws from the batteries. The batteries are rated for approximately 2 hours of operation without assistance from the battery chargers, based on the length of time they can supply the UPS units following loss of AC power (Ref. 1).

Each 120 VAC instrumentation bus receives power from a dedicated UPS unit which normally is supplied from its associated 125 VDC battery (through its 125 VDC Bus). Alternately, the UPS unit can be supplied from a 480 VAC MCC.

Redundant safeguards equipment such as motor-driven pumps and motor-operated valves are supplied by different VAC buses. For the purpose of discussion, this equipment has been grouped into "load groups". Load group AC/A contains components powered either directly or indirectly from 4160 VAC bus 5E. Load group AC/B contains components powered either directly or indirectly by 4160 VAC bus 6E. Components receiving DC power are assigned to load groups DC/A, DC/B, etc., based on the battery power source.

3.6.4 System Success Criteria

Basic system success criteria for mitigating transients and loss-of-coolant accidents are defined by front-line systems, which then create demands on support systems. Electric power system success criteria are defined as follows, without taking credit for cross-ties that may exist between independent load groups:

- Each Class 1E DC load group is supplied from its respective battery (also needed for diesel starting)
- Each Class 1E AC load group is isolated from the non-Class 1E system and is supplied from its respective emergency power source (i.e. diesel generator)
- Power distribution paths to essential loads are intact
- Power to the battery chargers is restored before the batteries are exhausted

3.6.5 Component Information

A. Standby diesel generators 1A, 1B
   1. Rated load: 6083 kW (continuous duty)
   2. Rated voltage: 4160 VAC
   3. Manufacturer: Fairbanks-Morse

B. Batteries 1A, 1B, 1C, 1D
   1. Rated voltage: 125 VDC
   2. Rated capacity: approximately 2 hours with design loads
   3. Type: lead-calcium

3.6.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The standby diesel generators are automatically started in the event of a loss of offsite power or receipt of a safety injection signal.
   2. Remote manual
      The diesel generators can be started from the control room and from the local control panel near each unit. Many distribution circuit breakers can be operated from the control room.

B. Diesel Generator Auxiliary Systems
   1. Diesel Generator Cooling Water System
      Each diesel generator is cooled by sea water from the service water system (see Section 3.9).
   2. Diesel Generator Starting Air System
      Each diesel generator is equipped with an independent starting air system, capable of starting the diesel engine within ten seconds.
   3. Diesel Fuel Oil Transfer and Storage System
      A "day tank" supplies the short-term fuel needs of each diesel, which can be replenished from a separate fuel oil storage tank. This tank has the

capacity to maintain the diesel engine at a continuous full load for seven days. The fuel oil storage tank and transfer system components are located in the lower level of the diesel generator building (El. -16'0").

4. Diesel Generator Lubrication System
   Each diesel generator is provided with an independent oil lubrication system.
5. Diesel Room Ventilation System
   This system consists of exhaust fans which maintain the environmental conditions in the diesel room within limits for which the diesel generator and switchgear have been qualified. This system may be needed for long-term operation of the diesel generator.

C. Switchgear and Battery Room Ventilation Systems
These systems maintain acceptable environmental conditions in the switchgear and battery rooms, and may be needed for long-term operation of the electric power systems. Details of these systems have not been determined.

3.6.7 Section 3.6 References

1. Seabrook 1 Final Safety Analysis Report, Sections 8.3 and 9.5.

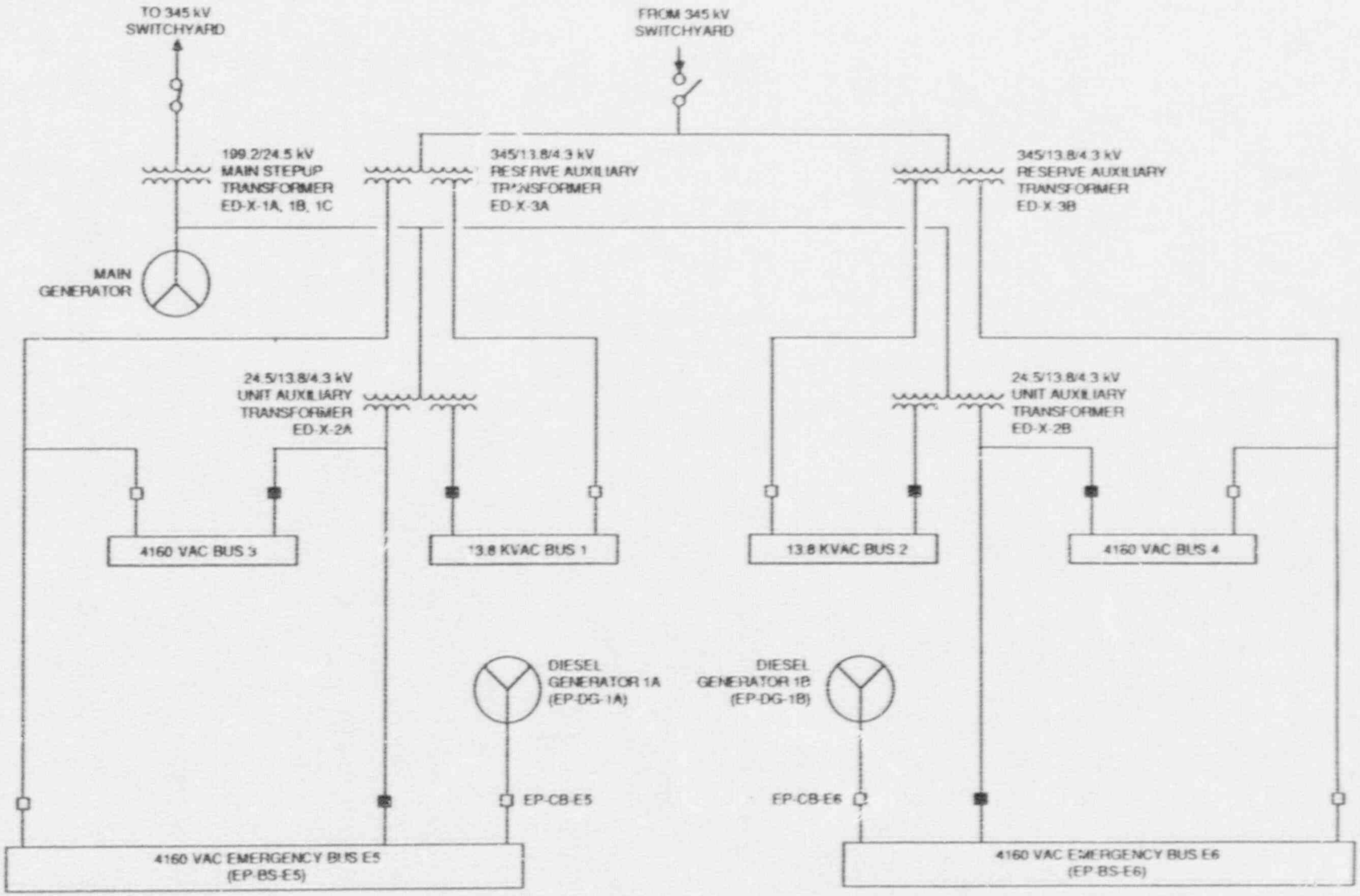
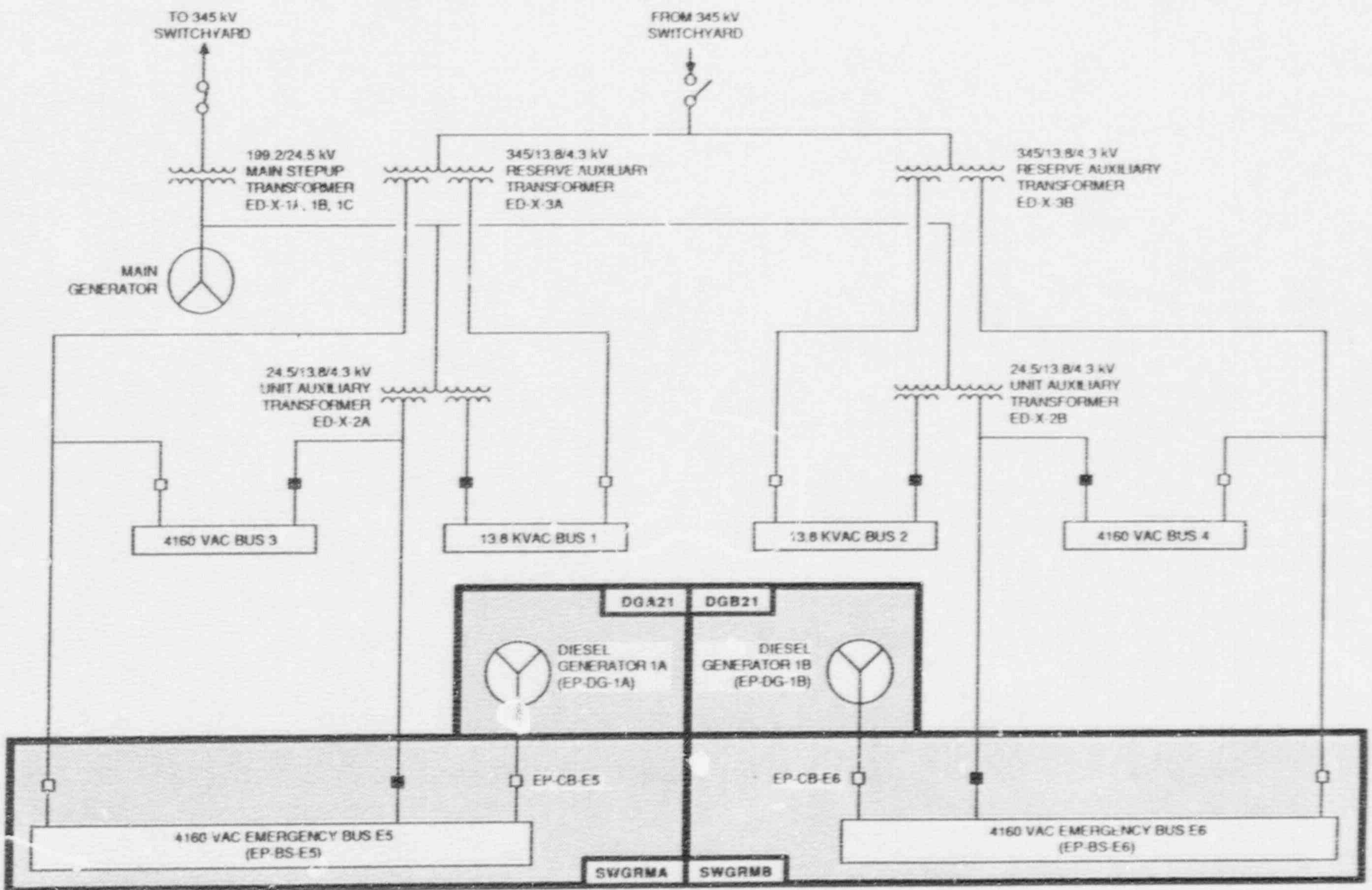


Figure 3.6-1. Seabrook 1 Station Electric Power System



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.6-2. Seabrook 1 Station Electric Power System Showing Component Locations

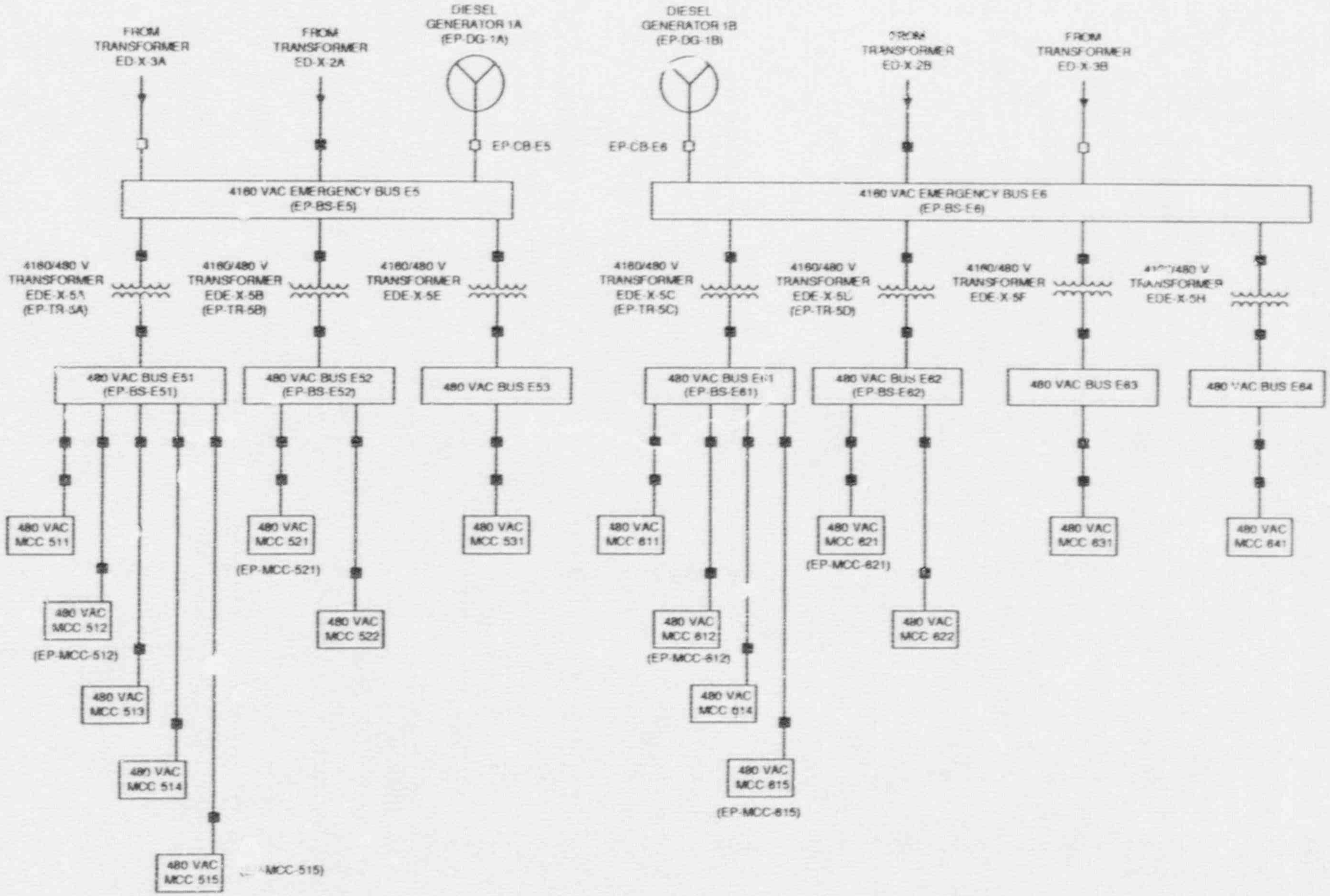
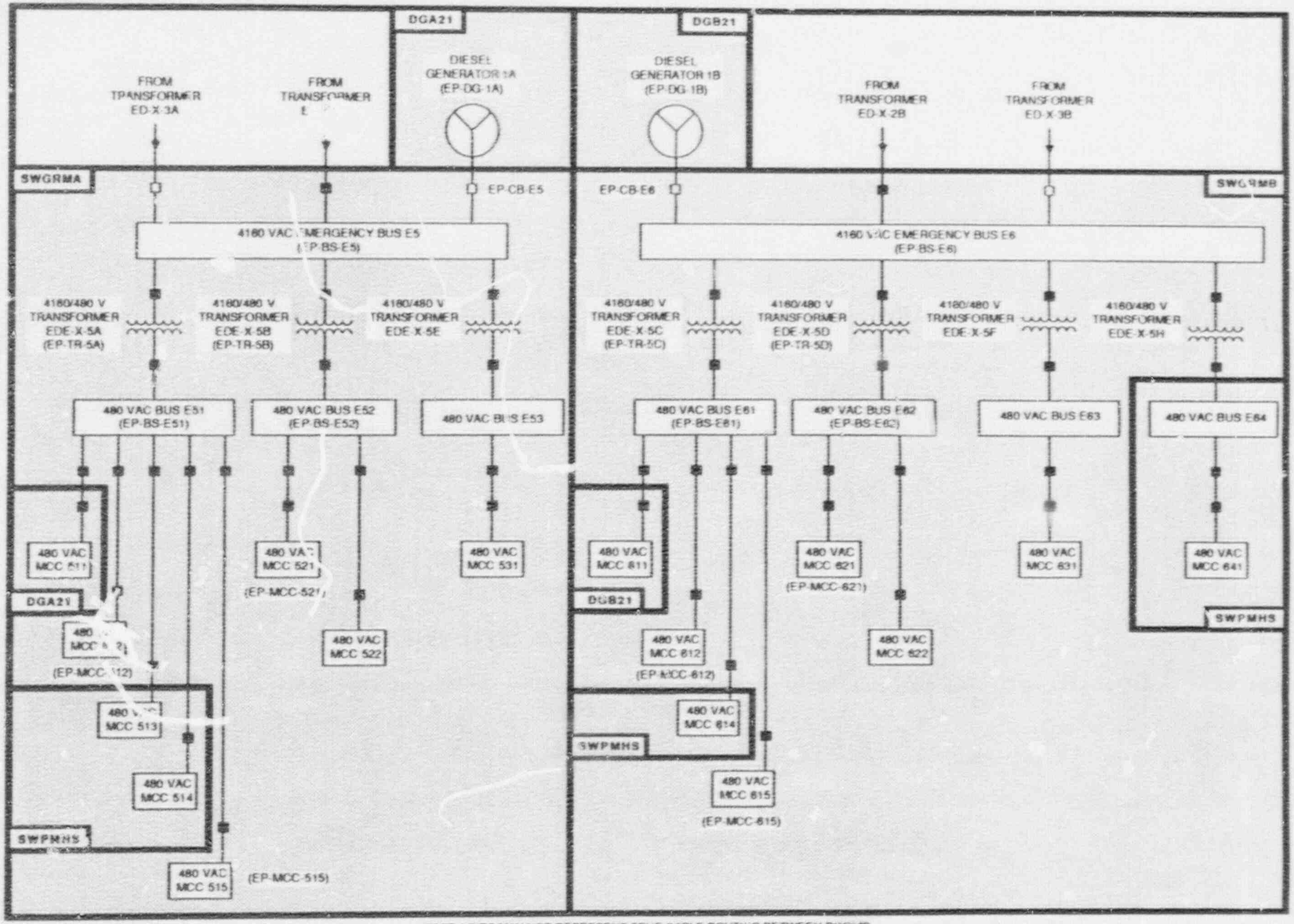


Figure 3.6-3. Seabrook 1 4160 and 480 VAC Electric Power Systems



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.6-4. Seabrook 1 4160 and 480 VAC Electric Power Systems Showing Component Locations

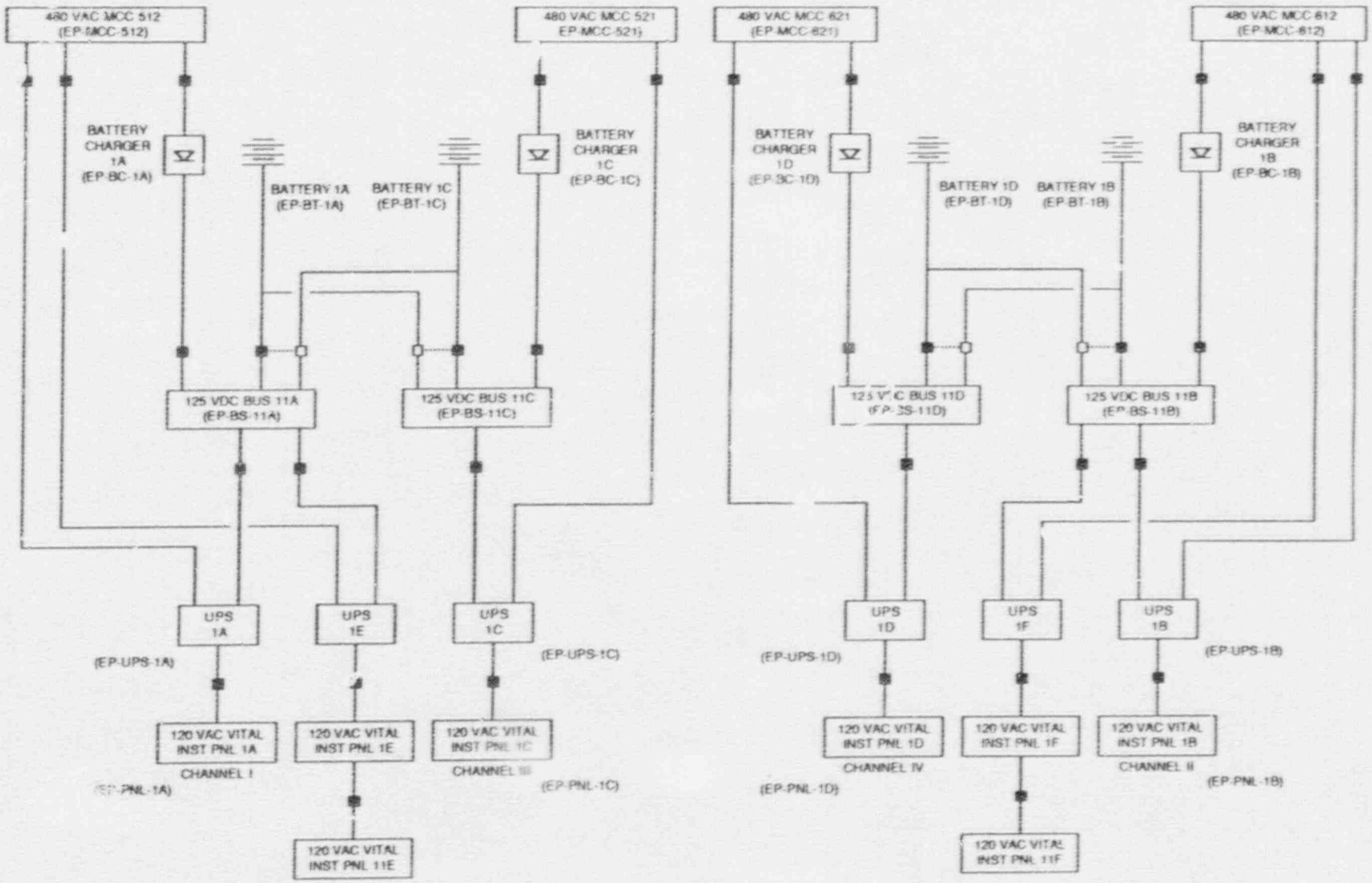
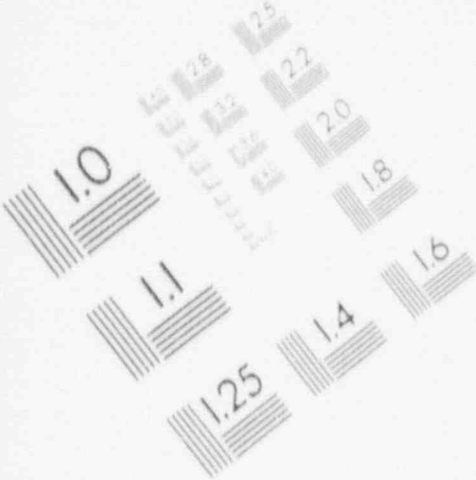
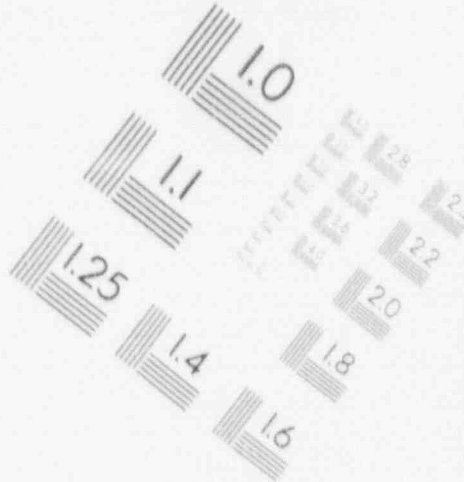


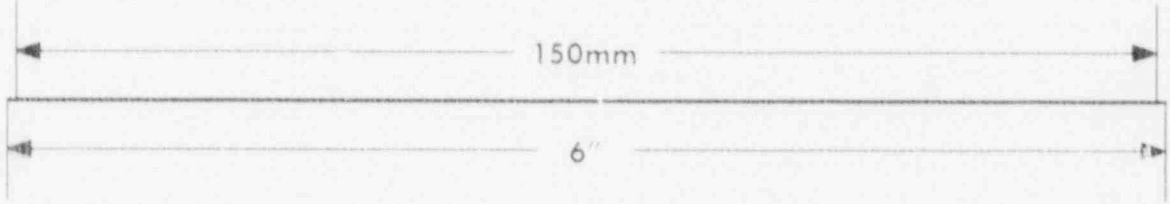
Figure 3.6-5. Seabrook 1 125 VDC and 120 VAC Electric Power Systems

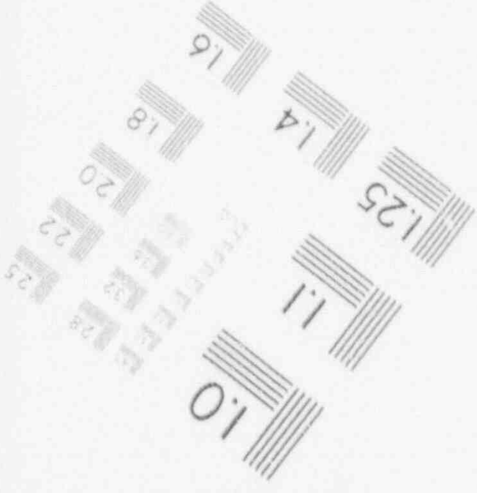
2

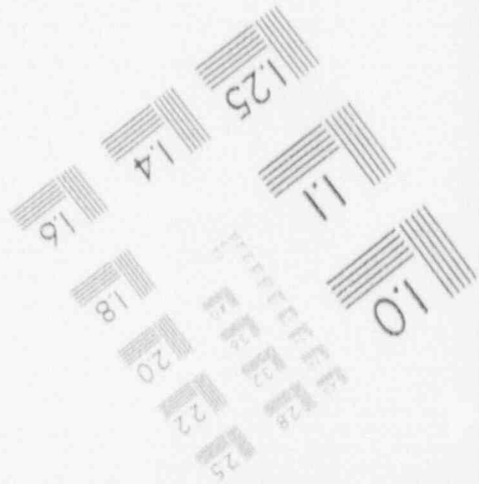
IMAGE EVALUATION TEST TARGET (MT-3)











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2

IMAGE EVALUATION TEST TARGET (MT-3)

1.0 1.1 1.25 1.4 1.6 1.8 2.0 2.2 2.5 2.8 3.2 3.6 4.0

150mm

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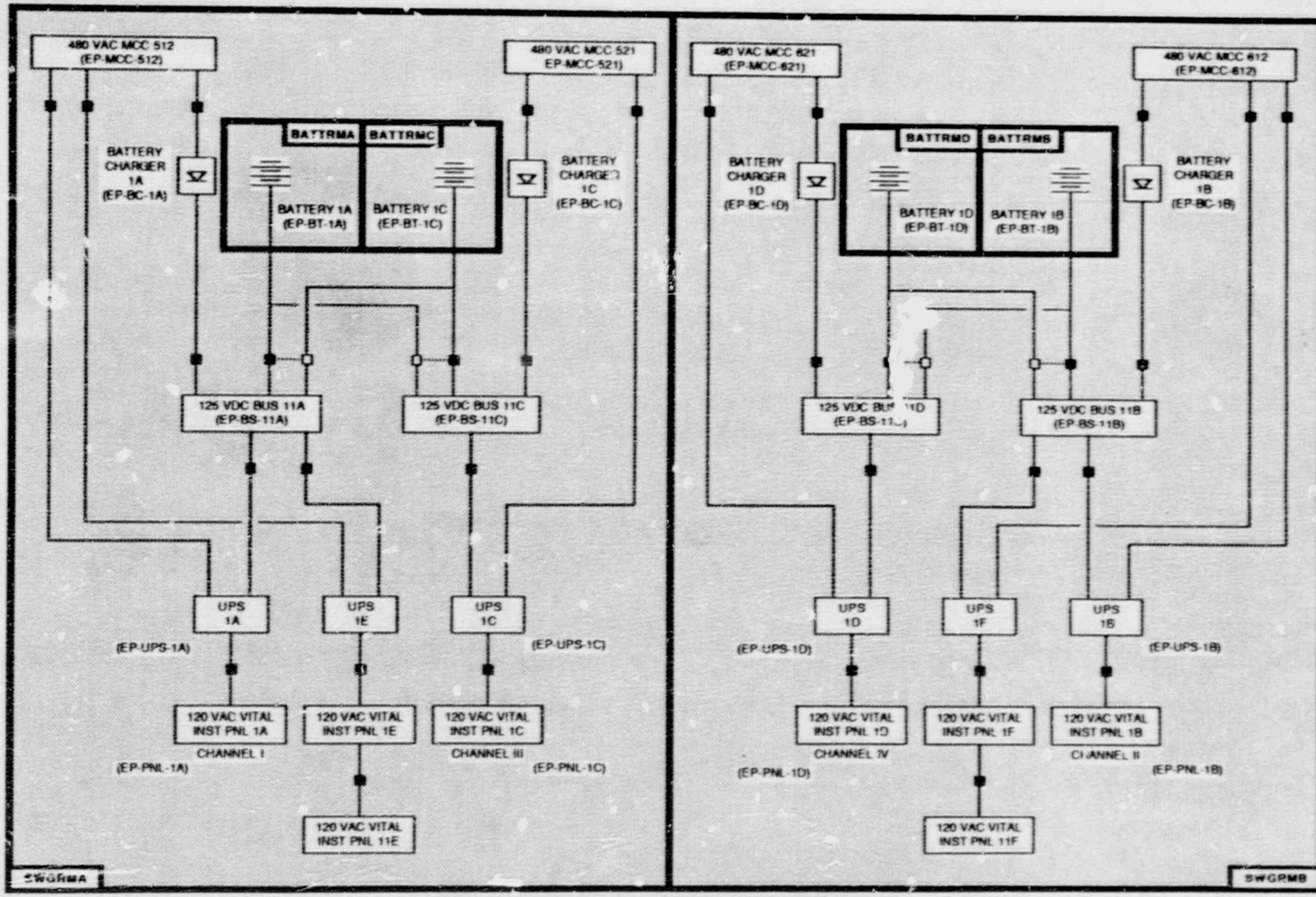

NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.6-6. Seabrook 1 125 VDC and 120 VAC Electric Power Systems Showing Component Locations

