NUCLEAR POWER PLANT
SYSTEM SOURCEBOOK

PERRY 1 & 2

50-440 and 50-441

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NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

PERRY 1 & 2

50-440 and 50-441

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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.

PERRY 1 & 2
RECORD OF REVISIONS

REVISION	ISSUE	COMMENTS
0	11/89	Original report

PERRY 1 & 2 SYSTEM SOURCEBOOK

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

1. SUMMARY DATA ON PLANT

Basic information on the Perry nuclear plant is listed below:

- Docket number	50-440 (Unit 1) and 50-441 (Unit 2)
- Operator	Cleveland Electric Illuminating Company
- Location	Lake County, Ohio
- Commercial operation date	11/87 (Unit 1), Unit 2 is indefinitely postponed
- Reactor type	BWR/6
- NSSS vendor	General Electric
- Power (MWt/MWe)	3579/1205
- Architect-engineer	Gilbert Associates, Inc.
- Containment type	Mark III

2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

The Perry nuclear plant has a single completed General Electric BWR/6 nuclear steam supply system on the site. The unit has a Mark III BWR containment incorporating the drywell/pressure suppression concept, and has a secondary containment structure of reinforced concrete. Other BWR/6 plants in the United States are as follows:

- Clinton 1
- Grand Gulf 1
- River Bend 1

The Perry plant has a high pressure core spray system, a reactor core isolation cooling system capable of steam-condensing operation in conjunction with the RHR system, a low pressure core spray system, and a multi-mode RHR system.

3. SYSTEM INFORMATION

This section contains descriptions of selected systems at Perry 1 and 2 in terms of general function, operation, system success criteria, major components, and support system requirements. A summary of major systems at Perry 1 and 2 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 Perry 1 & 2 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)	Same		
- High-Pressure Injection & Recirculation	High-Pressure Core Spray (HPCS) System	3.3	6.3
- Low-Pressure Injection & Recirculation	Low-Pressure Core Spray (LPCI)	3.3	5.4.7.1.1.2, 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
- Main Steam and Power Conversion Systems	Main Steam Supply System,	X	10.3
	Condensate and Feedwater Systems,	X	10.4.7
	Circulating Water System	X	10.4.5
- Other Heat Removal Systems	Steam-condensing RHR/RCIC operation	3.2	5.4.6.2.5.3, 5.4.7.1.1.5

Table 3-1. Summary of Perry 1 & 2 Systems Covered in this Report (Continued)

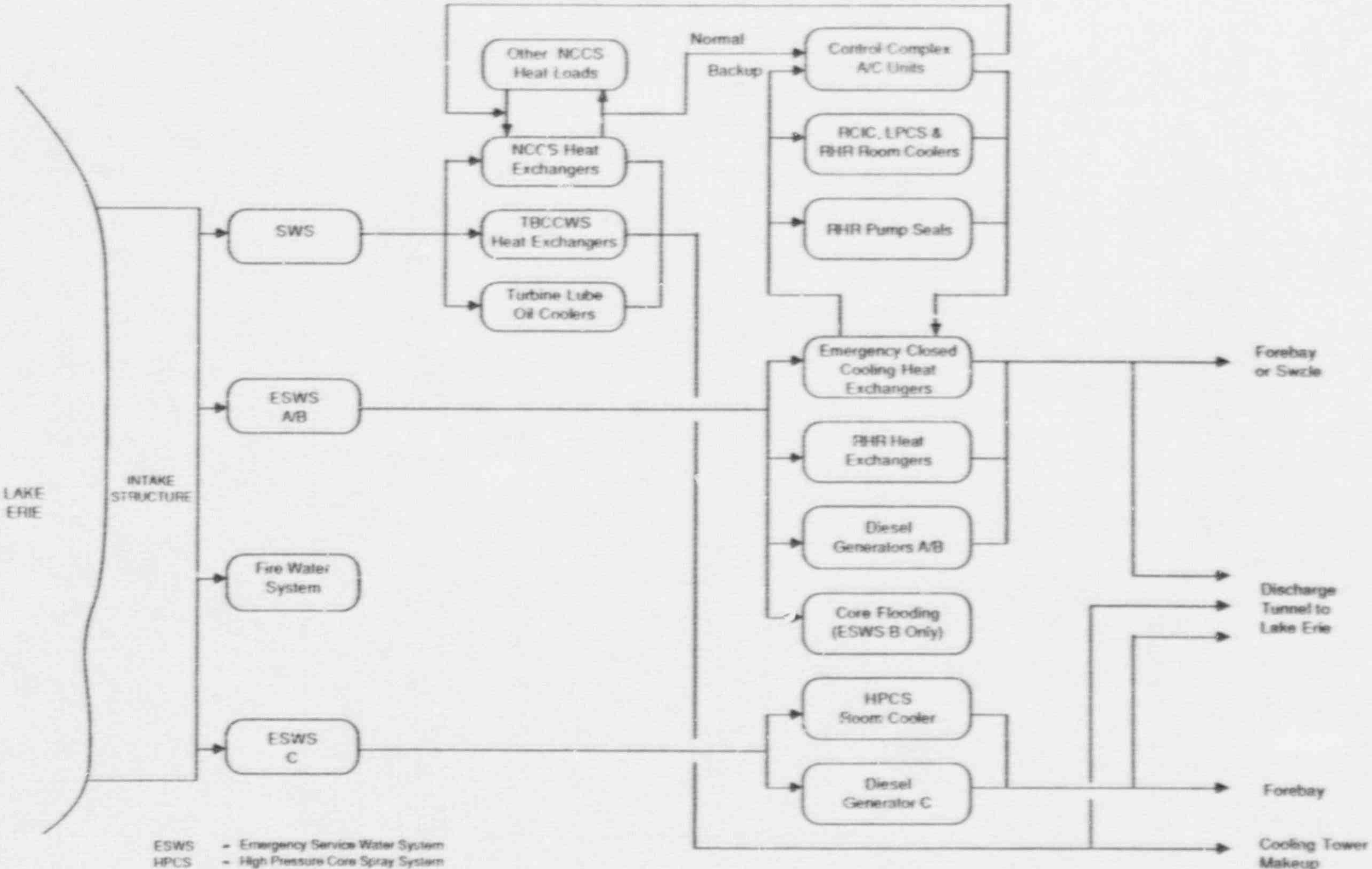
Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor Coolant Inventory Control Systems			
- Reactor Water Cleanup (RWCU) System	Same	X	5.4.8
- ECCS	See above	-	-
- Control Rod Drive Hydraulic System (CRDHS)	Same	3.6	4.6.1.1.2.4
Containment Systems			
- Primary Containment	Same (drywell and pressure suppression chamber)	X	6.2.1
- Secondary Containment	Same	X	6.2.3
- Standby Gas Treatment System (SGTS)	Annulus Exhaust Gas Treatment System	X	6.5.3
- Containment Heat Removal Systems			
- Suppression Pool Cooling System	Suppression Pool Cooling Mode (an operating mode of the RHR system)	3.3	5.4.7.1.1.3, 6.2.2
- Containment Spray System	Same (an operating mode of the RHR system)	3.3	6.2.2, 6.5.2
- Containment Fan Cooler System	Reactor Building Ventilation System	X	9.4.6
- Containment Normal Ventilation Systems	Drywell Cooling System,	X	9.4.6.2
	Cont inment Vessel Cooling System,	X	9.4.6.2
	Containment Vessel and Drywell Purge System	X	9.4.6.2
- Combustible Gas Control Systems	Same	X	6.2.5

Table 3-1. Summary of Perry 1 & 2 Systems Covered ' 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 (CRD) System	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)	Engineered Safety Feature Systems	3.4	7.3
- Remote Shutdown System	Same	3.4	7.4.1.4
- Other I&C Systems	Various Other Systems	X	7.5 to 7.7
Support Systems			
- Class 1E Electric Power System	Same	3.5	8.3
- Non-Class 1E Electric Power System	Same	3.5	82, 8.3
- Diesel Generator Auxiliary Systems	Same	3.5	8.3.1.1.3.2, 8.3.1.1.3.3, 9.5.4 to 9.5.9
- Component Cooling Water (CCW) System	Emergency Closed Cooling System	3.8	9.2.2

Table 3-1. Summary of Perry 1 & 2 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)	Same	X	9.2.7
- Residual Heat Removal Service Water (RHRSW) System	Emergency Service Water (ESW) System	3.7	9.2.1
- Other Cooling Water Systems	Nuclear Closed Cooling System	X	9.2.8
	Turbine Building Closed Cooling System	X	9.2.9
- Fire Protection Systems	Same	X	9.5.1
- Heating, Ventilating, and Air-Conditioning (HVAC) Systems	Same	X	9.4
- Instrument and Service Air Systems	Compressed Air Systems	X	9.3.1
- Refueling and Fuel Storage Systems	Fuel Storage and Handling	X	9.1
- Radioactive Waste Systems	Radioactive Waste Management Systems	X	11
- Radiation Protection Systems	Same	X	12



ESWS - Emergency Service Water System
HPCS - High Pressure Core Spray System
LPCS - Low Pressure Core Spray System
NCCS - Nuclear Closed Cooling System
RCIC - Reactor Core Isolation Cooling System
RHR - Residual Heat Removal System
SWS - Service Water System
TBCCWS - Turbine Building Closed Cooling Water System

Note: Cooling water systems for Perry 2 are similar except that the Perry 2 Emergency Closed Cooling System and NCCS provide cooling to the spent fuel pool heat exchangers rather than the control complex chillers.

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

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) two recirculation pumps, (d) 19 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.

A portion 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 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 by the Residual Heat Removal (RHR) System operating in the containment cooling mode. The Emergency Service Water System completes the heat transfer path from the containment to the ultimate heat sink (see Section 3.7). Actuation systems provide for automatic closure of the MSIVs and isolation of other lines connected to the RCS.

RCS overpressure protection is provided by nineteen safety/relief valves which discharge to the suppression pool.

3.1.4 System Success Criteria

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

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

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

3.1.5 Component Information

A. RCS
1. Steam flow: 15.4×10^6 lb/hr
2. Normal operating pressure: 1040 psia

B. Safety/relief Valves (19)
1. Set pressure: 8 @ 1165 psig, 895,000 lb/hr (each)
   6 @ 1180 psig, 906,000 lb/hr (each)
   5 @ 1190 psig, 913,000 lb/hr (each)

C. Recirculation Pumps (2)
1. Rated flow: 42,000 gpm
2. Type: Constant speed, vertical, solid shaft, totally enclosed, air-water cooled induction motor.

D. Jet Pumps (20)
1. Rated flow: 104.0×10^6 lb/hr (total)

3.1.6 Support Systems and Interfaces

A. Motive Power
The recirculation pumps are powered from 13.8 kV non-Class 1E buses.

B. MSIV Operating Power
The MSIVs are operated by pneumatic pressure and by the action of compressed springs. The control unit is attached to the air cylinder. This unit contains air pilot valves and solenoid operated valves. The solenoid valves control opening and closing of the air valves and provide exercising capability at slow speed. Remote manual switches in the control room enable the operator to operate the valves. Operating air is supplied to the valves from the plant air system. An air tank between the control valve and a check valve provides backup operating air.

C. Recirculation Pump Cooling
The system providing recirculation pump cooling has not been identified.

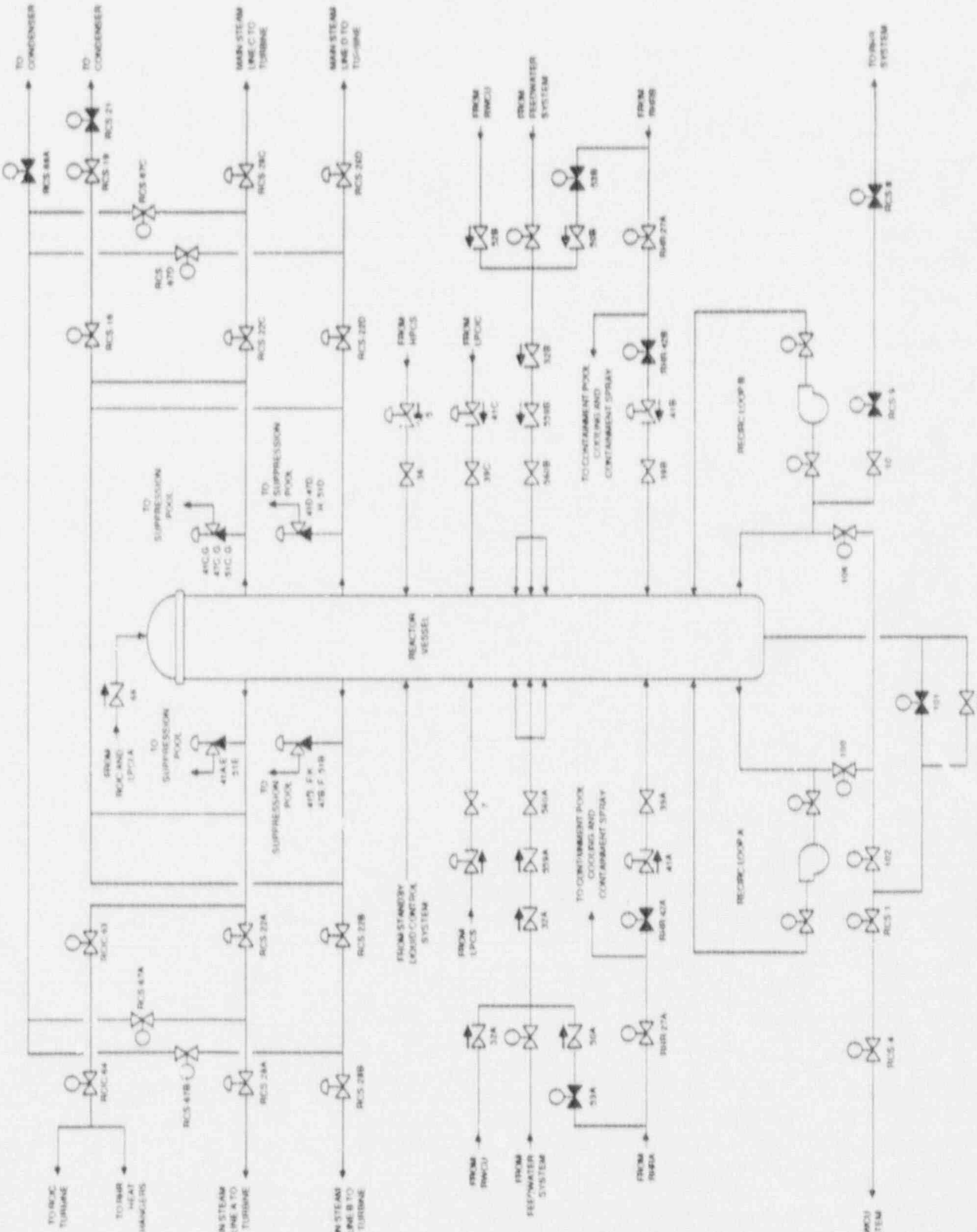


Figure 3.1-1. Perry 1 Reactor Coolant System

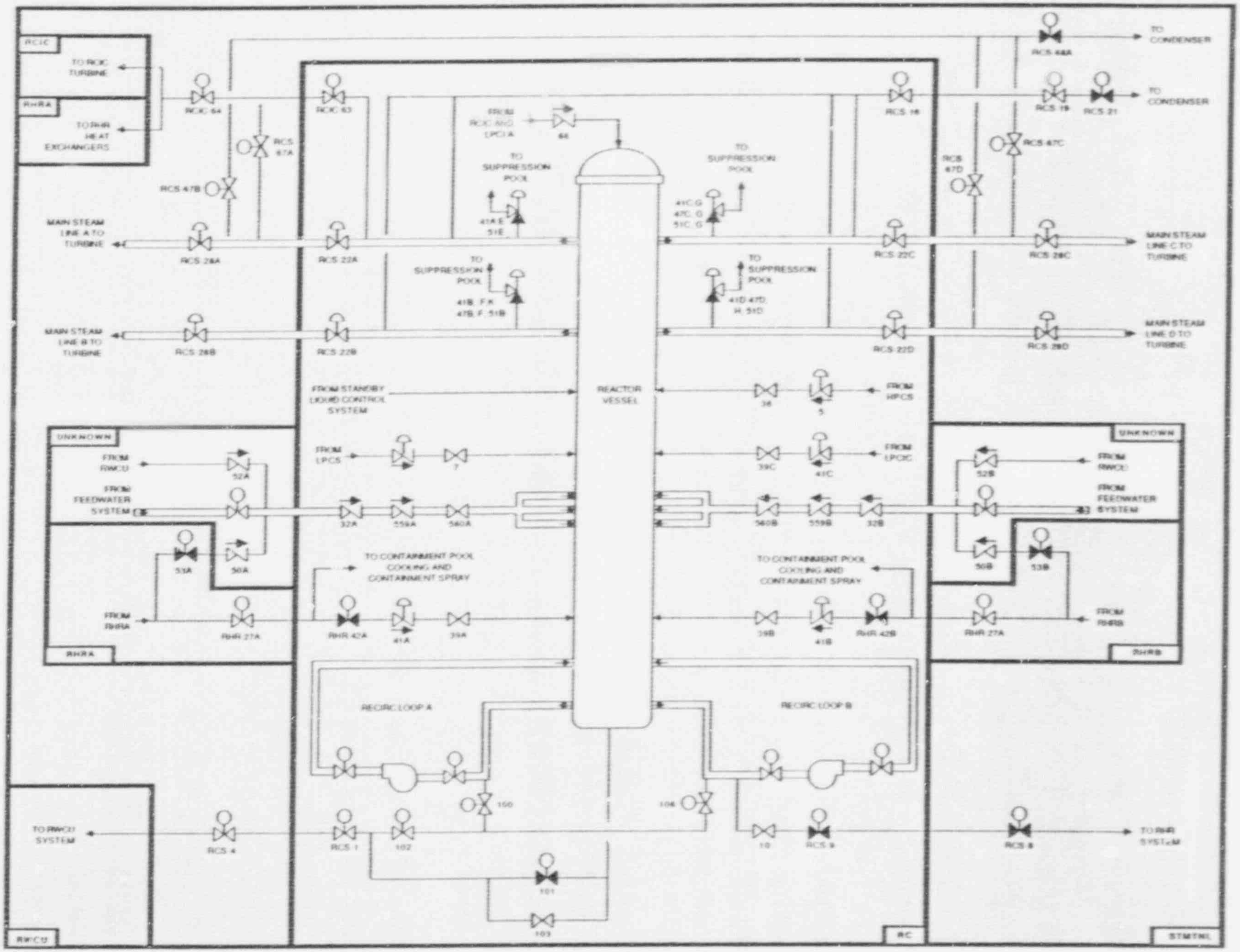


Figure 3.1-2. Perry 1 Reactor Coolant System, Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RCIC-63	MOV	RC	EP-125-P1B	125	BATEQRMB	DC/B
RCIC-64	MOV	STMTNL	EP-MCC-1A07	480	SWGR1	AC/A
RCS-1	MOV	RC	EP-MCC-1C07	480	SWGR2	AC/B
RCS-16	MOV	RC	EP-MCC-1C07	480	SWGR2	AC/B
RCS-19	MOV	STMTNL	EP-MCC-1A07	480	SWGR1	AC/A
RCS-21	MOV	STMTNL				
RCS-22	AOV	RC				
RCS-28	AOV	STMTNL				
RCS-4	MOV	STMTNL	EP-MCC-1A07	480	SWGR1	AC/A
RCS-67	MOV	STMTNL	EP-MCC-1A07	480	SWGR1	AC/A
RCS-68A	MOV	STMTNL	EP-MCC-1C07	480	SWGR2	AC/B
RCS-8	MOV	STMTNL	EP-MCC-1B07	480	SWGR1	AC/A
RCS-9	MOV	RC	EP-MCC-1D07	480	SWGR2	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 turbine-driven 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, in which condensed steam is delivered from the RHR heat exchanger outlets to the RCIC pump suction, for return to the RCS. The RCIC turbine is driven by steam from main steam line A. The turbine exhausts to the suppression pool.

Simplified drawings of the reactor core isolation cooling system are shown in Figures 3.2-1 and 3.2-2. Interfaces between the RCIC and the RCS are shown in Section 3.1. 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 an RPV low water level signal, the turbine-pump steam supply valves are opened and makeup water is supplied to the RPV via a dedicated penetration. 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 the 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 core heat is transferred to the RHR system rather than to the suppression pool. The RCIC turbine still exhausts to the suppression pool.

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 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: 700 gpm @ 150 to 1,177 psig
   2. Rated Capacity: 100%
   3. Type: centrifugal

B. Condensate Storage Tank
   1. Capacity: 150,000 gal (reserved for RCIC and HPCS use)

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. The system automatically shuts down when the reactor vessel water level reaches high reactor water level, and automatically restarts if the level returns to the low level trip point.
    b. The RCIC pump is automatically isolated upon receipt of any of the following signals:
    - RCIC isolation signal
    - Turbine over-speed
    - Pump low suction pressure
    - Turbine high exhaust pressure

    When the signal is cleared, the trip throttle valve must be reset from the control room.

2. Remote Manual

    The RCIC pump can be actuated by remote manual means from the control room or the remote shutdown panel. Manual action is required to place the RCIC in the RHR steam condensing mode.

B. Motive Power

1. The RCIC turbine driven pump is supplied with steam from main steam line 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.

C. Other

1. Lubrication for the turbine-driven pump is supplied locally.
2. The RCIC lube oil cooler is cooled by water from the RCIC pump discharge.
3. Cooling for the RCIC pump room cooler is provided by the Emergency Closed Cooling System (see Section 3.8).

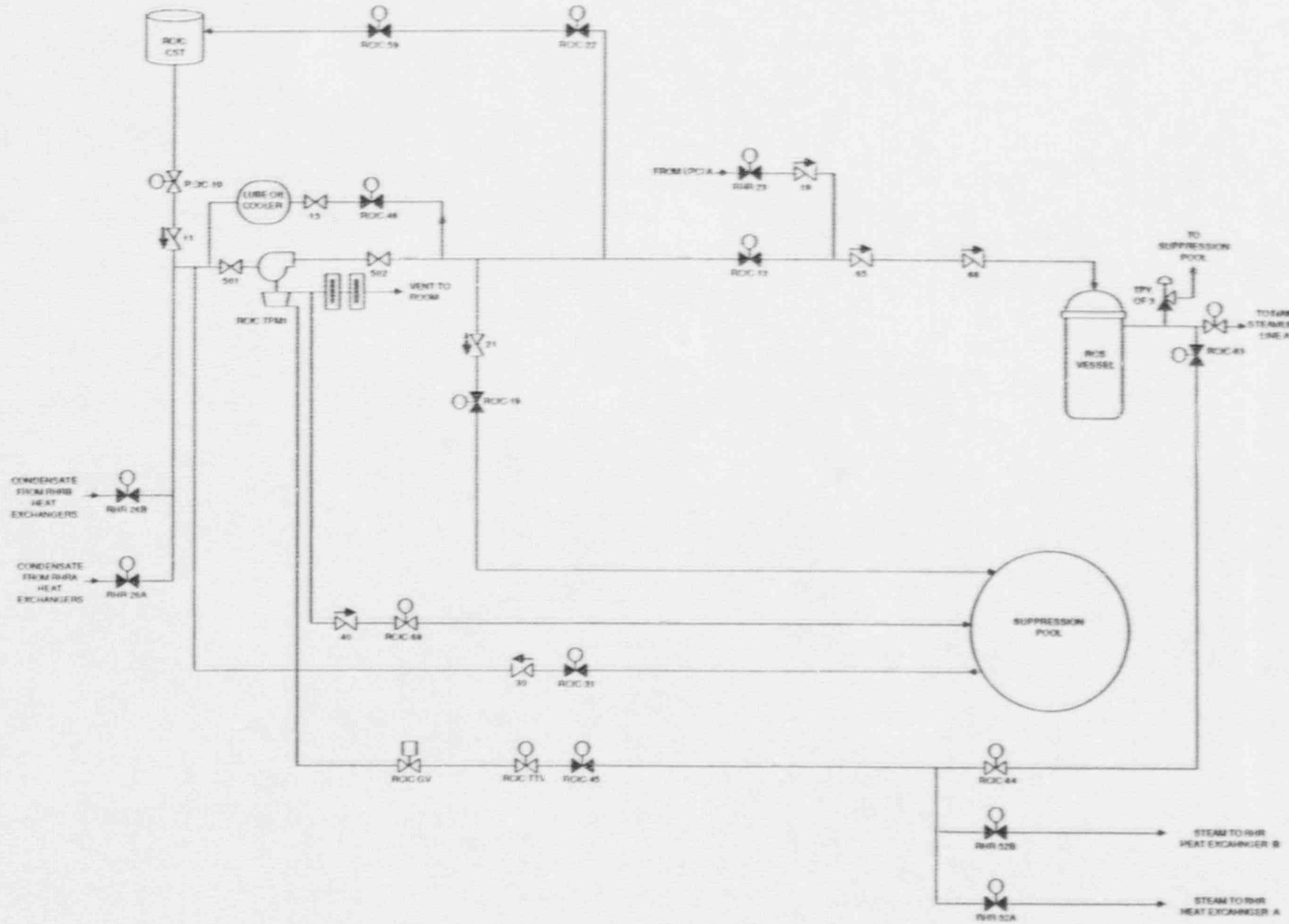


Figure 3.2-1. Perry 1 Reactor Core Isolation Cooling System

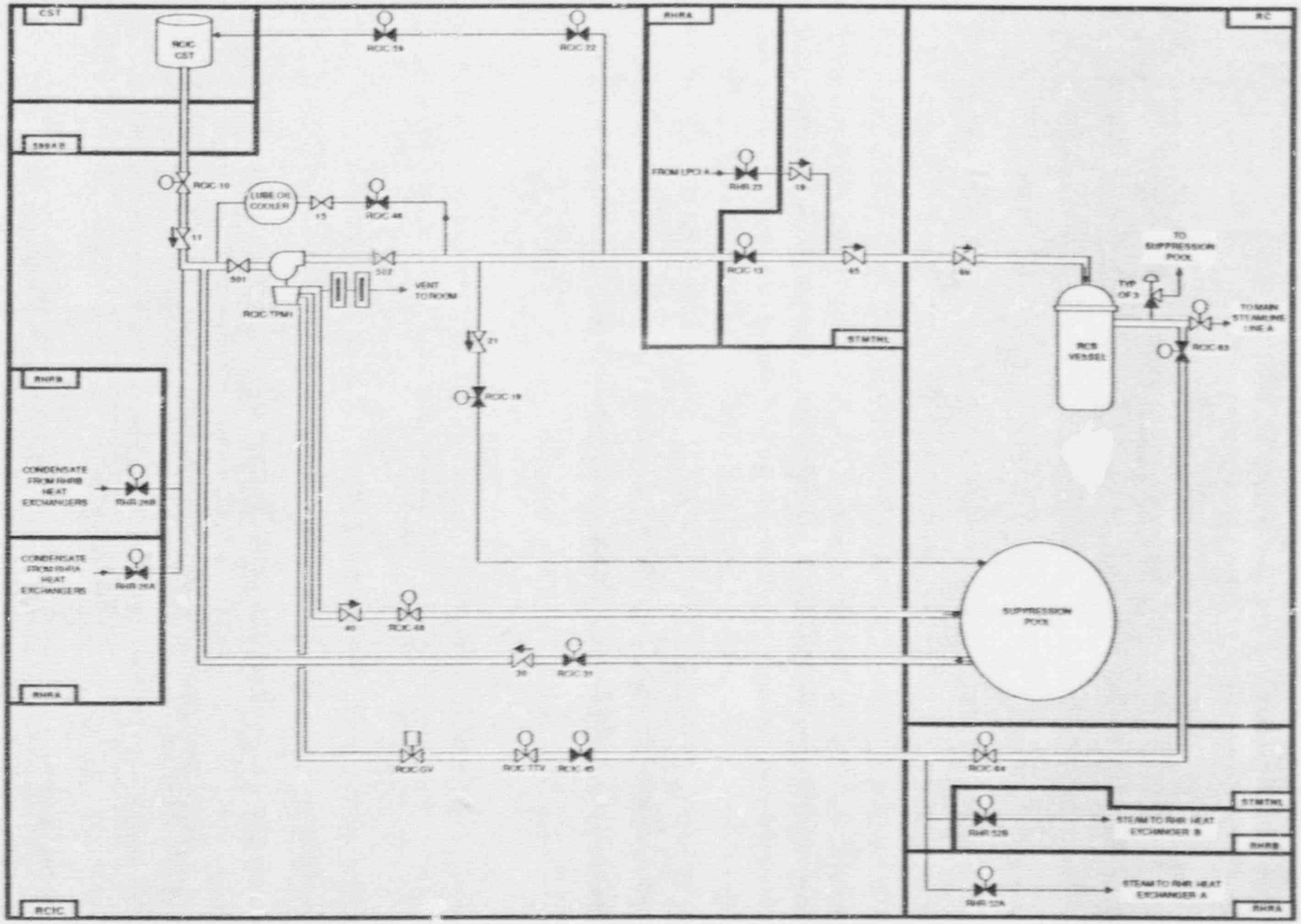


Figure 3.2-2. Perry 1 Reactor Core Isolation Cooling System, Showing Component Locations

Table 3.2-1. Perry 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.
RCIC-10	MOV	RCIC	EP-125-B1A	125	BATEQRMA	DC/A
RCIC-13	MOV	RHRA	EP-125-B1A	125	BATEQRMA	DC/A
RCIC-19	MOV	RCIC	EP-125-B1A	125	BATEQRMA	DC/A
RCIC-22/59	MOV	RCIC	EP-125-B1A	125	BATEQRMA	DC/A
RCIC-31	MOV	RCIC	EP-125-B1A	125	BATEQRMA	DC/A
RCIC-45	MOV	RCIC	EP-125-B1A	125	BATEQRMA	DC/A
RCIC-46	MOV	RCIC	EP-125-B1A	125	BATEQRMA	DC/A
RCIC-63	MOV	RC	EP-125-B1B	125	BATEQRMB	DC/B
RCIC-64	MOV	STMTNL	EP-MCC-1A07	480	SWGR1	AC/A
RCIC-68	MOV	RCIC	EP-125-B1A	125	BATEQRMA	DC/A
RCIC-CST	TANK	CST				
RCIC-TPM1	TDP	RCIC				

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 19 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 or high drywell pressure, 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 emergency 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 success criteria are not clearly defined in the Perry 1 FSAR but can be inferred from pump capacities that are defined based on certain design basis accidents that are considered in the licensing process. On this basis, the ECI system success criteria for a large LOCA are the following:

- The low pressure core spray pump with a suction on the suppression pool, or
- 1 of 3 low pressure coolant injection pumps with a suction on the suppression pool or,
- The high pressure core spray pump with a suction on the suppression pool or the condensate storage tank.

The ECI system success criteria for a small LOCA are the following:

- The high-pressure core spray (HPCS) pump with a suction on the suppression pool or the condensate storage tank, or
- The automatic depressurization system (ADS) and 1 of 3 LPCI pumps with a suction on the suppression pool or
- the automatic depressurization system and the low pressure core spray pump with a suction on the suppression pool.

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 injection systems essentially are operating in a recirculation mode when drawing water from the suppression pool.

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

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

For the suppression pool cooling function to be successful, one of two RHR trains must be aligned for containment heat removal and the associated emergency 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: 517 gpm @ 1177 psid, 6000 gpm @ 200 psid
   2. Rated capacity: 100%
   3. Type: centrifugal

B. Motor-driven LPCS pump P1
   1. Rated flow: 6,000 gpm @ 122 psid (vessel to drywell)
   2. Rated capacity: 100%
   3. Type: centrifugal

C. Motor-driven LPCI pumps PM2A, PM2B, PM2C
   1. Rated flow: 6500 gpm @ 20 psid (vessel to drywell) each
   2. Rated capacity: 100%
   3. Type: centrifugal

D. RHR Heat Exchangers 1A, 1B, 1C, 1D
   1. Heat transfer capability: 46.9×10^6 Btu/hr
   2. Rated capacity: 50%
   3. Type: shell and tube

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: 90°F
   3. Minimum water volume: 117,105 ft^3

G. Condensate Storage Tank
   1. Capacity: 150,000 gallon available supply (f[illegible] 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 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. The Emergency Service Water System provides cooling water to the RHR heat exchangers and the HPCS pump room coolers (see Section 3.7).
   3. The Emergency Closed Cooling System provides cooling water to the RHR pump seals (see Section 3.8).
   4. The RHR pump motors are air-cooled by the ventilation system.

