UNITED STATES NUCLEAR REGULATORY COMMISSION

NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

GRAND GULF 1

50-416

SAIC

SAIC 89/1007

NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

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

GRAND GULF 1
RECORD OF REVISIONS

REVISION	ISSUE	COMMENTS
0	1/89	Original report

GRAND GULF SYSTEM SOURCEBOOK

This sourcebook contains summary information on the Grand Gulf Nuclear Station. 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 Grand Gulf 1 nuclear power plant is listed below:

- Docket number	50-416
- Operator	System Energy Resources, Inc. (a subsidiary of Middle South Utilities)
- Location	Claiborne County, Mississippi
- Commercial operation date	July 1985
- Reactor type	BWR/6
- NSSS vendor	General Electric
- Power (MWt/MWe)	3833/1290
- Architect-engineer	Bechtel
- Containment type	Steel and reinforced concrete cylinder (Mark III)

2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

The Grand Gulf 1 plant contains a General Electric BWR-6 nuclear steam supply system with a Mark III containment incorporating the drywell/pressure suppression concept. The plant also has a secondary containment structure of reinforced concrete. Other BWR-6 plants in the United States are as follows:

Clinton 1
Perry 1 & 2
River Bend 1

Grand Gulf 1 uses a high pressure core spray system, a reactor core isolation cooling system, a low pressure core spray system, and a multi-mode RHR system. The reactor core isolation cooling and RHR systems include the capability for steam condensing.

3. SYSTEM INFORMATION

This section contains descriptions of selected systems at Grand Gulf 1 in terms of general function, operation, system success criteria, major components, and support system requirements. A summary of major systems at Grand Gulf 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 Grand Gulf 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
- Reactor Core Isolation Cooling (RCIC) Systems	Same	3.2	5.4.6
- Emergency Core Cooling Systems (ECCS)	Core Standby Cooling Systems		
- High-Pressure Injection & Recirculation	High-Pressure Core Spray (HPCS) System	3.3	6.3
- Low-pressure Injection & Recirculation	Low Pressure Core Spray (LPCS) System	3.3	6.3
	Low-Pressure Coolant Injection (LPCI) System (an operating mode of the RHR system)	3.3	6.3
- Automatic Depressurization System (ADS)	Same	3.3	6.3
- Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System)	Residual Heat Removal (RHR) System (a multi-mode system)	3.3	5.4.7, 6.3
- Main Steam and Power Conversion Systems	Main and Reheat Steam System,	X	5.4, 10.3
	Condensate and Feedwater System,	X	5.4, 10.4.7
	Circulating Water System	X	10.4.5
- Other Heat Removal Systems	Steam-condensing RHR/RCIC operation	3.2	6.3

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

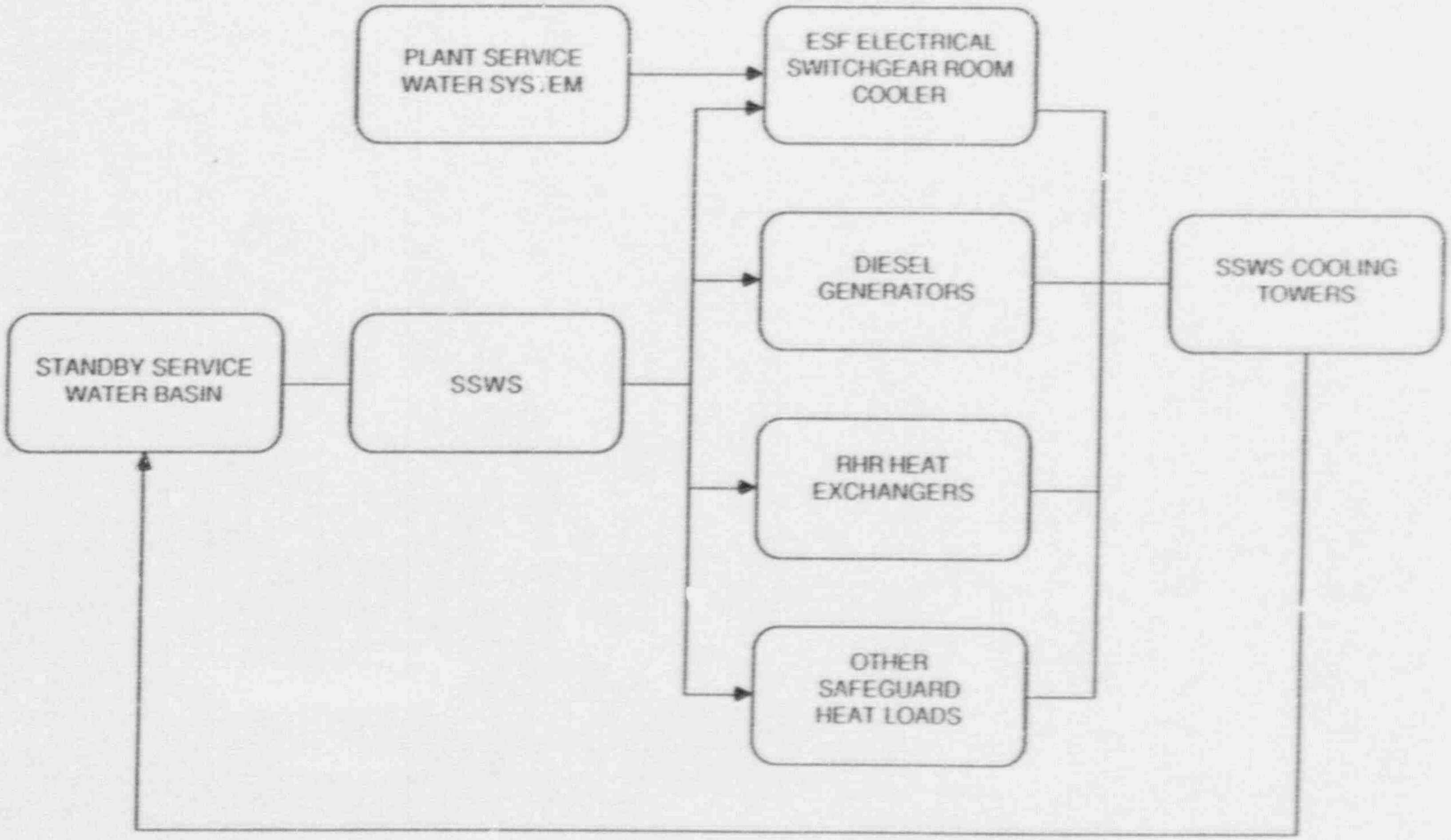
Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor Coolant Inventory Control Systems			
- Reactor Water Cleanup (RWCU) System	Same	X	5.4.8
- ECCS	See Core Standby Cooling Systems above	-	-
- Control Rod Drive Hydraulic System (CRDHS)	Same	3.6	4.6
Containment Systems			
- Primary Containment	Same (drywell and pressure suppression chamber)	X	6.2
- Secondary Containment	Same	X	6.2
- Standby Gas Treatment System (SGTS)	Same	X	6.5.3
- Containment Heat Removal Systems			
- Suppression Pool Cooling System	Same (an operating mode of the RHR system)	3.3	6.2.2
- Containment Spray System	Same (an operating mode of the RHR system)	3.3	6.5.2
- Containment Fan Cooler System	Containment Cooling System,	X	9.4.7
	Drywell Cooling System	X	9.4.8
- Containment Normal Ventilation Systems	Containment Cooling System,	X	9.4.7
	Drywell Cooling System	X	9.4.8
- Combustible Gas Control Systems	Drywell Purge System, Hydrogen Control System, Backup Containment Purge System	X	6.2.5
- Other Containment Systems	Suppression Pool Make-up System	X	6.2.7

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor and Reactivity Control Systems			
- Reactor Core	Same	X	4
- Control Rod System	Control Rod Drive Mechanisms	X	4.6
- Chemical Poison System	Standby Liquid Control System (SLCS)	X	9.3.5
Instrumentation & Control (I&C) Systems			
- Reactor Protection System (RPS)	Same	3.4	7.2
- Engineered Safety Feature Actuation System (ESFAS)	Various actuation systems	3.3	7.3
- Remote Shutdown System	Same	3.4	7.4
- Other I&C Systems	Various other systems	X	7.5, 7.6, 7.7
Support Systems			
- Class 1E Electric Power System	Same	3.5	8.3
- Non-Class 1E Electric Power System	Same	X	8.3
- Diesel Generator Auxiliary Systems	Same	3.5	8.3, 9.5.4 thru 9.5.7
- Component Cooling Water (CCW) System	Same	X	9.2.2

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Support Systems (continued)			
- Service Water System (SWS)	Standby Service Water System	3.7	9.2.1
- Residual Heat Removal Service Water (RHRSW) System	Standby Service Water System	3.7	9.2.1
- Other Cooling Water Systems	Turbine Building Cooling Water (TBCW) System,	X	9.2.9
	Plant Service Water System,	3.8	9.2.8
	Plant Chilled Water System	X	9.2.7
- Fire Protection Systems	Same	X	9.5.1
- Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems	Habitability Systems,	X	6.4
	HVAC Systems	X	9.4
- Instrument and Service Air Systems	Compressed Air System	X	9.3.1
- Refueling and Fuel Storage Systems	Same	X	9.1
- Radioactive Waste Systems	Same	X	11
- Radiation Protection Systems	Same	X	12



SSWS = Standby Service Water System

Figure 3-1. Cooling Water Systems Functional Diagram for Grand Gulf 1

3.1 REACTOR COOLANT SYSTEM (RCS)

3.1.1 System Function

The RCS, also called the Nuclear Steam Supply System (NSSS), is responsible for directing the steam produced in the reactor to the turbine where it is used to rotate a generator and produce electricity. 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) two recirculation loops, (c) recirculation pumps, (d) 20 safety/relief valves, and (e) connected piping out to a suitable isolation valve boundary. Simplified diagrams of the RCS and important system interfaces are shown in Figures 3.1-1 and 3.1-2. 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 recirculation pump in each of the two recirculation loops and the associated jet pumps internal to the reactor vessel. The steam water mixture flows upward in the core to the steam dryers and separators where the entrained liquid is removed. The steam is piped through the main steam lines to the turbine. The separated liquid returns to the core, mixes with the feedwater and is recycled again.

About 1/2 of the liquid in the downcomer region of the reactor vessel is drawn off by the recirculation pumps. The discharge of these pumps is returned to the inlet nozzles of the jet pumps at high velocity. As the liquid enters the jet pumps the slow moving liquid in the upper region of the downcomer is induced to flow through the jet pumps, producing reactor coolant circulation.

The steam that is produced by the reactor is piped to the turbine via the four main steam lines. There are two main steam isolation valves (MSIVs) in each main steam line. Condensate from the turbine is returned to the RCS as feedwater.

Following a transient that involves the loss of the main condenser or loss of feedwater, heat from the RCS is dumped to the suppression chamber via safety/relief valves on the main steam lines. A LOCA inside containment or operation of the Automatic Depressurization System (ADS) also dumps heat to the suppression chamber. Makeup to the RCS is provided by the Reactor Core Isolation Cooling (RCIC) system (see Section 3.2) or by the Emergency Core Cooling System (ECCS, see Section 3.3). Heat is transferred from the containment to the ultimate heat sink by the Residual Heat Removal (RHR) system operating in the suppression pool cooling mode. Actuation systems provide for automatic closure of the MSIVs and isolation of other lines connected to the RCS.

3.1.4 System Success Criteria

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

- An unmitigatible LOCA is not initiated.
- If a mitigatible 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. Steam flow: 16.5 x 10^6 lb/hr.
   2. Normal operating pressure: 1074 psia

B. Safety/Relief Valves (20)
   1. Set pressure: 1165 to 1190 psig
   2. Relief capacity: 895,000 to 913,000 lb/hr (each)

C. Recirculation Pumps (2)
   1. Rated flow: 44,600 gpm @ 765 ft. head (332 psid)
   2. Type: Vertical centrifugal

D. Jet Pumps (24)
   1. Total flow: 34.1 x 10^6 lb/hr @ 85.51 ft. head

3.1.6 Support Systems and Interfaces

A. Motive Power
The recirculation pumps are supplied with Nonclass 1E power from AC motor generator sets.

B. MSIV Operating Power
The instrument air system supports normal operation of the MSIVs. Valve operation is controlled by redundant AC solenoid pilot valves (Ref. 1, Section 5.4.5.2). Both solenoid valves must be deenergized to cause MSIV closure. This design prevents spurious closure of an MSIV if a single solenoid valve should fail. MSIVs are designed to fail closed if instrument air is lost or if AC control power is lost to both solenoid pilot valves. This is achieved by a local dedicated air accumulator for each MSIV and an independent valve closing spring.

C. Recirculation Pump Cooling
The reactor plant component cooling water system provides cooling water to the recirculation pump coolers.

3.1.7 Section 3.1 References

1. Grand Gulf Final Safety Analysis Report.

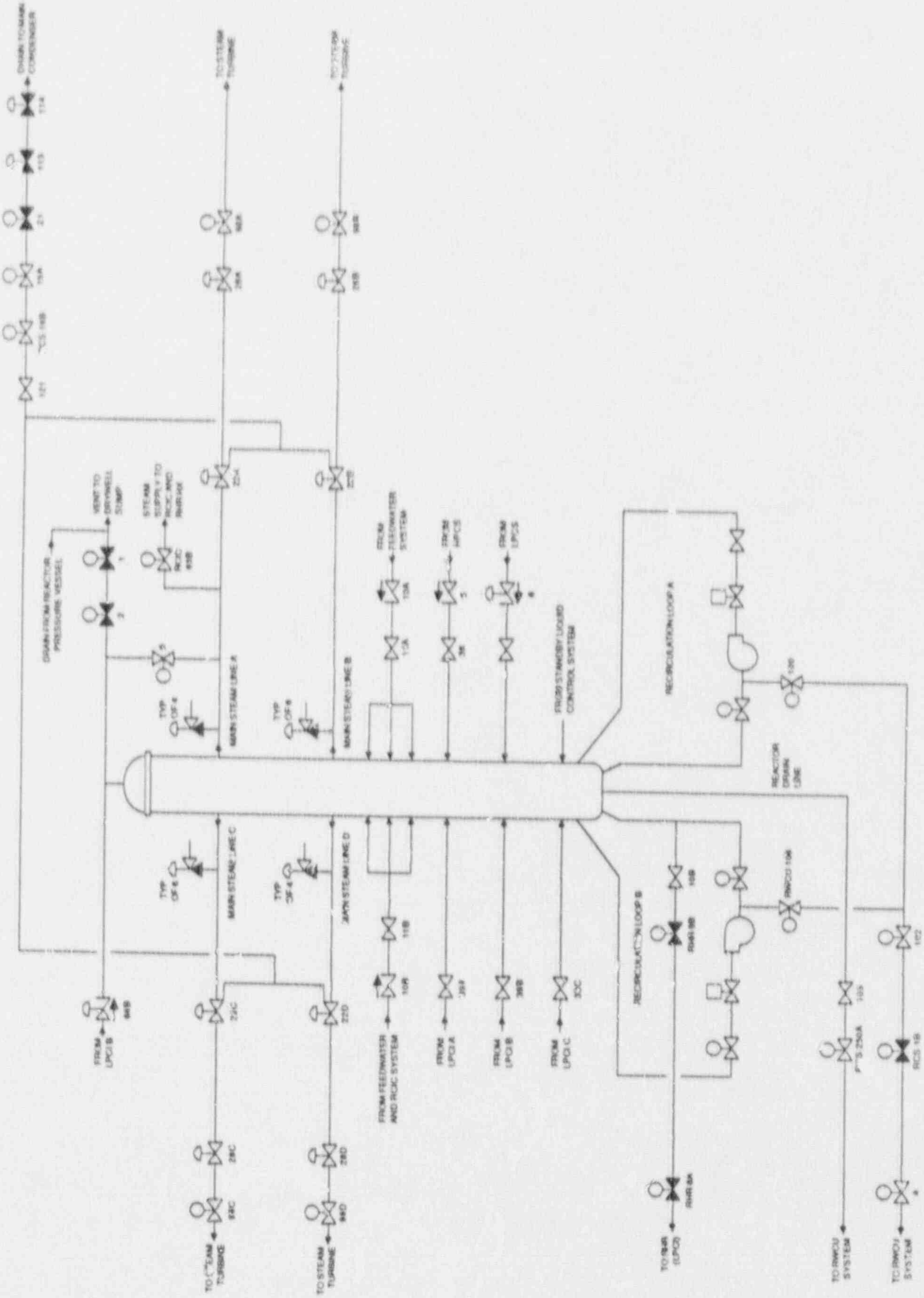


Figure 3.1-1. Grand Gulf Reactor Coolant System

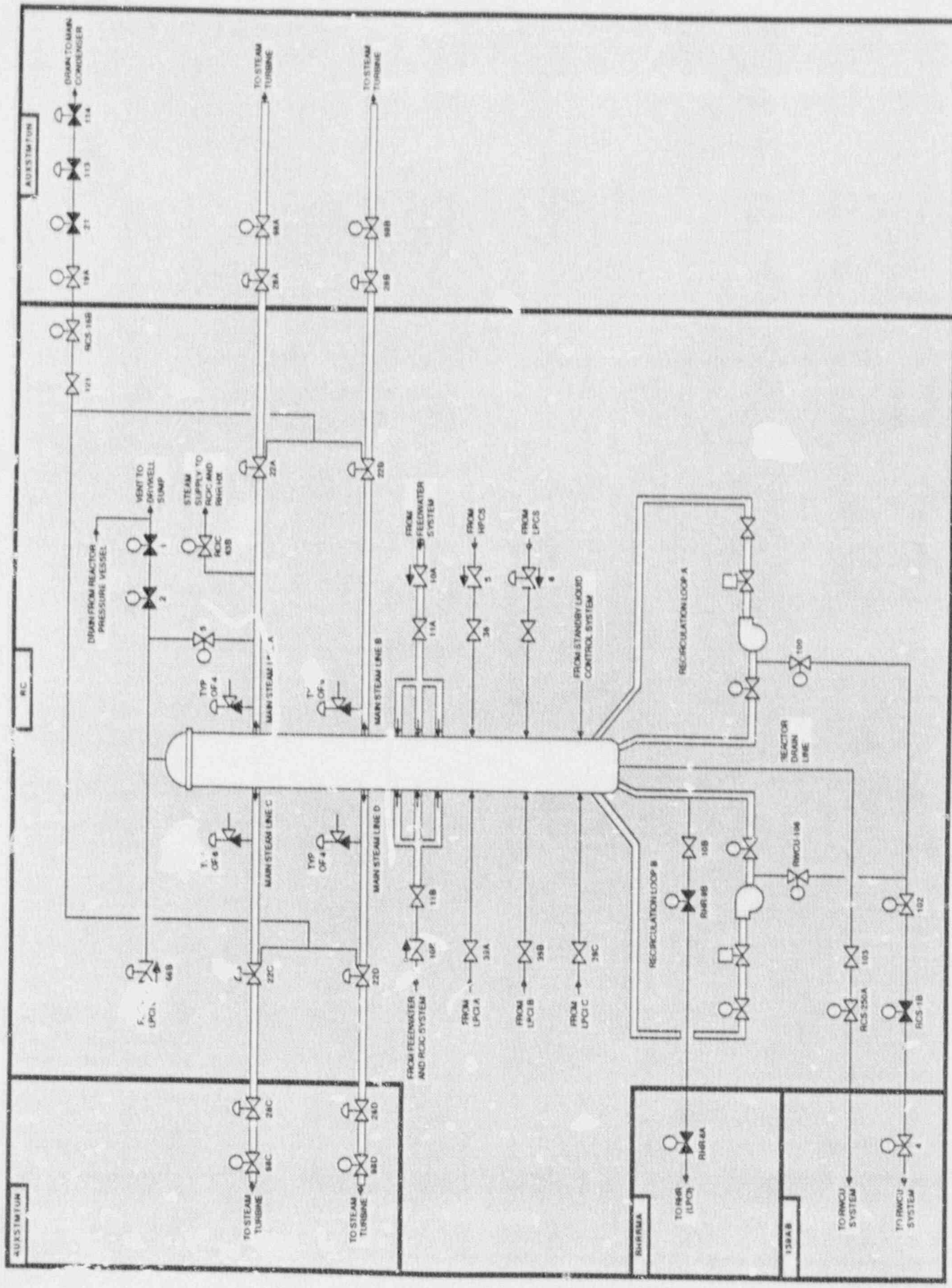


Figure 3.1-2. Grand Gulf Reactor Coolant System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RCIC-63B	MOV	RC	EP-MCC-16B31	480	SGRM119-8	AC/B
RCIC-64A	MOV	RCICRM	EP-MCC-15B31	480	SGRM119-7	AC/A
RCS-16B	MOV	RC	EP-MCC-16B31	480	SGRM119-8	AC/B
RCS-1B	MOV	RC	EP-MCC-16B31	480	SGRM119-8	AC/B
RCS-250A	MOV	RC	EP-MCC-15B11	[illegible]	SGRM119-9	AC/A
RHR-8A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-9B	MOV	RC	EP-MCC-16B31	480	SGRM119-8	AC/B

3.2 REACTOR CORE ISOLATION COOLING (RCIC) SYSTEM

3.2.1 System Function

The reactor core isolation cooling system provides adequate core cooling in the event that reactor isolation is accompanied by loss of feedwater flow. This system provides makeup at reactor operating pressure and does not require RCS depressurization. The RCIC system is not considered to be part of the Emergency Core Cooling System (ECCS, see Section 3.3) and does not have a LOCA mitigating function.

3.2.2 System Definition

The reactor core isolation cooling system consists of a steam-driven turbine pump and associated valves and piping for delivering makeup water from the condensate storage tank or the suppression pool to the reactor pressure vessel. The RCIC can also operate in conjunction with the RHR system in the steam condensing mode, for high-pressure decay heat removal. In this mode, steam from the reactor vessel is condensed in the RHR heat exchanger, and delivered to the RCIC pump suction for return to the RCS.

Simplified drawings of the reactor core isolation cooling system are shown in Figures 3.2-1 and 3.2-2. A summary of data on selected RCIC system components is presented in Table 3.2-1.

3.2.3 System Operation

During normal operation the RCIC is in standby with the steam supply valves to the RCIC turbine driven pump closed and the pump suction aligned to the condensate storage tank.

Upon receipt of a reactor pressure vessel (RPV) low water level signal, the turbine-pump steam supply valves are opened and makeup water is supplied to the RPV. The primary water supply for the RCIC is the condensate storage tank (CST). The suppression pool is used as a backup water supply. Reactor core heat is dumped to the suppression pool via the safety/relief valves which cycle as needed to limit RCS pressure. The RCIC turbine also exhausts to the suppression pool.

The RCIC can also operate in conjunction with the RHR system in th steam condensing mode, in which condensed steam is delivered from the RHR heat exchanger outlets to the RCIC pump suction, for return to the RCS. In this mode of operation, reactor decay heat is transferred via the RHR heat exchangers to the shutdown service water system (see Section 3.7) rather than to the suppression pool. The RCIC turbine still exhausts to the suppression pool.

The RCIC system is designed to operate on DC power only for an unspecified length of time. DC power is required for control and to operate most of the motor-operated valves in the system. The only valves requiring AC power are two normally open steam supply valves (63B and 64A).

3.2.4 System Success Criteria

For the RCIC system to be successful there must be at least one water source and supply path to the turbine-driven pump, an open steam supply path to the turbine, an open pump discharge path to the RCS, and an open turbine exhaust path to the suppression pool.

3.2.5 Component Information

A. Steam turbine-driven RCIC pump:
   1. Rated Flow: 825 gpm @ 2980 ft. head (1192 psid)
   2. Rated Capacity: 100%
   3. Type: centrifugal

B. Condensate Storage Tank
   1. Capacity: 170,000 gal available supply (for use by RCIC and HPCS)
   2. Pressure: atmospheric

3.2.6 Support System and Interfaces

A. Control Signals
   1. Automatic
      a. The RCIC pump is automatically actuated on a reactor vessel low water level signal.
      b. The RCIC pump is automatically tripped on a reactor vessel high water level signal signal. It may then be necessary to restart the pump manually.
   2. Remote Manual
      The RCIC pump can be actuated by remote manual means from the Main Control Room.

B. Motive Power
   1. The RCIC turbine driven pump is supplied with steam from main steam loop A, upstream of the main steam isolation valves.
   2. The RCIC motor-operated valves are either Class 1E AC or Class 1E DC loads that can be supplied from the standby diesel generators or the station batteries, respectively, as described in Section 3.5. The RCIC is capable of operating on DC power alone for an unspecified period of time.

C. Other
   1. Lubrication for the turbine-driven pump is supplied locally.
   2. The RCIC turbine lube oil cooler is cooled by water diverted from the RCIC pump discharge.
   3. A room ventilation system cooled by the standby service water system (see Section 3.7) provides RCIC room cooling.

3.2.7 Section 3.2 References

1. Kolaczkowski, A.M and Payne, A.C., "Station Blackout Accident Analyses (Part of NRC Task Action Plan A-44)," NUREG/CR-3226, Sandia National Laboratories, May 1983.

2. Drouin, Mary T. et al., "Analysis of Core Damage Frequency From Internal Events: Grand Gulf 1," NUREG/CR-4550, Sandia National Laboratories, April 1987.

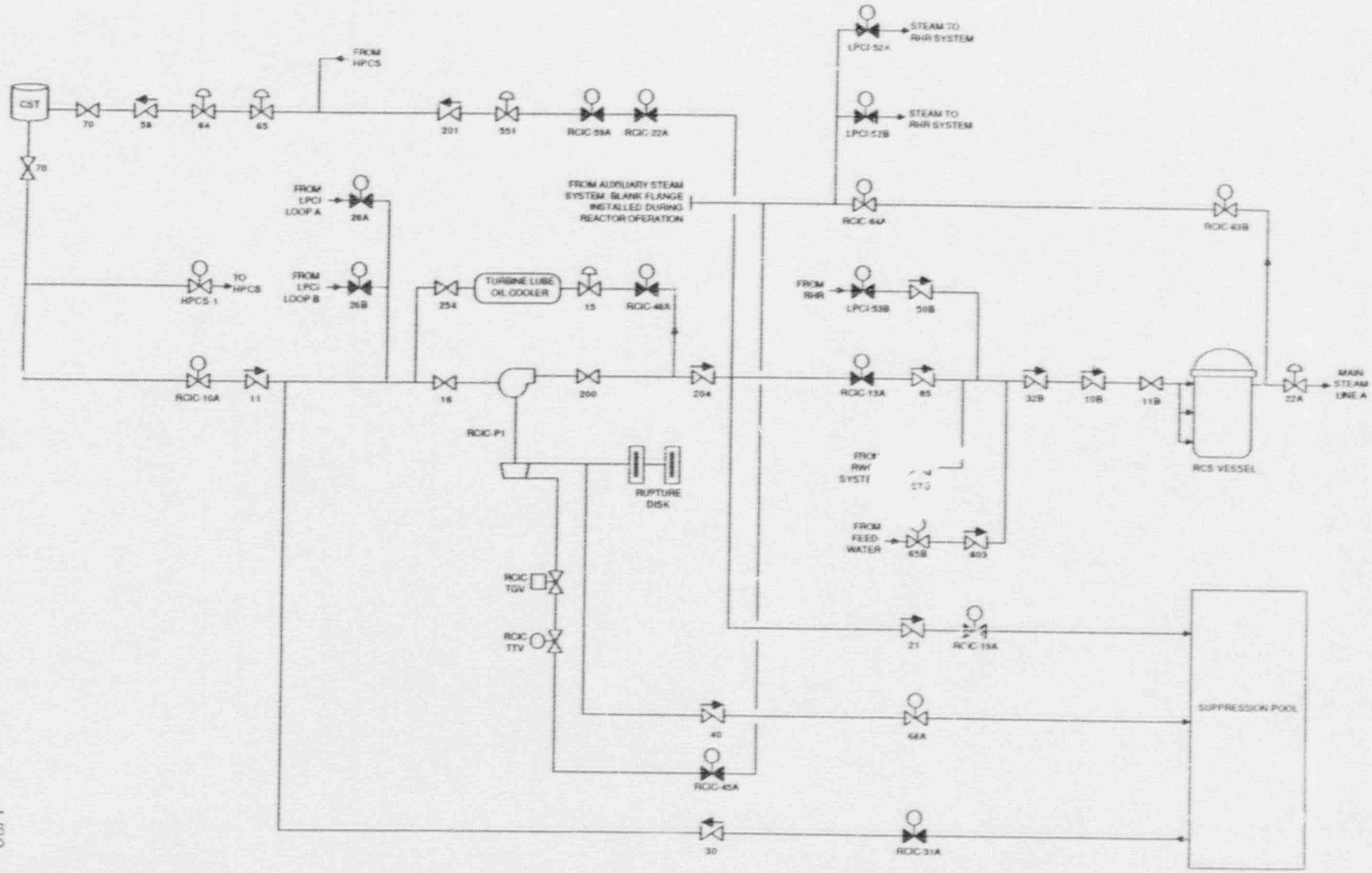


Figure 3.2-1. Grand Gulf 1 Reactor Core Isolation Cooling System

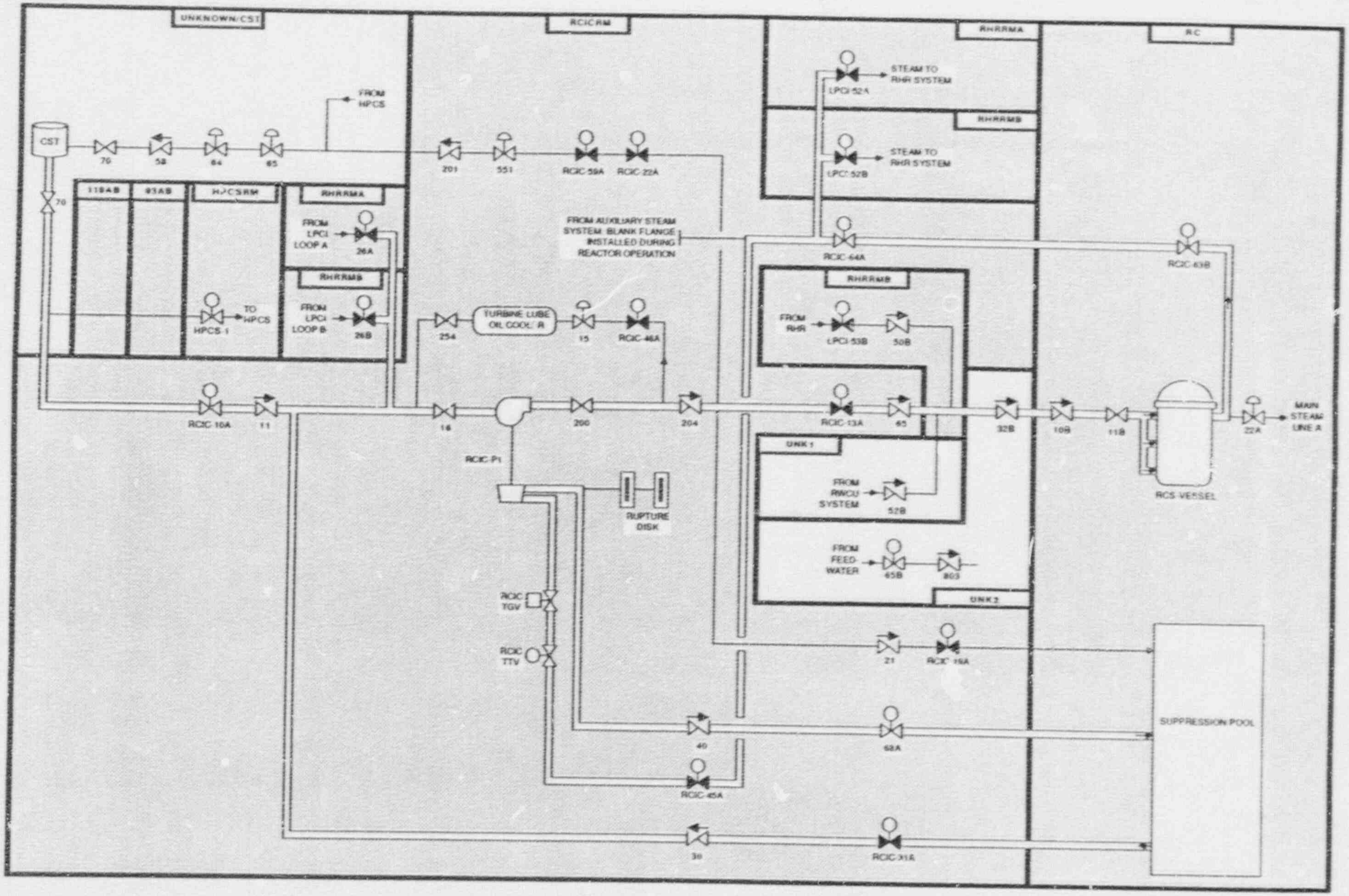


Figure 3.2-2. Grand Gulf 1 Reactor Core Isolation Cooling System Showing Component Locations

Table 3.2-1. Grand Gulf 1 Reactor Core Isolation Cooling System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CST	TANK	CST				
RCIC-10A	MOV	RCICRM	EP-DC-1DA2	125	SGRM119-7	DC/1
RCIC-13A	MOV	RCICRM	EP-DC-1DA2	125	SGRM119-7	DC/1
RCIC-19A	MOV	RCICRM	EP-DC-1DA2	125	SGRM119-7	DC/1
RCIC-22A	MOV	RCICRM	EP-DCMCC-11DA	125	SWGR15AA	DC/1
RCIC-31A	MOV	RCICRM	EP-DC-1DA2	125	SGRM119-7	DC/1
RCIC-45A	MOV	RCICRM	EP-DCMCC-11DA	125	SWGR15AA	DC/1
RCIC-46A	MOV	RCICRM	EP-DC-1DA2	125	SGRM119-7	DC/1
RCIC-59A	MOV	RCICRM	EP-DCMCC-11DA	125	SWGR15AA	DC/1
RCIC-63B	MOV	RC	EP-MCC-16B31	480	SGRM119-8	AC/B
RCIC-64A	MOV	RCICRM	EP-MCC-15B31	480	SGRM119-7	AC/A
RCIC-P1	TDP	RCICRM				
RCIC-TGV	HV	RCICRM				
RCIC-TTV	MOV	RCICRM				
SUPP POOL	TANK	RC				

3.3 EMERGENCY CORE COOLING SYSTEM (ECCS)

3.3.1 System Function

The ECCS 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 ECCS also performs suppression pool cooling and containment spray functions and has a capability for mitigating transients.

3.3.2 System Definition

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

- High Pressure Core Spray (HPCS) System
- Automatic Depressurization System (ADS)
- Low Pressure Core Spray System (LPCS)
- Low Pressure Coolant Injection (LPCI) System

The HPCS system is provided to supply make-up water to the reactor pressure vessel (RPV) in the event of a small break LOCA which does not result in a rapid depressurization of the reactor vessel. The HPCS also is capable of providing makeup to RCS following a large LOCA. The HPCS system consists of a motor-driven pump, system piping, valves and controls. A dedicated diesel generator supplies electric power to HPCS components.

The automatic depressurization system (ADS) provides automatic RPV depressurization following a small break LOCA or transient so that the low pressure systems (LPCI and LPCS) can provide makeup to the RCS. The ADS utilizes 8 of the 20 safety/relief valves that discharge the high pressure steam to the suppression pool.

The LPCS system supplies make-up water to the reactor vessel at low pressure. The system consists of a motor-driven pump to supply water from the suppression pool to a spray sparger in the reactor vessel above the core.

The low pressure coolant injection system is an operating mode of the RHR system, and provides make-up water to the reactor vessel at low pressure. The LPCI system consists of three loops, designated LPCIA, LPCIB, and LPCIC. Each loop consists of a motor driven pump which supplies water from the suppression pool into the reactor vessel. Loops A and B of the RHR system can be manually realigned as needed to perform suppression pool cooling or containment spray as part of the basic emergency core cooling function. *The RHR heat exchangers also can be aligned for steam condensing operation in conjunction with the RCIC system (see Section 3.2). This is not an ECCS function.*

Simplified drawings of the HPCS system are shown in Figures 3.3-1 and 3.3-2. The LPCS system is shown in Figures 3.3-3 and 3.3-4. A flow diagram of LPCIA is shown in Figures 3.3-5 and 3.3-6, LPCIB is shown in Figures 3.3-7 and 3.3-8, and LPCIC is shown in Figures 3.3-9 and 3.3-10. Interfaces between these systems and the RCS are shown in Section 3.1. A summary of data on selected ECCS components is presented in Table 3.3-1.

3.3.3 System Operation

All ECCS systems normally are in standby. The manner in which the ECCS operates to protect the reactor core is a function of the rate at which coolant is being lost from the RCS. The HPCS system is normally aligned to take a suction on the Condensate Storage Tank (CST). The HPCS system is automatically started in response to decreasing RPV water level, and will serve as the primary source of makeup if RCS pressure remains high. Reactor core heat is dumped to the suppression pool via the pipe break or the safety/relief valves which cycle as needed to limit RCS pressure. A dedicated diesel

generator supplies electric power to HPCS components. If the break is of such a size that the coolant loss exceeds the HPCS system capacity, then the LPCS and LPCI systems can provide higher capacity makeup to the reactor vessel at low pressure.

The Automatic Depressurization System will automatically reduce RCS pressure if a break has occurred and RPV water level is not maintained by the HPCS system. Rapid depressurization permits flow from the LPCS or LPCI systems to enter the vessel. Water can be taken from the suppression pool by each of these systems for injection into the core.

RHR loops A and B can be aligned for suppression pool cooling, with heat being transferred to the shutdown service water system (See Section 3.7) via the RHR heat exchangers. RHR loops A and/or B can be aligned for suppression pool cooling while any remaining RHR loops continue to function in a LPCI mode.

3.3.4 System Success Criteria

LOCA mitigation requires that both the emergency coolant injection (ECI) and emergency coolant recirculation (ECR) functions be accomplished. The ECI system success criteria for a large LOCA are the following (Ref. 1):

- The high pressure core spray system (HPCS) with suction on the suppression pool or the condensate storage tank (CST), or
- The low pressure core spray system (LPCS) with suction on the suppression pool, or
- Any 1 of the 3 low pressure coolant injection loops (i.e. LPCIA, LPCIB, LPCIC) with suction on the suppression pool.