Table 3.6-1. Seabrook 1 Electric Power System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
EP-BC-1A	BC	SWGRMA	EP-MCC-512	480	SWGRMA	DC/A
EP-BC-1B	BC	SWGRMB	EP-MCC-612	480	SWGRMB	DC/B
EP-BC-1C	BC	SWGRMA	EP-MCC-521	480	SWGRMA	DC/C
EP-BC-1D	BC	SWGRMB	EP-MCC-621	480	SWGRMB	DC/D
EP-BS-11A	BUS	SWGRMA	EP-BC-1A	125	SWGRMA	DC/A
EP-BS-11B	BUS	SWGRMB	EP-BC-1B	125	SWGRMB	DC/B
EP-BS-11C	BUS	SWGRMA	EP-BC-1C	125	SWGRMA	DC/C
EP-BS-11D	BUS	SWGRMB	EP-BC-1D	125	SWGRMB	DC/D
EP-BS-E5	BUS	SWGRMA	EP-DG-1A	4160	DGA21	AC/A
EP-BS-E51	BUS	SWGRMA	EP-TR-5A	480	SWGRMA	AC/A
EP-BS-E52	BUS	SWGRMA	EP-TR-5B	480	SWGRMA	AC/A
EP-BS-E6	BUS	SWGRMB	EP-DG-1B	4160	DGB21	AC/B
EP-BS-E61	BUS	SWGRMB	EP-TR-5C	480	SWGRMB	AC/B
EP-BS-E62	BUS	SWGRMB	EP-TR-5D	480	SWGRMB	AC/B
EP-BT-1A	BATT	BATTRMA				
EP-BT-1B	BATT	BATTRMB				
EP-BT-1C	BATT	BATTRMC				
EP-BT-1D	BATT	BATTRMD				
EP-CB-E5	CB	SWGRMA				
EP-CB-E6	CB	SWGRMB				
EP-DG-1A	DG	DGA21				AC/A
EP-DG-1B	DG	DGB21				AC/B
EP-MCC-512	MCC	SWGRMA	EP-BS-E51	480	SWGRMA	AC/A
EP-MCC-515	MCC	SWGRMA	EP-BS-E51	480	SWGRMA	AC/A
EP-MCC-521	MCC	SWGRMA	EP-BS-E52	480	SWGRMA	AC/A
EP-MCC-612	MCC	SWGRMB	EP-BS-E61	480	SWGRMB	AC/B
EP-MCC-615	MCC	SWGRMB	EP-BS-E61	480	SWGRMB	AC/B
EP-MCC-621	MCC	SWGRMB	EP-BS-E62	480	SWGRMB	AC/B

Table 3.6-1. Seabrook 1 Electric Power System Data Summary for Selected Components (Continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
EP-PNL-1A	PNL	SWGRMA	EP-UPS-1A	120	SWGRMA	AC/A
EP-PNL-1B	PNL	SWGRMB	EP-UPS-1B	120	SWGRMB	AC/B
EP-PNL-1C	PNL	SWGRMA	EP-UPS-1C	120	SWGRMA	AC/A
EP-PNL-1D	PNL	SWGRMB	EP-UPS-1D	120	SWGRMB	AC/B
EP-TR-5A	TR	SWGRMA	EP-BS-E5	4160	SWGRMA	AC/A
EP-TR-5B	TR	SWGRMA	EP-BS-E5	4160	SWGRMA	AC/A
EP-TR-5C	TR	SWGRMB	EP-BS-E6	4160	SWGRMB	AC/B
EP-TR-5D	TR	SWGRMB	EP-BS-E6	4160	SWGRMB	AC/B
EP-UPS-1A	UPS	SWGRMA	EP-MCC-512	480	SWGRMA	AC/A
EP-UPS-1B	UPS	SWGRMB	EP-MCC-612	480	SWGRMB	AC/B
EP-UPS-1C	UPS	SWGRMA	EP-MCC-521	480	SWGRMA	AC/A
EP-UPS-1D	UPS	SWGRMB	EP-MCC-621	480	SWGRMB	AC/B
SWS-16	HV	PAB				
SWS-18	HV	PAB				

Table 3.6-2. Partial Listing of Electrical Sources and Loads at Seabrook 1

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-BC-1A	125	DC/A	SWGRMA	EP	EP-BS-11A	BUS	SWGRMA
EP-BC-1B	125	DC/B	SWGRMB	EP	EP-BS-11B	BUS	SWGRMB
EP-BC-1C	125	DC/C	SWGRMA	EP	EP-BS-11C	BUS	SWGRMA
EP-BC-1D	125	DC/D	SWGRMB	EP	EP-BS-11D	BUS	SWGRMB
EP-BS-11A	125	DC/A	SWGRMA	AFWS	AFW-127	HV	MSFWPPCHW
EP-BS-11A	125	DC/A	SWGRMA	RCS	RCS-456A	NV	RC
EP-BS-11B	125	DC/B	SWGRMB	AFWS	AFW-128	HV	MSFWPPCHE
EP-BS-11B	125	DC/B	SWGRMB	RCS	RCS-456B	NV	RC
EP-BS-E5	4160	AC/A	SWGRMA	CCWS	CCW-11A	MDP	PAB
EP-BS-E5	4160	AC/A	SWGRMA	CCWS	CCW-11C	MDP	PAB
EP-BS-E5	4160	AC/A	SWGRMA	CHRS	CBS-9A	MDP	VAULT1
EP-BS-E5	4160	AC/A	SWGRMA	CVCS	CHG-2A	MDP	CHGPMRM
EP-BS-E5	4160	AC/A	SWGRMA	ECCS	RHR-8A	MDP	VAULT1
EP-BS-E5	4160	AC/A	SWGRMA	ECCS	SI-6	MDP	VAULT1
EP-BS-E5	4160	AC/A	SWGRMA	EP	EP-TR-5A	TR	SWGRMA
EP-BS-E5	4160	AC/A	SWGRMA	EP	EP-TR-5B	TR	SWGRMA
EP-BS-E5	4160	AC/A	SWGRMA	SWS	SWS-41A	MDP	SWPMHS
EP-BS-E5	4160	AC/A	SWGRMA	SWS	SWS-41C	MDP	SWPMHS
EP-BS-E51	480	AC/A	SWGRMA	EP	EP-MCC-512	MCC	SWGRMA
EP-BS-E51	480	AC/A	SWGRMA	EP	EP-MCC-515	MCC	SWGRMA
EP-BS-E52	480	AC/A	SWGRMA	EP	EP-MCC-521	MCC	SWGRMA
EP-BS-E6	4160	AC/B	SWGRMB	AFWS	AFW-37B	MDP	EFWPMBLDG
EP-BS-E6	4160	AC/B	SWGRMB	CCWS	CCW-11B	MDP	PAB
EP-BS-E6	4160	AC/B	SWGRMB	CCWS	CCW-11D	MDP	PAB
EP-BS-E6	4160	AC/B	SWGRMB	CHRS	CBS-9B	MDP	VAULT2
EP-BS-E6	4160	AC/B	SWGRMB	CVCS	CHG-2B	MDP	CHGPMRM
EP-BS-E6	4160	AC/B	SWGRMB	ECCS	RHR-8B	MDP	VAULT2
EP-BS-E6	4160	AC/B	SWGRMB	ECCS	SI-6B	MDP	VAULT2
EP-BS-E6	4160	AC/B	SWGRMB	EP	EP-TR-5C	TR	SWGRMB
EP-BS-E6	4160	AC/B	SWGRMB	EP	EP-TR-5D	TR	SWGRMB
EP-BS-E6	4160	AC/B	SWGRMB	SWS	SWS-41B	MDP	SWPMHS

Table 3.6-2. Partial Listing of Electrical Sources and Loads at Seabrook 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-BS-E6	4160	AC/B	SWGRMB	SWS	SWS-41D	MDP	SWPMHS
EP-BS-E61	480	AC/B	SWGRMB	EP	EP-MCC-612	MCC	SWGRMB
EP-BS-E61	480	AC/B	SWGRMB	EP	EP-MCC-615	MCC	SWGRMB
EP-BS-E62	480	AC/B	SWGRMB	EP	EP-MCC-621	MCC	SWGRMB
EP-DG-1A	4160	AC/A	DGA21	EP	EP-BS-E5	BUS	SWGRMA
EP-DG-1B	4160	AC/B	DGB21	EP	EP-BS-E6	BUS	SWGRMB
EP-MCC-271	480	NON-CLASS	UNKNOWN	SWS	SWS-63	MOV	DISTRST
EP-MCC-512	480	AC/A	SWGRMA	CCWS	CCW-137	MOV	VAULT1
EP-MCC-512	480	AC/A	SWGRMA	CCWS	CCW-145	MOV	VAULT1
EP-MCC-512	480	AC/A	SWGRMA	CVCS	CHG-112D	MOV	RWST
EP-MCC-512	480	AC/A	SWGRMA	ECCS	CHG-460	MOV	VAULT1
EP-MCC-512	480	DC/A	SWGRMA	EP	EP-BC-1A	BC	SWGRMA
EP-MCC-512	480	AC/A	SWGRMA	EP	EP-UPS-1A	UPS	SWGRMA
EP-MCC-512	480	AC/A	SWGRMA	SWS	SWS-15	MOV	PAB
EP-MCC-512	480	AC/A	SWGRMA	SWS	SWS-20	MOV	PAB
EP-MCC-512	480	AC/A	SWGRMA	SWS	SWS-4	MOV	PAB
EP-MCC-514	480	AC/A	SWPMHS	SWS	SWS-2	MOV	SWPMHS
EP-MCC-514	480	AC/A	SWPMHS	SWS	SWS-22	MOV	SWPMHS
EP-MCC-515	480	AC/A	SWGRMA	AFWS	AFW-4214A	MOV	EFWPMBLDG
EP-MCC-515	480	AC/A	SWGRMA	AFWS	AFW-4214A	MOV	EFWPMBLDG
EP-MCC-515	480	AC/A	SWGRMA	AFWS	AFW-4224A	MOV	EFWPMBLDG
EP-MCC-515	480	AC/A	SWGRMA	AFWS	AFW-4224A	MOV	EFWPMBLDG
EP-MCC-515	480	AC/A	SWGRMA	AFWS	AFW-4234A	MOV	EFWPMBLDG
EP-MCC-515	480	AC/A	SWGRMA	AFWS	AFW-4234A	MOV	EFWPMBLDG
EP-MCC-515	480	AC/A	SWGRMA	AFWS	AFW-4244A	MOV	EFWPMBLDG
EP-MCC-515	480	AC/A	SWGRMA	AFWS	AFW-4244A	MOV	EFWPMBLDG
EP-MCC-521	480	AC/A	SWGRMA	CHRS	CBS-11	MOV	PPA
EP-MCC-521	480	AC/A	SWGRMA	CHRS	CBS-8	MOV	PPA
EP-MCC-521	480	AC/A	SWGRMA	CVCS	SI-138	MOV	PPA
EP-MCC-521	480	AC/A	SWGRMA	ECCS	CBS-47	MOV	VAULT1
EP-MCC-521	480	AC/A	SWGRMA	ECCS	CBS-49	MOV	VAULT1

Table 3.6-2. Partial Listing of Electrical Sources and Loads at Seabrook 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-MCC-521	480	AC/A	SWGRMA	ECCS	RHR-35	MOV	VAULT1
EP-MCC-521	480	AC/A	SWGRMA	ECCS	SI-112	MOV	VAULT1
EP-MCC-521	480	DC/C	SWGRMA	EP	EP-BC-1C	BC	SWGRMA
EP-MCC-521	480	AC/A	SWGRMA	EP	EP-UPS-1C	UPS	SWGRMA
EP-MCC-521	480	AC/A	SWGRMA	RCS	RCS-122	MOV	RC
EP-MCC-521	480	AC/A	SWGRMA	RCS	RCS-23	MOV	RC
EP-MCC-521	480	AC/A	SWGRMA	RCS	RCS-88	MOV	RC
EP-MCC-522	480	AC/A	SWGRMA	ECCS	SI-102	MOV	PPA
EP-MCC-522	480	AC/A	SWGRMA	ECCS	SI-114	MOV	PPA
EP-MCC-612	480	AC/B	SWGRMB	CCWS	CCW-266	MOV	VAULT2
EP-MCC-612	480	AC/B	SWGRMB	CCWS	CCW-272	MOV	VAULT2
EP-MCC-612	480	AC/B	SWGRMB	CVCS	CHG-112E	MOV	RWST
EP-MCC-612	480	AC/B	SWGRMB	ECCS	CHG-461	MOV	VAULT1
EP-MCC-612	480	AC/B	SWGRMB	ECCS	CHG-475	MOV	VAULT1
EP-MCC-612	480	DC/B	SWGRMB	EP	EP-BC-1B	BC	SWGRMB
EP-MCC-612	480	AC/B	SWGRMB	EP	EP-UPS-1B	UPS	SWGRMB
EP-MCC-612	480	AC/B	SWGRMB	SWS	SWS-19	MOV	PAB
EP-MCC-612	480	AC/B	SWGRMB	SWS	SWS-5	MOV	PAB
EP-MCC-614	480	AC/B	SWPMHS	SWS	SWS-29	MOV	SWPMHS
EP-MCC-614	480	AC/B	SWPMHS	SWS	SWS-31	MOV	SWPMHS
EP-MCC-615	480	AC/B	SWGRMB	AFWS	AFW-4214B	MOV	EFWPMBLDG
EP-MCC-615	480	AC/B	SWGRMB	AFWS	AFW-4214B	MOV	EFWPMBLDG
EP-MCC-615	480	AC/B	SWGRMB	AFWS	AFW-4224B	MOV	EFWPMBLDG
EP-MCC-615	480	AC/B	SWGRMB	AFWS	AFW-4224B	MOV	EFWPMBLDG
EP-MCC-615	480	AC/B	SWGRMB	AFWS	AFW-4234B	MOV	EFWPMBLDG
EP-MCC-615	480	AC/B	SWGRMB	AFWS	AFW-4234B	MOV	EFWPMBLDG
EP-MCC-615	480	AC/B	SWGRMB	AFWS	AFW-4244B	MOV	EFWPMBLDG
EP-MCC-615	480	AC/B	SWGRMB	AFWS	AFW-4244B	MOV	EFWPMBLDG
EP-MCC-621	480	AC/B	SWGRMB	CHRS	CBS-14	MOV	PPA
EP-MCC-621	480	AC/B	SWGRMB	CHRS	CBS-17	MOV	PPA
EP-MCC-621	480	AC/B	SWGRMB	CVCS	SI-139	MOV	PPA

Table 3.6-2. Partial Listing of Electrical Sources and Loads at Seabrook 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-MCC-621	480	AC/B	SWGRMB	ECCS	CBS-51	MOV	VAULT2
EP-MCC-621	480	AC/B	SWGRMB	ECCS	CBS-53	MOV	VAULT2
EP-MCC-621	480	AC/B	SWGRMB	ECCS	RHR-36	MOV	VAULT2
EP-MCC-621	480	AC/B	SWGRMB	ECCS	SI-111	MOV	VAULT2
EP-MCC-621	480	DC/D	SWGRMB	EP	EP-BC-1D	BC	SWGRMB
EP-MCC-621	480	AC/B	SWGRMB	EP	EP-UPS-1D	UPS	SWGRMB
EP-MCC-621	480	AC/B	SWGRMB	RCS	RCS-12[illegible]	MOV	RC
EP-MCC-621	480	AC/B	SWGRMB	RCS	RCS-22	MOV	RC
EP-MCC-621	480	AC/B	SWGRMB	RCS	RCS-87	MOV	RC
EP-MCC-622	480	AC/B	SWGRMB	ECCS	SI-77	MOV	PPA
EP-TR-5A	480	AC/A	SWGRMA	EP	EP-BS-E51	BUS	SWGRMA
EP-TR-5B	480	AC/A	SWGRMA	EP	EP-BS-E52	BUS	SWGRMA
EP-TR-5C	480	AC/B	SWGRMB	EP	EP-BS-E61	BUS	SWGRMB
EP-TR-5D	480	AC/B	SWGRMB	EP	EP-BS-E62	BUS	SWGRMB
EP-UPS-1A	120	AC/A	SWGRMA	EP	EP-PNL-1A	PNL	SWGRMA
EP-UPS-1B	120	AC/B	SWGRMB	EP	EP-PNL-1B	PNL	SWGRMB
EP-UPS-1C	120	AC/A	SWGRMA	EP	EP-PNL-1C	PNL	SWGRMA
EP-UPS-1D	120	AC/B	SWGRMB	EP	EP-PNL-1D	PNL	SWGRMB

3.7 CONTAINMENT HEAT REMOVAL SYSTEMS

3.7.1 System Function

The containment heat removal systems consist of an integrated set of subsystems that provide the functions of containment heat removal and containment pressure control following a loss of coolant accident. In conjunction with the ECCS, the containment heat removal systems complete the post-LOCA heat transfer path from the reactor core to the ultimate heat sink.

3.7.2 System Definition

The containment heat removal systems include the following of two separate subsystems:

- Containment Structure Cooling System
- Containment Building Spray (CBS) System

The containment structure cooling system consists of six fan-coil units (evenly divided into two trains) designed to maintain the normal ambient temperature in the containment structure at or below 120°F. All units are identical, each consisting of a double-wall insulated steel housing containing a centrifugal fan, a discharge damper, and six banks of cooling coils with filters at opposite ends of the housing. Each train of cooling units is supplied cooling water and electrical power from the corresponding train of the primary component cooling water system (PCCWS) and Class 1E electric power system.

The containment building spray system is comprised of two independent trains, each of which consists of a 100-percent capacity pump, a heat exchanger, and two spray headers. Coolant for the pumps is supplied by the RWST during the injection mode while for recirculation the containment recirculation sumps supply water. Cooling for these pumps and heat exchangers is provided by the PCCWS.

Simplified drawings of the Containment Building Spray System are shown in Figures 3.7-1 to 3.7-3. The interface between the containment fan coolers and the primary component cooling water system is shown on the PCCWS drawings in Section 3.8. A summary of data on selected containment heat removal system components is presented in Table 3.7-1.

3.7.3 System Operation

During normal plant operation, five cooling units of the containment structure cooling system are operating to maintain the normal ambient air temperature in the containment structure at or below 120°F. The system also functions to prevent the concrete temperature in the area of the reactor supports from exceeding 150°F. Recirculated air is cooled and discharged from the five operating units into a common sheet metal ductwork header and distributed throughout the containment.

During normal plant operation, the containment building spray system is in standby. The injection phase of the CBS system is automatically initiated by a containment spray actuation signal which is generated by a high-high containment pressure signal ("P" signal). This signal starts the CBS pumps and opens the discharge valves to the spray headers. Coolant for the pumps is supplied by the RWST until a low-low level in the RWST occurs, in conjunction with a safety injection signal ("S" signal). At this point, the recirculation phase is automatically initiated, and coolant for the CBS pumps is supplied from the containment recirculation sumps.

3.7.4 System Success Criteria

The post-accident containment heat removal function can be accomplished by the operation of one train of containment building spray or by the operation of one train of containment structure cooling (3 cooling units) (Ref. 2).

3.7.5 Component Information

A. Containment Building Spray Pumps 9A, 99B
   1. Rated flow: 3010 gpm @ 540 ft. head (234 psid)
   2. Rated capacity: 100%
   3. Type: horizontal centrifugal

B. Containment Spray Heat Exchangers (2)
   1. Type: shell and U-tube
   2. Heat Removal Capacity: 1.49×10^6 Btu/hr °F

C. Containment Fan Cooler Units (6)
   1. Design duty: unknown
   2. Water flow rate: 330 gpm @ 85°F

D. Refueling Water Storage Tank
   1. Capacity: 475,000 gal
   2. Operating pressure: atmospheric

3.7.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The CBS system is automatically actuated by a containment spray actuation signal which is generated by a high-high containment pressure signal (P signal).
   2. Remote manual
      The CBS system can be actuated by remote manual means from the main control board in the control room.

B. Motive Power
   The CBS pumps, containment fan cooler units, and related motor-operated valves are Class 1E AC loads that can be supplied from the standby diesel generators, as described in Section 3.6. Redundant loads are supplied from separate load groups.

C. Cooling Water
   The CBS pumps and containment fan cooler units are cooled by the primary component cooling water system (see Section 3.8).

D. Other
   1. Lubrication and cooling are assumed to be provided locally for the CBS pumps.
   2. Room cooling for the CBS pump rooms is provided by the containment enclosure air handling system.

3.7.7 Section 3.5 References

1. Seabrook 1 Final Safety Analysis Report, Section 6.2.2 and 6.5.
2. Seabrook Station Probabilistic Safety Assessment, Section 7.12.

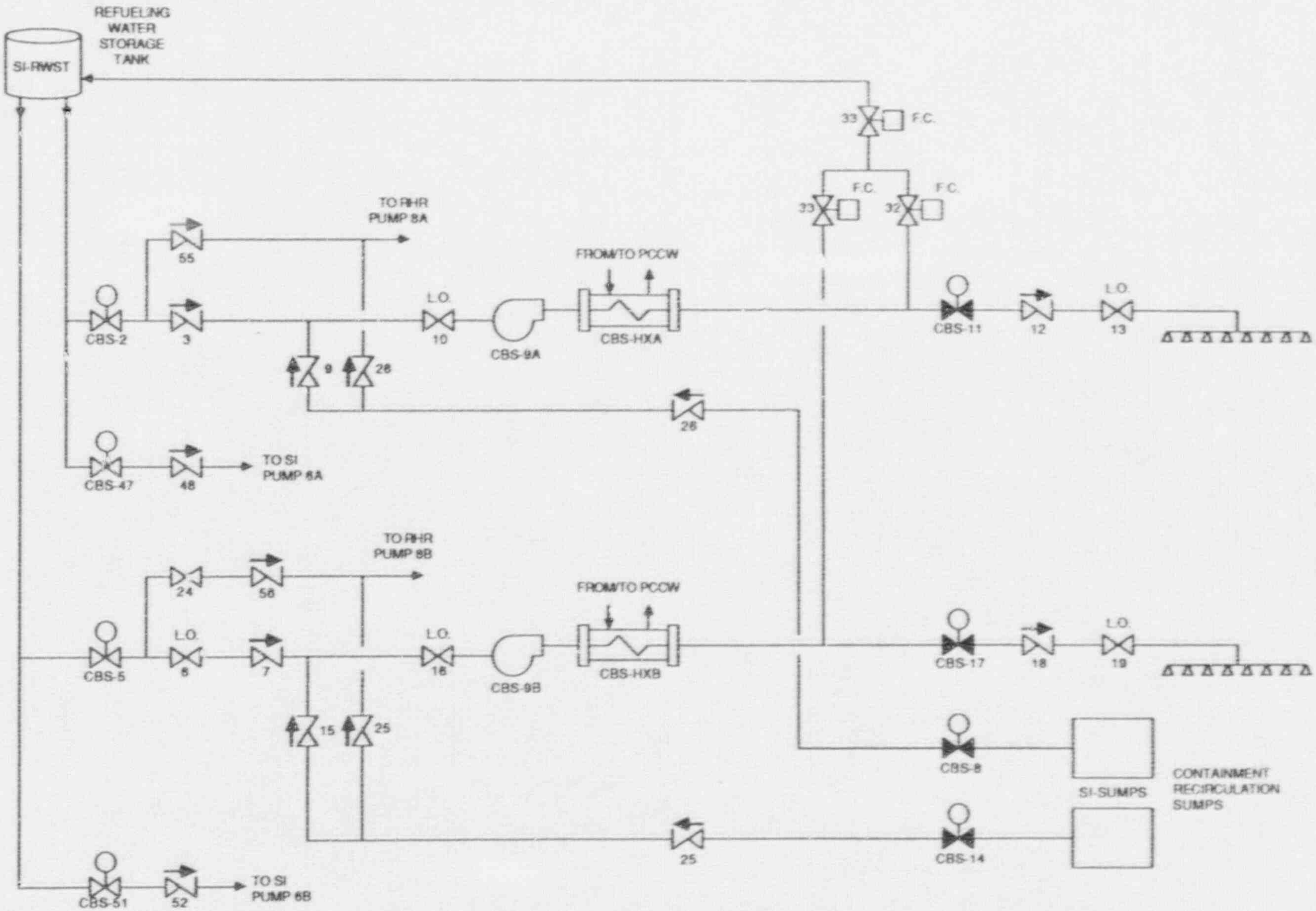

Figure 3.7-1. Seabrook 1 Containment Building Spray System

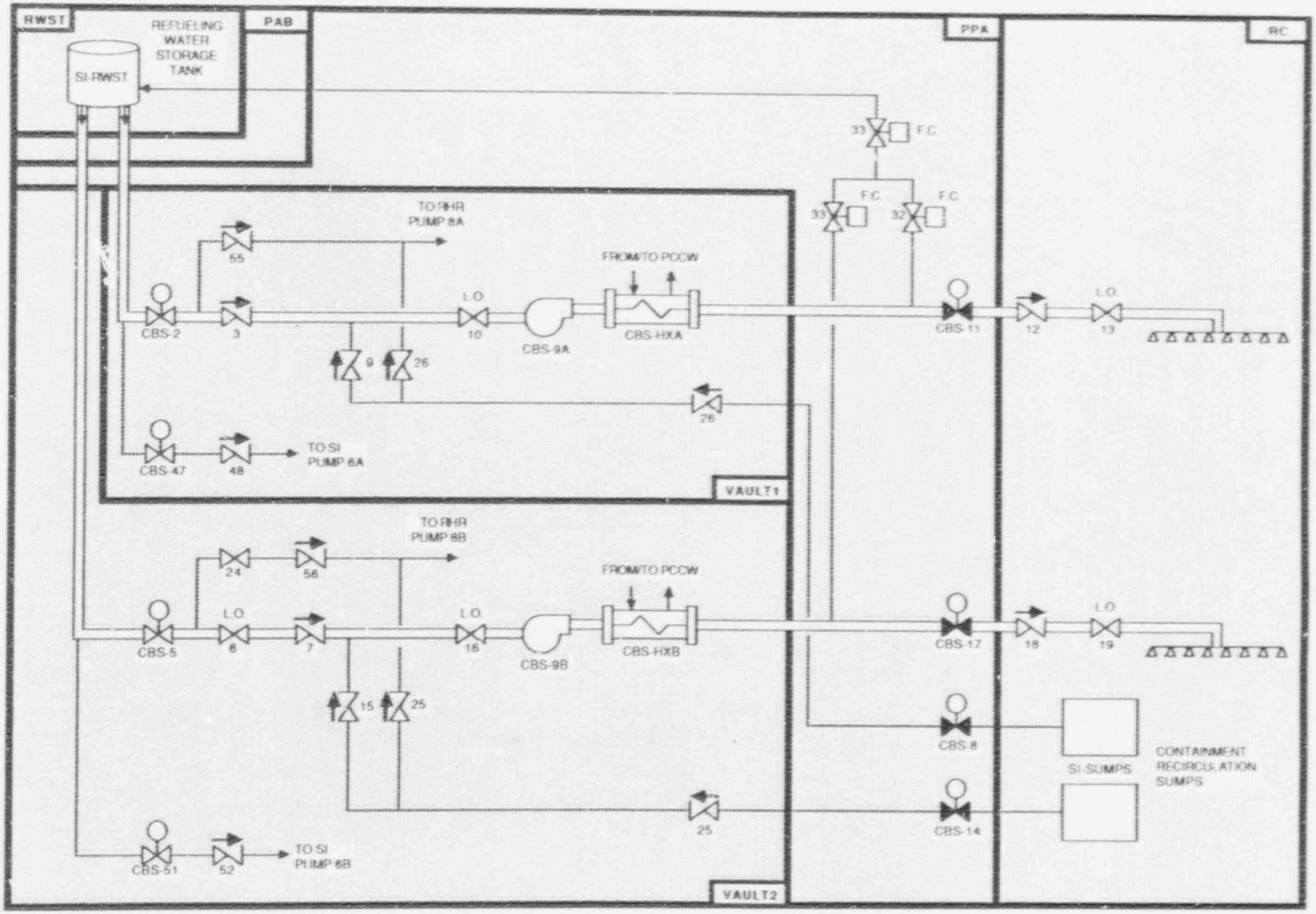

Figure 3.7-2. Seabrook 1 Containment Building Spray System (Injection Mode) Showing Component Locations

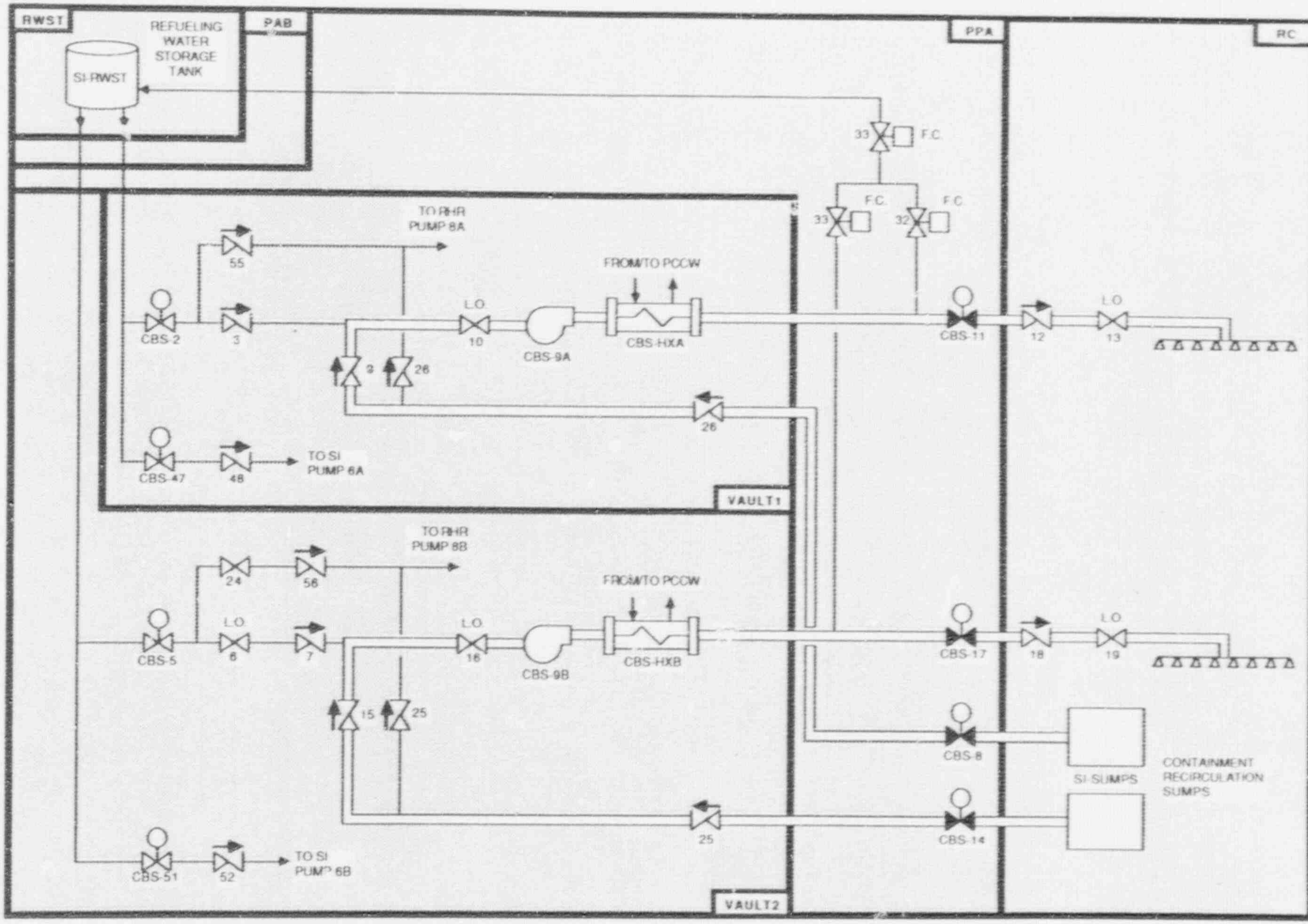

Figure 3.7-3. Seabrook 1 Containment Building Spray System (Recirculation Mode) Showing Component Locations

Table 3.7-1. Seabrook 1 Containment Heat Removal System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CBS-11	MOV	PPA	EP-MCC-521	480	SWGRMA	AC/A
CBS-14	MOV	PPA	EP-MCC-621	480	SWGRMB	AC/B
CBS-17	MOV	PPA	EP-MCC-621	480	SWGRMB	AC/B
CBS-8	MOV	PPA	EP-MCC-521	480	SWGRMA	AC/A
CBS-9A	MDP	VAULT1	EP-BS-E5	4160	SWGRMA	AC/A
CBS-9B	MDP	VAULT2	EP-BS-E6	4160	SWGRMB	AC/B
CBS-HXA	HX	VAULT1				
CBS-HXB	HX	VAULT2				
SI-SUMPS	TK	RC				

3.8 PRIMARY COMPONENT COOLING WATER SYSTEM (PCCWS)

3.8.1 System Function

The primary component cooling water system (PCCWS) provides cooling for the following components which are needed for plant operation or to satisfy one or more basic safety functions:

- Containment Building Spray (CBS) Pumps
- Containment Spray Heat Exchangers
- Residual Heat Removal (RHR) Pumps
- RHR Heat Exchangers
- Safety Injection (SI) Pumps
- Centrifugal Charging Pumps
- Containment Structure Cooling Units
- Containment Enclosure Coolers
- Reactor Coolant Pump (RCP) Thermal Barrier Cooling Heat Exchangers

The PCCWS transfers heat to the SWS for rejection to the ultimate heat sink. The PCCWS serves as an intermediate system between the RCS and SWS, thereby reducing the probability of leakage to the environment of potentially radioactive coolant.