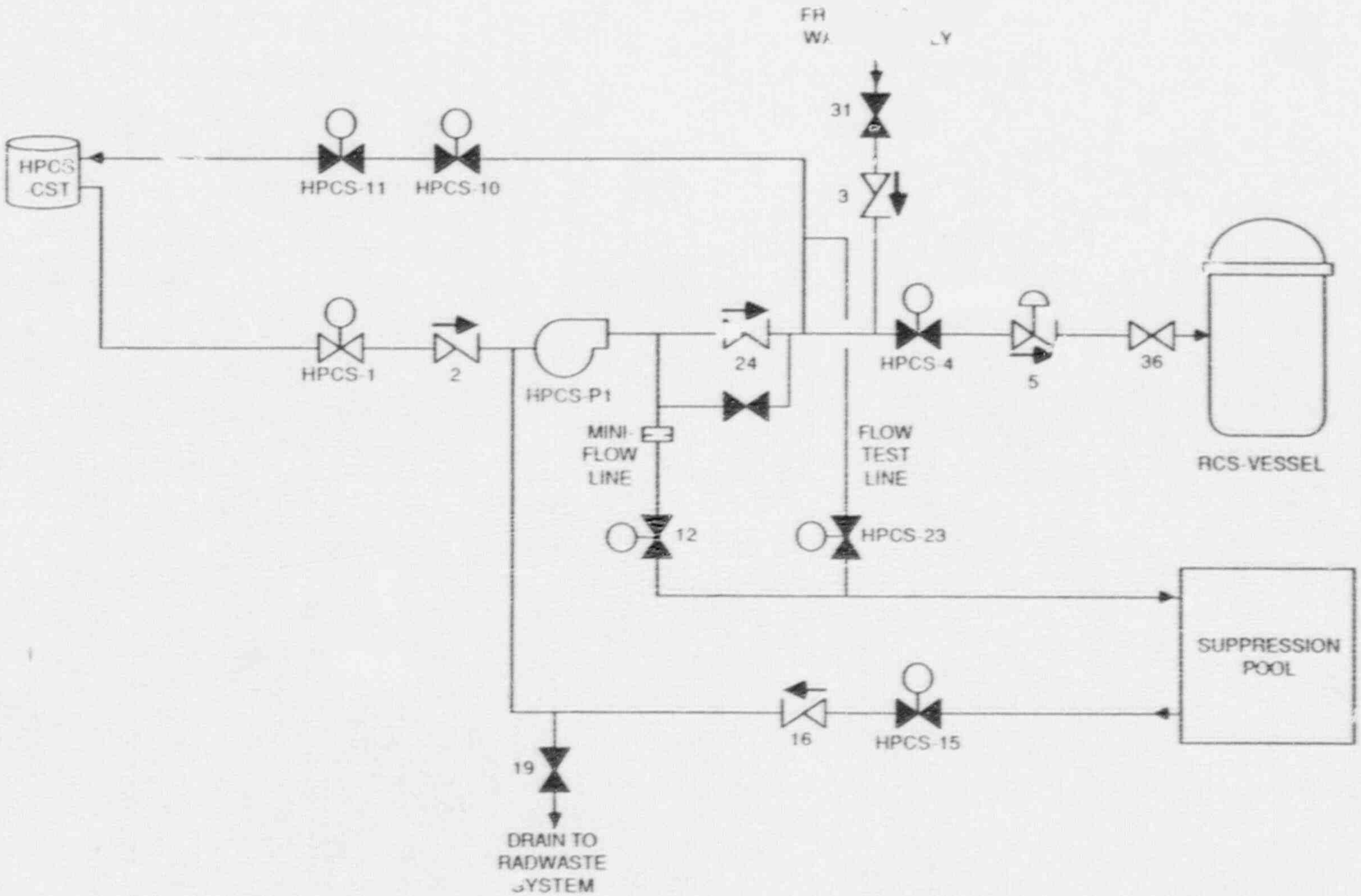


Figure 3.3-1. Perry 1 High Pressure Core Spray System

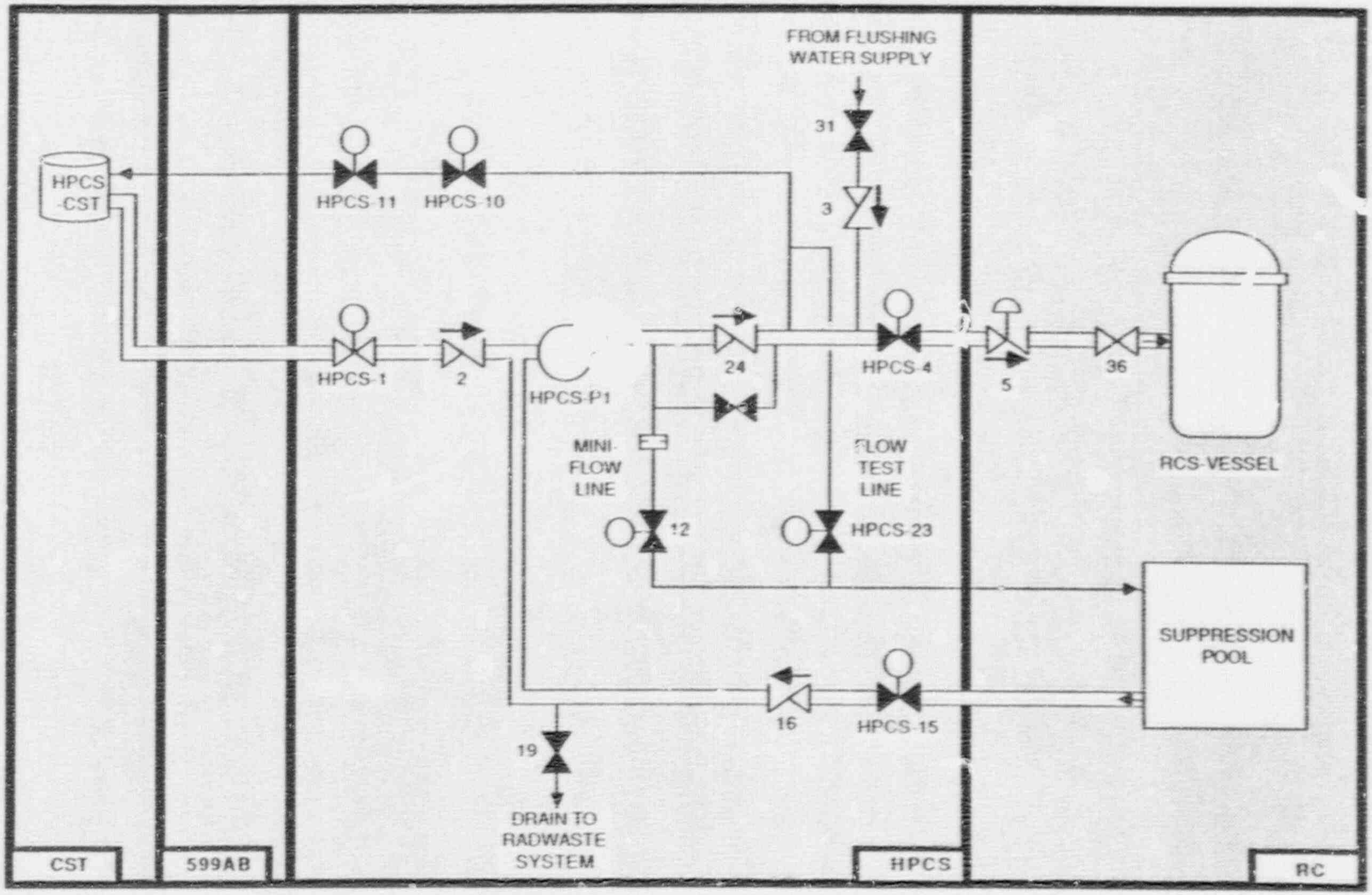


Figure 3.3-2. Perry 1 High Pressure Core Spray System, Showing Component Locations

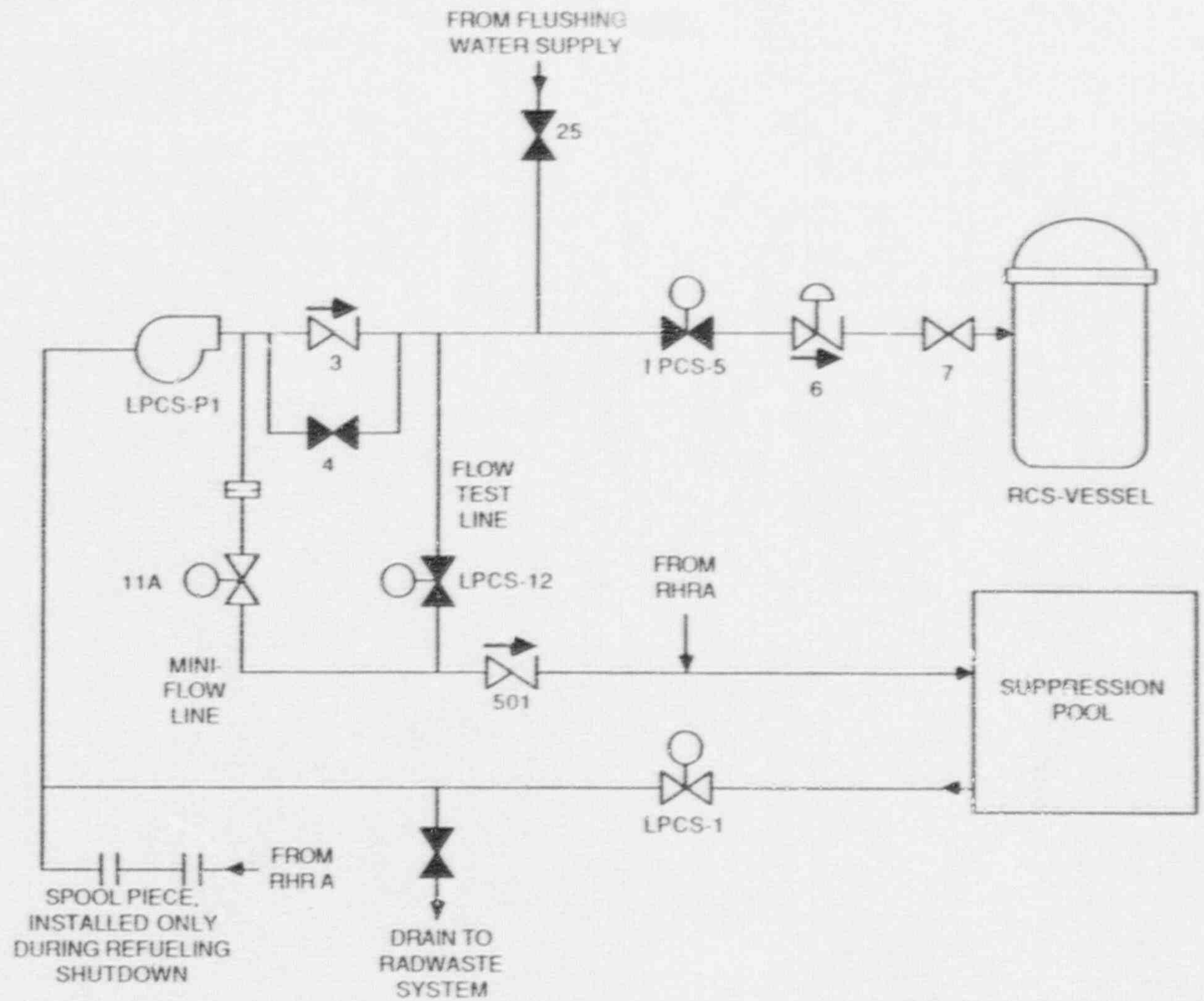


Figure 3.3-3. Perry 1 Low Pressure Core Spray System

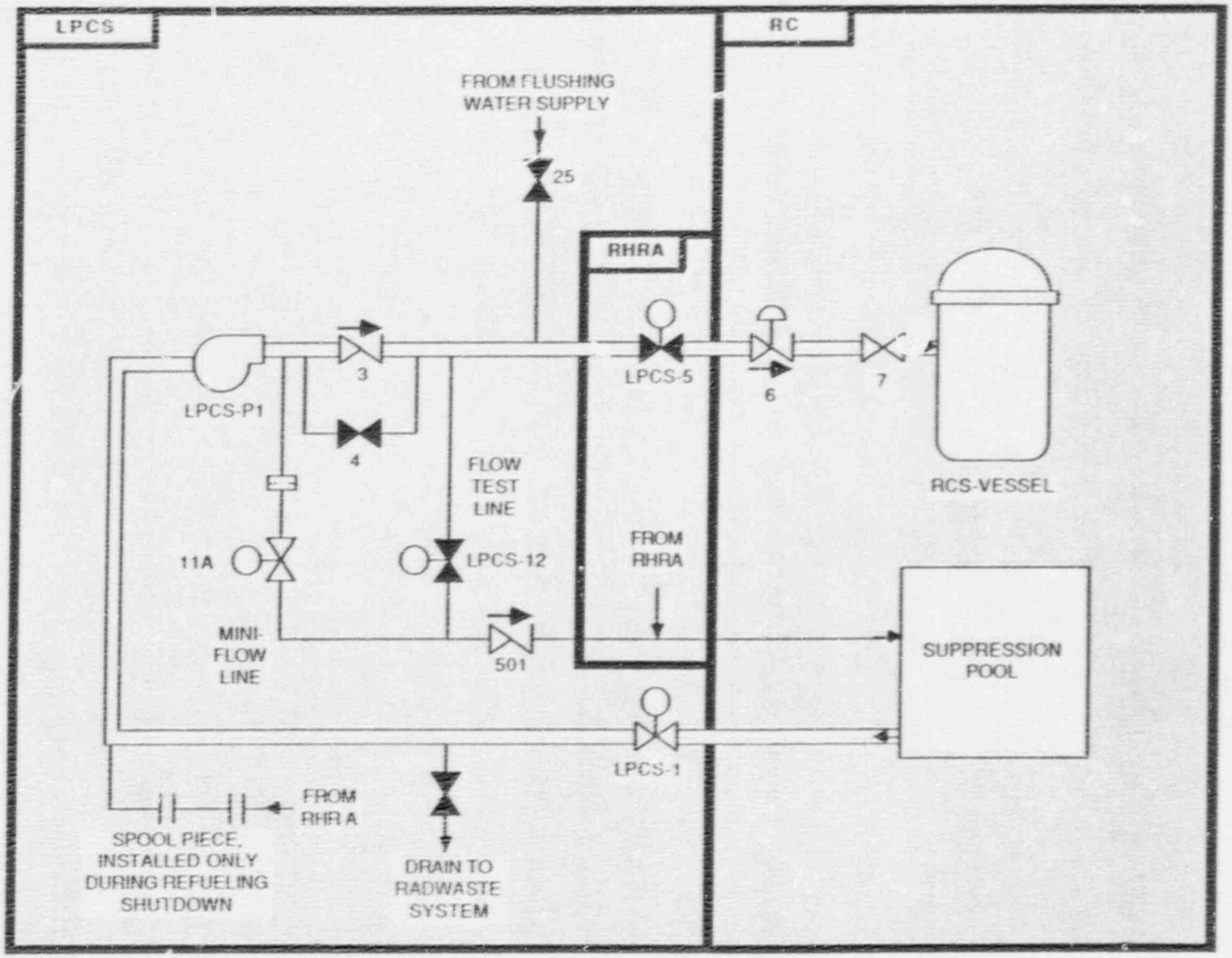


Figure 3.3-4. Perry 1 Low Pressure Core Spray System, Showing Component Locations

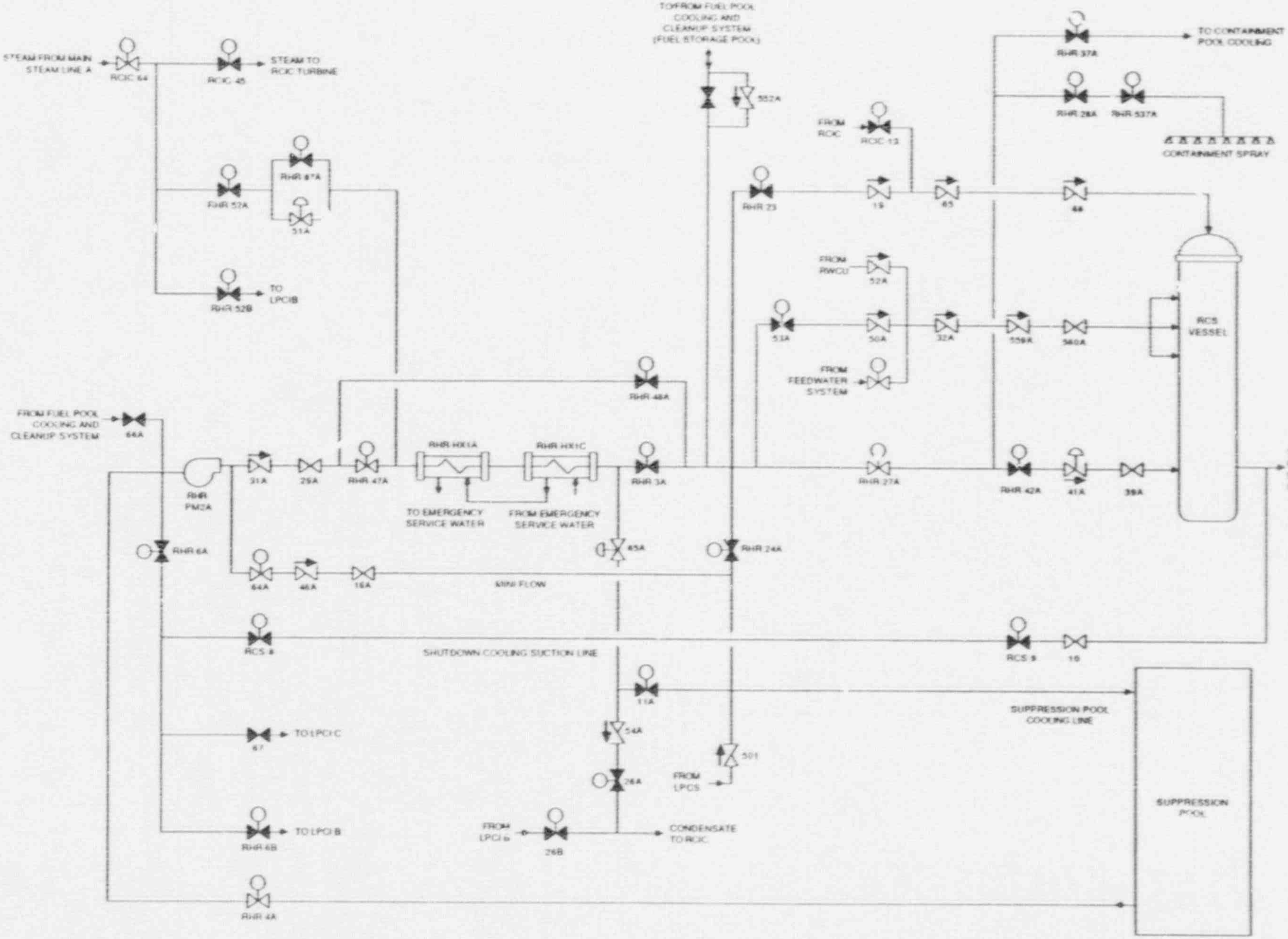


Figure 3.3-5. Perry 1 Residual Heat Removal System Loop A

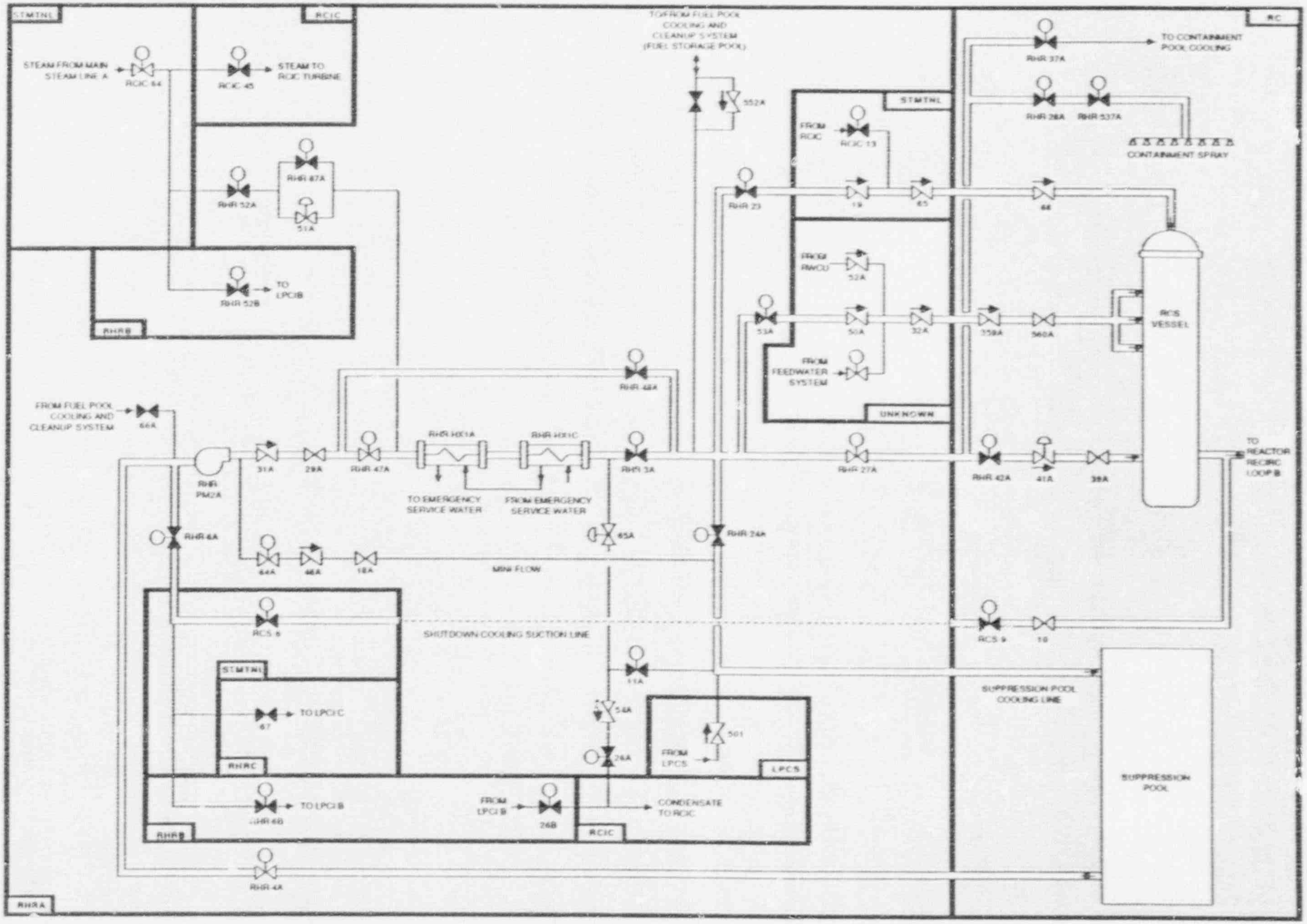


Figure 3.3-6. Perry 1 Residual Heat Removal System Loop A, Showing Component Locations

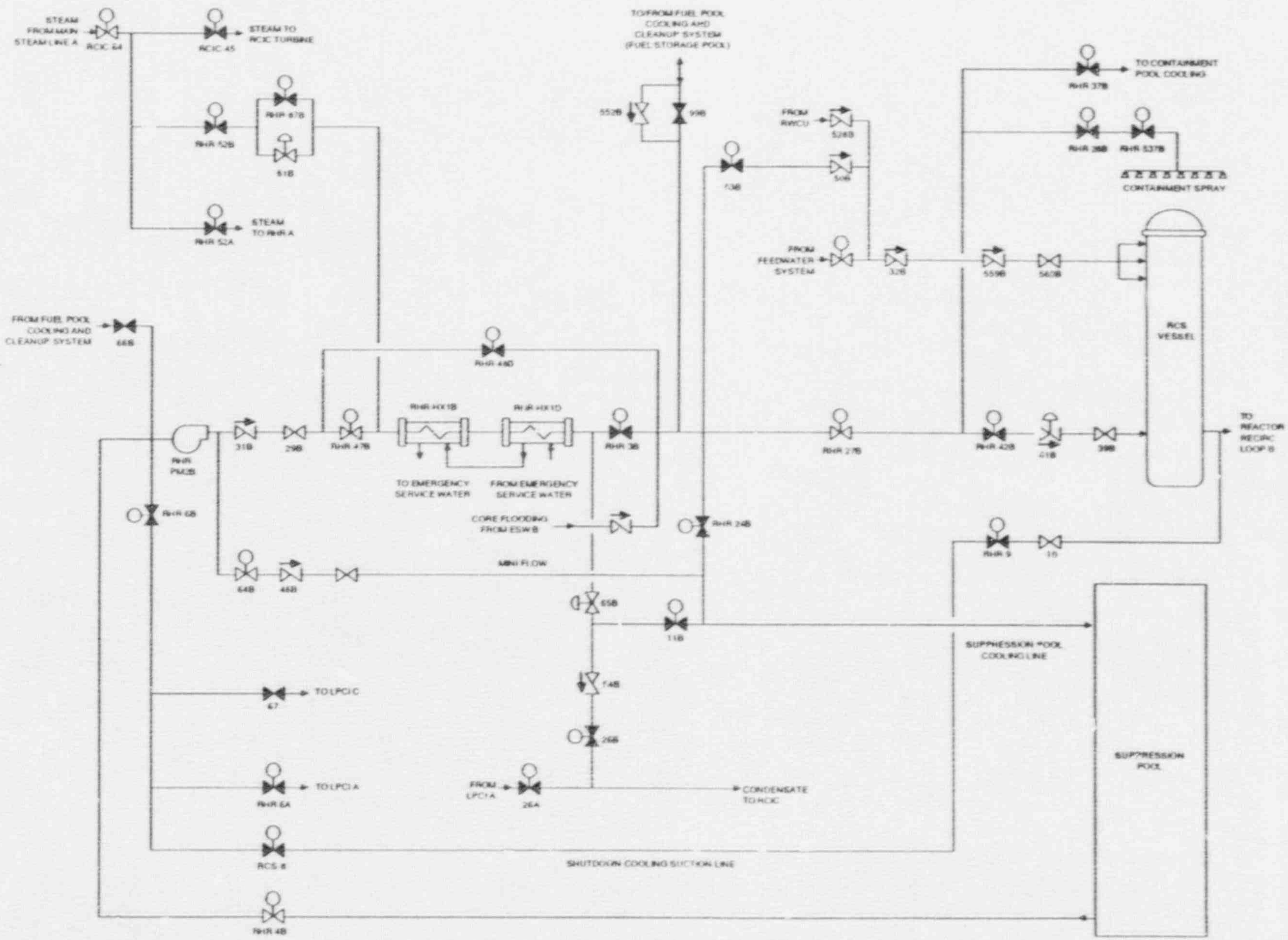


Figure 3.3-7. Perry 1 Residual Heat Removal System Loop B

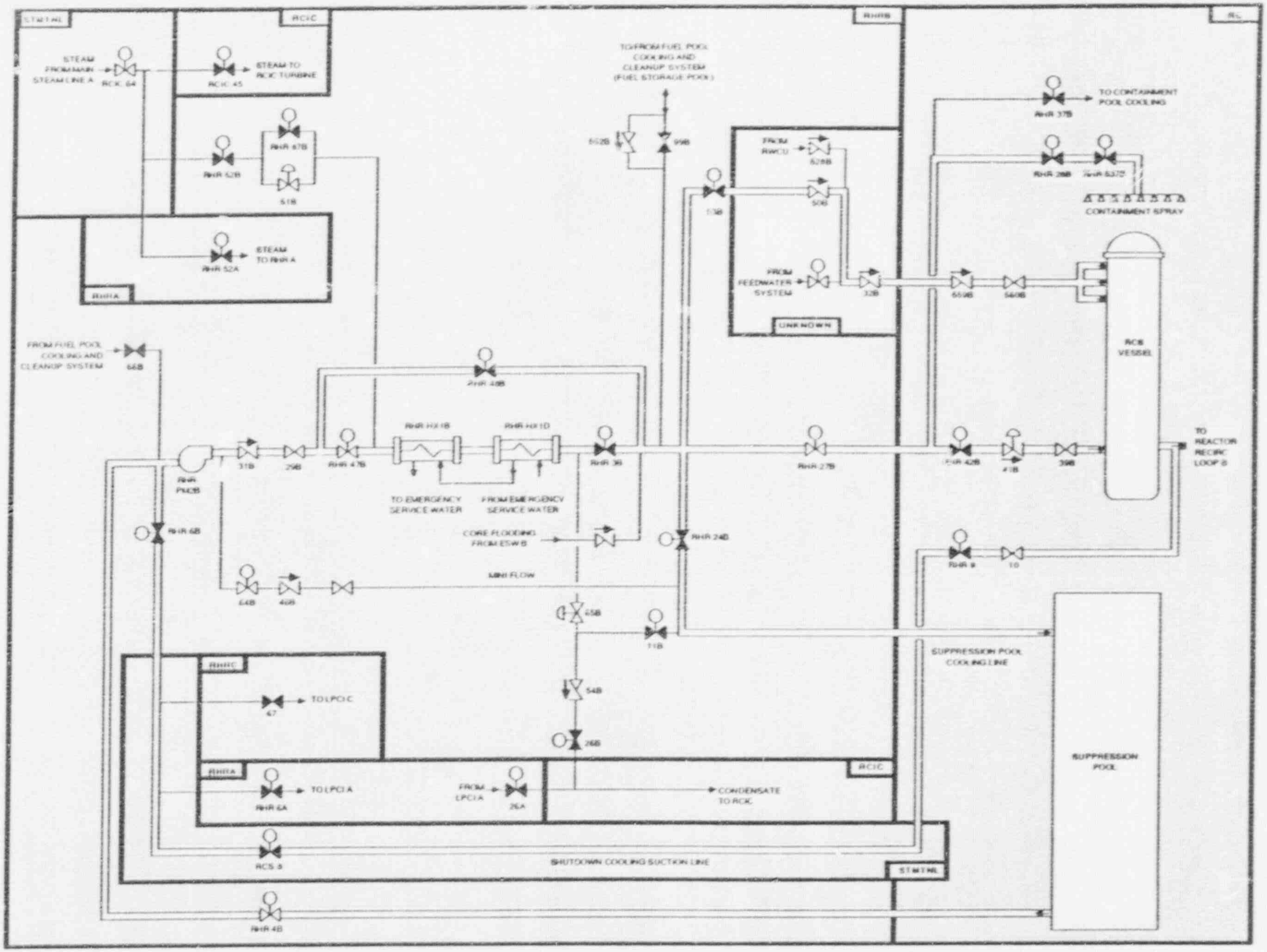


Figure 3.3-8. Perry 1 Residual Heat Removal System Loop B, Showing Component Locations

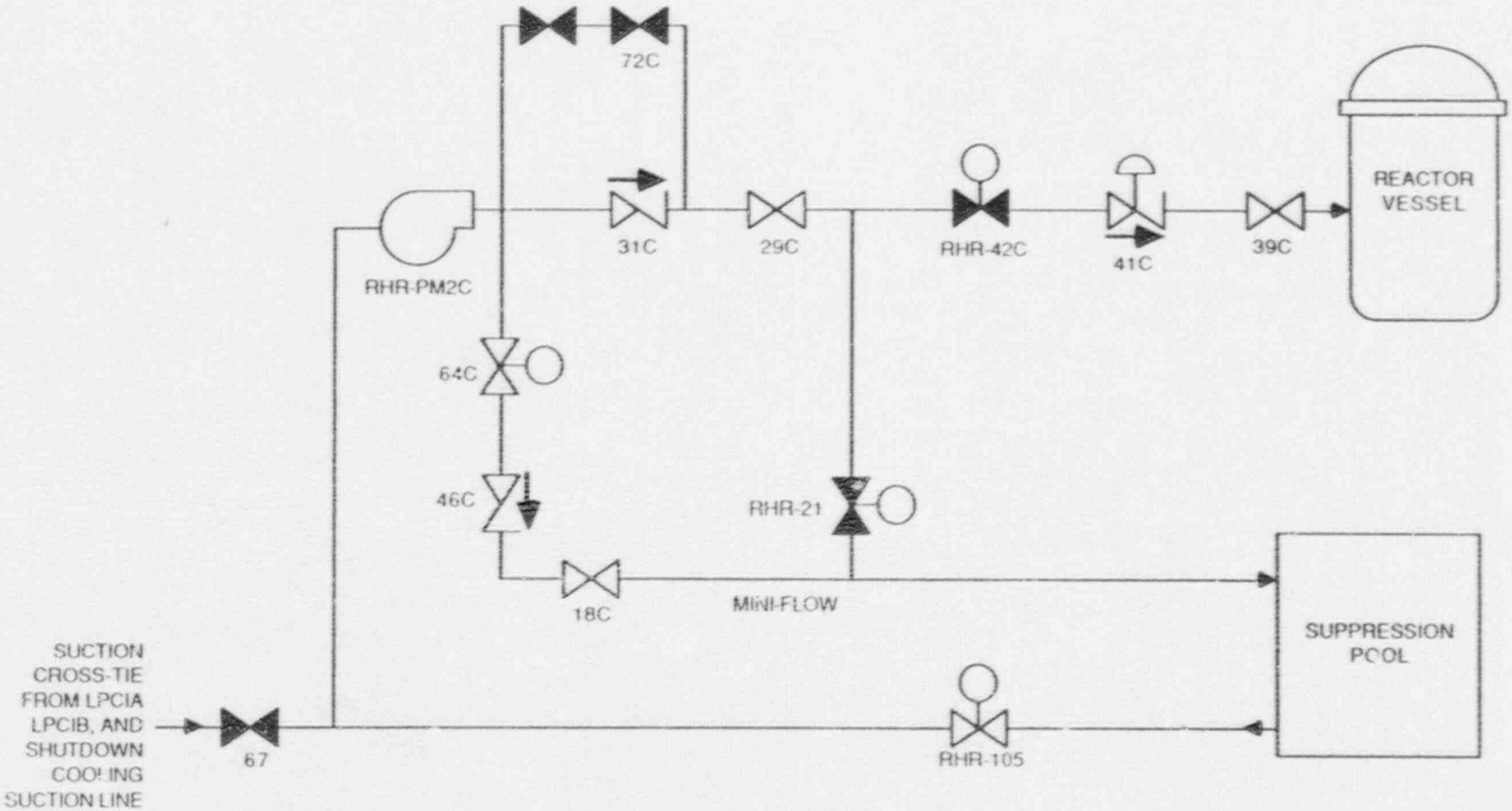


Figure 3.3-9. Perry 1 Residual Heat Removal System Loop C

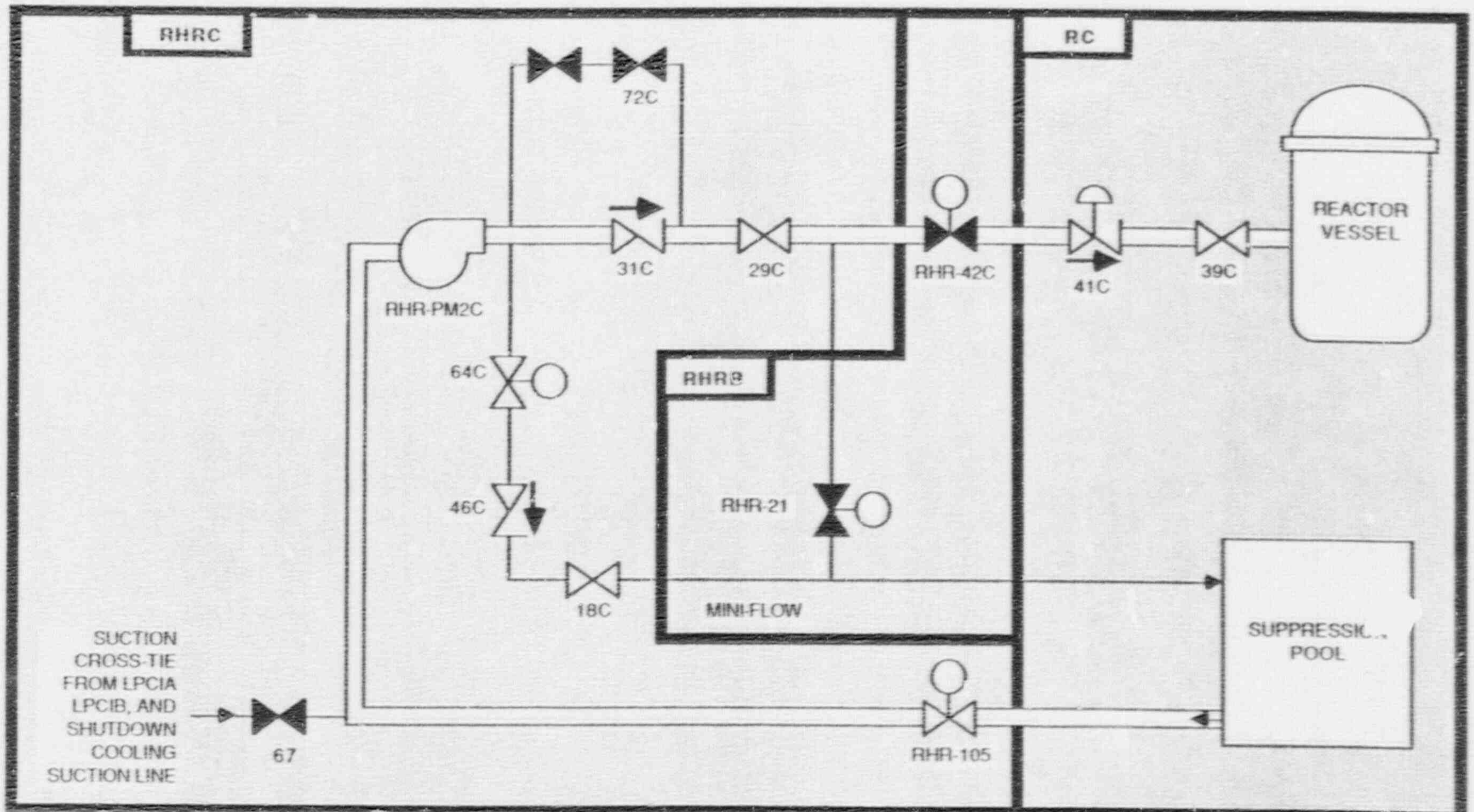


Figure 3.3-10. Perry 1 Residual Heat Removal System Loop C, Showing Component Locations