The ECI system success criteria for a small LOCA, are the following (Ref. 1):

- The high pressure core spray (HPCS) system with suction on the suppression pool or the condensate storage tank, or
- The automatic depressurization system (ADS) and the low pressure core spray (LPCS) system, or
- The automatic depressurization system (ADS) and 1 of 3 loops in the low pressure coolant injection (LPCIA, LPCIB, LPCIC) system.

The success criterion for the ADS is the use of any 1 of 2 ADS trains. It is possible that the coolant inventory control function for some small LOCAs can be satisfied by low-capacity high pressure injection systems such as the control rod drive hydraulic system (see Section 3.6).

The ECR success criteria for LOCAs are integrated with the ECI success criteria above. All systems essentially are operating in a recirculation mode when drawing water from the suppression pool.

For transients, the success criteria for reactor coolant inventory control involve the following:

- The reactor core isolation cooling (RCIC) system (not part of the ECCS, see Section 3.2), or
- Small LOCA mitigating systems as described above

For the suppression pool cooling function to be successful, one of two RHR trains must be aligned for containment heat removal and the associated shutdown service water train must be operating to complete the heat transfer path from the RHR heat exchangers to the ultimate heat sink.

3.3.5 Component Information

A. Motor-driven HPCS pump P1
   1. Rated flow: 550 gpm @ 1177 psig, 7115 gpm @ 200 psig
   2. Rated capacity: 100%
   3. Type: centrifugal

B. Motor-driven LPCS pump P1
   1. Rated flow: 7,000 gpm @ 122 psid (vessel to drywell)
   2. Rated capacity: 100%
   3. Type: centrifugal

C. Motor-driven LPCI pumps P1A, P1B, P1C
   1. Rated flow: 7450 gpm @ 20 psid (vessel to drywell) each
   2. Rated capacity: 100%
   3. Type: centrifugal

D. RHR Heat Exchangers 1A, 2A, 1B, and 2B
   1. Heat transfer capability: 184.7×10^6 Btu/hr per loop
   2. Rated capacity: 100%
   3. Type: inverted U-tube, single pass shell, multi pass tube, vertical mounting

E. Automatic-depressurization valves (8)
   1. Rated flow: 800,000 lb/hr @ 1125 psig (each)

F. Pressure Suppression Chamber
   1. Design temperature: 185°F
   2. Maximum operating temperature: 95°F
   3. Minimum water volume: 135,291 ft^3

G. Condensate Storage Tank
   1. Capacity: 170,000 gallon available supply (for use by RCIC and HPCS)
   2. Pressure: atmospheric

3.3.6 Support Systems and Interfaces

A. Control signals
   1. Automatic
      a. The HPCS pump, LPCS pump, and the LPCI pumps, and all their associated valves function upon receipt of low water level in the reactor vessel or high pressure in the drywell.
      b. The HPCS pump is automatically tripped on a reactor vessel high water level signal. It may then be necessary to restart the pump manually.
      c. The ADS system is actuated upon coincident signals of the reactor vessel low water level, drywell high pressure, confirmed reactor vessel low water level, and a permissive signal indicating LPCS or LPCI pump discharge pressure. There is a 2 minute delay to ensure the HPCS has time to operate.
      d. HPCS pump suction is automatically switched to the suppression pool on high suppression pool water level or low water level in the condensate storage tank.

e. LPCI initiation automatically causes all RHR components to perform their function under the LPCI mode.

2. Remote manual
ECCS pumps and valves and the ADS can be actuated by remote manual means from the main control room.

B. Motive Power

1. The ECCS motor-driven pumps and motor-operated valves are Class 1E AC loads that can be supplied from the emergency diesel generators, as described in Section 3.5.
2. The components of the HPCS are powered from a dedicated diesel generator (Diesel generator 1C, see Section 3.5).

C. Other

1. Lubrication and cooling for the ECCS pumps are assumed to be supplied locally.
2. ECCS pump room ventilation systems are cooled by standby service water (see Section 3.7).
3. The shutdown service water system provides cooling water to the RHR heat exchangers, the RHR pump seals and the ECCS pump room coolers (see Section 3.7).

3.3.7 Section 3.3 References

1. Drouin, Mary T. et al., "Analysis of Core Damage Frequency From Internal Events: Grand Gulf 1," NUREG/CR-4550, Sandia National Laboratories, April 1987.

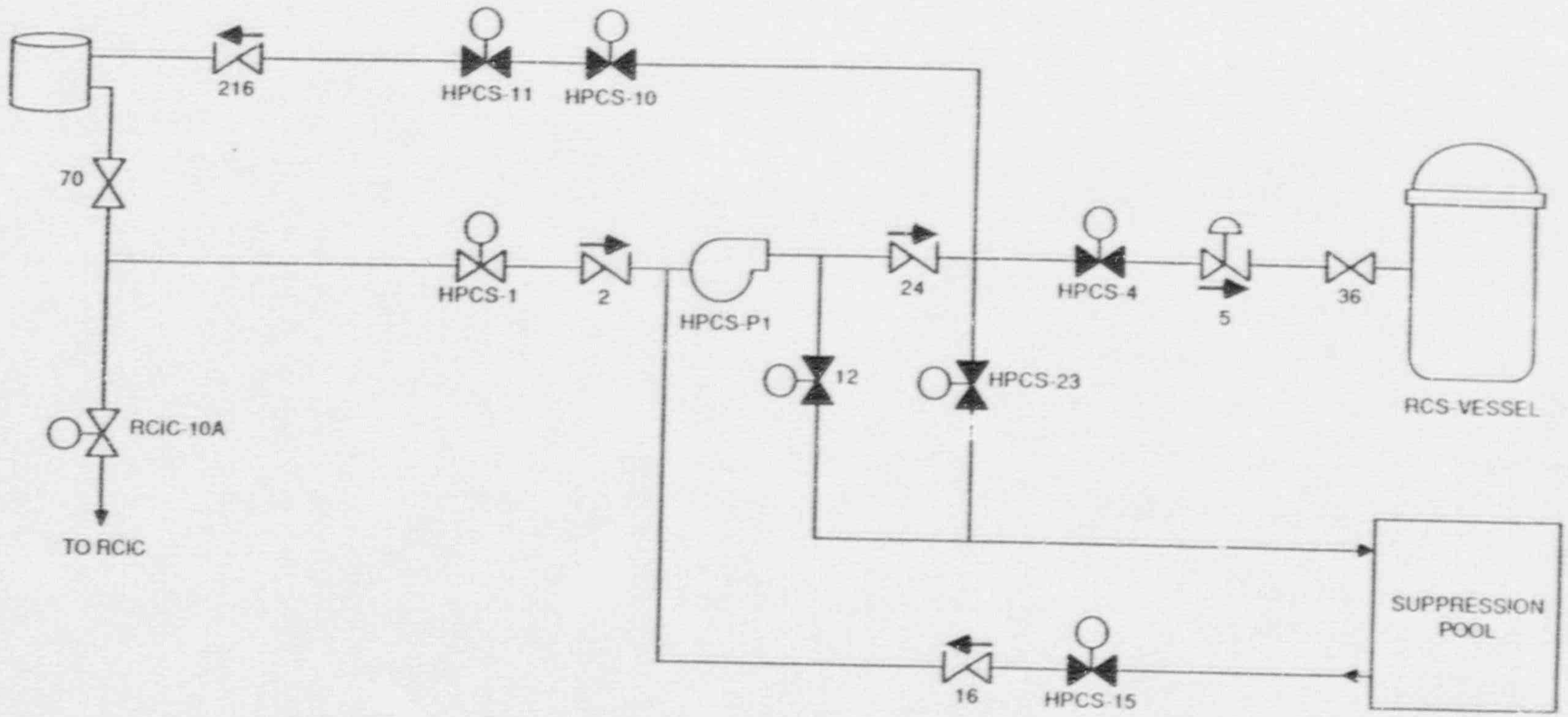


Figure 3.3-1. Grand Gulf 1 High Pressure Core Spray System

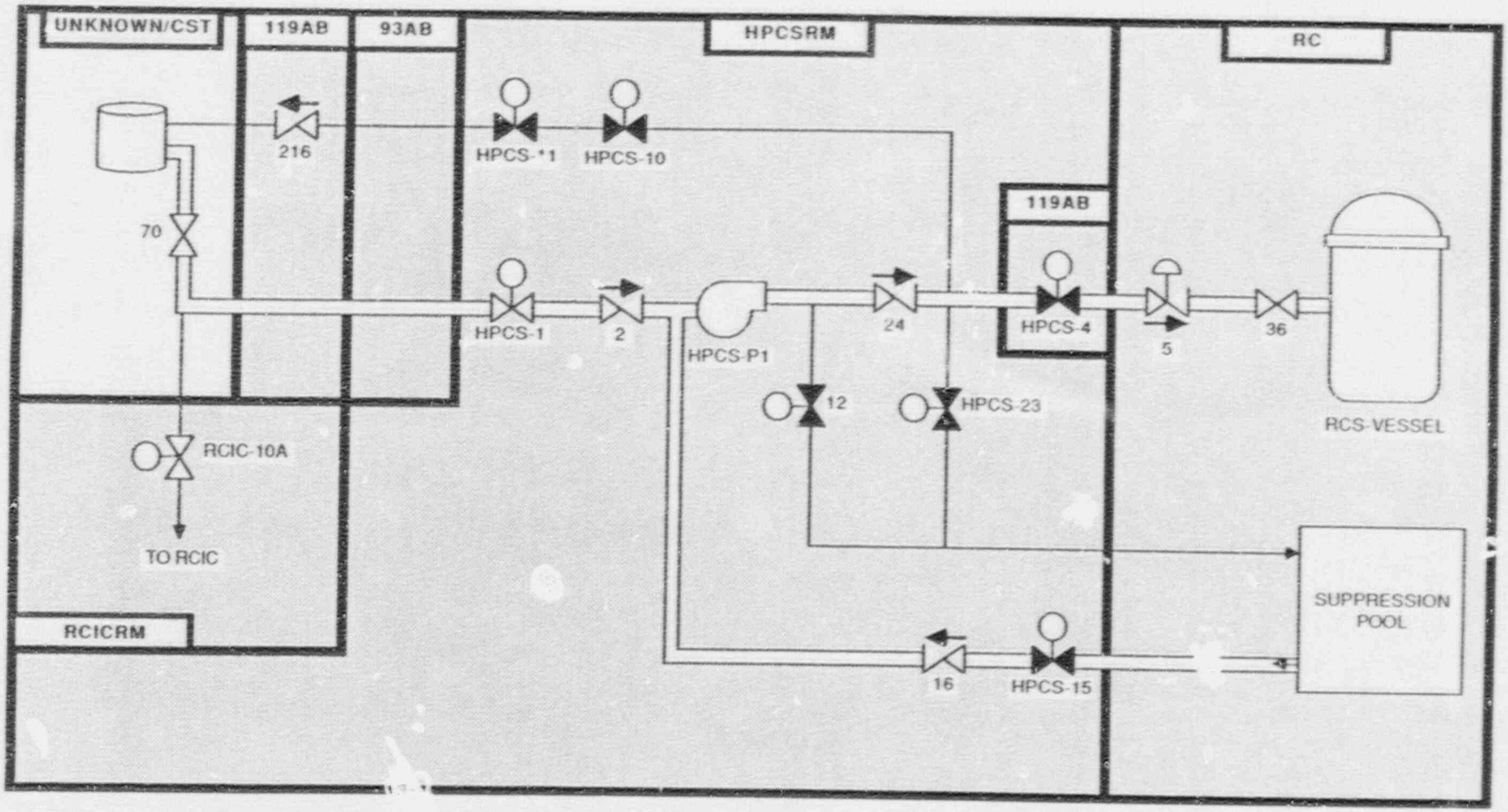


Figure 3.3-2. Grand Gulf 1 High Pressure Core Spray System
Showing Component Locations

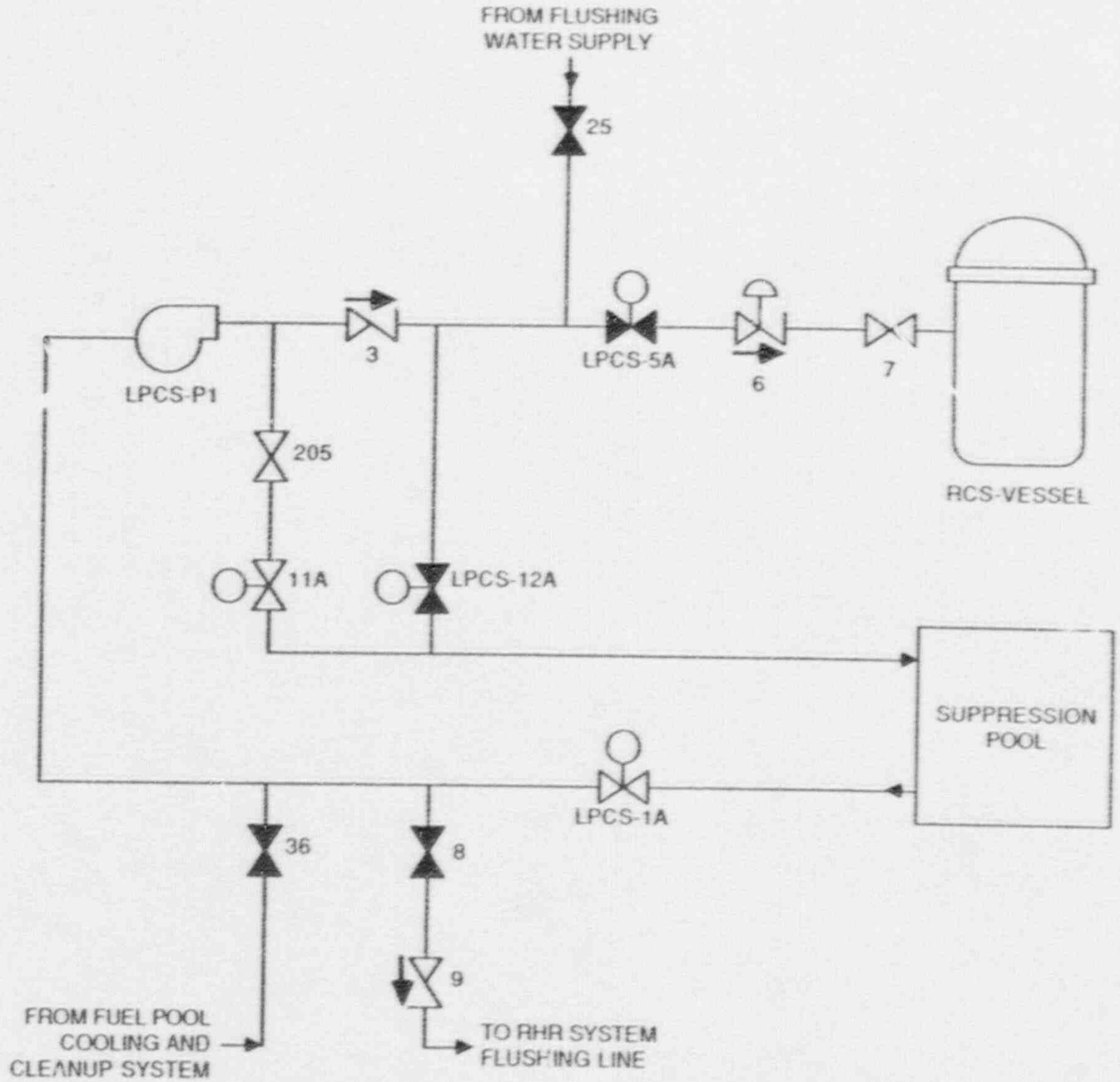


Figure 3.3-3. Grand Gulf 1 Low Pressure Core Spray System

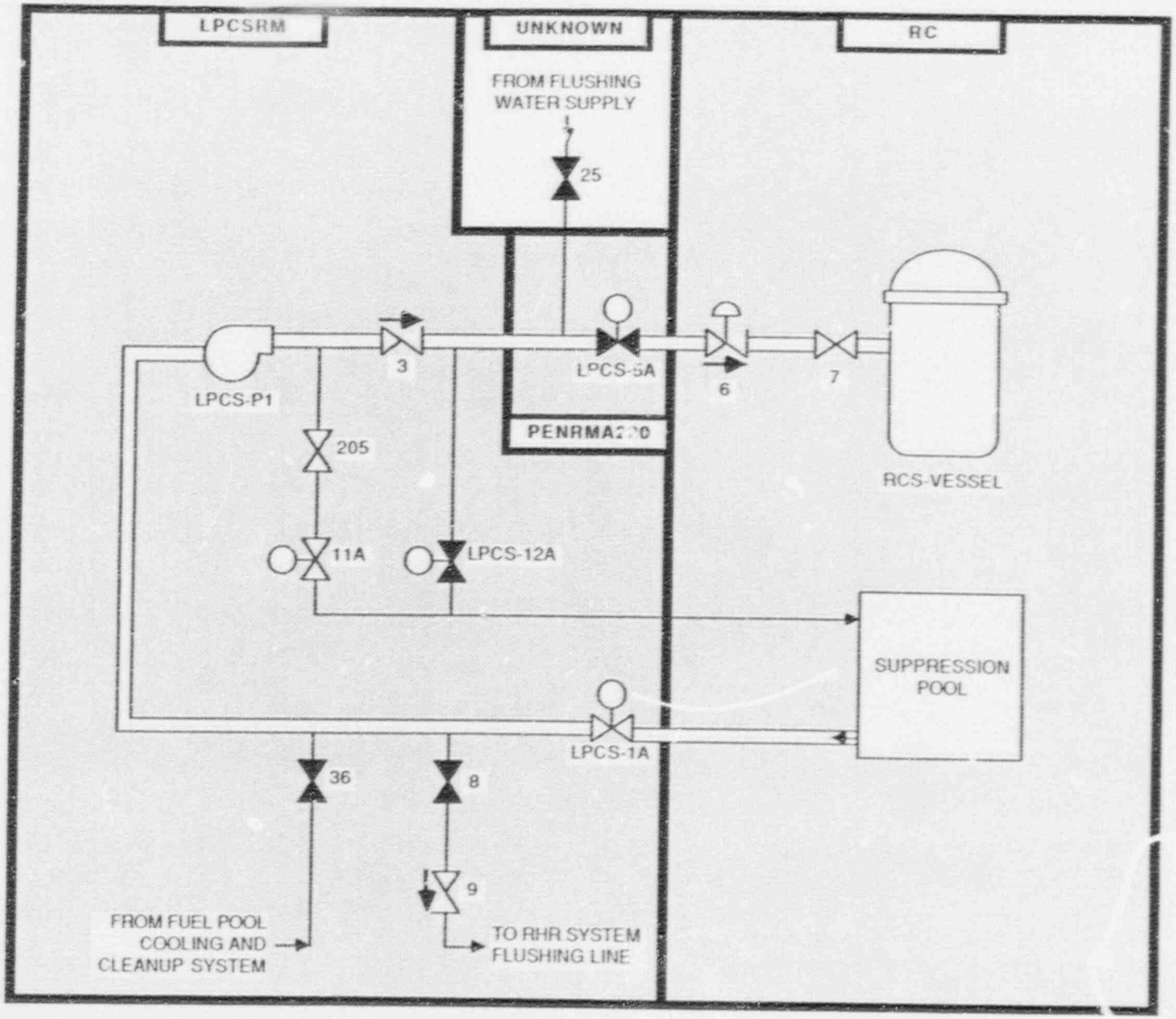


Figure 3.3-4. Grand Gulf 1 Low Pressure Core Spray System Showing Component Locations

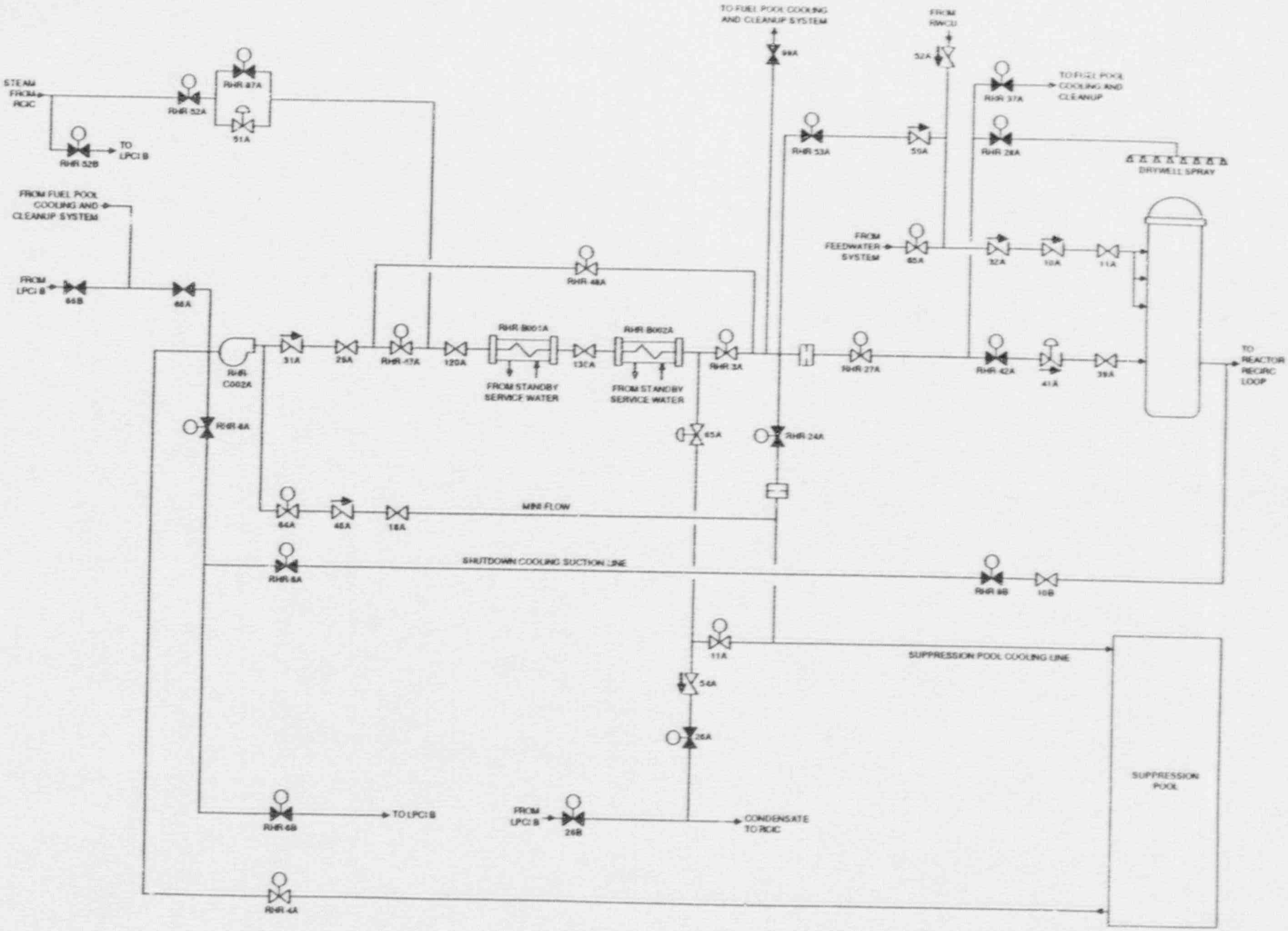


Figure 3.3-5. Grand Gulf 1 Residual Heat Removal System Loop A

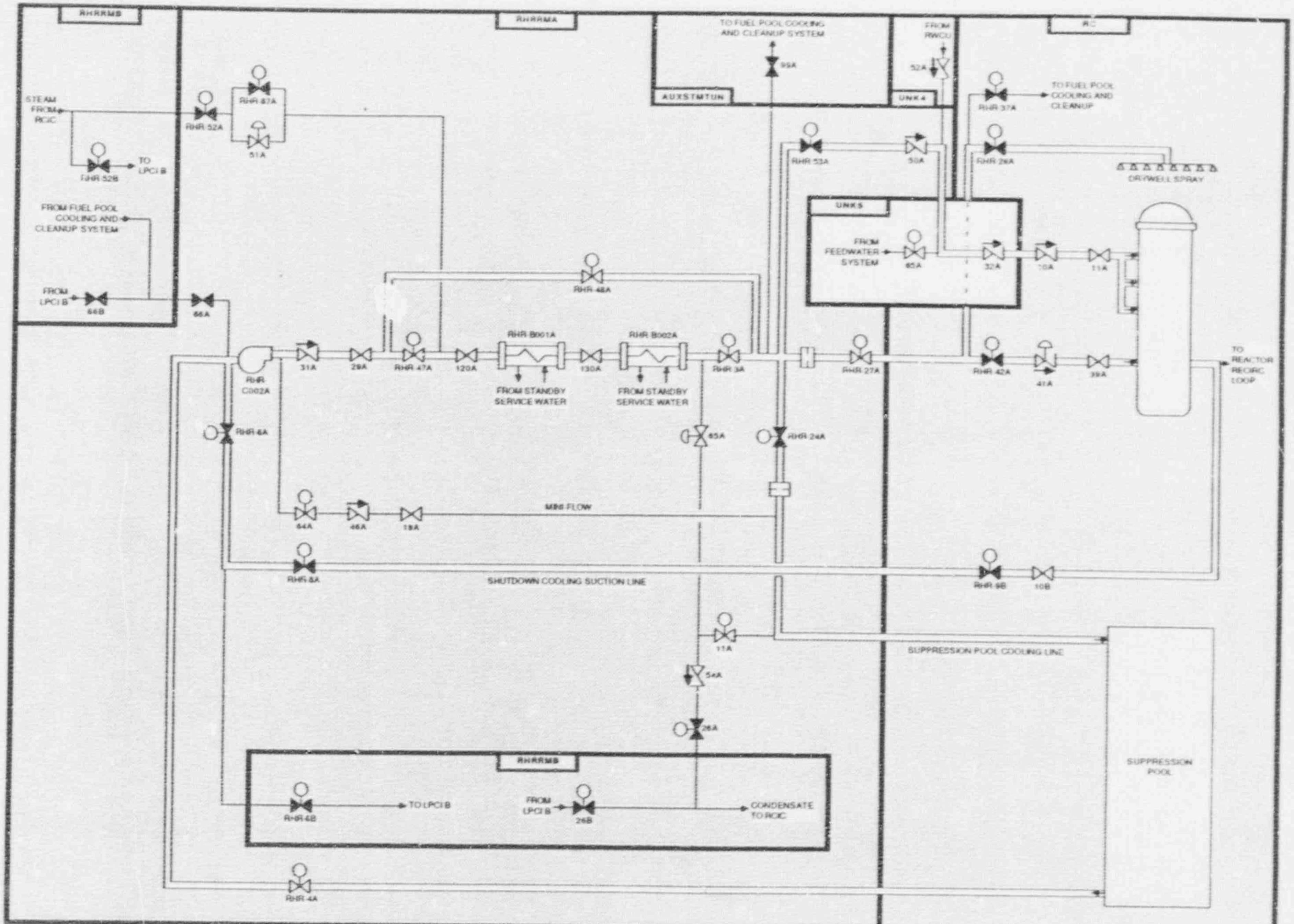


Figure 3.3-6. Grand Gulf 1 Residual Heat Removal System Loop A Showing Component Locations

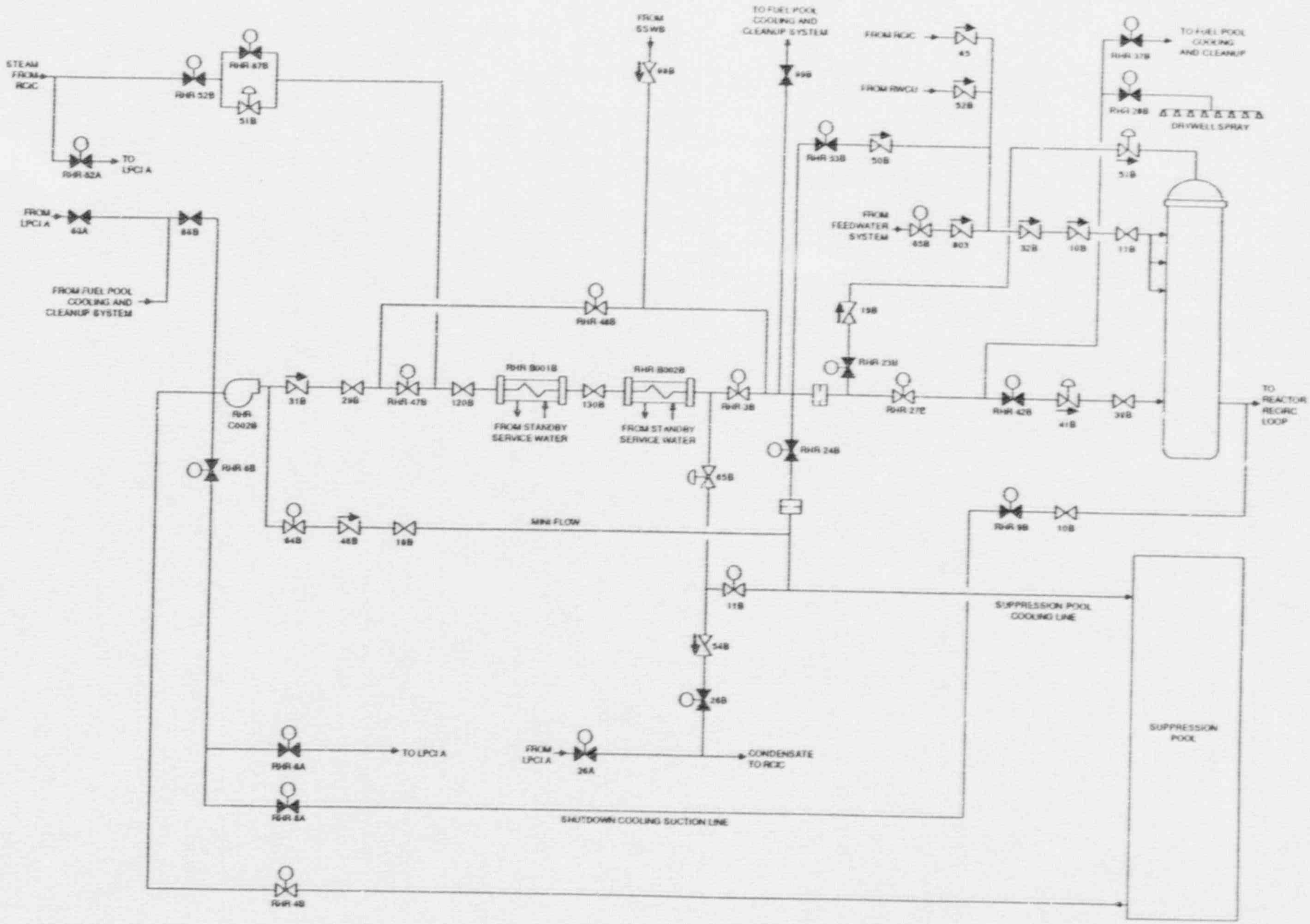


Figure 3.3-7. Grand Gulf 1 Residual Heat Removal System Loop B

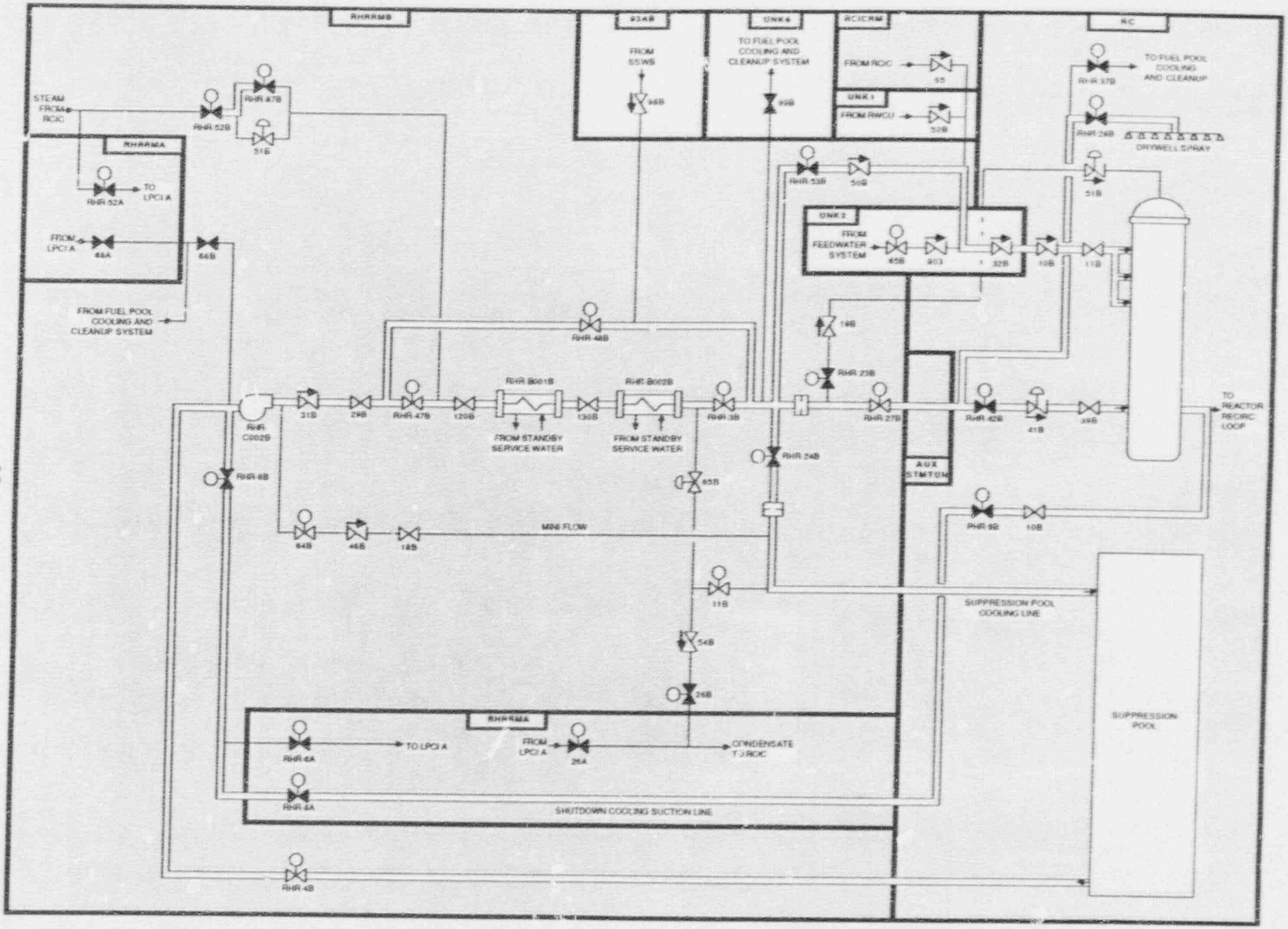


Figure 3.3-8. Grand Gulf 1 Residual Heat Removal System Loop B Showing Component Locations