3.8.2 System Definition

The primary component cooling water system (PCCWS) is a closed loop cooling water system consisting of two separate 100-percent capacity redundant trains. Each PCCWS train consists of one heat exchanger, two 100-percent capacity pumps, one PCCWS head tank, and associated piping, valves, and instrumentation. The heat transferred through the heat exchangers is rejected to the service water system.

Simplified drawings of the PCCWS are shown in Figures 3.8-1 and 3.8-2. A summary of data on selected PCCWS components is presented in Table 3.8-1.

3.8.3 System Operation

During normal plant operation, both loops of the PCCWS are operating with one pump per loop being utilized. The PCCWS pumps take suction from the discharge header and circulate the component cooling water through the PCCWS heat exchanger, and then through the components to be cooled. Heat from the PCCWS heat exchangers is transferred to the SWS. A high-high containment pressure signal ("P" signal), causes the non-essential services inside the containment supplied by the PCCWS to be isolated. A containment isolation phase A ("T" signal) causes the non-essential services outside containment to be isolated.

The head tank is connected to the main PCCWS line on the suction side of the pumps and functions to ensure that the system is kept filled and pump suction head requirements are maintained.

3.8.4 System Success Criteria

One PCCWS train utilizing one of two pumps is capable of fulfilling system requirements for safe shutdown (Ref. 1, Sec. 9.2.2.2). The Service Water System is required to remove heat from the corresponding PCCWS heat exchanger (see Section 3.9).

3.8.5 Component Information

A. Primary Component Cooling Water pumps 11A, 11B, 11C, 11D
   1. Rated flow: 11,000 gpm @ 200 ft. head (87 psid)
   2. Rated capacity: 100%
   3. Type: horizontal centrifugal

B. Primary Component Cooling Water heat exchangers A, B
   1. Heat transferred: 210×10^6 Btu/hr each
   2. Rate capacity: 100%
   3. Type: Vertical shell, straight tube

C. Primary Component Cooling Water head tanks (2)
   1. Total volume: 2000 gallons each
   2. Design pressure: 100 psig

3.8.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. All non-safeguard services outside containment are automatically isolated on a "T" signal or on a low head tank level signal.
      b. The spent fuel pool heat exchanger is automatically isolated on a "T" signal.
      c. All non-essential services inside containment are automatically isolated on a "P" signal.
   2. Remote manual
      The PCCWS can be operated from the main control room under normal and abnormal conditions. The system controls required for safe shutdown are also provided in the RSS locations.

B. Motive Power
   The motor-driven PCCWS pumps and motor-operated valves are Class 1E loads that can be supplied from the standby diesel generators as described in Section 3.6.

C. Other
   1. Heat is transferred from the PCCWS heat exchangers to the service water system (see Section 3.9).
   2. Cooling for the PCCWS pumps is provided locally.
   3. Lubrication is assumed to be provided locally for the PCCWS pumps.
   4. Normal ventilation for the PCCWS pump area is provided by the primary auxiliary building air handling (PAH) ventilation system.

3.8.7 Section 3.8 References

1. Seabrook 1 Final Safety Analysis Report, section 9.2.2.
2. Seabrook Station Probabilisitic Safety Assessment, Section 7.4.

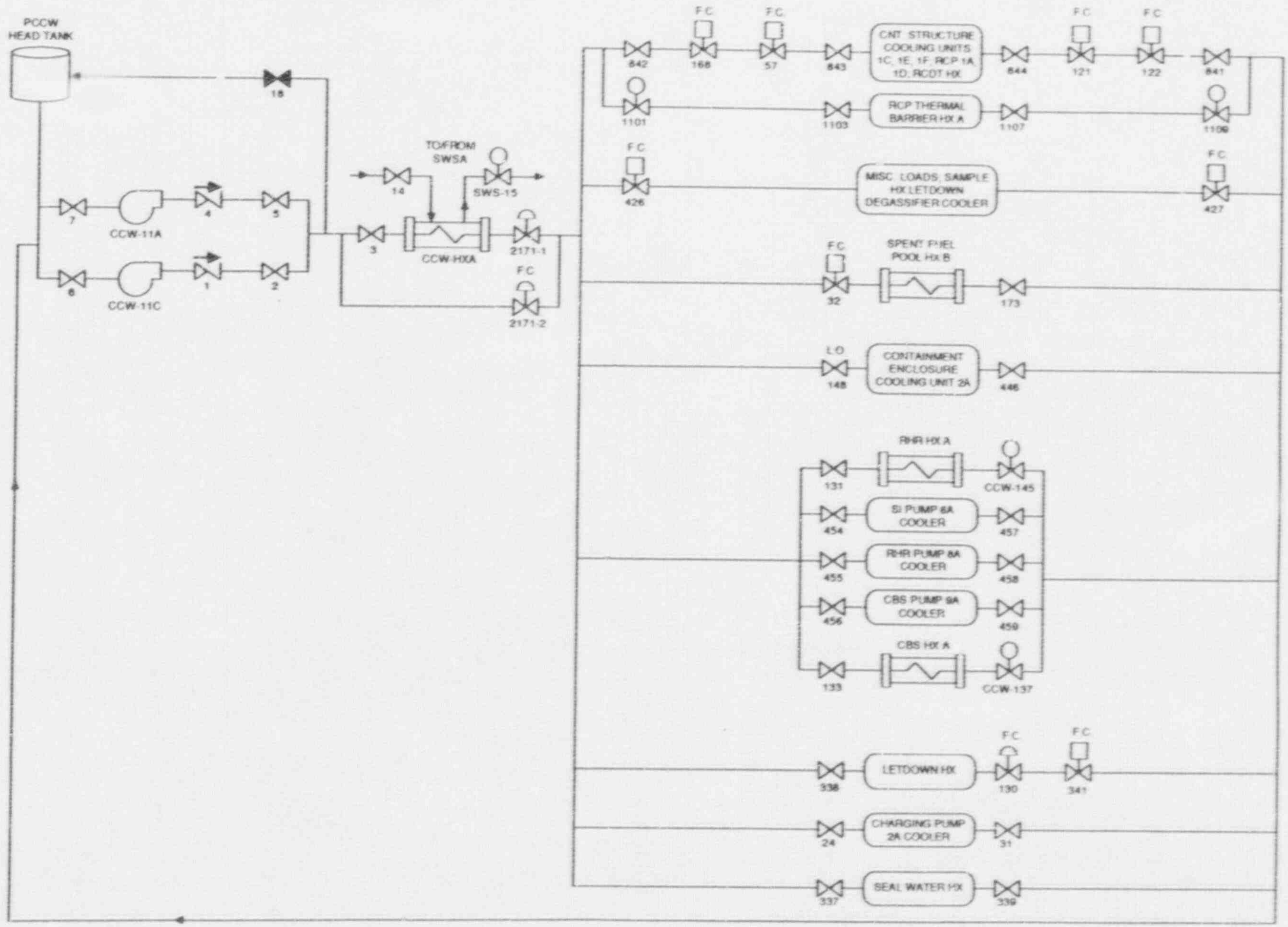

Figure 3.8-1. Seabrook 1 Primary Component Cooling Water System (Train A)

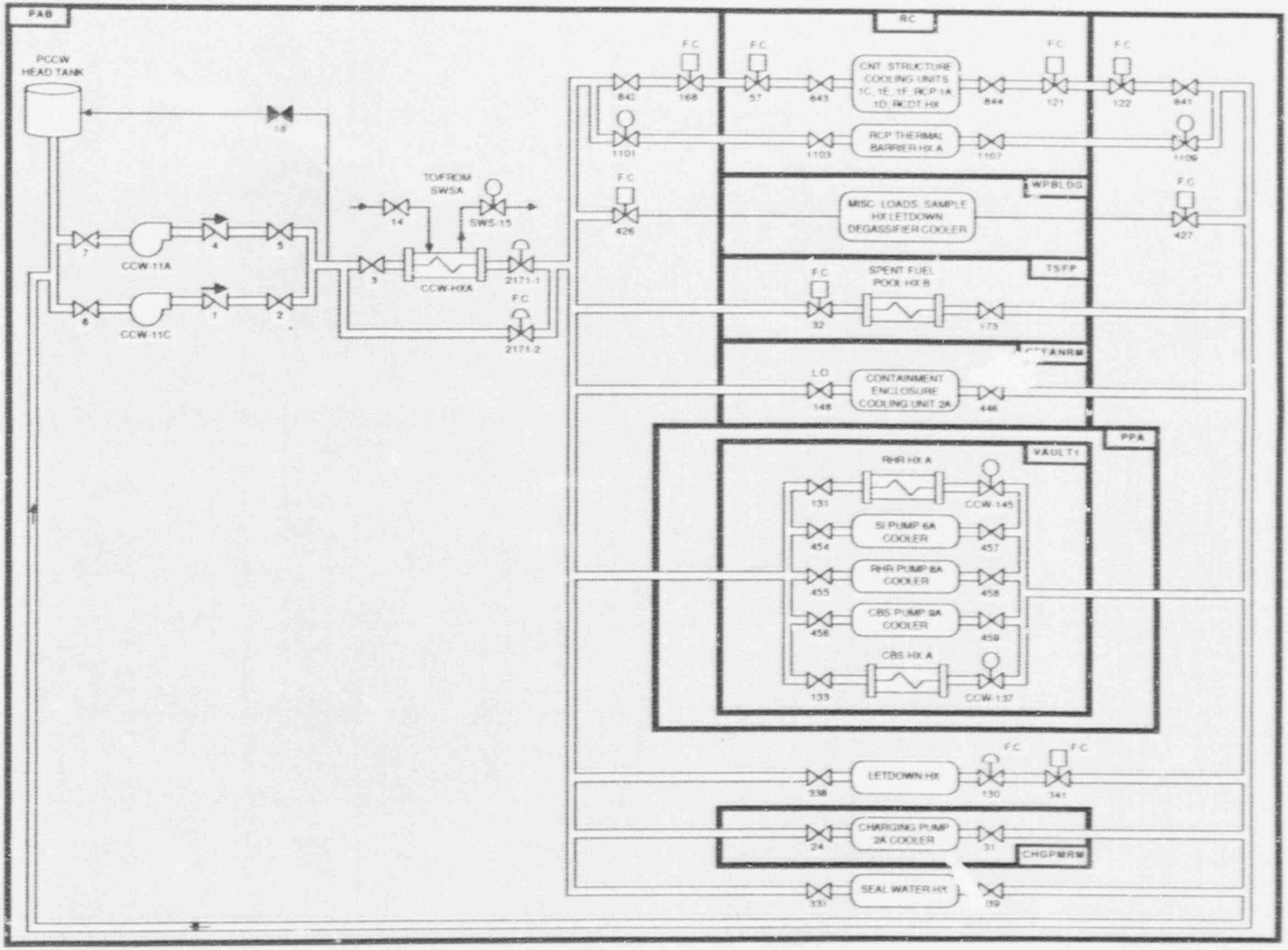

Figure 3.8-2. Seabrook 1 Primary Component Cooling Water System (Train A) Showing Component Locations

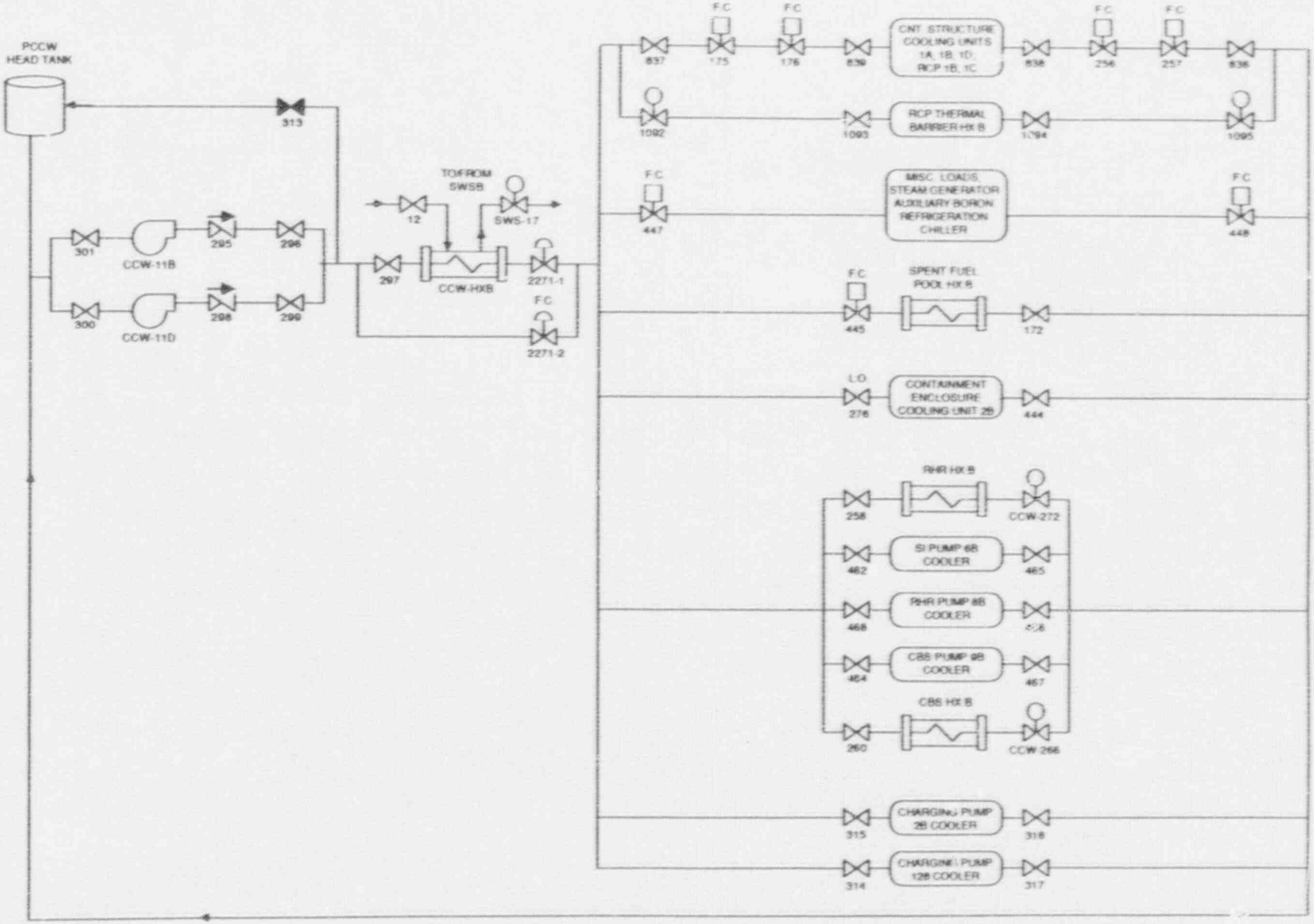

Figure 3.8-3. Seabrook 1 Primary Component Cooling Water System (Train B)

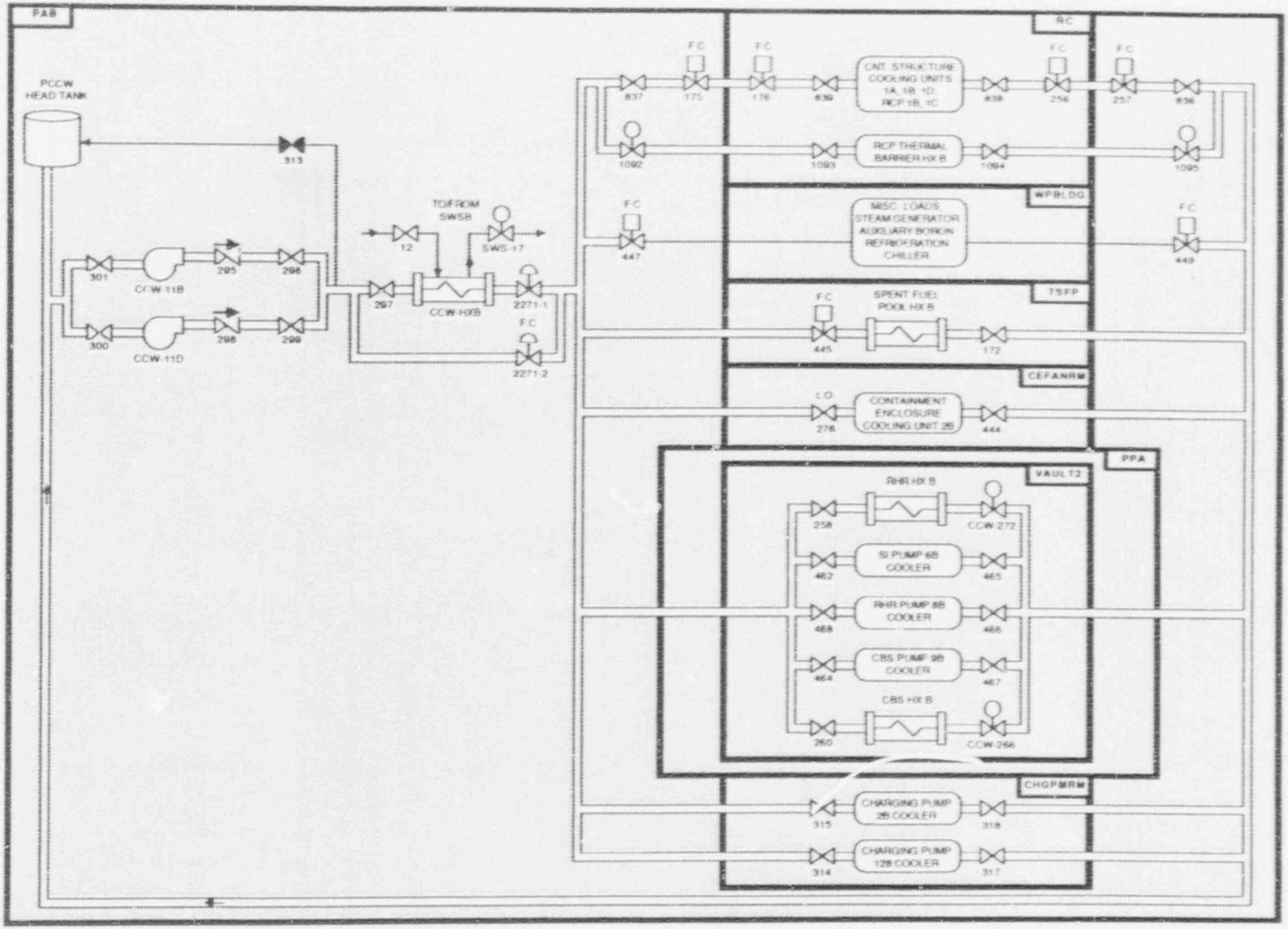

Figure 3.8-4. Seabrook 1 Primary Component Cooling Water System (Train B) Showing Component Locations

3.9 SERVICE WATER SYSTEM

3.9.1 System Function

The service water system (SWS) provides cooling water for the standby diesel generator jacket water coolers, the primary component cooling water (PCCW) heat exchangers, the secondary component cooling water (SCCW) heat exchangers, and the condenser water box priming pump seal water heat exchangers, and transfers the heat removed from these systems to an ultimate heat sink.

3.9.2 System Definition

The service water system (SWS) consists of two completely independent and redundant flow trains (train A and train B), each comprised of two 100-percent capacity pumps, valves, and distribution piping. The ultimate heat sink for all operating and accident heat loads normally is the Atlantic Ocean, with water supplied via a suction tunnel to an intake transition structure. Service water is returned to the Atlantic Ocean via a discharge transition structure and a discharge tunnel. In the event that seawater flow to the service water pumphouse is restricted, a mechanical draft evaporative cooling tower is provided to dissipate shutdown and accident heat loads. The SWS operates as an open-loop system when using the Atlantic Ocean as the ultimate heat sink, and as a closed-loop system when the cooling tower is the ultimate heat sink.

Simplified drawings of the SWS are shown in Figures 3.9-1 to 3.9-3. A summary of data on selected SWS components is presented in Table 3.9-1.

3.9.3 System Operation

The service water system normally is operating during power operation, with one pump per train running and the other pump in standby. The SWS pumps in each train take suction from a common bay in the service water pumphouse and discharge to a common header, supplying a PCCWS heat exchanger, a diesel generator jacket water cooler, and non-essential heat loads in the turbine building. If the discharge pressure of the operating pump falls below a control setpoint, the standby pump will automatically start. Given a safety injection ("S") signal, loss of offsite power, or a tower actuation (TA) signal, the service water supply to the non-essential header is isolated to conserve cooling water flow to safety-related equipment.

A full-flow overflow line is provided in the SWS return line to the intake/discharge transition structure. This overflow is located outside of the primary auxiliary building and is intended to allow continued operation of the SWS with a blocked discharge line and an available suction source from the Atlantic Ocean.

3.9.4 System Success Criteria

A single service water pump supplying a single SWS train can provide sufficient capability to dissipate essential heat loads. Either the Atlantic Ocean or the cooling tower may serve as the ultimate heat sink.

3.9.5 Component Information

A. Service Water System pumps 41A, 41B, 41C, 41D
   1. Rated flow: 10,500 gpm @ 158 ft. head (68.5 psid)
   2. Rated capacity: 100% (each)
   3. Type: Vertical, centrifugal

B. Cooling Tower
   1. Type: Mechanical draft, evaporative

2. Independent cell (Unit 1)
   a. Number of fans: 1
   b. Design heat load: 217.5 x 10^6 Btu/hr
3. Common cell (Unit 1/2)
   a. Number of fans: 2
   b. Design heat load: 240 x 10^6 Btu/hr
4. Total basin capacity: 3.9 x 10^6 gallons

C. Cooling Tower Pumps 110A, 110B
   1. Rated flow: 13,000 gpm @ 170 ft. head (73.7 psid)
   2. Rated capacity: 100% each
   3. Type: Vertical, centrifugal

3.9.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. The standby pump will automatically start if the discharge pressure of the operating pump falls below a control setpoint.
      b. Given a safety injection ("S") signal, a loss of offsite power, or a tower actuation (TA) signal, the service water supply to the non-essential header is isolated. A TA signal is automatically generated upon detecting low-low pump discharge pressure in two out of three elements for each train.
   2. Remote Manual
      The SWS pumps can be operated from the main control board or from the switchgear room.

B. Motive Power
   The motor-driven SWS pumps and motor-operated valves are Class 1E loads that can be supplied from the standby diesel generators as described in Section 3.6

C. Other
   1. Lubrication and cooling are assumed to be provided locally for the SWS pumps.
   2. SWS pump room ventilation is provided by the service water pumphouse heating and ventilation system. Two exhaust fans and dampers in the pumphouse provide ventilation and cooling for the pump room area.

3.9.7 Section 3.9 References

1. Seabrook 1 Final Safety Analysis Report, Section 9.2.1.
2. Seabrook Station Probabilistic Safety Assessment, Section 7.3.

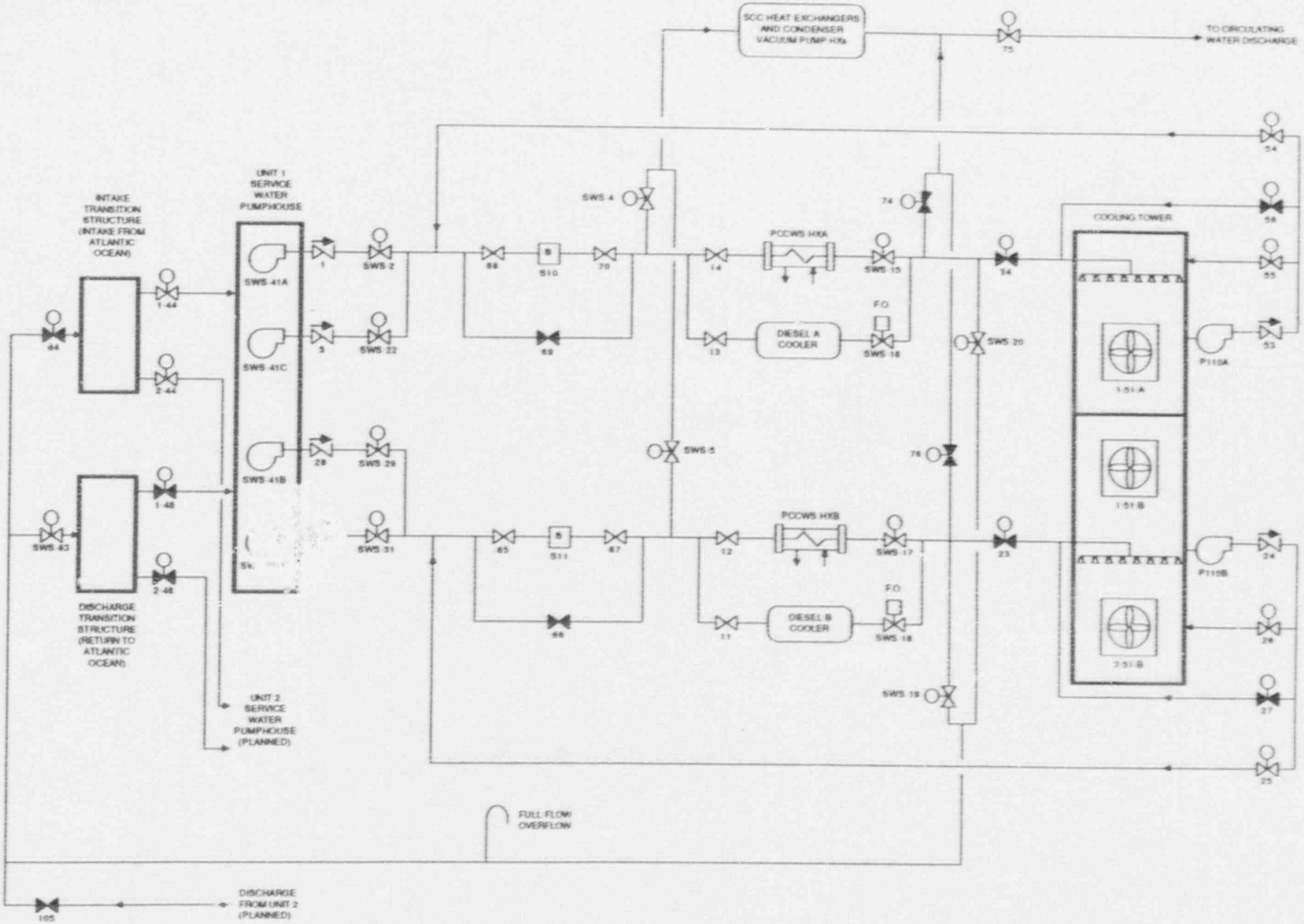

Figure 3.9-1. Seabrook 1 Service Water System

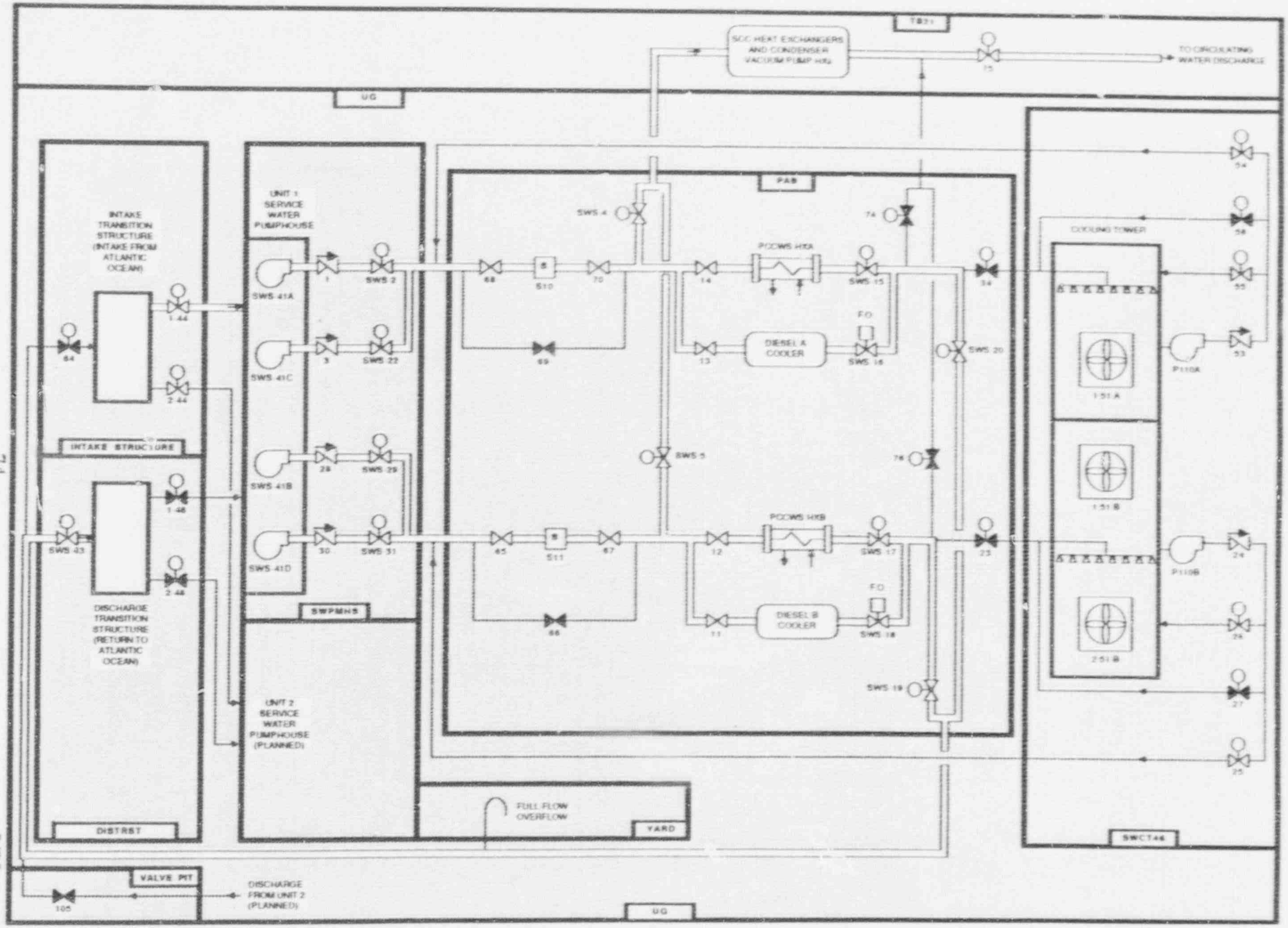

Figure 3.9-2. Seabrook 1 Service Water System (Open-Loop Operation) Showing Component Locations