Table 3.3-1. Perry 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	HPCS	EP-MCC-EF1E	480	SWGR3	AC/C
HPCS-10	MOV	HPCS	EP-MCC-EF1E	480	SWGR3	AC/C
HPCS-11	MOV	HPCS	EP-MCC-EF1E	480	SWGR3	AC/C
HPCS-15	MOV	HPCS	EP-MCC-EF1E	480	SWGR3	AC/C
HPCS-23	MOV	HPCS	EP-MCC-EF1E	480	SWGR3	AC/C
HPCS-4	MOV	HPCS	EP-MCC-EF1E	480	SWGR3	AC/C
HPCS-P1	MDP	HPCS	EP-BS-EH13	4160	SWGR3	AC/C
LPCS-1	MOV	LPCS	EP-MCC-1A07	480	SWGR1	AC/A
LPCS-12	MOV	LPCS	EP-MCC-1A07	480	SWGR1	AC/A
LPCS-5	MOV	RHRA	EP-MCC-1A07	480	SWGR1	AC/A
LPCS-P1	MDP	LPCS	EP-BS-EH11	4160	SWGR1	AC/A
RHR-105	MOV	RHRC	EP-MCC-1D07	480	SWGR2	AC/B
RHR-21	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-23	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A
RHR-24A	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A
RHR-24A	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A
RHR-24B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-24B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-27A	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A
RHR-27B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-28A	MOV	RC	EP-MCC-1B07	480	SWGR1	AC/A
RHR-28A	MOV	RC	EP-MCC-1B07	480	SWGR1	AC/A
RHR-28B	MOV	RC	EP-MCC-1D07	480	SWGR2	AC/B
RHR-28B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-37A	MOV	RC	EP-MCC-1B07	480	SWGR1	AC/A
RHR-37B	MOV	RC	EP-MCC-1D07	480	SWGR2	AC/B
RHR-3A	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A

Table 3.3-1. Perry 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-3B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-42A	MOV	RC	EP-MCC-1B07	480	SWGR1	AC/A
RHR-42B	MOV	RC	EP-MCC-1D07	480	SWGR2	AC/B
RHR-42C	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-47A	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A
RHR-47B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-48A	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A
RHR-48A	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A
RHR-48B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-48B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-4A	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A
RHR-4B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-52A	MOV	RHRA	EP-MCC-EF1B	480	SWGR1	AC/A
RHR-52B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-537A	MOV	RC	EP-MCC-1D07	480	SWGR2	AC/B
RHR-537A	MOV	RC	EP-MCC-1B07	480	SWGR1	AC/A
RHR-537B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-537B	MOV	RC	EP-MCC-1D07	480	SWGR2	AC/B
RHR-6A	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A
RHR-6B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-87A	MOV	RHRA	EP-MCC-EF1B	480	SWGR1	AC/A
RHR-87B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
RHR-HX1A/C	HX	RHRA				
RHR-HX1B/D	HX	RHRB				
RHR-PM2A	MDP	RHRA	EP-BS-BEH11	4160	SWGR1	AC/A
RHR-PM2B	MDP	RHRB	EP-BS-EH12	4160	SWGR2	AC/B
RHR-PM2C	MDP	RHRC	EP-BS-EH12	4160	SWGR2	AC/B

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), the Engineered Safety Features System (ESF), and systems for the display of plant information to the operators. The RPS and the Engineered Safety Features System 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 shutdown the reactor when plant conditions exceed one or more specified limits. The Engineered Safety Features System will automatically actuate selected safety systems based on the specific limits or combinations of limits that are exceeded. A completely separate and diverse system, the Redundant Reactivity Control System (RRCS), is provided to mitigate the effects of a postulated Anticipated Transient Without Scram (ATWS).

3.4.2 System Definition

The RPS includes sensor and transmitter units, logic units, and output trip relays that generate a reactor trip signal. The Engineered Safety Features System includes independent sensor and transmitter units, logic units and relays that interface with the control circuits for the many different sets of components that can be actuated by this system. Operator instrumentation display systems consist of display panels in the control room and at the auxiliary control panel that are powered by the 120 VAC electric power system (see Section 3.6) The RRCS consists of control panels, their associated ATWS detection and actuation logic, and the necessary interface logic for those systems required to perform specific functions in response to an ATWS event.

3.4.3 System Operation

A. RPS

There are at lease four trip channels for each variable. The trip channels are designated as A, C, B, and D. Each trip channel is associated with the trip logic of the same designation. Trip logics A and C outputs are combined in a one-out-of-two logic arrangement to control the "A" pilot scram valve solenoid in each of the four rod groups (a rod group consists of approximately 25 percent of the total of control rods). Trip logics B and D control the "B" pilot scram valve solenoids in each of the four rod groups.

When a trip channel relay deenergizes, the trip logic deenergizes the trip actuator logic which deenergizes the pilot scram valves associated with that trip actuator logic. The other pilot scram valves for each rod must also be deenergized before the scram valves provide a reactor scram. There is one dual coil pilot scram valve and two scram valves for each control rod. The pilot scram valve is solenoid operated, with the solenoids normally energized. The pilot scram valve controls the air supply to the scram valves for each control rod. With either pilot scram valve coil energized, air pressure holds the scram valves closed. The scram valves control the supply and discharge paths for control rod drive water.

When trip logics A or C and B or D are tripped, air is vented from the scram valves and allows control rod drive water to act on the control rod drive piston. Thus, all control rods are scrammed. The water displaced by the movement of each rod piston is exhausted into a scram discharge volume. To restore the RPS to normal operation following any single actuator logic trip or a scram, the trip actuators must be reset manually. After a 10-second delay, reset is possible only if the conditions that caused the scram have been cleared. The trip actuators are reset by operating switches in the control room. Four reset switches (1 per trip channel) are provided.

There are two 125 VDC solenoid operated backup scram valves that provide a second means of controlling the air supply to the scram valves for all control rods. When the solenoid for either back scram valve is energized, the associated backup scram valve vents the air supply for the scram valves. This action initiates insertion of any withdrawn control rods regardless of the action of the scram pilot valves. The backup scram valves' solenoids are energized (initiate scram) when trip logic A or C and B or D are both tripped.

The following conditions result in reactor trip:

- Neutron monitoring (NMS) system
- Neutron monitoring (IRM) system
- Reactor vessel high pressure
- Reactor vessel low water level
- Reactor vessel high water level
- Turbine stop valve position
- Turbine control valve position
- Main steam line isolation valve position
- Scram discharge volume water level
- Drywell high pressure
- Main steam line high radiation
- Manual
- Reactor mode switch in SHUTDOWN position

B. Redundant Reactivity Control System (RRCS)

The RRCS solid state logic is divided into Divisions 1 and 2, each of which is subdivided into Channels A and B. The logic is energized to trip, and both Channels A and B of either division must be tripped in order to initiate the RRCS protective actions. The system can be manually initiated by depressing two pushbuttons (tripping both Channels A and B) in the same division. This manual initiation function is designed so that no single operator action can result in an inadvertent initiation. The manual initiation pushbuttons are located in the control room near the RPS manual scram pushbuttons. There are four RRCS manual initiation pushbuttons.

The RRCS sensors monitor reactor dome pressure and reactor water level. The logic will cause the immediate energization of the Alternate Rod Insertion (ARI) valves when either the reactor vessel high dome pressure trip setpoint or low water level 2 setpoint is reached, or the manual pushbuttons are armed and depressed. Energization of the RRCS ARI valves depressurizes the scram air header independent of the logic and vent valves of the RPS system. The valves are sized to allow insertion of all control rode to begin within 15 seconds.

The RRCS sensors and logic are also designed to automatically initiate the recirculation pump trip logic whenever the reactor pressure or the reactor water level reaches the RRCS sensor settings.

C. ESF

The ESF also utilizes a two-out-of-four coincidence of like initiating trip signals from four independent measurement channels, with two output actuation trains.

The ESF logic is similar to that of the RPS. 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
- Emergency service water system
- Various room cooling systems
  - ECCS equipment room HVAC system
  - Essential switchgear heat removal HVAC system
  - Diesel generator HVAC system
  - Emergency service water pump room HVAC system
  - Main control room HVAC system
  - Containment and Reactor Vessel Isolation and Control System (CRVICS)
  - Main Steam Line Isolation Valve
  - Leakage Control System (MSIV-LCS)
  - Containment Cooling and Purification System
  - Containment Combustible Gas Control System.
  - Suppression Pool Makeup System
  - Containment Vacuum Relief
  - Drywell Vacuum Relief

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

D. Remote Shutdown

The Remote Shutdown System (RSS) is designed to achieve a cold reactor shutdown from outside the control room. A summary of equipment controlled from the Perry 1 remote shutdown panels is presented in Table 3.4-1. The functions needed for Division 1 remote shutdown control are provided with manual transfer switches at the remote shutdown panel. These switches override controls from the control room and transfer the controls to the Division 1 remote shutdown panel. Division 1 remote shutdown control is not possible without actuation of the transfer devices. All necessary power supplies and control logic are also transferred. Operation of the transfer devices causes an alarm in the control room. Access to the Division 1 remote shutdown panel is administratively and procedurally controlled. All system equipment (i.e. valves and pumps) necessary for proper system lineup and complete system control are located on the Division 1 remote shutdown panel.

Redundant remote shutdown capability is provided using the Division 2 remote shutdown controls. These controls are designed to parallel the controls from the control room. All signals required for the Division 2 remote shutdown panel will be supplied from the ERIS Data Acquisition Cabinet. An indicating panel for the Division 2 shutdown system is located in the Division 2 switchgear room. Access to the Division 2 remote shutdown system is regulated by keylocked switches mounted on the switchgear panels. The keylocked switches are used to control pumps and valves of associated essential safe shutdown systems.

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 usually is implemented by the scram circuit breakers which must open in response to a scram signal. Typically, there are two series scram circuit breakers in the power path to the scram rods. In this case, one of two circuit breakers must open. Details of the scram system for Perry 1 have not been determined.

B. RRCS

Details of the success criteria for the Perry 1 RRCS have not been determined.

C. ESF

A single component usually receives a signal from only one ESF output train. ESF Trains A and B must be available in order to automatically actuate their respective components. ESF typically uses 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 ESF output channels to send an actuation signal. Note that there may be some ESF 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 ESF system for Perry 1 have not been determined.

D. 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 an ESF 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 reactor protection system (RPS) power supply is a non-Class 1E system. The normal 120 VAC power to each of the two reactor protection systems is supplied, via a separate bus, by its own high inertia motor generator set. Each drive motor is supplied from 480 VAC non-Class 1E buses. High inertia is provided by a flywheel. The alternate source of the 120 VAC power is the station non-Class 1E power supply. The alternate power switch design and arrangement prevents paralleling of the power sources.

2. Other Actuation and Control Systems
   The control power interfaces for the various front-line systems are summarized in Table 3.4-2. This table was developed using information concerning the MCCs and busses used to actuate the motor operated valves and pumps of the front line systems because direct information concerning the control of these valves and pumps was not available.
3. Operator Instrumentation
   Power for instrumentation systems is provided by the 120 VAC electric power distribution system (see Section 3.5).

Table 3.4-1. Summary of Equipment Controlled from the Perry 1 Remote Shutdown Panels

The following equipment have transfer and control switches located at the Division 1 remote shutdown control panel:

RCIC Valves	(RCIC-10, RCIC-13, RCIC-19, RCIC-22, C004, RCIC-31, RCIC-45, RCIC-46, RCIC-59, RCIC-63, RCIC-64, RCIC-68, RCIC-76, RCIC-77, RCIC-78, RCIC-TTV)
RHR Valves	(RHR-3A, RHR-4A, RHR-6A, RHR-6B, RCS-8,RCS-9, RHR-11A, RHR-23, RHR-24A, RHR-26A, RHR-27A, RHR-28A, RHR-37A, RHR-42A, RHR-47A, RHR-48A, RHR-40, RHR-52A, RHR-53A, and RHR-64A)
RHR Pump	(RHR-PM2A)
ESWS Valves	(ESW-14A, ESW-68A, and ESW-130A)
ESWS Pump	(ESW-P1A)

Emergency closed cooling pumps A and B.

The following equipment have control switches located at their respective motor control centers or switchgear panels.

RHR Valves	(RHR-3B, RHR-4B, RHR-11B, RHR-24B, RHR-26B, RHR-27B, RHR-28B, RHR-37B, RHR-42B, RHR-47B, RHR-48B, RHR-52B, RHR-53B, and RHR-64B).
RHR Pump	(ESW-P1A)
ESWS Valves	(ESWS-14B, ESWS-68B, and ESWS-130B)
ESWS Pump	(ESW-P1B).

Table 3.4-2. Matrix of Perry 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			■
ESW A	■		
ESW B		■	
ESW C			■

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 VAC trains for each unit. The 4160 VAC trains for Unit 1 are denoted EH11, EH12, and EH13 and the trains for Unit 2 are denoted EH21, EH22, and EH23. The Class 1E AC system is comprised of three divisions: Division 1 and 2 are redundant, while Division 3 supplies power for the high pressure core spray (HPCS) system. Divisions 1 and 2 supply power from the 4.16 kV buses to 480 volt double-ended load centers and 480 volt motor control centers. Division 3 supplies power from the 4.16 kV bus to a 4160/480 volt transformer which feeds a 480 volt motor control center. The 480 VAC trains in Division 1 and 2 are denoted EF1A, EF1B, EF1C, and EF1D. The 480 VAC MCC in Division 3 is denoted EF1E.

The Class 1E 120 VAC instrumentation system for Unit 1 consists of two independent Class 1E 120 VAC instrumentation and control power buses. Each division consists of a 480/120 V transformer and instrumentation panel EB-1-B1 or bus B-1-A. The 480 VAC power supply is provided by the corresponding 480 VAC Class 1E motor control center. There are also three vital instrument buses V-1-A, V-1-B, or V-1-C that can be powered from the 125 VDC bus D-1-A or the 480 VAC MCC 1D08.

Three Class 1E 125 VDC subsystems are provided for each unit. The subsystems are identified as Division 1, 2, and 3. The buses in these divisions are denoted 1A, 1B, and 1C respectively. The subsystems in Division 1 and 2 are redundant while Division 3 supplies the HPCS system. Each subsystem provides the control power for its associated Class 1E AC power load group channel: 4.16 kV switchgear, 480 V load centers, and standby diesel generator. Also these DC subsystems provide DC power to the engineered safety feature valve actuation, diesel generator auxiliaries, plant alarm and indication circuits, and emergency lighting system.

The Division 1 and 2 subsystems consist of a 125 VDC bus, two distribution panels, one 125 VDC battery bank, and two battery chargers. Division 2 has an additional 125 VDC MCC. The division 3 subsystem consists of a 125 VDC bus, a distribution panel, one 125 VDC battery bank, and two battery charges.

Simplified one-line diagrams of the electric power system are shown in Figures 3.5-1 to 3.5-8. 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

Each Class 1E 4160 VAC bus is provided with a preferred and alternate offsite power source and one standby diesel generator. The normal power source for buses EH11, EH12, and EH13 is the 13.8 kV bus L10 and the normal power source for buses EH21, EH22, and EH23 is 13.8 kV bus L20. Details of the station electric power system are shown in Figures 3.5-1 and 3.5-2.

The diesel generator for each division is automatically started upon receipt of a LOCA signal or an under voltage signal at the associated division bus. If the diesel generator is started by a LOCA signal only, the diesel generator is not connected to the bus but remains in standby operation, non-Class 1E 4.16 kV buses (stub buses) fed from Division 1 and 2 buses are shed, and LOCA loads are started and fed from offsite power. If an undervoltage signal follows a LOCA, loads are sequentially connected to the associated bus after the diesel generator has reached rated voltage and frequency. Diesel generators 1A, 1B, and 1C are connected to the 4160 VAC Safeguard buses EH11, EH12, and EH13, respectively. Each diesel is connected to only one bus. In turn, each 4160 VAC Safeguard bus supplies power to 480 buses through transformers. Details of the 4160 and 480 VAC systems are shown in Figures 3.5-3 and 3.5-4.

The Class 1E 120 VAC system consists of two independent divisions. Each division consists of a 480/120 VAC transformer and a distribution panel. Vital AC power consists of three vital distribution panels, an inverter, and a transformer. Details of the 120 VAC system are shown in Figures 3.5-5 and 3.5-6.

The Class 1E 125 VDC system consists of three independent divisions. Each division is comprised of a 125 VDC bank of batteries and two battery charges. The battery bank in Divisions 1 and 2 will supply its respective loads for 2 hours without recharging. The capacity of the battery bank in Division 3 has not been determined. Details of the 125 VDC system are shown in Figures 3.5-7 and 3.5-8.

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 EH11. Load group "AC/B" contains components powered either directly or indirectly from 4160 bus EH12. Load group "AC/C" contains components powered either directly or indirectly from 4160 bus EH13. Components receiving 125 VDC power are assigned to load groups "A," "B," or "C," based on the associated battery.

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: 7,000 kW
   2. Rated voltage: 4160 VAC
   3. Manufacturer: unknown

B. Standby diesel generator 1C
   1. Continuous rating: 2,560 kW
   2. Rated voltage: 4160 VAC
   3. Manufacturer: unknown

C. 125 VDC station batteries 1A, 1B
   1. Type: lead-acid
   2. Rated voltage: 125 VDC
   3. Design capacity: about 2 hours minimum with design loads

D. 125 VDC station battery 1C
   1. Type: lead-calcium
   2. Rated voltage: 125 VDC
   3. Design capacity: unknown

3.5.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The standby diesel generators are automatically started upon receipt of a LOCA signal or an under voltage signal from the associated bus. Only the generator differential and overspeed trip functions will shut down the diesel generators after a start resulting from a LOCA signal. Nonessential trip functions "high jacket water temperature," "high engine bearing temperature," "low turbocharger oil pressure," "low lubricating oil pressure," and "high vibration level" are bypassed upon receipt of a LOCA signal but will shut down the diesel generators when operating in all other modes.
   2. Remote manual
      The diesel generators can be started, and many distribution circuit breakers can be operated from the main control room.
   3. Local manual
      The diesel generators can be started locally.

B. Diesel Generator Auxiliary Systems
   1. Cooling
      The Emergency Service Water System (see Section 3.7) provides for diesel cooling.
   2. Fueling
      An independent day tank (550 gallons for diesel generators 1A and 1B and 555 gallons for diesel generator 1C) is provided for each diesel. Long-term fuel tanks with enough fuel for 7 days of operation are located underground. The fuel tanks for diesel generators 1A and 1B contain 90,000 gallons of fuel and the fuel tank for diesel generator 1C contains 39,375 gallons of fuel.
   3. Lubrication
      Each diesel generator has a self-contained lubrication system.
   4. Starting
      An independent starting air supply is provided for each diesel generator.
   5. Control power
      Each diesel generator is dependent on 125 VDC power from a station battery for control power.
   6. Diesel room ventilation
      Diesel room ventilation fans provide room cooling during diesel operation.

C. Switchgear and Battery Room Ventilation

Ventilation capabilities for the essential switchgear rooms and battery rooms have not be determined.

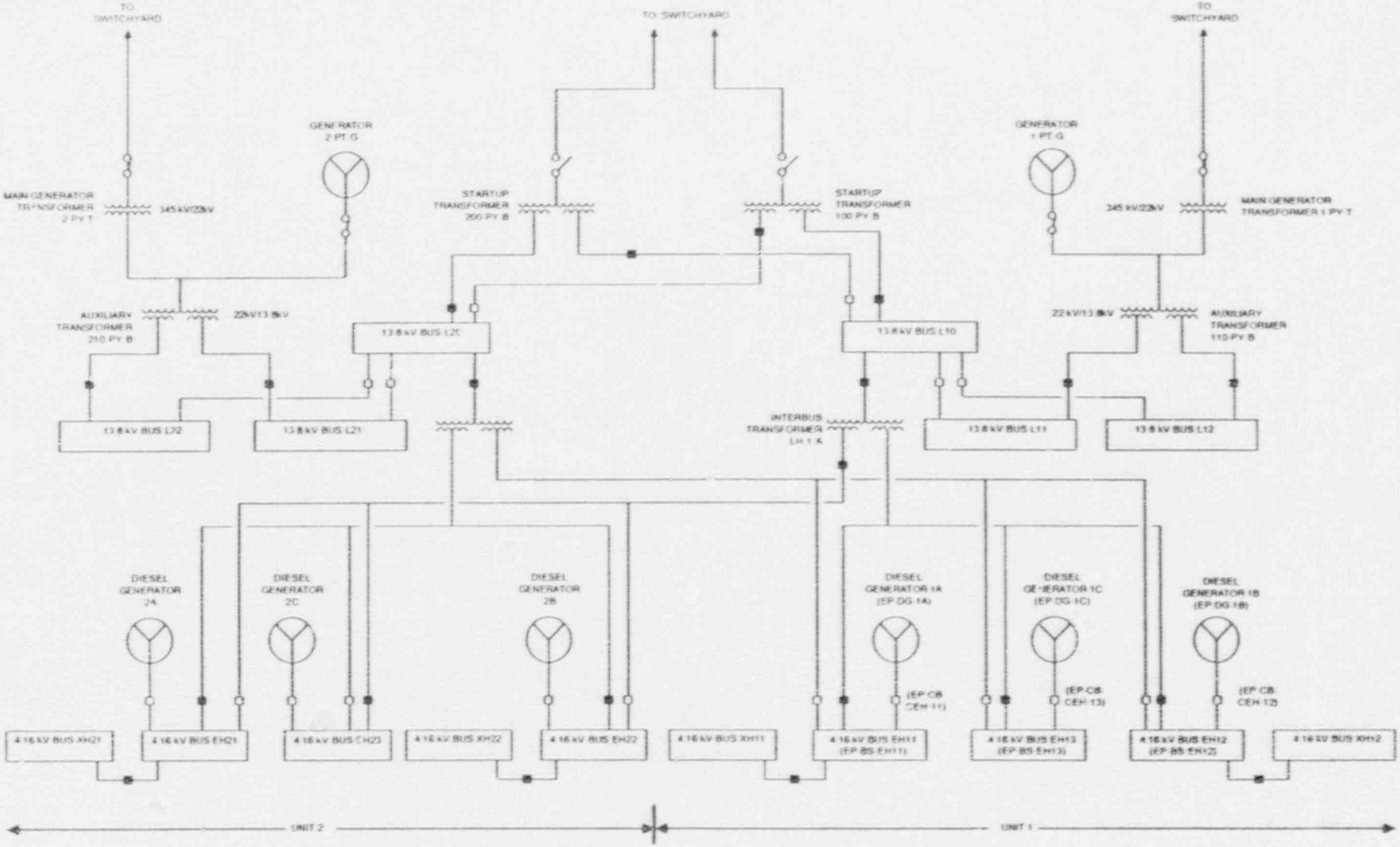
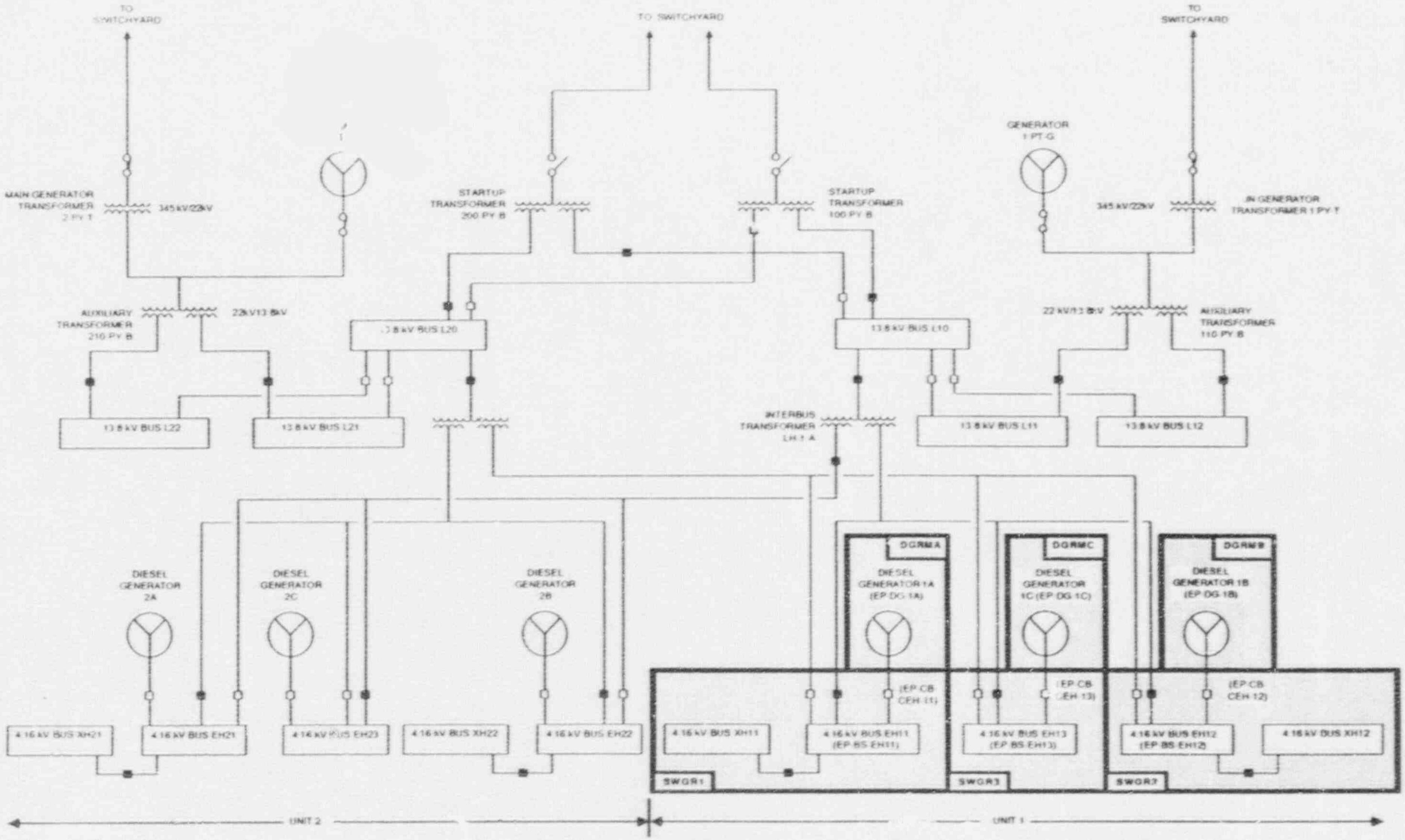


Figure 3.5-1. Perry 1 and 2 4160 VAC Electric Power Distribution System



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-2. Perry 1 and 2 4160 VAC Electric Power Distribution System, Showing Component Locations

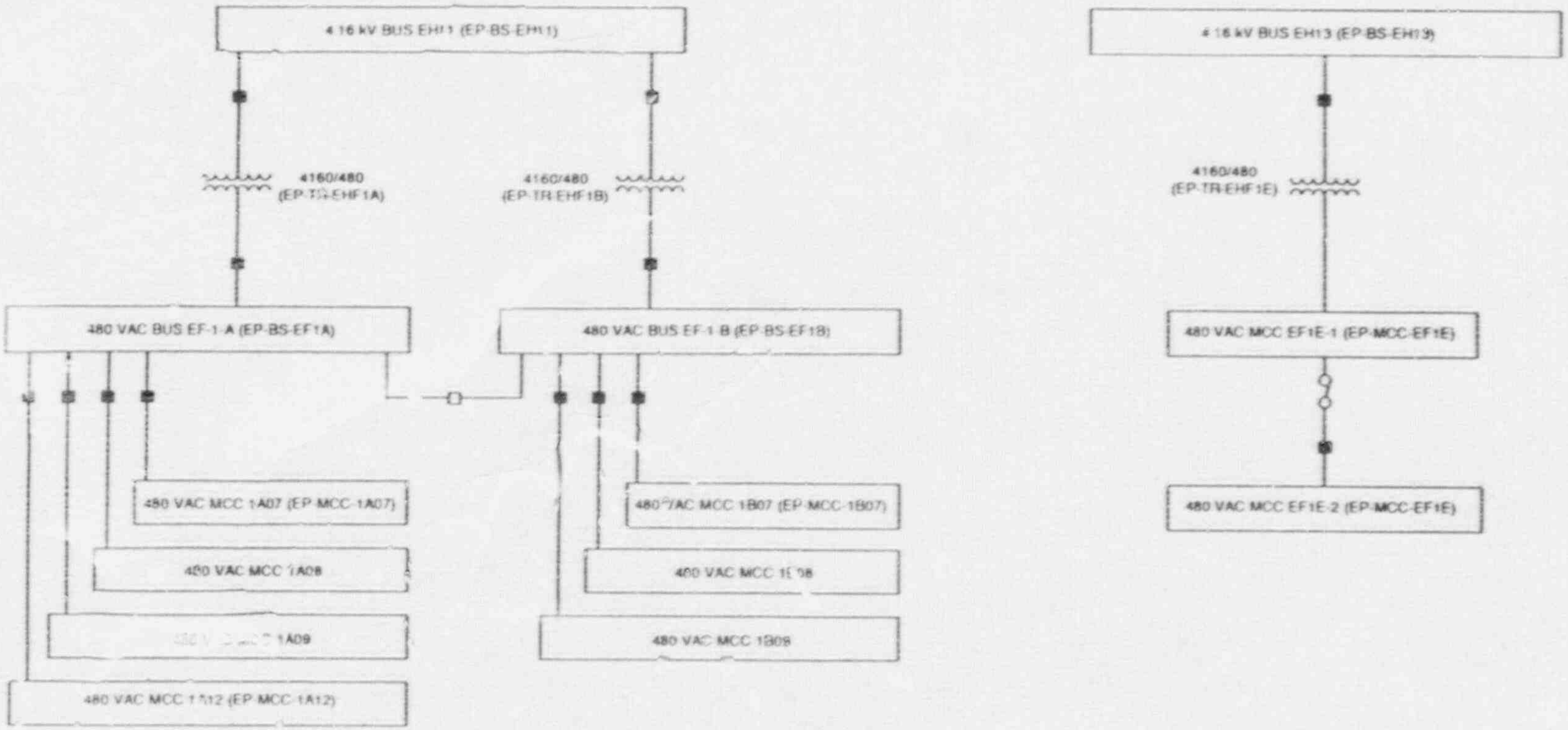


Figure 3.5-3. Perry 1 480 VAC Electric Power System (Page 1 of 2)