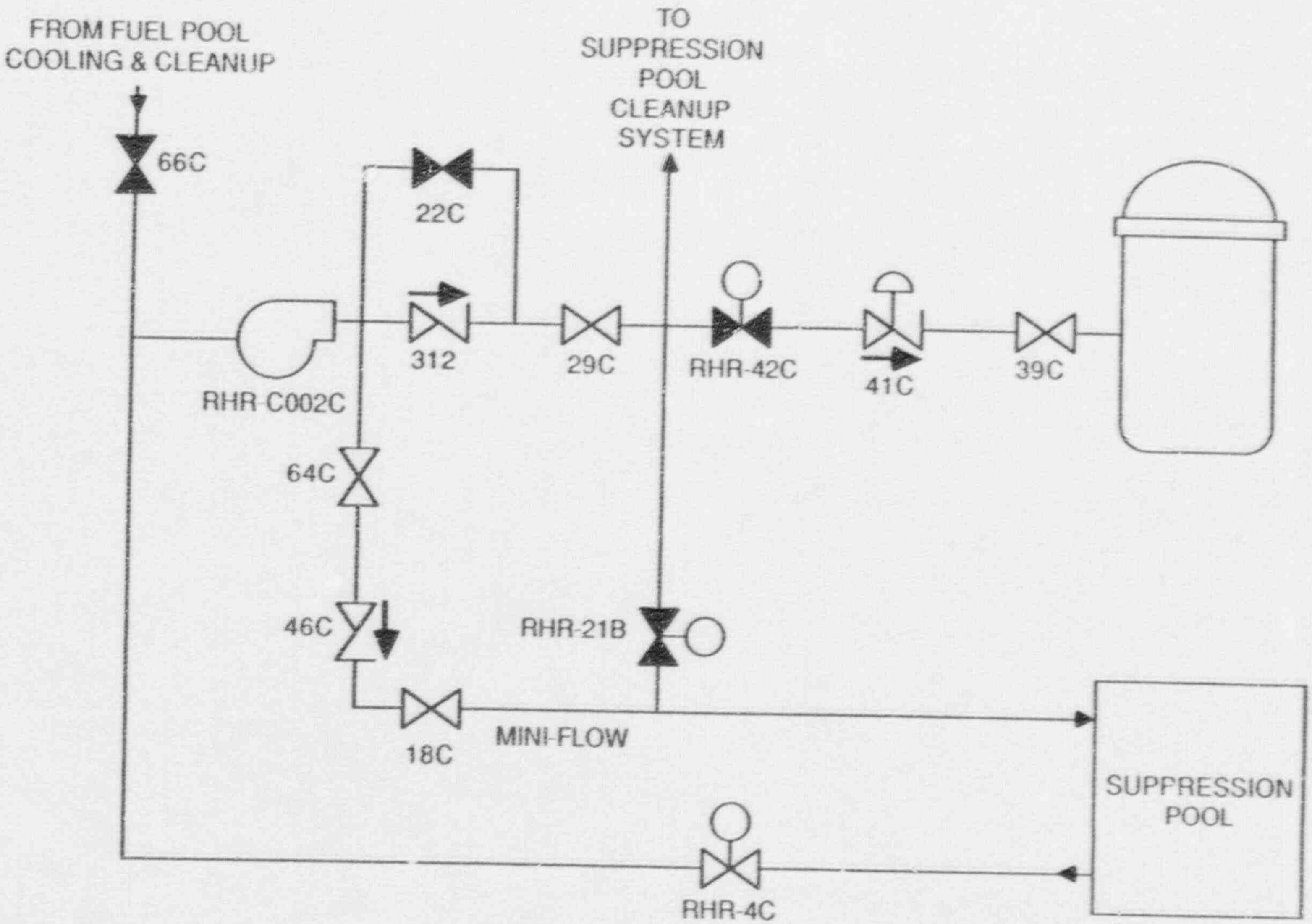


Figure 3.3-9. Grand Gulf 1 Low Pressure Injection System Loop C

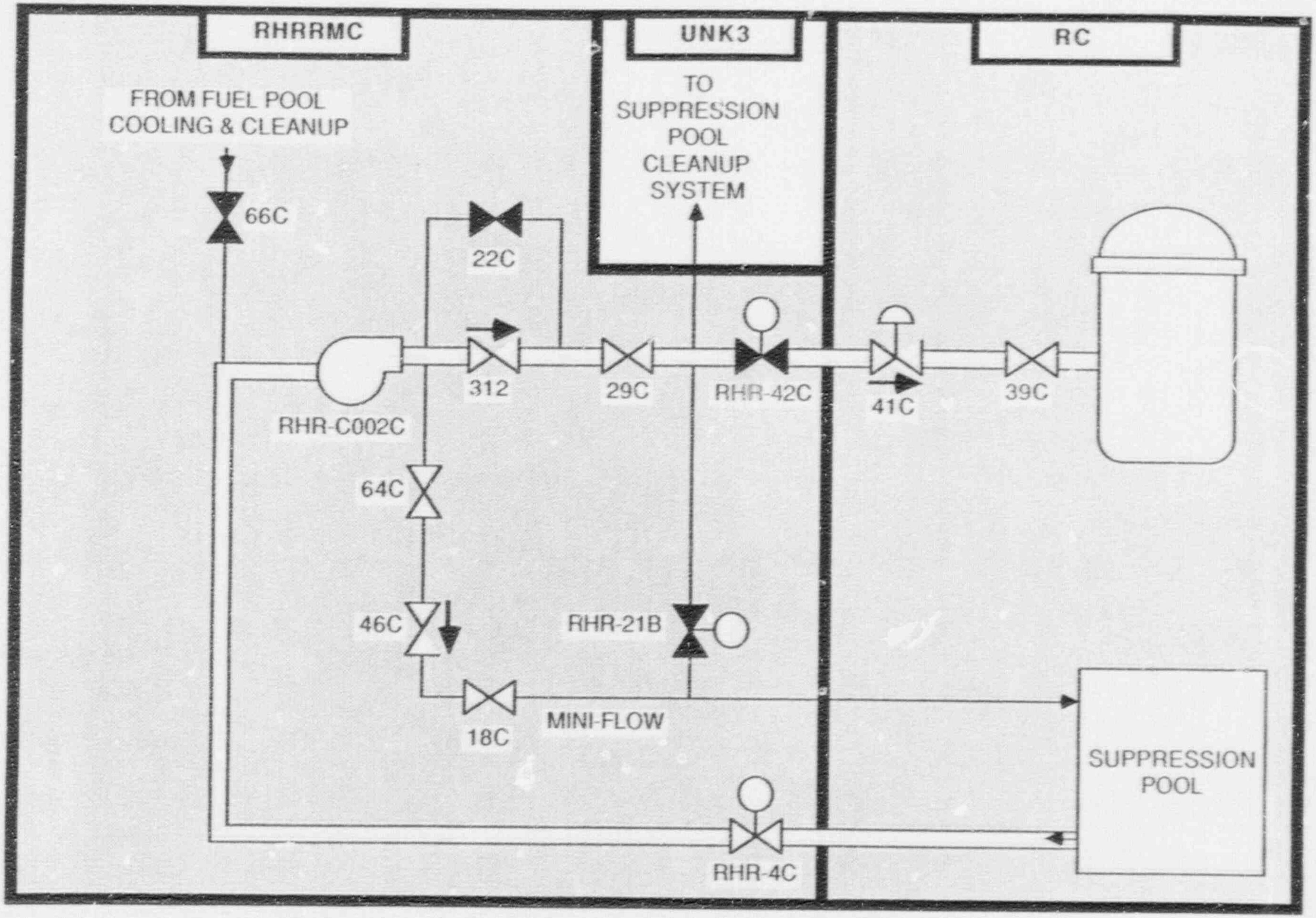


Figure 3.3-10. Grand Gulf 1 Low Pressure Injection System Loop C Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
HPCS-1	MOV	HPCSRM	EP-MCC-17B11	480	SWGR17AC	AC/C
HPCS-10	MOV	HPCSRM	EP-MCC-17B11	480	SWGR17AC	AC/C
HPCS-11	MOV	HPCSRM	EP-MCC-17B11	480	SWGR17AC	AC/C
HPCS-15	MOV	HPCSRM	EP-MCC-17B11	480	SWGR17AC	AC/C
HPCS-23	MOV	HPCSRM	EP-MCC-17B11	480	SWGR17AC	AC/C
HPCS-4	MOV	119AB	EP-MCC-17B11	480	SWGR17AC	AC/C
HPCS-P1	MDP	HPCSRM	EP-BS-17AC	4160	SWGR17AC	AC/C
LPCS-12A	MOV	LPCSRM	EP-MCC-15B11	480	SGRM119-9	AC/A
LPCS-1A	MOV	LPCSRM	EP-MCC-15B11	480	SGRM119-9	AC/A
LPCS-5A	MOV	PENRMA220	EP-MCC-15B11	480	SGRM119-9	AC/A
LPCS-P1	MDP	LPCSRM	EP-BS-15AA	4160	SWGR15AA	AC/A
RHR-21B	MOV	RHRRMC	EP-MCC-16B11	480	SGRM119-10	AC/B
RHR-24A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-24A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-24B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-24B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-27A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-27A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-27B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-27B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-28A	MOV	RC	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-28A	MOV	RC	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-28B	MOV	RC	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-28B	MOV	RC	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-37A	MOV	RC	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-37B	MOV	RC	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-3A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-3B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B

Table 3.3-1. Grand Gulf 1 Emergency Core Cooling System Data Summary for Selected Components (Continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RHR-42A	MOV	RC	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-42B	MOV	RC	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-42C	MOV	RHRRMC	EP-MCC-16B11	480	SGRM119-10	AC/B
RHR-47A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-47B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-48A	MOV	RHRRMA	EP-MCC15B31	480	SGRM119-7	AC/A
RHR-48B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-48B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-4A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-4B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-4C	MOV	RHRRMC	EP-MCC-16B11	480	SGRM119-10	AC/B
RHR-52A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-52B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-53A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-53A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-53B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-53B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-6A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-6B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-87A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A
RHR-87B	MOV	RHRRMB	EP-MCC-16B31	480	SGRM119-8	AC/B
RHR-B001A	HX	RHRRMA				
RHR-B001B	HX	RHRRMB				
RHR-B002A	HX	RHRRMA				
RHR-B002B	HX	RHRRMB				
RHR-C002A	MDP	RHRRMA	EP-BS-15AA	4160	SWGR15AA	AC/A
RHR-C002B	MDP	RHRRMB	EP-BS-16AB	4160	SWGR16AB	AC/B
RHR-C002C	MDP	RHRRMC	EP-BS-16AB	4160	SWGR16AB	AC/B

Table 3.3-1. Grand Gulf 1 Emergency Core Cooling System Data Summary for Selected Components (Continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RHR48A	MOV	RHRRMA	EP-MCC-15B31	480	SGRM119-7	AC/A

3.4 INSTRUMENTATION AND CONTROL (I&C) SYSTEMS

3.4.1 System Function

The instrumentation and control systems consist of the Reactor Protection System (RPS), actuation logic and controls for various Engineered Safety Features (ESF) systems, and systems for the display of plant information to the operators. The RPS and ESF actuation systems monitor the reactor plant, and alert the operator to take corrective action before specified limits are exceeded. The RPS will initiate an automatic reactor trip (scram) to rapidly shut down the reactor when plant conditions exceed one or more specified limits. The ESF actuation systems 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.

3.4.2 System Definition

The RPS includes sensor and transmitter units, logic units, and output trip relays that interface with the control circuits for components in the Control Rod Drive Hydraulic System (see Section 3.6). The ESF actuation systems include independent sensor and transmitter units, logic units, and relays that interface with the control circuits for the many different components that can be actuated. Operator instrumentation display systems consist of display panels that are powered by 125 VDC or 120 VAC power. A summary of data on selected I&C system components is presented in Table 3.4-1.

3.4.3 System Operation

A. RPS

The RPS has four input instrument channels and two output actuation trains. The RPS monitors and automatically initiates a scram based on the following variables:

- Neutron monitoring (APRM) system
- Neutron monitoring (IRM) system
- Neutron monitoring (SRM) system (REFUEL mode only)
- Reactor vessel high pressure
- Reactor vessel low water level
- Reactor vessel high water level (RUN mode only)
- Turbine stop valve closure
- Turbine control valve fast closure
- Main steam line isolation valve closure (RUN mode only)
- Scram discharge volume high water level
- Drywell high pressure
- Main steam line high radiation

In addition, the operator can manually initiate a scram. Both output channels must be de-energized to initiate a scram. The failure of a single component or power supply does not prevent a desired scram or cause an unwanted scram.

B. ESF

ESF actuation systems have up to four input instrument channels for each sensed parameter, and two output trains. In general, each train controls equipment powered from different Class 1E electrical buses. The ESF systems that can be automatically actuated include the following (not a complete listing):

- Emergency Core Cooling System
  - HPCS
  - LPCS
  - LPCI/RHR
  - ADS
- Standby power systems
- Shutdown service water system
- Various room cooling systems
  - ECCS equipment room HVAC system
  - Essential switchgear heat removal HVAC system
  - Diesel generator HVAC system
  - Shutdown service water pump room HVAC system
  - Main control room HVAC system

Details regarding ESF actuation logic are included in the system description for the actuated system.

C. Remote Shutdown

The remote shutdown system provides controls for reactor systems needed to carry out the shutdown function from outside the control room and bring the reactor to a safe shutdown condition in an orderly manner.

Controls and instrumentation for the remote shutdown system are physically located on two panels. One panel is used for the control and instrumentation of systems powered from the ESF division 1 bus, while the other panel is used for systems powered from the ESF division 2 bus. The two remote shutdown panels are located in a room adjacent to the ESF switchgear rooms located at elevation 111 ft. of the control building. The two panels are 9 feet apart, and all cabling associated with the panels and the systems which they operate are separated.

Sufficient instrumentation and controls are provided outside the control room on the seismic Category I remote shutdown panels 1N22-P150 and 1N22-P151 to:

- Achieve hot shutdown of the reactor.
- Maintain the unit in a safe condition during hot shutdown.
- Achieve cold shutdown of the reactor.

The controls on the remote shutdown system panels are in parallel with the control room controls and, therefore, operate the same equipment. Items of the following systems which are essential to the residual heat removal function during the safe shutdown period have controls and instrumentation located on the remote shutdown panels:

- Reactor core isolation cooling (RCIC) system.
- Residual heat removal (RHR) systems A and B
- Shutdown service water (SSW) systems A and B
- Nuclear boiler system (safety-relief valves).

Upon loss of offsite power, the standby diesel generators are automatically started and power is automatically restored to the ESF division 1 and 2 buses. Manual controls are also available locally at the diesel generator control panels as a backup to automatic initiation.

3.4.4 System Success Criteria

A. RPS

The RPS 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 RPS. A reactor scram is implemented by the scram pilot valves in the control rod drive hydraulic system (see Section 3.6). Details of the RPS for Grand Gulf 1 have not been determined.

B. Other Actuation Systems

A single component usually receives a signal from only one actuation system output train. Trains A and B must be available in order to automatically actuate their respective components. Actuation systems other than the RPS typically use hindrance input logic (normal = 1, trip = 0) and transmission output logic (normal = 0, trip = 1). In this case, an input 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) Control power is needed for the actuation system output channels to send an actuation signal. Note that there may be some actuation subsystems that utilize hindrance output logic. For these subsystems, loss of control power will cause system or component actuation, as is the case with the RPS. Details of the other actuation systems for Grand Gulf 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 RPS or other actuation 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., the remote shutdown panel or a motor control center). To make these judgments, data on key plant parameters must be available to the operators.

3.4.5 Support Systems and Interfaces

A. Control Power

1. RPS

   The RPS is powered from the 120 VAC RPS system. Backup scram valves are powered from the 125 VDC system.
2. Other actuation and control systems

   Control power sources for other actuation and control systems are identified in Table 3.4-1.
3. Operator Instrumentation

   Operator instrumentation displays are powered from 120 VAC panels through transformers from ESF motor control centers.

3.4.6 Section 3.4 References

1. Grand Gulf Final Safety Analysis Report, Section 7.4

Table 3.4-1. Matrix of Grand Gulf 1 Control Power Sources

SYSTEM	125 VDC Division		
	1	2	3
RCIC	■		
HPCS			■
ADS A	■		
ADS B		■	
RHR (LPCI) A	■		
RHR (LPCI) B		■	
RHR (LPCI) C		■	
LPCS	■		
DIESEL 1 & AUXILIARIES	■		
DIESEL 2 & AUXILIARIES		■	
DIESEL 3 & AUXILIARIES			■
SSW A	■		
SSW B		■	
SSW C			■
I & C			
OUTBOARD MSIV'S	■		
INBOARD MSIV'S		■	

3.5 ELECTRIC POWER SYSTEM

3.5.1 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.

3.5.2 System Definition

The onsite Class 1E electric power system consists of three independent 4160 and 480 VAC trains, denoted A, B, and C. Train C is dedicated to components of the HPCS system. Each AC power division has a standby diesel generator which serves as the AC power source when both the preferred and alternate sources of offsite power are unavailable. The Engineered Safety Features (ESF) AC divisions require DC Power from the associated ESF DC buses for circuit breaker control power, diesel generator field flashing, and the diesel fuel oil booster pump.

The 125 VDC power system consists of three independent divisions denoted 1, 2, and 3. Each division has two separate battery chargers which normally supply the load and a bank of batteries which function as a backup. Each ESF DC battery bank consists of 60 lead-calcium type cells connected in series to produce the rated output of 125 VDC.

The 120 VAC essential power system consists of redundant distribution panels fed through transformers connected to separate ESF motor control centers.

The 120/240 VAC uninterruptible power system consists of various AC buses with transformers and DC buses with inverters. This system supplies power for services necessary for the normal operation and reliability of the plant but are not required for plant safety.

Simplified one-line diagrams of the electric power system are shown in Figures 3.5-1 to 3.5-9. A summary of data on selected electric power system components is presented in Table 3.5-1. A partial listing of electrical sources and loads is presented in Table 3.5-2.

3.5.3 System Operation

During normal operating conditions, the Class 1E AC power system is supplied from the 500 kV offsite power system via the 500 kV switchyard and Service Transformer Number 11. The alternate source of offsite power is the 115 kV Line to Port Gibson which is supplied via ESF Transformer Number 11 and is physically and electrically separated from the 500 kV switchyard.

The three standby diesel generators are started automatically upon loss of voltage on the associated standby 4160 VAC bus, low reactor water level, high drywell pressure signal of 2 psig, or a LOCA signal. The diesel generators can also be started manually. Diesel generator 1A is connected to 4160 VAC bus 15AA, diesel generator 1B is connected to 4160 VAC bus 16AB, and the HPCS diesel generator 1C is connected to 4160 VAC bus 17AC. Bus 15AA feeds the 480 VAC buses 15BA1, 15BA2, 15BA3, 15BA4, 15BA5, and 15BA6, which in turn feed various train A motor control centers (MCCs). Bus 16AB feeds the 480 VAC buses 16BB1, 16BB2, 16BB3, 16BB4, 16BB5, and 16BB6, which in turn feed various train B MCCs. Bus 17AC feeds the 480 VAC bus 17B01 which supplies the MCC 17B11. Details of the 4160 and 480 VAC systems are shown in Figures 3.5-1 through 3.5-6.

The 125 VDC independent Class 1E power systems consist of three independent electrical divisions. These systems are shown in detail in Figures 3.5-7 and 3.5-8. The DC power portion of each division consists of a main DC motor control center that distributes power to: (a) a 125 VDC distribution panel and (b) various DC loads that are powered directly from the MCC. Two battery chargers powered from 480 VAC

MCCs normally supply power to all DC loads and maintain the associated 125 VDC battery in a fully charged state. The 125 VDC system is a required control power source for most front-line systems. Each ESF battery bank can supply the required DC loads for eleven hours after a loss of AC power if unnecessary loads are shed. When all loads are connected, the batteries in divisions 1 and 2 will last a minimum of 4 hours and the batteries in division 3 will last a minimum of 2 hours.

The 120 VAC Class 1E power system supplies power to instrumentation systems. Normal power is supplied to the 120 VAC system from the 480 VAC MCCs via regulated isolation transformers. Drawings of the essential instrument power system were not available.

The 120/240 VAC uninterruptible power system is shown in Figure 3.5-9. This system is designed to provide a source of power which satisfies the voltage and frequency variation limit requirements of the station computers. A high degree of power continuity is provided, with the ability to transfer to an alternate AC source of power with sufficient speed so the operation of the computers and instruments are not affected.

Normally, the uninterruptible AC power system receives its power from an inverter static switch arrangement which is fed by the station 125 VDC non-Class 1E battery and non-Class 1E battery chargers which are connected to one of the Class 1E buses. Any failure in the equipment from the 125 VDC supply circuit enables the static switch to transfer the power source automatically to an alternate source fed from a 480 volt Class 1E AC bus through a transformer. However, when a LOCA occurs, the Class 1E feed from the load center that feeds the chargers is tripped.

Redundant safeguards equipment such as motor driven pumps and motor operated valves are supplied by different buses or MCCs. For the purpose of discussion, this equipment has been grouped into "load groups". Load group "AC/A" contains components receiving electric power either directly of indirectly from 4160 bus 15AA. Load group "AC/B" contains components powered either directly or indirectly from 4160 bus 16AB. Load group "AC/C" contains components powered either directly or indirectly from 4160 bus 17AC. Components receiving DC power are assigned to load groups "DC/1" to "DC/3", based on the battery source.

3.5.4 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 initially 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

3.5.5 Component Information

A. Standby diesel generators 1A, 1B
   1. Continuous power rating: 7000 kW
   2. Rated voltage: 4160 VAC
   3. Manufacturer: Delaval

B. HPCS diesel generator 1C
  1. Continuous power rating: 3300 kW
  2. Rated voltage: 4160 VAC
  3. Manufacturer: General Motors

C. Station batteries 1A, 1B, 1C, and 1D
  1. Type: Lead-calcium
  2. Rated voltage: 125 VDC
  3. Design capacity: Division 1&2 4 hours minimum
     Division 3 2 hours minimum

3.5.6 Support Systems and Interfaces

A. Control Signals
  1. Automatic
     The standby diesel generators are automatically started on loss of voltage on their associated bus, low reactor water level, high drywell pressure signal of 2 psig, or on a LOCA signal
  2. Remote manual
     The diesel generators can be started, and many distribution circuit breakers can be operated from the main control room.

B. Diesel Generator Auxiliary Systems
The following auxiliaries are provided for each emergency diesel generator:

- Cooling
  The shutdown service water system (see Section 3.7) provides for diesel cooling.
- Fueling
  An independent day tank is provided for each diesel. The day tanks for the Division 1 and 2 diesel generators can support 1 1/2 hours of diesel operation at design load, and the day tank for the Division 3 diesel generator can support 2 hours of diesel operation. Long-term fuel tanks are located underground below the diesel generator rooms.
- Lubrication
  Each diesel generator has a self-contained lubrication system.
- Starting
  An independent starting air accumulator is provided for each diesel generator.
- Control power
  Each diesel generator is dependent on 125 VDC power from a station battery for control power.
- Diesel room ventilation fans provide room cooling during diesel operation.
- Combustion air intake, exhaust, and crankcase ventilation
- Standby generator excitation subsystem

C. Switchgear Room Ventilation
The essential switchgear rooms have fan cooler units that are cooled by the Shutdown Service Water System (SSWS, see Section 3.7).

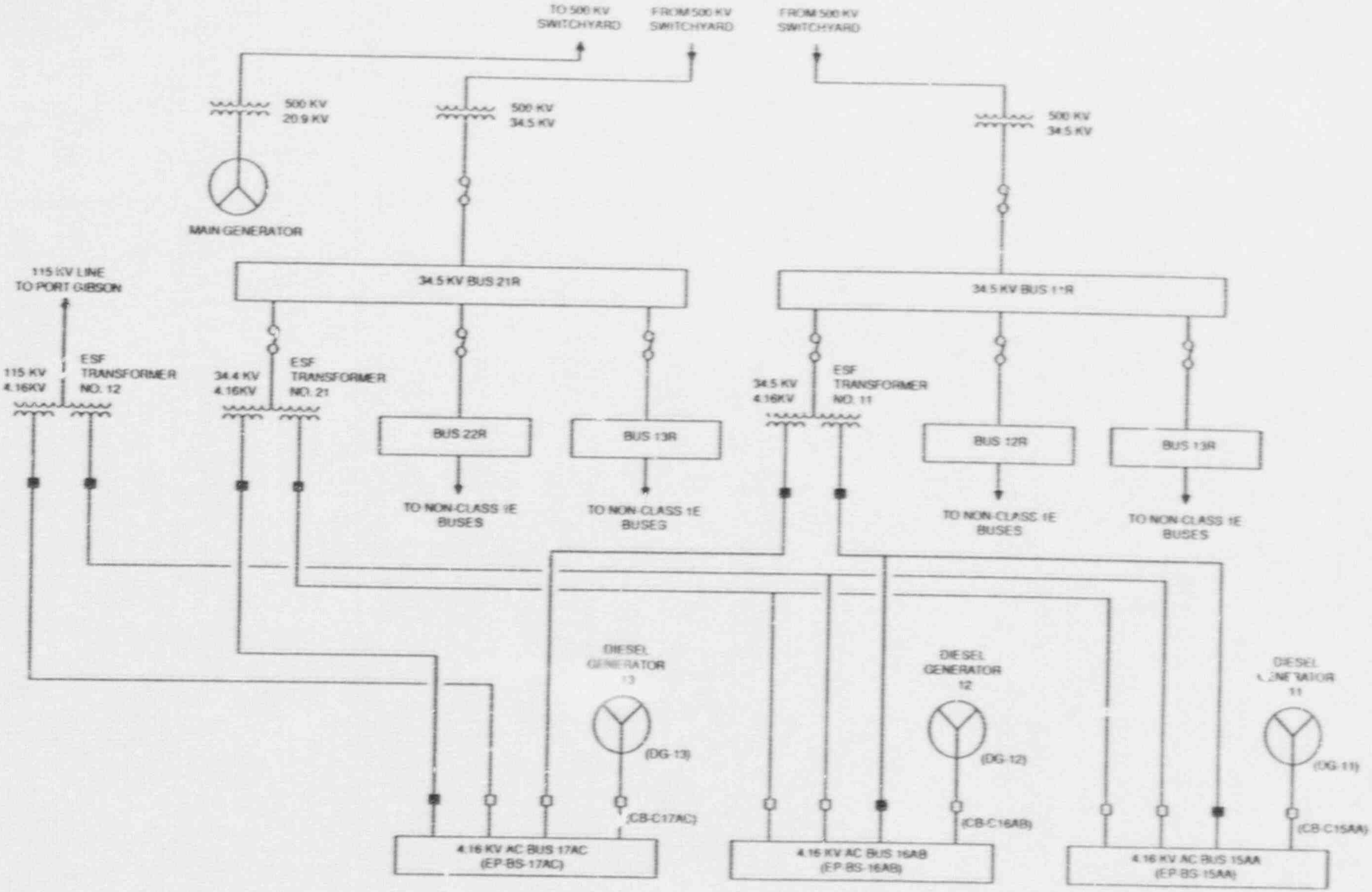
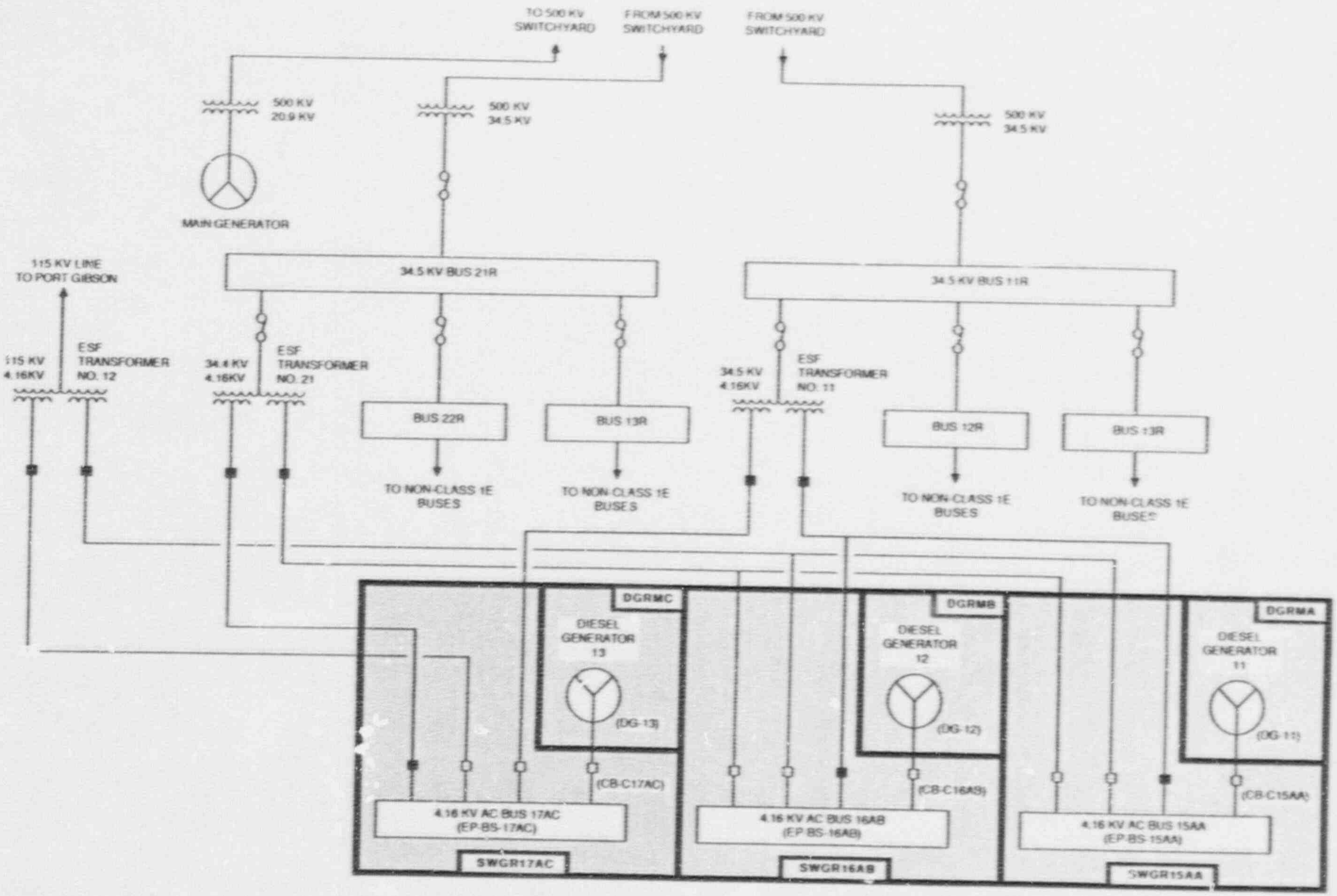


Figure 3.5-1. Grand Gulf 1 4160 VAC Electric Power Distribution System



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-2. Grand Gulf 1 4160 VAC Electric Power Distribution System Showing Component Locations

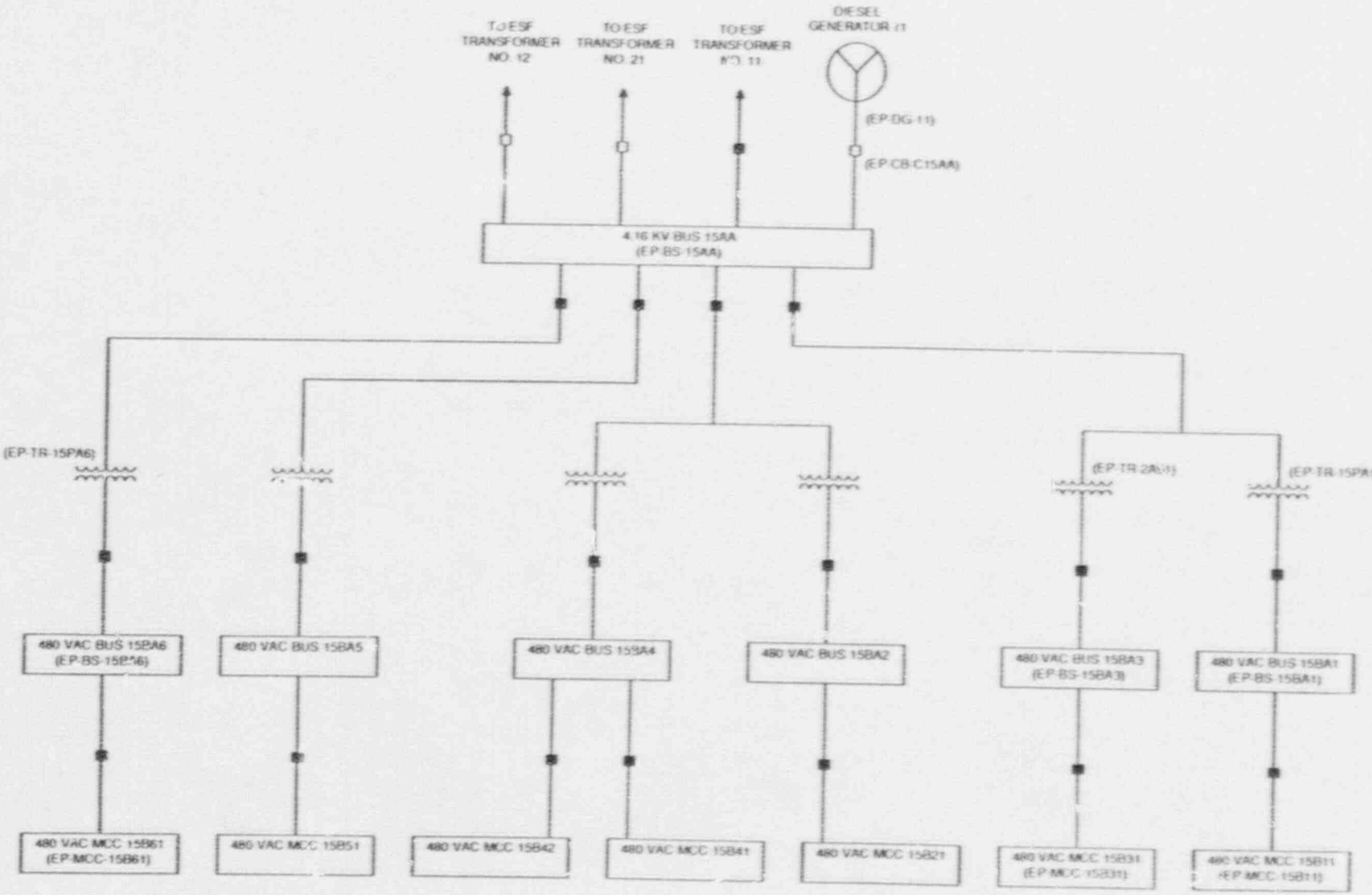
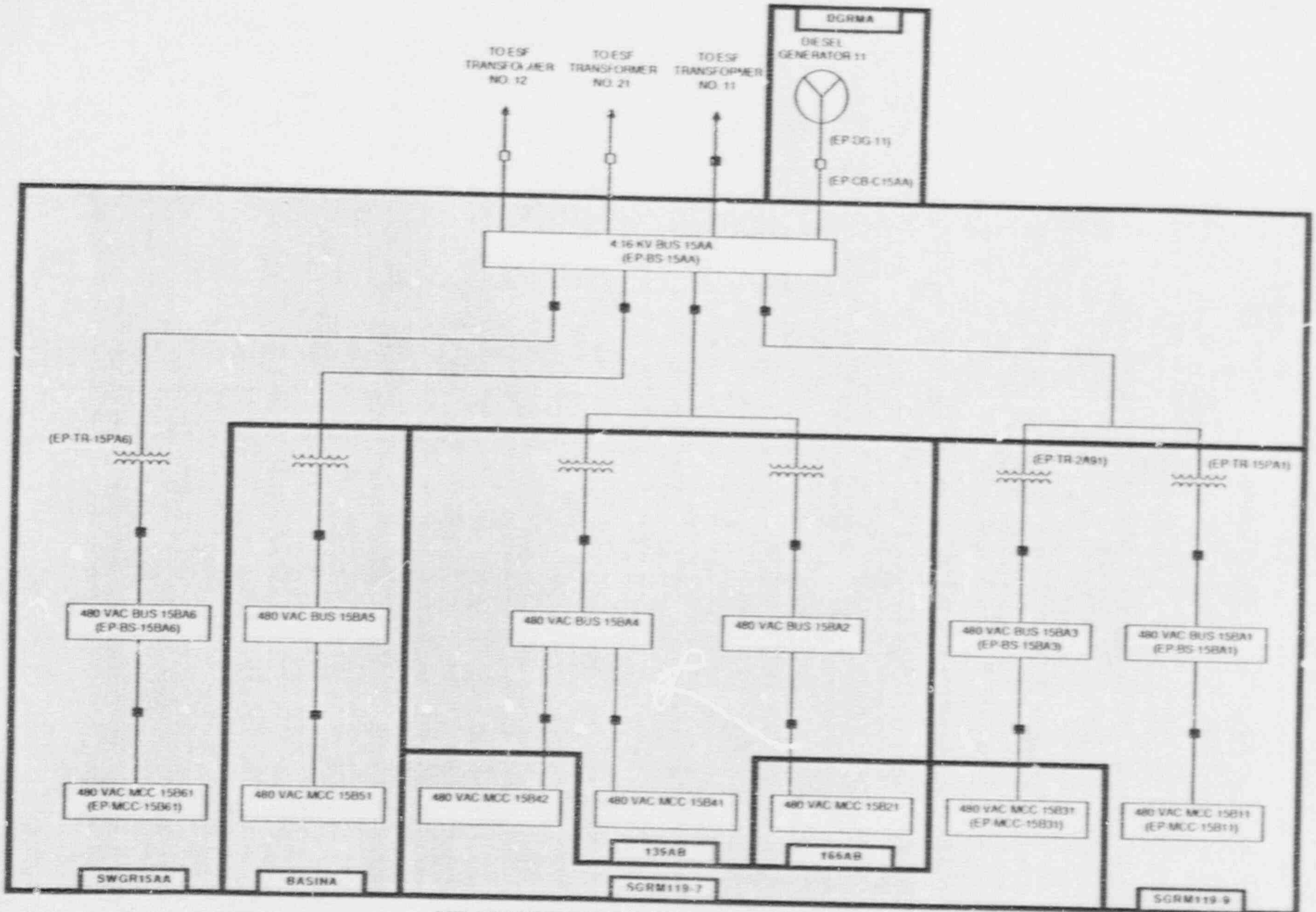


Figure 3.5-3. Grand Gulf 1 480 VAC Train A Electric Power Distribution System



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-4. Grand Gulf 1 480 VAC Train A Electric Power Distribution System Showing Component Locations