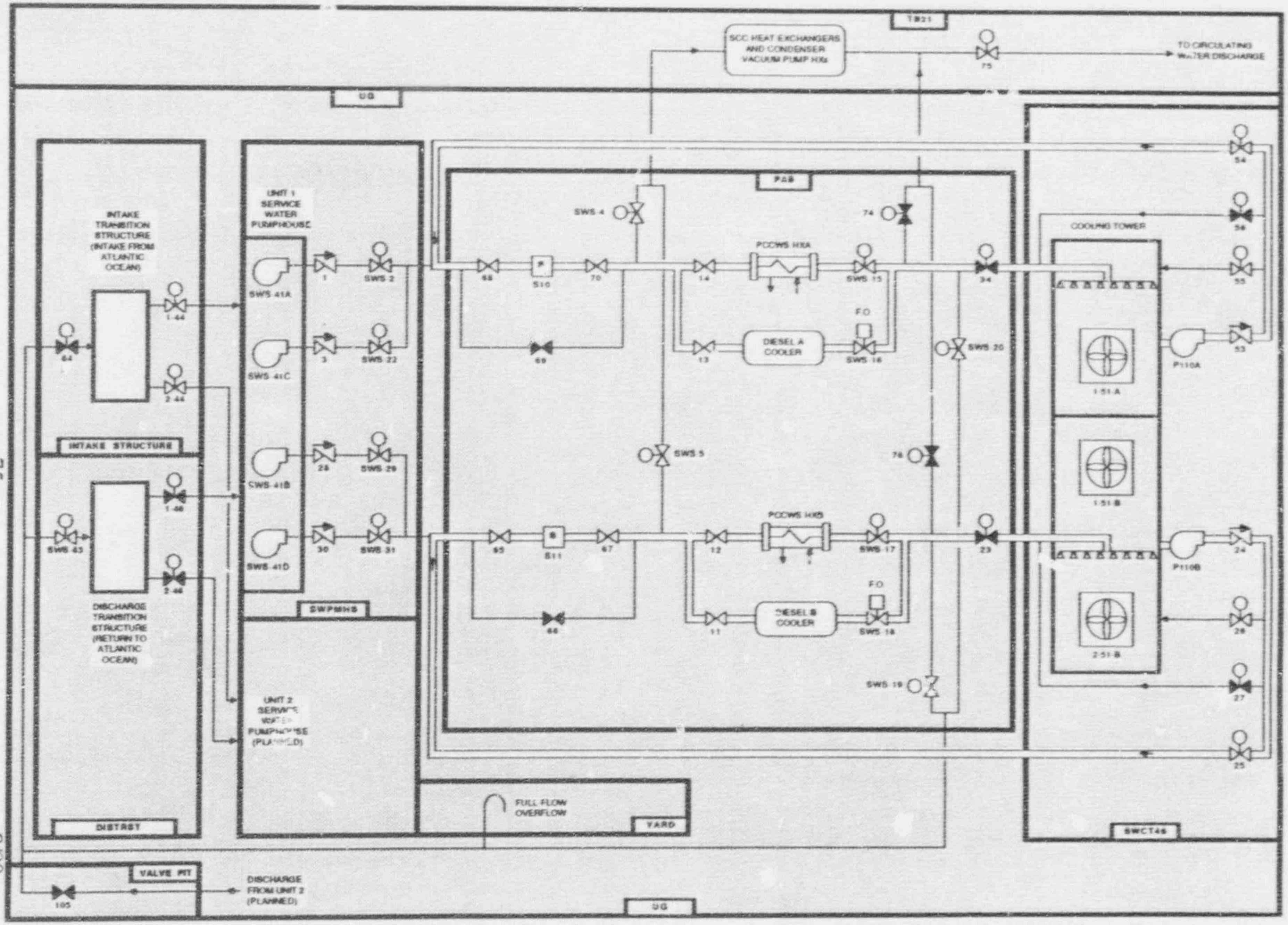

Figure 3.9-3. Seabrook 1 Service Water System (Closed-Loop Operation) Showing Component Locations

Table 3.9-1. Seabrook 1 Service Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
SWS-15	MOV	PAB	EP-MCC-512	480	SWGRMA	AC/A
SWS-17	MOV	PAB				
SWS-19	MOV	PAB	EP-MCC-612	480	SWGRMB	AC/B
SWS-2	MOV	SWPMHS	EP-MCC-514	480	SWPMHS	AC/A
SWS-20	MOV	PAB	EP-MCC-512	480	SWGRMA	AC/A
SWS-22	MOV	SWPMHS	EP-MCC-514	480	SWPMHS	AC/A
SWS-29	MOV	SWPMHS	EP-MCC-614	480	SWPMHS	AC/B
SWS-31	MOV	SWPMHS	EP-MCC-614	480	SWPMHS	AC/B
SWS-4	MOV	PAB	EP-MCC-512	480	SWGRMA	AC/A
SWS-41A	MDP	SWPMHS	EP-BS-E5	4160	SWGRMA	AC/A
SWS-41B	MDP	SWPMHS	EP-BS-E6	4160	SWGRMB	AC/B
SWS-41C	MDP	SWPMHS	EP-BS-E5	4160	SWGRMA	AC/A
SWS-41D	MDP	SWPMHS	EP-BS-E6	4160	SWGRMB	AC/B
SWS-5	MOV	PAB	EP-MCC-612	480	SWGRMB	AC/B
SWS-63	MOV	DISTRST	EP-MCC-271	480	UNKNOWN	NON-

4. PLANT INFORMATION

4.1 SITE AND BUILDING SUMMARY

The Seabrook 1 site is located on the western shore of Hampton Harbor in the township of Seabrook, New Hampshire. It is approximately 11 miles south of Portsmouth, New Hampshire and 2 miles west of the Atlantic Ocean. The site is bounded on the north, east, and south by marshland; the only access to the site is from the west via two roads. Figure 4-1 (Ref. 1) shows a general view of Seabrook as a two unit station, even though work on Unit 2 has been postponed indefinitely. Figure 4-2 shows a simplified plot plan.

The major structures associated with Seabrook 1 are the containment structure, containment enclosure, primary auxiliary building, fuel storage building, control building, diesel generator building, turbine generator building, emergency feedwater pump house, main steam and feedwater pipe chase, service water pump house, ocean intake and discharge structures, and ultimate heat sink cooling tower.

The containment encloses the reactor coolant system (RCS) and is a reinforced concrete structure in the form of a right vertical cylinder with a hemispherical dome. A containment enclosure (i.e., a secondary containment) surrounds the primary containment and is designed to entrap, filter and then discharge any leakage from the primary containment structure.

The primary auxiliary building contains most of the auxiliary systems for the RCS. Those systems whose major components are in the primary auxiliary building include the CVCS, PCCWS, LPSI system, RHR system, and containment spray system. The RHR and containment spray pumps and their associated heat exchangers are located in water tight compartments in the northern part of the primary auxiliary building (RHR Spray Equipment Vault).

The control building contains an electrical equipment room which houses the switchgear, batteries, rod drive controls, a cable spreading room, and control room. The diesel generator building houses the two diesel generators together with their auxiliary equipment. The service water pump house contains the four service water pumps. The emergency feedwater pump building houses the emergency feedwater pumps and emergency feedwater control valves.

4.2 FACILITY LAYOUT DRAWINGS

Figures 4-3 through 4-12, Figures 4-21 through 4-23, and Figures 4-28 through 4-29 show various section views of the Seabrook 1 station. Figures 4-13 through 4-20, Figures 4-24 through 4-27, and Figure 4-30 show simplified layout drawings for Seabrook 1. Major rooms, stairways, elevators and doorways are included, however some interior features are omitted in these simplified layout drawings. Labels printed in uppercase correspond to the location codes listed in Table 4-1 and used in the component data listings and system drawings in Section 3. Some additional labels are included for information and are printed in the lowercase type.

A listing of components by location is presented in Table 4-2. Components included in Table 4-2 are those found in the system data tables in Section 3, therefore this table is only a partial listing of the components and equipment that are located in a particular room or area of the plant.

4.3 SECTION 4 REFERENCES

1. Heddleson, F.A., "Design Data and Safety Features of Commercial Nuclear Power Plants," ORNL-NSIC-55, Volume III, Oak Ridge National Laboratory, April, 1974.