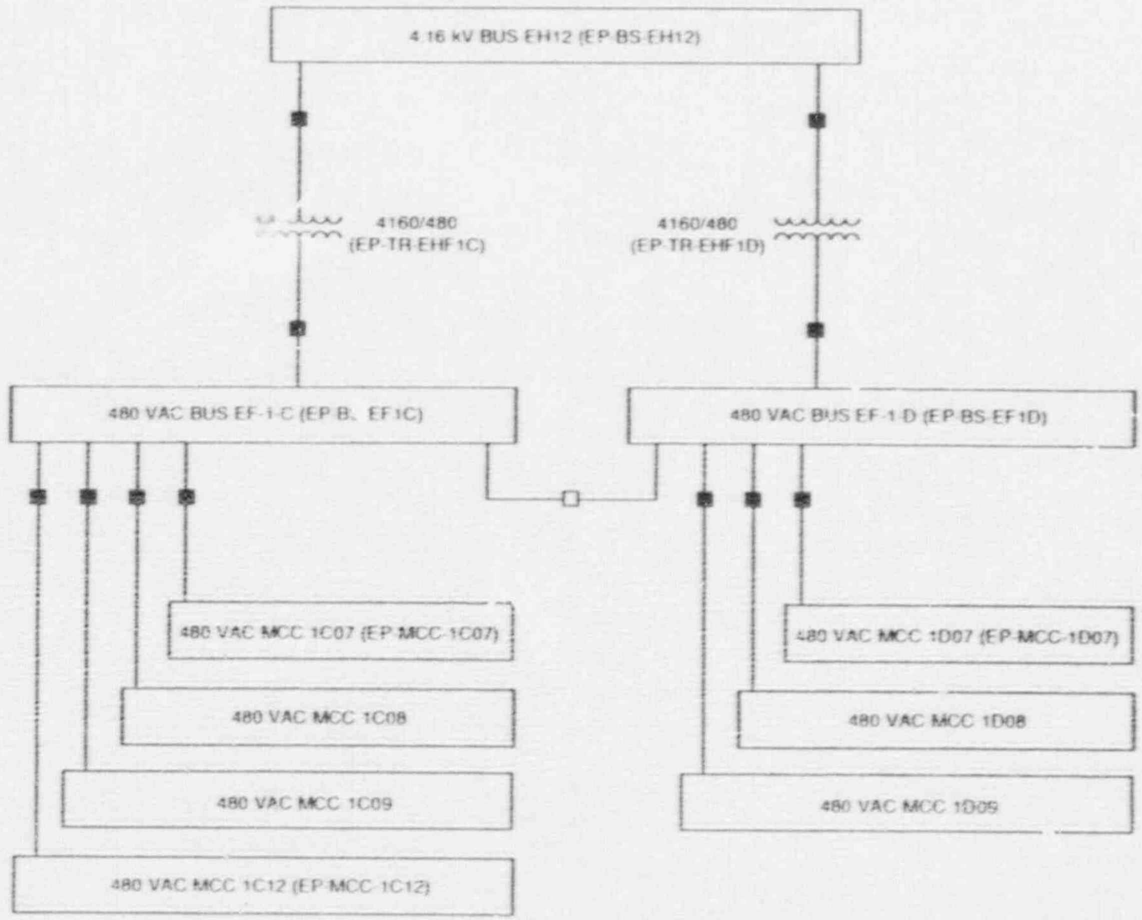


Figure 3.5-3. Perry 1 480 VAC Electric Power System (Page 2 of 2)

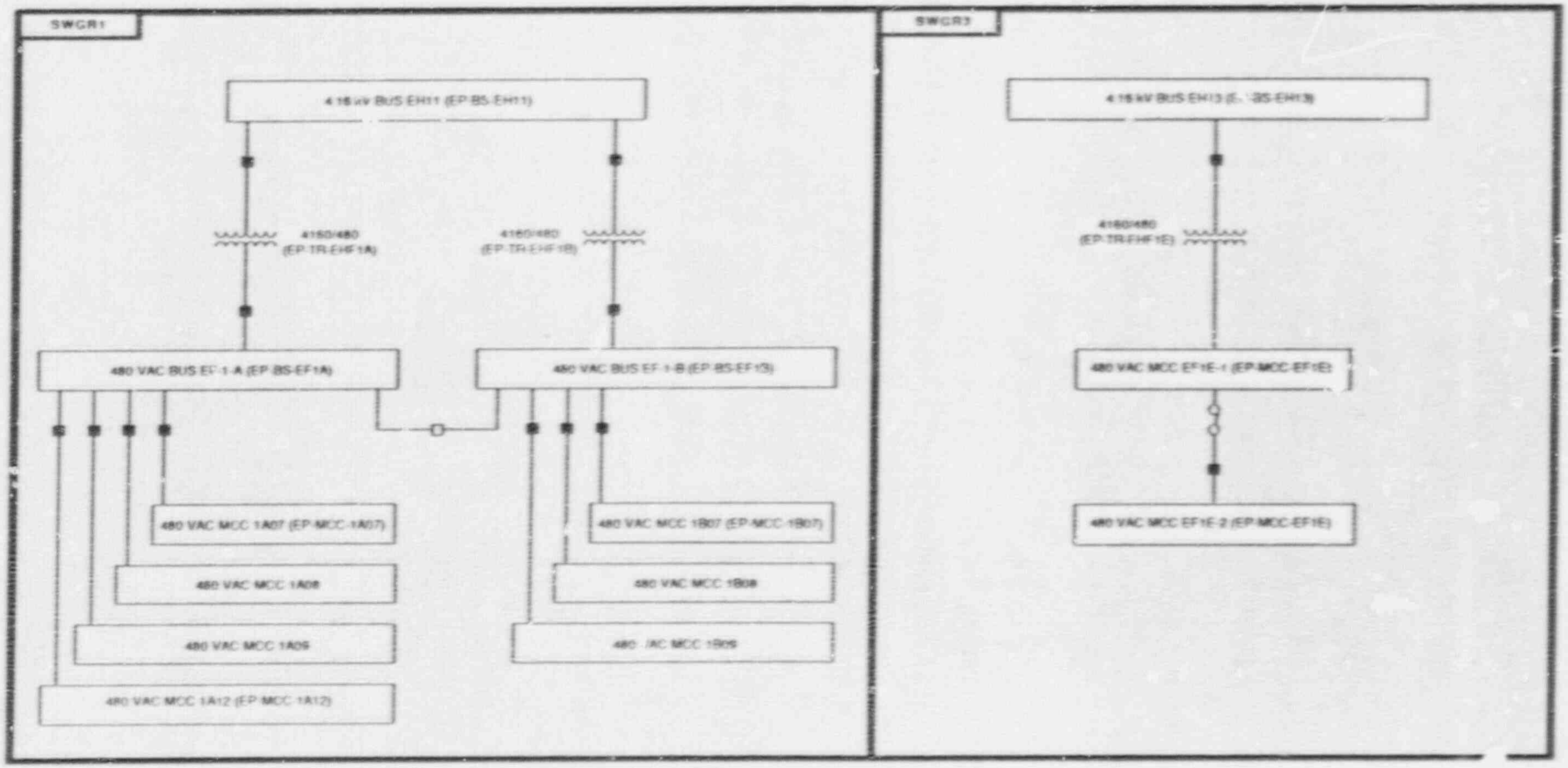


Figure 3.5-4. Perry 1 480 VAC Electric Power System, Showing Component Locations (Page 1 of 2)

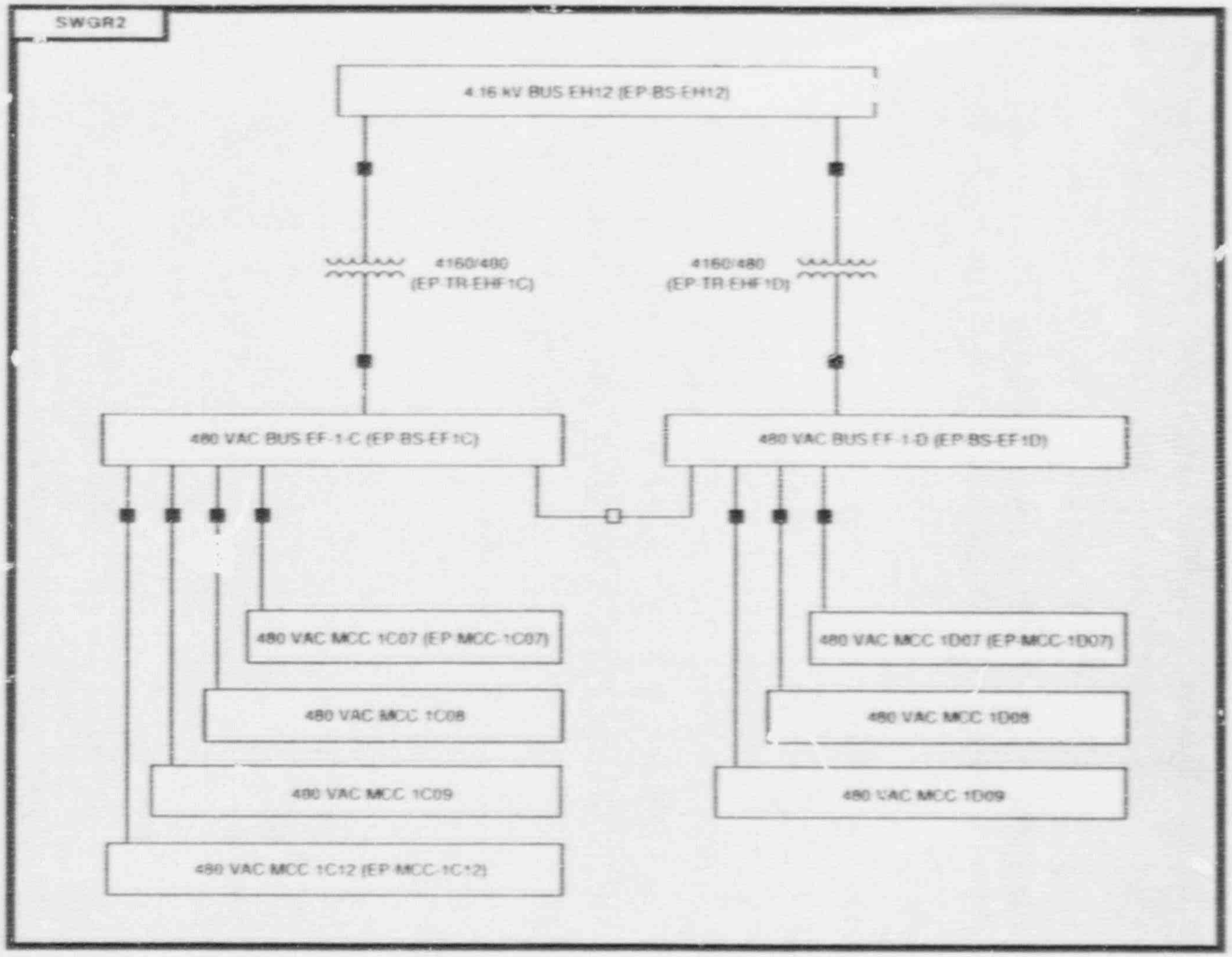


Figure 3.5-4. Perry 1 480 VAC Electric Power System, Showing Component Locations (Page 2 of 2)

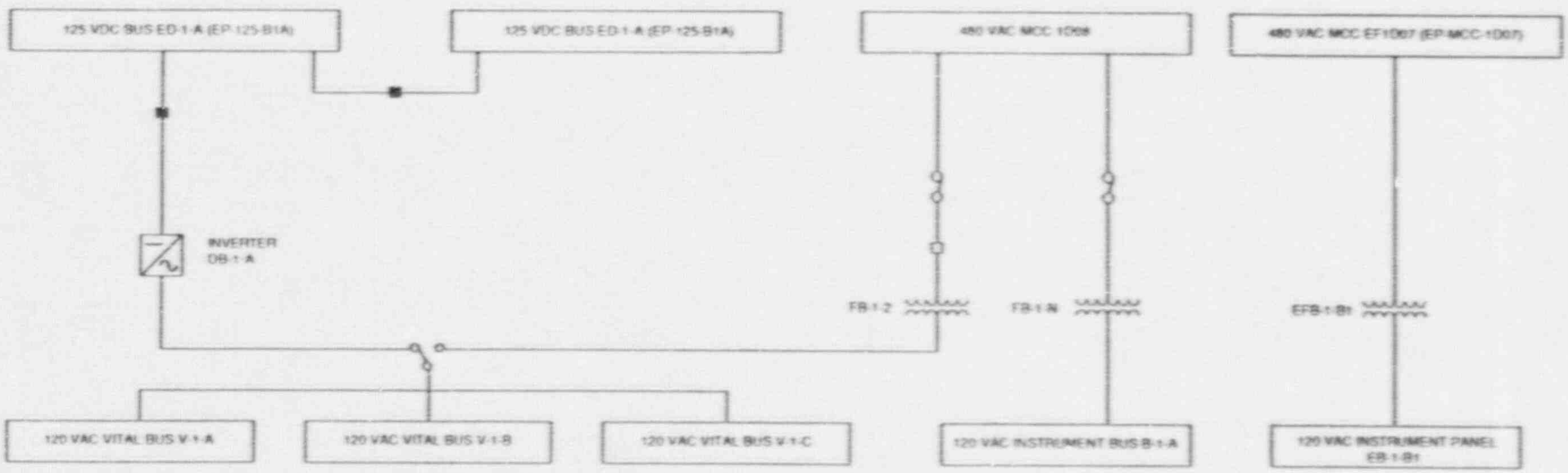


Figure 3.5-5. Perry 1 120 VAC Vital and Instrument Buses

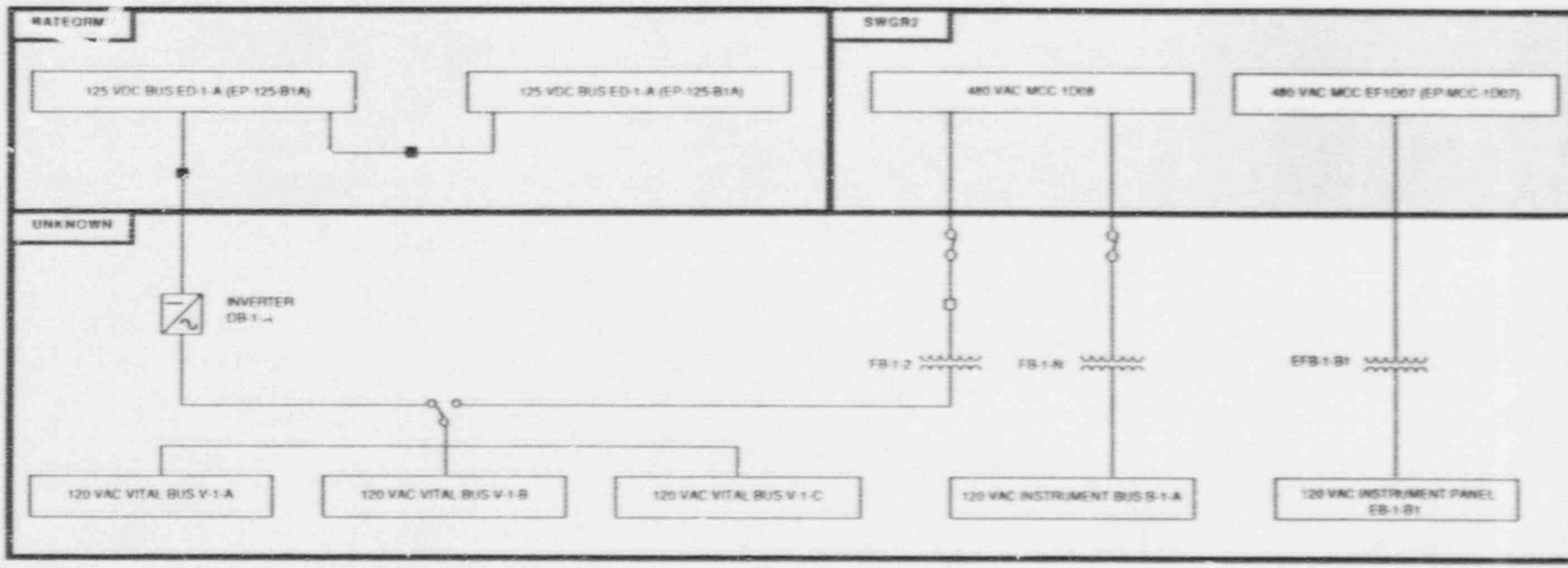


Figure 3.5-6. Perry 1 120 VAC Vital and Instrument Buses, Showing Component Locations

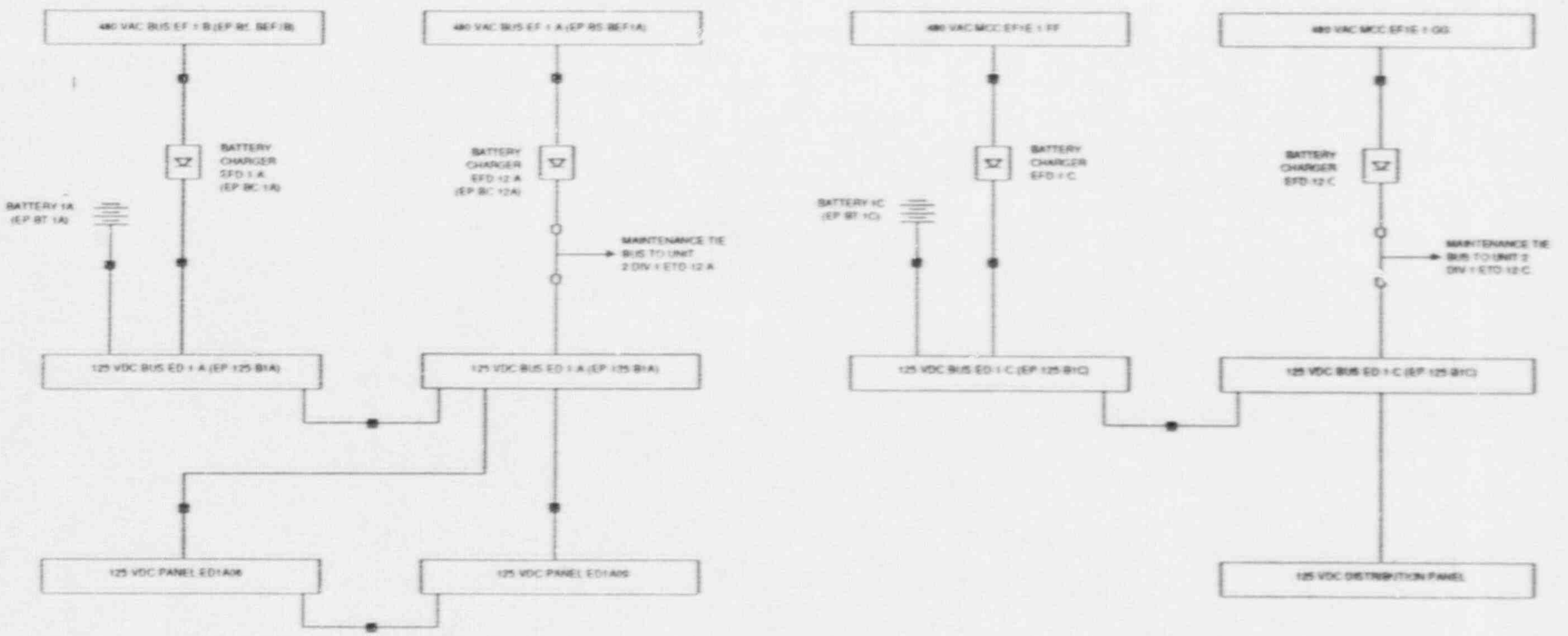


Figure 3.5-7. Perry 1 125 VDC Electric Power System (Page 1 of 2)

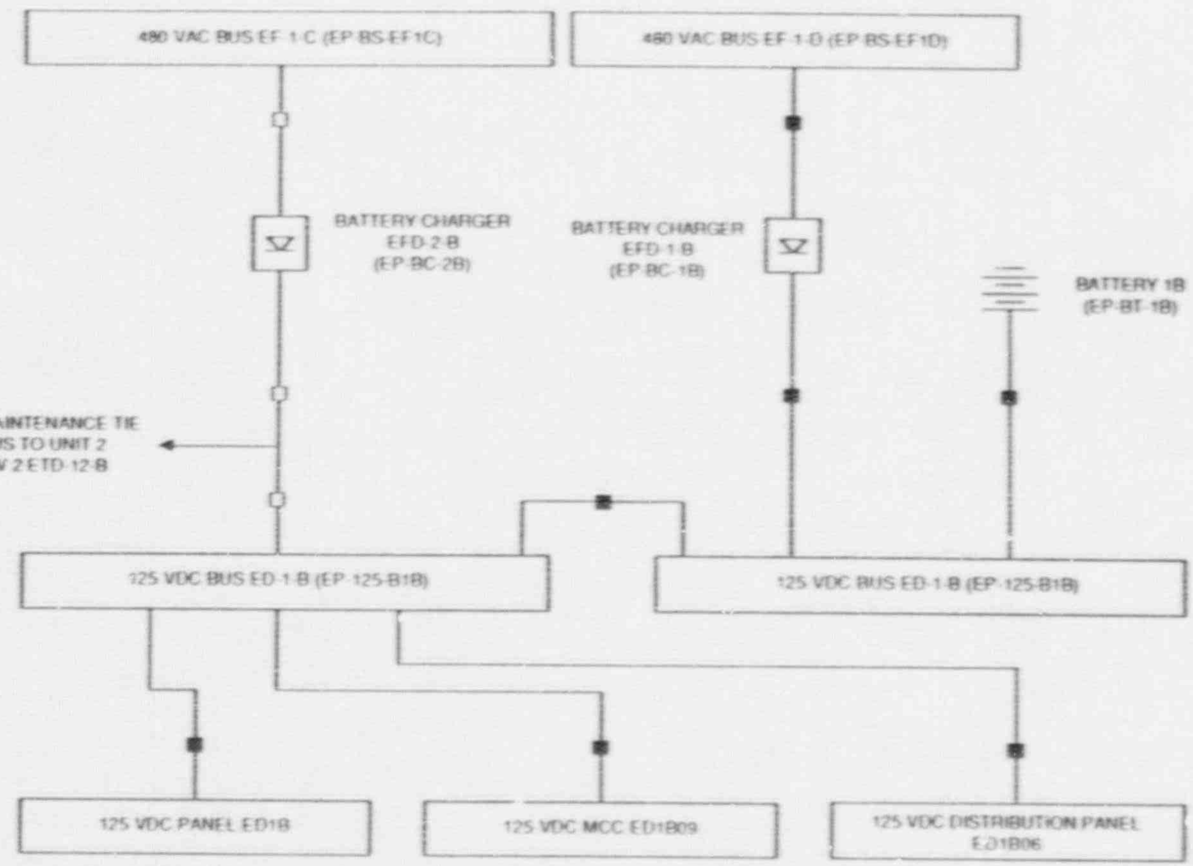
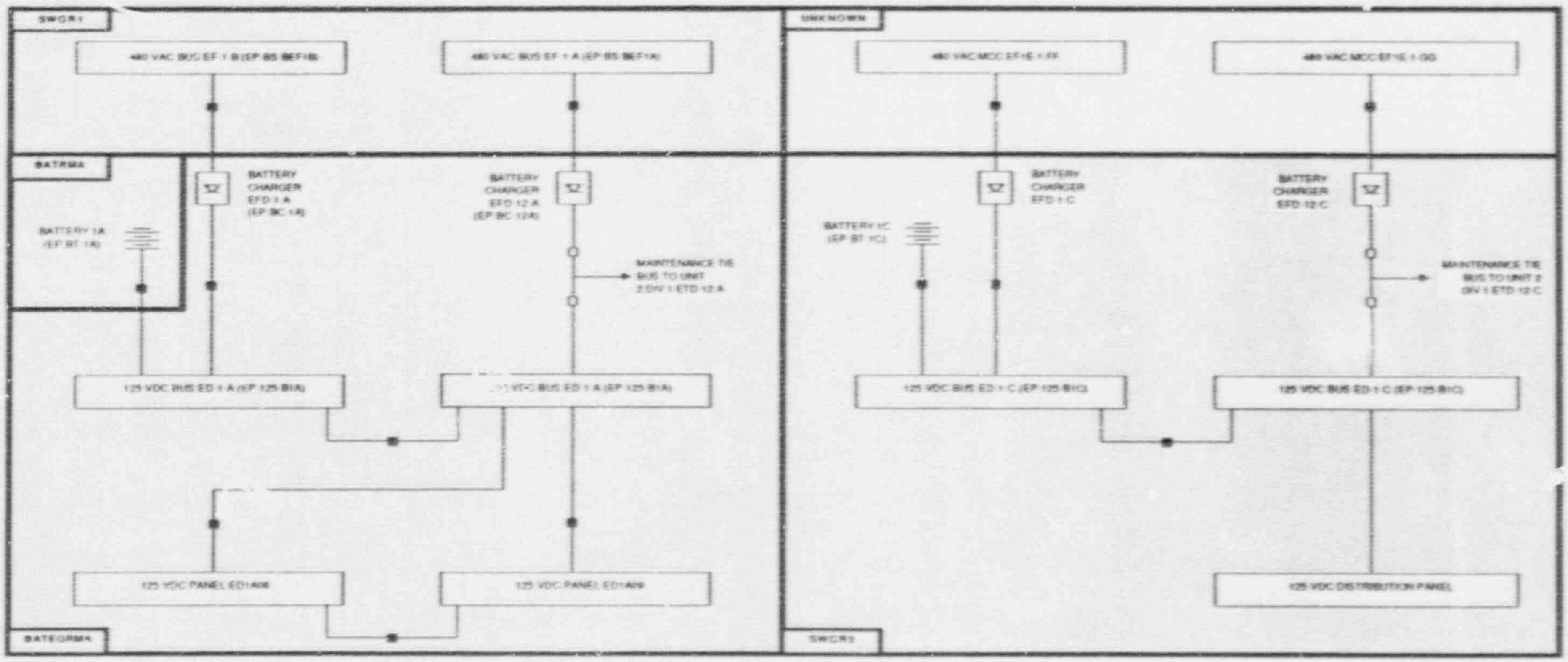
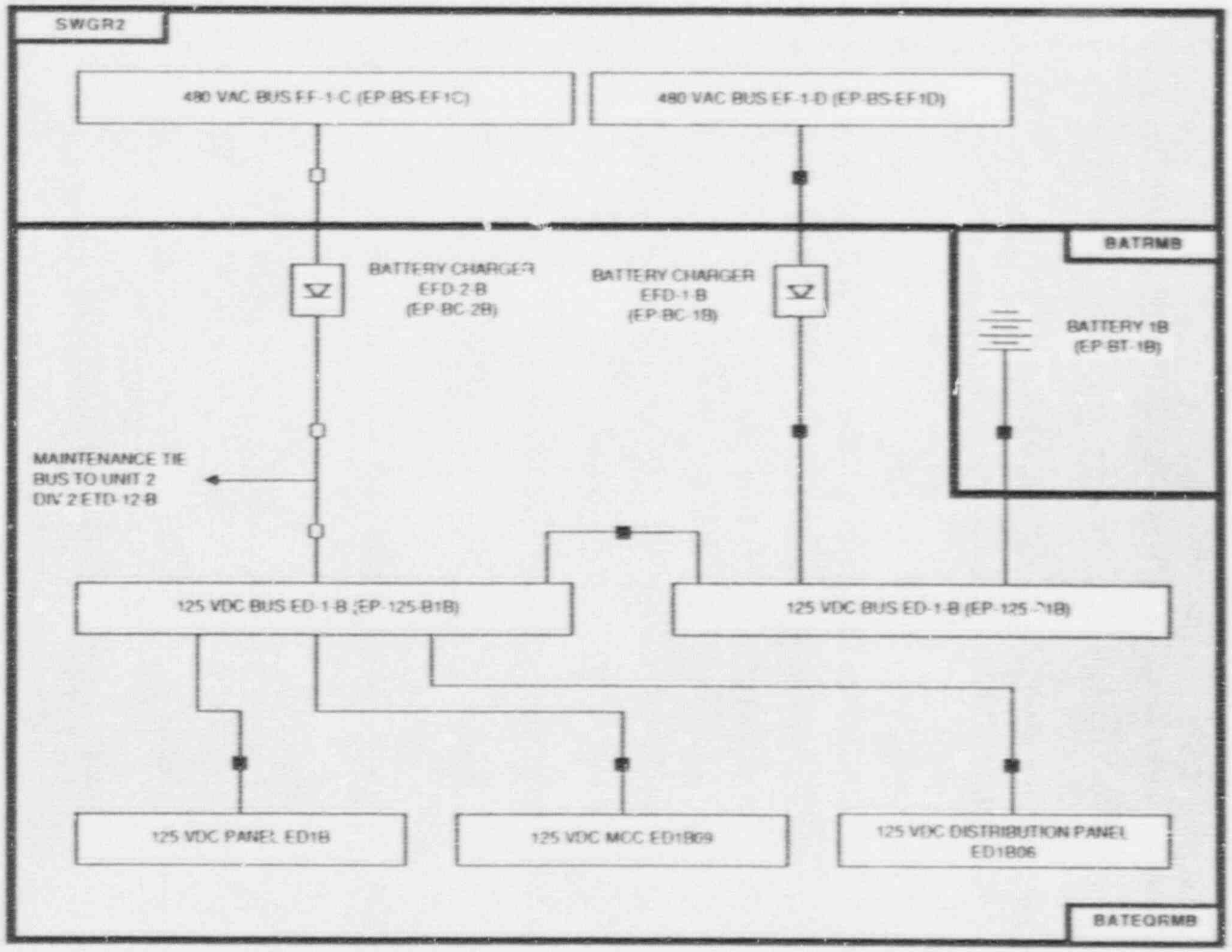


Figure 3.5-7. Perry 1 125 VDC Electric Power System (Page 2 of 2)



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-8. Perry 1 125 VDC Electric Power System, Showing Component Locations (Page 1 of 2)



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS.