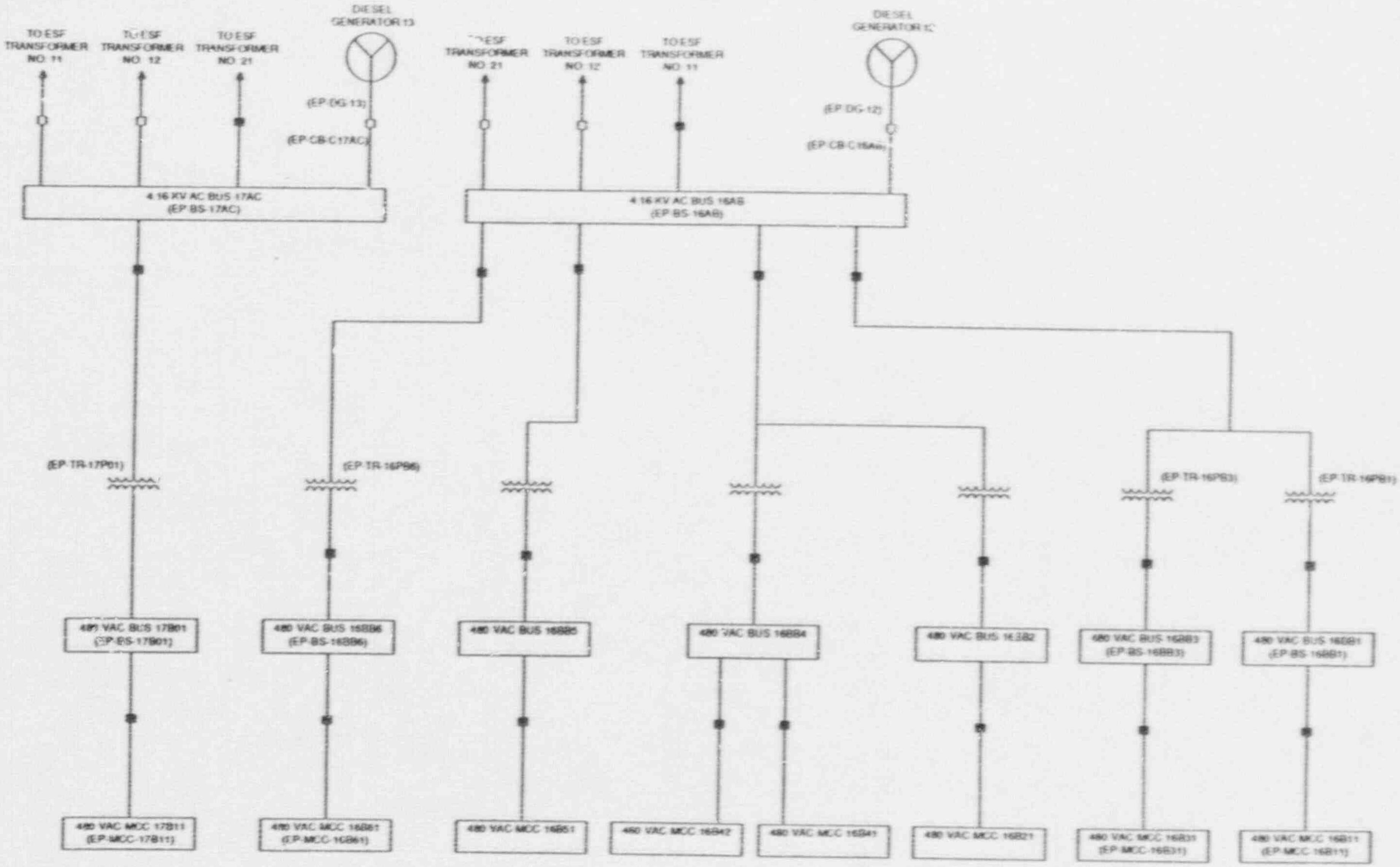
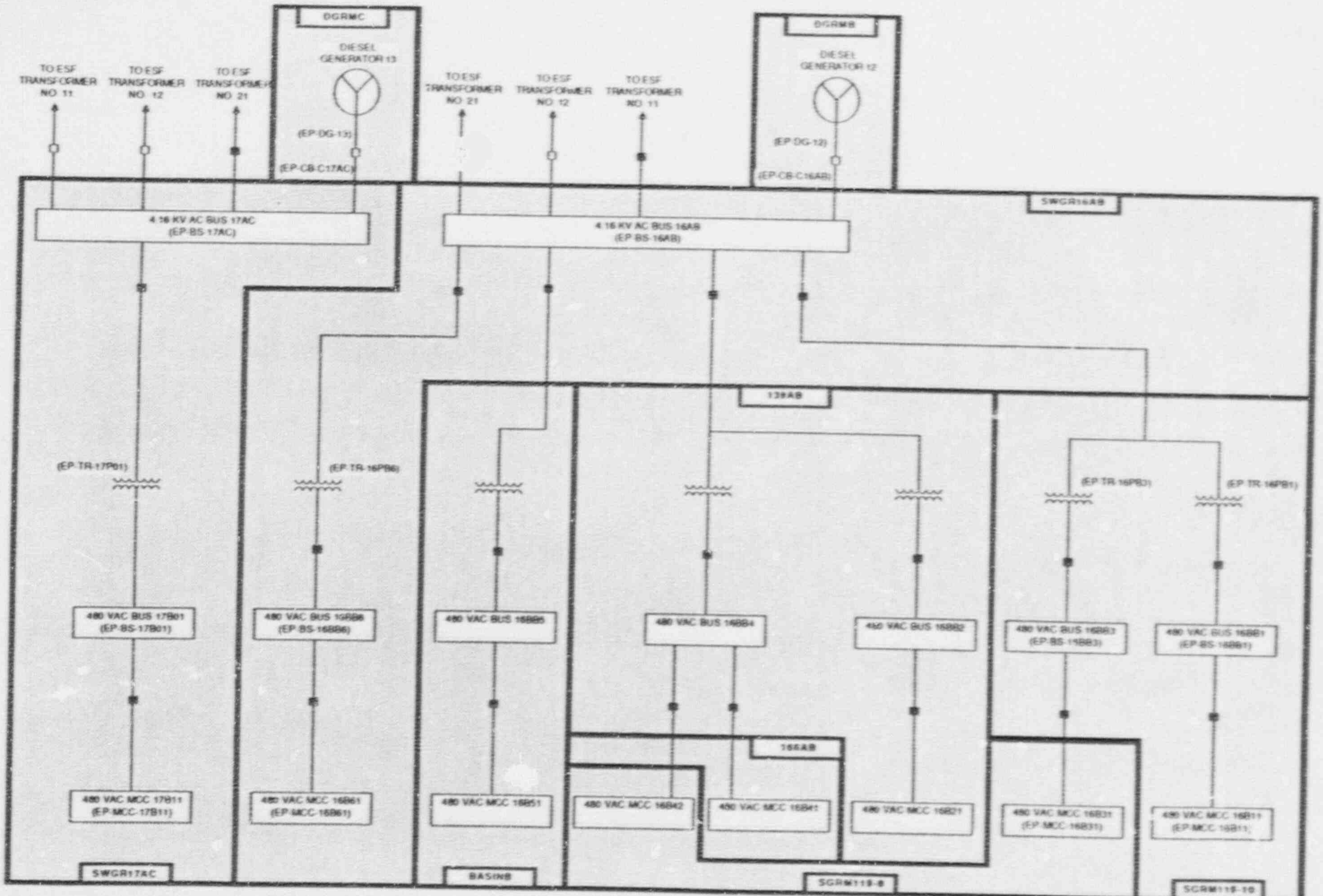


Figure 3.5-5. Grand Gulf 1 480 VAC Trains B and C Electric Power Distribution System



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-6. Grand Gulf 1 480 VAC Trains B and C Electric Power Distribution System Showing Component Locations

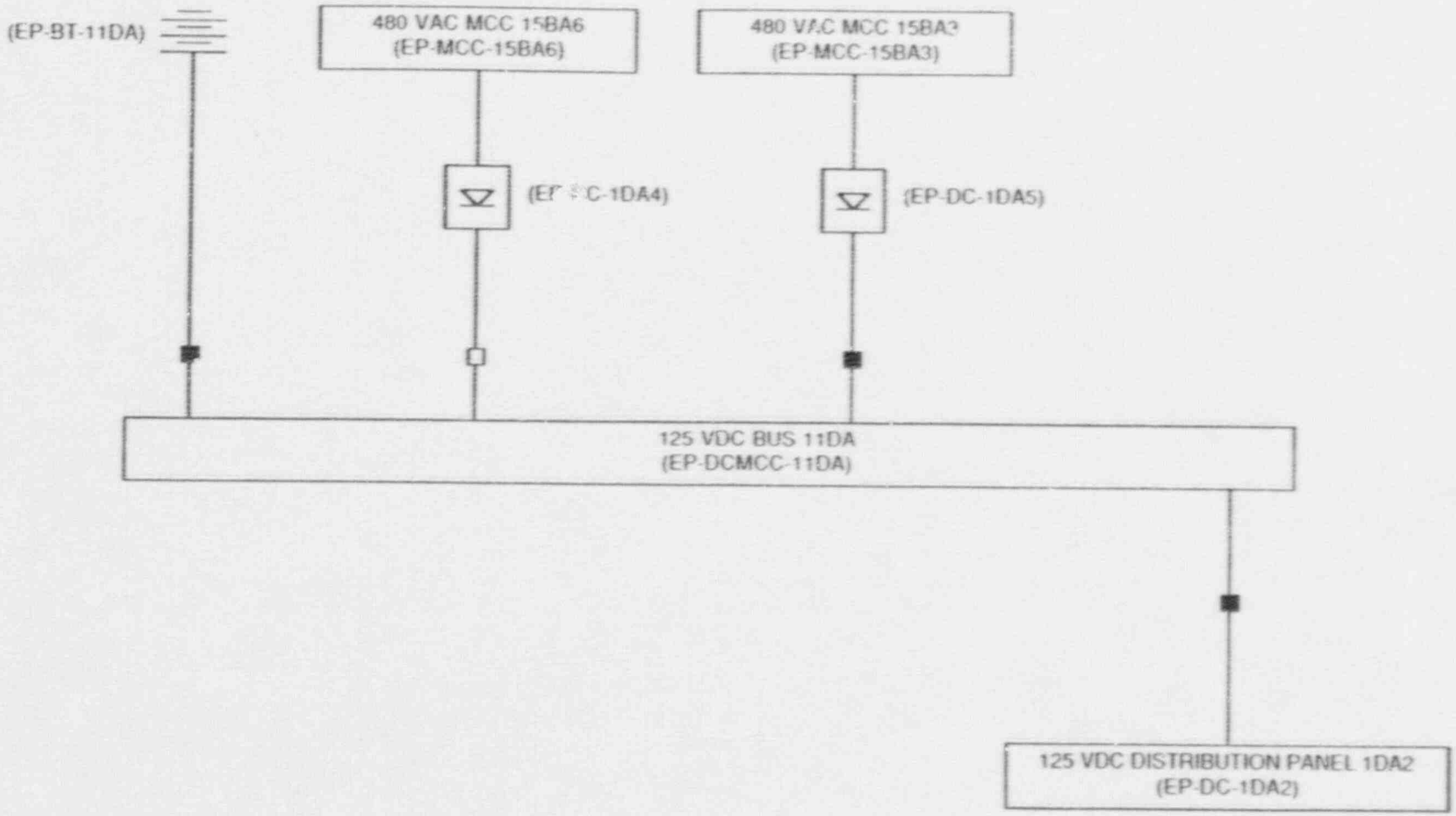


Figure 3.5-7. Grand Gulf 125 VDC Electrical Power Distribution System (Page 1 of 3)

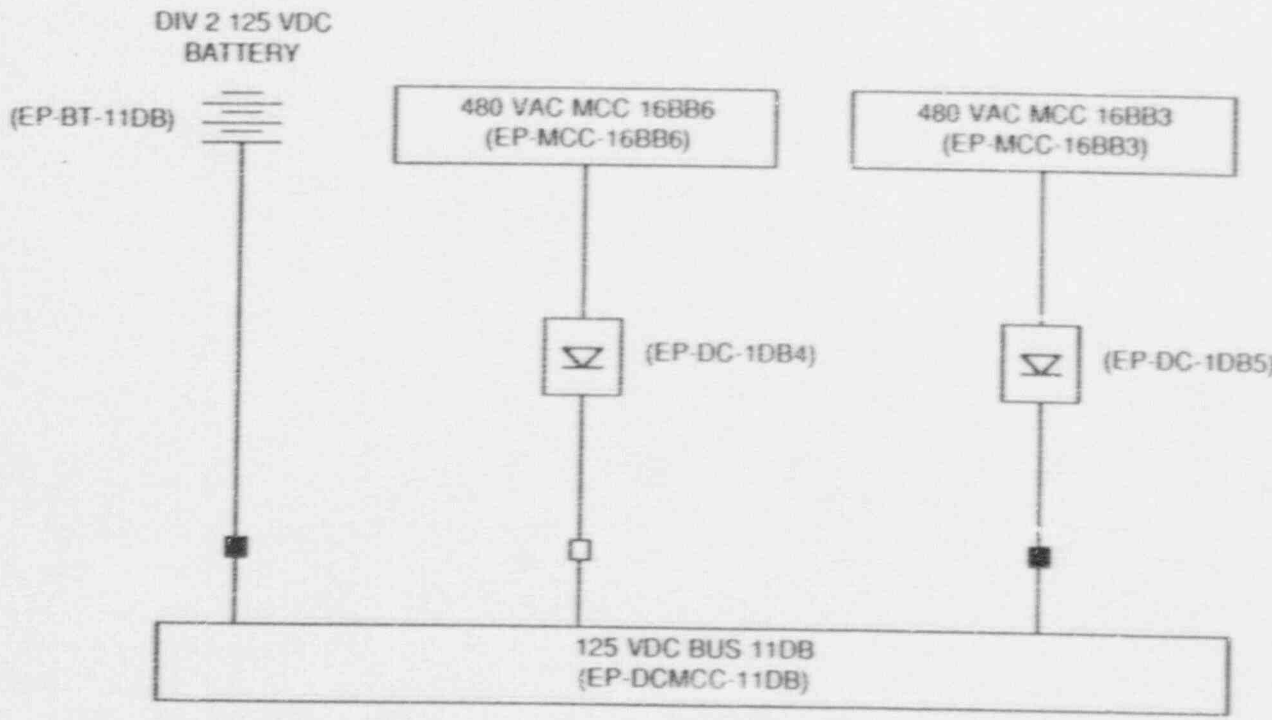


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Figure 3.5-7. Grand Gulf 125 VDC Electrical Power Distribution System (Page 2 of 3)

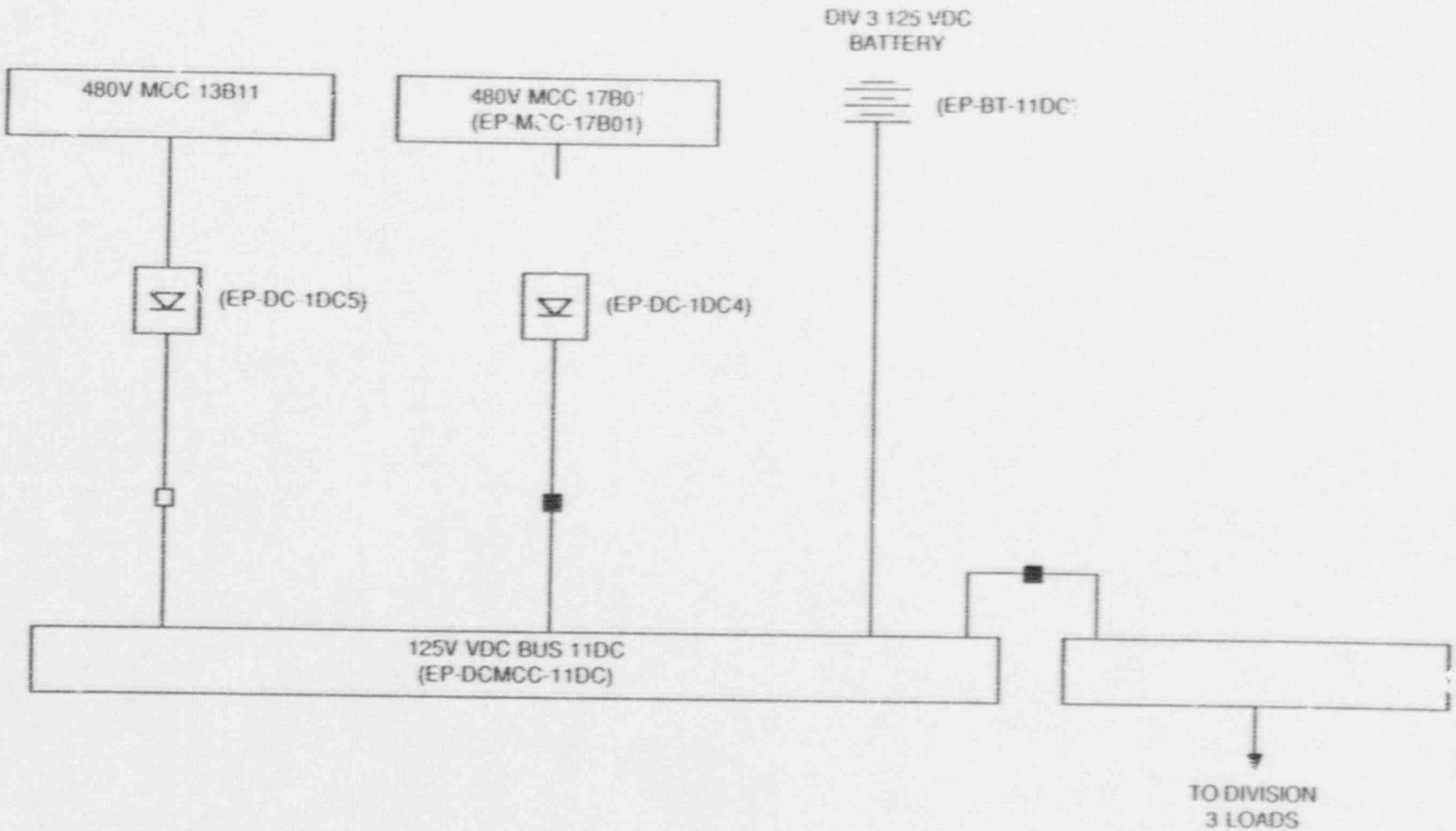
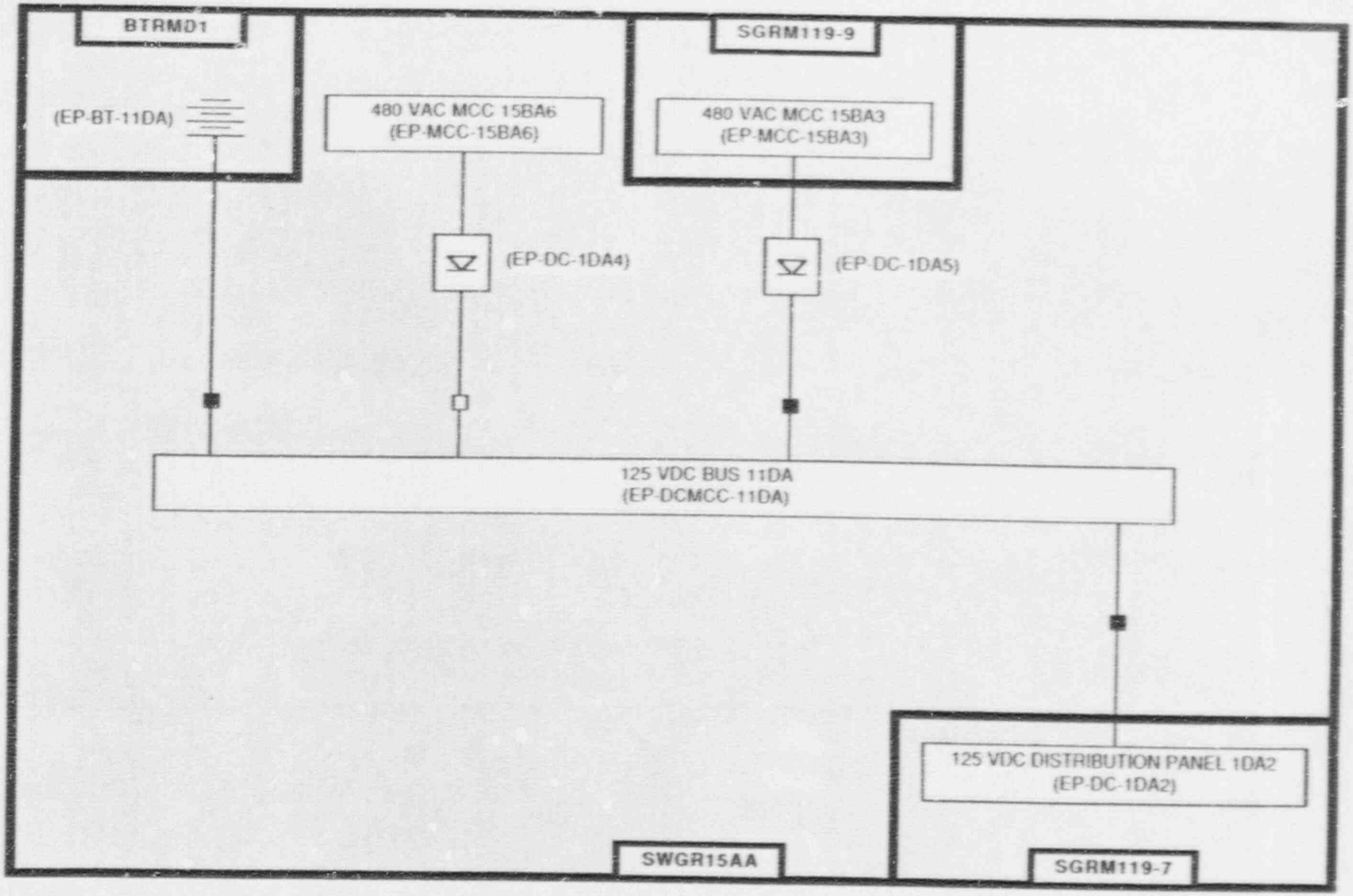
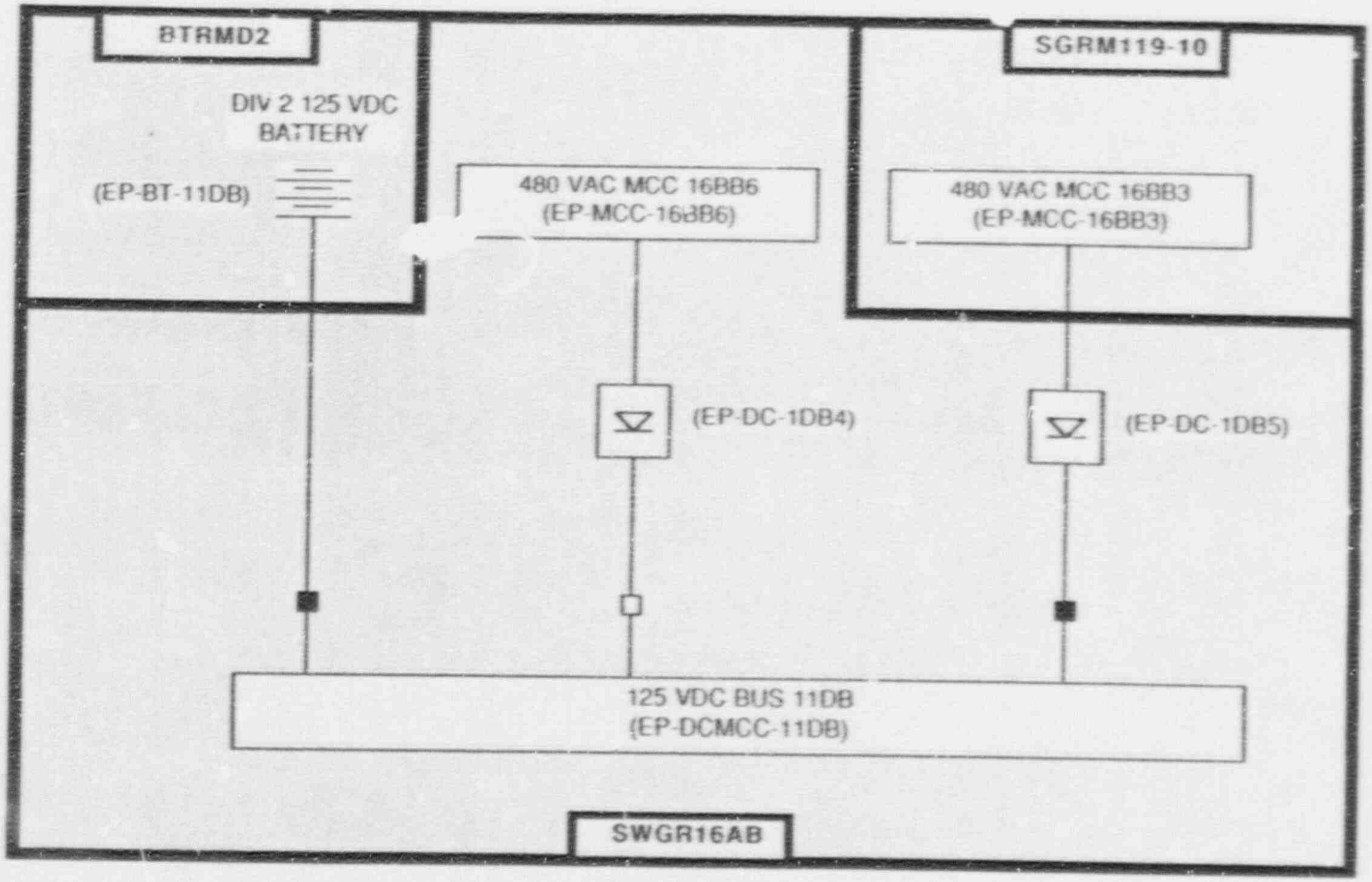


Figure 3.5-7. Grand Gulf 125 VDC Electrical Power Distribution System (Page 3 of 3)



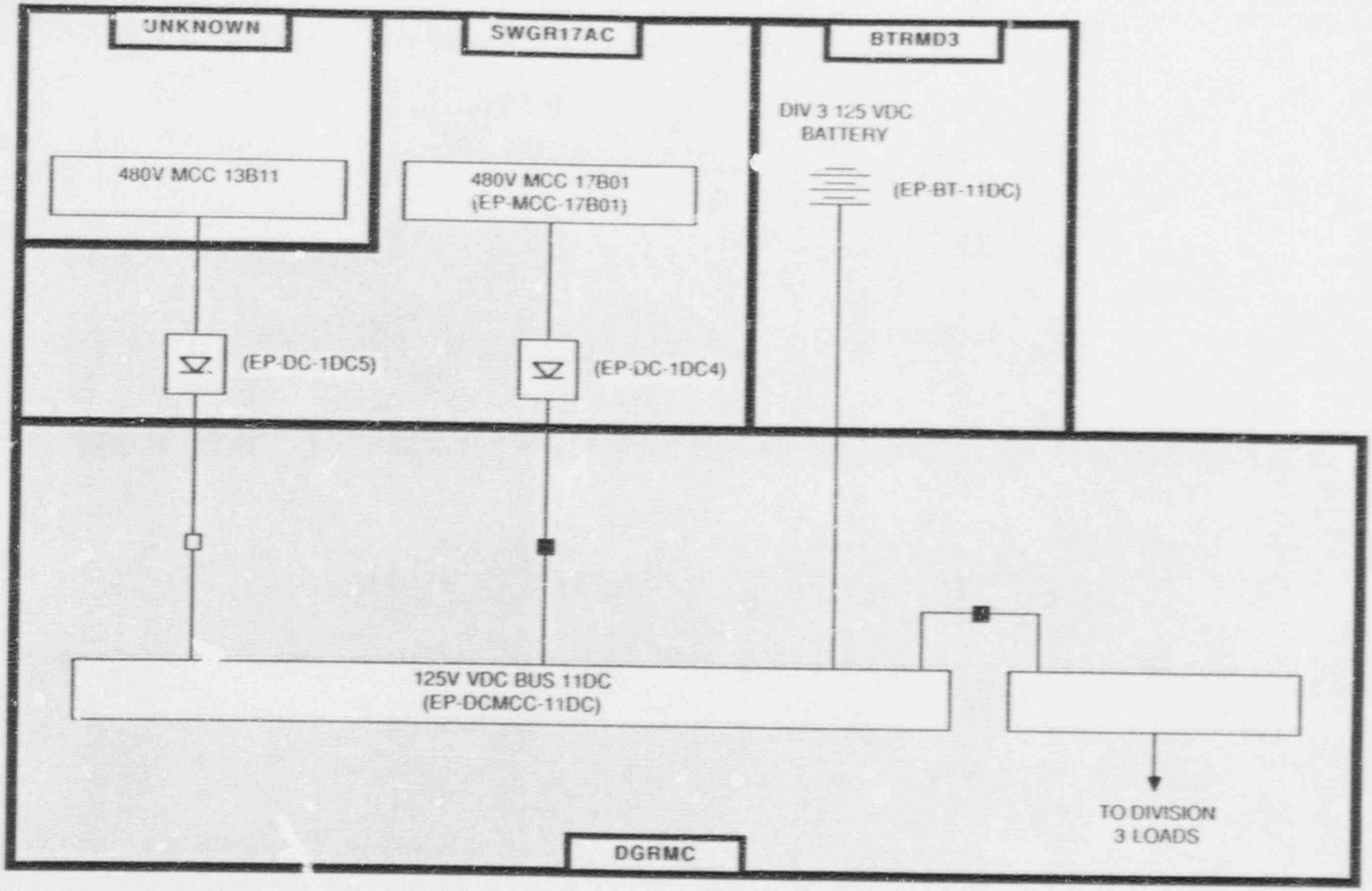
NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-8. Grand Gulf 125 VDC Electrical Power Distribution System Showing Component Locations (Page 1 of 3)



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-8. Grand Gulf 125 VDC Electrical Power Distribution System Showing Component Locations (Page 2 of 3)



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-8. Grand Gulf 125 VDC Electrical Power Distribution System Showing Component Locations (Page 3 of 3)

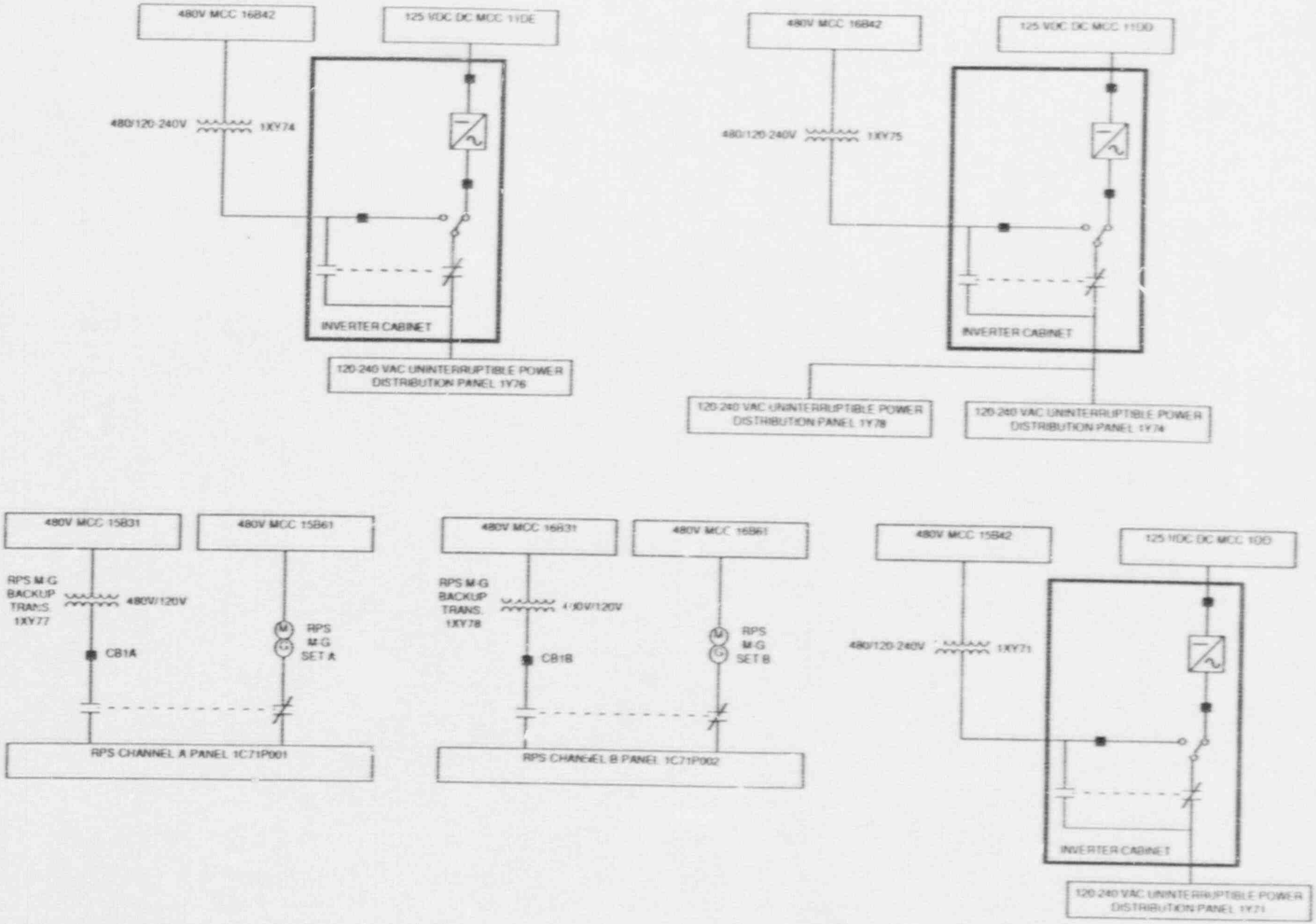


Figure 3.5-9. Grand Gulf 1 120 VAC Uninterruptible Electrical Power Distribution System

Table 3.5-1. Grand Gulf 1 Electric Power System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
DG-018A	MOV	DGRMA	EP-MCC-15B11	480	SGRM119-9	AC/A
DG-018B	MOV	DGRMB	EP-MCC-16B11	480	SGRM119-10	AC/B
EP-BS-15AA	BUS	SWGR15AA	EP-DG-11	4160	DGRMA	AC/A
EP-BS-15AA	BUS	SWGR15AA	OFFSITE	4160		AC/A
EP-BS-15BA1	BUS	SGRM119-9	TR-15PA1	480	SGRM119-9	AC/A
EP-BS-15BA3	BUS	SGRM119-9	TR-2A91	480	SGRM119-9	AC/A
EP-BS-15BA6	BUS	SWGR15AA	TR-15PA6	480	SWGR15AA	AC/A
EP-BS-16AB	BUS	SWGR16AB	EP-DG-12	4160	DGRMB	AC/B
EP-BS-16AB	BUS	SWGR16AB	OFFSITE	4160		AC/B
EP-BS-16BB1	BUS	SGRM119-10	TR-16PB1	480	SGRM119-10	AC/B
EP-BS-16BB3	BUS	SGRM119-10	TR-16PB3	480	SGRM119-10	AC/B
EP-BS-16BB6	BUS	SWGR16AB	TR-16PB6	480	SWGR16AB	AC/B
EP-BS-17AC	BUS	SWGR17AC	EP-DG-13	4160	DGRMC	AC/C
EP-BS-17AC	BUS	SWGR17AC	OFFSITE	4160		AC/C
EP-BS-17B01	BUS	SWGR17AC	TR-17P01	480	SWGR17AC	AC/C
EP-BT-11DA	BATT	BTRMD1		125		DC/1
EP-BT-11DB	BATT	BTRMD2		125		DC/2
EP-BT-11DC	BATT	BTRMD3		125		DC/3
EP-CB-C15AA	CB	SWGR15AA	EP-DG-11	4160	DGRMA	AC/A
EP-CB-C16AB	CB	SWGR16AB	EP-DG-12	4160	DGRMB	AC/B
EP-CB-C17AC	CB	SWGR17AC	EP-DG-13	4160	DGRMC	AC/C
EP-DC-1DA2	PNL	SGRM119-7	EP-DCMCC-11DA	125	SWGR15AA	DC/1
EP-DC-1DA4	INV	SWGR15AA	EP-BS-15BA6	480	SWGR15AA	DC/1
EP-DC-1DA5	INV	SWGR15AA	EP-BS-15BA3	480	SGRM119-9	DC/1
EP-DC-1DB4	INV	SWGR16AB	EP-BS-16BB6	480	SWGR16AB	DC/2
EP-DC-1DB5	INV	SWGR16AB	EP-BS-16BB3	480	SGRM119-10	DC/2
EP-DCMCC-11DA	MCC	SWGR15AA	EP-DC-1DA5	125	SWGR15AA	DC/1
EP-DCMCC-11DA	MCC	SWGR15AA	EP-DC-1DA4	125	SWGR15AA	DC/1

Table 3.5-1. Grand Gulf 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-DCMCC-11DA	MCC	SWGR15AA	EP-BT-11DA	125	BTRMD1	DC/1
EP-DCMCC-11DB	MCC	SWGR16AB	EP-DC-1DB5	125	SWGR16AB	DC/2
EP-DCMCC-11DB	MCC	SWGR16AB	EP-DC-1DB4	125	SWGR16AB	DC/2
EP-DCMCC-11DB	MCC	SWGR16AB	EP-BT-11DB	125	BTRMD2	DC/2
EP-DCMCC-11DC	MCC	DGRMC	EP-DC-1DC4	125	SWGR17AC	DC/3
EP-DCMCC-11DC	MCC	DGRMC	EP-BT-11DC	125	BTRMD3	DC/3
EP-DG-11	DG	DGRMA		4160		AC/A
EP-DG-12	DG	DGRMB		4160		AC/B
EP-DG-13	DG	DGRMC		4160		AC/C
EP-MCC-15B11	MCC	SGRM119-9	EP-BS-15BA1	480	SGRM119-9	AC/A
EP-MCC-15B31	MCC	SGRM119-7	EP-BS-15BA3	480	SGRM119-9	AC/A
EP-MCC-15B61	MCC	SWGR15AA	EP-BS-15BA6	480	SWGR15AA	AC/A
EP-MCC-16B11	MCC	SGRM119-10	EP-BS-16BB1	480	SGRM119-10	AC/B
EP-MCC-16B31	MCC	SGRM119-8	EP-BS-16BB3	480	SGRM119-10	AC/B
EP-MCC-16B61	MCC	SWGR16AB	EP-BS-16BB6	480	SWGR16AB	AC/B
EP-MCC-17B11	MCC	SWGR17AC	EP-BS-17B01	480	SWGR17AC	AC/C
EP-TR-15PA1	TRAN	SWGR15AA	EP-BS-15AA	480	SWGR15AA	AC/A
EP-TR-15PA6	TRAN	SWGR15AA	EP-BS-15AA	480	SWGR15AA	AC/A
EP-TR-16PB1	TRAN	SWGR16AB	EP-BS-16AB	480	SWGR16AB	AC/B
EP-TR-16PB3	TRAN	SWGR16AB	EP-BS-16AB	480	SWGR16AB	AC/B
EP-TR-16PB6	TRAN	SWGR16AB	EP-BS-16AB	480	SWGR16AB	AC/B
EP-TR-17P01	TRAN	SWGR17AC	EP-BS-17AC	480	SWGR17AC	AC/C
EP-TR-2A91	TRAN	SWGR15AA	EP-BS-15AA	480	SWGR15AA	AC/A