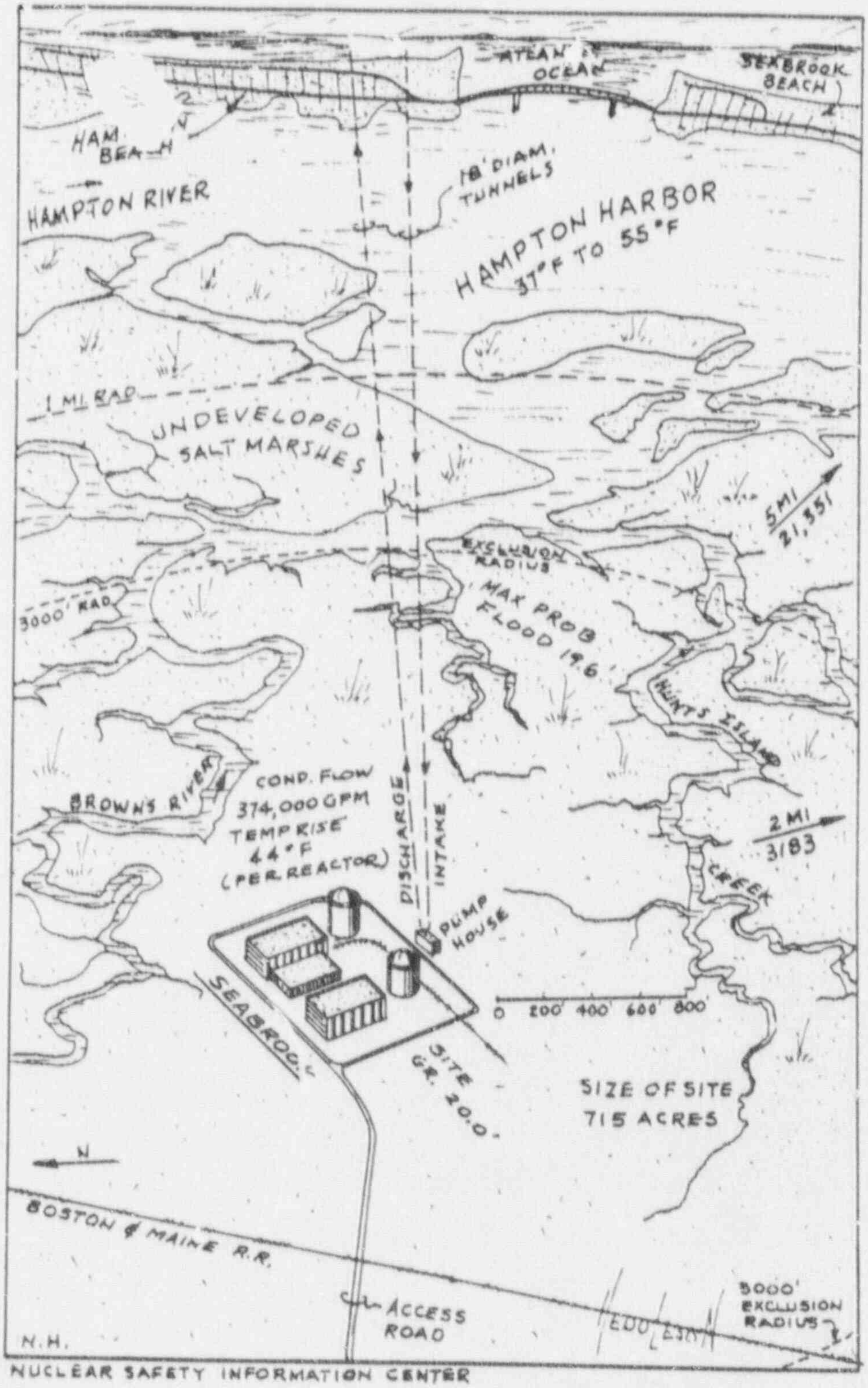

Figure 4-1. General View of Seabrook 1 Site and Vicinity

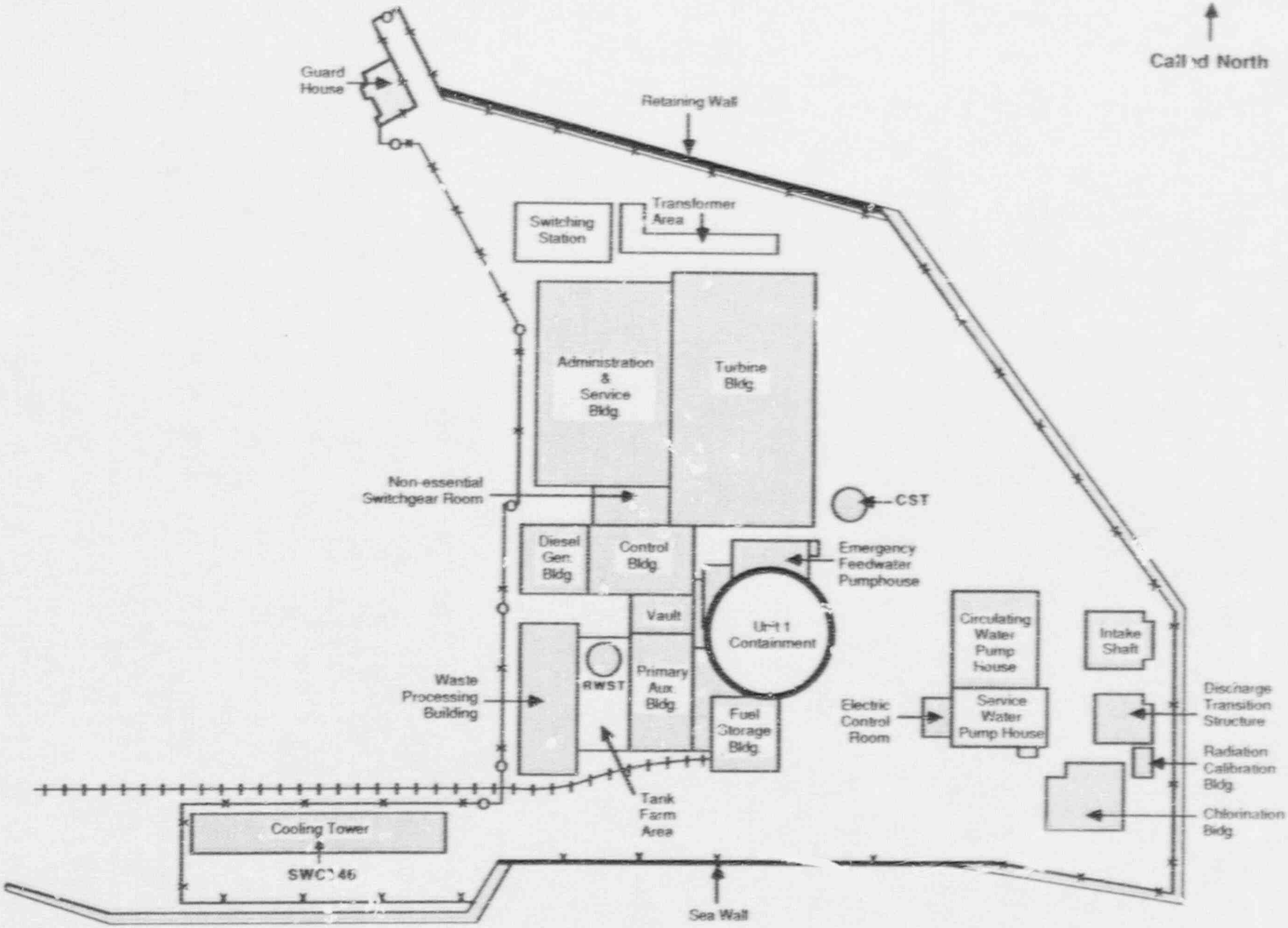

Figure 4-2. Seabrook 1 Simplified Site Plan

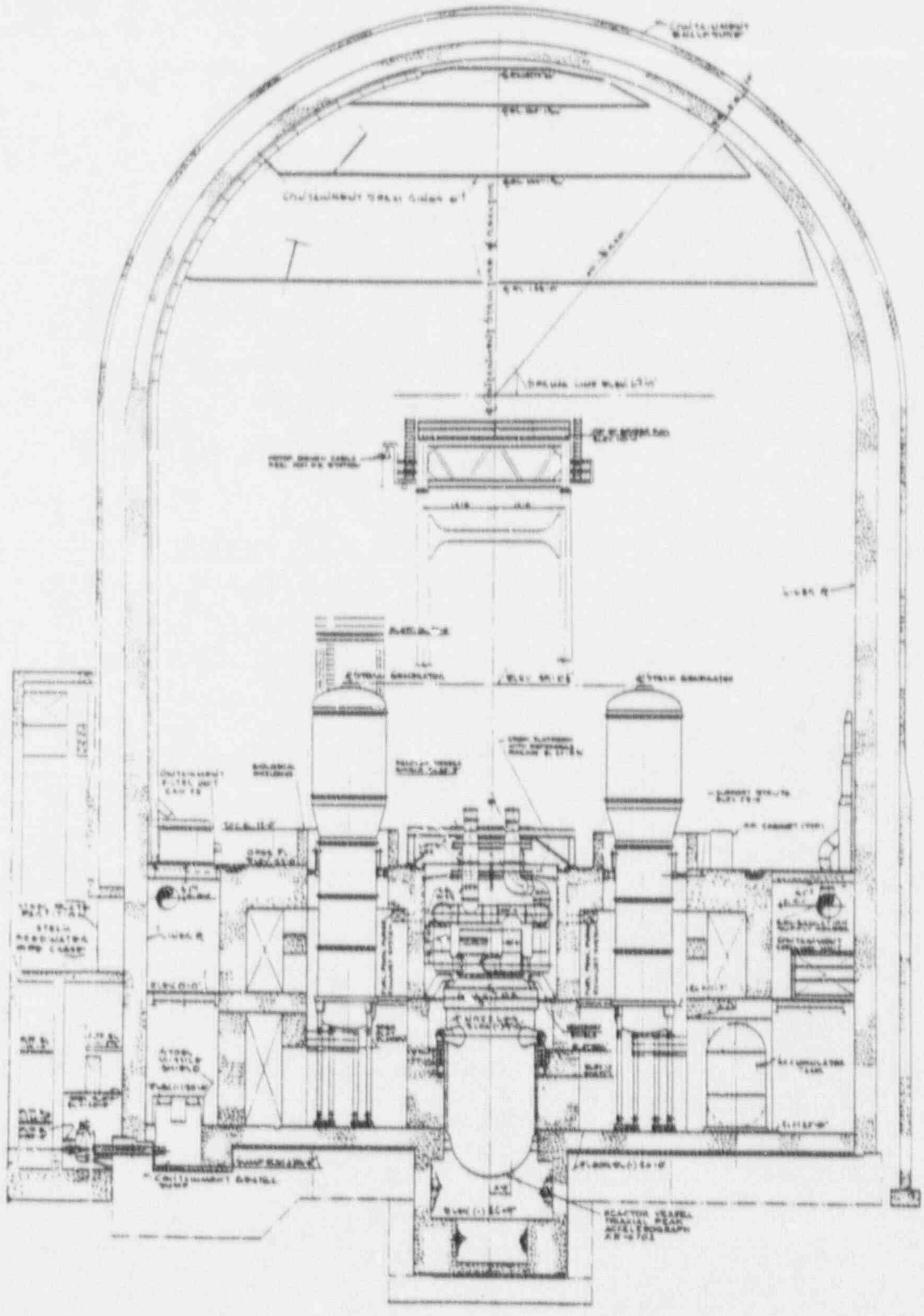

Figure 4-3. Seabrook 1 Reactor Containment Section, Looking North

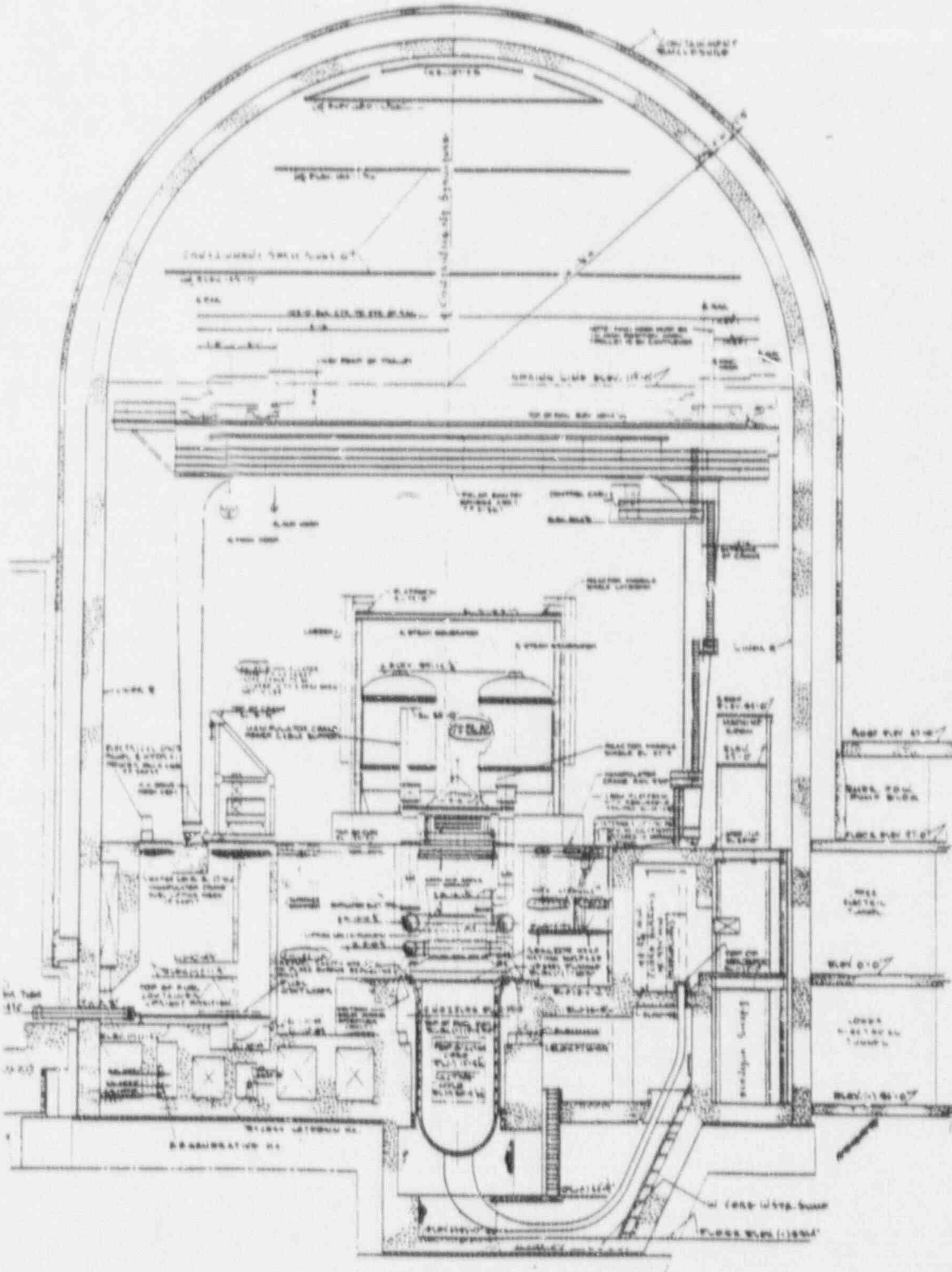

Figure 4-4. Seabrook 1 Reactor Containment Section, Looking West

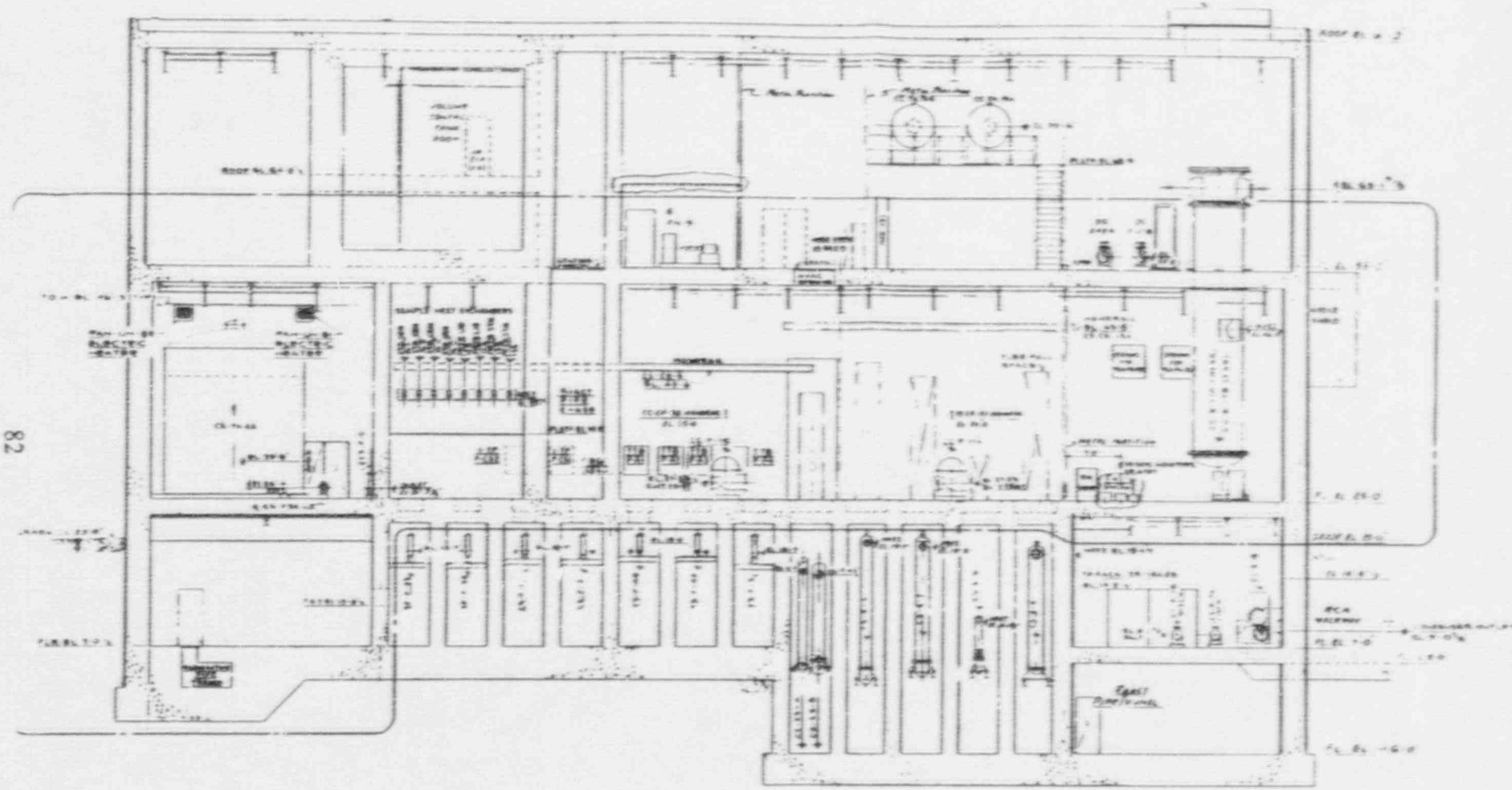

Figure 4-5. Seabrook 1 Primary Auxiliary Building Section 1, Looking West

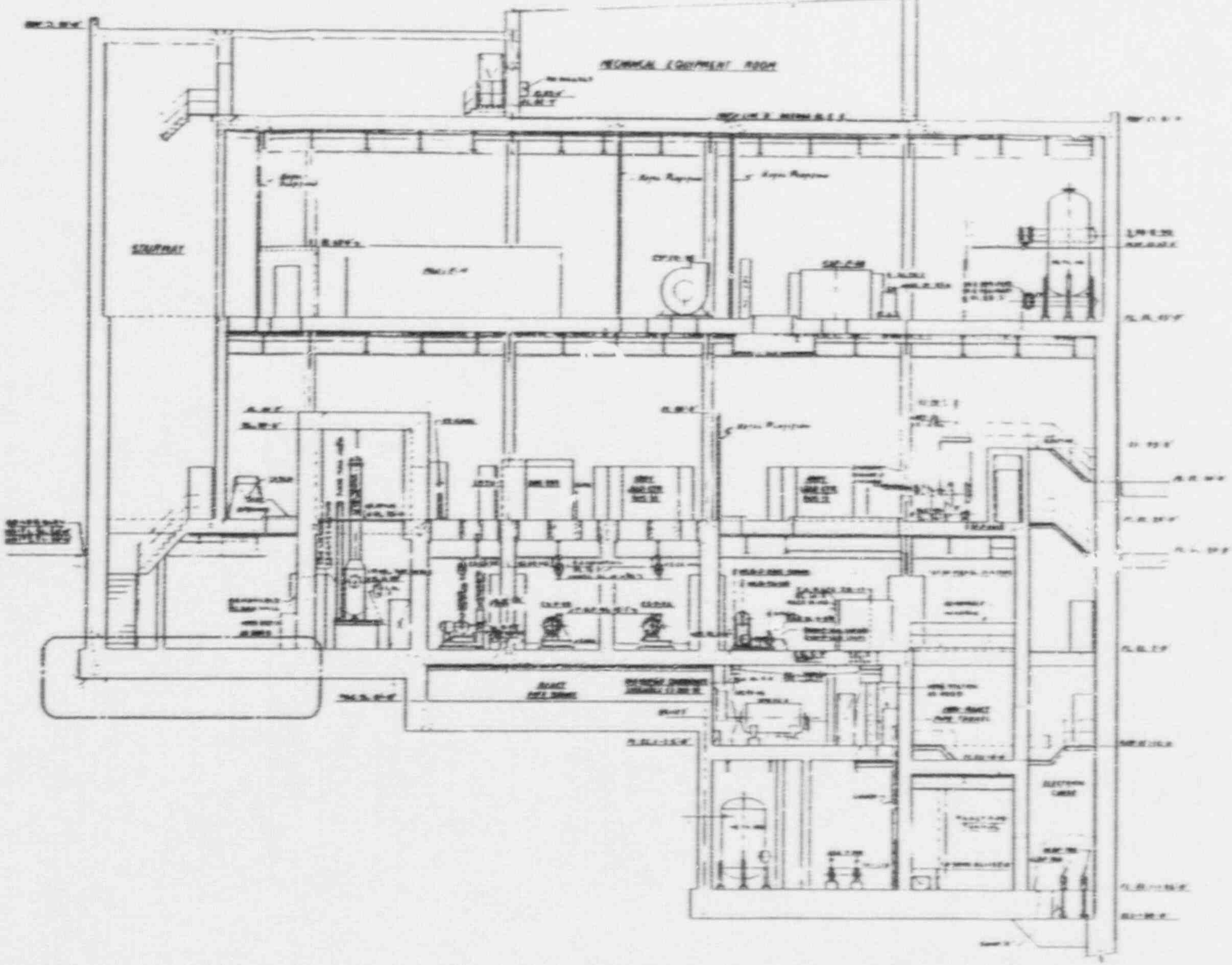

Figure 4-6. Seabrook 1 Primary Auxiliary Building Section 2, Looking West

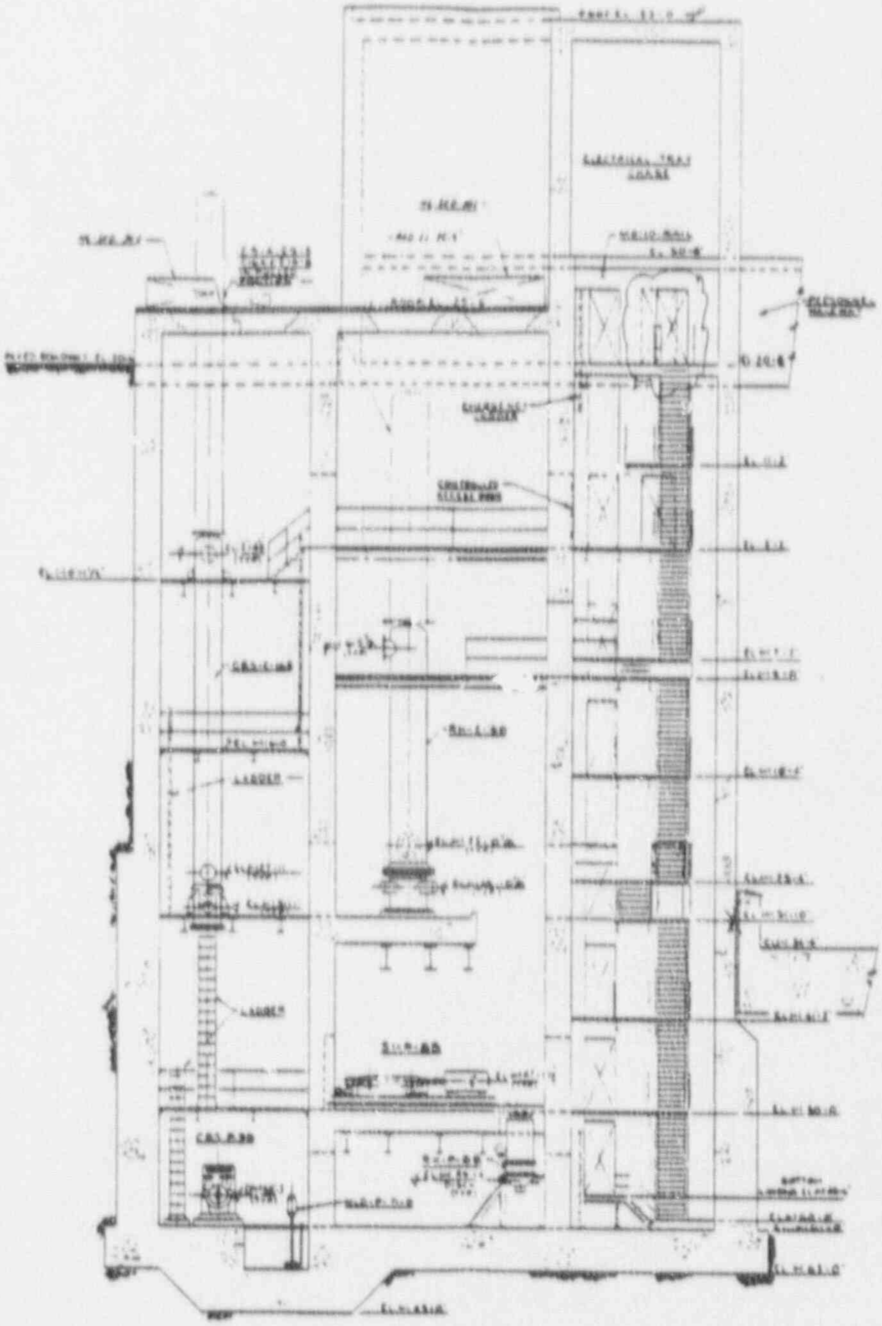

Figure 4-7. Seabrook 1 RHR Spray Equipment Vault Section, Looking North

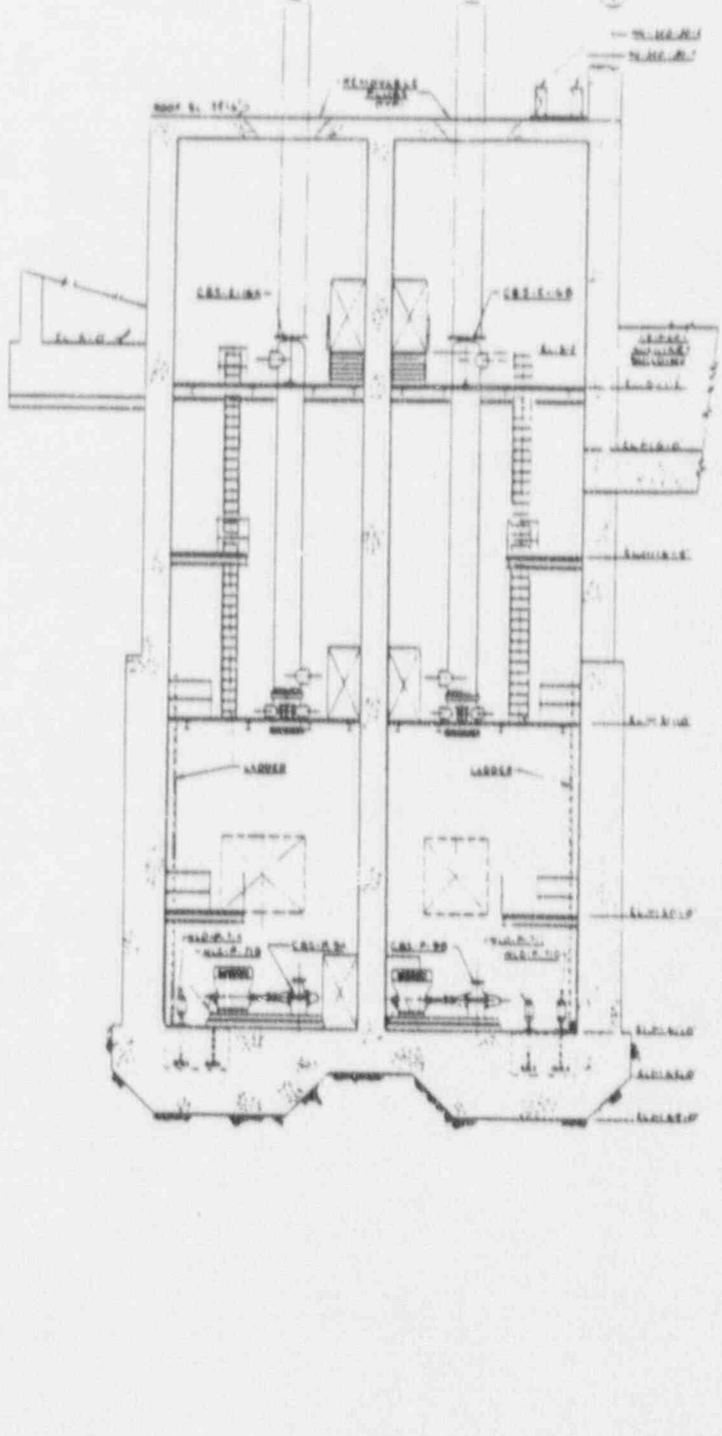

Figure 4-8. Seabrook 1 RHR Spray Equipment Vault Section 1, Looking East

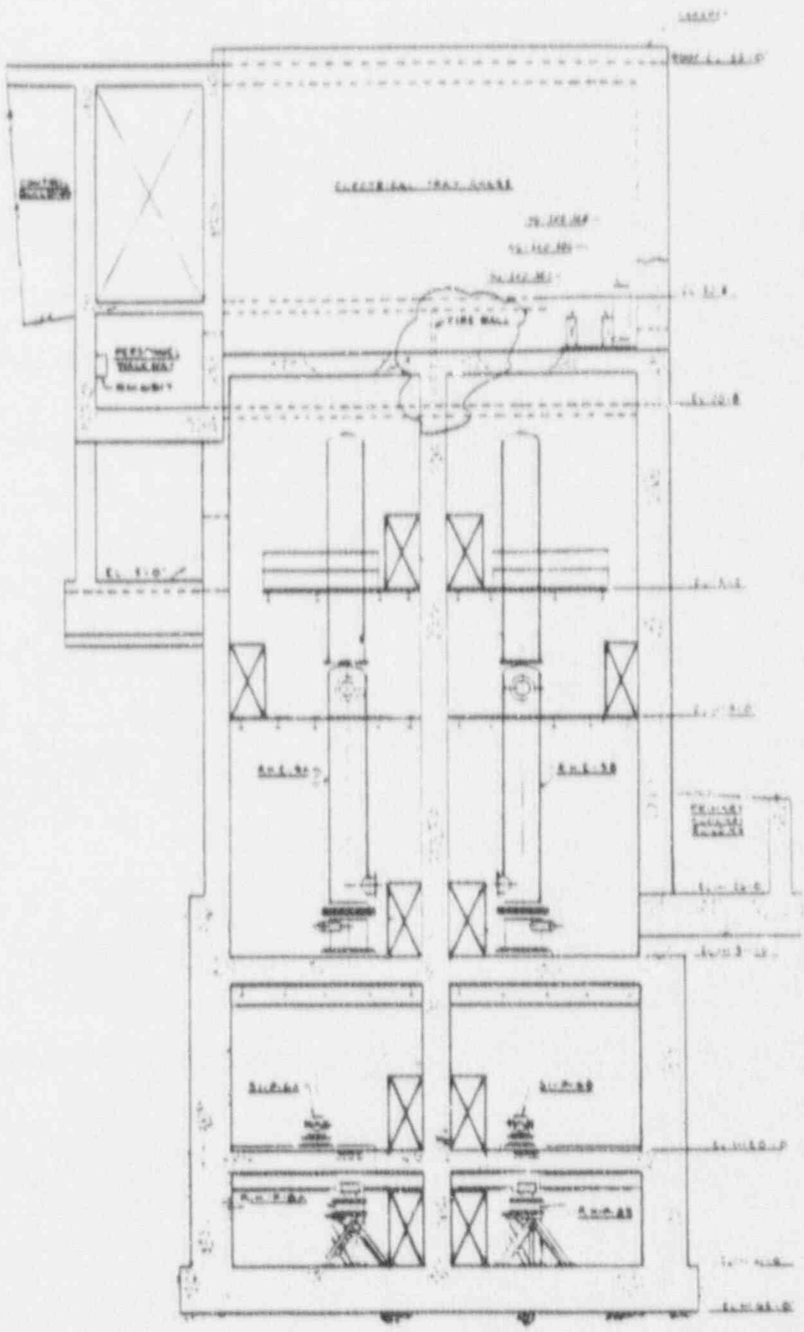

Figure 4-9. Seabrook 1 RHR Spray Equipment Vault Section 2, Looking East

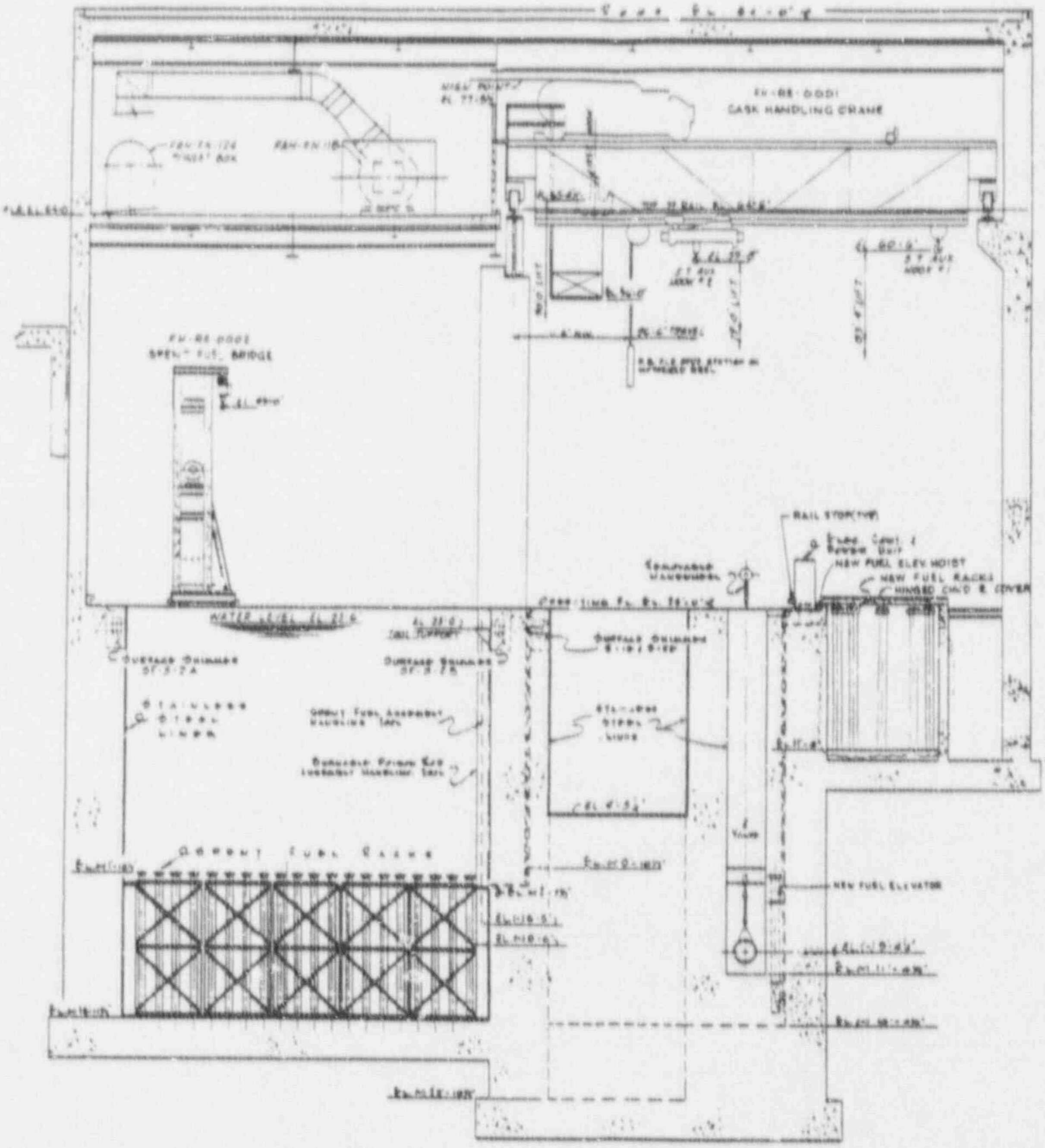

Figure 4-10. Seabrook 1 Fuel Storage Building Section 1, Looking North

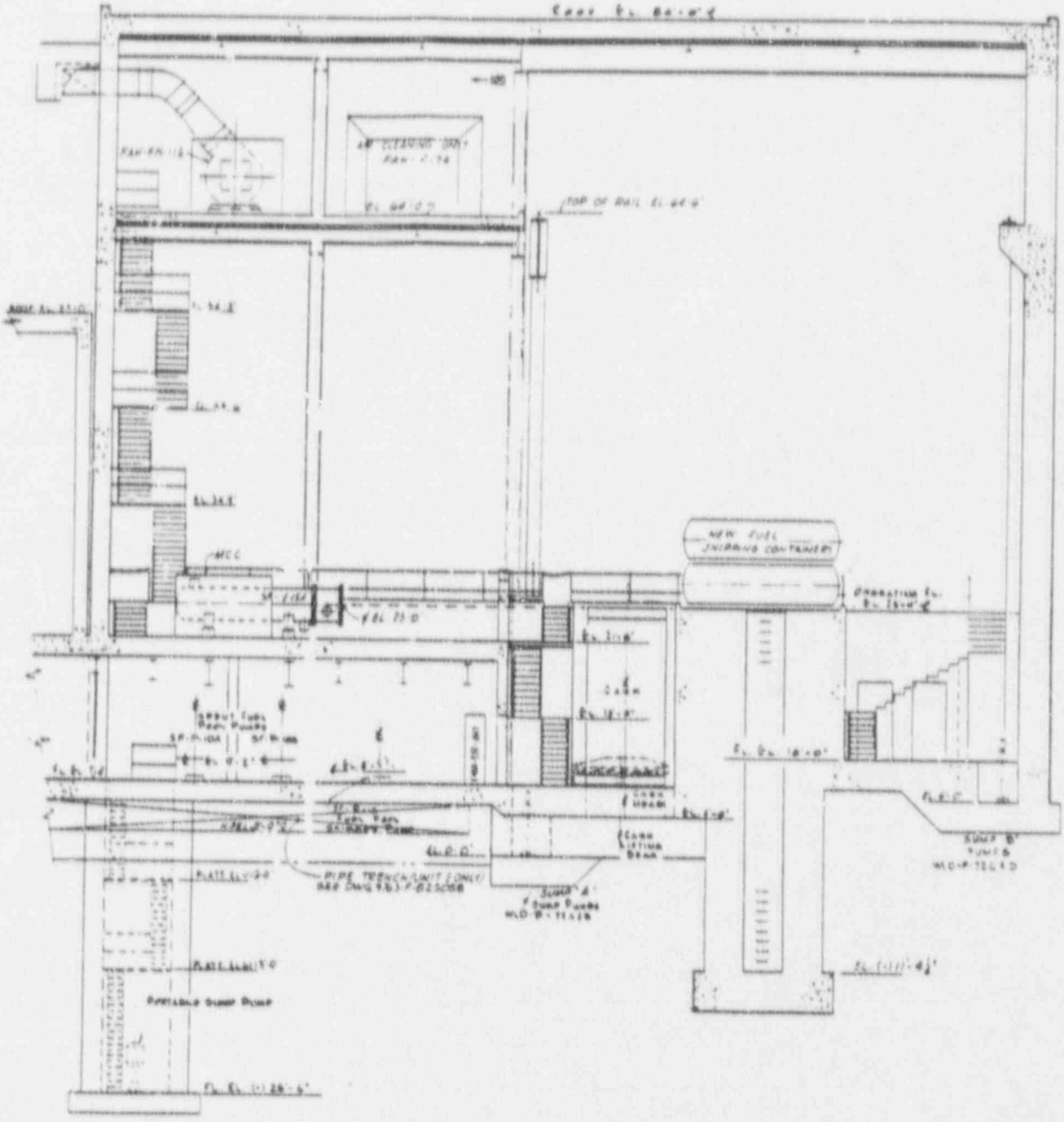

Figure 4-11. Seabrook 1 Fuel Storage Building Section 2, Looking North

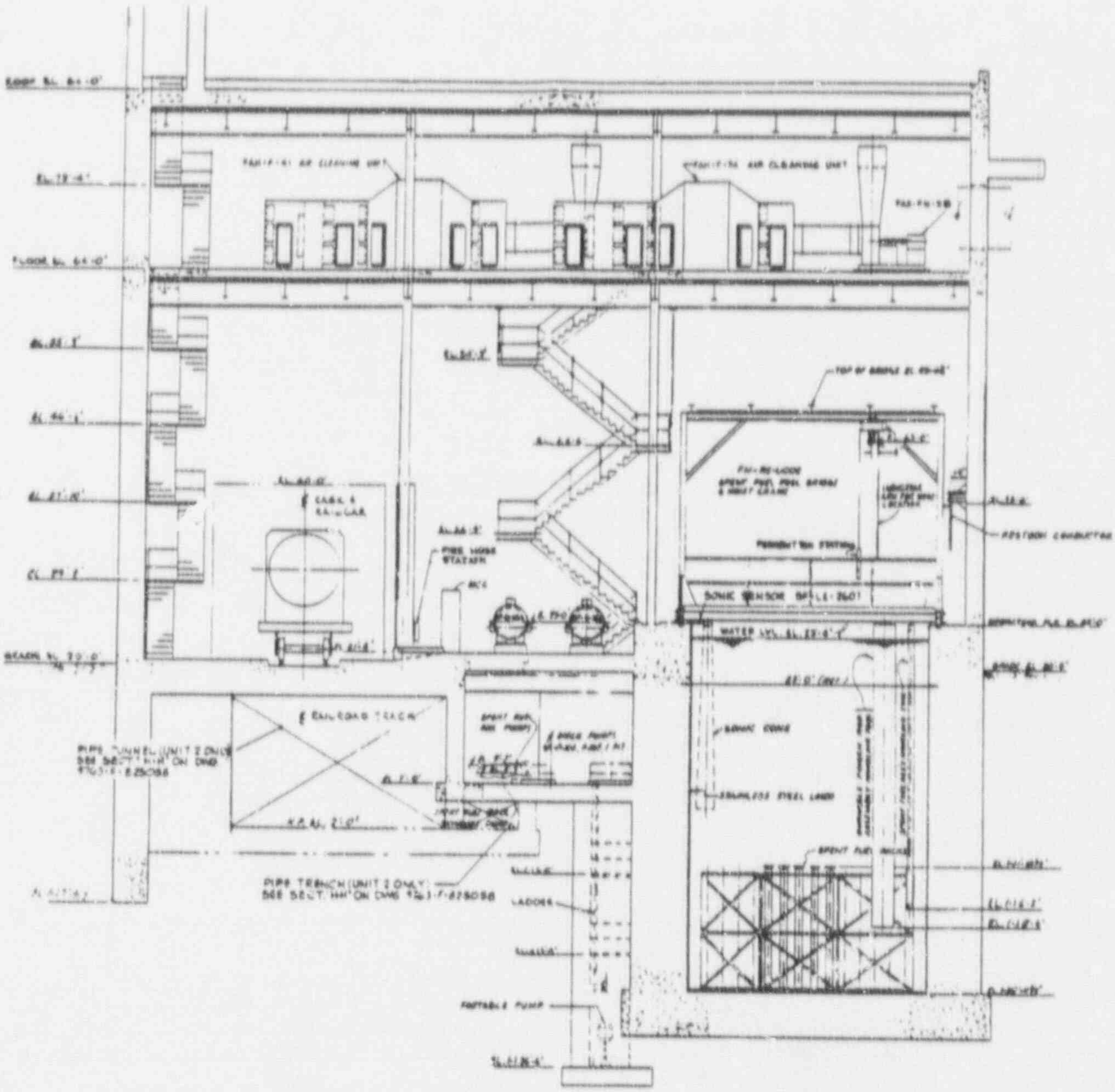

Figure 4-12. Seabrook 1 Fuel Storage Building Section, Looking West

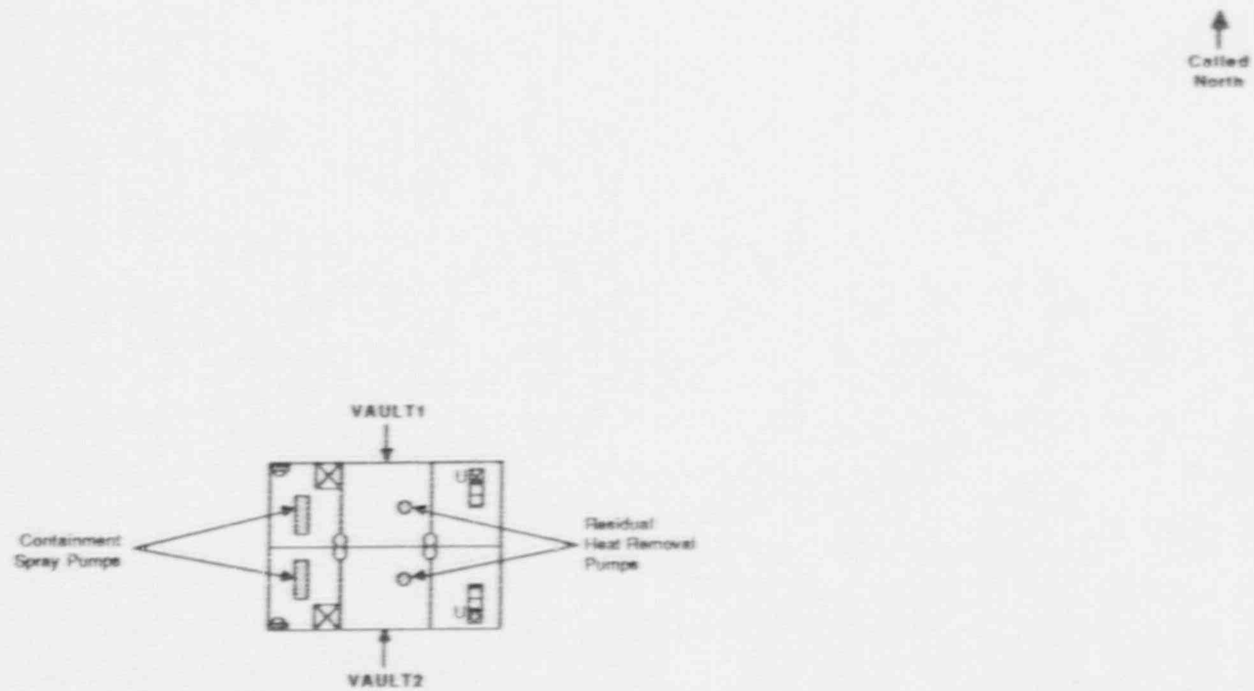

Figure 4-13. Seabrook 1 RHR Spray Equipment Vault (Elevation -61'-0")

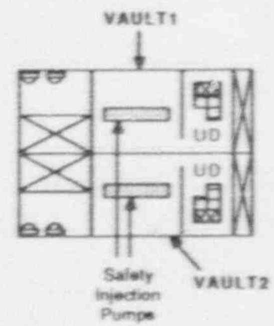

Figure 4-14. Seabrook 1 RHR Spray Equipment Vault (Elevation -50'-0")

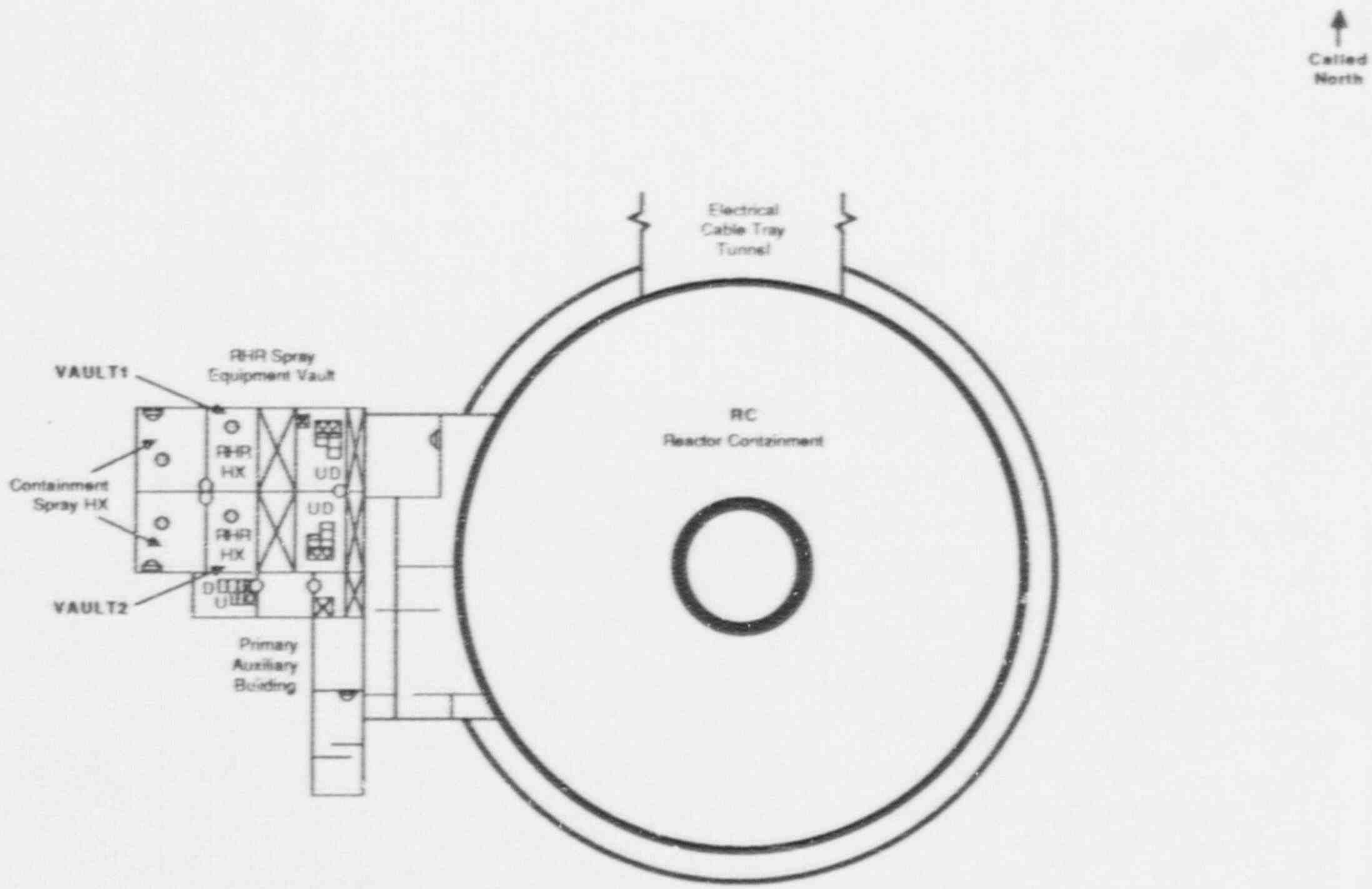

Figure 4-15. Seabrook 1 Reactor Containment (El. -26'-0"), RHR Spray Equipment Vault (El. -31'-10"), and Primary Auxiliary Building (El. -26'-0")