Figure 3.5-8. Perry 1 125 VDC Electric Power System, Showing Component Locations (Page 2 of 2)

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CB-CEH11	CB	SWGR1	EP-DG-1A	4160	DGRMA	AC/A
CB-CEH12	CB	SWGR2	EP-DG-1B	4160	DGRMB	AC/B
CB-CEH13	CB	SWGR3	EP-DG-1C	4160	DGRMC	AC/C
EP-125-B1A	BUS	BATEQRMA	EP-BC-1A	125	BATEQRMA	DC/A
EP-125-B1A	BUS	BATRMA	EP-BC-12A	125	BATEQRMA	DC/A
EP-125-B1A	BUS	BATEQRMA	EP-BC-1A	125	BATEQRMA	DC/A
EP-125-B1A	BUS	BATEQRMA	EP-BC-12A	125	BATEQRMA	DC/A
EP-125-B1B	BUS	BATEQRMB	EP-BC-1B	125	BATEQRMB	DC/B
EP-125-B1B	BUS	BATEQRMB	EP-BC-1B	125	BATEQRMB	DC/B
EP-125-B1B	BUS	BATRMB	EP-BC-2B	125	BATEQRMB	DC/B
EP-125-B1B	BUS	BATEQRMB	EP-BC-1B	125	BATEQRMB	DC/B
EP-125-B1B	BUS	BATEQRMB	EP-BC-2B	125	BATEQRMB	DC/B
EP-125-B1C	BUS	SWGR3	EP-BT-1C	125	SWGR3	DC/C
EP-BC-12A	BC	BATEQRMA	EP-BS-BEF1A	125	BATEQRMA	DC/A
EP-BC-1A	BC	BATEQRMA	EP-BS-BEF1B	125	SWGR1	DC/A
EP-BC-1B	BC	BATEQRMB	EP-BS-BEF1D	125	SWGR2	DC/B
EP-BC-2B	BC	BATEQRMB	EP-BS-BEF1C	125	BATEQRMB	DC/B
EP-BS-EF1A	BUS	SWGR1	EP-TR-EHF1A	480	SWGR1	AC/A
EP-BS-EF1B	BUS	SWGR1	EP-TR-EHF1B	480	SWGR1	AC/A
EP-BS-EF1C	BUS	SWGR2	EP-TR-EHF1C	480	SWGR2	AC/B
EP-BS-EF1D	BUS	SWGR2	EP-TR-EHF1D	480	SWGR2	AC/B
EP-BS-EH11	BUS	SWGR1	EP-DG-1A	4160	DGRMA	AC/A
EP-BS-EH12	BUS	SWGR2	EP-DG-1B	4160	DGRMB	AC/B
EP-BS-EH13	BUS	SWGR3	EP-DG-1C	4160	DGRMC	AC/C
EP-BT-1A	BAT	BATRMA	EP-125-B1A	125	BATEQRMA	DC/A
EP-BT-1B	BAT	BATRMB	EP-125-B1B	125	BATEQRMB	DC/B
EP-BT-1C	BAT	SWGR3	EP-125-B1C	125	SWGR3	DC/C

Table 3.5-1. Perry 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-DG-1A	DG	DGRMA		4160		AC/A
EP-DG-1B	DG	DGRMB		4160		AC/B
EP-DG-1C	DG	DGRMC		4160		AC/C
EP-MCC-1A07	MCC	SWGR1	EP-BS-EF1A	480	SWGR1	AC/A
EP-MCC-1A12	MCC	SWGR1	EP-BS-EF1A	480	SWGR1	AC/A
EP-MCC-1B07	MCC	SWGR1	EP-BS-EF1B	480	SWGR1	AC/A
EP-MCC-1C07	MCC	SWGR2	EP-BS-EF1C	480	SWGR2	AC/B
EP-MCC-1C12	MCC	SWGR2	EP-BS-EF1C	480	SWGR2	AC/B
EP-MCC-1D07	MCC	SWGR2	EP-BS-EF1D	480	SWGR2	AC/B
EP-MCC-EF1E	MCC	SWGR3	EP-TR-EHF1E	480	SWGR3	AC/C
EP-TR-EHF1A	TRAN	SWGR1	EP-BS-EH11	4160	SWGR1	AC/A
EP-TR-EHF1B	TRAN	SWGR1	EP-BS-EH11	4160	SWGR1	AC/A
EP-TR-EHF1C	TRAN	SWGR2	EP-BS-EH12	4160	SWGR2	AC/B
EP-TR-EHF1D	TRAN	SWGR2	EP-BS-EH12	480	SWGR2	AC/B
EP-TR-EHF1E	TRAN	SWGR3	EP-BS-EH13	4160	SWGR3	AC/C

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Perry 1

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-125-B1A	125	DC/A	BATEQRMA	EP	EP-BT-1A	BAT	BATRMA
EP-125-B1A	125	DC/A	BATEQRMA	RCIC	RCIC-10	MOV	RCIC
EP-125-B1A	125	DC/A	BATEQRMA	RCIC	RCIC-13	MOV	RHRA
EP-125-B1A	125	DC/A	BATEQRMA	RCIC	RCIC-19	MOV	RCIC
EP-125-B1A	125	DC/A	BATEQRMA	RCIC	RCIC-22/59	MOV	RCIC
EP-125-B1A	125	DC/A	BATEQRMA	RCIC	RCIC-31	MOV	RCIC
EP-125-B1A	125	DC/A	BATEQRMA	RCIC	RCIC-45	MOV	RCIC
EP-125-B1A	125	DC/A	BATEQRMA	RCIC	RCIC-46	MOV	RCIC
EP-125-B1A	125	DC/A	BATEQRMA	RCIC	RCIC-68	MOV	RCIC
EP-125-B1B	125	DC/B	BATEQRMB	EP	EP-BT-1B	BAT	BATRMB
EP-125-B1B	125	DC/B	BATEQRMB	RCIC	RCIC-63	MOV	RC
EP-125-B1B	125	DC/B	BATEQRMB	RCS	RCIC-63	MOV	RC
EP-125-B1C	125	DC/C	SWGR3	EP	EP-BT-1C	BAT	SWGR3
EP-BC-12A	125	DC/A	BATEQRMA	EP	EP-125-B1A	BUS	BATRMA
EP-BC-12A	125	DC/A	BATEQRMA	EP	EP-125-B1A	BUS	BATEQRMA
EP-BC-1A	125	DC/A	BATEQRMA	EP	EP-125-B1A	BUS	BATEQRMA
EP-BC-1A	125	DC/A	BATEQRMA	EP	EP-125-B1A	BUS	BATEQRMA
EP-BC-1A	125	DC/A	BATEQRMA	EP	EP-125-B1A	BUS	BATEQRMA
EP-BC-1B	125	DC/B	BATEQRMB	EP	EP-125-B1B	BUS	BATEQRMB
EP-BC-1B	125	DC/B	BATEQRMB	EP	EP-125-B1B	BUS	BATEQRMB
EP-BC-1B	125	DC/B	BATEQRMB	EP	EP-125-B1B	BUS	BATEQRMB
EP-BC-2B	125	DC/B	BATEQRMB	EP	EP-125-B1B	BUS	BATRMB
EP-BC-2B	125	DC/B	BATEQRMB	EP	EP-125-B1B	BUS	BATEQRMB
EP-BS-BEF1A	125	DC/A	BATEQRMA	EP	EP-BC-12A	BC	BATEQRMA
EP-BS-BEF1B	125	DC/A	SWGR1	EP	EP-BC-1A	BC	BATEQRMA
EP-BS-BEF1C	125	DC/B	BATEQRMB	EP	EP-BC-2B	BC	BATEQRMB
EP-BS-BEF1D	125	DC/B	SWGR2	EP	EP-BC-1B	BC	BATEQRMB
EP-BS-BEH11	4160	AC/A	SWGR1	ECCS	RHR-PM2A	MDP	RHRA
EP-BS-EF1A	480	AC/A	SWGR1	EP	EP-MCC-1A07	MCC	SWGR1
EP-BS-EF1A	480	AC/A	SWGR1	EP	EP-MCC-1A12	MCC	SWGR1
EP-BS-EF1B	480	AC/A	SWGR1	EP	EP-MCC-1B07	MCC	SWGR1

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Perry 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-BS-EF1C	480	AC/B	SWGR2	EP	EP-MCC-1C07	MCC	SWGR2
EP-BS-EF1C	480	AC/B	SWGR2	EP	EP-MCC-1C12	MCC	SWGR2
EP-BS-EF1D	480	AC/B	SWGR2	EP	EP-MCC-1D07	MCC	SWGR2
EP-BS-EH11	4160	AC/A	SWGR1	ECCS	LPCS-P1	MDP	LPCS
EP-BS-EH11	4160	AC/A	SWGR1	EP	EP-TR-EHF1A	TRAN	SWGR1
EP-BS-EH11	4160	AC/A	SWGR1	EP	EP-TR-EHF1B	TRAN	SWGR1
EP-BS-EH11	4160	AC/A	SWGR1	ESW	ESW-P1A	MDP	ESWPMPHSE
EP-BS-EH12	4160	AC/B	SWGR2	ECCS	RHR-PM2B	MDP	RHRB
EP-BS-EH12	4160	AC/B	SWGR2	ECCS	RHR-PM2C	MDP	RHRC
EP-BS-EH12	4160	AC/B	SWGR2	EP	EP-TR-EHF1C	TRAN	SWGR2
EP-BS-EH12	480	AC/B	SWGR2	EP	EP-TR-EHF1D	TRAN	SWGR2
EP-BS-EH12	4160	AC/B	SWGR2	ESW	ESW-P1B	MDP	ESWPMPHSE
EP-BS-EH13	4160	AC/C	SWGR3	ECCS	HPCS-P1	MDP	HPCS
EP-BS-EH13	4160	AC/C	SWGR3	EP	EP-TR-EHF1E	TRAN	SWGR3
EP-BT-1C	125	DC/C	SWGR3	EP	EP-125-B1C	BUS	SWGR3
EP-DG-1A	4160	AC/A	DGRMA	EP	CB-CEH11	CB	SWGR1
EP-DG-1A	4160	AC/A	DGRMA	EP	EP-BS-EH11	BUS	SWGR1
EP-DG-1B	4160	AC/B	DGRMB	EP	CB-CEH12	CB	SWGR2
EP-DG-1B	4160	AC/B	DGRMB	EP	EP-BS-EH12	BUS	SWGR2
EP-DG-1C	4160	AC/C	DGRMC	EP	CB-CEH13	CB	SWGR3
EP-DG-1C	4160	AC/C	DGRMC	EP	EP-BS-EH13	BUS	SWGR3
EP-MCC-1A07	480	AC/A	SWGR1	ECCS	LPCS-1	MOV	LPCS
EP-MCC-1A07	480	AC/A	SWGR1	ECCS	LPCS-12	MOV	LPCS
EP-MCC-1A07	480	AC/A	SWGR1	ECCS	LPCS-5	MOV	RHRA
EP-MCC-1A07	480	AC/A	SWGR1	RCIC	RCIC-64	MOV	STMTNL
EP-MCC-1A07	480	AC/A	SWGR1	RCS	RCIC-64	MOV	STMTNL
EP-MCC-1A07	480	AC/A	SWGR1	RCS	RCS-19	MOV	STMTNL
EP-MCC-1A07	480	AC/A	SWGR1	RCS	RCS-4	MOV	STMTNL
EP-MCC-1A07	480	AC/A	SWGR1	RCS	RCS-67	MOV	STMTNL
EP-MCC-1A12	480	AC/A	SWGR1	ESW	ESW-130A	MOV	ESWPMPHSE
EP-MCC-1A12	480	AC/A	SWGR1	ESW	ESW-130B	MOV	ESWPMPHSE

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Perry 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-23	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-24A	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-24A	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-27A	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-28A	MOV	RC
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-28A	MOV	RC
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-37A	MOV	RC
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-3A	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-42A	MOV	RC
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-47A	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-48A	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-48A	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-4A	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-537A	MOV	RC
EP-MCC-1B07	480	AC/A	SWGR1	ECCS	RHR-6A	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	ESW	ESW-14A	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	ESW	ESW-68A	MOV	RHRA
EP-MCC-1B07	480	AC/A	SWGR1	RCS	RCS-8	MOV	STMTNL
EP-MCC-1C07	480	AC/B	SWGR2	RCS	RCS-1	MOV	RC
EP-MCC-1C07	480	AC/B	SWGR2	RCS	RCS-16	MOV	RC
EP-MCC-1C07	480	AC/B	SWGR2	RCS	RCS-68A	MOV	STMTNL
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-105	MOV	RHRC
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-21	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-24B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-24B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-27B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-28B	MOV	RC
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-28B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-37B	MOV	RC
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-3B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-42B	MOV	RC

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Perry 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-42C	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-47B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-48B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-48B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-4B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-52B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-537A	MOV	RC
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-537B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-537B	MOV	RC
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-6B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ECCS	RHR-87B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ESW	ESW-14B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	ESW	ESW-68B	MOV	RHRB
EP-MCC-1D07	480	AC/B	SWGR2	RCS	RCS-9	MOV	RC
EP-MCC-EF1B	480	AC/A	SWGR1	ECCS	RHR-52A	MOV	RHRA
EP-MCC-EF1B	480	AC/A	SWGR1	ECCS	RHR-87A	MOV	RHRA
EP-MCC-EF1E	480	AC/C	SWGR3	ECCS	HPCS-1	MOV	HPCS
EP-MCC-EF1E	480	AC/C	SWGR3	ECCS	HPCS-10	MOV	HPCS
EP-MCC-EF1E	480	AC/C	SWGR3	ECCS	HPCS-11	MOV	HPCS
EP-MCC-EF1E	480	AC/C	SWGR3	ECCS	HPCS-15	MOV	HPCS
EP-MCC-EF1E	480	AC/C	SWGR3	ECCS	HPCS-23	MOV	HPCS
EP-MCC-EF1E	480	AC/C	SWGR3	ECCS	HPCS-4	MOV	HPCS
EP-MCC-EF1E	480	AC/C	SWGR3	ESW	ESW-140C	MOV	ESWPMPHSE
EP-MCC-EF1E	480	AC/C	SWGR3	ESW	ESW-P1C	MDP	ESWPMPHSE
EP-TR-EHF1A	480	AC/A	SWGR1	EP	EP-BS-EF1A	BUS	SWGR1
EP-TR-EHF1B	480	AC/A	SWGR1	EP	EP-BS-EF1B	BUS	SWGR1
EP-TR-EHF1C	480	AC/B	SWGR2	EP	EP-BS-EF1C	BUS	SWGR2
EP-TR-EHF1D	480	AC/B	SWGR2	EP	EP-BS-EF1D	BUS	SWGR2
EP-TR-EHF1E	480	AC/C	SWGR3	EP	EP-MCC-EF1E	MCC	SWGR3

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 a 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 exceeds the supply pressure at the drive, 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 200 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 respond 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: 500,000 gal (per unit)

C. Scram Accumulator
   1. Normal pressure: 1400 to 1500 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
   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 Section 3.6 References

1. Harrington, R.M., and Ott, L.J., "The Effect of Small-Capacity, High-Pressure Injection Systems on TQUV Sequences at Browns Ferry Unit One," NUREG/CR-3179, Oak Ridge National Laboratory, September 1983.

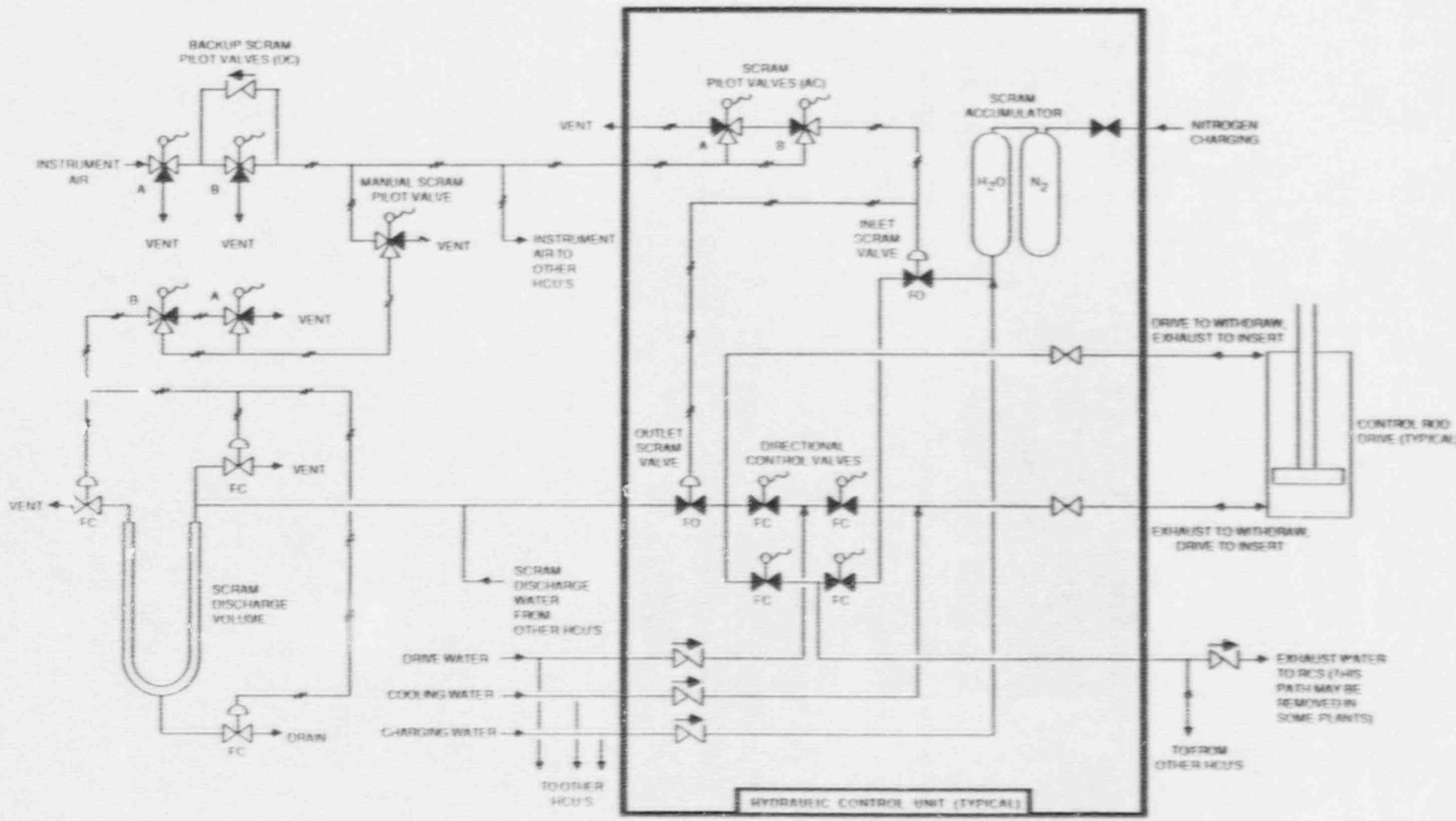


Figure 3.6-1. Simplified Diagram of Portions of the Control Rod Drive Hydraulic System That are Related to the Scram Function

3.7 EMERGENCY SERVICE WATER SYSTEM (ESWS)

3.7.1 System Function

The emergency service water system provides cooling water from the ultimate heat sink to various heat loads in the plant required for safe shutdown. The ESWS completes the decay heat removal path from the RHR system to the ultimate heat sink. Train B of the ESWS can be aligned to supply water to the RHR system for low pressure core flooding if needed. In addition, the ESWS can provide emergency makeup to the fuel pool (from Unit 1 system only), de-ice the ESWS pumphouse traveling screens, and provide emergency makeup to the emergency closed cooling system surge tanks.

3.7.2 System Definition

A separate ESWS is provided for Units 1 and 2. Each ESWS is composed of three separate open loop subsystems designated A, B, and C. Loops A and B consist of a motor-driven pump and distribution piping which supply cooling water to two RHR heat exchangers, an emergency closed cooling system heat exchanger, and a diesel engine jacket water cooler. Loop C consists of a motor-driven pump and distribution piping which supply cooling water to the HPCS diesel engine heat exchanger, and the HPCS room cooler. Simplified drawings of the ESW system are shown in Figures 3.7-1 and 3.7-2. A summary of data on selected ESWS components is presented in Table 3.7-1.

3.7.3 System Operation

The ESWS is normally shutdown but operates during hot standby, normal shutdown, post-accident (with loss of preferred AC power) and testing of the service water system. The system is initiated automatically by a LOCA signal or can be initiated remotely from the control room. In addition, Loop C is automatically initiated with the startup of the HPCS system.

Each loop is supplied by a separate pump which is operated from a preferred power source or standby source (diesel generator). The primary source of water to the emergency service water pumphouse is supplied directly from Lake Erie via a branch tunnel taken off the main intake tunnel to the service water pumphouse. A backup supply is available by means of a branch tunnel from the main discharge tunnel.

Should the normal ESWS supply from the intake tunnel be interrupted, sluice gates open allowing water from the discharge tunnel to flow into the forebay and supply the ESWS system. The sluice gates open automatically upon receiving a low water level signal from the ESWS pumphouse forebay. Upon indication on the control room panel that the sluice gates are open, manual valves may be administratively closed to prevent warm ESWS water from dumping to the discharge tunnel and forming a closed loop system. With the manual valves closed, the ESWS discharges to the swale.

3.7.4 System Success Criteria

The success criteria for a particular ESWS loop is that the single ESWS pump must operate, have access to an adequate water supply, and an intact and unblocked flow path must be available to supply essential heat loads served by the ESWS loop.

3.7.5 Component Information

A. Emergency Service Water Pumps P1A and P1B
   1. Rated flow: 11,500 gpm @ 160 ft. head (69 psid)
   2. Rated capacity: 100%
   3. Type: vertical centrifugal

B. Emergency Service Water Pump P1C
   1. Rated flow: 960 gpm @ 160 ft head (69 psid)
   2. Rated capacity: 100%
   3. Type: vertical centrifugal

3.7.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      All ESWS pumps are initiated by a LOCA signal. Loop C is initiated with the startup of the HPCS system. The normally closed, motor-operated RHR heat exchanger isolation valves open upon receipt of an ECCS signal.
   2. Remote manual
      The ESWS pumps can be actuated by remote manual means from the control room.

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

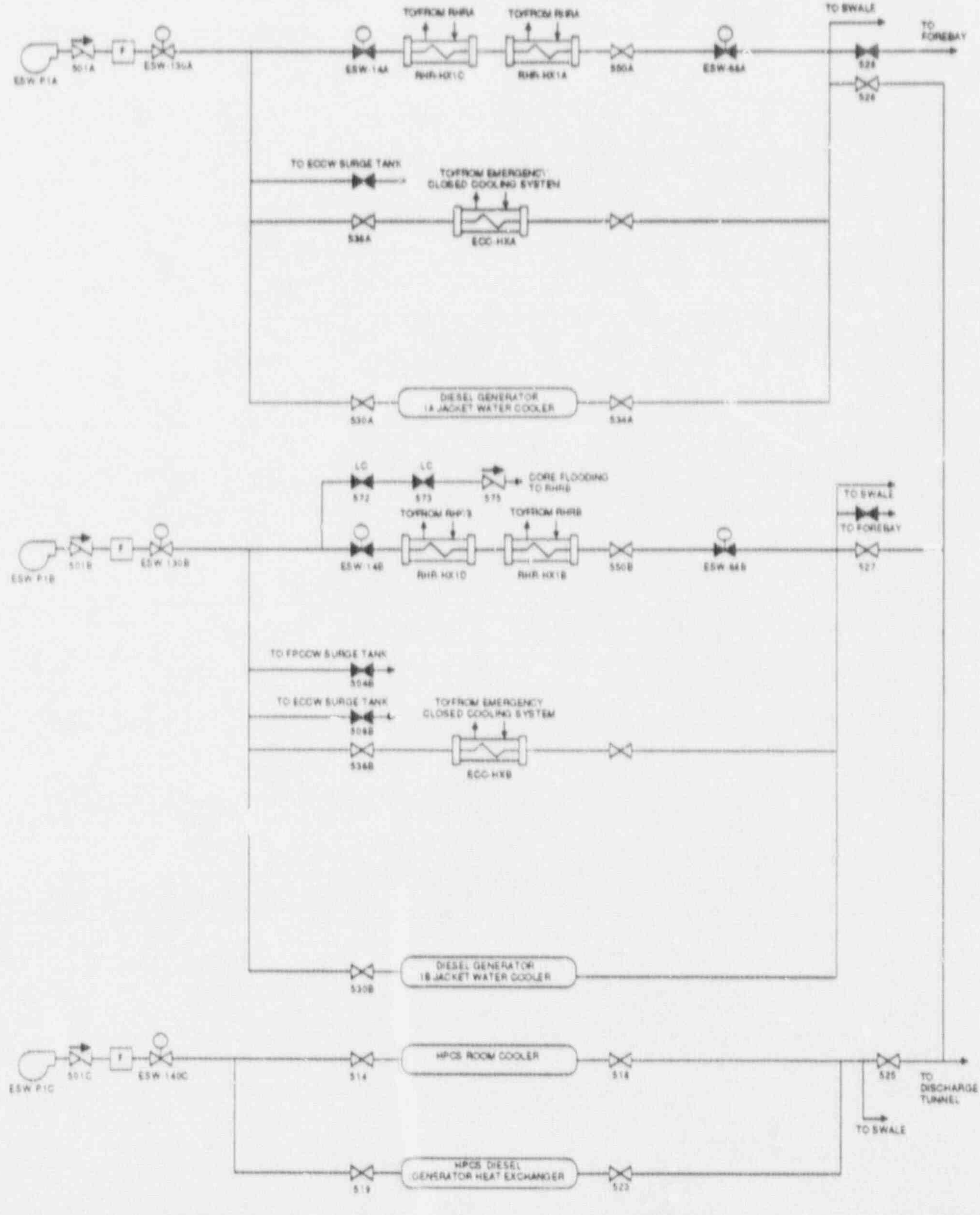


Figure 3.7-1. Perry 1 Emergency Service Water System

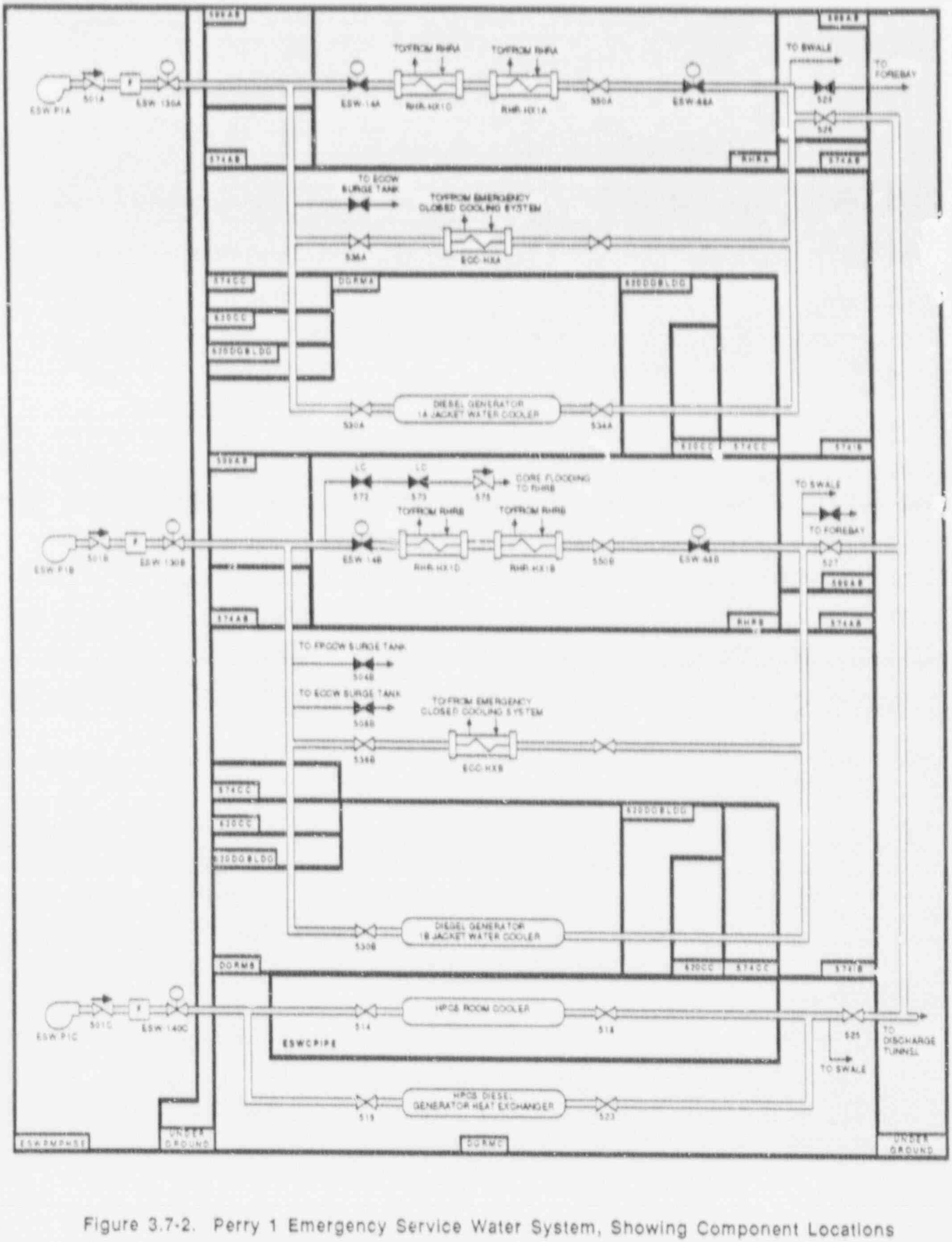


Figure 3.7-2. Perry 1 Emergency Service Water System, Showing Component Locations

Table 3.7-1. Perry 1 Emergency Service Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
ESW-130A	MOV	ESWPMPHSE	EP-MCC-1A12	480	SWGR1	AC/A
ESW-130B	MOV	ESWPMPHSE	EP-MCC-1A12	480	SWGR1	AC/A
ESW-140C	MOV	ESWPMPHSE	EP-MCC-EF1E	480	SWGR3	AC/C
ESW-14A	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A
ESW-14B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
ESW-68A	MOV	RHRA	EP-MCC-1B07	480	SWGR1	AC/A
ESW-68B	MOV	RHRB	EP-MCC-1D07	480	SWGR2	AC/B
ESW-P1A	MDP	ESWPMPHSE	EP-BS-EH11	4160	SWGR1	AC/A
ESW-P1B	MDP	ESWPMPHSE	EP-BS-EH12	4160	SWGR2	AC/B
ESW-P1C	MDP	ESWPMPHSE	EP-MCC-EF1E	480	SWGR3	AC/C

3.8 EMERGENCY CLOSED COOLING (ECC) SYSTEM

3.8.1 System Function

The ECC system provides cooling water to various plant components during hot standby, normally shutdown, post-accident, or support testing. This system is a closed loop intermediate cooling system between the components being cooled and the Emergency Service Water System.

3.8.2 System Definition

The ECC system is a closed loop system that has its heat exchanger cooled by the Emergency Service Water System. A separate ECC system serves each unit. These systems are completely independent and nearly identical. The ECC system associated with Unit 1 is capable of supplying cooling water to the control complex chillers. These chillers support ventilation cooling in the control room, battery and switchgear rooms, and miscellaneous control complex areas. The ECC system associated with Unit 2 is designed to provide cooling water to the Fuel Pool heat exchanger following a design basis accident. Since Unit 2 has not been built, it is not known how the fuel pool will currently be cooled during a design basis accident.

The ECC system has two independent loops, each consisting of one pump, heat exchanger, and a surge tank. A chemical addition tank is shared by both units. A simplified drawing of the ECC system is shown in Figure 3.8-1.

3.8.3 System Operation

During normal operation, the control complex chillers are cooled by the Nuclear Closed Cooling System. Following a design basis accident, these chillers, RHR pump seals, and LPCS, RHR, and RCIC pump room coolers are cooled by the ECC system. During hot standby, normal shutdown, or support testing, initiation of the system is a remote manual function. It could not be determined if manual action is required to initiated the system following an accident.

Water from the two bed water storage distribution system is used for initial system operation and system makeup. In addition, a source of emergency makeup water is provided from the ESWS. Loops A and B of these ESWS supply the emergency makeup water to loops A and B of the ECC system, respectively. This is a remote manual function requiring operator action in the control room. Surge tank low level indication with an alarm is annunciated in the control room to indicate that operator action is required.

3.8.4 System Success Criteria

System success criteria for the ECC system is on a per train basis. For a particular ECC system loop the ECC pump must operate and an intact and unblocked flow path must be available to supply essential heat loads served by the ECC system.

3.8.5 Component Information

A. Emergency Closed Cooling System Pumps 1A, 1B
   1. Design flow: 2,300 gpm @ 139 ft. head
   2. Rated capacity per pump: 100%
   3. Type: horizontal split case

B. Emergency Closed Cooling System Heat Exchangers A, B
   1. Design duty: 13.6×10^6 Btu/hr.
   2. Type: Single pass, shell and tube

C. Surge Tank
   1. Volume: 660 gal.

3.8.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      No automatic signals to initiated the ECC system were identified.
   2. Remote manual
      The ECC system can be initiated from the control room.

B. Motive Power
   The pumps may be operated from the preferred off-site power supply or from a standby on-site power source.

C. Other
   1. The ECC system heat exchangers are cooled by the ESW system (see Section 3.7).
   2. Normal makeup to the EC system surge tank is provided by the two bed water storage and distribution system.