TABLE 3.5-2. PARTIAL LISTING OF ELECTRICAL SOURCES AND LOADS AT GRAND GULF 1

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-BS-15AA	4160	AC/A	SWGR15AA	ECCS	LPCS-P1	MDP	LPCSRM
EP-BS-15AA	4160	AC/A	SWGR15AA	ECCS	RHR-C002A	MDP	RHRRMA
EP-BS-15AA	480	AC/A	SWGR15AA	EP	EP-TR-15PA1	TRAN	SWGR15AA
EP-BS-15AA	480	AC/A	SWGR15AA	EP	EP-TR-15PA6	TRAN	SWGR15AA
EP-BS-15AA	480	AC/A	SWGR15AA	EP	EP-TR-2A91	TRAN	SWGR15AA
EP-BS-15AA	4160	AC/A	SWGR15AA	SSW	SSW-C001A	MDP	BASINA
EP-BS-15BA1	480	AC/A	SGRM119-9	EP	EP-MCC-15B11	MCC	SGRM119-9
EP-BS-15BA3	480	DC/1	SGRM119-9	EP	EP-DC-1DA5	INV	SWGR15AA
EP-BS-15BA3	480	AC/A	SGRM119-9	EP	EP-MCC-15B31	MCC	SGRM119-7
EP-BS-15BA6	480	DC/1	SWGR15AA	EP	EP-DC-1DA4	INV	SWGR15AA
EP-BS-15BA6	480	AC/A	SWGR15AA	EP	EP-MCC-15B61	MCC	SWGR15AA
EP-BS-16AB	4160	AC/B	SWGR16AB	ECCS	RHR-C002B	MDP	RHRRMB
EP-BS-16AB	4160	AC/B	SWGR16AB	ECCS	RHR-C002C	MDP	RHRRMC
EP-BS-16AB	480	AC/B	SWGR16AB	EP	EP-TR-16PB1	TRAN	SWGR16AB
EP-BS-16AB	480	AC/B	SWGR16AB	EP	EP-TR-16PB3	TRAN	SWGR16AB
EP-BS-16AB	480	AC/B	SWGR16AB	EP	EP-TR-16PB6	TRAN	SWGR16AB
EP-BS-16AB	4160	AC/B	SWGR16AB	SSW	SSW-C001B	MDP	B[illegible]NB
EP-BS-16BB1	480	AC/B	SGRM119-10	EP	EP-MCC-16B11	MCC	SGRM119-10
EP-BS-16BB3	480	DC/2	SGRM119-10	EP	EP-DC-1DB5	INV	SWGR16AB
EP-BS-16BB3	480	AC/B	SGRM119-10	EP	EP-MCC-16B31	MCC	SGRM119-8
EP-BS-16BB6	480	DC/2	SWGR16AB	EP	EP-DC-1DB4	INV	SWGR16AB
EP-BS-16BB6	480	AC/B	SWGR16AB	EP	EP-MCC-16B61	MCC	SWGR16AB
EP-BS-17AC	4160	AC/C	SWGR17AC	ECCS	HPCS-P1	MDP	HPCSRM
EP-BS-17AC	480	AC/C	SWGR17AC	EP	EP-TR-17P01	TRAN	SWGR17AC
EP-BS-17B01	480	AC/C	SWGR17AC	EP	EP-MCC-17B11	MCC	SWGR17AC
EP-BS-17B01	480	AC/C	SWGR17AC	SSW	SSW-C002C	MDP	BASINA
EP-BT-11DA	125	DC/1	BTRMD1	EP	EP-DCMCC-11DA	MCC	SWGR15AA
EP-BT-11DB	125	DC/2	BTRMD2	EP	EP-DCMCC-11DB	MCC	SWGR16AB
EP-BT-11DC	125	DC/3	BTRMD3	EP	EP-DCMCC-11DC	MCC	DGRMC
EP-DC-1DA2	125	DC/1	SGRM119-7	RCIC	RCIC-10A	MOV	RCICRM
EP-DC-1DA2	125	DC/1	SGRM119-7	RCIC	RCIC-13A	MOV	RCICRM

TABLE 3.5-2. PARTIAL LISTING OF ELECTRICAL SOURCES AND LOADS AT GRAND GULF 1 (CONTINUED)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-DC-1DA2	125	DC/1	SGRM119-7	RCIC	RCIC-19A	MOV	RCICRM
EP-DC-1DA2	125	DC/1	SGRM119-7	RCIC	RCIC-31A	MOV	RCICRM
EP-DC-1DA2	125	DC/1	SGRM119-7	RCIC	RCIC-46A	MOV	RCICRM
EP-DC-1DA4	125	DC/1	SWGR15AA	EP	EP-DCMCC-11 DA	MCC	SWGR15AA
EP-DC-1DA5	125	DC/1	SWGR15AA	EP	EP-DCMCC-11 DA	MCC	SWGR15AA
EP-DC-1DB4	125	DC/2	SWGR16AB	EP	EP-DCMCC-11 DB	MCC	SWGR16AB
EP-DC-1DB5	125	DC/2	SWGR16AB	EP	EP-DCMCC-11 DB	MCC	SWGR16AB
EP-DC-1DC4	125	DC/3	SWGR17AC	EP	EP-DCMCC-11 DC	MCC	DGRMC
EP-DCMCC-11 DA	125	DC/1	SWGR15AA	EP	EP-DC-1DA2	PNL	SGRM119-7
EP-DCMCC-11 DA	125	DC/1	SWGR15AA	RCIC	RCIC-22A	MOV	RCICRM
EP-DCMCC-11 DA	125	DC/1	SWGR15AA	RCIC	RCIC-45A	MOV	RCICRM
EP-DCMCC-11 DA	125	DC/1	SWGR15AA	RCIC	RCIC-59A	MOV	RCICRM
EP-DG-11	4160	AC/A	DGRMA	EP	EP-BS-15AA	BUS	SWGR15AA
EP-DG-11	4160	AC/A	DGRMA	EP	EP-CB-C15AA	CB	SWGR15AA
EP-DG-12	4160	AC/B	DGRMB	EP	EP-BS-16AB	BUS	SWGR16AB
EP-DG-12	4160	AC/B	DGRMB	EP	EP-CB-C16AB	CB	SWGR16AB
EP-DG-13	4160	AC/C	DGRMC	EP	EP-BS-17AC	BUS	SWGR17AC
EP-DG-13	4160	AC/C	DGRMC	EP	EP-CB-C17AC	CB	SWGR17AC
EP-MCC-15B1 1	480	AC/A	SGRM119-9	ECCS	LPCS-12A	MOV	LPCSRM
EP-MCC-15B1 1	480	AC/A	SGRM119-9	ECCS	LPCS-1A	MOV	LPCSRM
EP-MCC-15B1 1	480	AC/A	SGRM119-9	ECCS	LPCS-5A	MOV	FENRMA220
EP-MCC-15B1 1	480	AC/A	SGRM119-9	EP	DG-018A	MOV	DGRMA
EP-MCC-15B1 1	480	AC/A	SGRM119-9	RCS	RCS-250A	MOV	RC
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-24A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-24A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-27A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-27A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-28A	MOV	RC
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-28A	MOV	RC
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-37A	MOV	RC
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-3A	MOV	RHRRMA

TABLE 3.5-2. PARTIAL LISTING OF ELECTRICAL SOURCES AND LOADS AT GRAND GULF 1 (CONTINUED)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-42A	MOV	RC
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-47A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-4A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-52A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-53A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-53A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-6A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	RHR-87A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	ECCS	[illegible]R48A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	RCIC	RCIC-64A	MOV	RCICRM
EP-MCC-15B3 1	480	AC/A	SGRM119-7	RCS	RCIC-64A	MOV	RCICRM
EP-MCC-15B3 1	480	AC/A	SGRM119-7	RCS	RHR-8A	MOV	RHRRMA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	SSW	SSW-001A	MOV	BASINA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	SSW	SSW-005A	MOV	BASINA
EP-MCC-15B3 1	480	AC/A	SGRM119-7	SSW	SSW-006B	MOV	BASINB
EP-MCC-15B3 1	480	AC/A	SGRM119-7	SSW	SSW-014A	MOV	93AB
EP-MCC-15B3 1	480	AC/A	SGRM119-7	SSW	SSW-014A	MOV	93AB
EP-MCC-15B3 1	480	AC/A	SGRM119-7	SSW	SSW-068A	MOV	93AB
EP-MCC-16B1 1	480	AC/B	SGRM119-10	ECCS	RHR-21B	MOV	RHRRMC
EP-MCC-16B1 1	480	AC/B	SGRM119-10	ECCS	RHR-42C	MOV	RHRRMC
EP-MCC-16B1 1	480	AC/B	SGRM119-10	ECCS	RHR-4C	MOV	RHRRMC
EP-MCC-16B1 1	480	AC/B	SGRM119-10	EP	DG-018B	MOV	DGRMB
EP-MCC-16B3 1	480	AC/B	SGRM119-8	ECCS	RHR-24B	MOV	RHRRMB
EP-MCC-16B3 1	480	AC/B	SGRM119-8	ECCS	RHR-24B	MOV	RHRRMB
EP-MCC-16B3 1	480	AC/B	SGRM119-8	ECCS	RHR-27B	MOV	RHRRMB
EP-MCC-16B3 1	480	AC/B	SGRM119-8	ECCS	RHR-27B	MOV	RHRRMB
EP-MCC-16B3 1	480	AC/B	SGRM119-8	ECCS	RHR-28B	MOV	RC
EP-MCC-16B3 1	480	AC/B	SGRM119-8	ECCS	RHR-28B	MOV	RC
EP-MCC-16B3 1	480	AC/B	SGRM119-8	ECCS	RHR-37B	MOV	RC
EP-MCC-16B3 1	480	AC/B	SGRM119-8	ECCS	RHR-3B	MOV	RHRRMB
EP-MCC-16B3 1	480	AC/B	SGRM119-8	ECCS	RHR-42B	MOV	RC

TABLE 3.5-2. PARTIAL LISTING OF ELECTRICAL SOURCES AND LOADS AT GRAND GULF 1 (CONTINUED)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-MCC-16B31	480	AC/B	SGRM119-8	ECCS	RHR-47B	MOV	RHRRMB
EP-MCC-16B31	480	AC/B	SGRM119-8	ECCS	RHR-48B	MOV	RHRRMB
EP-MCC-16B31	480	AC/B	SGRM119-8	ECCS	RHR-48B	MOV	RHRRMB
EP-MCC-16B31	480	AC/B	SGRM119-8	ECCS	RHR-4B	MOV	RHRRMB
EP-MCC-16B31	480	AC/B	SGRM119-8	ECCS	RHR-52B	MOV	RHRRMB
EP-MCC-16B31	480	AC/B	SGRM119-8	ECCS	RHR-53B	MOV	RHRRMB
EP-MCC-16B31	480	AC/B	SGRM119-8	ECCS	RHR-53B	MOV	RHRRMB
EP-MCC-16B31	480	AC/B	SGRM119-8	ECCS	RHR-6B	MOV	RHRRMB
EP-MCC-16B31	480	AC/B	SGRM119-8	ECCS	RHR-87B	MOV	RHRRMB
EP-MCC-16B31	480	AC/B	SGRM119-8	RCIC	RCIC-63B	MOV	RC
EP-MCC-16B31	480	AC/B	SGRM119-8	RCS	RCIC-63B	MOV	RC
EP-MCC-16B31	480	AC/B	SGRM119-8	RCS	RCS-16B	MOV	RC
EP-MCC-16B31	480	AC/B	SGRM119-8	RCS	RCS-1B	MOV	RC
EP-MCC-16B31	480	AC/B	SGRM119-8	RCS	RHR-9B	MOV	RC
EP-MCC-16B31	480	AC/B	SGRM119-8	SSW	SSW-001B	MOV	BASINB
EP-MCC-16B31	480	AC/B	SGRM119-8	SSW	SSW-005B	MOV	BASINB
EP-MCC-16B31	480	AC/B	SGRM119-8	SSW	SSW-006A	MOV	BASINA
EP-MCC-16B31	480	AC/B	SGRM119-8	SSW	SSW-014B	MOV	93AB
EP-MCC-16B31	480	AC/B	SGRM119-8	SSW	SSW-014B	MOV	93AB
EP-MCC-16B31	480	AC/B	SGRM119-8	SSW	SSW-068B	MOV	93AB
EP-MCC-17B11	480	AC/C	SWGR17AC	ECCS	HPCS-1	MOV	HPCSRM
EP-MCC-17B11	480	AC/C	SWGR17AC	ECCS	HPCS-10	MOV	HPCSRM
EP-MCC-17B11	480	AC/C	SWGR17AC	ECCS	HPCS-11	MOV	HPCSRM
EP-MCC-17B11	480	AC/C	SWGR17AC	ECCS	HPCS-15	MOV	HPCSRM
EP-MCC-17B11	480	AC/C	SWGR17AC	ECCS	HPCS-23	MOV	HPCSRM
EP-MCC-17B11	480	AC/C	SWGR17AC	ECCS	HPCS-4	MOV	119AB
EP-MCC-17B11	480	AC/C	SWGR17AC	SSW	SSW-011C	MOV	BASINA
EP-MCC15B31	480	AC/A	SGRM119-7	ECCS	RHR-48A	MOV	RHRRMA
OFFSITE	4160	AC/A		EP	EP-BS-15AA	BUS	SWGR15AA
OFFSITE	4160	AC/B		EP	EP-BS-16AB	BUS	SWGR16AB
OFFSITE	4160	AC/C		EP	EP-BS-17AC	BUS	SWGR17AC

TABLE 3.5-2. PARTIAL LISTING OF ELECTRICAL SOURCES AND LOADS AT GRAND GULF 1 (CONTINUED)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
TR-15PA1	480	AC/A	SGRM119-9	EP	EP-BS-15BA1	BUS	SGRM119-9
TR-15PA6	480	AC/A	SWGR15AA	EP	EP-BS-15BA6	BUS	SWGR15AA
TR-16PB1	480	AC/B	SGRM119-10	EP	EP-BS-16BB1	BUS	SGRM119-10
TR-16PB3	480	AC/B	SGRM119-10	EP	EP-BS-16BB3	BUS	SGRM119-10
TR-16PB6	480	AC/B	SWGR16AB	EP	EP-BS-16BB6	BUS	SWGR16AB
TR-17P01	480	AC/C	SWGR17AC	EP	EP-BS-17B01	BUS	SWGR17AC
TR-2A91	480	AC/A	SGRM119-9	EP	EP-BS-15BA3	BUS	SGRM119-9

3.6 CONTROL ROD DRIVE HYDRAULIC SYSTEM (CRDHS)

3.6.1 System Function

The CRDHS supplies pressurized water to operate and cool the control rod drive mechanisms during normal operation. This system implements a scram command from the reactor protection system (RPS) and drives control rods rapidly into the reactor. The CRDHS also can provide makeup water to the RCS.

3.6.2 System Definition

The CRDHS consists of two high-head, low-flow CRD supply pumps, piping, filters, control valves, one hydraulic control unit for each control rod drive mechanism, and instrumentation. Water is supplied from the condensate treatment system or the condensate storage tanks. The CRDHS also includes scram valves, scram accumulators, and a scram discharge volume.

Details of the scram portion of typical BWR CRDHS is shown in Figure 3.6-1.

3.6.3 System Operation

During normal operation the CRDHS pumps provide a constant flow for drive mechanism cooling and system pressure stabilization. Excess water not used for cooling is discharged to the RCS. Control rods are driven in or out by the coordinated operation of the direction control valves. Insertion speed is controlled by flow through the insert speed control valve. Rod motion may be either stepped or continuous.

A reactor scram is implemented by pneumatic scram valves in the CRDHS. An inlet scram valve opens to align the insert side of each control rod drive mechanism (CRDM) to the scram accumulator. An outlet scram valve opens to vent the opposite side of each CRDM to the scram discharge volume. This coordinated action results in rapid insertion of control rods into the reactor.

The control rod drive accumulators are necessary to scram the control rods within the required time. It should be noted that each drive has an internal ball check valve which allows reactor pressure to be admitted under the drive piston. If reactor pressure is above 600 psi, the ball check valve ensures rod insertion in the event that the scram accumulator is not charged or the inlet scram valve fails to open. The insertion time, however, will be slower than the scram time with a properly functioning scram system.

Although not intended as a makeup system, the CRDHS can provide a source of cooling water to the RCS during vessel isolation. In BWR/6 plants, RCS makeup at high pressure is performed by the RCIC (see Section 3.2) and HPCS (see Section 3.3) systems. The maximum RCS makeup rate of the CRDHS is about 165 gpm with both pumps operating (Ref. 1).

3.6.4 System Success Criteria

For the scram function to be accomplished, the following actions must occur in the CRDHS:

- A scram signal must be transmitted by the RPS to the actuated devices (i.e., pilot valves) in the CRDHS.
- The pneumatic inlet scram valve and outlet scram valve must open in the hydraulic control units (HCUs) for the individual control rod drives. This is accomplished by venting the instrument air supply to each valve as follows:
  - Both scram pilot valves in each HCU must be deenergized, or
  - Either backup scram pilot valve must be energized.
- A high-pressure water source must be available from the scram accumulator in each HCU.
- A hydraulic vent path to the scram discharge volume must be available and sufficient collection volume must exist in the scram discharge volume.

- A specified number of control rods must responds and insert into the reactor core (specific number needed is not known).

3.6.5 Component Information

A. Control rod drive pumps (2)
   1. Rated capacity: 100% (for control rod drive function)
   2. Type: centrifugal

B. Condensate Storage Tank
   1. Capacity: 300,000 gal

C. Scram Accumulator
   1. Normal pressure: 1750 psig

D. Scram Discharge Volume
   1. Normal pressure: Atmospheric

3.6.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The RPS transmits scram commands to solenoid pilot valves which control the pneumatic scram valves
   2. Remote Manual
      a. A reactor scram can be initiated manually from the control room
      b. The CRDHS can be operated manually from the control room to insert and withdraw rods, or to inject water into the RCS

B. Motive Power
   1. The control rod drive pumps are Class 1E AC loads that can be supplied from the emergency diesel generator as described in Section 3.5.

3.6.7 VAA Model of the CRDHS

The CRDHS was not explicitly included in the VAA model. The CRD hydraulic control units, scram valves, and scram discharge volume are located in the reactor containment (area RC). As discussed in Section 3.4, this area is included in the area transform for the reactor protection system (event RPS-D). No credit is taken for the makeup capability of the CRDHS.

3.6.8 Section 3.6 References

1. Drouin, Mary, T. et al., "Analysis of Core Damage Frequency from Internal Events: Grand Gulf 1, "NUREG/CR-4550, Sandia National Laboratories, April, 1987.

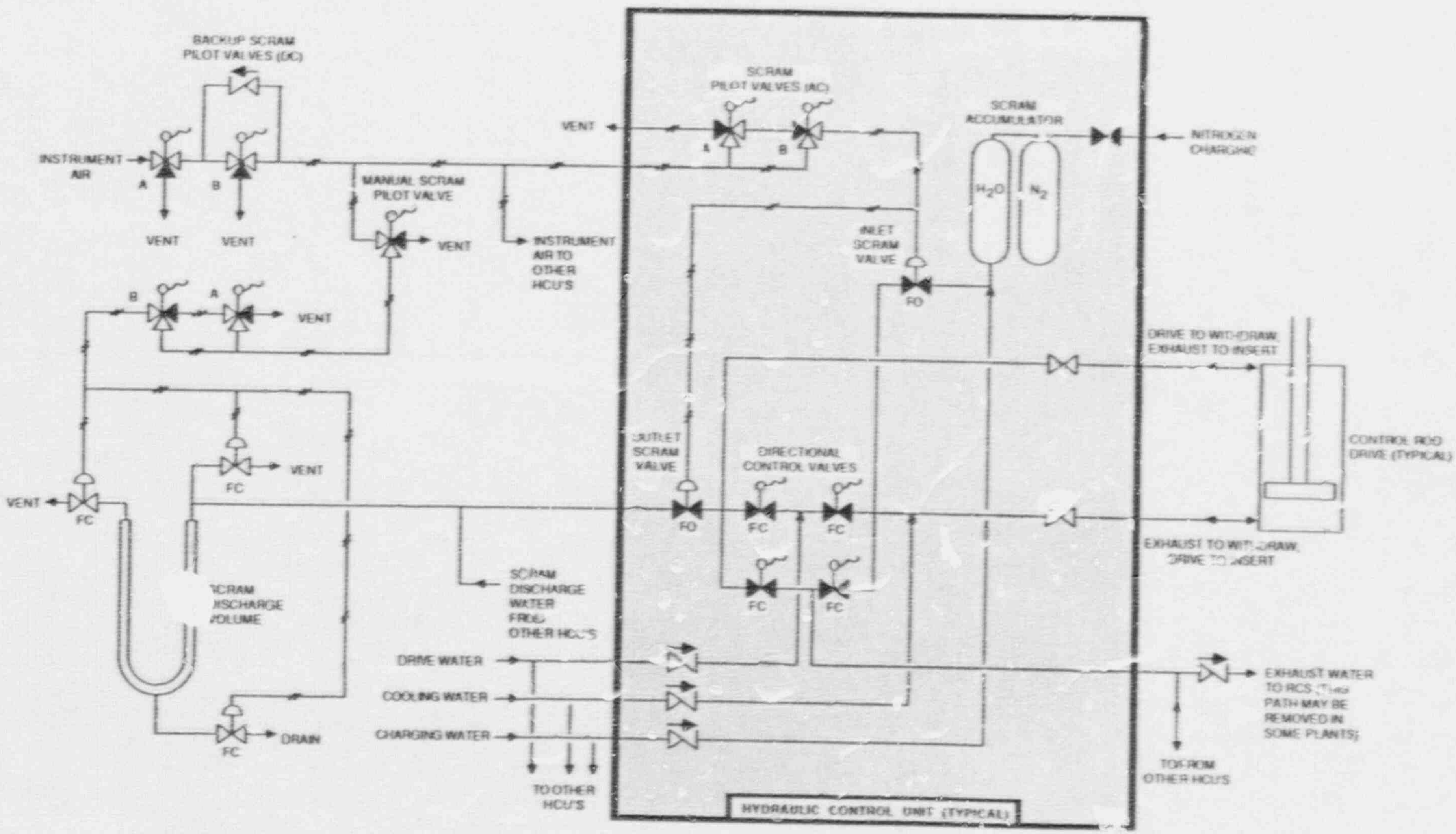


Figure 3.6-1. Simplified Diagram Of Portions Of The Control Rod Drive Hydraulic System That Are Related To The Scram Function

3.7 SHUTDOWN SERVICE WATER SYSTEM (SSWS)

3.7.1 System Function

The Shutdown Service Water System provides cooling water from the ultimate heat sink to various heat loads in the plant required for safe shutdown. The SSWS completes the decay heat transfer path from the RHR system to the ultimate heat sink. Train B of the SSWS also can be aligned to supply water to the RHR system for low pressure core flooding if needed.

3.7.2 System Definition

The SSW system consists of three separate trains, each containing one motor driven pump and distribution piping serving the heat loads assigned to that train.

Simplified drawings of the three SSWS trains are shown in Figures 3.7-1 to 3.7-6. A summary of data on selected SSWS components is presented in Table 3.7-1.

3.7.3 System Operation

The SSWS pumps normally are shut down, and heat loads in the SSWS are supplied with cooling water via interties with the plant service water (PSWS). The SSWS operates only during reactor shutdown, reactor isolation, and post-LOCA. The pumps draw water from the SSW cooling towers, which serve as the ultimate heat sink.

SSWS trains A and B can be cross-connected to each other. SSWS train C is dedicated to serving heat loads associated with the HPCS, and is not cross-connected with the other SSWS trains.

When the SSWS is automatically actuated, the pumps are started and the intertie line with the PSW system is isolated.

3.7.4 System Success Criteria

The success criteria for the SSWS are defined on a per-train basis. For each train of the SSWS, the SSW pump must operate, the intertie between the SSWS and the PSWS must be isolated, and the flow paths to the various heat loads must be open.

3.7.5 Component Information

A. Shutdown Service Water, Divisions I and II
   1. Rated flow: 12,000 gpm @ 220 ft. head (95 psid)
   2. Rated capacity: 100%
   3. Type: vertical centrifugal

B. Shutdown Service Water Pump, Division III
   1. Rated flow: 1,300 gpm @ 175 ft head (76 psid)
   2. Rated capacity: 100%
   3. Type: vertical centrifugal

3.7.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic

      Upon receipt of a LOCA or loss of offsite power signal, all cooling tower fans, SSW pumps, and HPCS service water pumps will start. At the same time, the plant service water lines to the standby service water components that are required during normal operation are isolated automatically, and the respective SSW system lines are opened to those components.

2. Remote manual
   The SSW pumps can be actuated by remote manual means from the control room.

B. Motive Power
   The SSW pumps are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.5.

C. Pump Cooling and Pump Room Cooling
   Cooling water is diverted from the SSWS supply header to provide cooling water for the bearings of the respective SSWS pump, and for the SSWS room cooler.

3.7.7 Section 3.7 References

1. Drouin, Mary T. et al., "Analysis of Core Frequency from Internal Events: Grand Gulf 1," NUREG/CR-4550, Sandia National Laboratories, April, 1987.

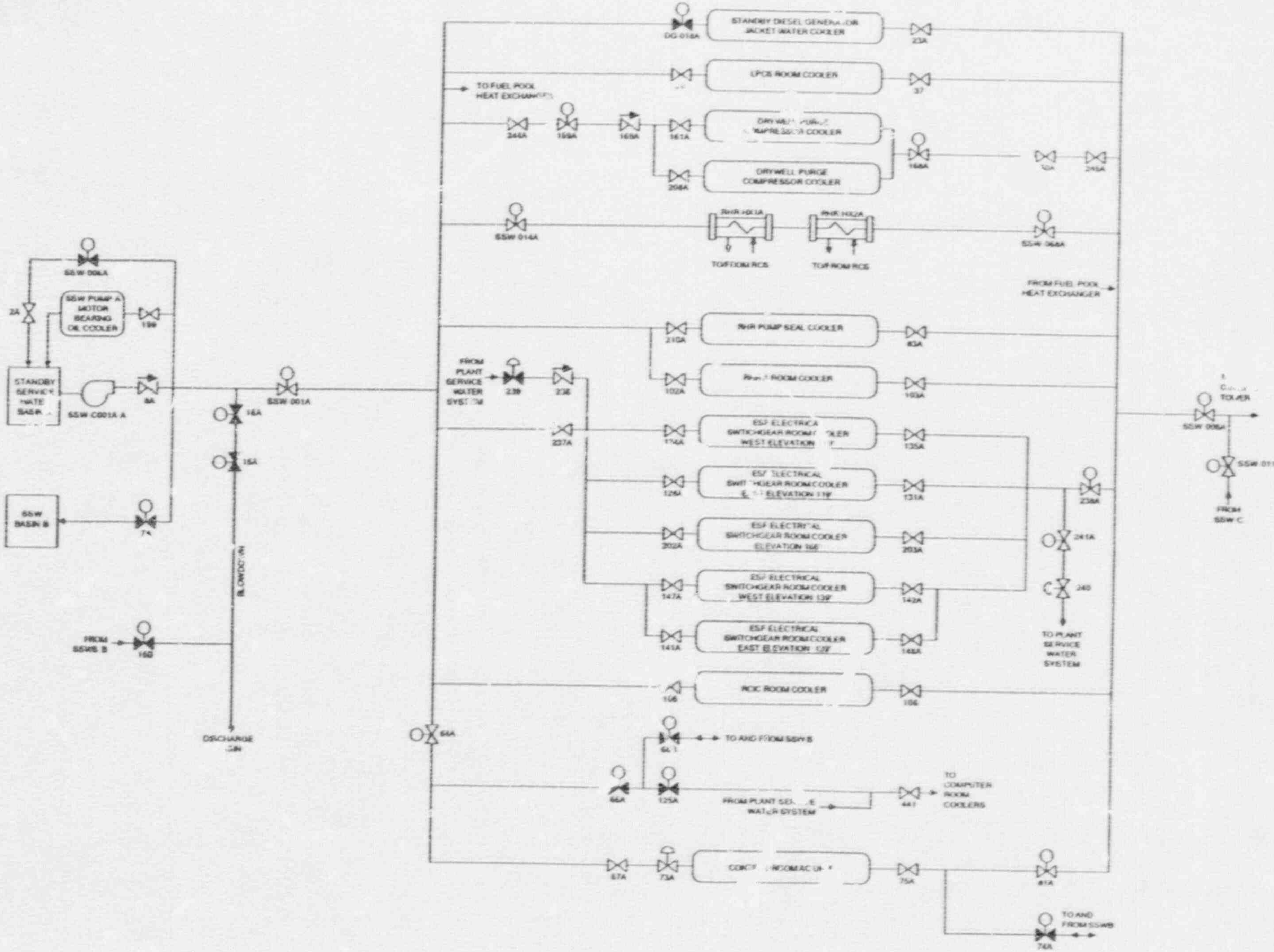


Figure 3.7-1. Grand Gulf 1 Shutdown Service Water System, Train A

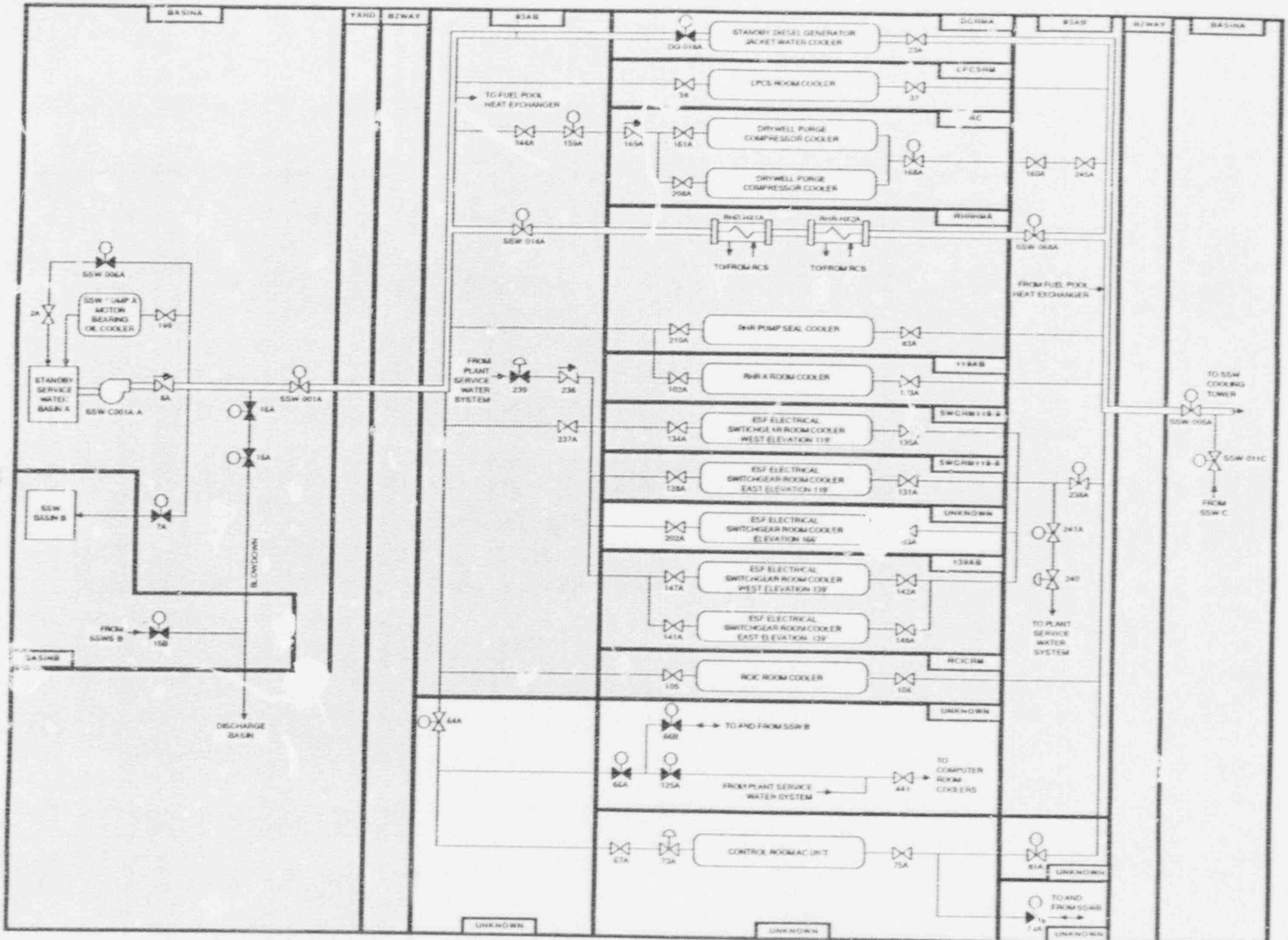


Figure 3.7-2. Grand Gulf 1 Shutdown Service Water System, Train A Showing Component Locations

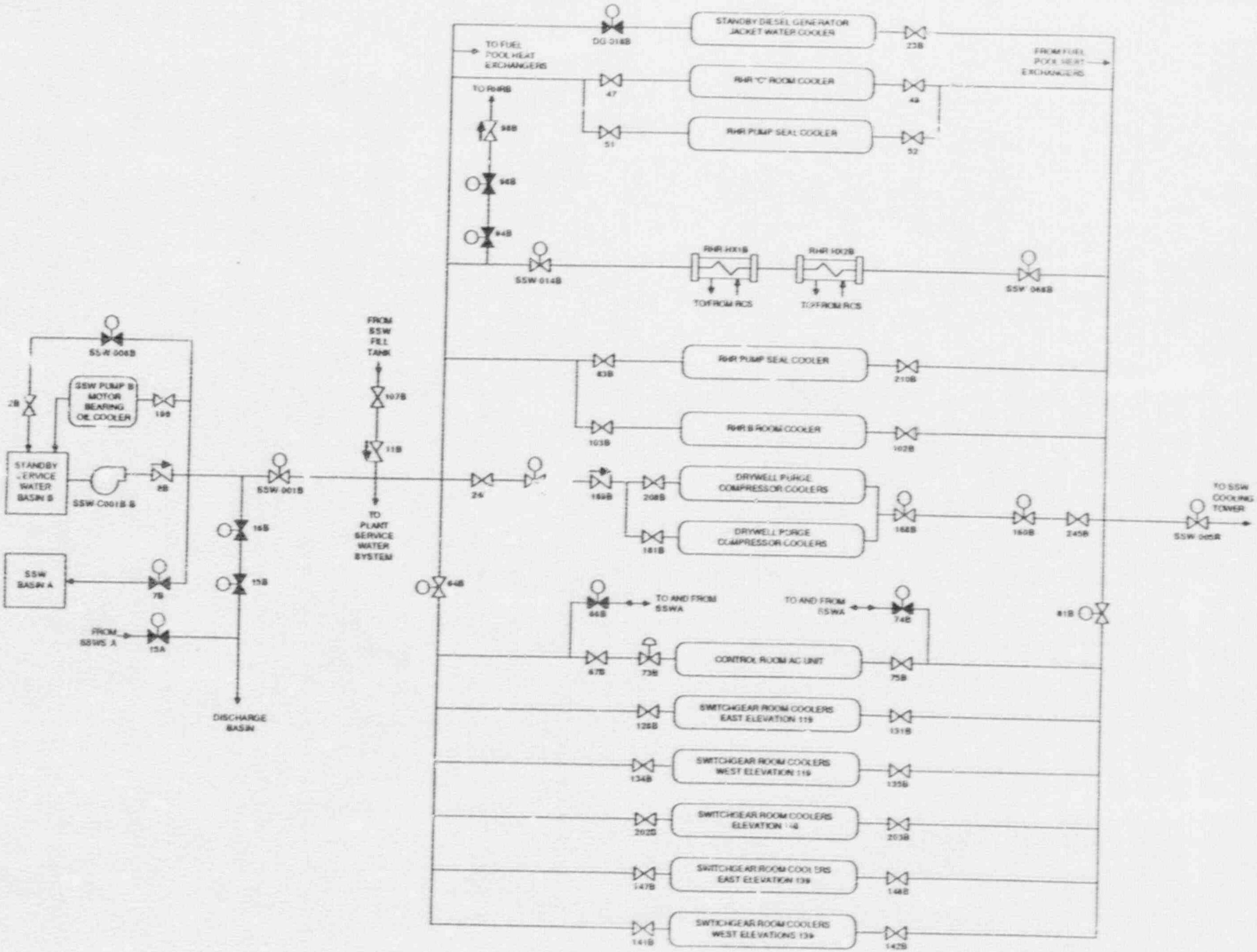


Figure 3.7-3. Grand Gulf 1 Shutdown Service Water System, Train B

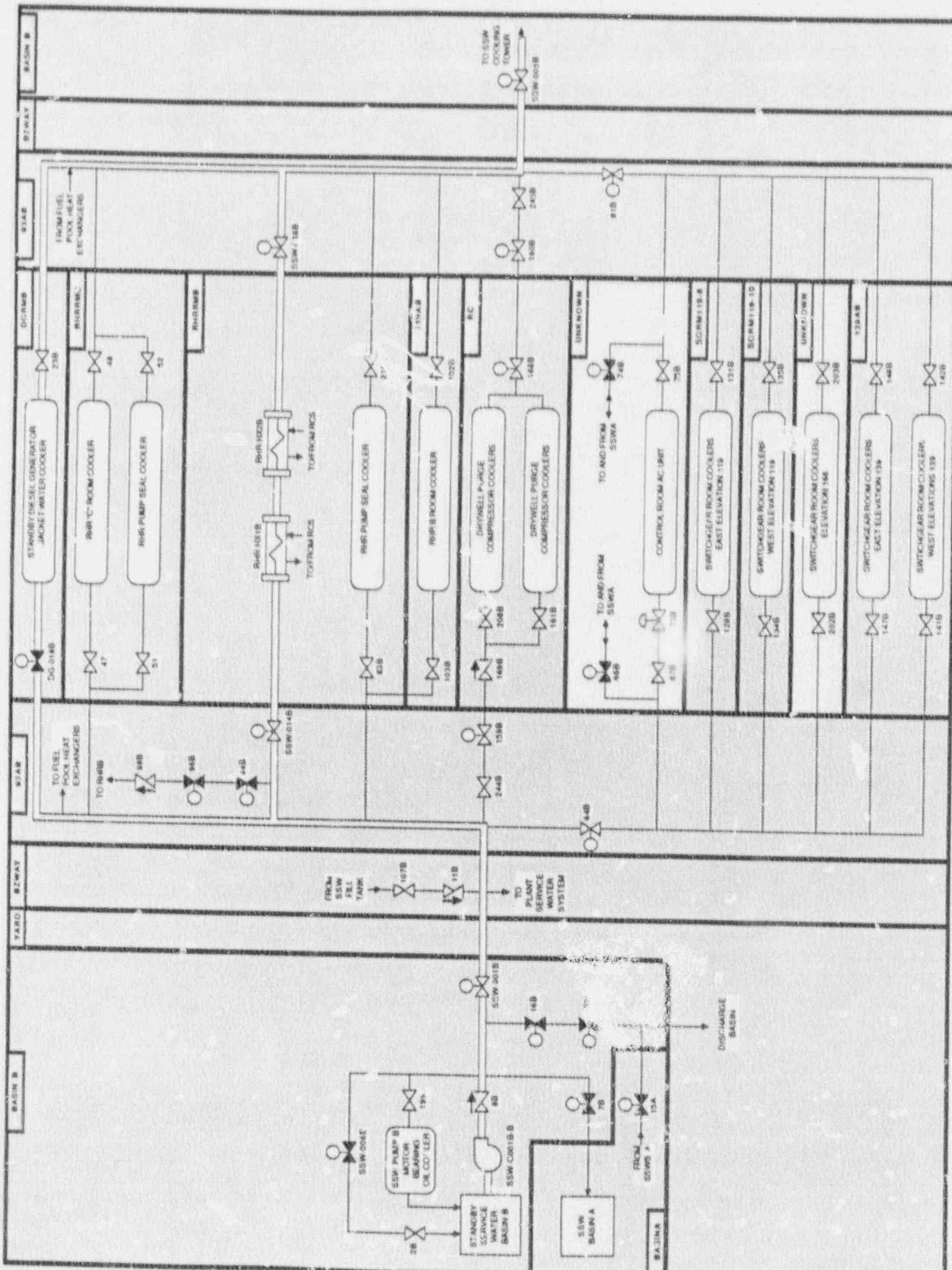


Figure 3.7-4. Grand Gulf 1 Shutdown Service Water System, Train B Showing Component Locations