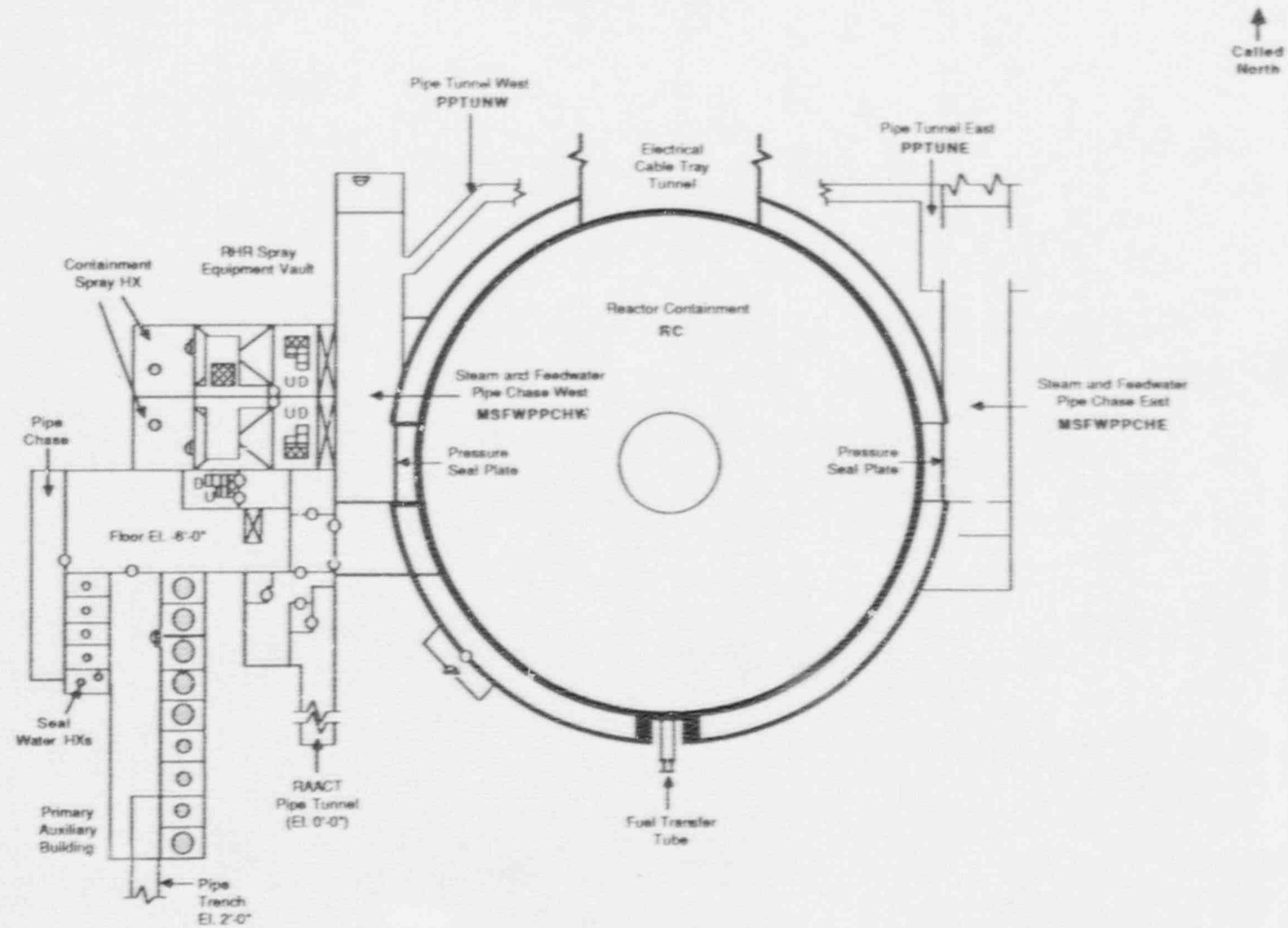

Figure 4-16. Seabrook 1 Reactor Containment (El. 0'-0"), RHR Spray Equipment Vault (El. 0'-0"), and Primary Auxiliary Building (El. -6'-0")

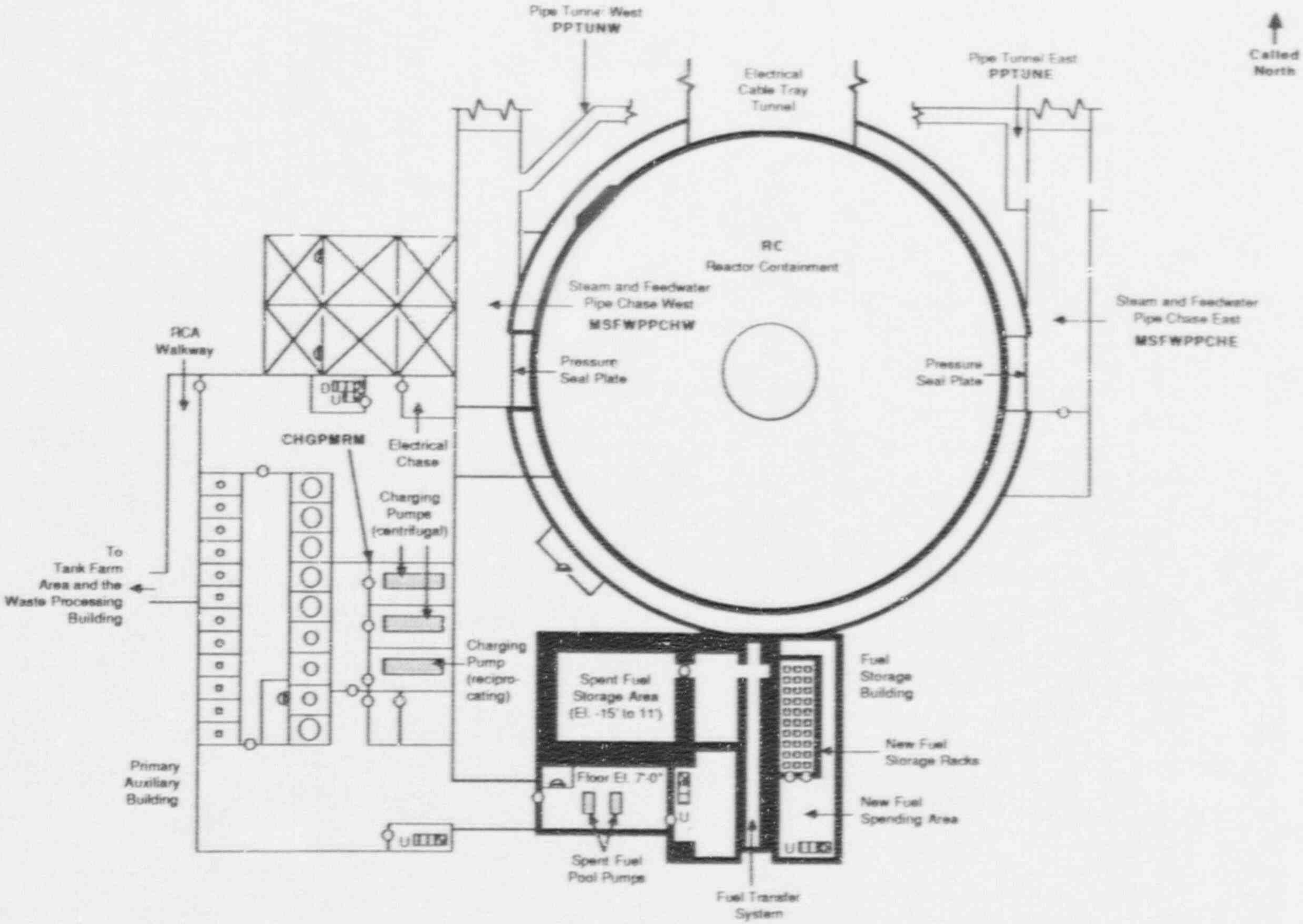

Figure 4-17. Seabrook 1 Reactor Containment, RHR Spray Equipment Vault, Primary Auxiliary Building and Fuel Storage Building (El. 7'-0")

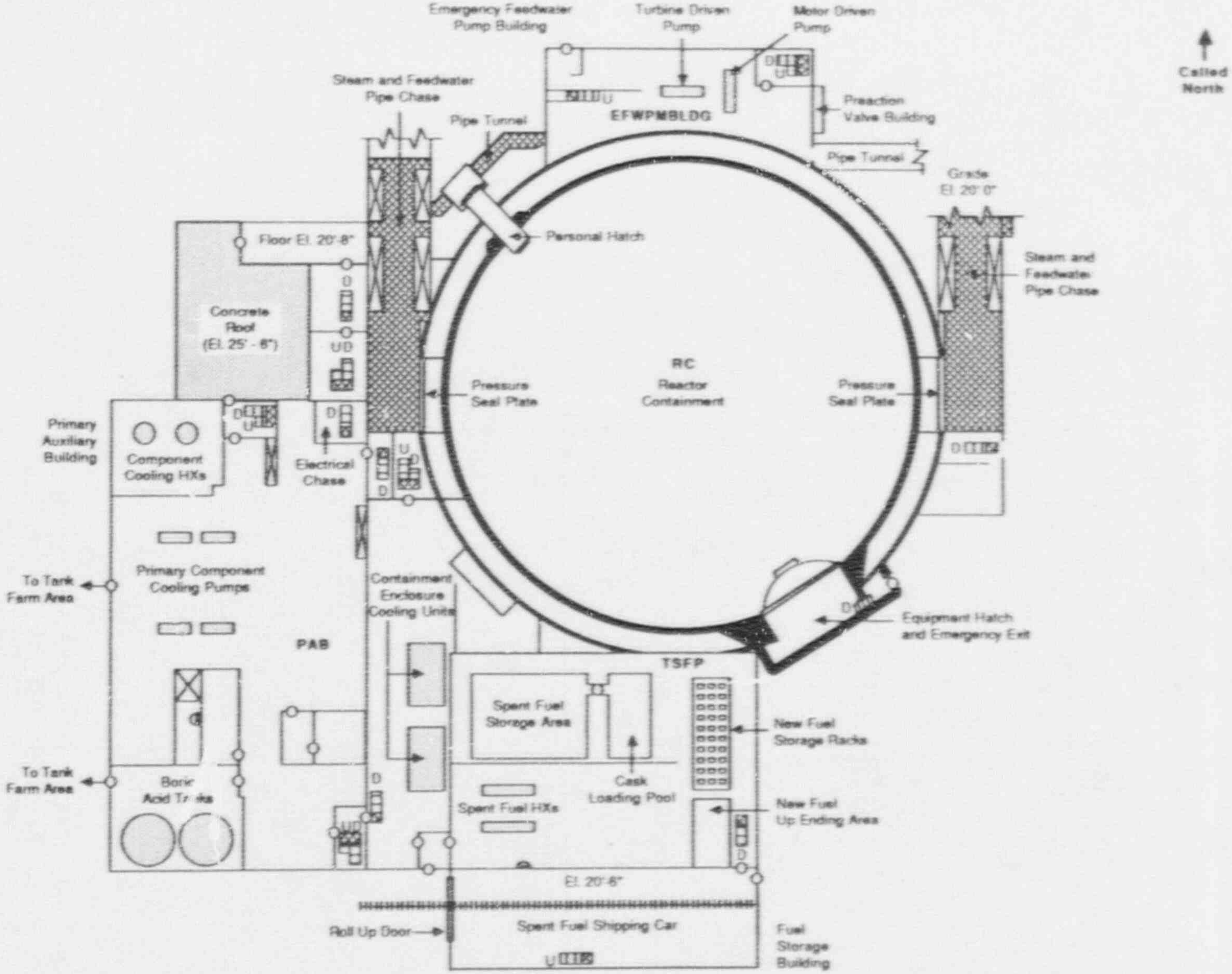

Figure 4-18. Seabrook 1 Reactor Containment (El. 25'-0"), RHR Spray Equipment Vault (El. 20'-8"), Primary Auxiliary Building (El. 25'-0"), Fuel Storage Building (El. 25'-0"), and Emergency Feedwater Pump Building (El. 27'-0")

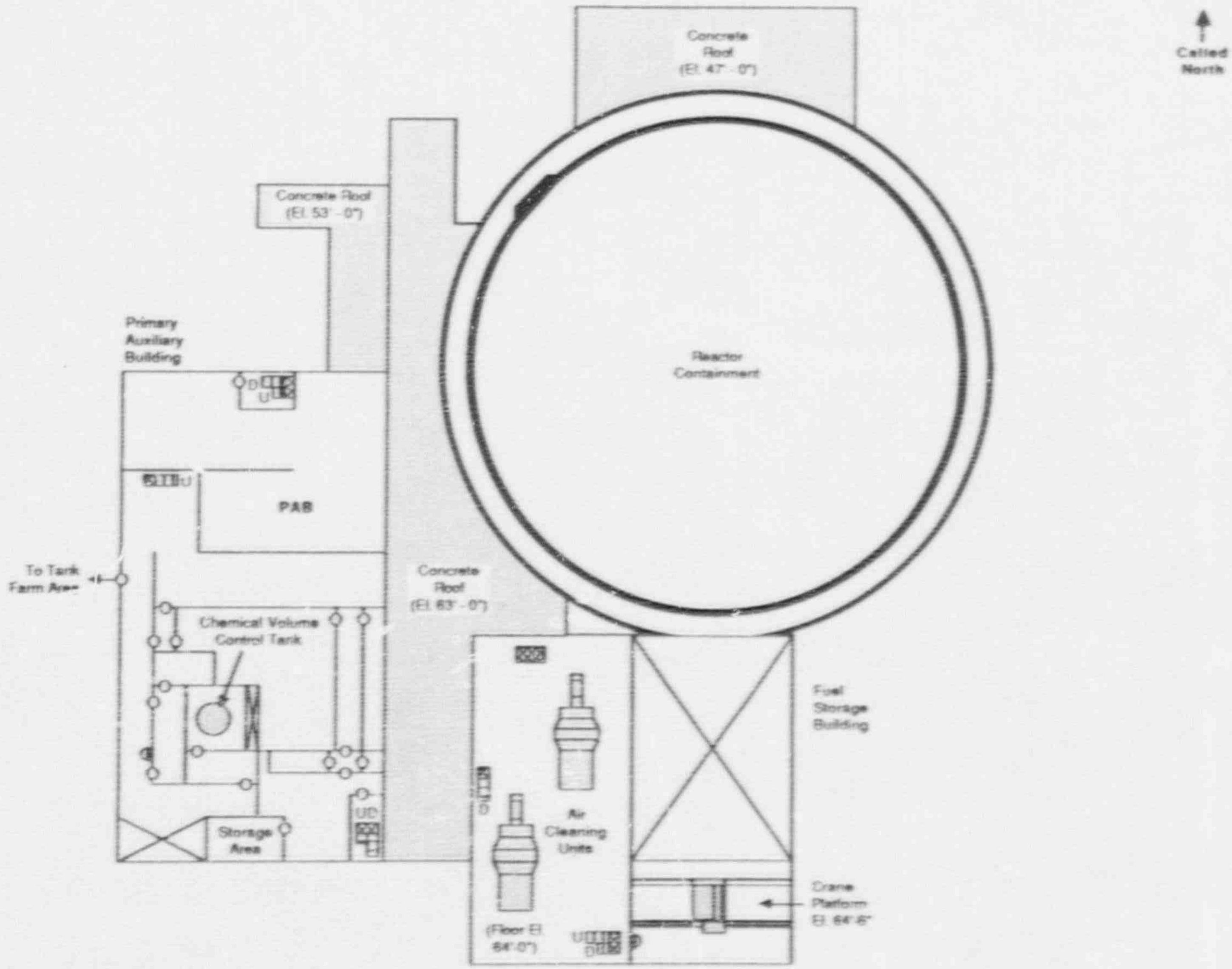

Figure 4-19. Seabrook 1 Reactor Containment (El. 53'-0"), Primary Auxiliary Building (El. 53'-0"), and Fuel Storage Building (El. 64'-0")

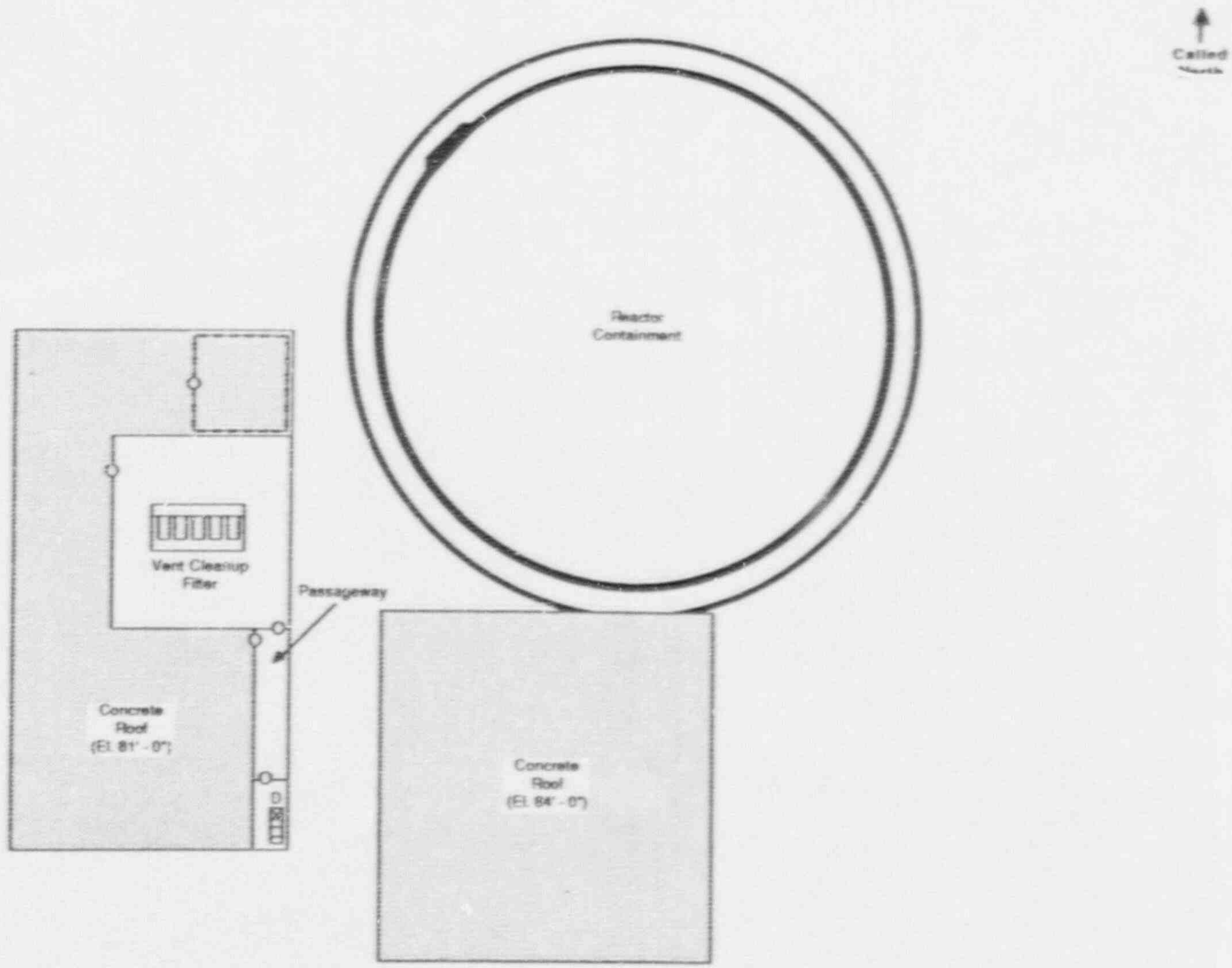

Figure 4-20. Seabrook 1 Reactor Containment (El. 81'-0") and Primary Auxiliary Building (El. 81'-0")

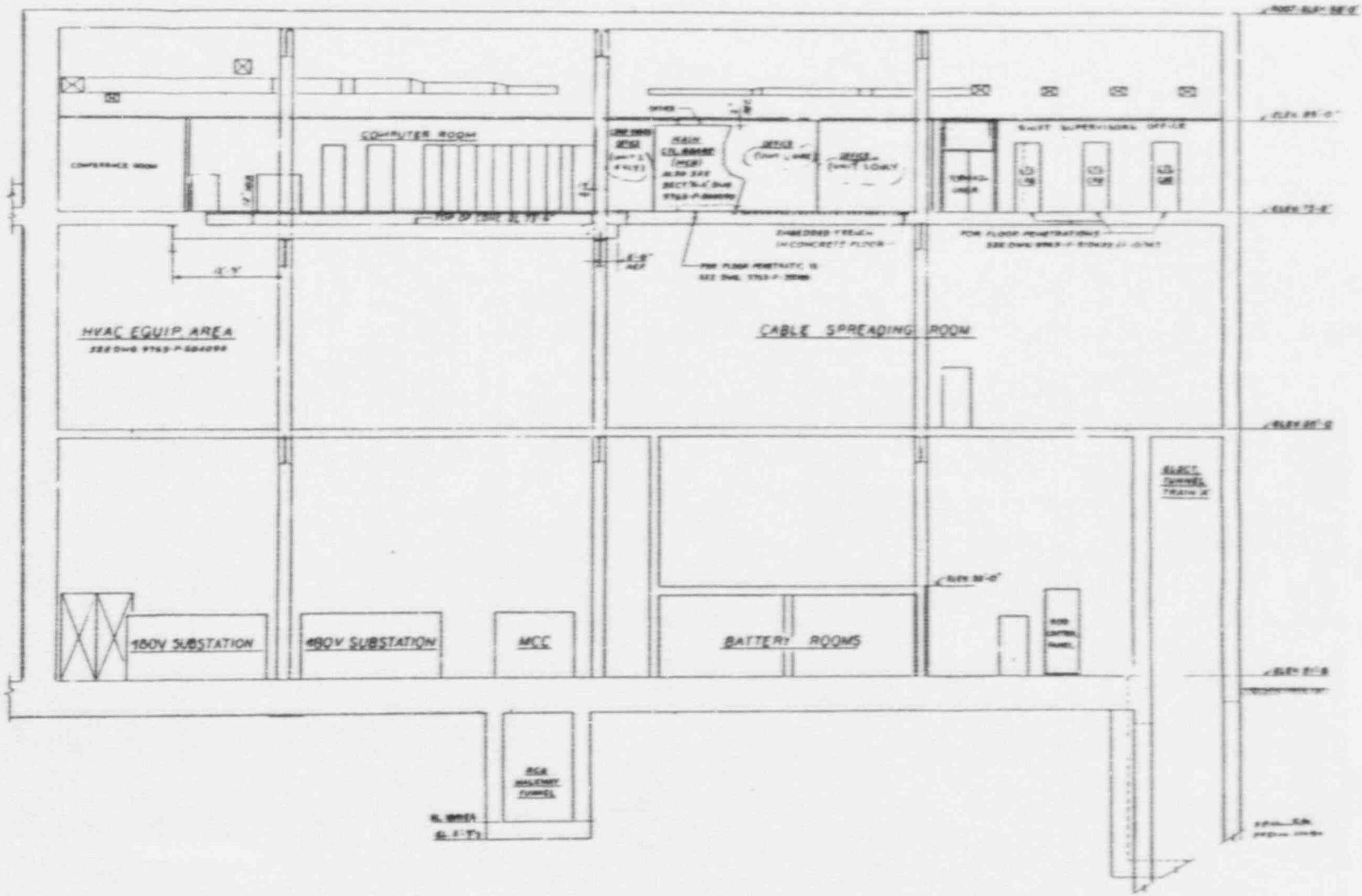

Figure 4-21. Seabrook 1 Control Building Section, Looking North

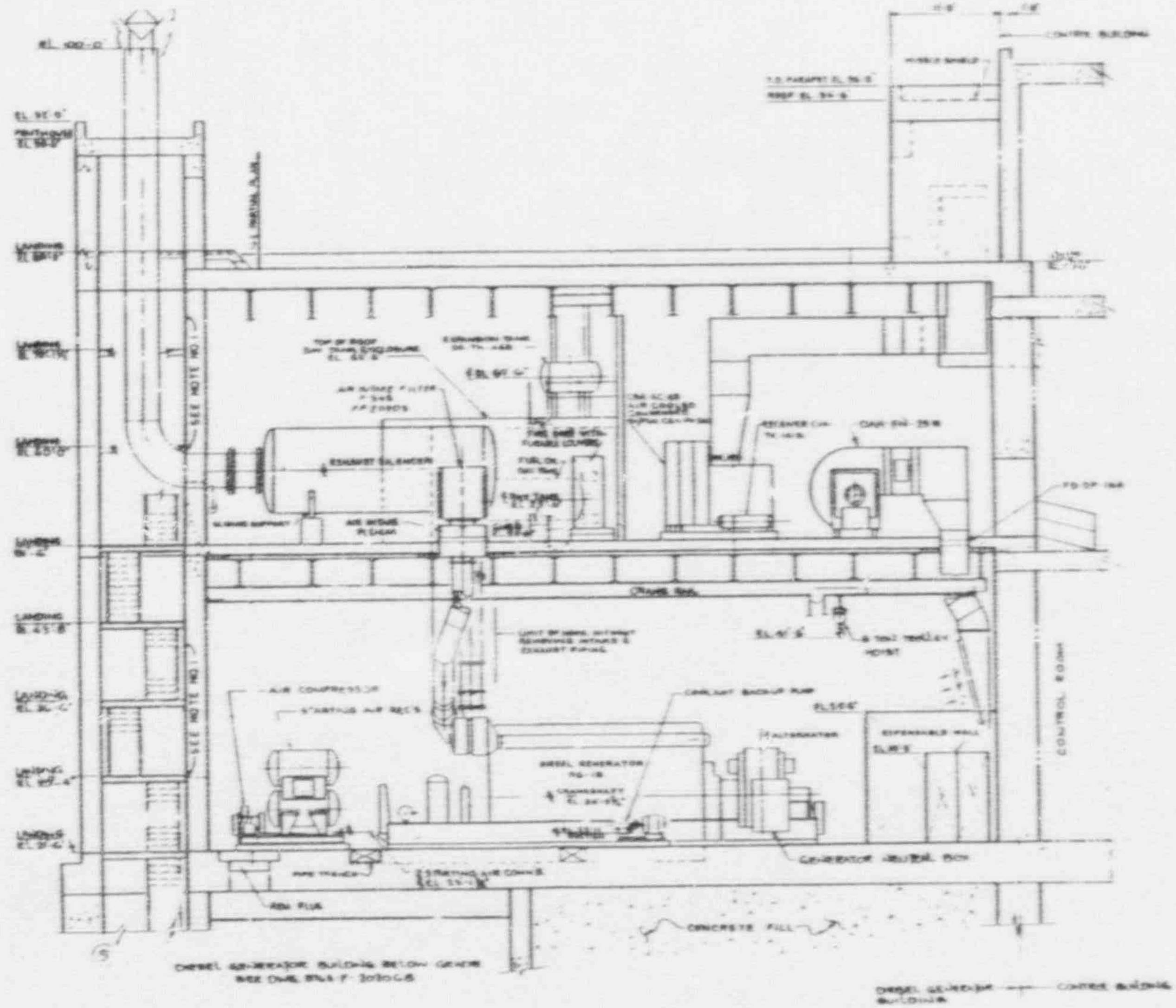

Figure 4-22. Seabrook 1 Diesel Generator Building Section, Looking North

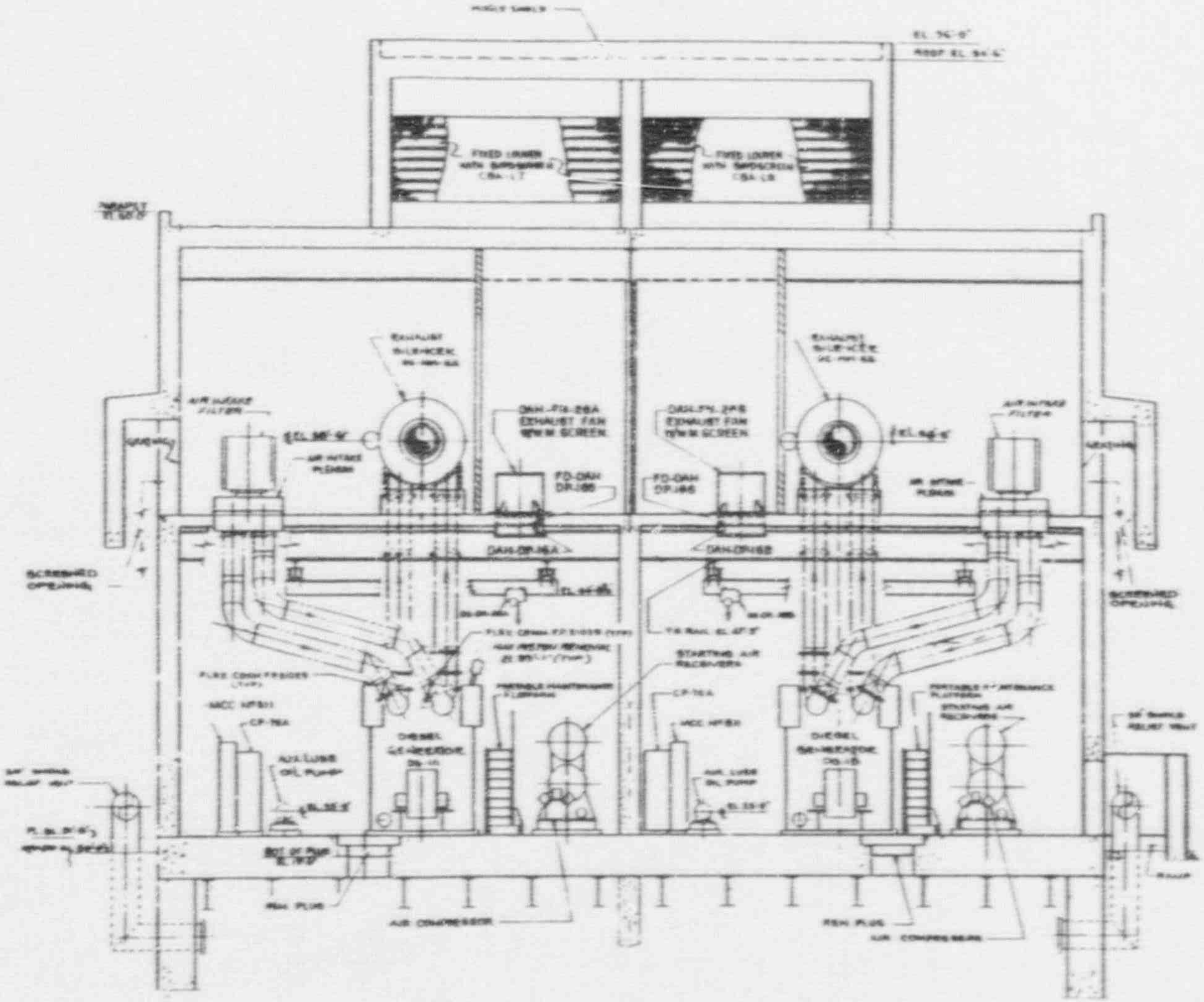

Figure 4-23. Seabrook 1 Diesel Generator Building Section, Looking East

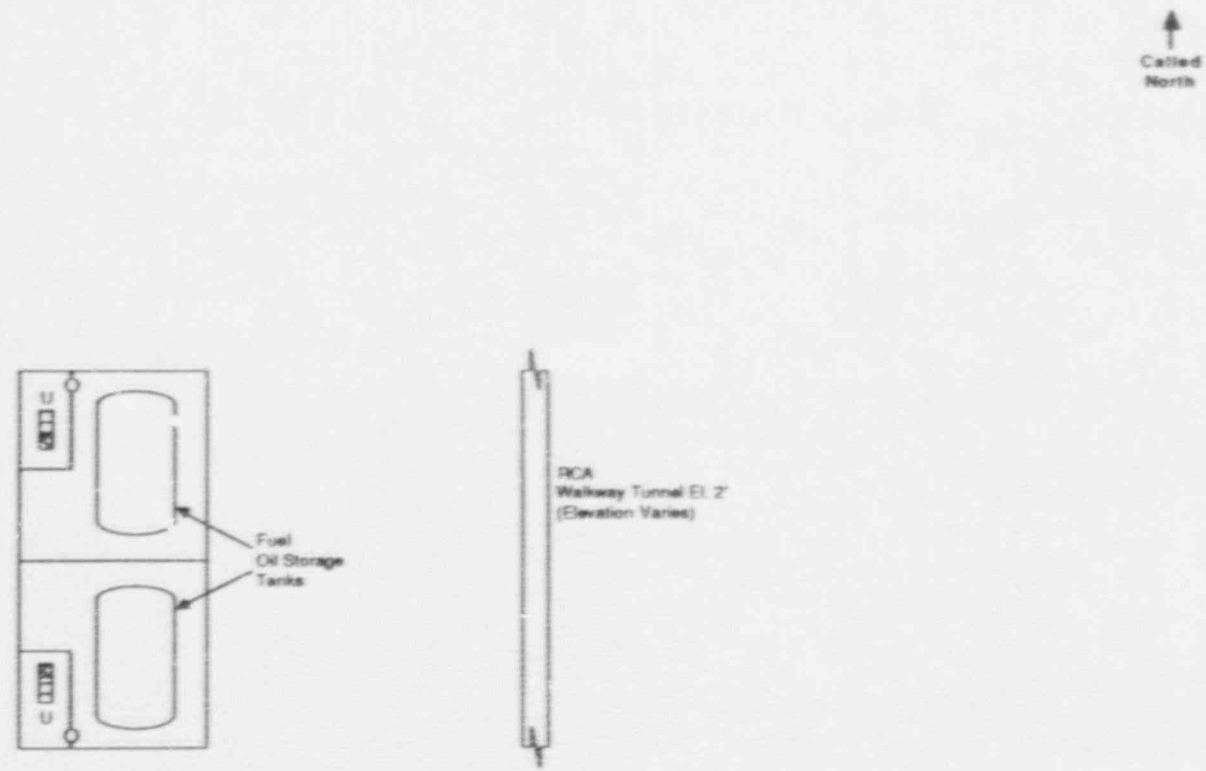

Figure 4-24. Seabrook 1 Diesel Generator Building (El. -16'-0")