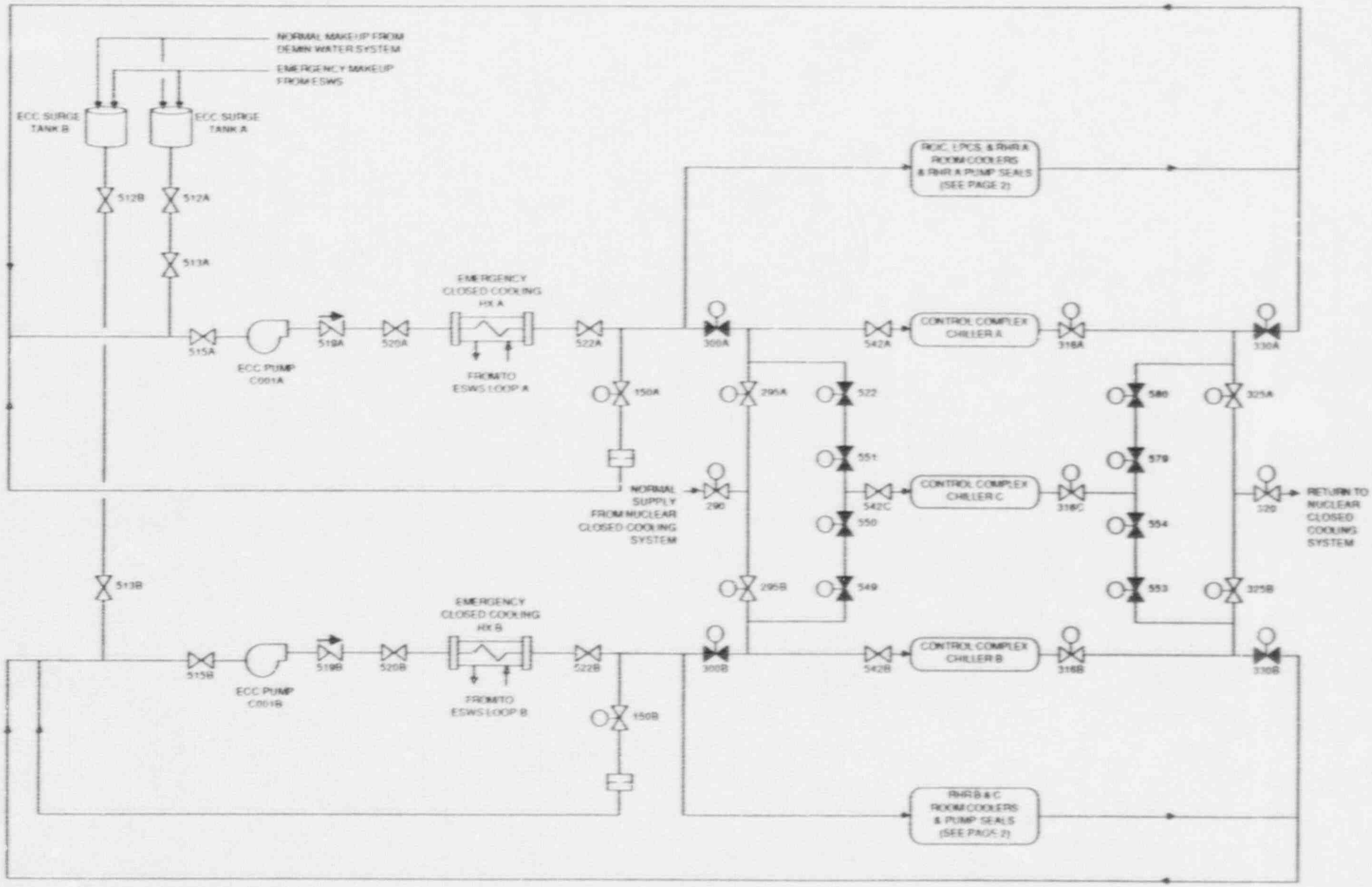


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Figure 3.8-1. Perry 1 Emergency Closed Cooling System (Page 1 of 2)

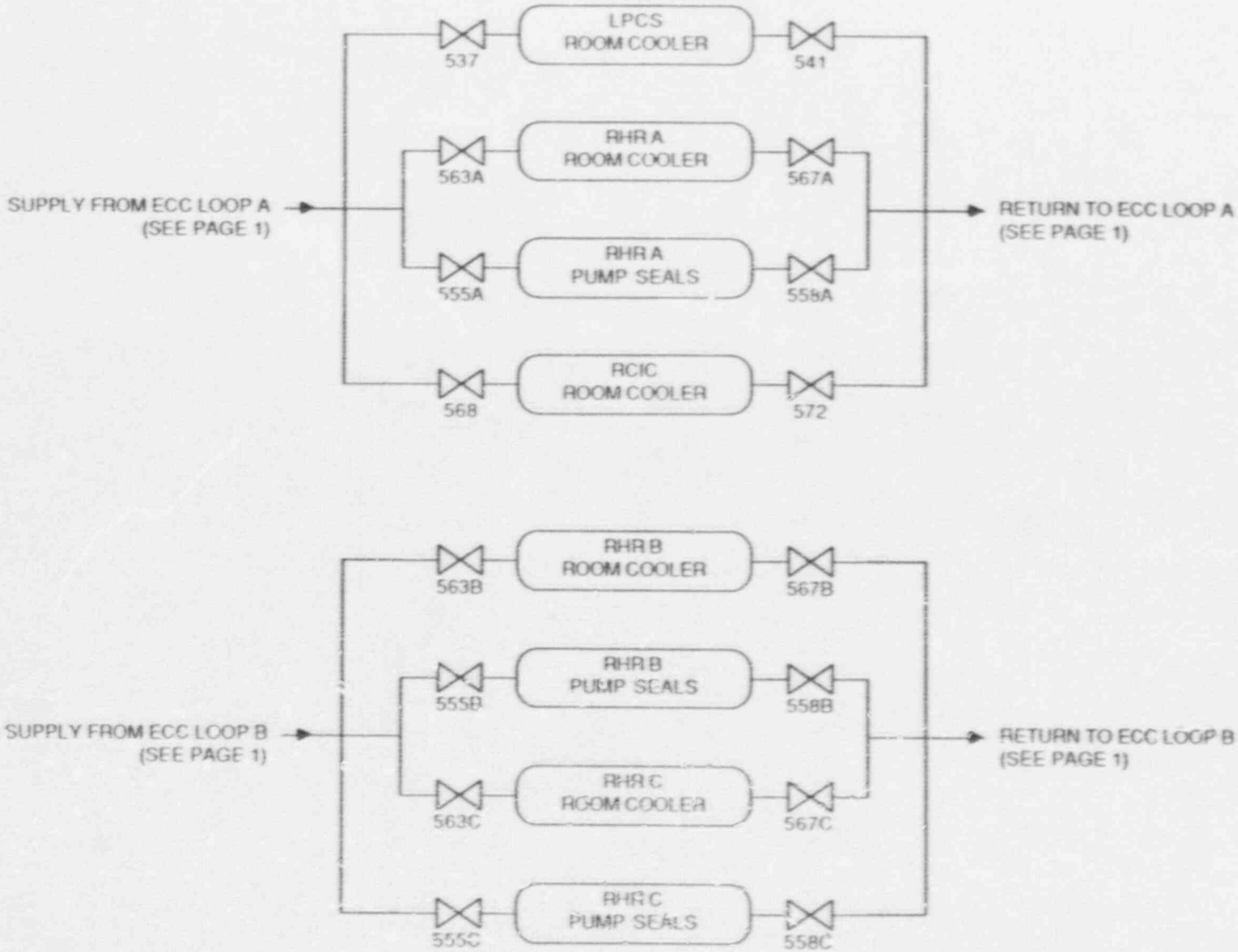

Figure 3.8-1. Perry 1 Emergency Closed Cooling System (Page 2 of 2)

4. PLANT INFORMATION

4.1 SITE AND BUILDING SUMMARY

The Perry 1 and 2 site is located in a rural area of Lake County, Ohio. The site is approximately seven miles northeast of Painesville and 35 miles northeast of Cleveland, the nearest large principle city. The eastern two-thirds of the site is within the boundaries of North Perry Village while the western third is within Perry Township. Lake Erie borders the site to the north. A general view of the site is shown in Figures 4-1 (from Ref. 1) and a more detailed site plan is shown in Figure 4-2.

The two reactor buildings for Units 1 and 2 are separated by a common intermediate building. The auxiliary and turbine buildings for Unit 1 are located north of the Unit 1 containment, and the auxiliary and turbine buildings for Unit 2 are located south of the Unit 2 containment. The turbine buildings contain the main turbine and balance of plant systems. The control complex is located west of the intermediate building. The control complex contains the control room, switchgear rooms, remote shutdown panel, battery rooms, and the cable spreading rooms. The control rooms for the two units are in separate areas on the 654 foot elevation.

The diesel generator building contains the six diesel generators required by Units 1 and 2. This building is located west of the control complex. The long-term fuel oil storage tanks are located below ground adjacent to the diesel generator building.

Cooling towers are located east of the turbine buildings. North of the Unit 1 turbine building is the emergency service water pump house. The emergency service water pump house contains the ESWS pumps for both units.

One condensate storage tank (CST) is provided for each unit. The Unit 1 CST is located just northeast of the Unit 1 turbine building and the Unit 2 CST is located just southeast of the Unit 2 turbine building.

4.2 FACILITY LAYOUT DRAWINGS

Figures 4-3 through 4-10 are section views of the Perry 1 and 2 reactor intermediate, auxiliary and turbine buildings. Layout drawings of these buildings are shown in Figures 4-11 to 4-18. The ESW pump house is shown in section view in Figure 4-19 and in plan view in Figure 4-20. 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 3, Oak Ridge National Laboratory, Nuclear Safety Information Center, April 1974.

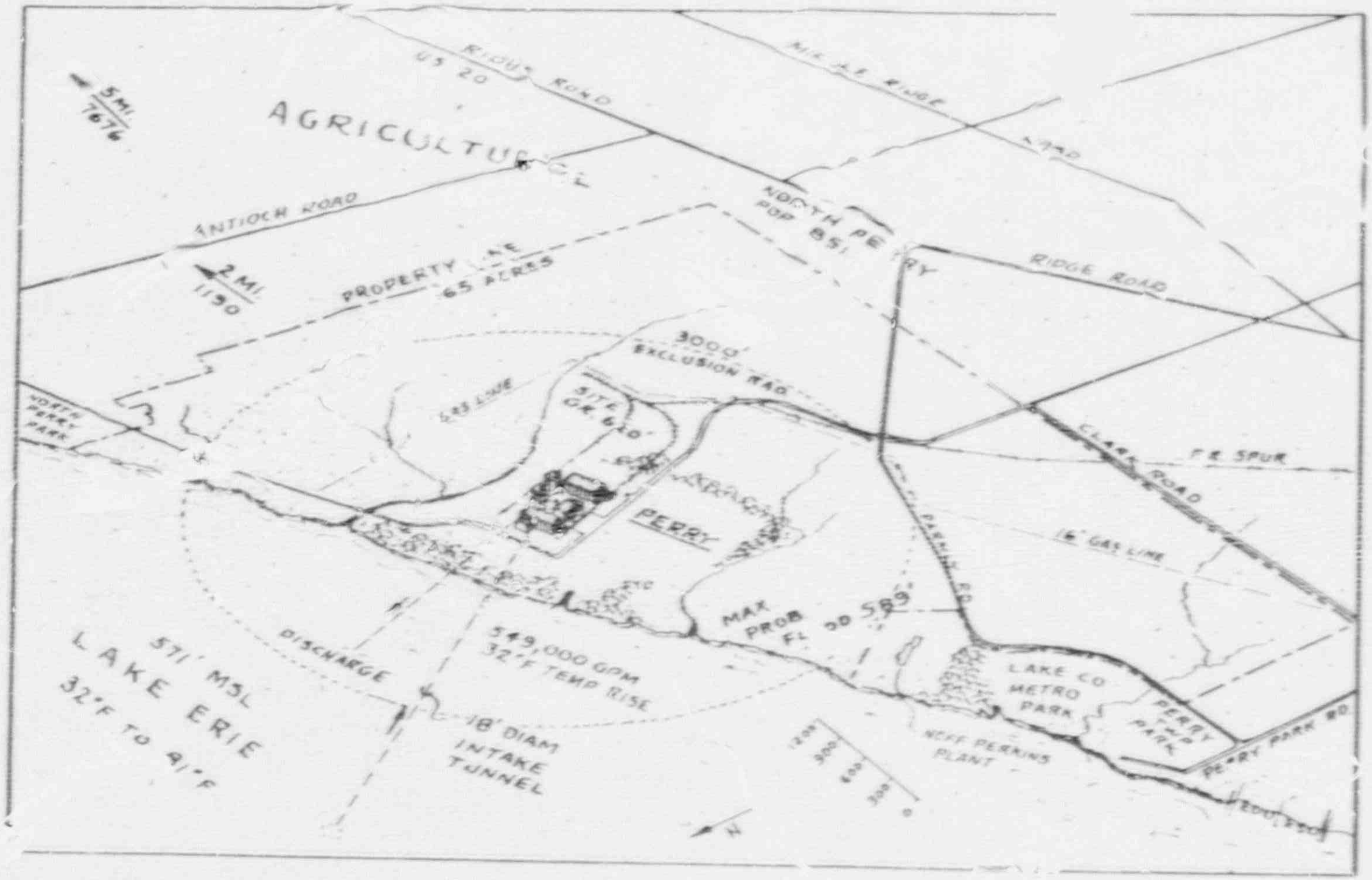

Figure 4-1. General View of the Perry Site and Vicinity

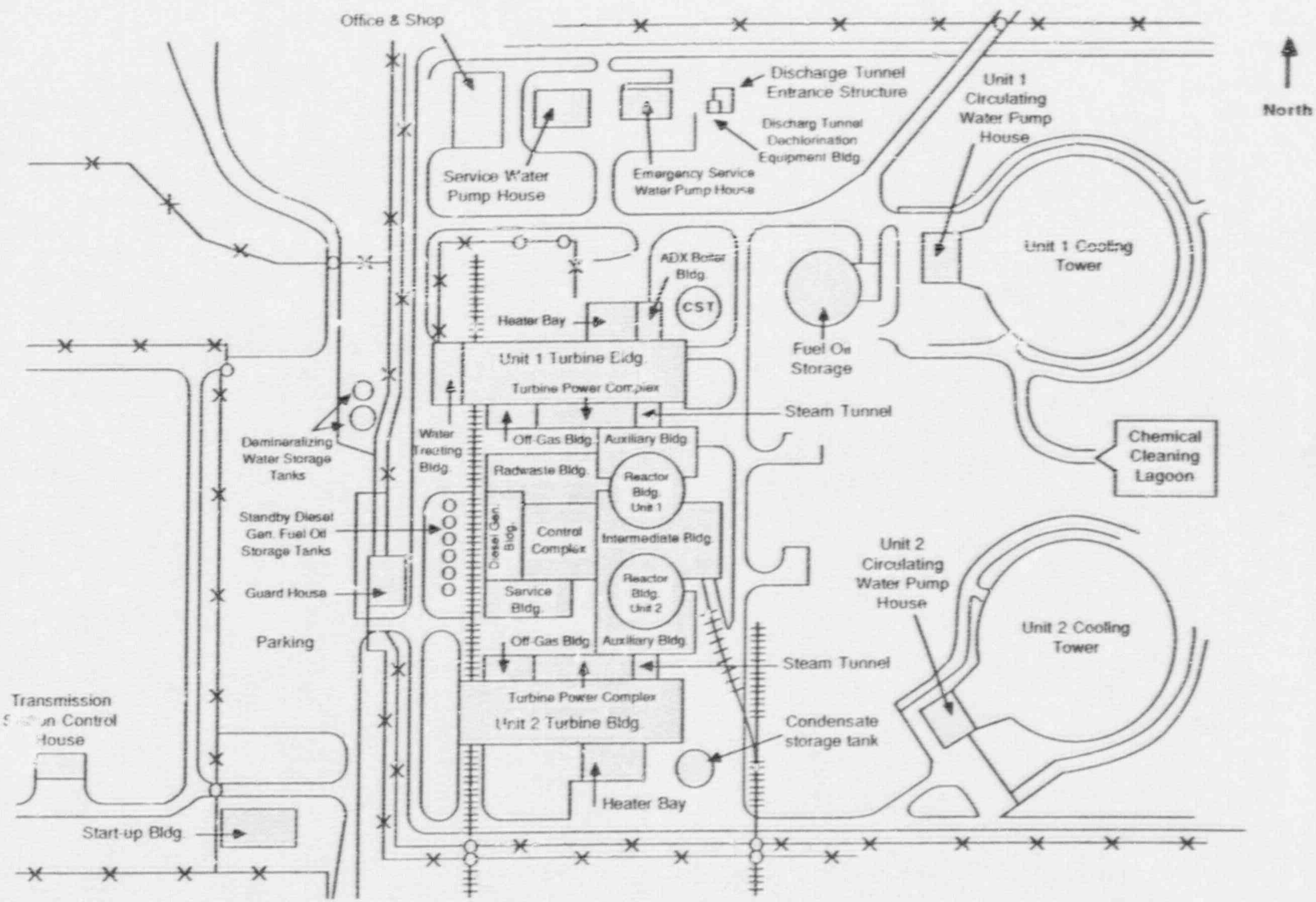

Figure 4-2. Perry 1 and 2 Simplified Site Plan

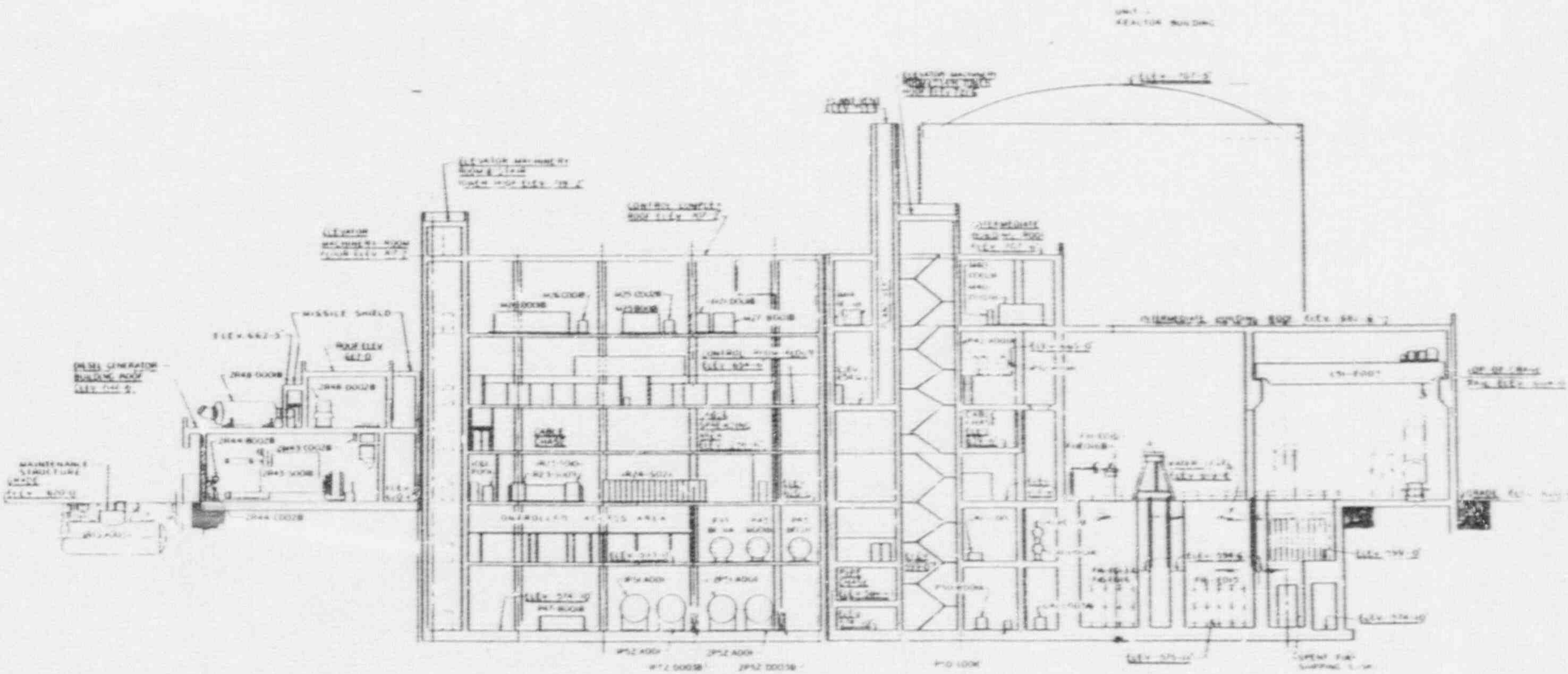

Figure 4-3. Perry 1 Reactor Building, Intermediate Building, and Control Complex Section, Looking North

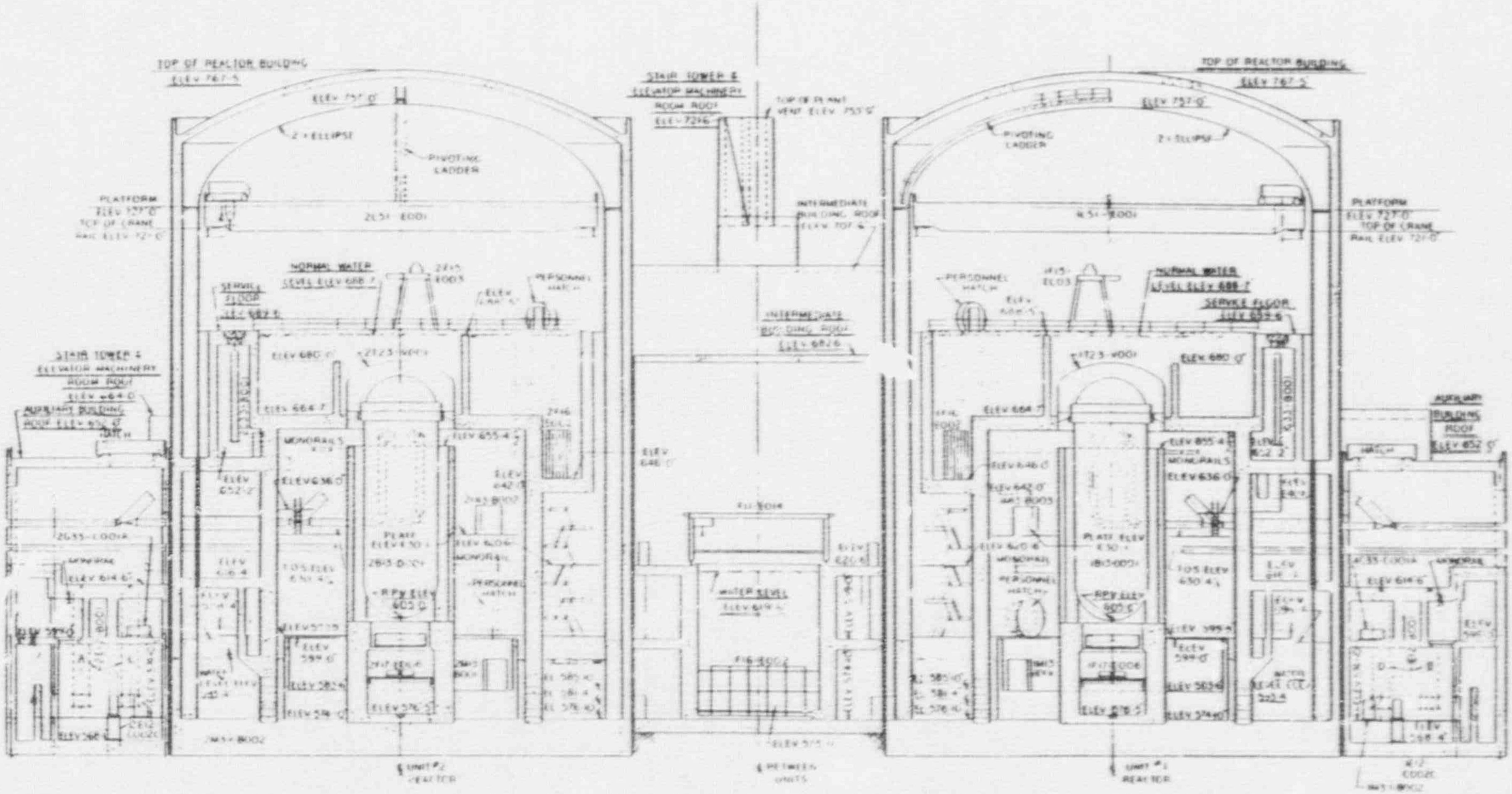

Figure 4-4. Perry 1 and 2 Intermediate Building, Auxiliary Buildings, and Reactor Buildings Section, Looking West

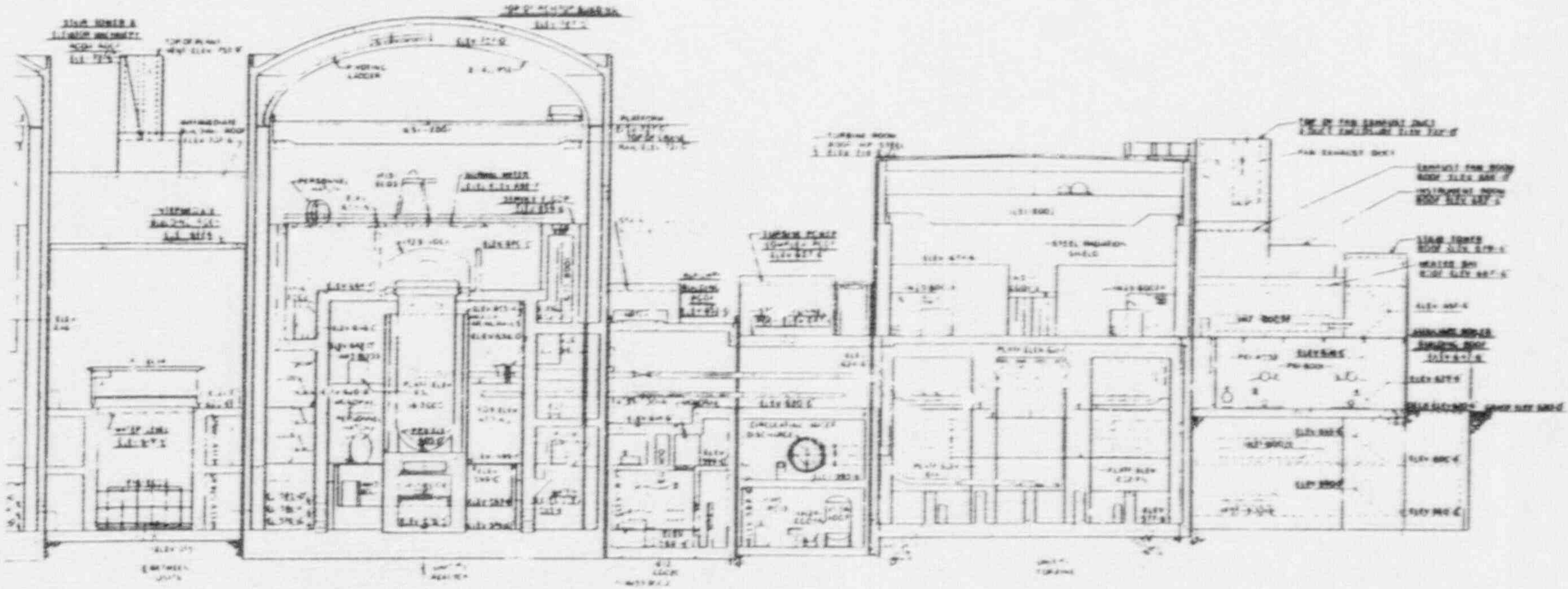

Figure 4-5. Perry 1 Turbine Building, Auxiliary Building, Reactor Building, and Intermediate Building Section, Looking West

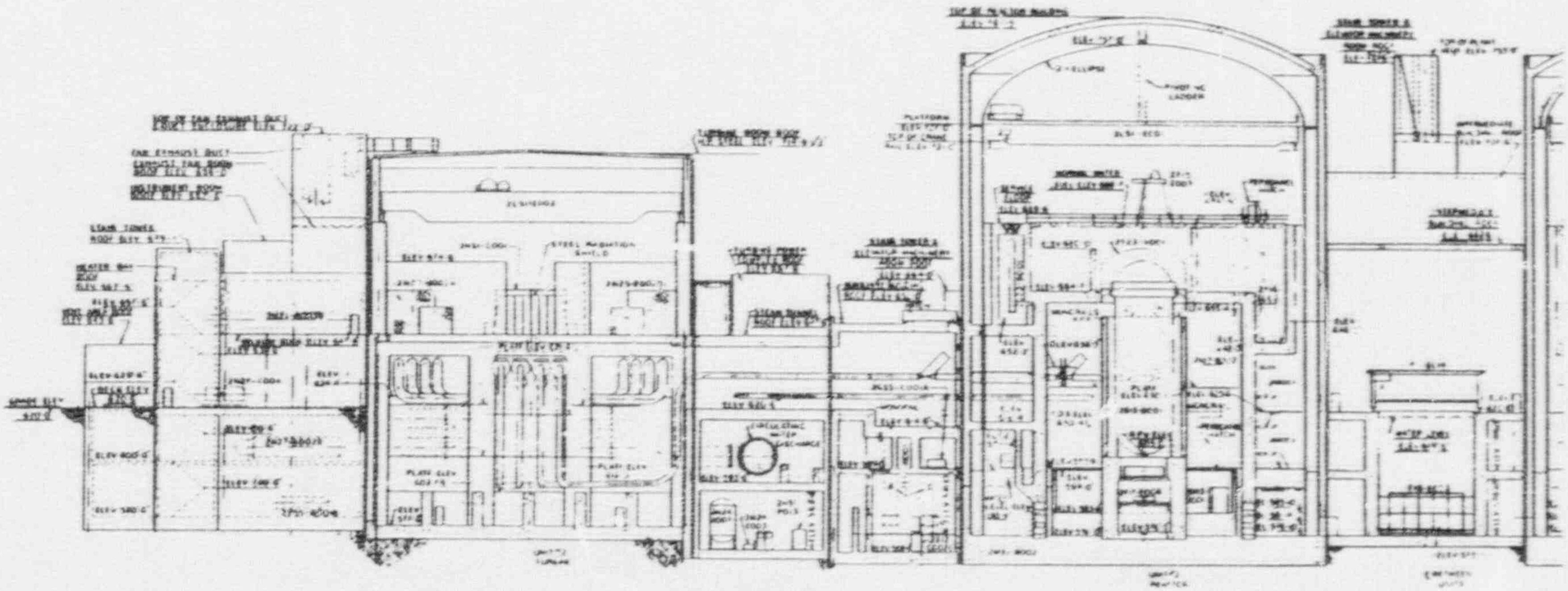

Figure 4-6. Perry 2 Turbine Building, Auxiliary Building, Reactor Building, and Intermediate Building Section, Looking West