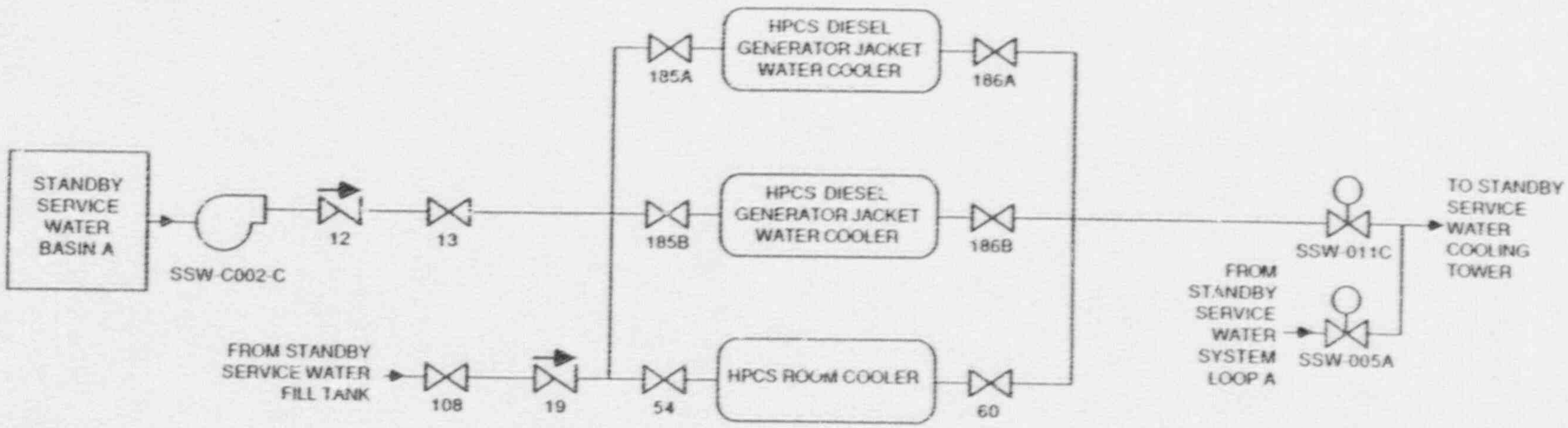


Figure 3.7-5. Grand Gulf 1 Shutdown Service Water System, Train C

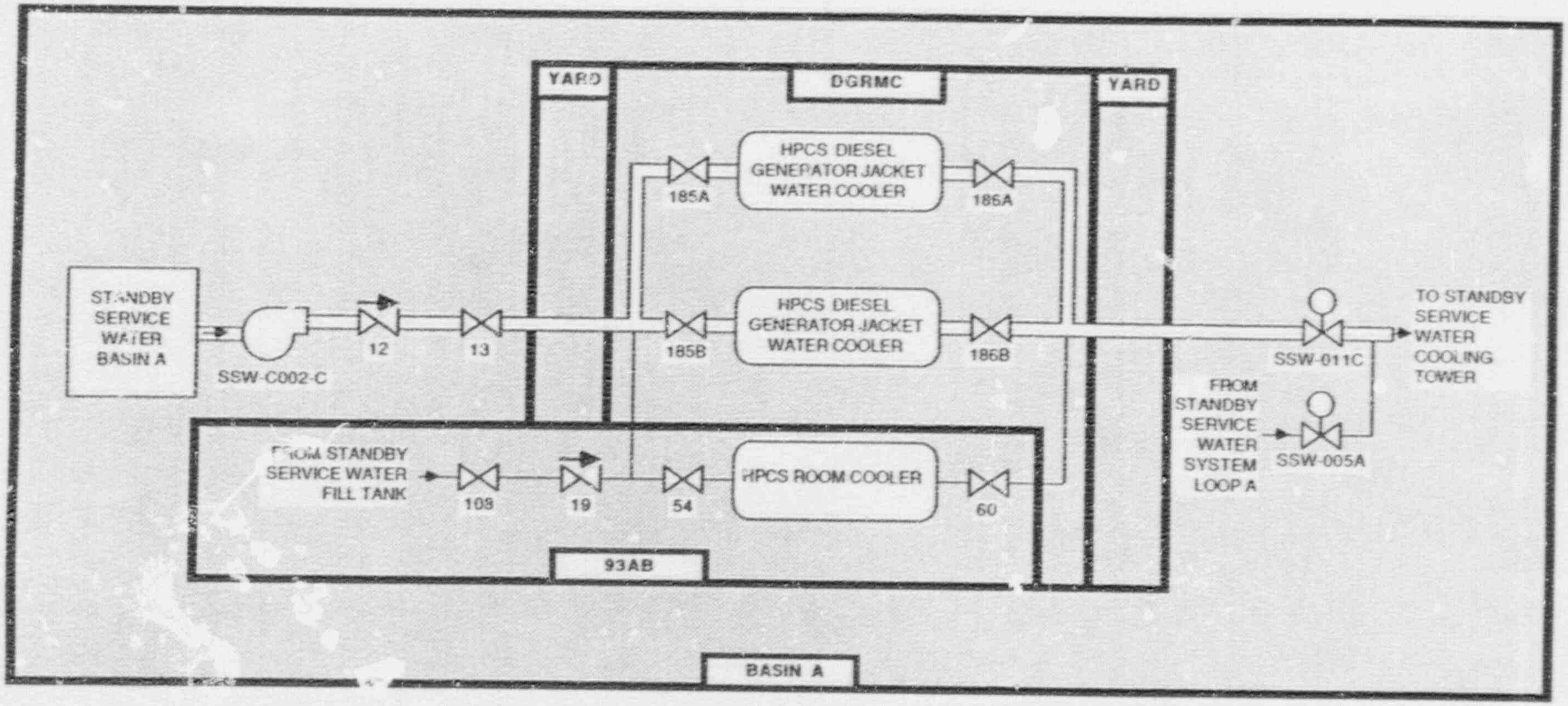


Figure 3.7-6. Grand Gulf 1 Shutdown Service Water System, Train C Showing Component Locations

Table 3.7-1. Grand Gulf 1 Shutdown Service Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
SSW-001A	MOV	BASINA	EP-MCC-15B31	480	SGRM119-7	AC/A
SSW-001B	MOV	BASINB	EP-MCC-16B31	480	SGRM119-8	AC/B
SSW-005A	MOV	BASINA	EP-MCC-15B31	480	SGRM119-7	AC/A
SSW-005B	MOV	BASINB	EP-MCC-16B31	480	SGRM119-8	AC/B
SSW-006A	MOV	BASINA	EP-MCC-16B31	480	SGRM119-8	AC/B
SSW-006B	MOV	BASINB	EP-MCC-15B31	480	SGRM119-7	AC/A
SSW-011C	MOV	BASINA	EP-MCC-17B11	480	SWGR17AC	AC/C
SSW-014A	MOV	93AB	EP-MCC-15B31	480	SGRM119-7	AC/A
SSW-014A	MOV	93AB	EP-MCC-15B31	480	SGRM119-7	AC/A
SSW-014B	MOV	93AB	EP-MCC-16B31	480	SGRM119-8	AC/B
SSW-014B	MOV	93AB	EP-MCC-16B31	480	SGRM119-8	AC/B
SSW-068A	MOV	93AB	EP-MCC-15B31	480	SGRM119-7	AC/A
SSW-068B	MOV	93AB	EP-MCC-16B31	480	SGRM119-8	AC/B
SSW-C001A	MDP	BASINA	EP-BS-15AA	4160	SWGR15AA	AC/A
SSW-C001B	MDP	BASINB	EP-BS-16AB	4160	SWGR16AB	AC/B
SSW-C002C	MDP	BASINA	EP-BS-17B01	480	SWGR17AC	AC/C

4. PLANT INFORMATION

4.1 SITE AND BUILDING SUMMARY

The Grand Gulf 1 site is located in Claiborne County, Mississippi on the east side of the Mississippi River approximately 25 miles south of Vicksburg and 37 miles north-northeast of Natchez, Mississippi. The site contains a single BWR/6 plant. The second unit planned for the site is on indefinite hold. A general view of the site is shown in Figure 4-1 (from Ref. 1) and a more detailed site plan is shown in Figure 4-2.

The containment building is surrounded by the auxiliary building. The spent fuel storage pool, HPCS, RCIC, LPCS, LPCI (RHR), and reactor water cleanup systems are located on various elevations of the auxiliary building. Personnel airlocks for entering containment are on the 119 and 208 foot elevation of the auxiliary building.

To the west of the auxiliary building is the diesel generator building. Diesel generators 11, 12, and 13 are located in separate rooms on the 132 ft. elevation of the diesel generator building. Long-term fuel tanks are located underground.

To the north of the auxiliary building is the control building. The control room is located on the 166 ft. elevation of the control building between the lower cable spreading room on the 148 ft. level and the upper cable spreading room on the 189 ft level. On the 111 ft elevation of the control building is the electrical power distribution equipment for all AC and DC divisions.

The turbine building is located on the east side of the auxiliary and control building. The switchyard is located further to the east.

The condensate storage tank (CST) is located just south of auxiliary building and the firewater pump house is located southwest of the CST.

Note that Grand Gulf was originally planned as a two unit plant, with some shared facilities in the control, diesel generator/HVAC, and radwaste buildings. The detailed layouts of these buildings in areas that would have used Unit 2 equipment and systems are not known.

4.2 FACILITY LAYOUT DRAWINGS

Figures 4-3 through 4-17 are section views and simplified layout drawings of the Grand Gulf 1 reactor building, auxiliary building, control building, diesel generator, and cooling tower basin and pumphouse. Some outlying buildings are not shown in these drawings. Major rooms, stairways, elevators, and doorways are shown in the simplified layout drawings, however, many interior walls have been omitted for clarity. 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 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, Nuclear Safety Information Center, April 1974.

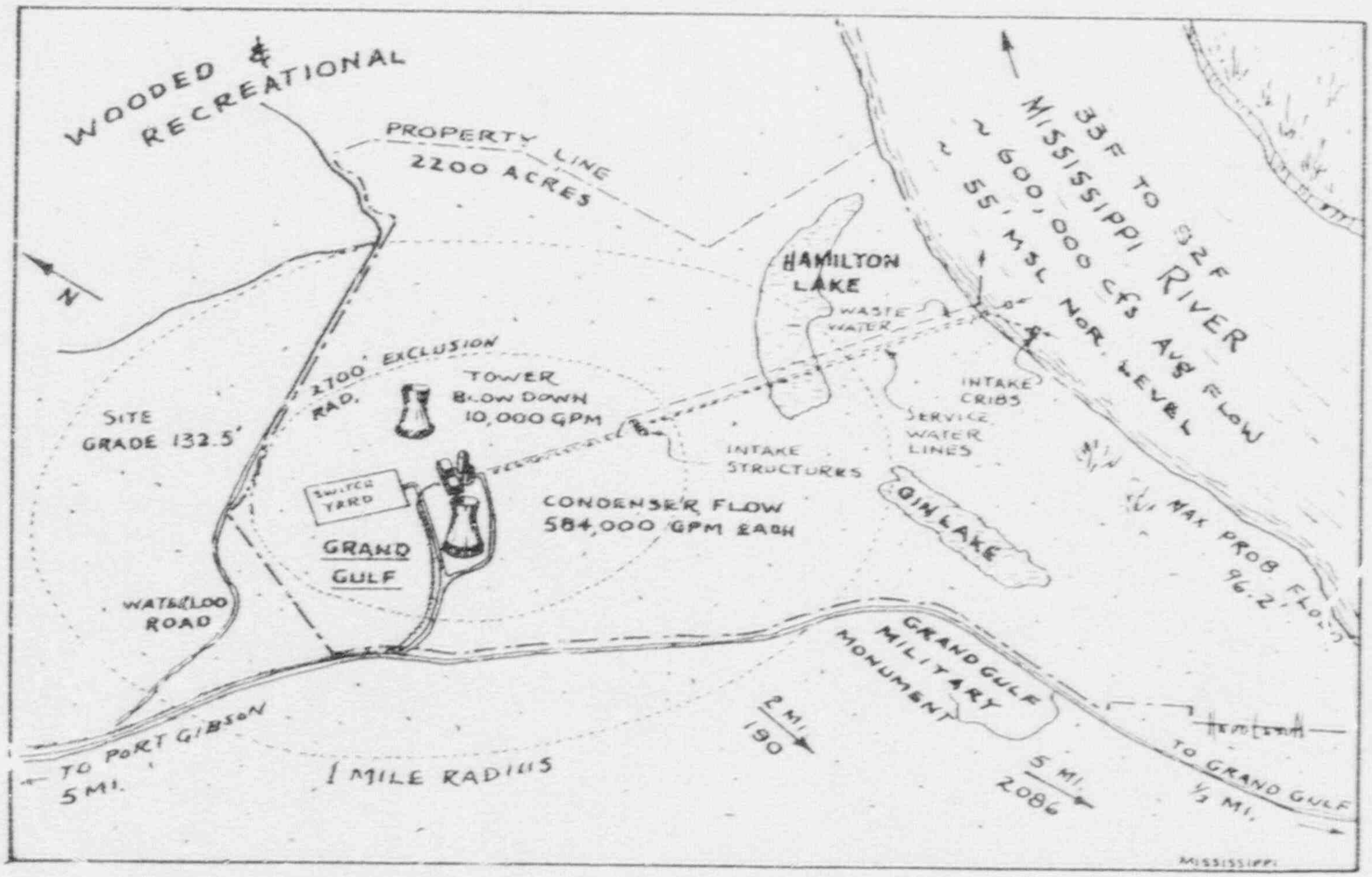


Figure 4-1. General View of the Grand Gulf Site and Vicinity

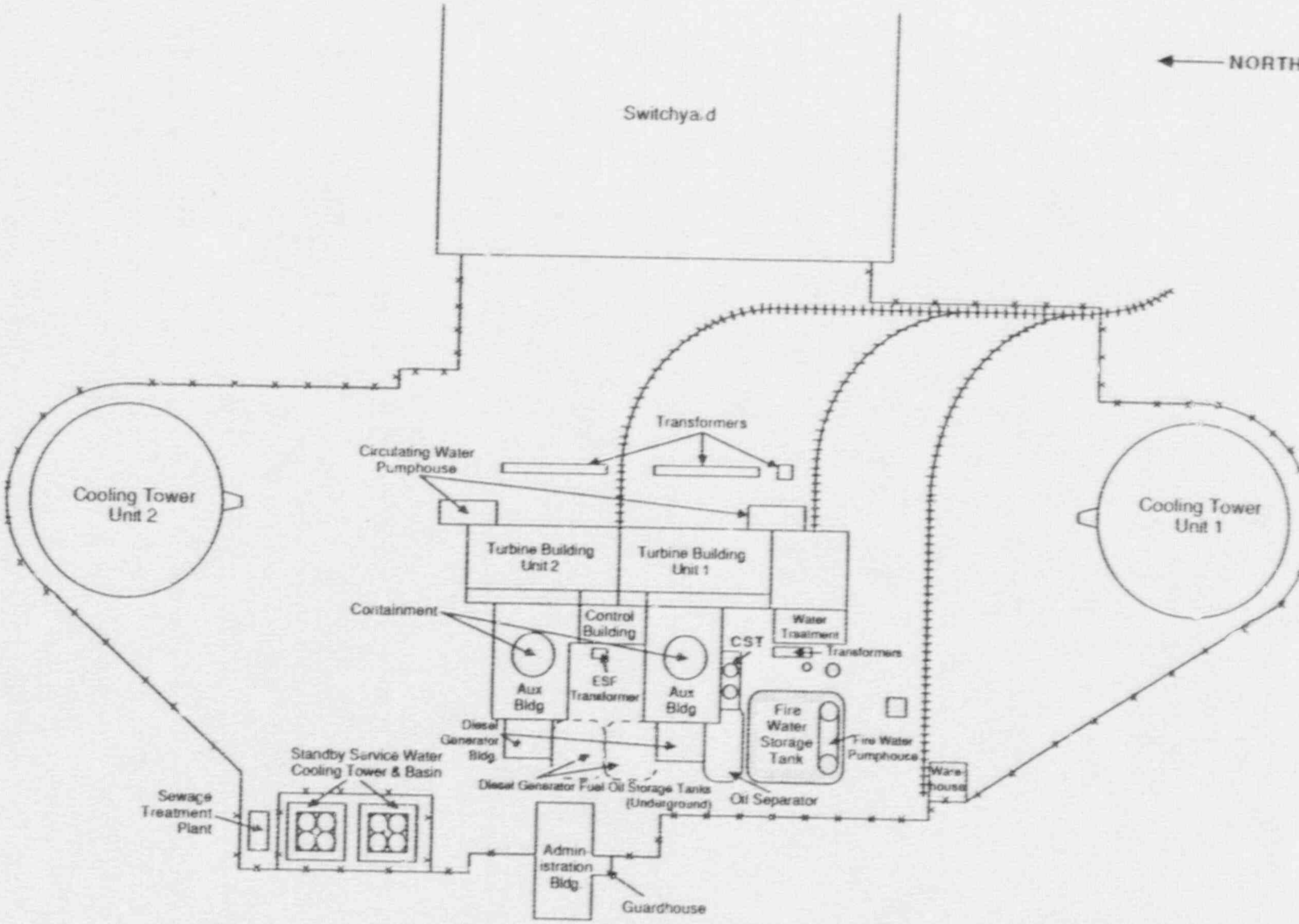


Figure 4-2. Grand Gulf Simplified Site Plan

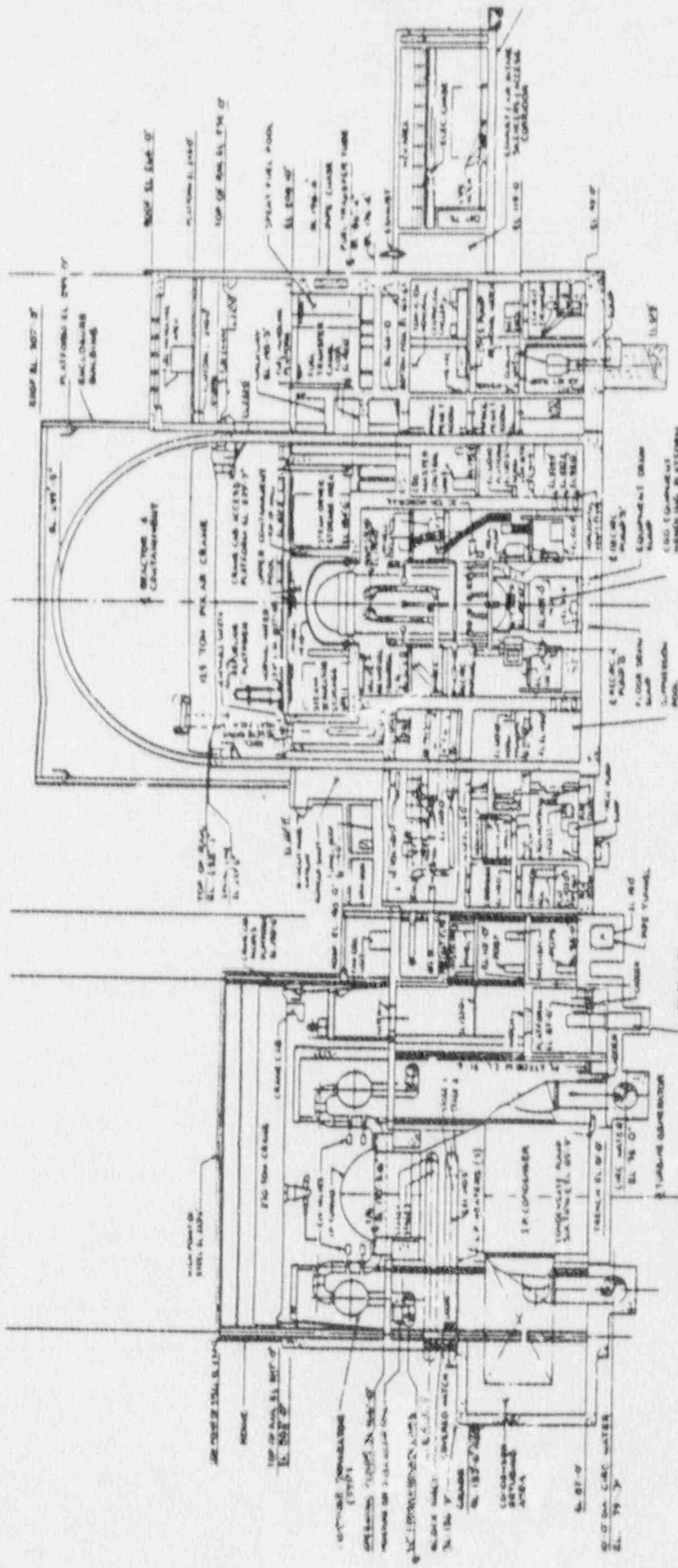


Figure 4-3. Elevation View of Grand Gulf Reactor and Turbine Buildings (looking south)

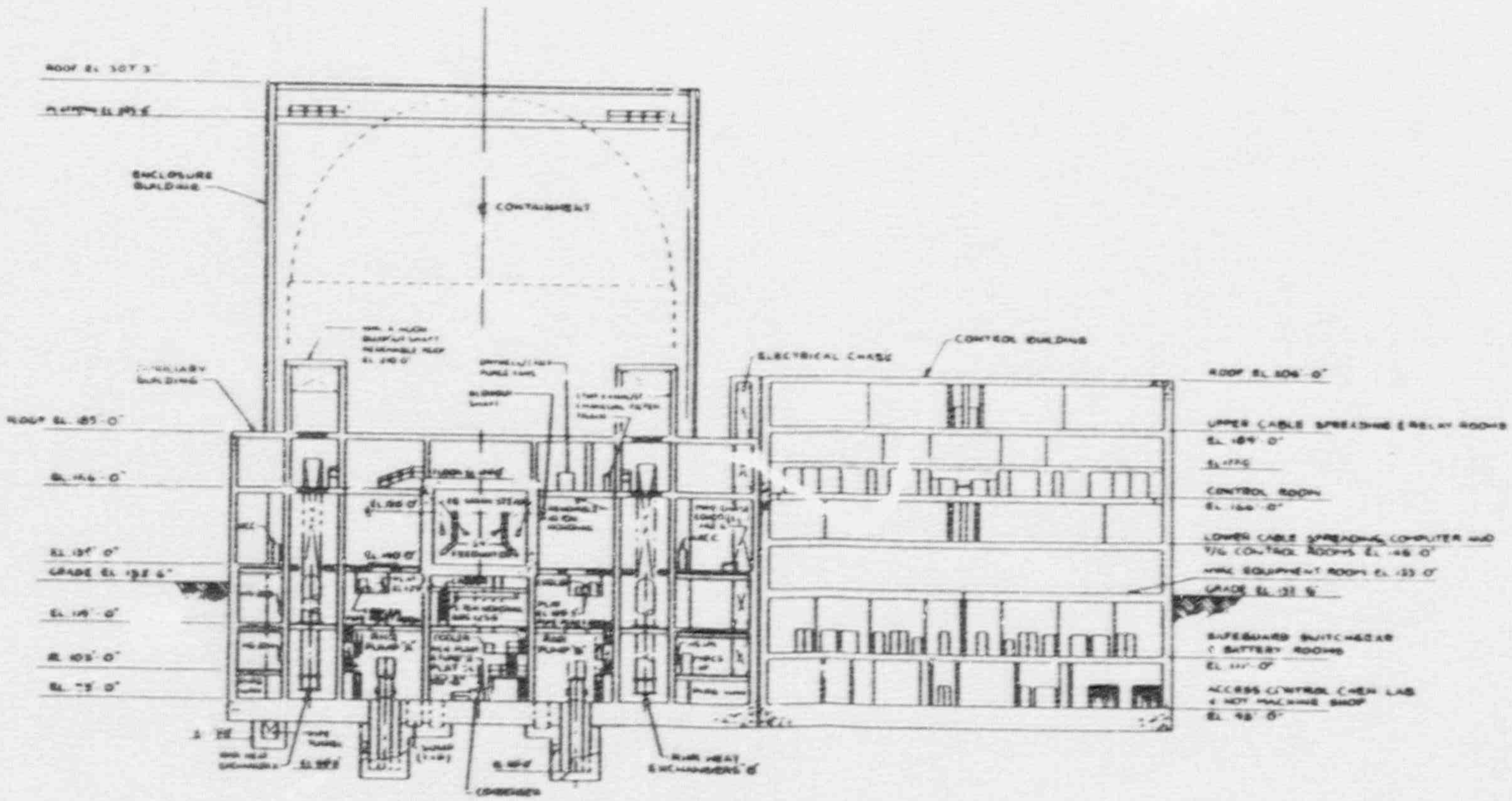


Figure 4-4. Elevation View of Grand Gulf Reactor and Control Buildings (looking west)

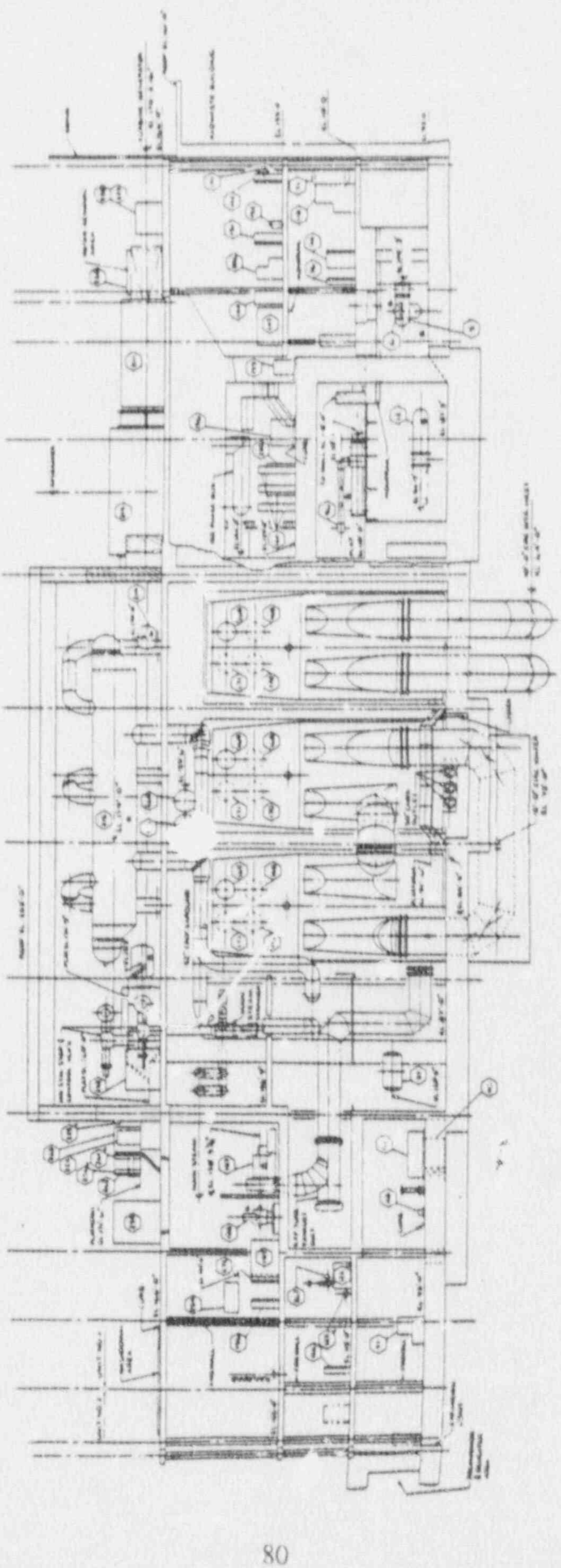


Figure 4-5. Elevation View of Grand Gulf Tubine Building (looking east)

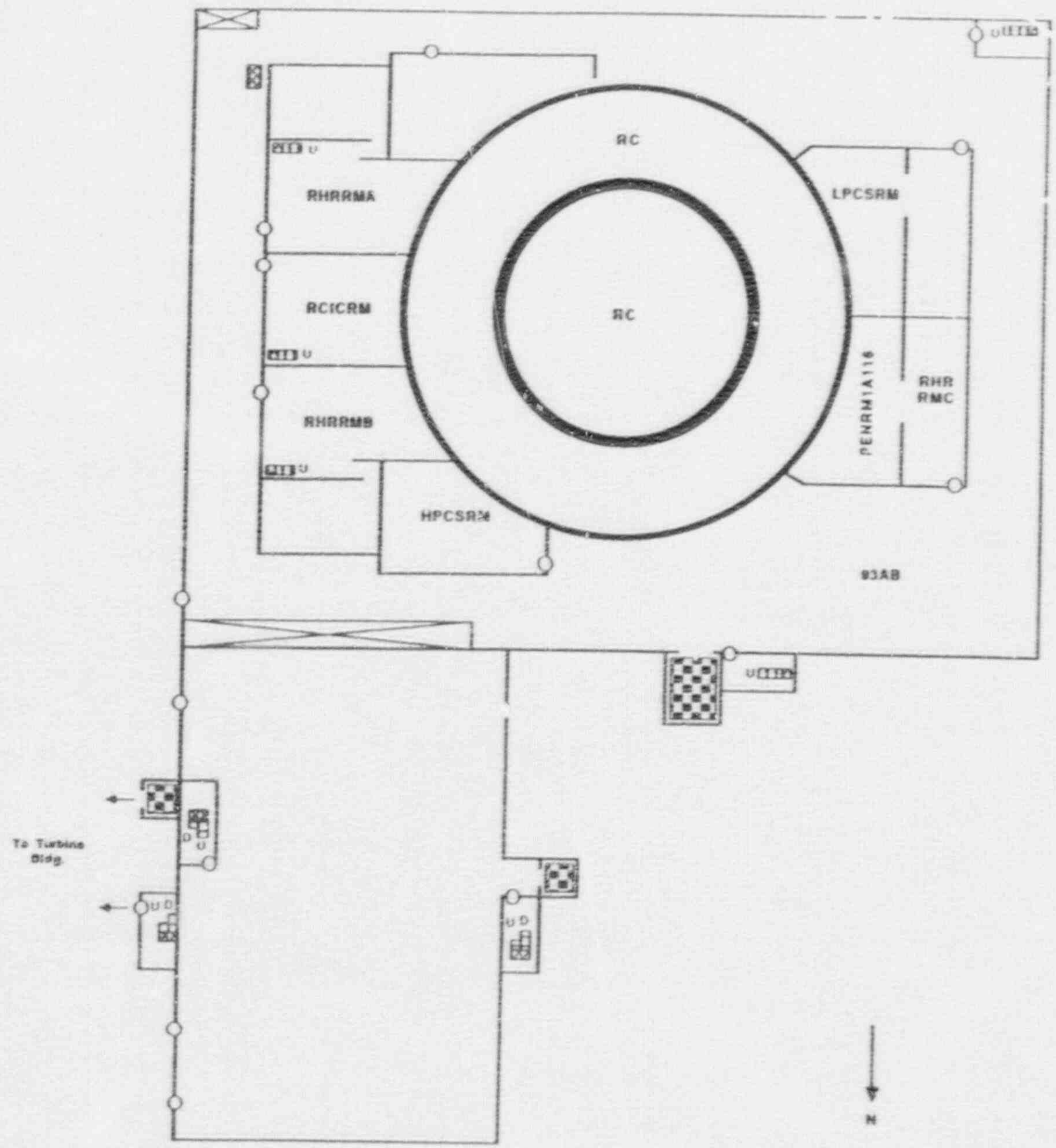


Figure 4-6. Grand Gulf 1 Reactor Building (El. 93'0" to 100'9") and Control Building (El. 93'9")

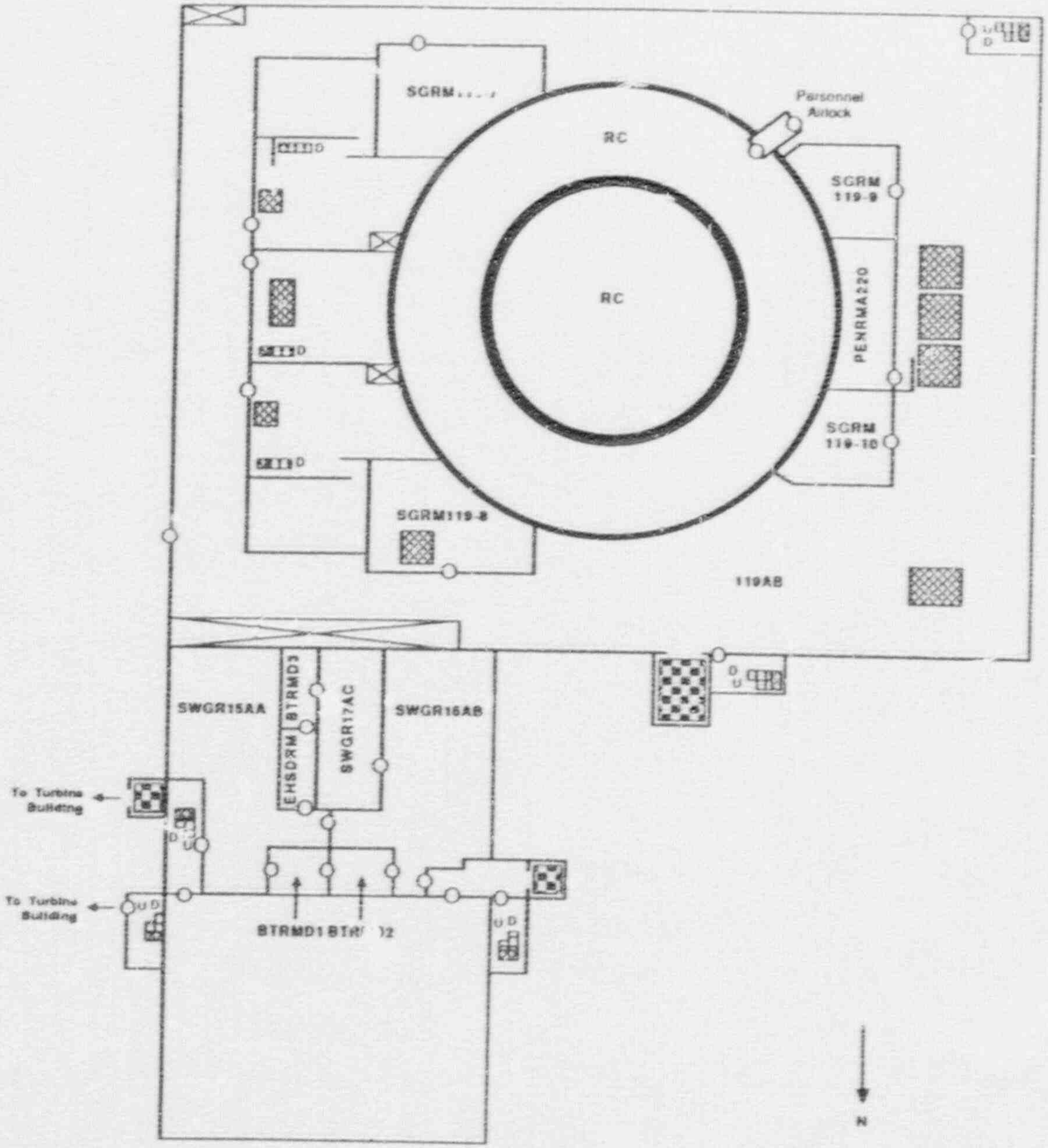


Figure 4-7. Grand Gulf 1 Reactor Building (El. 114'6" to 120'10") and Control Building (El. 111'0")

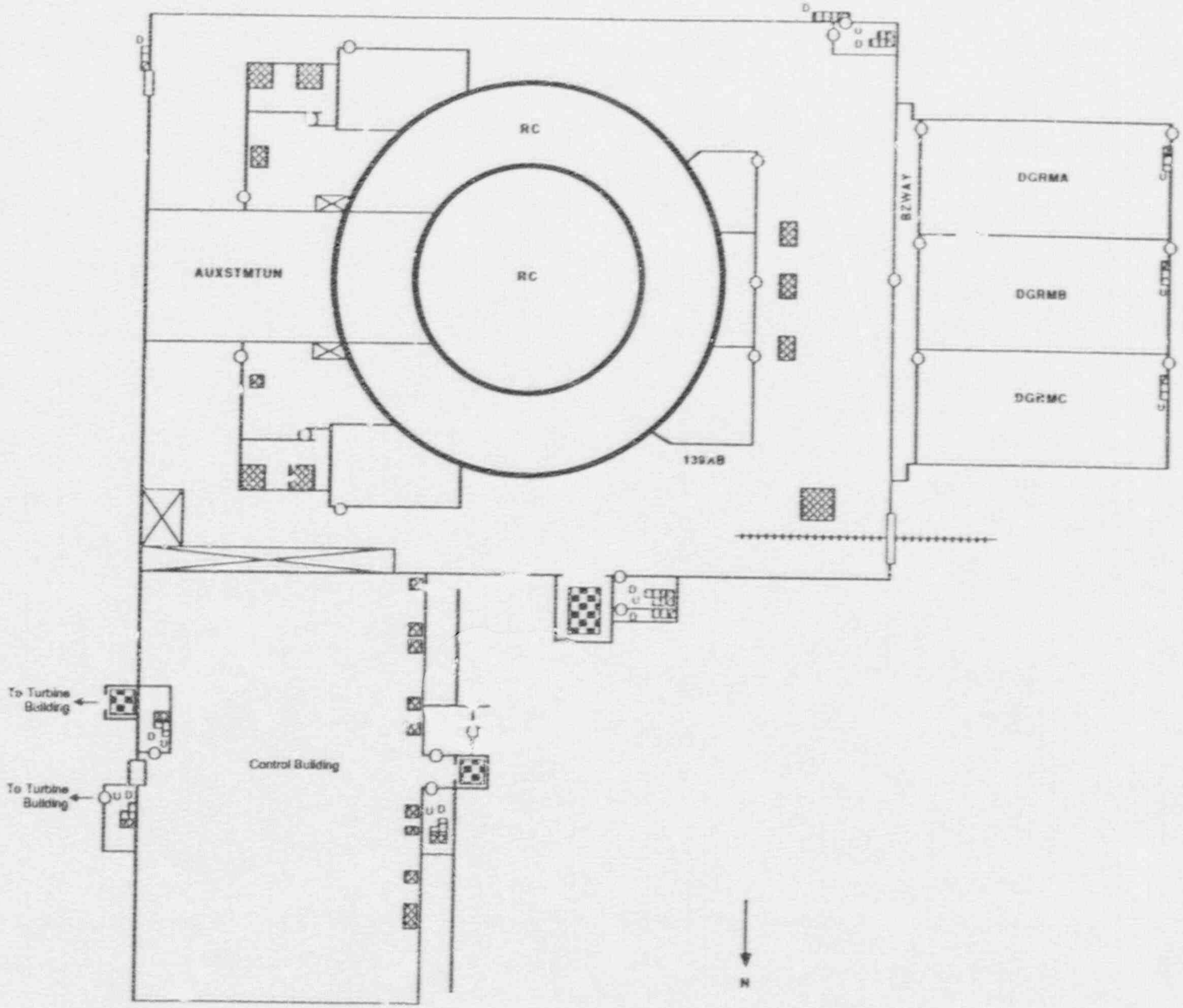


Figure 4-8. Grand Gulf 1 Reactor Building (El. 139'2" to 147'7"), Control Building (El. 133'0"), and Diesel Generator Building (El. 133'0").