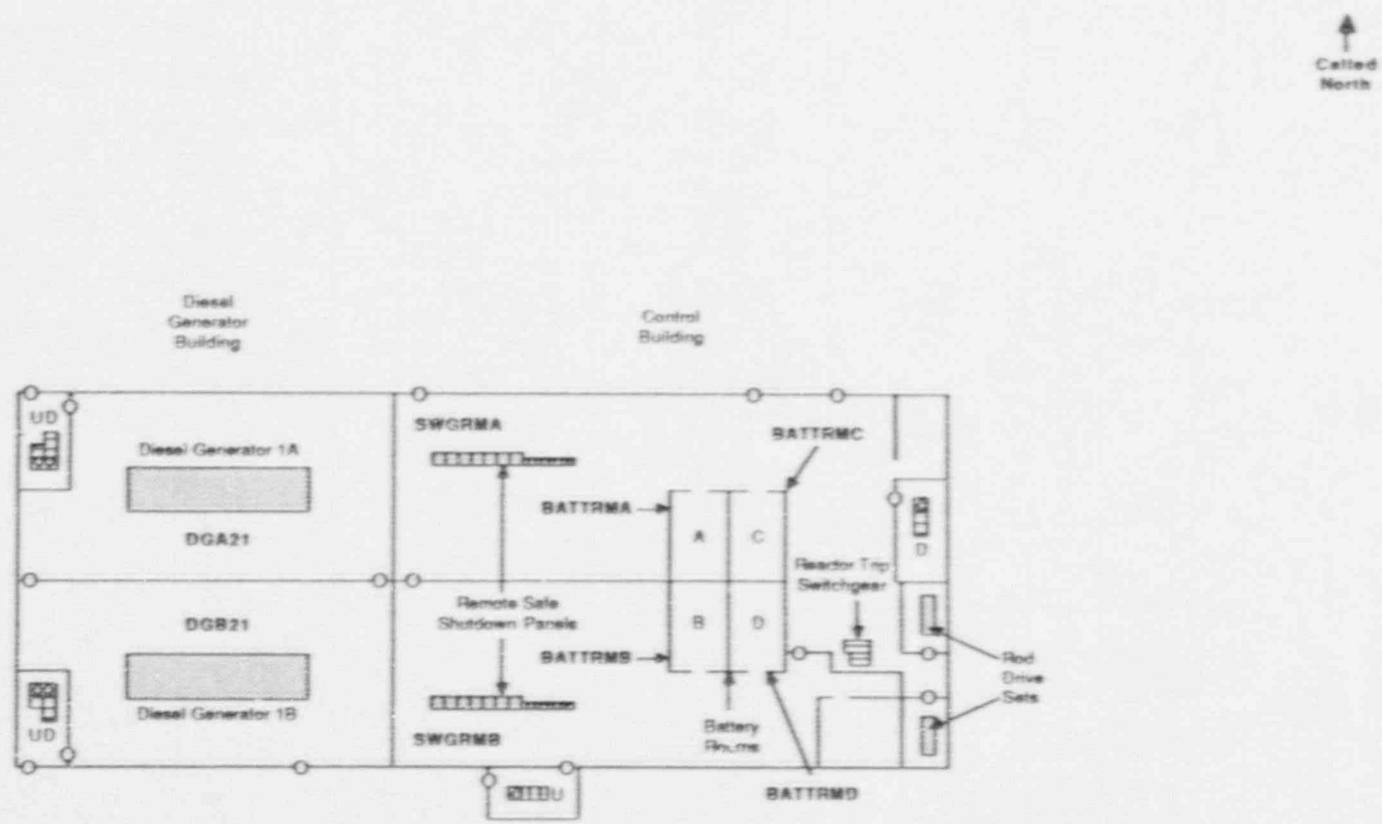

Figure 4-25. Seabrook 1 Diesel Generator Building and Control Building (El. 21'-6")

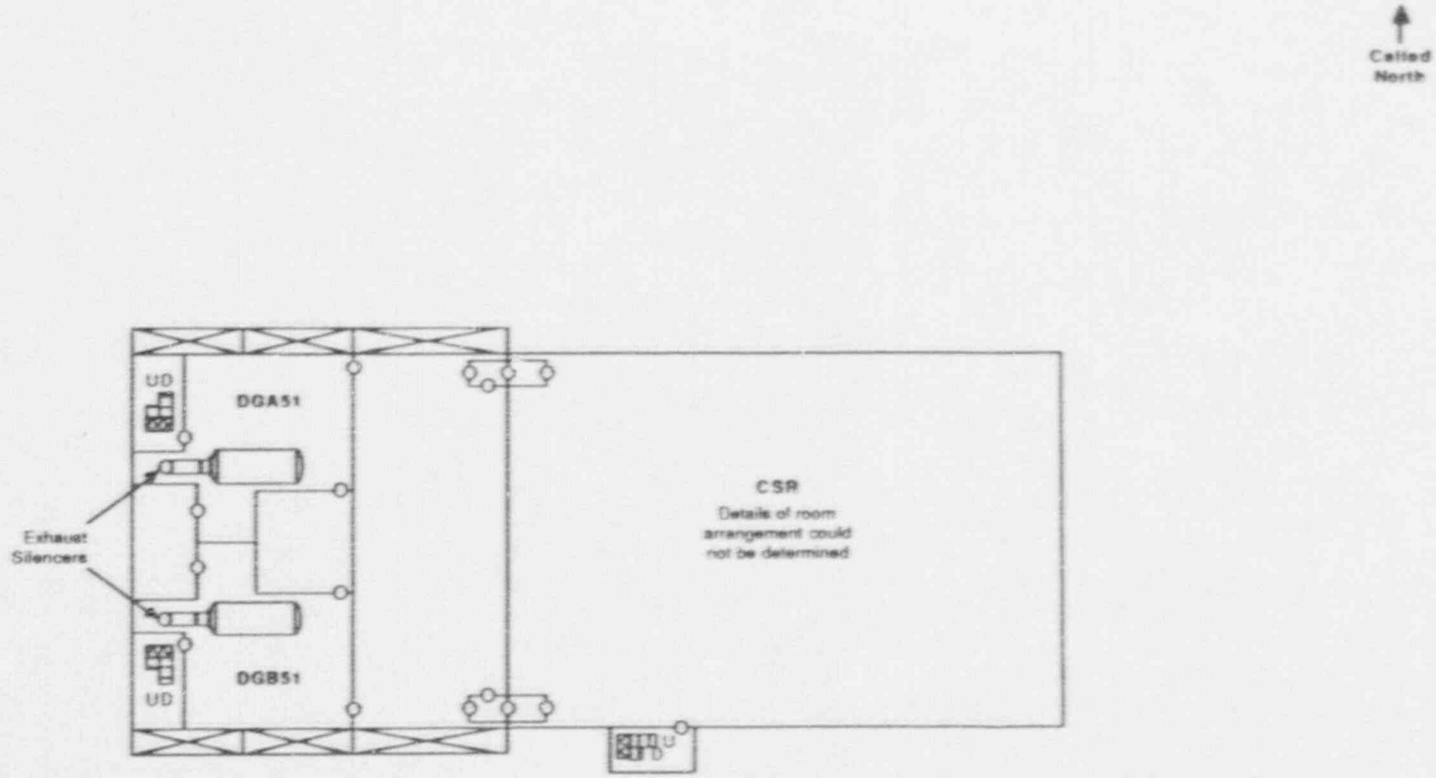

Figure 4-26. Seabrook 1 Diesel Generator Building (El. 51'-6") and Control Building (El. 50'-0")

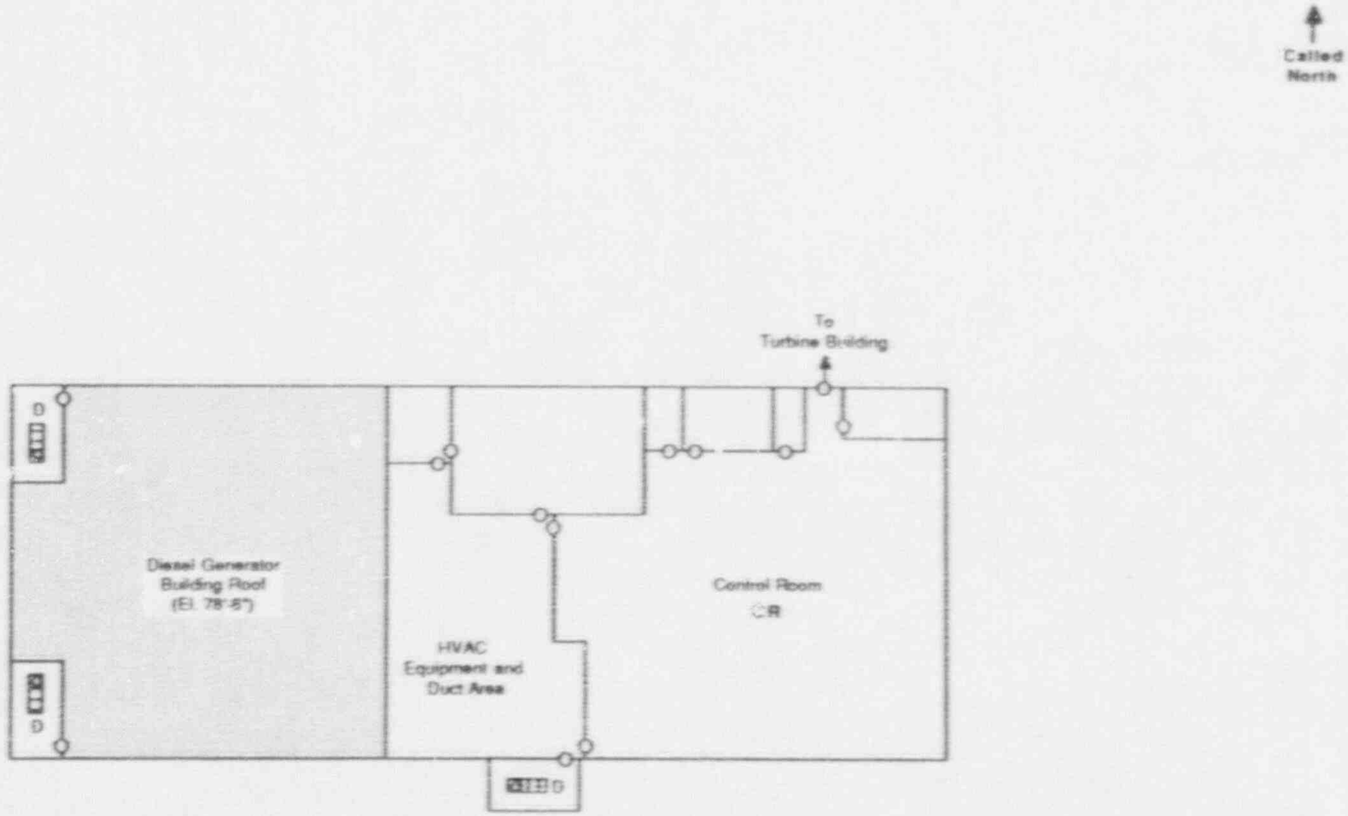

Figure 4-27. Seabrook 1 Diesel Generator Building (El. 78'-6") and Control Building (El. 75'-0")

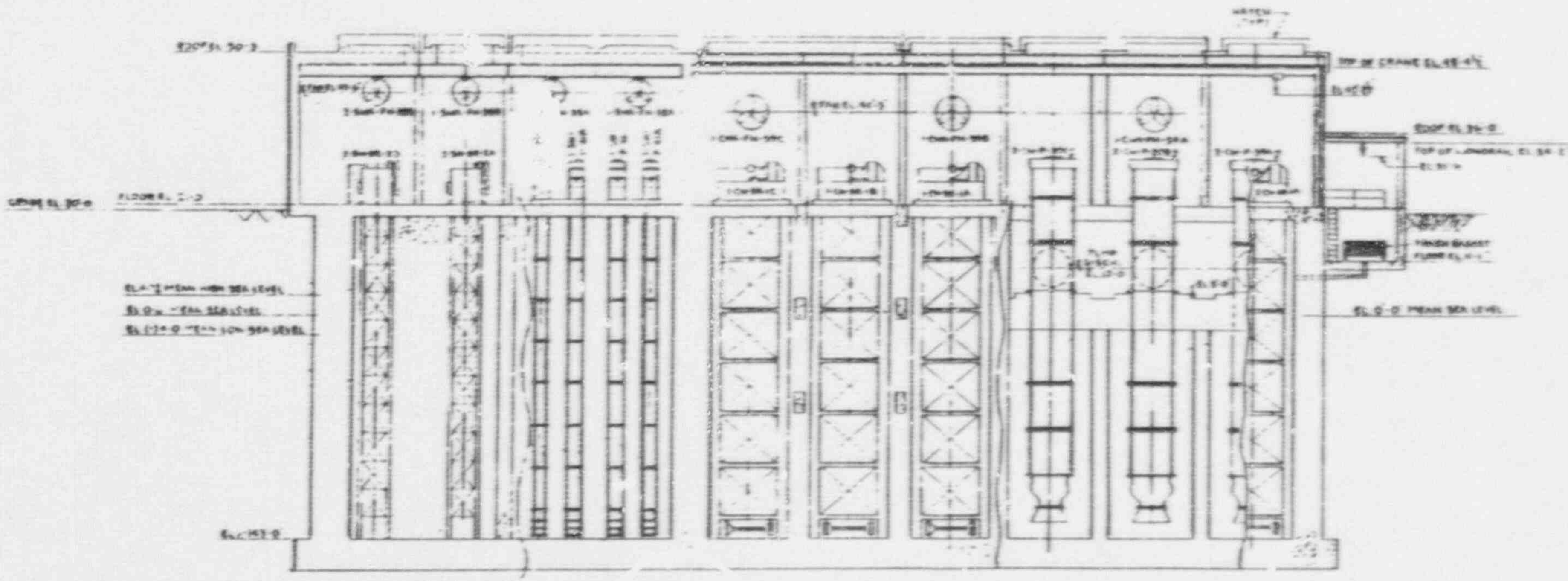

Figure 4-28. Seabrook 1 Service and Circulating Water Pump House Section, Looking West

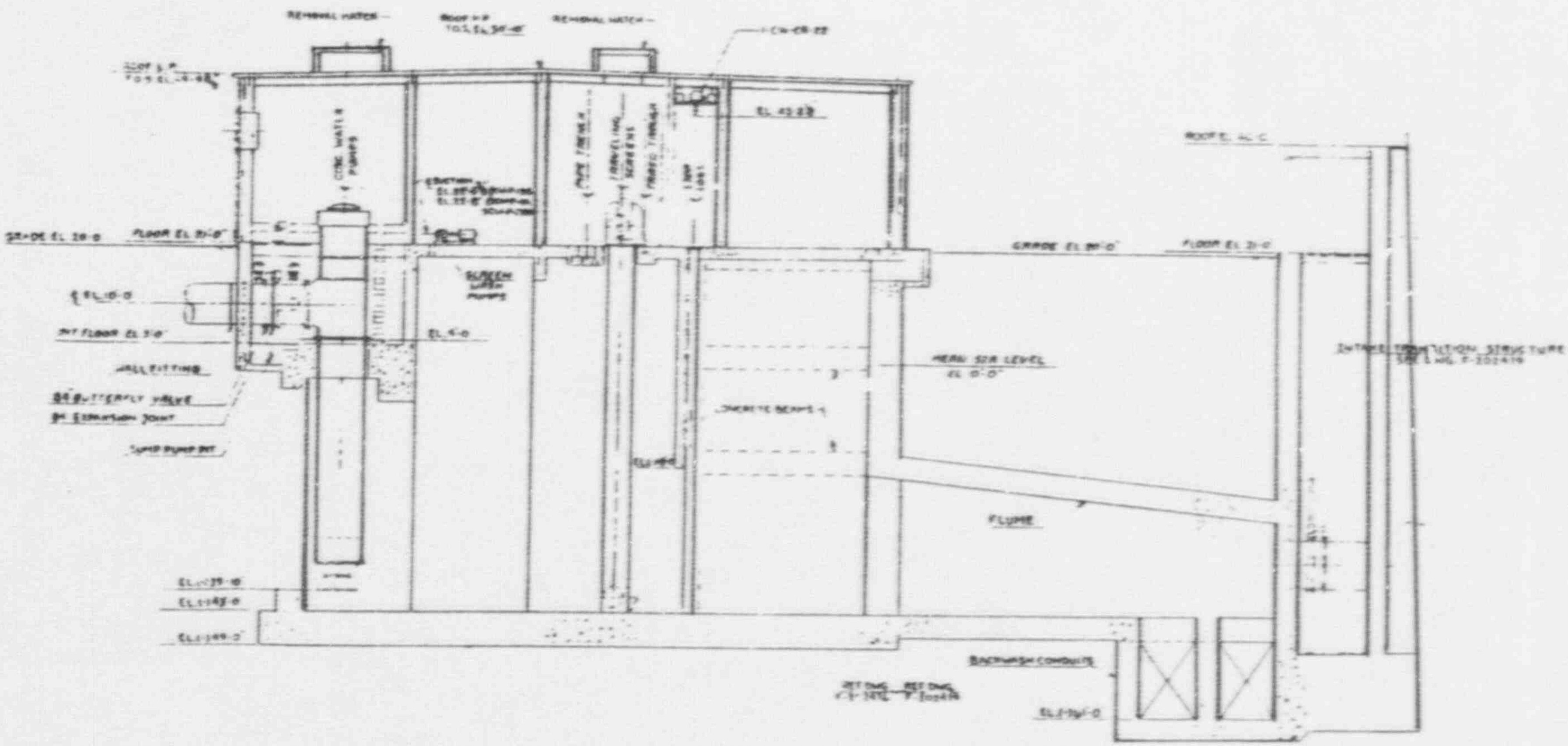

Figure 4-29. Seabrook 1 Service and Circulating Water Pump House Section, Looking North

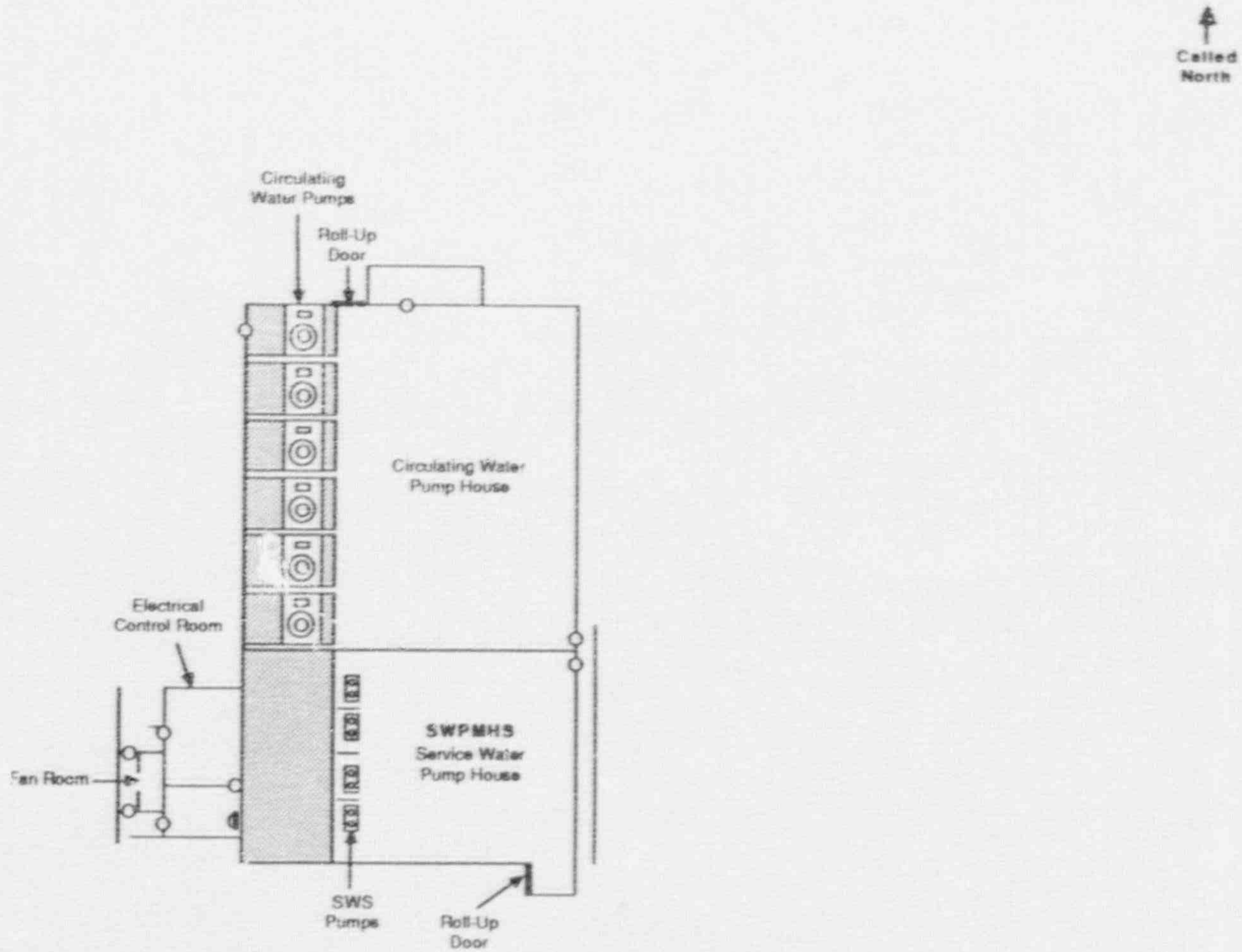

Figure 4-30. Seabrook 1 Service Water and Circulating Water Pump House (El. 21'-0")

Table 4-1. Definition of Seabrook 1 Building and Location Codes

Abbreviation	Description
1. BATTRMA	Battery room A in switchgear room A (area SWGRMA).
2. BATTRMB	Battery room B in switchgear room B (area SWGRMB).
3. BATTRMC	Battery room C in switchgear room A (area SWGRMA).
4. BATTRMD	Battery room D in switchgear room B (area SWGRMB).
5. CEFANRM	Containment enclosure fan room.
6. CHGPMRM	Charging pump room at the 7' elevation of the primary auxiliary building.
7. CR	Control room at the 75' elevation of the control building.
8. CSR	Cable spreading room at the 51' elevation of the control building.
9. CST	Condensate storage tank, northeast of the reactor containment.
10. DGA21	Diesel generator room A, 21' elevation.
11. DGA51	Diesel generator room A, 51' elevation.
12. DGB21	Diesel generator room B, 21' elevation.
13. DGB51	Diesel generator room B, 51' elevation.
14. DISTRST	Discharge transition structure (service water).
15. EFWPMBLDG	Emergency feedwater pump building, north of reactor containment.
16. MSFWPPCHE	Main steam and feedwater pipe chase, east of reactor containment .
17. MSFWPPCHW	Main steam and feedwater pipe chase, west of reactor containment.
18. PAB	Primary auxiliary building.
19. PPA	Pipe tunnel between primary auxiliary building and reactor containment .

Table 4-1. Definition of Seabrook 1 Building and Location Codes (Continued)

Abbreviation	Description
20. PPTUNE	East pipe tunnel that runs from the steam and feedwater pipe chase to emergency feedwater pump building.
21. PPTUNW	West pipe tunnel that runs from the steam and feedwater pipe chase to emergency feedwater pump building.
22. RC	Reactor containment.
23. RWST	Refueling water storage tank, located in the tank farm area.
24. SWCT46	Service water cooling tower, 46' elevation.
25. SWGRMA	Switchgear room A at the 21' elevation of the control building.
26. SWGRMB	Switchgear room B at the 21' elevation of the control building.
27. SWPMHS	Service water pump house.
28. TB21	Turbine building, 21' elevation.
29 TSFP	Spent fuel pool operating floor at the 25' elevation of the fuel storage building.
30. VAULT1	Vault 1 of the RHR spray equipment vault.
31. VAULT2	Vault 2 of the RHR spray equipment vault.