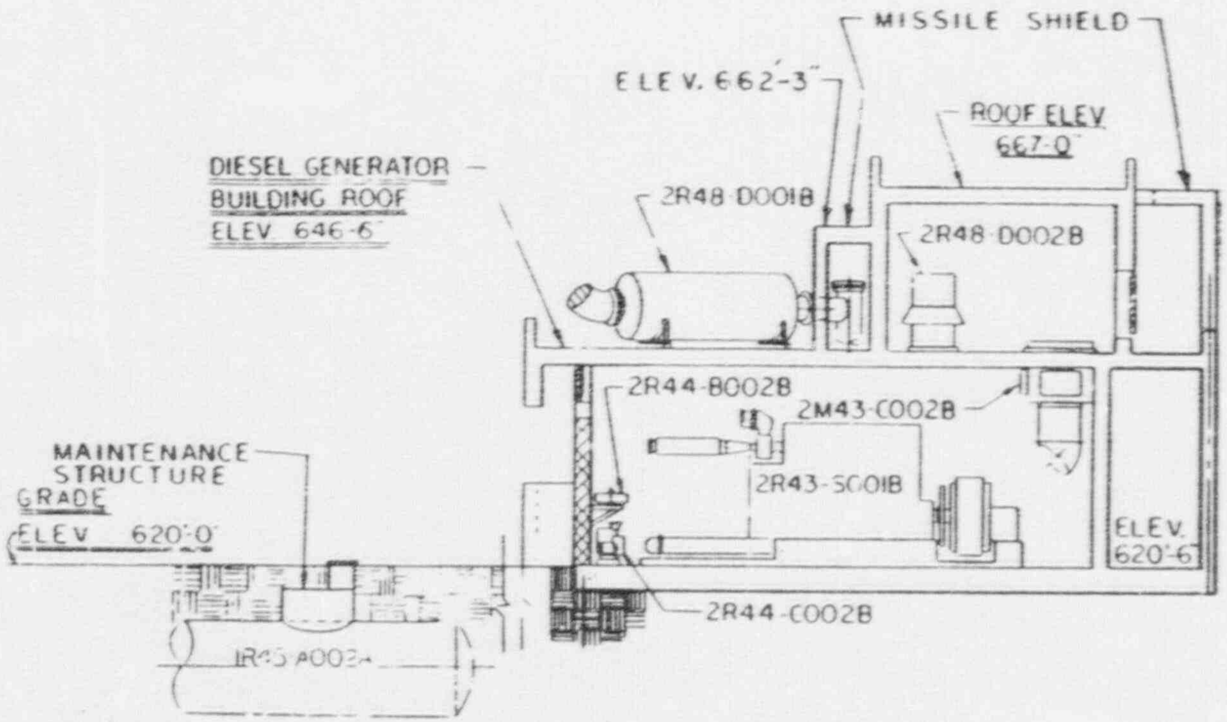

Figure 4-7. Perry 1 and 2 Diesel Generator Building, Looking North

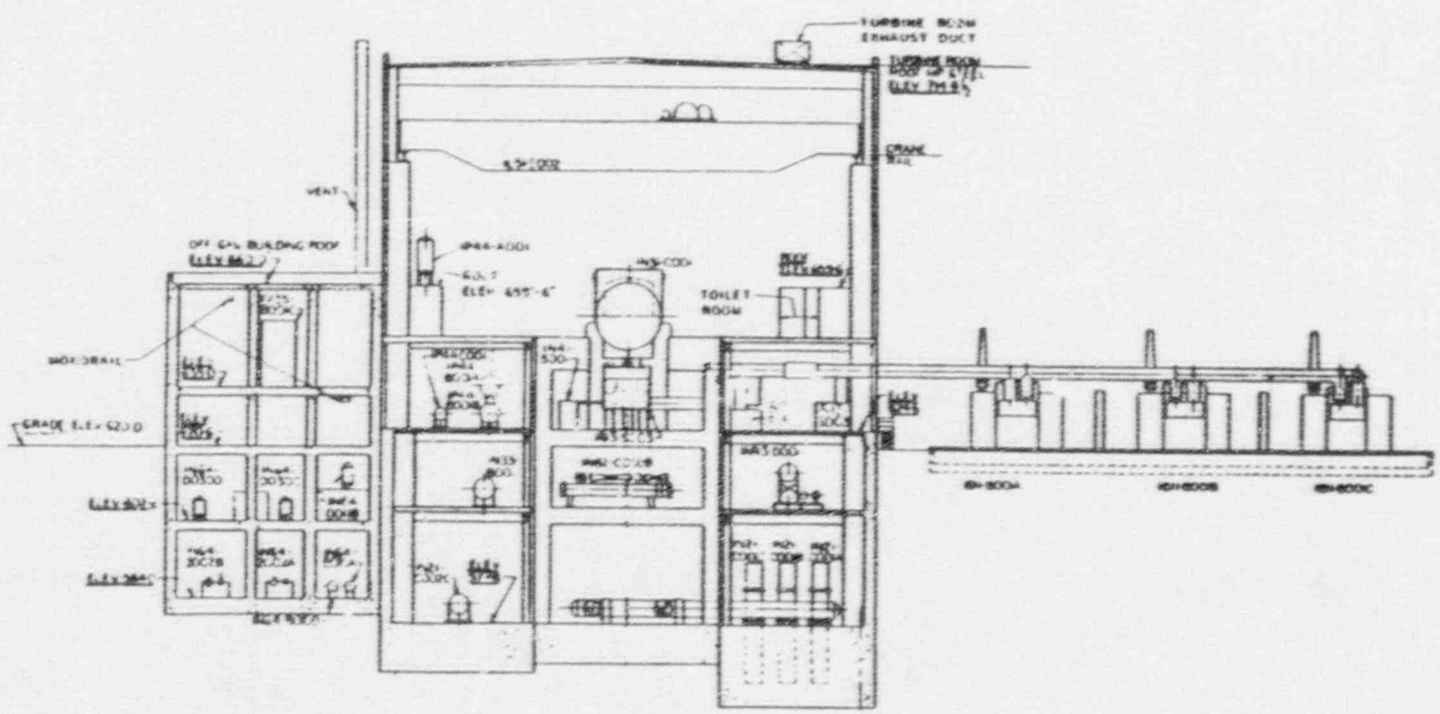

Figure 4-8. Perry 1 Turbine Building and Off-Gas Building Section, Looking West

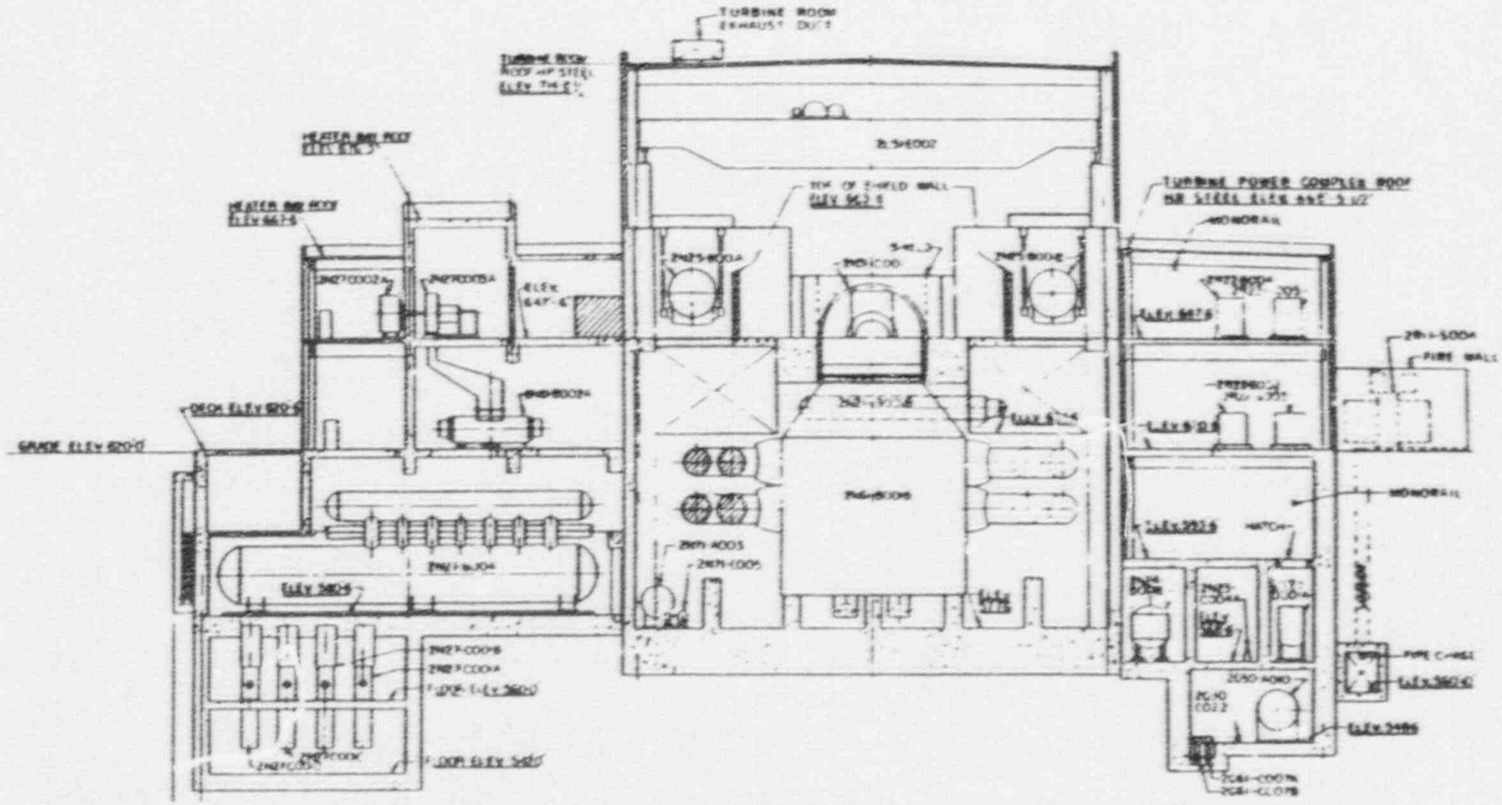

Figure 4-9. Perry 2 Turbine Building Section, Looking West

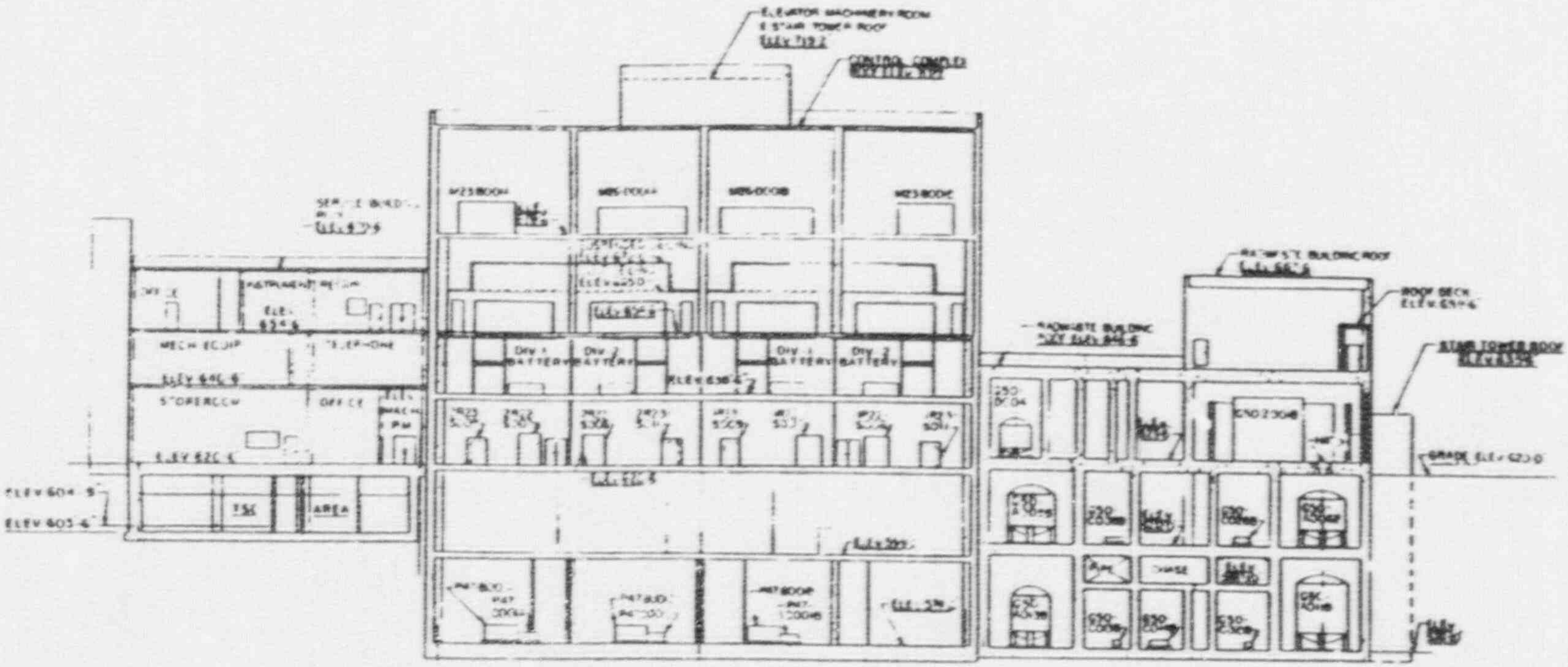

Figure 4-10. Perry 1 and 2 Service Building, Control Complex, and Radwaste Building Section, Looking West

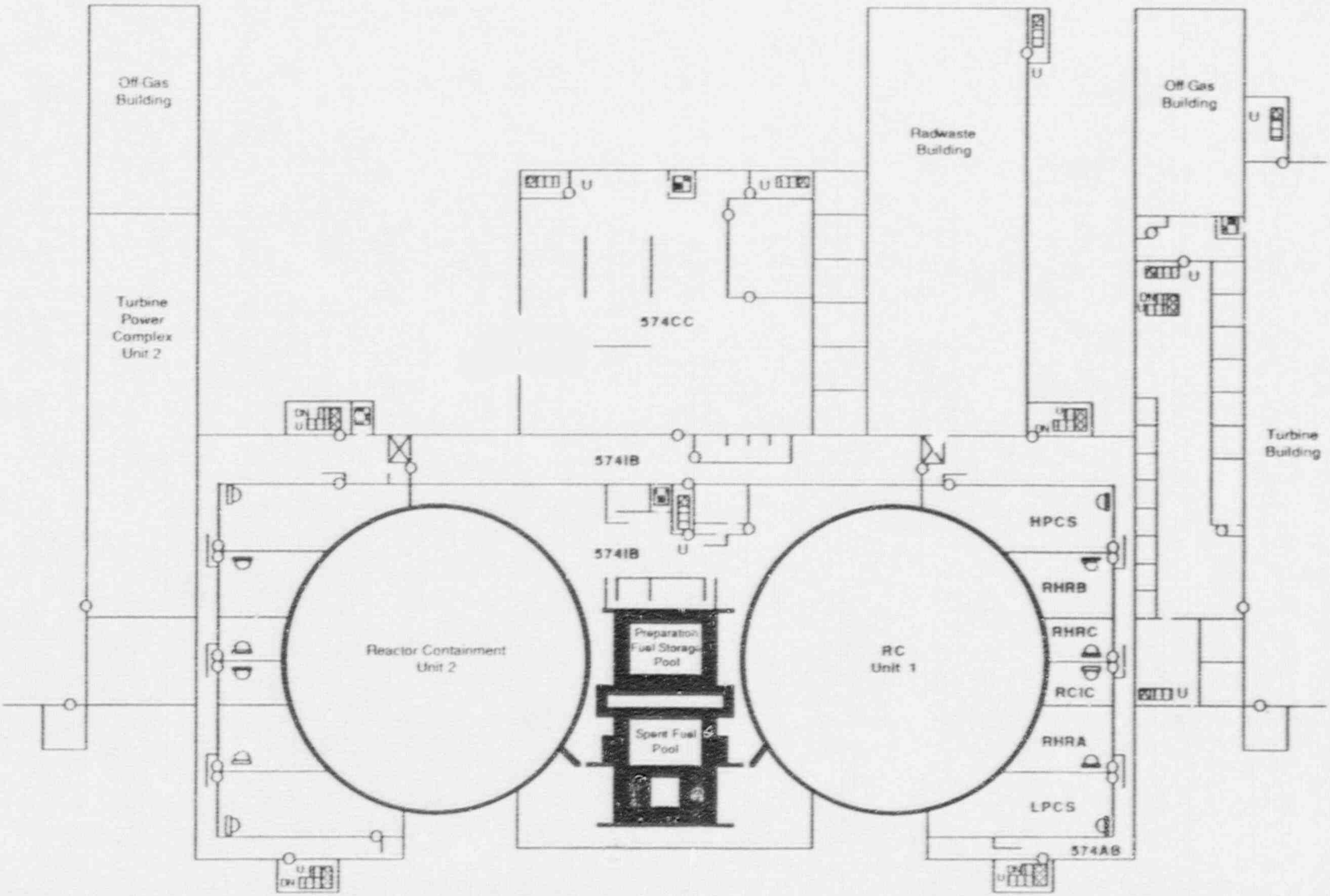

Figure 4-11. Perry 1 and 2 Reactor Building Elevation 574'10", Auxiliary Buildings Elevation 568'4", Intermediate Building Elevation 574'10", Control Complex Elevation 574'10", and Turbine Power Complex Elevation 568'6"

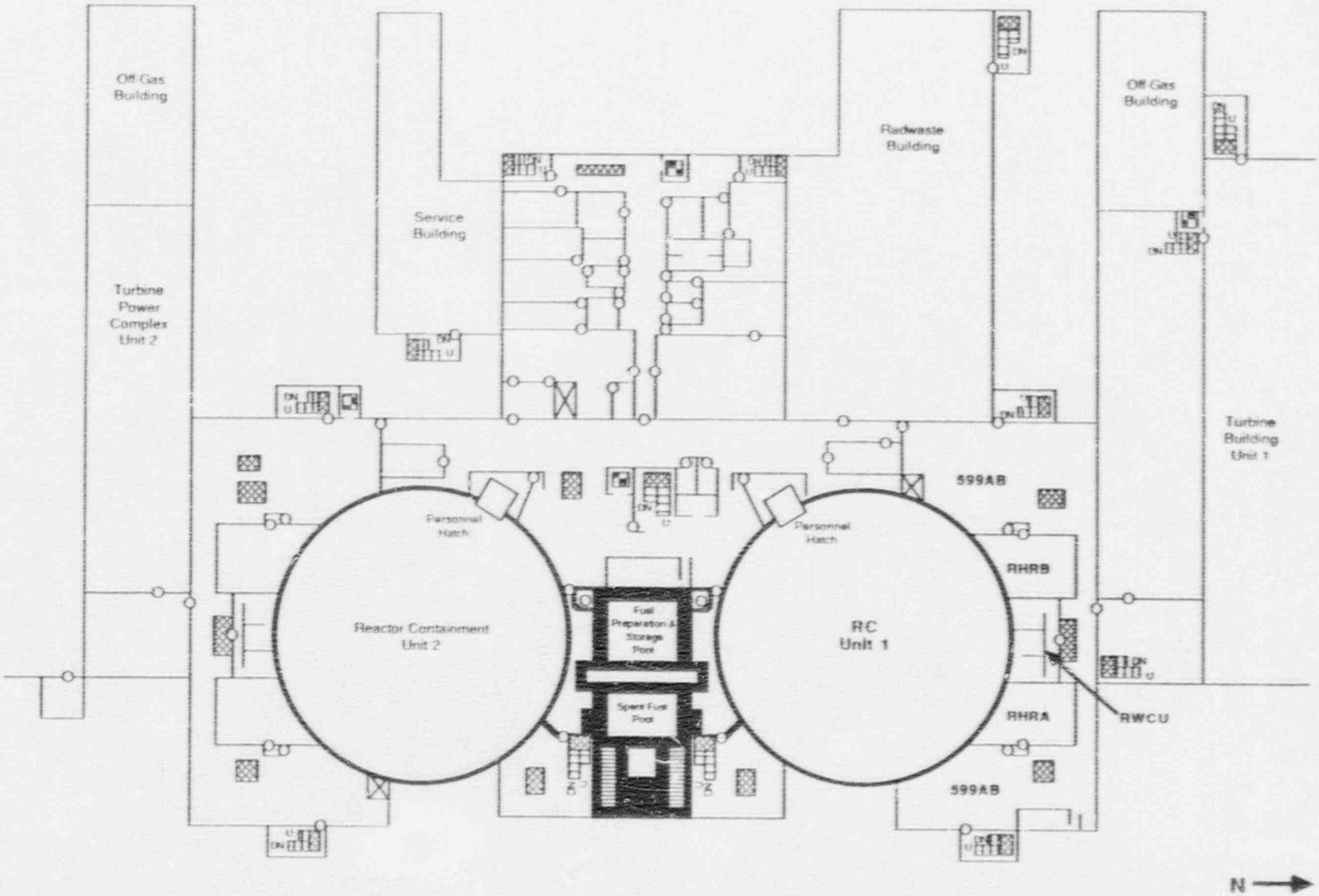

Figure 4-12. Perry 1 and 2 Reactor Building, Auxiliary Buildings, Intermediate Building, Control Complex, Elevation 599', and Turbine Power Complex, Elevation 593'6"

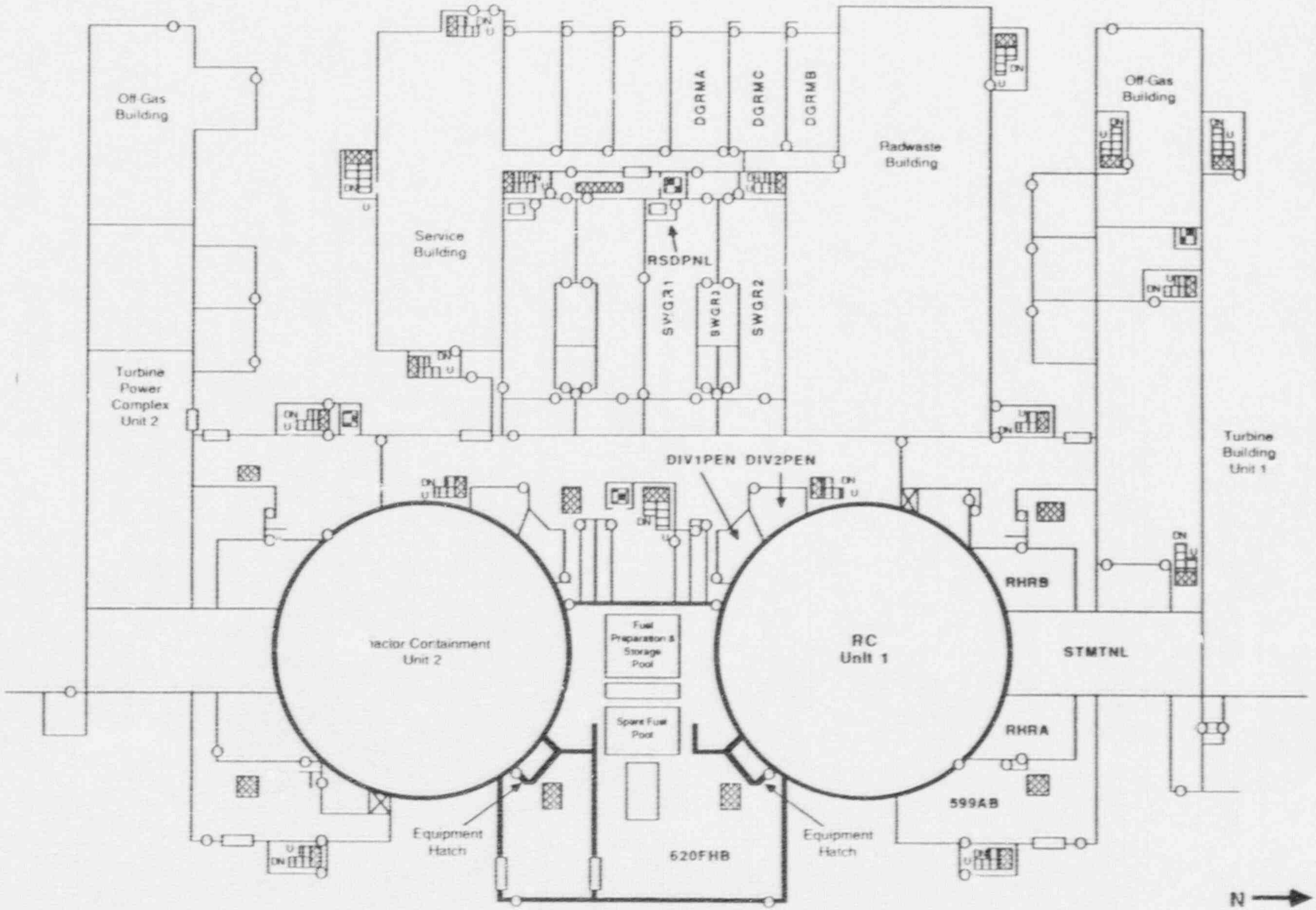

Figure 4-13. Perry 1 and 2 Reactor Building, Auxiliary Buildings, Intermediate Building, Control Complex, Diesel Generator Building, and Turbine Power Complex, Elevation 620'6"

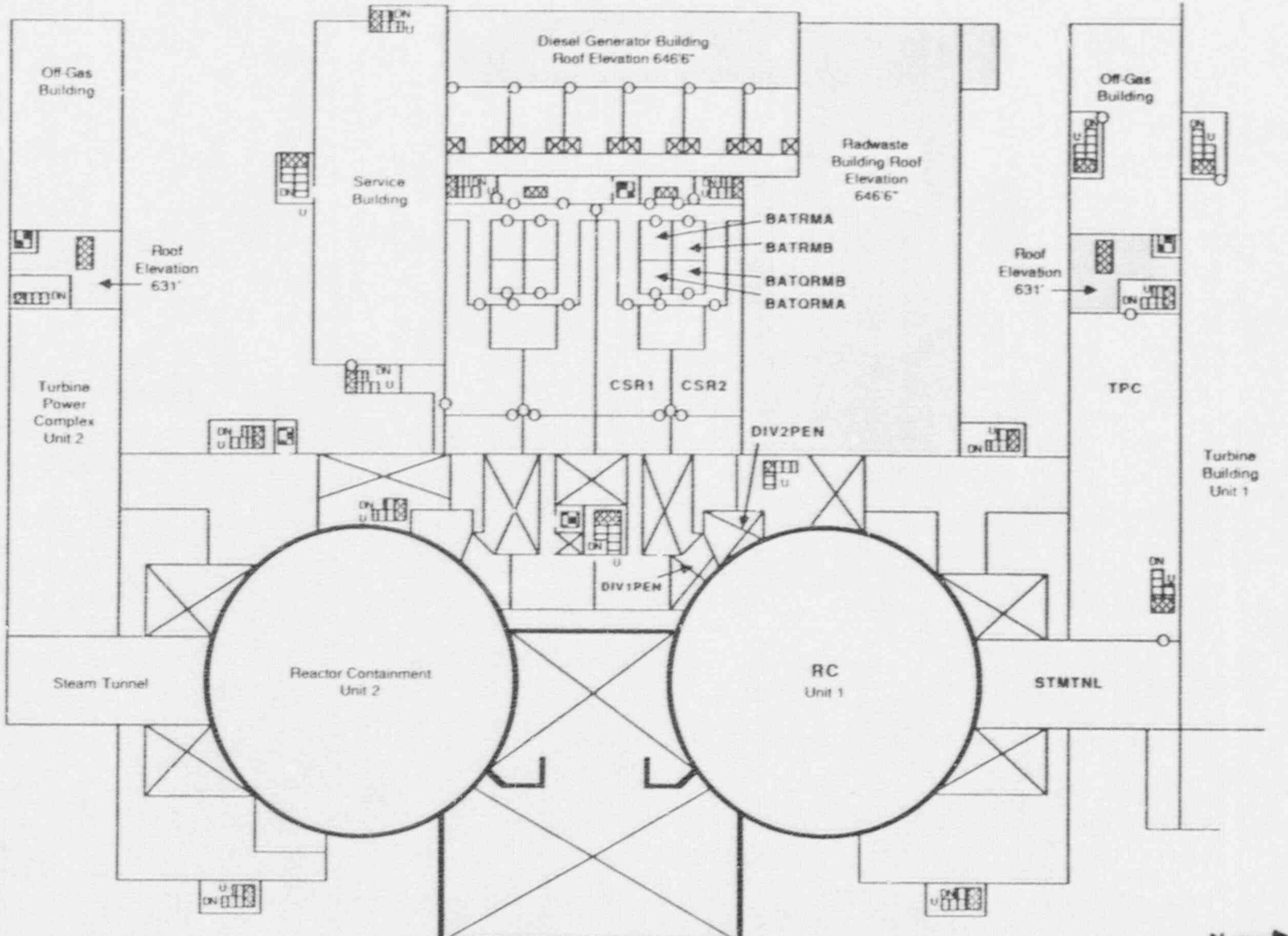

Figure 4-14. Perry 1 and 2 Reactor Building, Auxiliary Buildings, Intermediate Buildings Elevation 639'6", Control Complex Elevation 638', Turbine Power Complex Elevation 647'6", and Diesel Generator Building

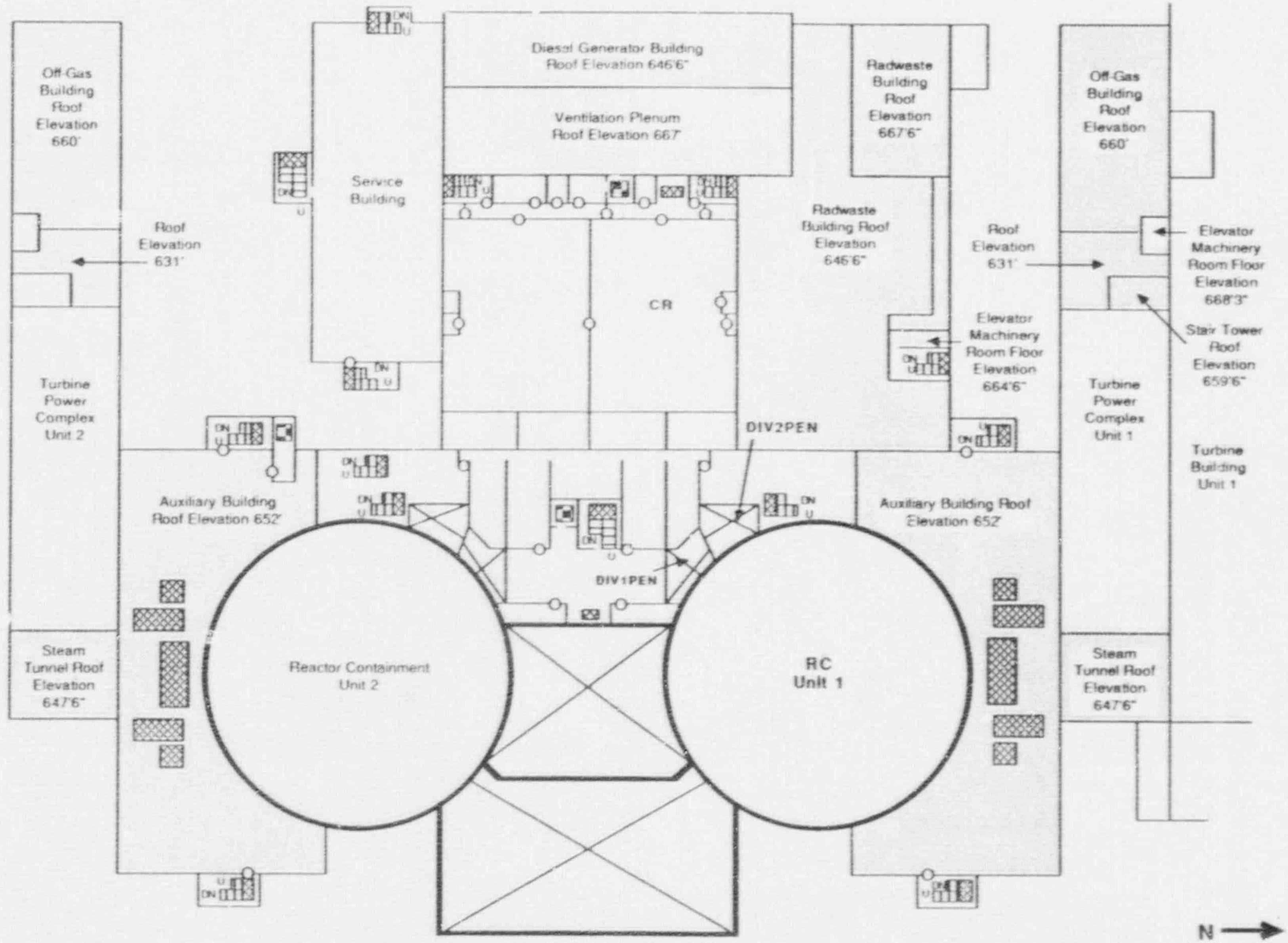

Figure 4-15. Perry 1 and 2 Reactor Building Elevation 654', Auxiliary Building Elevation 652', Intermediate Building Elevation 654', Control Complex Elevation 654', and Turbine Power Complex

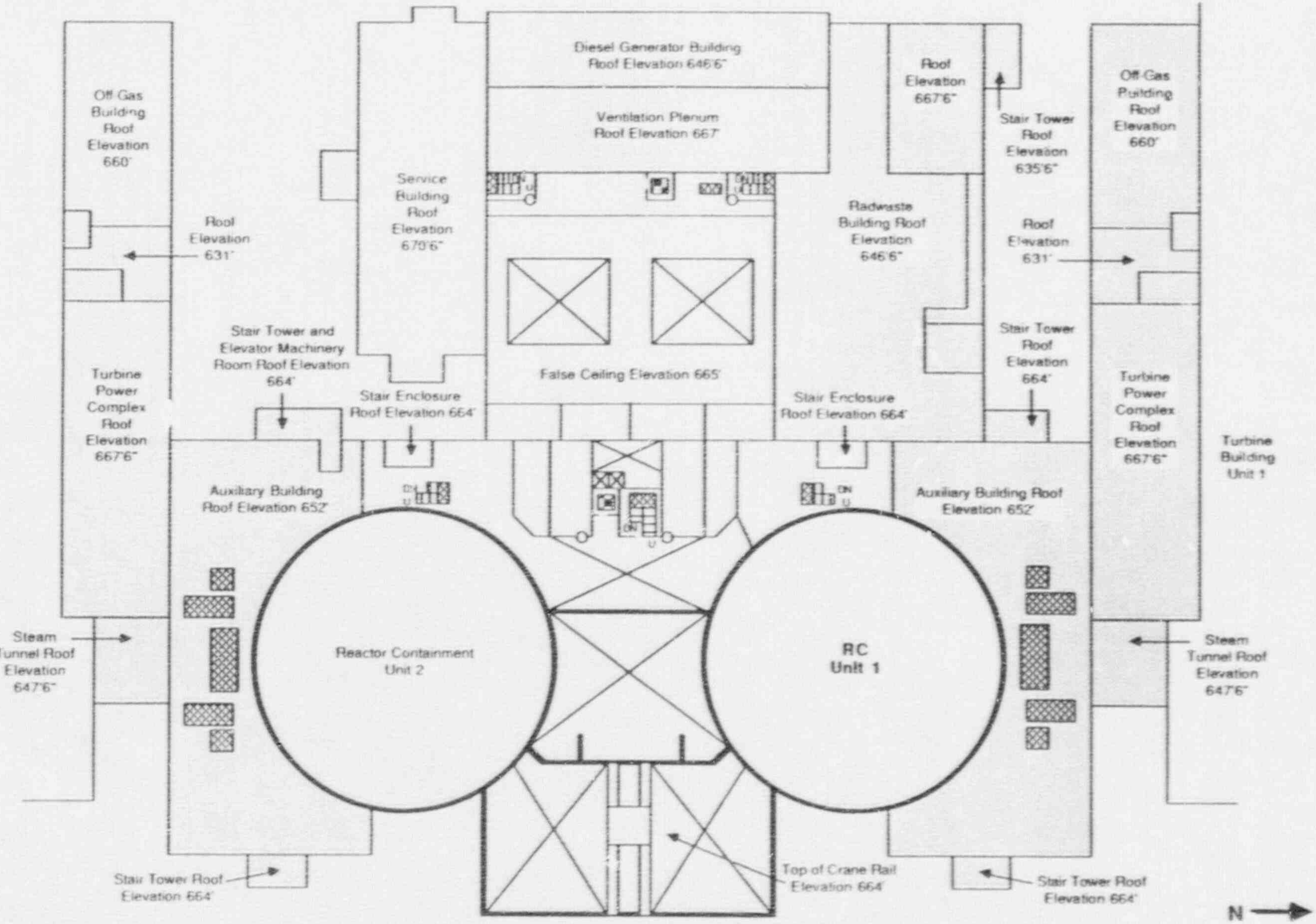

Figure 4-16. Perry 1 and 2 Reactor Building, Auxiliary Building, Intermediate Building, and Control Complex Elevation 664'

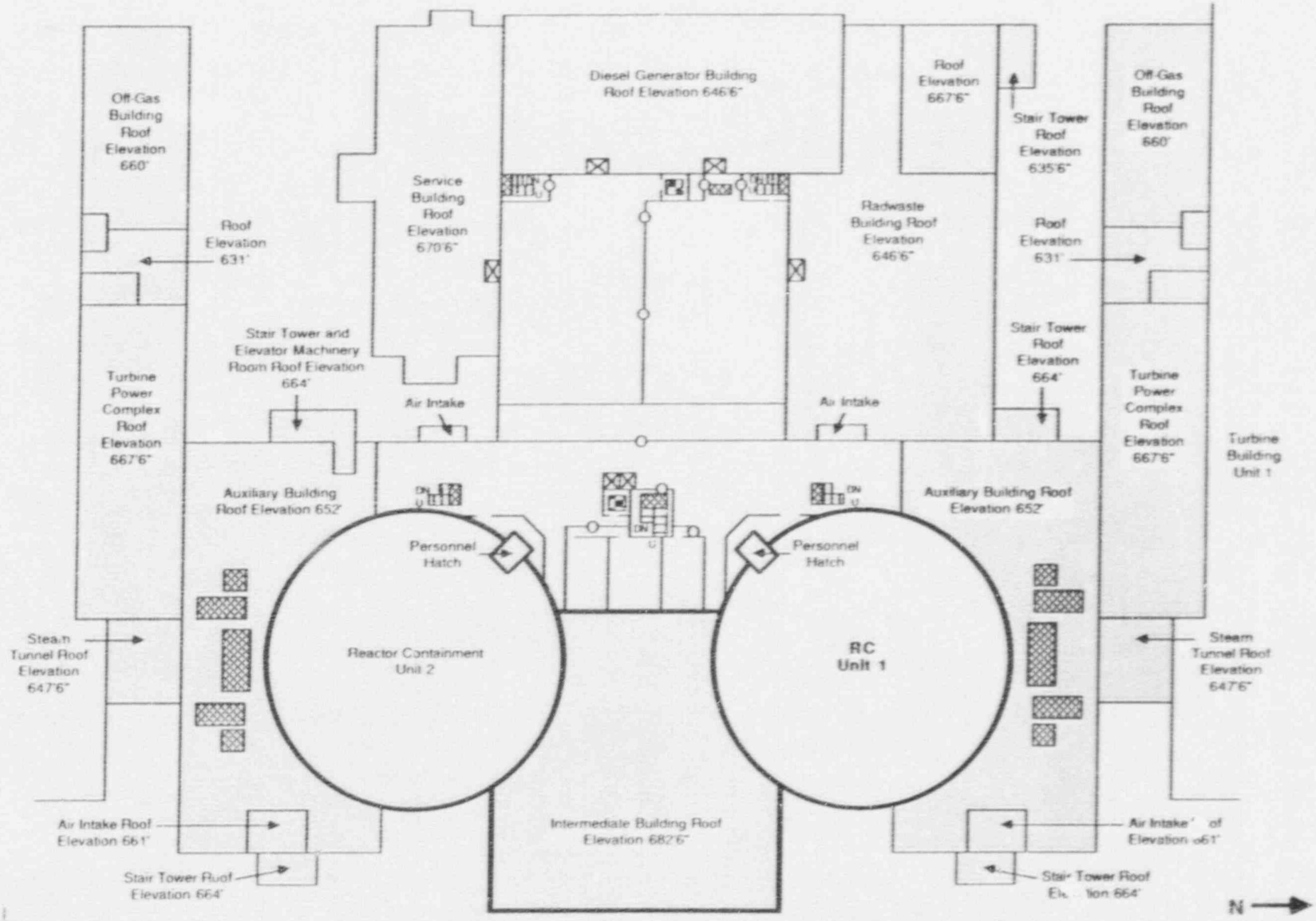

Figure 4-17. Perry 1 and 2 Reactor Building, Auxiliary Building, and Intermediate Building Elevation 682'6", and Control Complex Elevation 679'6"