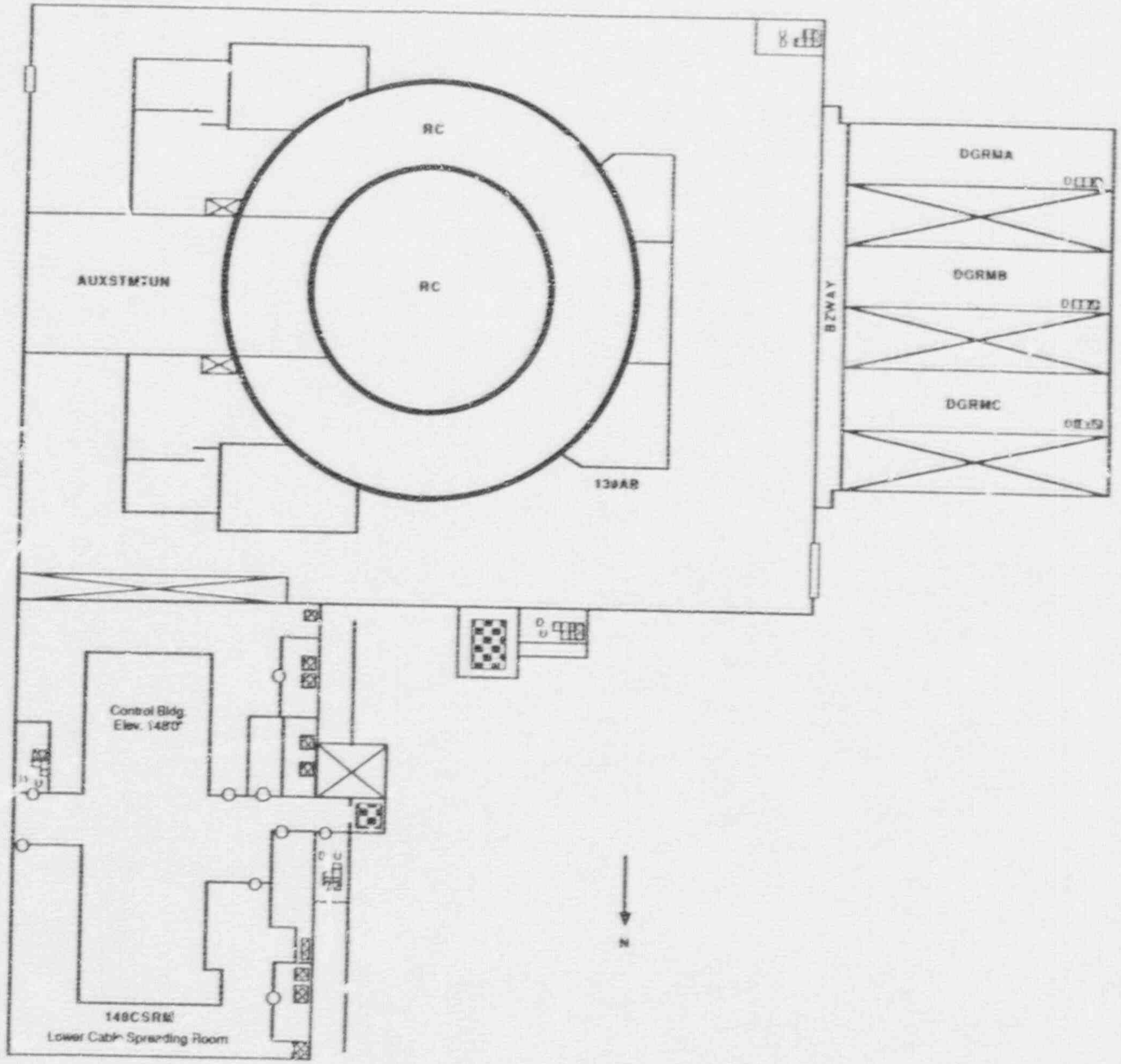


Figure 4-9. Grand Gulf 1 Reactor Building (El. 139'2" to 147'7"), Control Building (El. 148'0"), and Diesel Generator Building (El. 158'0").

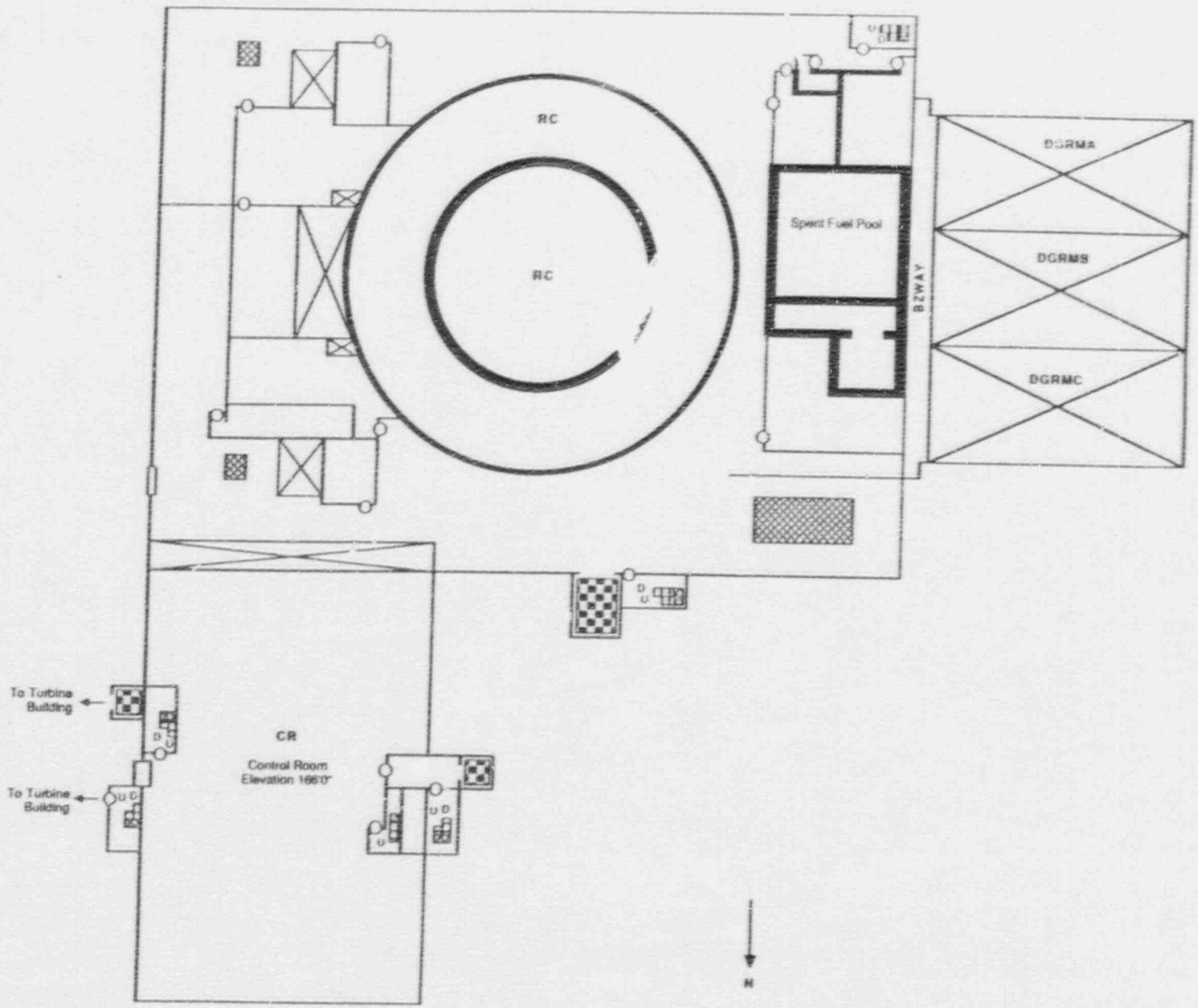


Figure 4-10. Grand Gulf 1 Reactor Building (El. 166'0") and Control Building (El. 166'0"), and Deisel Generator Building (El. 166'0").

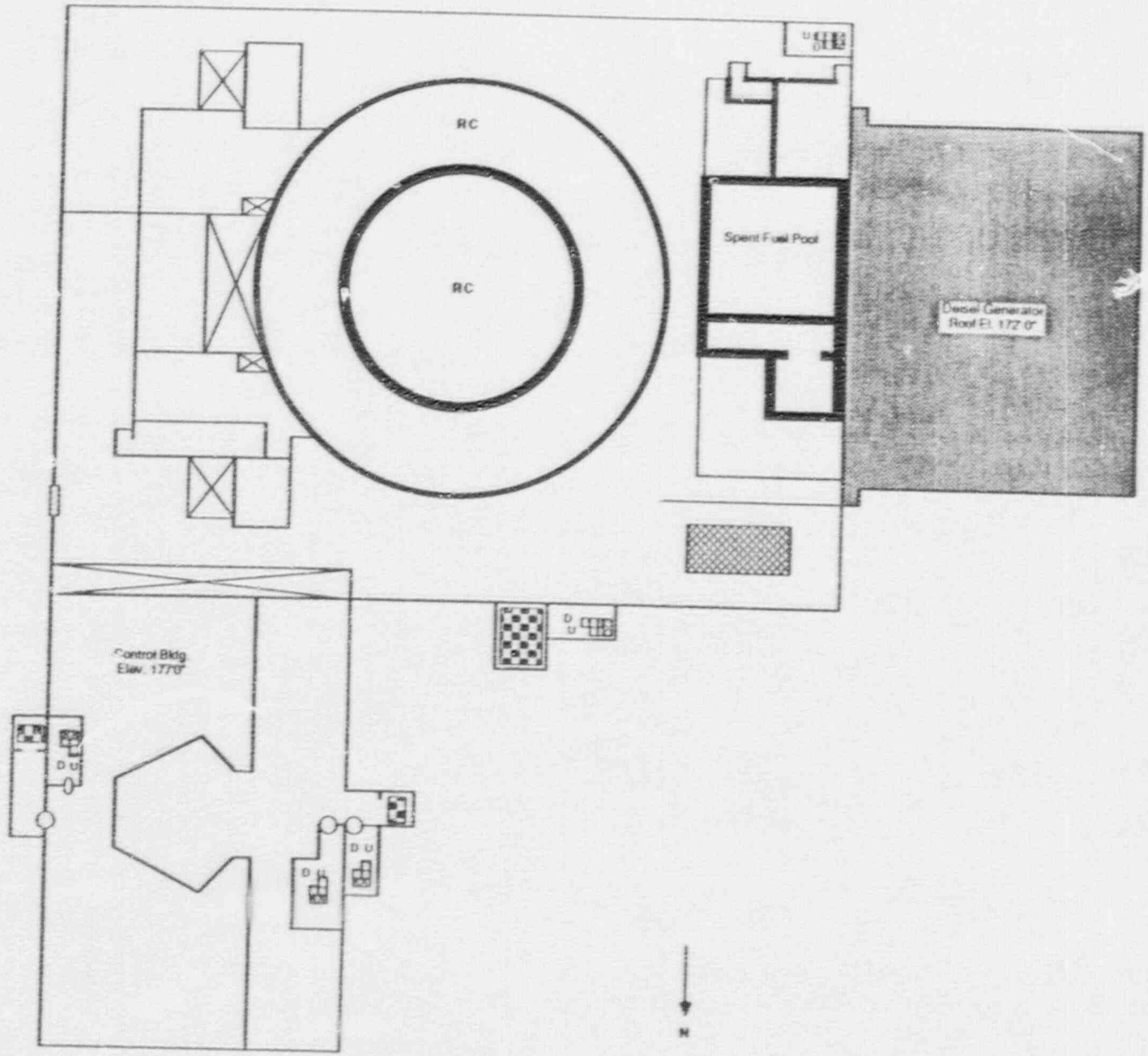


Figure 4-11. Grand Gulf 1 Reactor Building (El. 177'0") and Control Building (El. 177'0"), and Deisel Generator Building (El. 172'0").

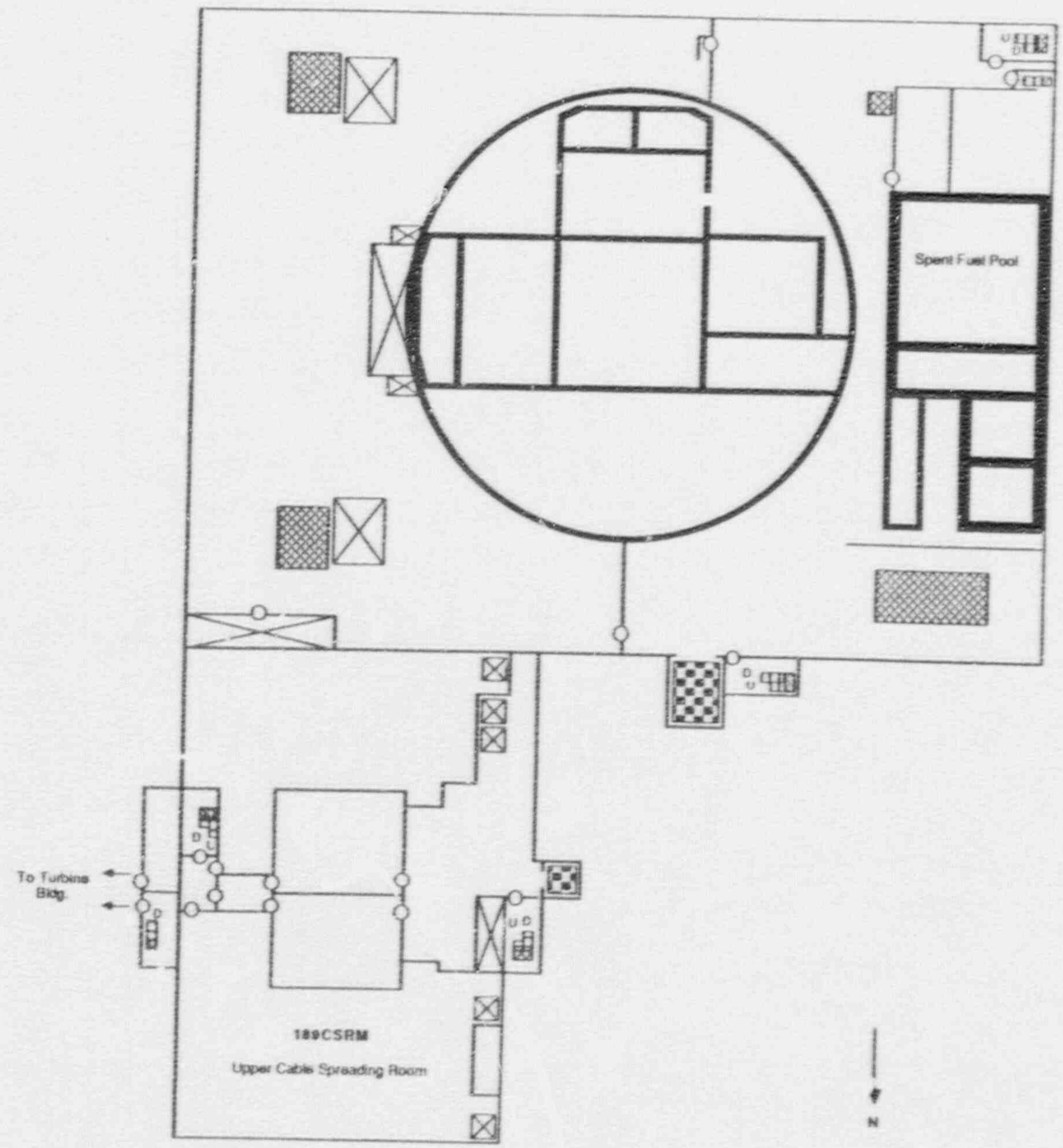


Figure 4-12. Grand Gulf 1 Reactor Building (El. 184'6" to 189'0") and Control Building (El. 189'0")

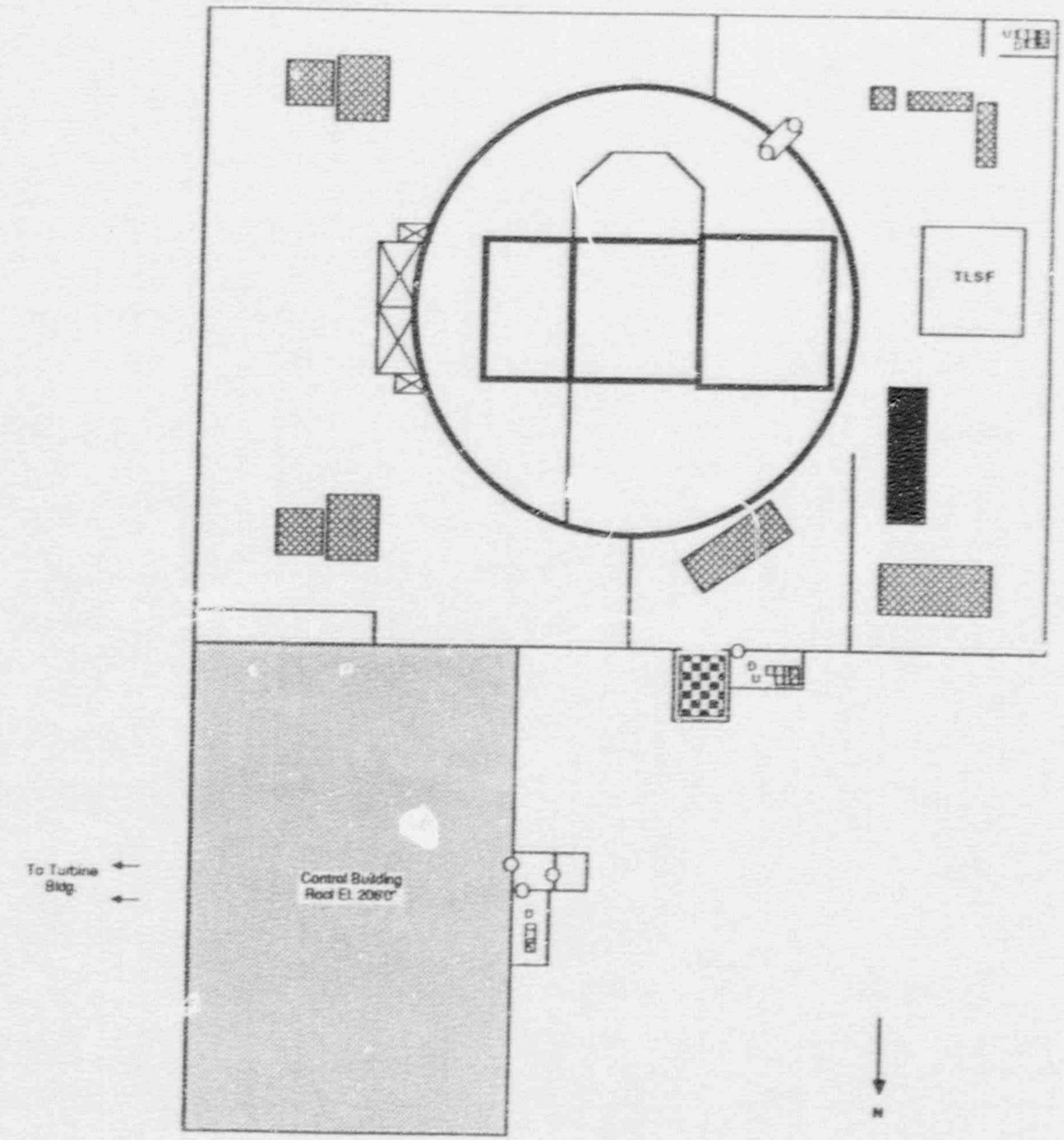


Figure 4-13. Grand Gulf 1 Reactor Building (El. 208'10")

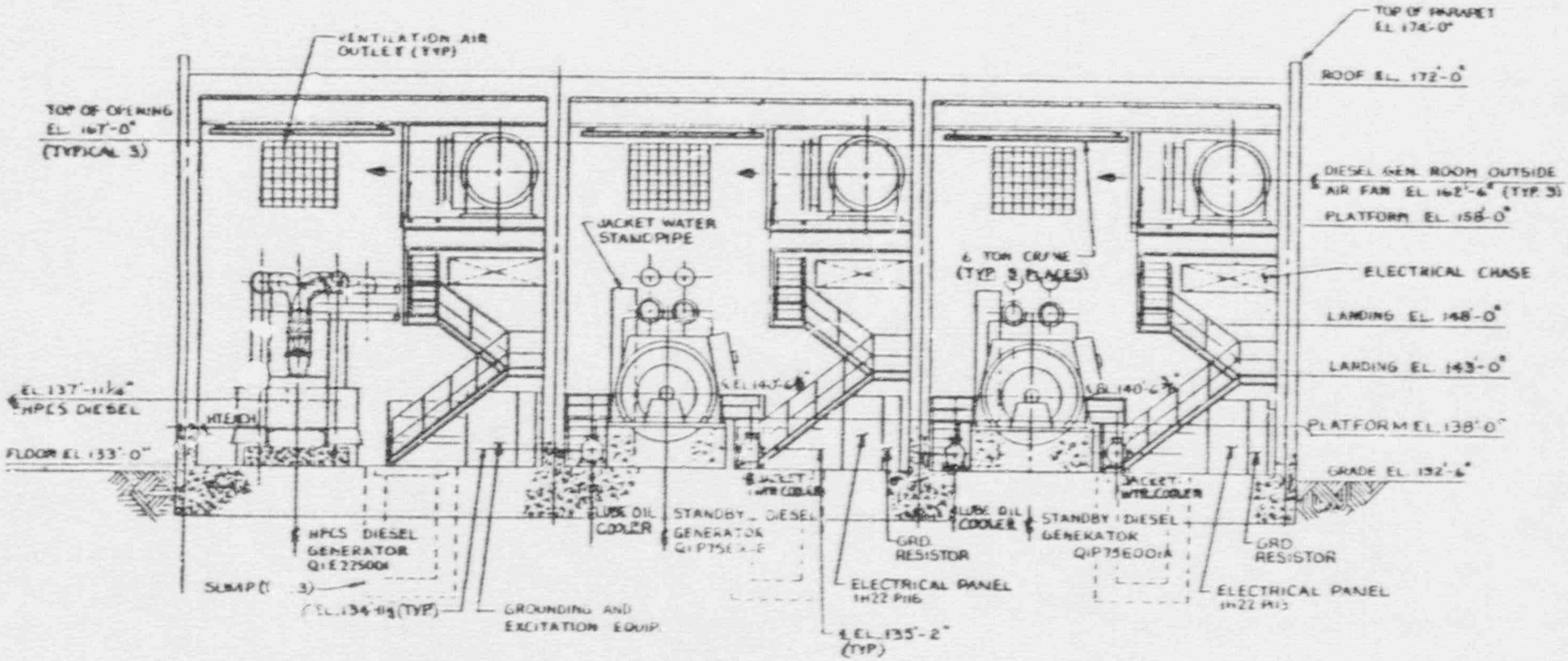


Figure 4-14. Elevation View of Grand Gulf 1 Diesel Building (looking east)

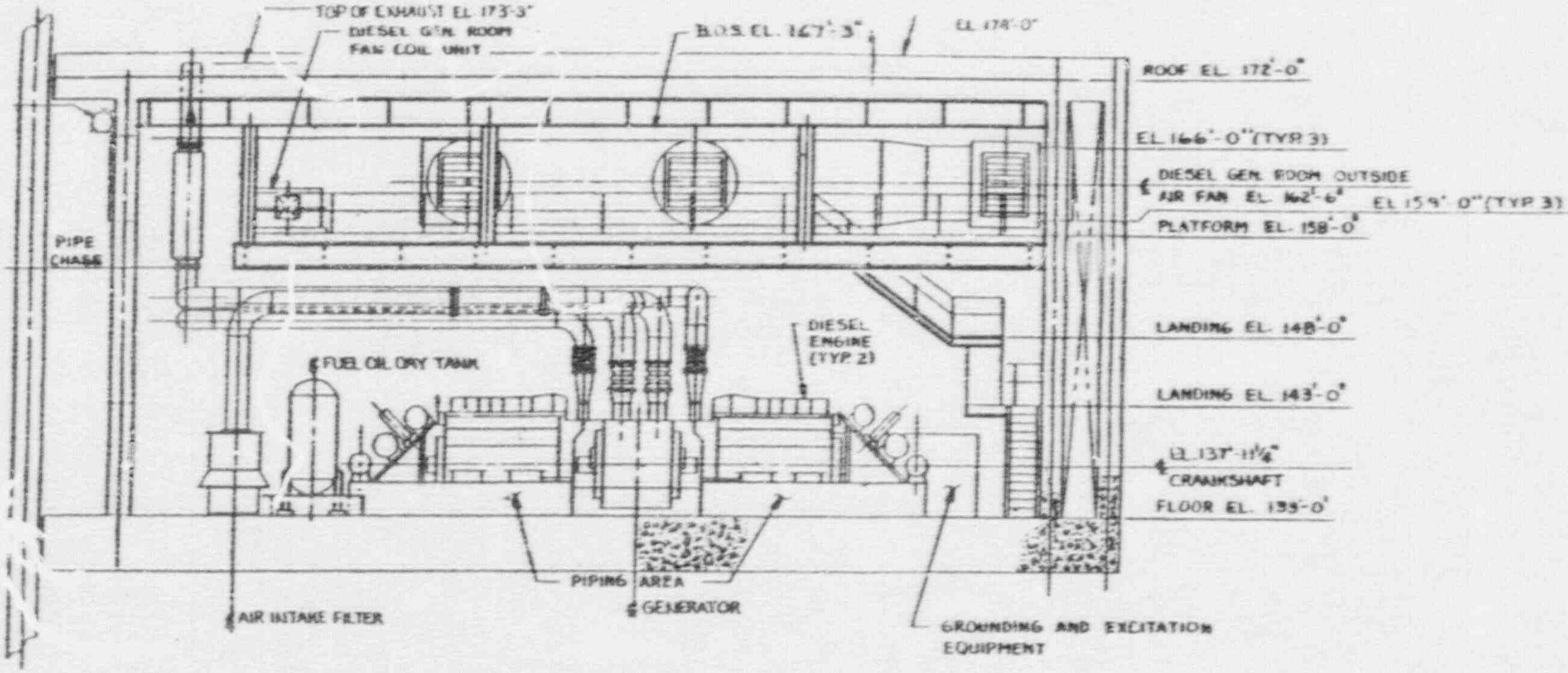


Figure 4-15. Elevation View of Grand Gulf 1 Diesel Building, Typical of Diesel Rooms A and B (looking south)

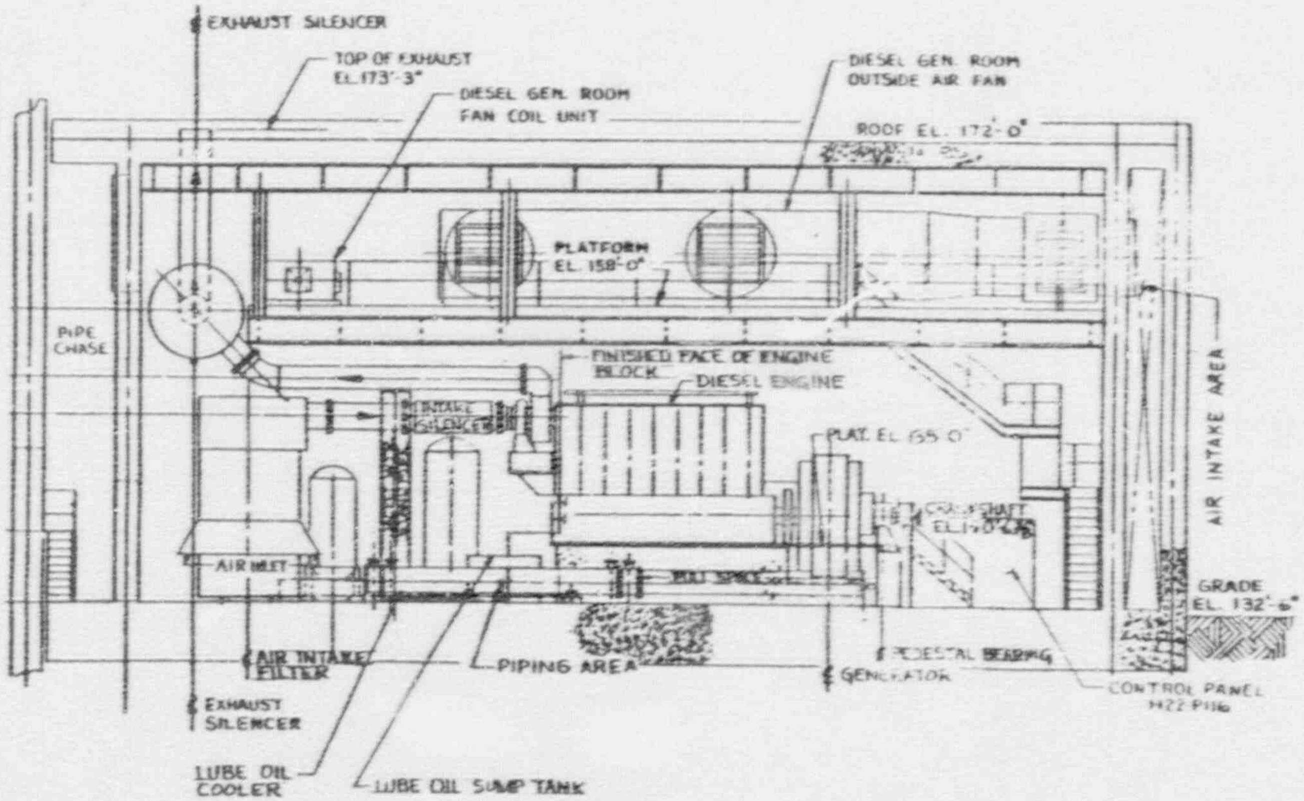


Figure 4-16. Elevation View of Grand Gulf 1 Diesel Building, HPCS Diesel Room (looking south)

2

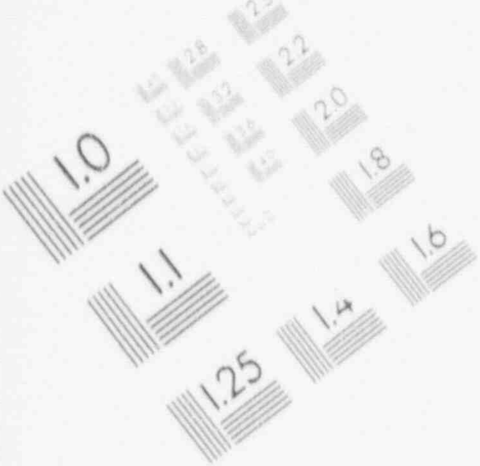
IMAGE EVALUATION TEST TARGET (MT-3)

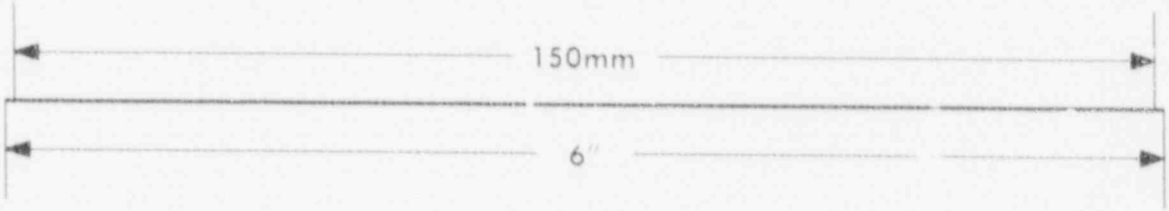
150mm

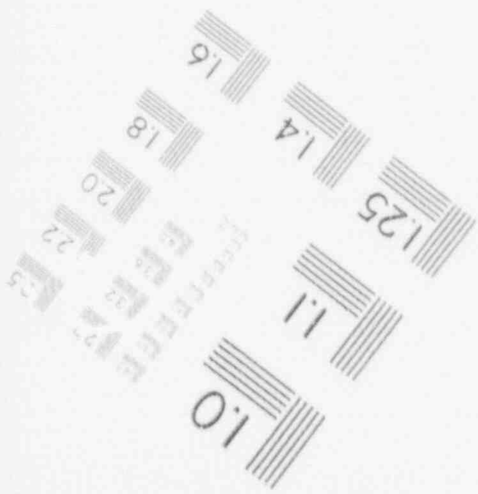
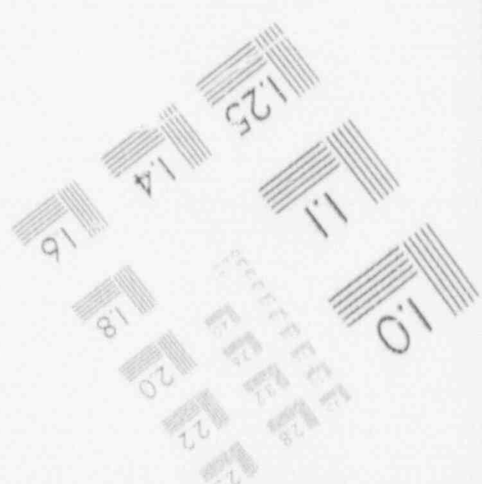
6"

2

IMAGE EVALUATION TEST TARGET (MT-3)





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(716) 265-1600

2

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

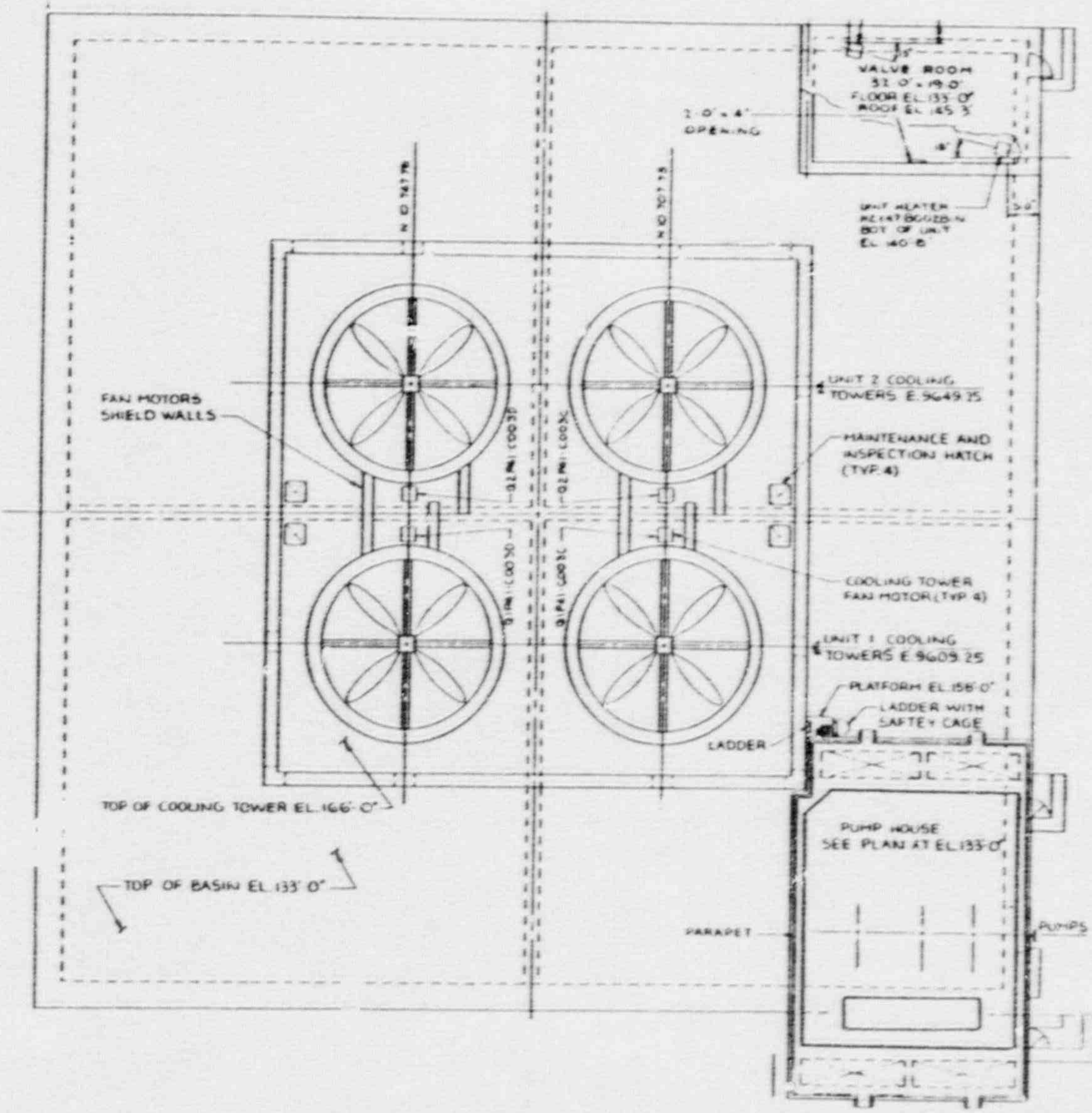


Figure 4-17. Grand Gulf 1 Cooling Tower Basin (Typical of 2)