Table 4-2. Partial Listing of Components by Location at Seabrook 1

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
BATTRMA	EP	EP-BT-1A	BATT
BATTRMB	EP	EP-BT-1B	BATT
BATTRMC	EP	EP-BT-1C	BATT
BATTRMD	EP	EP-BT-1D	BATT
CHGPMRM	CVCS	CHG-2A	MDP
CHGPMRM	CVCS	CHG-2B	MDP
CST	AFWS	AFW-CST	TK
CST	AFWS	AFW-CST	TK
DGA21	EP	EP-DG-1A	DG
DGB21	EP	EP-DG-1B	DG
DISTRST	SWS	SWS-63	MOV
EFWPMBLDG	AFWS	AFW-37A	TDP
EFWPMBLDG	AFWS	AFW-4214A	MOV
EFWPMBLDG	AFWS	AFW-4214B	MOV
EFWPMBLDG	AFWS	AFW-4244A	MOV
EFWPMBLDG	AFWS	AFW-4244B	MOV
EFWPMBLDG	AFWS	AFW-4234A	MOV
EFWPMBLDG	AFWS	AFW-4234B	MOV
EFWPMBLDG	AFWS	AFW-4224A	MOV
EFWPMBLDG	AFWS	AFW-4224B	MOV
EFWPMBLDG	AFWS	AFW-37B	MDP
EFWPMBLDG	AFWS	AFW-129	NV
EFWPMBLDG	AFWS	AFW-4224A	MOV
EFWPMBLDG	AFWS	AFW-4224B	MOV
EFWPMBLDG	AFWS	AFW-4234A	MOV
EFWPMBLDG	AFWS	AFW-4234B	MOV
EFWPMBLDG	AFWS	AFW-4214A	MOV
EFWPMBLDG	AFWS	AFW-4214B	MOV
EFWPMBLDG	AFWS	AFW-4244A	MOV
EFWPMBLDG	AFWS	AFW-4244B	MOV

Table 4-2. Partial Listing of Components by Location at Seabrook 1 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
MSFWP[illegible]HE	AFWS	AFW-128	HV
MSFWPPCHW	AFWS	AFW-127	HV
PAB	CCWS	CCW-HXA	HX
PAB	CCWS	CCW-11A	MDP
PAB	CCWS	CCW-11C	MDP
PAB	CCWS	CCW-HXB	HX
PAB	CCWS	CCW-11B	MDP
PAB	CCWS	CCW-11D	MDP
PAB	EP	SWS-16	HV
PAB	EP	SWS-18	HV
PAB	SWS	SWS-15	MOV
PAB	SWS	SWS-17	MOV
PAB	SWS	SWS-4	MOV
PAB	SWS	SWS-5	MOV
PAB	SWS	SWS-20	MOV
PAB	SWS	SWS-19	MOV
PPA	CHRS	CBS-17	MOV
PPA	CHRS	CBS-14	MOV
PPA	CHRS	CBS-11	MOV
PPA	CHRS	CBS-8	MOV
PPA	CVCS	SI-138	MOV
PPA	CVCS	SI-139	MOV
PPA	ECCS	SI-77	MOV
PPA	ECCS	SI-102	MOV
PPA	ECCS	SI-114	MOV
RC	CHRS	SI-SUMPS	TK
RC	CHRS	SI-SUMPS	TK
RC	CVCS	RCS-RV	RV
RC	ECCS	RCS-RV	RV
RC	ECCS	SI-SUMPS	TK

Table 4-2. Partial Listing of Componants by Location at Seabrook 1 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RC	ECCS	SI-SUMPS	TK
RC	ECCS	RCS-RV	RV
RC	ECCS	RCS-RV	RV
RC	RCS	RCS-RV	RV
RC	RCS	RCS-22	MOV
RC	RCS	RCS-23	MOV
RC	RCS	RCS-87	MOV
RC	RCS	RCS-88	MOV
RC	RCS	RCS-456A	NV
RC	RCS	RCS-456B	NV
RC	RCS	RCS-124	MOV
RC	RCS	RCS-122	MOV
RWST	CVCS	SI-RWST	TK
RWST	CVCS	CHG-112D	MOV
RWST	CVCS	CHG-112E	MOV
RWST	ECCS	SI-RWST	TK
SWGRMA	EP	EP-BS-E5	BUS
SWGRMA	EP	EP-CB-E5	CB
SWGRMA	EP	EP-BS-E51	BUS
SWGRMA	EP	EP-TR-5A	TR
SWGRMA	EP	EP-BS-E52	BUS
SWGRMA	EP	EP-TR-5B	TR
SWGRMA	EP	EP-BS-11A	BUS
SWGRMA	EP	EP-BC-1A	BC
SWGRMA	EP	EP-MCC-512	MCC
SWGRMA	EP	EP-MCC-515	MCC
SWGRMA	EP	EP-MCC-521	MCC
SWGRMA	EP	EP-BS-11C	BUS
SWGRMA	EP	EP-BC-1C	BC
SWGRMA	EP	EP-PNL-1A	PNL

Table 4-2. Partial Listing of Components by Location at Seabrook 1 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
SWGRMA	EP	EP-UPS-1A	UPS
SWGRMA	EP	EP-PNL-1C	PNL
SWGRMA	EP	EP-UPS-1C	UPS
SWGRMB	EP	EP-BS-E6	BUS
SWGRMB	EP	EP-CB-E6	CB
SWGRMB	EP	EP-BS-E61	BUS
SWGRMB	EP	EP-TR-5C	TR
SWGRMB	EP	EP-BS-E62	BUS
SWGRMB	EP	EP-TR-5D	TR
SWGRMB	EP	EP-BS-11B	BUS
SWGRMB	EP	EP-BC-1B	BC
SWGRMB	EP	EP-MCC-612	MCC
SWGRMB	EP	EP-MCC-615	MCC
SWGRMB	EP	EP-MCC-621	MCC
SWGRMB	EP	EP-BS-11D	BUS
SWGRMB	EP	EP-BC-1D	BC
SWGRMB	EP	EP-PNL-1B	PNL
SWGRMB	EP	EP-UPS-1B	UPS
SWGRMB	EP	EP-PNL-1D	PNL
SWGRMB	EP	EP-UPS-1D	UPS
SWPMHS	SWS	SWS-2	MOV
SWPMHS	SWS	SWS-41A	MDP
SWPMHS	SWS	SWS-22	MOV
SWPMHS	SWS	SWS-41C	MDP
SWPMHS	SWS	SWS-29	MOV
SWPMHS	SWS	SWS-41B	MDP
SWPMHS	SWS	SWS-31	MOV
SWPMHS	SWS	SWS-41D	MDP
VAULT1	CCWS	CCW-137	MOV
VAULT1	CCWS	CCW-145	MOV

Table 4-2. Partial Listing of Components by Location at Seabrook 1 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
VAULT1	CHRS	CBS-HXA	HX
VAULT1	CHRS	CBS-9A	MDP
VAULT1	ECCS	CBS-49	MOV
VAULT1	ECCS	CHG-475	MOV
VAULT1	ECCS	CHG-460	MOV
VAULT1	ECCS	CHG-461	MOV
VAULT1	ECCS	RHR-HXA	HX
VAULT1	ECCS	RHR-35	MOV
VAULT1	ECCS	RHR-8A	MDP
VAULT1	ECCS	SI-6	MDP
VAULT1	ECCS	SI-112	MOV
VAULT1	ECCS	CBS-47	MOV
VAULT2	CCWS	CCW-266	MOV
VAULT2	CCWS	CCW-272	MOV
VAULT2	CHRS	CBS-HXB	HX
VAULT2	CHRS	CBS-9B	MDP
VAULT2	ECCS	CBS-53	MOV
VAULT2	ECCS	RHR-8B	MDP
VAULT2	ECCS	RHR-HXB	HX
VAULT2	ECCS	RHR-36	MOV
VAULT2	ECCS	SI-6B	MDP
VAULT2	ECCS	SI-111	MOV
VAULT2	ECCS	CBS-51	MOV

5. BIBLIOGRAPHY FOR SEABROOK 1

1. NUREG-0501, "Seabrook Alternative Site Review: NRC Staff Testimony," USNRC Office of Nuclear Reactor Regulation, December 1978.

2. NUREG-0895, "Final Environmental Statement Related to the Operation of Seabrook Station, Units 1 and 2," USNRC Office of Nuclear Reactor Regulation, December 1982.

3. NUREG-0896, "Safety Evaluation Report Related to the Operation of Seabrook Station, Units 1 and 2," USNRC Division of Licensing, March 1983.

4. NUREG-1207, "Technical Specifications for Seabrook Station, Unit 1," Division of Pressurized Water Reactor Licensing, October 1986.

5. NUREG-1331, "Technical Specifications for Seabrook Station, Unit 1," USNRC Office of Nuclear Reactor Regulation, Division of Reactor Projects, May 1989.

6. NUREG/CR-2903, "An Independent Assessment of Evaluation Time Estimates for a Peak Population Scenario in the Emergency Planning Zone of the Seabrook Power Station," Battelle Memorial Institute, Pacific Northwest Laboratory, November 1982.

7. NUREG/CR-3531, "Review of Seabrook Units 1 and 2 Auxiliary Feedwater System Reliability Analysis," Brookhaven National Laboratory, February 1984.

8. NUREG/CR-4552, "A Review of the Seabrook Station Probabilistic Safety Assessment," Brookhaven National Laboratory, March 1987.

9. PLG-0300, "Seabrook Station Probabilistic Risk Assessment," Pickard, Lowe, and Garrick, Inc., December 1983.

APPENDIX A
DEFINITION OF SYMBOLS USED IN THE SYSTEM AND LAYOUT DRAWINGS

A1. SYSTEM DRAWINGS

A1.1 Fluid System Drawings

The simplified system drawings are accurate representations of the major flow paths in a system and the important interfaces with other fluid systems. As a general rule, small fluid lines that are not essential to the basic operation of the system are not shown in these drawings. Lines of this type include instrumentation lines, vent lines, drain lines, and other lines that are less than 1/3 the diameter of the connecting major flow path. There usually are two versions of each fluid system drawing; a simplified system drawing, and a comparable drawing showing component locations. The drawing conventions used in the fluid system drawings are the following:

- Flow generally is left to right.
  - Water sources are located on the left and water "users" (i.e., heat loads) or discharge paths are located on the right.
  - One exception is the return flow path in closed loop systems which is right to left.
  - Another exception is the Reactor Coolant System (RCS) drawing which is "vessel-centered", with the primary loops on both sides of the vessel.
  - Horizontal lines always dominate and break vertical lines.

- Component symbols used in the fluid system drawings are defined in Figure A-1.
  - Most valve and pump symbols are designed to allow the reader to distinguish among similar components based on their support system requirements (i.e., electric power for a motor or solenoid, steam to drive a turbine, pneumatic or hydraulic source for valve operation, etc.)
  - Valve symbols allow the reader to distinguish among valves that allow flow in either direction, check (non-return) valves, and valves that perform an overpressure protection function. No attempt has been made to define the specific type of valve (i.e., as a globe, gate, butterfly, or other specific type of valve).
  - Pump symbols distinguish between centrifugal and positive displacement pumps and between types of pump drives (i.e., motor, turbine, or engine).

- Locations are identified in terms of plant location codes defined in Section 4 of this Sourcebook.
  - Location is indicated by shaded "zones" that are not intended to represent the actual room geometry.
  - Locations of discrete components represent the actual physical location of the component.
  - Piping locations between discrete components represent the plant areas through which the piping passes (i.e. including pipe tunnels and underground pipe runs).
  - Component locations that are not known are indicated by placing the components in an unshaded (white) zone.
  - The primary flow path in the system is highlighted (i.e., bold white line) in the location version of the fluid system drawings.

A1.2 Electrical System Drawings

The electric power system drawings focus on the Class 1E portions of the plant's electric power system. Separate drawings are provided for the AC and DC portions of the Class 1E system. There often are two versions of each electrical system drawing; a simplified system drawing, and a comparable drawing showing component locations. The drawing conventions used in the electrical system drawings are the following:

- Flow generally is top to bottom
  - In the AC power drawings, the interface with the switchyard and/or offsite grid is shown at the top of the drawing.
  - In the DC power drawings, the batteries and the interface with the AC power system are shown at the top of the drawing.
  - Vertical lines dominate and break horizontal lines.

- Component symbols used in the electrical system drawings are defined in Figure A-2.

- Locations are identified in terms of plant location codes defined in Section 4 of this Sourcebook.
  - Locations are indicated by shaded "zones" that are not intended to represent the actual room geometry.
  - Locations of discrete components represent the actual physical location of the component.
  - The electrical connections (i.e., cable runs) between discrete components, as shown on the electrical system drawings, DO NOT represent the actual cable routing in the plant
  - Component locations that are not known are indicated by placing the discrete components in an unshaded (white) zone.

A2. SITE AND LAYOUT DRAWINGS

A2.1 Site Drawings

A general view of each reactor site and vicinity is presented along with a simplified site plan showing the arrangement of the major buildings, tanks, and other features of the site. The general view of the reactor site is obtained from ORNL-NSIC-55 (Ref. 1). The site drawings are approximately to scale, but should not be used to estimate distances on the site. As-built scale drawings should be consulted for this purpose.

Labels printed in bold uppercase correspond to the location codes defined in Section 4 and used in the component data listings and system drawings in Section 3. Some additional labels are included for information and are printed in lowercase type.

A2.2 Layout Drawings

Simplified building layout drawings are developed for the portions of the plant that contain components and systems that are described in Section 3 of this Sourcebook. Generally, the following buildings are included: reactor building, auxiliary building, fuel building, diesel building, and the intake structure or pumphouse. Layout drawings generally are not developed for other buildings.

Symbols used in the simplified layout drawings are defined in Figure A-3. Major rooms, stairways, elevators, and doorways are shown in the simplified layout drawings however, many interior walls have been omitted for clarity. The building layout drawings, are approximately to scale, should not be used to estimate room size or distances. As-built scale drawings for should be consulted his purpose.

Labels printed in uppercase bolded also correspond to the location codes defined in Section 4 and used in the component data listings and system drawings in Section 3. Some additional labels are included for information and are printed in lowercase type.

A3. APPENDIX A REFERENCES

1. Heddleson, F.A., "Design Data and Safety Features of Commercial Nuclear Power Plants.", ORNL-NSIC-55, Volumes 1 to 4, Oak Ridge National Laboratory, Nuclear Safety Information Center, December 1973 (Vol.1), January 1972 (Vol. 2), April 1974 (Vol. 3), and March 1975 (Vol. 4)

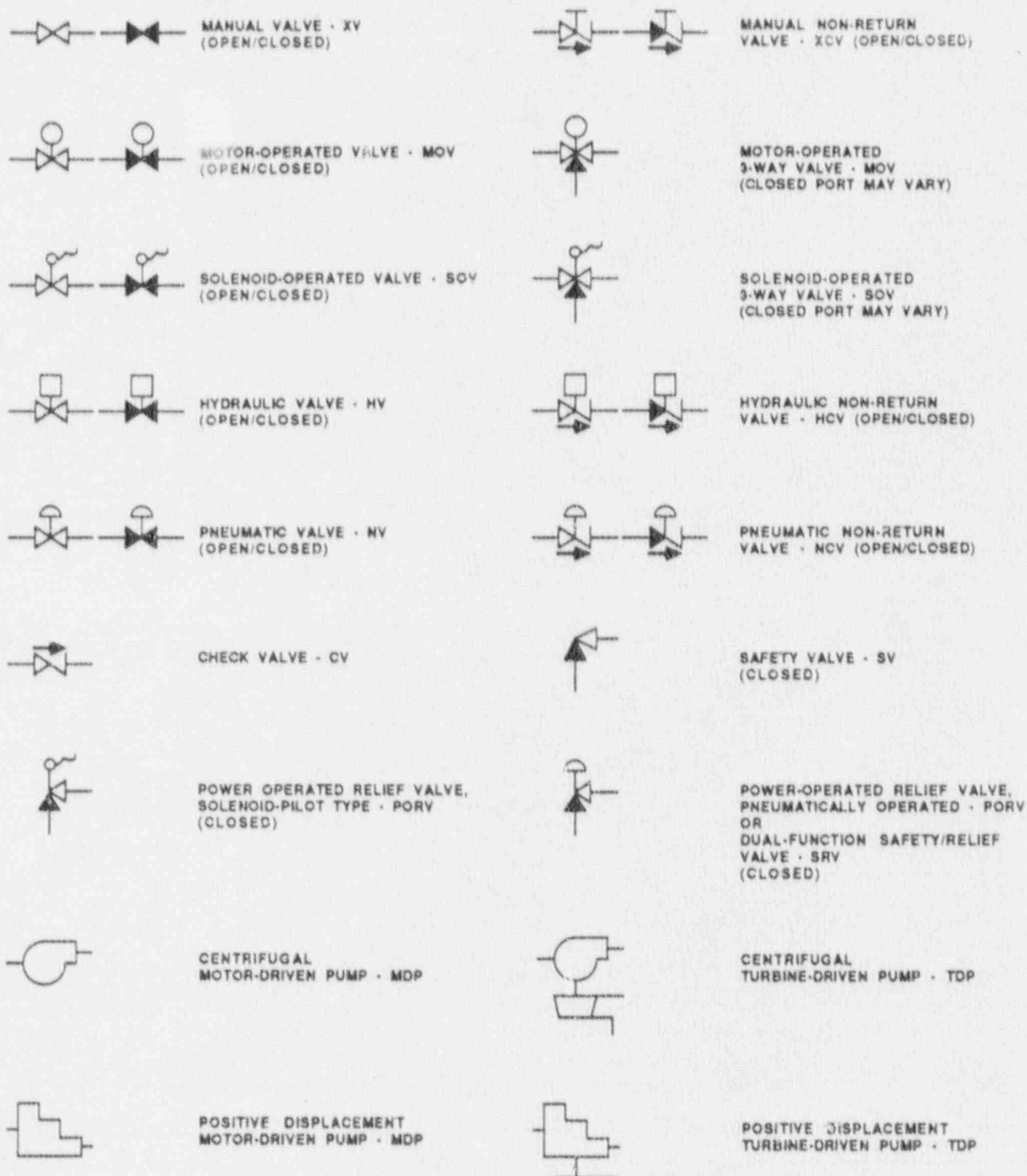

Figure A-1. Key To Symbols In Fluid System Drawings

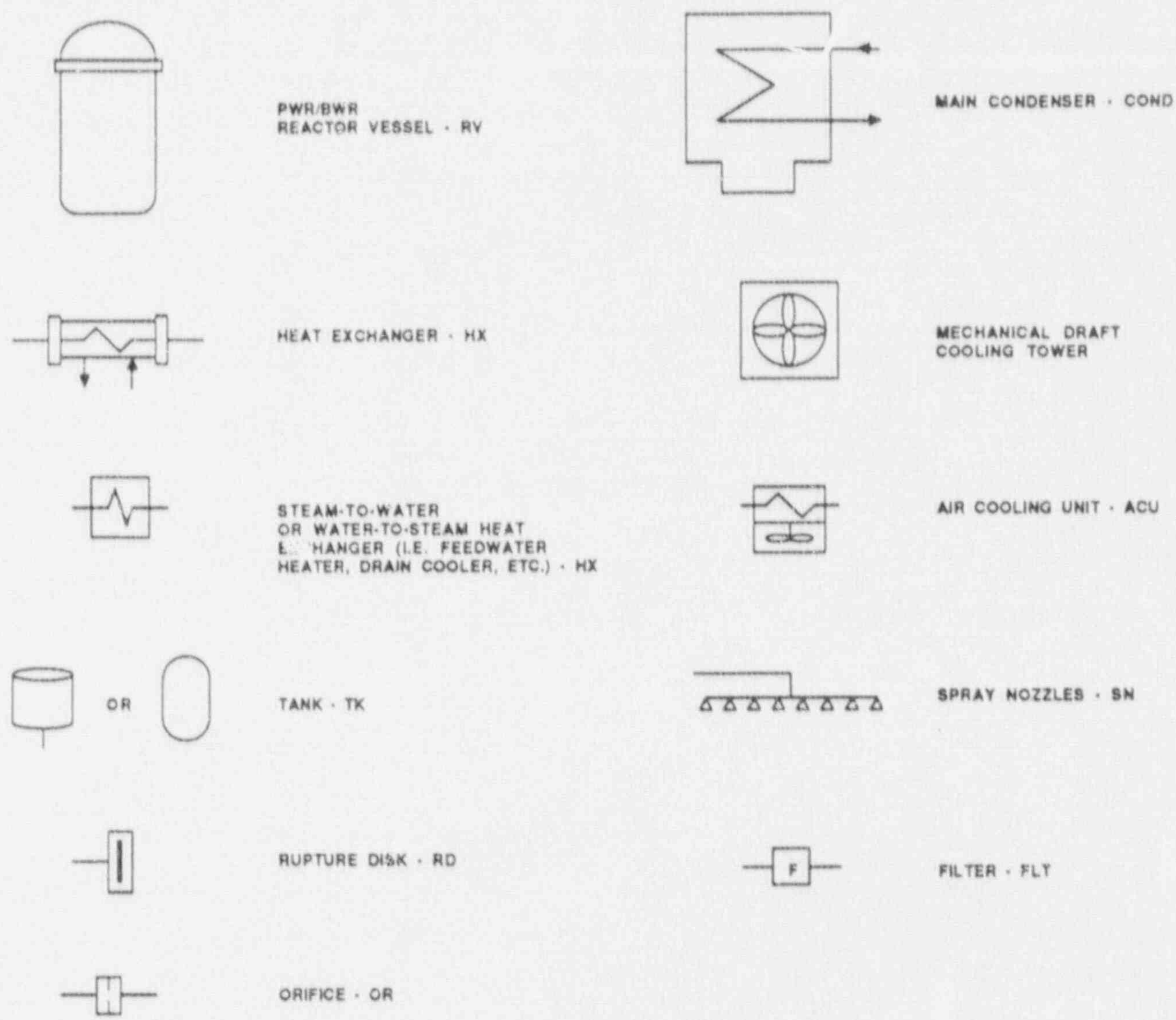

Figure A-1. Key To Symbols In Fluid System Drawings (Continued)

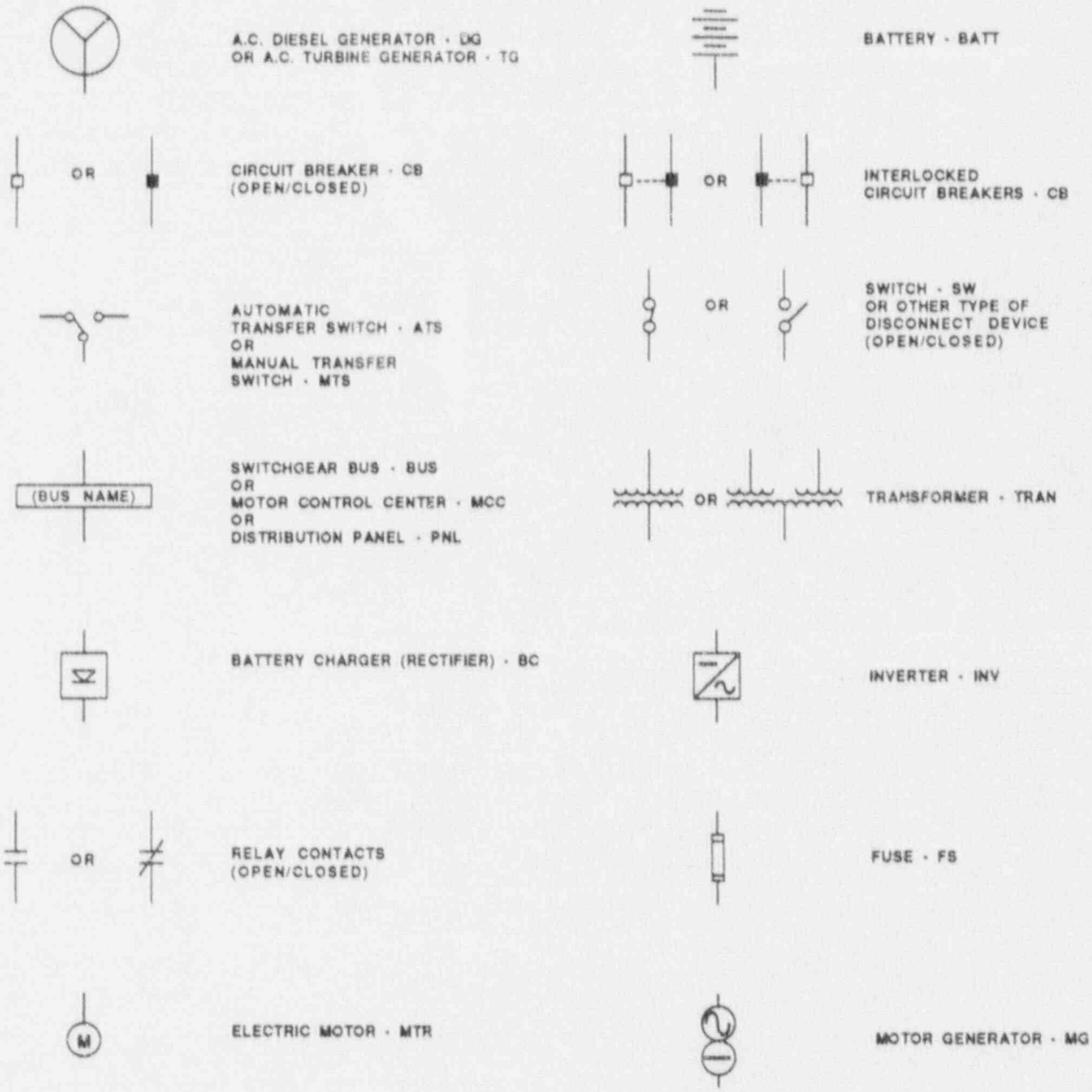

Figure A-2. Key To Symbols In Electrical System Drawings

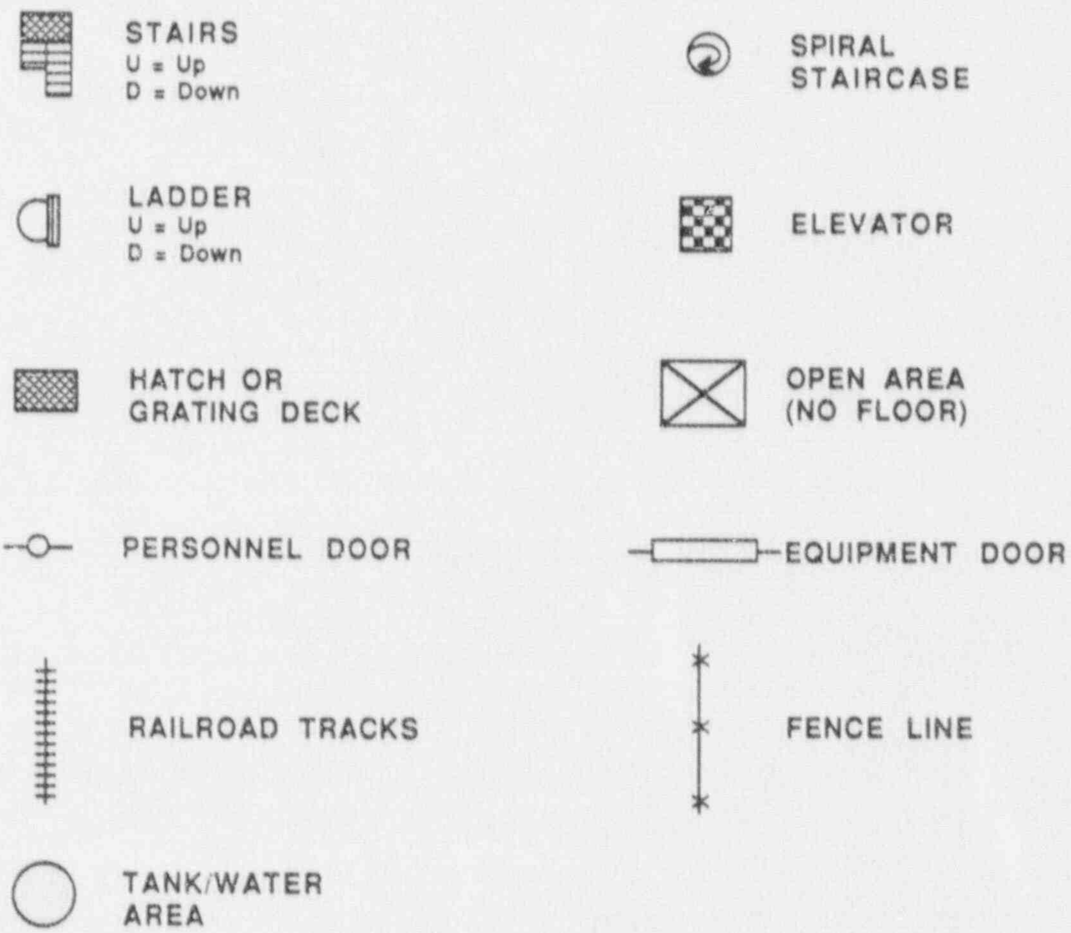

Figure A-3. Key To Symbols In Facility Layout Drawings

APPENDIX B
DEFINITION OF TERMS USED IN THE DATA TABLES

Terms appearing in the data tables in Sections 3 and 4 of this Sourcebook are defined as follows:

SYSTEM (also LOAD SYSTEM) - All components associated with a particular system description in the Sourcebook have the same system code in the data base. System codes used in this Sourcebook are the following:

Code	Definition
RCS	Reactor Coolant System
AFWS	Auxiliary Feedwater System
ECCS	Emergency Core Cooling System (including HPSI and LPSI)
CVCS	Charging System
CHRS	Containment Heat Removal System (including spray and fan cooler systems)
I&C	Instrumentation and Control Systems
EP	Electric Power System
CCWS	Component Cooling Water System
SWS	Service Water System

COMPONENT ID (also LOAD COMPONENT ID) - The component identification (ID) code in a data table matches the component ID that appears in the corresponding system drawing. The component ID generally begins with a system preface followed by a component number. The system preface is not necessarily the same as the system code described above. For component IDs, the system preface corresponds to what the plant calls the component (e.g. HPI, RHR). An example is HPI-730, denoting valve number 730 in the high pressure injection system, which is part of the ECCS. The component number is a contraction of the component number appearing in the plant piping and instrumentation drawings (P&IDs) and electrical one-line system drawings.

LOCATION (also COMPONENT LOCATION and POWER SOURCE LOCATION) - Refer to the location codes defined in Section 4.

COMPONENT TYPE (COMP TYPE) - Refer to Table B-1 for a list of component type codes.

POWER SOURCE - The component ID of the power source is listed in this field (see COMPONENT ID, above). In this data base, a "power source" for a particular component (i.e. a load or a distribution component) is the next higher electrical distribution or generating component in a distribution system. A single component may have more than one power source (i.e. a DC bus powered from a battery and a battery charger).

POWER SOURCE VOLTAGE (also VOLTAGE) - The voltage "seen" by a load of a power source is entered in this field. The downstream (output) voltage of a transformer, inverter, or battery charger is used.

EMERGENCY LOAD GROUP (EMERG LOAD GROUP) - AC and DC load groups (or electrical divisions) are defined as appropriate to the plant. Generally, AC load groups are identified as AC/A, AC/B, etc. The emergency load group for a third-of-a-kind load (i.e. a "swing" load) that can be powered from either of two AC load groups would be identified as AC/AB. DC load group follows similar naming conventions.

TABLE B-1. COMPONENT TYPE CODES

COMPONENT	COMP TYPE
VALVES:	
Motor-operated valve	MOV
Pneumatic (air-operated) valve	NV or AOV
Hydraulic valve	HV
Solenoid-operated valve	SOV
Manual valve	XV
Check valve	CV
Pneumatic non-return valve	NCV
Hydraulic non-return valve	HCV
Safety valve	SV
Dual function safety/relief valve	SRV
Power-operated relief valve (pneumatic or solenoid-operated)	PORV
PUMPS:	
Motor-driven pump (centrifugal or PD)	MDP
Turbine-driven pump (centrifugal of PD)	TDP
Diesel-driven pump (centrifugal of PD)	DDP
OTHER FLUID SYSTEM COMPONENTS:	
Reactor vessel	RV
Steam generator (U-tube or once-through)	SG
Heat exchanger (water-to-water HX, or water-to-air HX)	HX
Cooling tower	CT
Tank	TANK or TK
Sump	SUMP
Rupture disk	RD
Orifice	ORIF
Filter or strainer	FLT
Spray nozzle	SN
Heaters (i.e. pressurizer heaters)	HTR
VENTILATION SYSTEM COMPONENTS:	
Fan (motor-driven, any type)	FAN
Air cooling unit (air-to-water HX, usually including a fan)	ACU or FCU
Condensing (air-conditioning) unit	COND
EMERGENCY POWER SOURCES:	
Diesel generator	DG
Gas turbine generator	GT
Battery	BATT

TABLE B-1. COMPONENT TYPE CODES (Continued)

COMPONENT	COMP TYPE
ELECTRIC POWER DISTRIBUTION EQUIPMENT:	
Bus or switchgear	BUS
Motor control center	MCC
Distribution panel or cabinet	PNL or CAB
Transformer	TRAN or XFMR
Battery charger (rectifier)	BC or RECT
Inverter	INV
Uninterruptible power supply (a unit that may include battery, battery charger, and inverter)	UPS
Motor generator	MG
Circuit breaker	CB
Switch	SW
Automatic transfer switch	ATS
Manual transfer switch	MTS