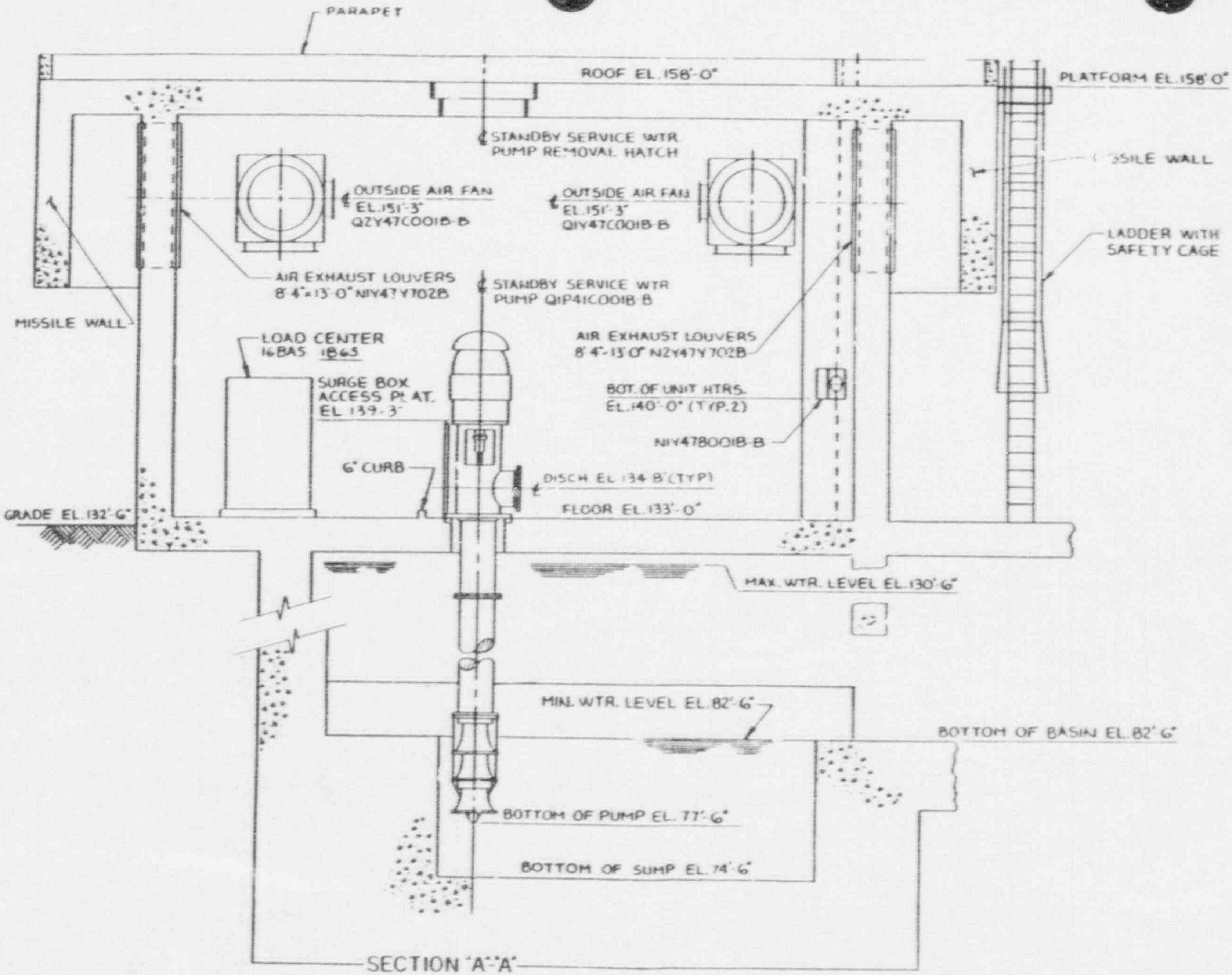


Figure 4-18. Elevation View of Grand Gulf 1 Cooling Tower Pumphouse (Typical of 2)

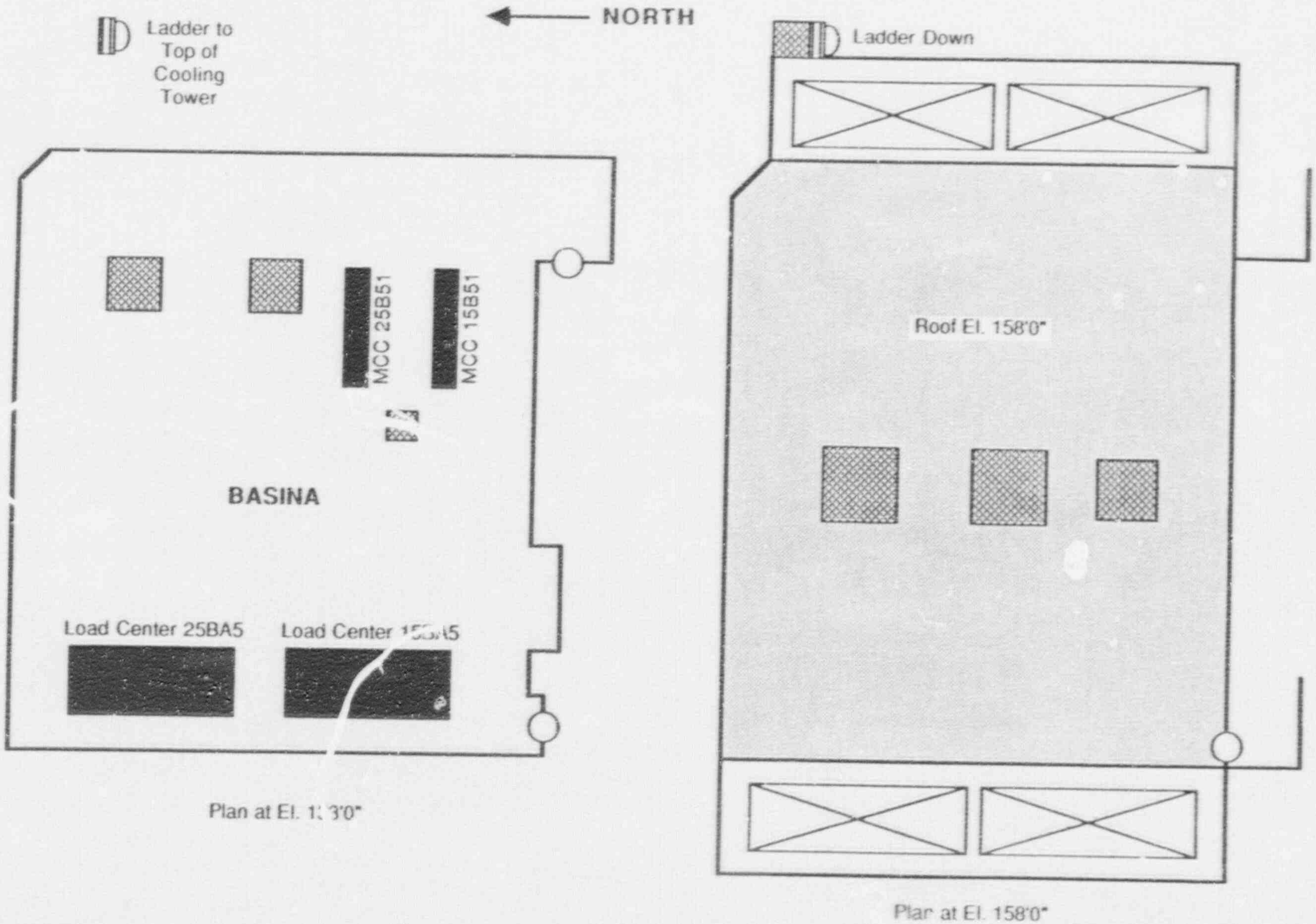
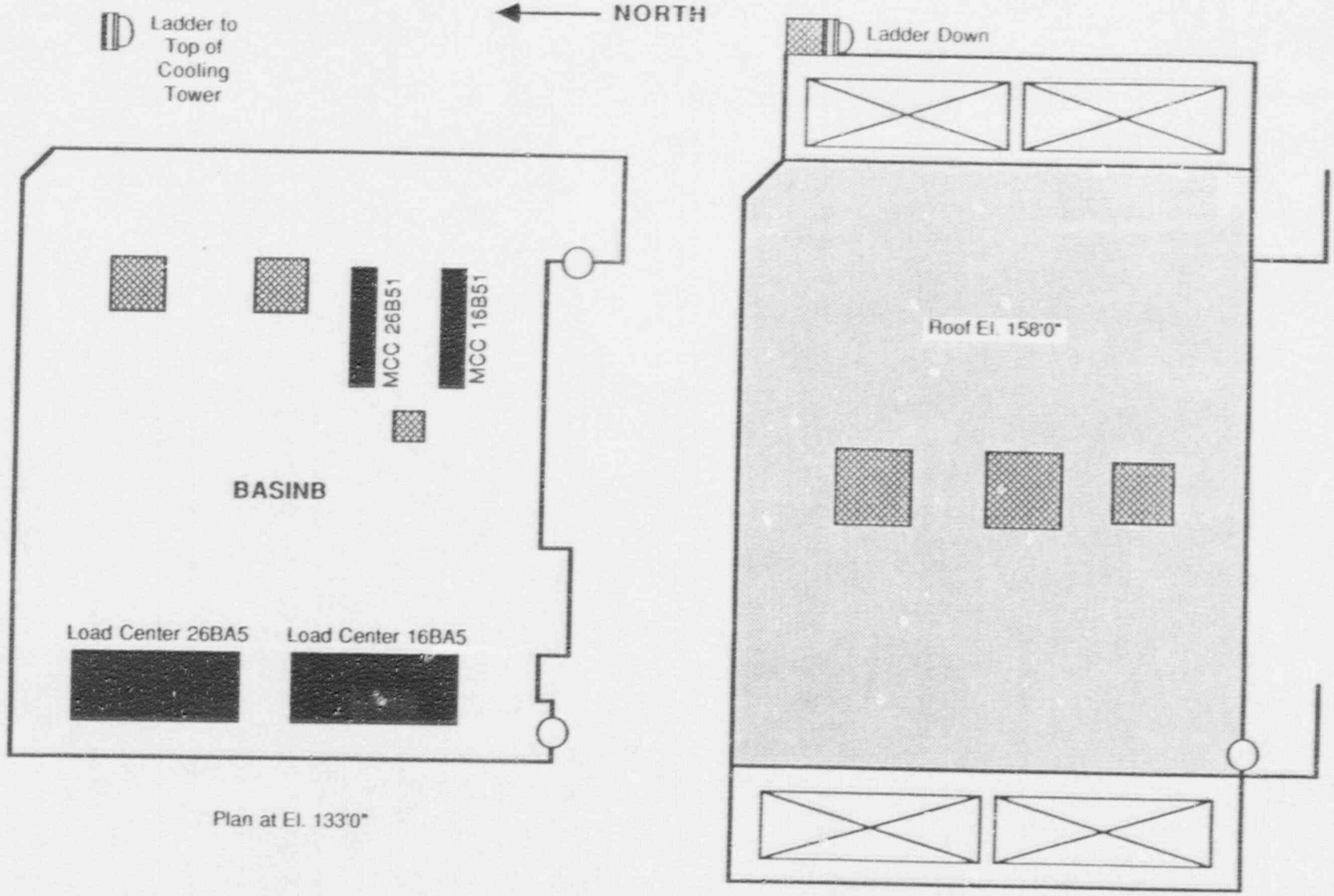


Figure 4-19. Grand Gulf 1 Service Water Cooling Tower Pump House A (Elevations 133'0" and 158'0")



Plan at El. 133'0"

Plan at El. 158'0"

Figure 4-20. Grand Gulf 1 Service Water Cooling Tower Pump House B (Elevations 133'0" and 158'0")

Table 4-1. Definition of Grand Gulf 1 Building and Location Codes

	Codes	Descriptions
1.	93AB	93' elevation of the Auxiliary Building
2.	119AB	119' elevation of the Auxiliary Building
3.	139AB	139' elevation of the Auxiliary Building
4.	148CSRM	Cable Spreading Room, located at the 148' elevation of the Control Building
5.	189CSRM	Cable Spreading Room, located at the 198' elevation of the Control Building
6.	AUXSTMTUN	Auxiliary Steam Tunnel, located on 140' elevation of Auxiliary Building - east side of Reactor Containment
7.	BTRMD1	Battery Room Division I, located on the 111' elevation of the Control Building
8.	BTRMD2	Battery Room Division II, located on the 111' elevation of the Control Building
9.	BTRMD3	Battery Room Division III, located on the 111' elevation of the Control Building
10.	BASINA	Basin A, located in the Standby Service Water Pumphouse
11.	BASINB	Basin B, located in the Standby Service Water Pumphouse
12.	BZWAY	Breeze Way - areas between Auxiliary Building and Diesel Generator Rooms (Pipe Chase just outside of Diesel Generator Rooms)
13.	CR	Control Room, located on the 166' elevation of the Control Building
14.	CST	Condensate Storage Tank, located in the Yard Area - For Unit 1, the CST is located south of the Auxiliary Building of Unit 1.
15.	DGRMA	Diesel Generator Room A, located in Diesel Generator Building
16.	DGRMB	Diesel Generator Room B, located in Diesel Generator Building
17.	DGRMC	Diesel Generator Room C, located in Diesel Generator Building
18.	EHSDRM	Emergency Hot Shutdown Room, located on the 111' elevation of the Control Building

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

Codes	Descriptions
19. HPCSRM	High Pressure Core Spray Room, located on the 93' elevation of the Auxiliary Building
20. LPCSRM	Low Pressure Core Spray Room, located on the 93' elevation of the Auxiliary Building
21. PENRMA220	Penetration Room A220, located on the 119' elevation of the Auxiliary Building - west side of Reactor Containment
22. PENRM1A116	Penetration Room 1A116, located on the 93' elevation of the Auxiliary Building - west side of Reactor Containment
23. RCICRM	Reactor Core Isolation Cooling System Pump Room, located on the 93' elevation of the Auxiliary Building - east side of the Reactor Containment
24. R C	Reactor Containment
25. RHRRMA	Residual Heat Removal System "A" Pump Room , located on the 93' elevation of the Auxiliary Building- east side of the Reactor Containment
27. RHRRMB	Residual Heat Removal System "B" Pump Room , located on the 93' elevation of the Auxiliary Building - east side of the Reactor Containment
28. RHRRMC	Residual Heat Removal System "C" Pump Room , located on the 93' elevation of the Auxiliary Building - west side of the Reactor Containment
29. SWGR15AA	4160V Switchgear 15AA Room, located on the 111' elevation of the Control Building - houses Switchgear 15BA6, MCC 15B61, and DC Switchboard 11DA
30. SWGR16AB	4160V Switchgear 16AB Room, located on the 111' elevation of the Control Building - houses Switchgear 16BB6, MCC 16B61, and DC Switchboard 11DB
31. SWGR17AC	4160V Switchgear 17AC Room, located on the 111' elevation of the Control Building - houses MCC 17B11 and MCC B01
32. SGRM119-9	480V Switchgear Room, located on the 119' elevation of the Auxiliary Building (Area 9) - houses MCC 15B11, Load Center 15BA1, and Load Center 15BA3

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

Codes	Descriptions
33. SGRM119-10	480V Switchgear Room, located on the 119' elevation of the Auxiliary Building (Area 10) - houses MCC 16B11, Load Center 16BB3, and Load Center 16BB1
34. SGRM119-7	480V Switchgear Room, located on the 119' elevation of the Auxiliary Building (Area 7) - houses MCC 15B31 and MCC15B42
35. SGRM119-8	480V Switchgear Room, located on the 119' elevation of the Auxiliary Building (Area 8) - houses MCC B31 and MCC 16B42
36. TLSF	Spent Fuel Pool operating floor, located on the 208' elevation of the Auxiliary Building

TABLE 4-2. PARTIAL LISTING OF COMPONENTS BY LOCATION AT GRAND GULF 1

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
119AB	ECCS	HPCS-4	MOV
93AB	SSW	SSW-014A	MOV
93AB	SSW	SSW-014B	MOV
93AB	SSW	SSW-014A	MOV
93AB	SSW	SSW-068A	MOV
93AB	SSW	SSW-014B	MOV
93AB	SSW	SSW-068B	MOV
BASINA	SSW	SSW-001A	MOV
BASINA	SSW	SSW-005A	MOV
BASINA	SSW	SSW-006A	MOV
BASINA	SSW	SSW-C001A	MDP
BASINA	SSW	SSW-011C	MOV
BASINA	SSW	SSW-C002C	MDP
BASINB	SSW	SSW-001B	MOV
BASINB	SSW	SSW-005B	MOV
BASINB	SSW	SSW-006B	MOV
BASINB	SSW	SSW-C001B	MDP
BTRMD1	EP	EP-BT-11DA	BATT
BTRMD2	EP	EP-BT-11DB	BATT
BTRMD3	EP	EP-BT-11DC	BATT
CST	ECCS	CST	TANK
CST	RCIC	CST	TANK
DGRMA	EP	EP-DG-11	DG
DGRMA	EP	DG-018A	MOV
DGRMB	EP	EP-DG-12	DG
DGRMB	EP	DG-018B	MOV
DGRMC	EP	EP-DG-13	DG
DGRMC	EP	EP-DCMCC-11DC	MCC
DGRMC	EP	EP-DCMCC-11DC	MCC
HPCSRM	ECCS	HPCS-1	MOV

TABLE 4-2. PARTIAL LISTING OF COMPONENTS BY LOCATION AT GRAND GULF 1 (CONTINUED)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
HPCSRM	ECCS	HPCS-15	MOV
HPCSRM	ECCS	HPCS-23	MOV
HPCSRM	ECCS	HPCS-10	MOV
HPCSRM	ECCS	HPCS-11	MOV
HPCSRM	ECCS	HPCS-P1	MDP
LPCSRM	ECCS	LPCS-1A	MOV
LPCSRM	ECCS	LPCS-12A	MOV
LPCSRM	ECCS	LPCS-P1	MDP
PENRMA220	ECCS	LPCS-5A	MOV
RC	ECCS	SUPP POOL	TANK
RC	ECCS	SUPP POOL	TANK
RC	ECCS	SUPP POOL	TANK
RC	ECCS	RHR-42A	MOV
RC	ECCS	RHR-42B	MOV
RC	ECCS	RHR-28A	MOV
RC	ECCS	RHR-28B	MOV
RC	ECCS	SUPP-POOL	TANK
RC	ECCS	RHR-28A	MOV
RC	ECCS	RHR-37A	MOV
RC	ECCS	RHR-37B	MOV
RC	ECCS	RHR-28B	MOV
RC	RCIC	SUPP POOL	TANK
RC	RCIC	RCIC-63B	MOV
RC	RCS	RCS-1B	MOV
RC	RCS	RCS-250A	MOV
RC	RCS	RHR-9B	MOV
RC	RCS	RCS-16B	MOV
RC	RCS	RCIC-63B	MOV
RCICRM	RCIC	RCIC-10A	MOV
RCICRM	RCIC	RCIC-31A	MOV

TABLE 4-2. PARTIAL LISTING OF COMPONENTS BY LOCATION AT GRAND GULF 1 (CONTINUED)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RCICRM	RCIC	RCIC-19A	MOV
RCICRM	RCIC	RCIC-22A	MOV
RCICRM	RCIC	RCIC-59A	MOV
RCICRM	RCIC	RCIC-13A	MOV
RCICRM	RCIC	RCIC-P1	TDP
RCICRM	RCIC	RCIC-TTV	MOV
RCICRM	RCIC	RCIC-64A	MOV
RCICRM	RCIC	RCIC-TGV	HV
RCICRM	RCIC	RCIC-45A	MOV
RCICRM	RCIC	RCIC-46A	MOV
RCICRM	RCS	RCIC-64A	MOV
RHRRMA	ECCS	RHR-24A	MOV
RHRRMA	ECCS	RHR48A	MOV
RHRRMA	ECCS	RHR-3A	MOV
RHRRMA	ECCS	RHR-87A	MOV
RHRRMA	ECCS	RHR-52A	MOV
RHRRMA	ECCS	RHR-27A	MOV
RHRRMA	ECCS	RHR-47A	MOV
RHRRMA	ECCS	RHR-53A	MOV
RHRRMA	ECCS	RHR-4A	MOV
RHRRMA	ECCS	RHR-6A	MOV
RHRRMA	ECCS	RHR-C002A	MDP
RHRRMA	ECCS	RHR-27A	MOV
RHRRMA	ECCS	RHR-53A	MOV
RHRRMA	ECCS	RHR-B001A	HX
RHRRMA	ECCS	RHR-48A	MOV
RHRRMA	ECCS	RHR-24A	MOV
RHRRMA	ECCS	RHR-B002A	HX
RHRRMA	RCS	RHR-8A	MOV
RHRRMB	ECCS	RHR-24B	MOV

TABLE 4-2. PARTIAL LISTING OF COMPONENTS BY LOCATION AT GRAND GULF 1 (CONTINUED)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RHRRMB	ECCS	RHR-48B	MOV
RHRRMB	ECCS	RHR-3B	MOV
RHRRMB	ECCS	RHR-87B	MOV
RHRRMB	ECCS	RHR-52B	MOV
RHRRMB	ECCS	RHR-27B	MOV
RHRRMB	ECCS	RHR-47B	MOV
RHRRMB	ECCS	RHR-53B	MOV
RHRRMB	ECCS	RHR-4B	MOV
RHRRMB	ECCS	RHR-6B	MOV
RHRRMB	ECCS	RHR-C002B	MDP
RHRRMB	ECCS	RHR-53B	MOV
RHRRMB	ECCS	RHR-27B	MOV
RHRRMB	ECCS	RHR-B001B	HX
RHRRMB	ECCS	RHR-48B	MOV
RHRRMB	ECCS	RHR-24B	MOV
RHRRMB	ECCS	RHR-B002B	HX
RHRRMC	ECCS	RHR-21B	MOV
RHRRMC	ECCS	RHR-4C	MOV
RHRRMC	ECCS	RHR-42C	MOV
RHRRMC	ECCS	RHR-C002C	MDP
SGRM119-10	EP	EP-BS-16BB3	BUS
SGRM119-10	EP	EP-BS-16BB1	BUS
SGRM119-10	EP	EP-MCC-16B11	MCC
SGRM119-7	EP	EP-MCC-15B31	MCC
SGRM119-7	EP	EP-DC-1DA2	PNL
SGRM119-8	EP	EP-MCC-16B31	MCC
SGRM119-9	EP	EP-BS-15BA1	BUS
SGRM119-9	EP	EP-BS-15BA3	BUS
SGRM119-9	EP	EP-MCC-15B11	MCC
SWGR15AA	EP	EP-BS-15AA	BUS

TABLE 4-2. PARTIAL LISTING OF COMPONENTS BY LOCATION AT GRAND GULF 1 (CONTINUED)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
SWGR15AA	EP	EP-CB-C15AA	CB
SWGR15AA	EP	EP-TR-15PA1	TRAN
SWGR15AA	EP	EP-TR-2A91	TRAN
SWGR15AA	EP	EP-DCMCC-11DA	MCC
SWGR15AA	EP	EP-DC-1DA4	INV
SWGR15AA	EP	EP-DC-1DA5	INV
SWGR15AA	EP	EP-TR-15PA6	TRAN
SWGR15AA	EP	EP-BS-15BA6	BUS
SWGR15AA	EP	EP-MCC-15B61	MCC
SWGR15AA	EP	EP-BS-15AA	BUS
SWGR15AA	EP	EP-DCMCC-11DA	MCC
SWGR15AA	EP	EP-DCMCC-11DA	MCC
SWGR16AB	EP	EP-BS-16AB	BUS
SWGR16AB	EP	EP-CB-C16AB	CB
SWGR16AB	EP	EP-TR-16PB3	TRAN
SWGR16AB	EP	EP-TR-16PB1	TRAN
SWGR16AB	EP	EP-DCMCC-11DB	MCC
SWGR16AB	EP	EP-DC-1DB4	INV
SWGR16AB	EP	EP-DC-1DB5	INV
SWGR16AB	EP	EP-TR-16PB6	TRAN
SWGR16AB	EP	EP-BS-16BB6	BUS
SWGR16AB	EP	EP-MCC-16B61	MCC
SWGR16AB	EP	EP-BS-16AB	BUS
SWGR16AB	EP	EP-DCMCC-11DB	MCC
SWGR16AB	EP	EP-DCMCC 11DB	MCC
SWGR17AC	EP	EP-BS-17AC	BUS
SWGR17AC	EP	EP-CB-C17AC	CB
SWGR17AC	EP	EP-BS-17B01	BUS
SWGR17AC	EP	EP-TR-17P01	TRAN
SWGR17AC	EP	EP-MCC-17B11	MCC

TABLE 4-2. PARTIAL LISTING OF COMPONENTS BY LOCATION AT GRAND GULF 1 (CONTINUED)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
SWGR17AC	EP	EP-BS-17AC	BUS

5. BIBLIOGRAPHY FOR GRAND GULF

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2. NUREG-0831 "Safety Evaluation Report Related to the Operation of the Grand Gulf Nuclear Station, Units 1 and 2", USNRC

3. NUREG-0934 "Technical Specifications for Grand Gulf Nuclear Station, Unit 1", USNRC

4. NUREG/CR-0383 "Tornado Damage at the Grand Gulf, Miss., Nuclear Power Plant Site: Aerial and Ground Surveys", Texas Tech. University and University of Chicago, October 1978

5. Cummings, J.C., et.al., "Review of the Grand Gulf Hydrogen Igniter System", NUREG/CR-2530, Sandia National Laboratories, March 1983

6. NUREG/CR-4550, Volume 6, "Analysis of Core Damage Frequency From Internal Events: Grand Gulf Unit 1", Sandia National Laboratories and Science Applications International Corp., April 1987

7. NUREG/CR-4551, Volume 4, "Evaluation of Severe Accident Risks and the Potential for Risk Reduction: Grand Gulf Unit 1", Sandia National Laboratories and Science Applications International Corp., April 1987

8. NUREG/CR-4700, Volume 4, "Containment Event Analysis for Postulated Severe Accidents: Grand Gulf Unit 1", Sandia National Laboratories and Science Applications International Corp., April 1987

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)

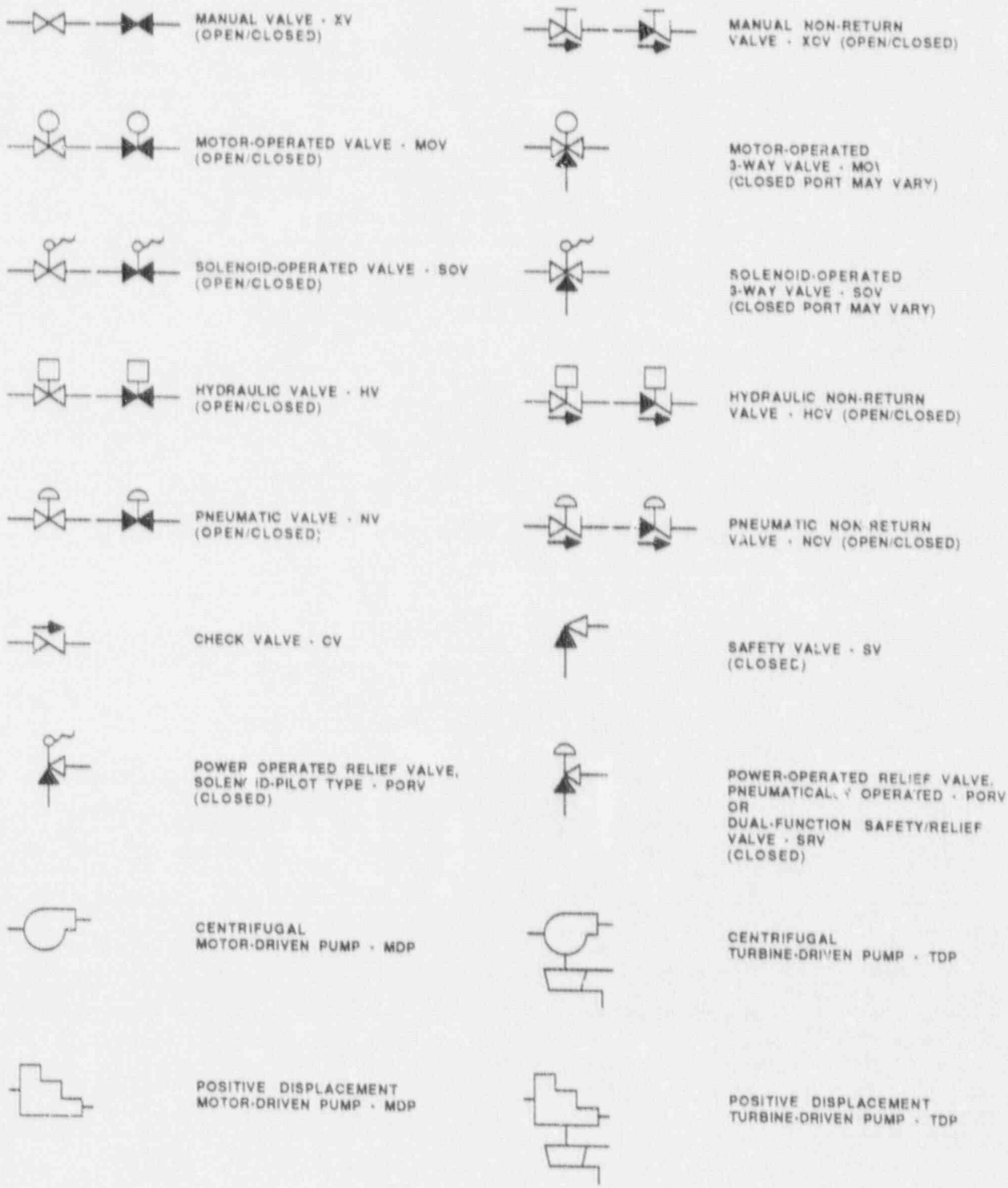

Figure A-1. Key To Symbols In Fluid System Drawings

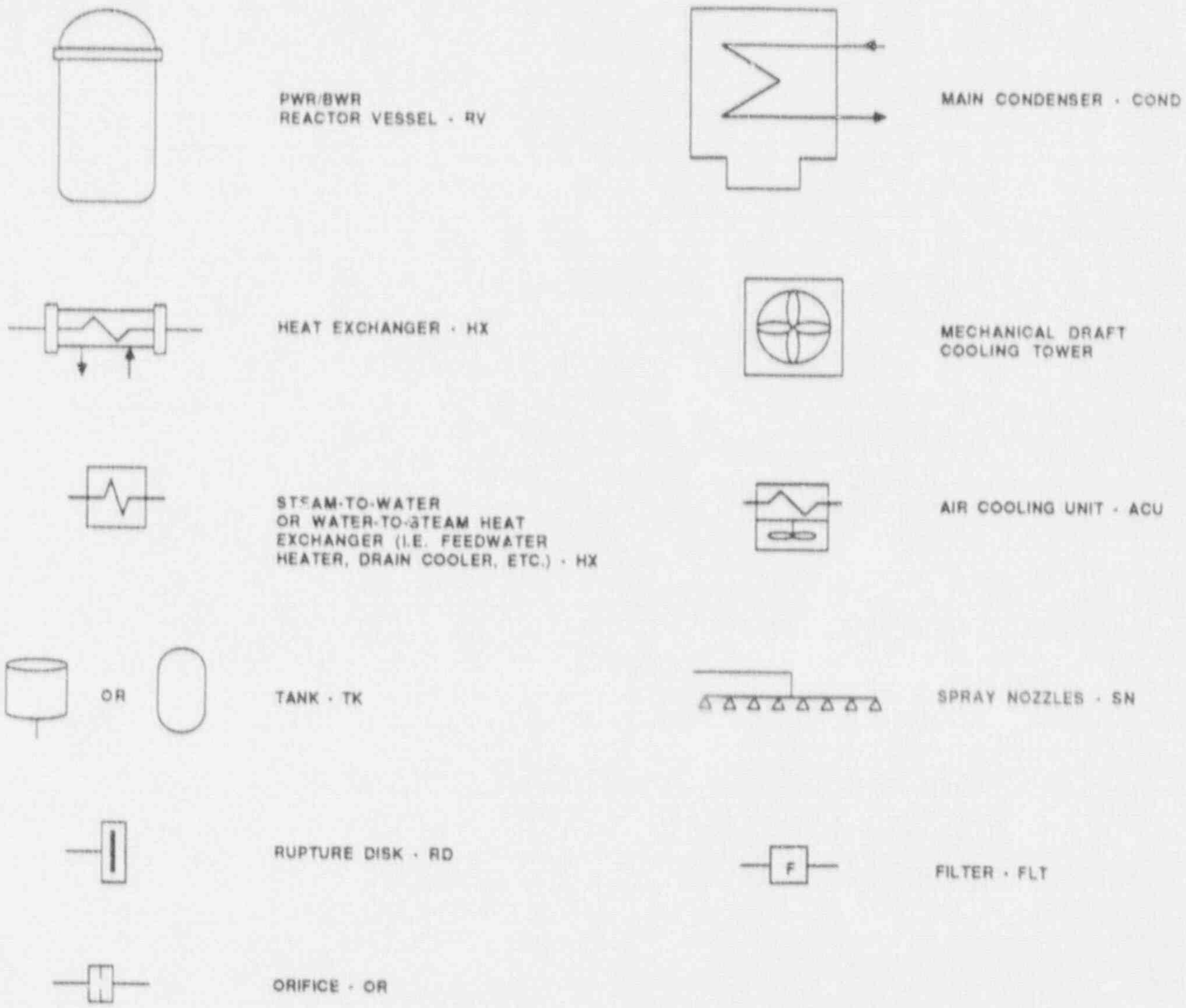

Figure A-1. Key To Symbols In Fluid System Drawings (Continued)

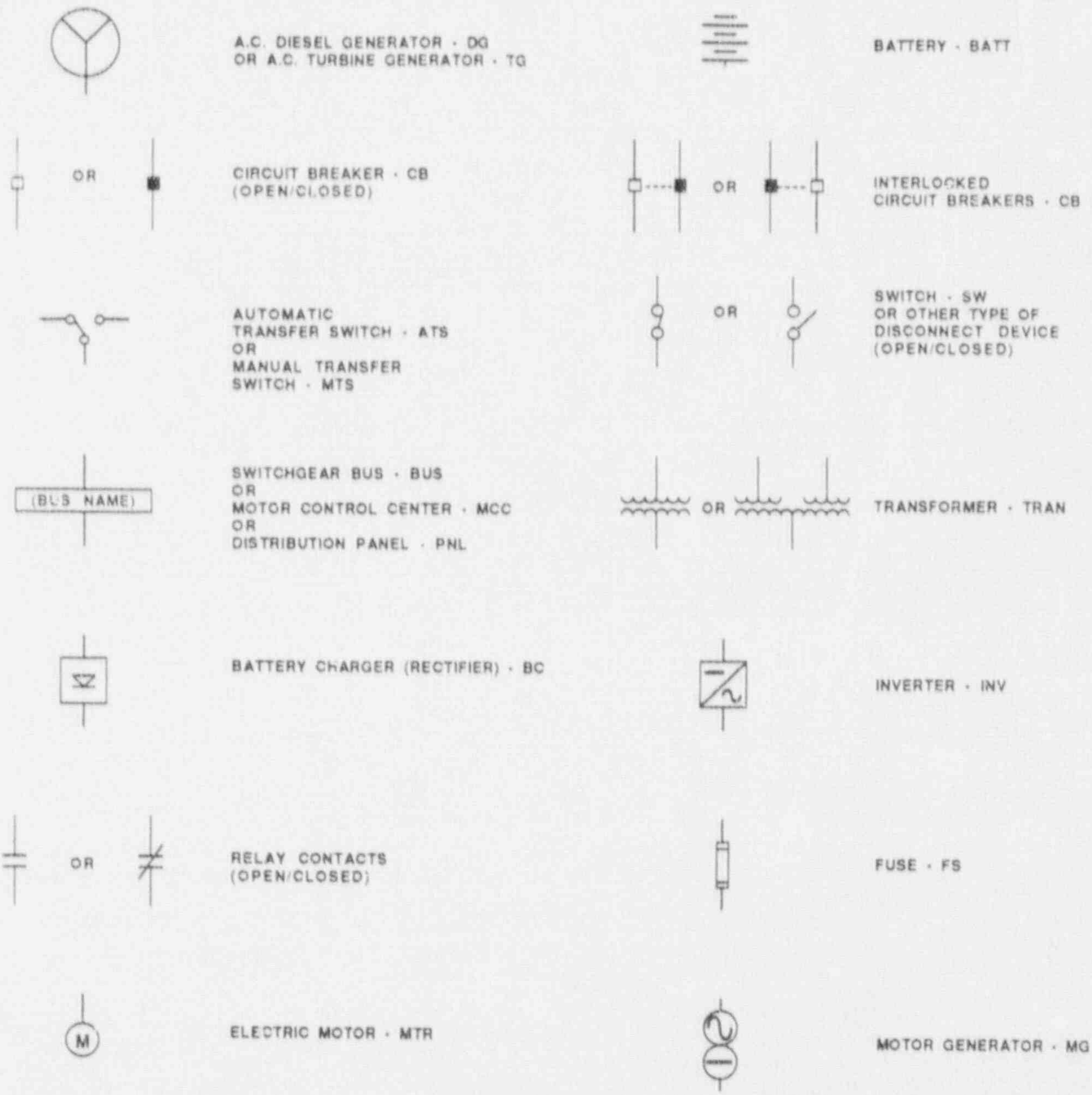

Figure A-2. Key To Symbols In Electrical System Drawings

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
RCIC	Reactor Core Isolation Cooling System
ECCS	Emergency Core Cooling System (including HPCS, LPCS, LPCI, and ADS)
I&C	Instrumentation and Control Systems
EP	Electric Power System
SW	Shutdown 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