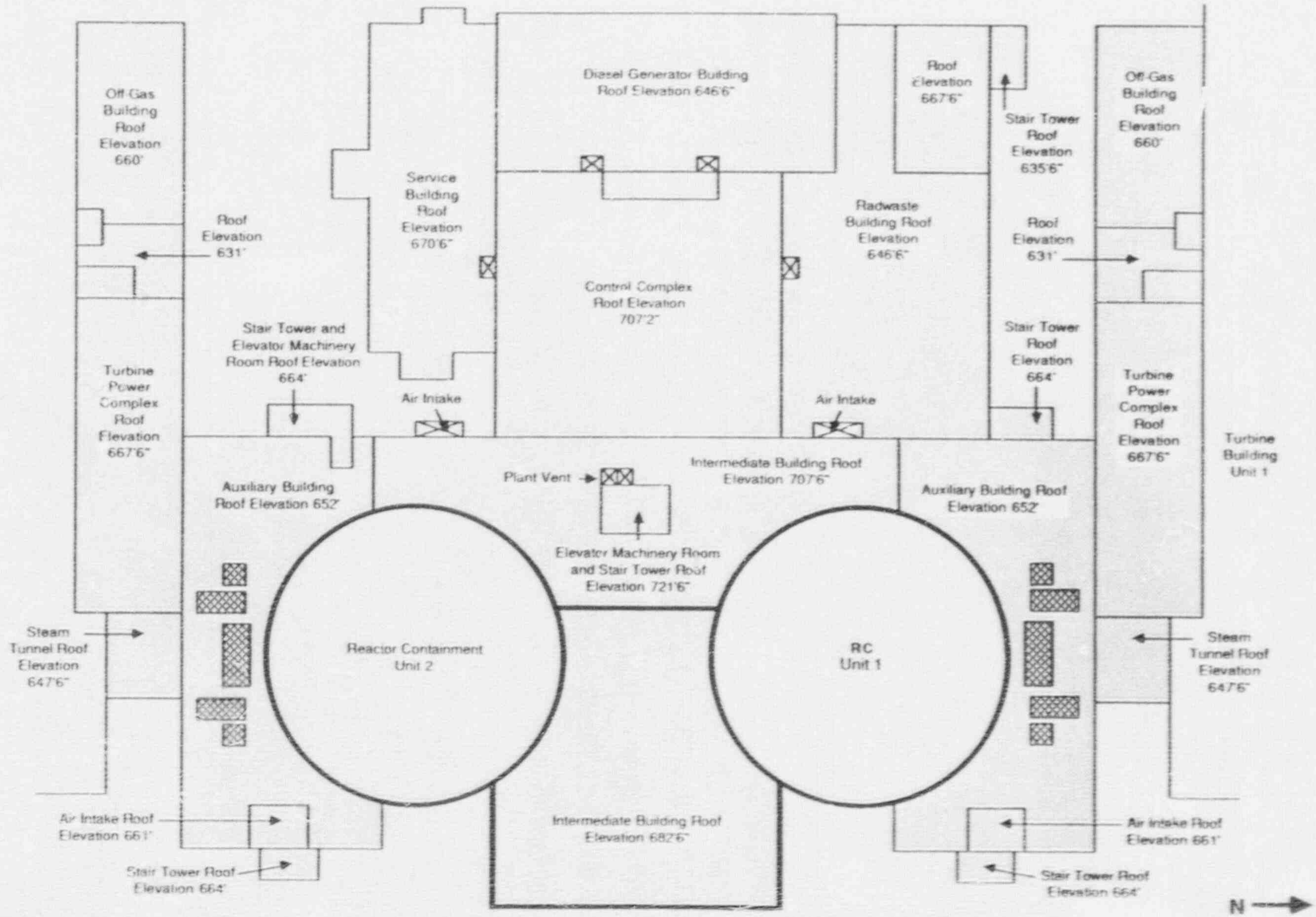

Figure 4-18. Perry 1 and 2 Reactor Building, Auxiliary Building, and Intermediate Building Roof Plan

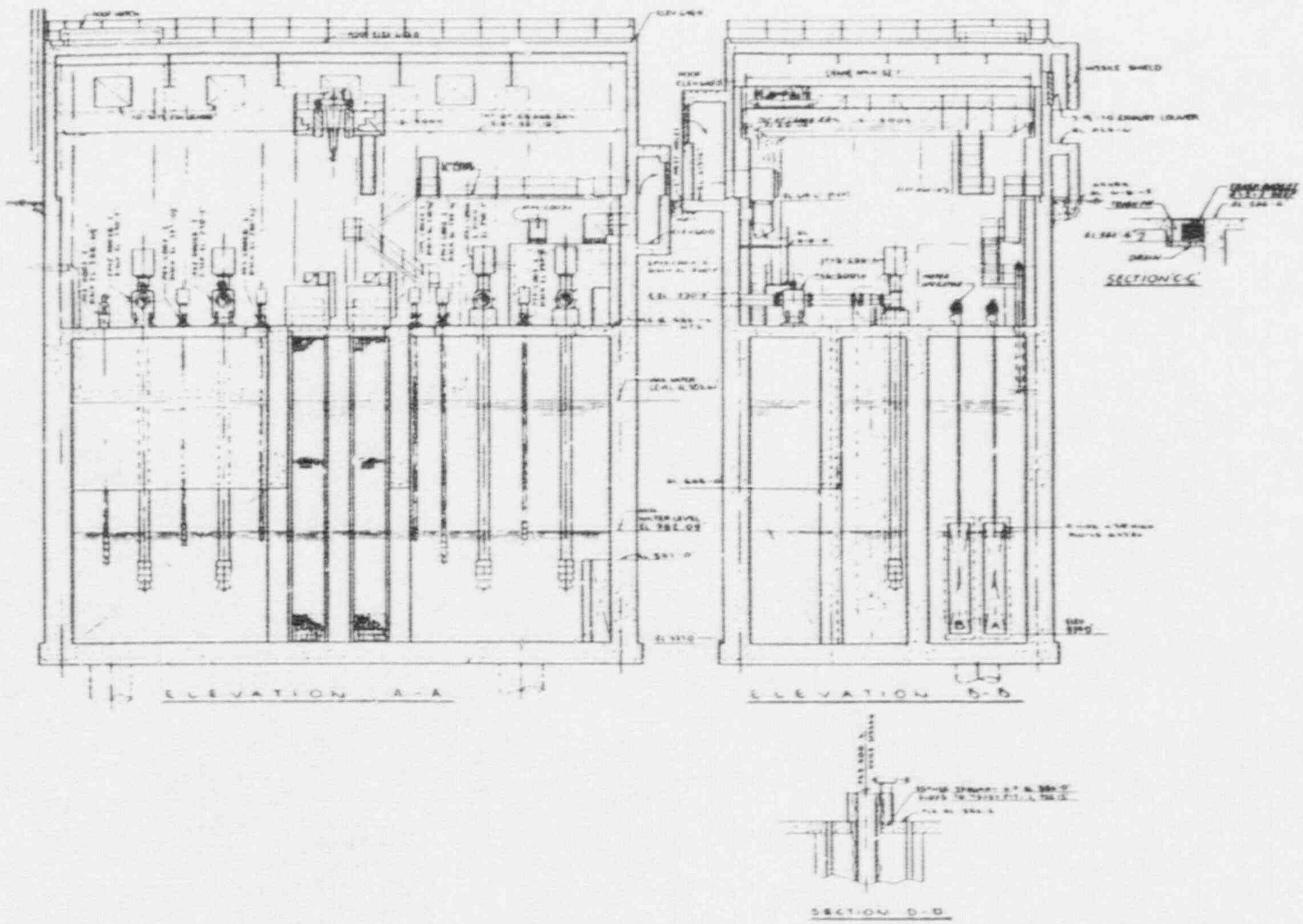

Figure 4-19. Perry 1 and 2 Emergency Service Water Pump House Section, Looking West

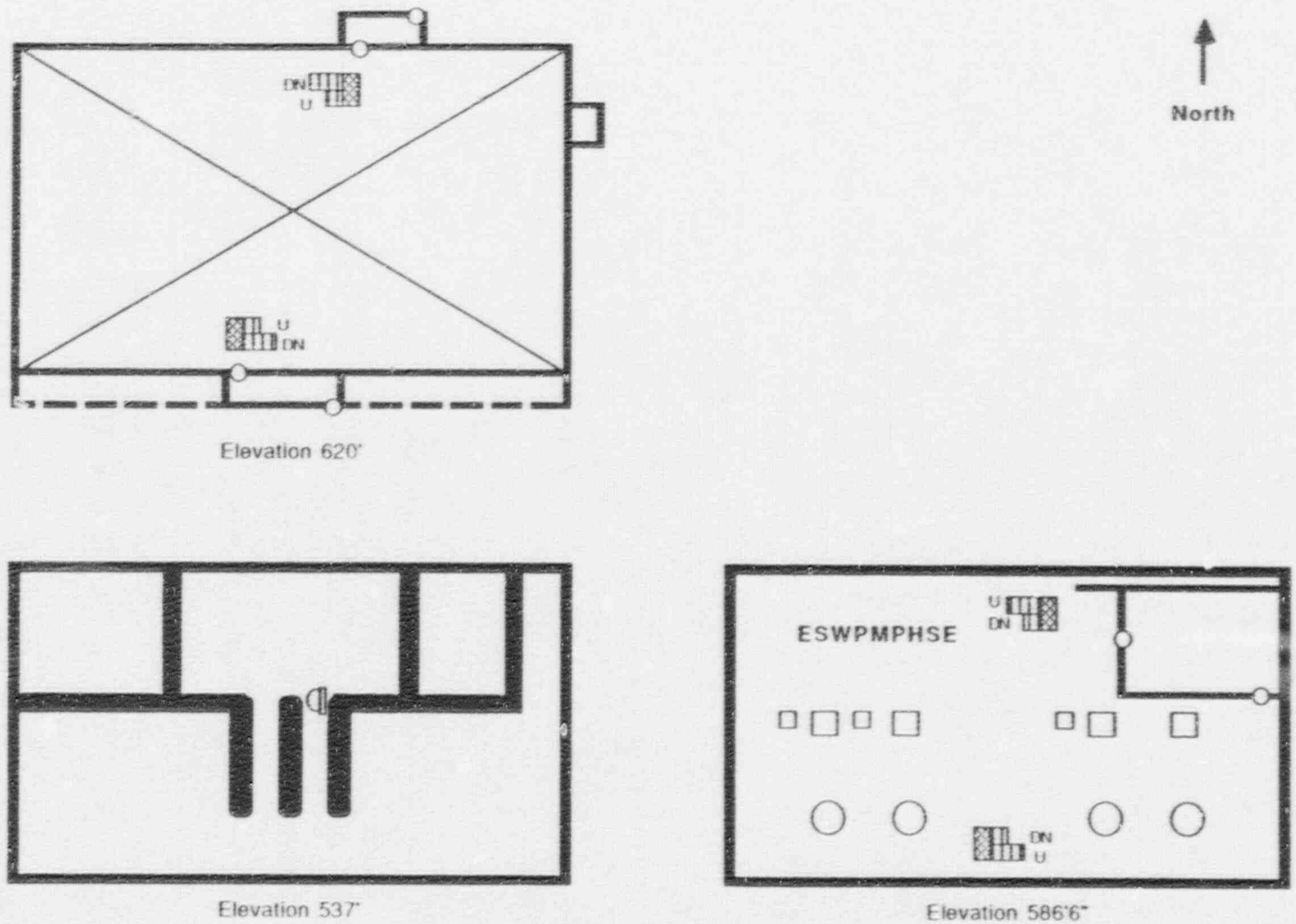

Figure 4-20. Perry 1 and 2 Emergency Service Water Pump House, Elevations 537', 586'6", and 620'

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

	Abbreviation	Description
1.	BATEQRMA	Battery Equipment Room A on Elevation 638' of the control complex
2.	BATEQRMB	Battery Equipment Room B on Elevation 638' of the control complex
3.	BATRMA	Battery Room A on elevation 638' of the control complex
4.	BATRMB	Battery Room B on elevation 638' of the control complex
5.	CR	Control Room on elevation 654' of the control complex
6.	CSR1	Cable Spreading Room No. 1 on elevation 638' of the control complex below area CR
7.	CSR2	Cable Spreading Room No. 2 on elevation 638' of the control complex below area CR
8.	CST	Condensate Storage Tank located in the yard
9.	DGRMA	Diesel Generator Room A on elevation 620' of the DG building
10.	DGRMB	Diesel Generator Room B on elevation 620' of the DG building
11.	DGRMC	Diesel Generator Room C on elevation 620' of the DG building
12.	DIV1PEN	Division 1 Penetration Room adjacent to containment elevation 620' and above in the intermediate building
13.	DIV2PEN	Division 2 Penetration Room adjacent to containment elevation 620' and above in the intermediate building
14.	ESWPMPHSE	Emergency Service Water Pump House located north of the dual unit building complex, service to both units
15.	HPCS	High Pressure Core Spray pump room on elevation 568' of the auxiliary building
16.	LPCS	Low Pressure Core Spray pump room on elevation 568' of the auxiliary building
17.	RC	Reactor Containment in reactor building levels 574' to 688'
18.	RCIC	Reactor Core Isolation Cooling pump room on elevation 568' of the auxiliary building
19.	RHRA	Residual Heat Removal Pump and equipment room A on elevation 568' of the auxiliary building

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

	Abbreviation	Description
20.	RHRB	Residual Heat Removal Pump and equipment room B on elevation 568' of the auxiliary building
21.	RHRC	Residual Heat Removal Pump and equipment room C on elevation 568' of the auxiliary building
22.	RSDPNL	Remote Shutdown Panel room in area SWGR1
23.	RWCU	Reactor Water Cleanup room on elevation 599' of the auxiliary building
24.	STMTNL	Steam tunnel between the reactor building and turbine building on elevation 620'
25.	SWGR1	Switchgear Room Division 1 on elevation 620' of the control complex
26.	SWGR2	Switchgear Room Division 2 on elevation 620' of the control complex
27.	SWGR3	Switchgear Room Division 3 on elevation 620' of the control complex
28.	TB	Turbine Building
29.	TPC	Turbine Power Complex area between auxiliary building and turbine building on elevation 647'
30.	574CC	Elevation 574' of the Control Complex
31.	574AB	Elevation 574' of the Auxiliary Building
32.	574IB	Elevation 574' of the Intermediate Building
33.	599AB	Elevation 599' of the Auxiliary Building
34.	620CC	Elevation 620' of the Control Complex
35.	620DGBLDG	Elevation 620' of the Diesel Generator Building
36.	620FHB	Elevation 620' of the Fuel Handling Building
37.	ESWCPIPE	Area containing ESWS loop C piping, specific location not determined

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
BATEQRMA	EP	EP-BC-1A	BC
BATEQRMA	EP	EP-125-B1A	BUS
BATEQRMA	EP	EP-125-B1A	BUS
BATEQRMA	EP	EP-125-B1A	BUS
BATEQRMA	EP	EP-125-B1A	BUS
BATEQRMA	EP	EP-BC-12A	BC
BATEQRMB	EP	EP-BC-1B	BC
BATEQRMB	EP	EP-125-B1B	BUS
BATEQRMB	EP	EP-125-B1B	BUS
BATEQRMB	EP	EP-125-B1B	BUS
BATEQRMB	EP	EP-125-B1B	BUS
BATEQRMB	EP	EP-BC-2B	BC
BATRMA	EP	EP-BT-1A	BAT
BATRMA	EP	EP-125-B1A	BUS
BATRMB	EP	EP-BT-1B	BAT
BATRMB	EP	EP-125-B1B	BUS
CST	ECCS	HPCS-CST	TANK
CST	RCIC	RCIC-CST	TANK
DGRMA	EP	EP-DG-1A	DG
DGRMB	EP	EP-DG-1B	DG
[illegible]MC	EP	EP-DG-1C	DG
ESWPMPHSE	ESW	ESW-130B	MOV
ESWPMPHSE	ESW	ESW-P1C	MDP
ESWPMPHSE	ESW	ESW-140C	MOV
ESWPMPHSE	ESW	ESW-P1A	MDP
ESWPMPHSE	ESW	ESW-130A	MOV
ESWPMPHSE	ESW	ESW-P1B	MDP
HPCS	ECCS	HPCS-1	MOV
HPCS	ECCS	HPCS-P1	MDP
HPCS	ECCS	HPCS-15	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
HPCS	ECCS	HPCS-4	MOV
HPCS	ECCS	HPCS-23	MOV
HPCS	ECCS	HPCS-10	MOV
HPCS	ECCS	HPCS-11	MOV
LPCS	ECCS	LPCS-P1	MDP
LPCS	ECCS	LPCS-1	MOV
LPCS	ECCS	LPCS-12	MOV
RC	ECCS	RHR-28A	MOV
RC	ECCS	RHR-37A	MOV
RC	ECCS	RHR-42A	MOV
RC	ECCS	RHR-28B	MOV
RC	ECCS	RHR-37B	MOV
RC	ECCS	RHR-42B	MOV
RC	ECCS	RHR-537A	MOV
RC	ECCS	RHR-28A	MOV
RC	ECCS	RHR-537A	MOV
RC	ECCS	RHR-537B	MOV
RC	RCIC	RCIC-63	MOV
RC	RCS	RCS-16	MOV
RC	RCS	RCIC-63	MOV
RC	RCS	RCS-9	MOV
RC	RCS	RCS-1	MOV
RC	RCS	RCS-22	AOV
RC	RCS	RCS-22	AOV
RCIC	RCIC	RCIC-22/59	MOV
RCIC	RCIC	RCIC-10	MOV
RCIC	RCIC	RCIC-31	MOV
RCIC	RCIC	RCIC-TPM1	TDP
RCIC	RCIC	RCIC-45	MOV
RCIC	RCIC	RCIC-68	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RCIC	RCIC	RCIC-46	MOV
RCIC	RCIC	RCIC-19	MOV
RHRA	ECCS	LPCS-5	MOV
RHRA	ECCS	RHR-[illegible]M2A	MDP
RHRA	ECCS	RHR-4A	MOV
RHRA	ECCS	RHR-23	MOV
RHRA	ECCS	RHR-24A	MOV
RHRA	ECCS	RHR-27A	MOV
RHRA	ECCS	RHR-3A	MOV
RHRA	ECCS	RHR-47A	MOV
RHRA	ECCS	RHR-48A	MOV
RHRA	ECCS	RHR-HX1A/C	HX
RHRA	ECCS	RHR-48A	MOV
RHRA	ECCS	RHR-24A	MOV
RHRA	ECCS	RHR-6A	MOV
RHRA	ECCS	RHR-87A	MOV
RHRA	ECCS	RHR-52A	MOV
RHRA	ESW	ESW-14A	MOV
RHRA	ESW	ESW-68A	MOV
RHRA	RCIC	RCIC-13	MOV
RHRB	ECCS	RHR-PM2B	MDP
RHRB	ECCS	RHR-4B	MOV
RHRB	ECCS	RHR-24B	MOV
RHRB	ECCS	RHR-27B	MOV
RHRB	ECCS	RHR-3B	MOV
RHRB	ECCS	RHR-47B	MOV
RHRB	ECCS	RHR-48B	MOV
[illegible]	ECCS	RHR-21	MOV
[illegible]	ECCS	RHR-42C	MOV
[illegible]	ECCS	RHR-24B	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RCIC	RCIC	RCIC-46	MOV
RCIC	RCIC	RCIC-19	MOV
RHRA	ECCS	LPCS-5	MOV
RHRA	ECCS	RHR-PM2A	MDP
RHRA	ECCS	RHR-4A	MOV
RHRA	ECCS	RHR-23	MOV
RHRA	ECCS	RHR-24A	MOV
RHRA	ECCS	RHR-27A	MOV
RHRA	ECCS	RHR-3A	MOV
RHRA	ECCS	RHR-47A	MOV
RHRA	ECCS	RHR-48A	MOV
RHRA	ECCS	RHR-HX1A/C	HX
RHRA	ECCS	RHR-48A	MOV
RHRA	ECCS	RHR-24A	MOV
RHRA	ECCS	RHR-6A	MOV
RHRA	ECCS	RHR-87A	MOV
RHRA	ECCS	RHR-52A	MOV
RHRA	ESW	ESW-14A	MOV
RHRA	ESW	ESW-68A	MOV
RHRA	RCIC	RCIC-13	MOV
RHRB	ECCS	RHR-PM2B	MDP
RHRB	ECCS	RHR-4B	MOV
RHRB	ECCS	RHR-24B	MOV
RHRB	ECCS	RHR-27B	MOV
RHRB	ECCS	RHR-3B	MOV
RHRB	ECCS	RHR-47B	MOV
RHRB	ECCS	RHR-48B	MOV
RHRB	ECCS	RHR-21	MOV
RHRB	ECCS	RHR-42C	MOV
RHRB	ECCS	RHR-24B	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RHRB	ECCS	RHR-28B	MOV
RHRB	ECCS	RHR-537B	MOV
RHRB	ECCS	RHR-HX1B/D	HX
RHRB	ECCS	RHR-48B	MOV
RHRB	ECCS	RHR-87B	MOV
RHRB	ECCS	RHR-52B	MOV
RHRB	ECCS	RHR-6B	MOV
RHRB	ESW	ESW-14B	MOV
RHRB	ESW	ESW-68B	MOV
RHRC	ECCS	RHR-PM2C	MDP
RHRC	ECCS	RHR-105	MOV
STMTNL	RCIC	RCIC-64	MOV
STMTNL	RCS	RCS-28	AOV
STMTNL	RCS	RCS-19	MOV
STMTNL	RCS	RCS-21	MOV
STMTNL	RCS	RCS-68A	MOV
STMTNL	RCS	RCIC-64	MOV
STMTNL	RCS	RCS-8	MOV
STMTNL	RCS	RCS-4	MOV
SWGR1	EP	RCS-67	MOV
SWGR1	EP	CB-CEH11	CB
SWGR1	EP	EP-BS-EH11	BUS
SWGR1	EP	EP-BS-EF1A	BUS
SWGR1	EP	EP-BS-EF1B	BUS
SWGR1	EP	EP-TR-EHF1A	TRAN
[illegible]	EP	EP-TR-EHF1B	TRAN
[illegible]	EP	EP-MCC-1A07	MCC
[illegible]	EP	EP-MCC-1B07	MCC
[illegible]	EP	EP-MCC-1A12	MCC
[illegible]	[illegible]	CB-CEH12	CB

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RHRB	ECCS	RHR-28B	MOV
RHRB	ECCS	RHR-537B	MOV
RHRB	ECCS	RHR-HX1B/D	HX
RHRB	ECCS	RHR-48B	MOV
RHRB	ECCS	RHR-87B	MOV
RHRB	ECCS	RHR-52B	MOV
RHRB	ECCS	RHR-6B	MOV
RHRB	ESW	ESW-14B	MOV
RHRB	ESW	ESW-68B	MOV
RHRC	ECCS	RHR-PM2C	MDP
RHRC	ECCS	RHR-105	MOV
STMTNL	RCIC	RCIC-64	MOV
STMTNL	RCS	RCS-28	AOV
STMTNL	RCS	RCS-19	MOV
STMTNL	RCS	RCS-21	MOV
STMTNL	RCS	RCS-58A	MOV
STMTNL	RCS	RCIC-64	MOV
STMTNL	RCS	RCS-8	MOV
STMTNL	RCS	RCS-4	MOV
STMTNL	RCS	RCS-67	MOV
SWGR1	EP	CB-CEH11	CB
SWGR1	EP	EP-BS-EH11	BUS
SWGR1	EP	EP-BS-EF1A	BUS
SWGR1	EP	EP-BS-EF1B	BUS
SWGR1	EP	EP-TR-EHF1A	TRAN
SWGR1	EP	EP-TR-EHF1B	TRAN
SWGR1	EP	EP-MCC-1A07	MCC
SWGR1	EP	EP-MCC-1B07	MCC
SWGR1	EP	EP-MCC-1A12	MCC
SWGR2	EP	CB-CEH12	CB

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
SWGR2	EP	EP-BS-EH12	BUS
SWGR2	EP	EP-BS-EF1C	BUS
SWGR2	EP	EP-TR-EHF1C	TRAN
SWGR2	EP	EP-TR-EHF1D	TRAN
SWGR2	EP	EP-BS-EF1D	BUS
SWGR2	EP	EP-MCC-1C07	MCC
SWGR2	EP	EP-MCC-1C12	MCC
SWGR2	EP	EP-MCC-1D07	MCC
SWGR3	EP	CB-CEH13	CB
SWGR3	EP	EF-125-B1C	BUS
SWGR3	EP	[illegible]-BS-EH13	BUS
SWGR3	EP	EP-BT-[illegible]	BAT
SWGR3	EP	EP-MCC-EF1E	MCC
SWGR3	EP	EP-TR-EHF1E	TRAN

5. BIBLIOGRAPHY FOR PERRY 1 AND 2

1. NUREG-0884, "Draft Environmental Statement Related to the Operation of Perry Nuclear Power Plant, Units 1 and 2," USNRC Office of Nuclear Reactor Regulation, March 1982.

2. NUREG-0887, "Safety Evaluation Report Related to the Operation of Perry Nuclear Power Plant, Units 1 and 2," USNRC Office of Nuclear Reactor Regulation, January 1983.

3. NUREG-1162, "Technical Specifications for Perry Nuclear Power Plant, Unit 1," USNRC Division of Boiling Water Reactor (BWR) Licensing, March 1986.

4. NUREG-1204, "Technical Specifications for Perry Nuclear Power Plant, Unit 1," USNRC Office of Nuclear Reactor Regulation, November 1986.

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)

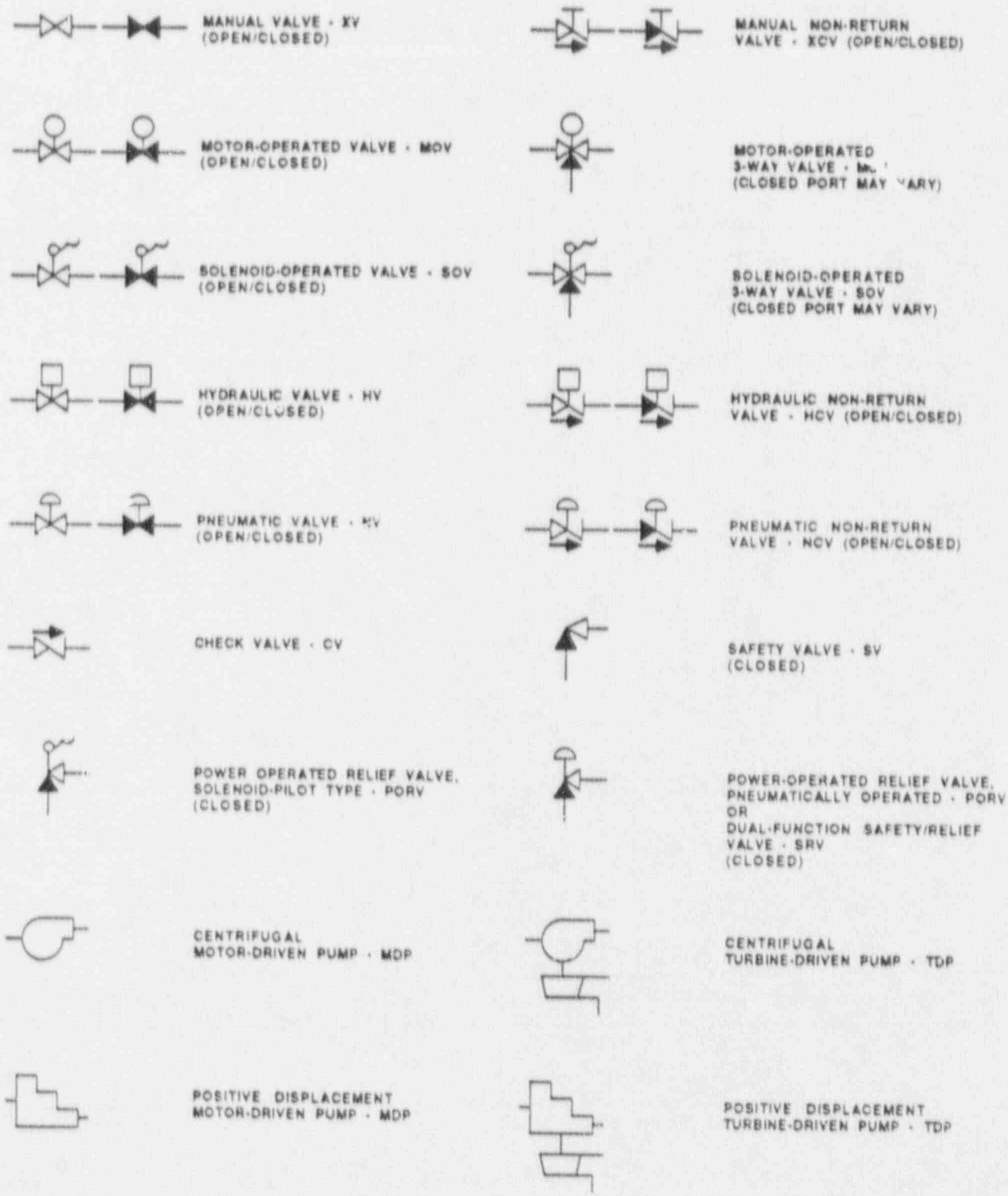

Figure A-1. Key To Symbols In Fluid System Drawings

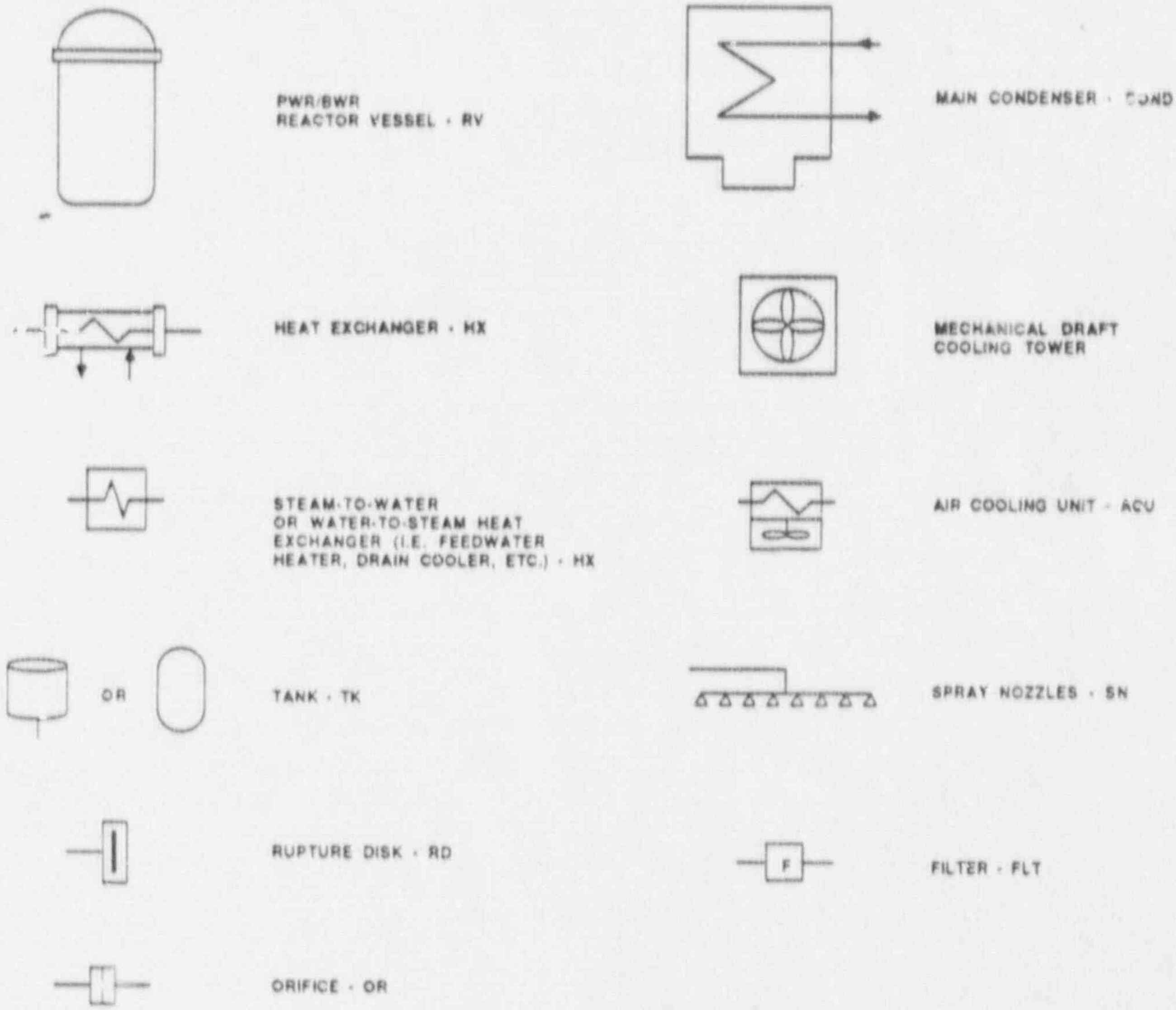

Figure A-1. Key To Symbols In Fluid System Drawings (Continued)

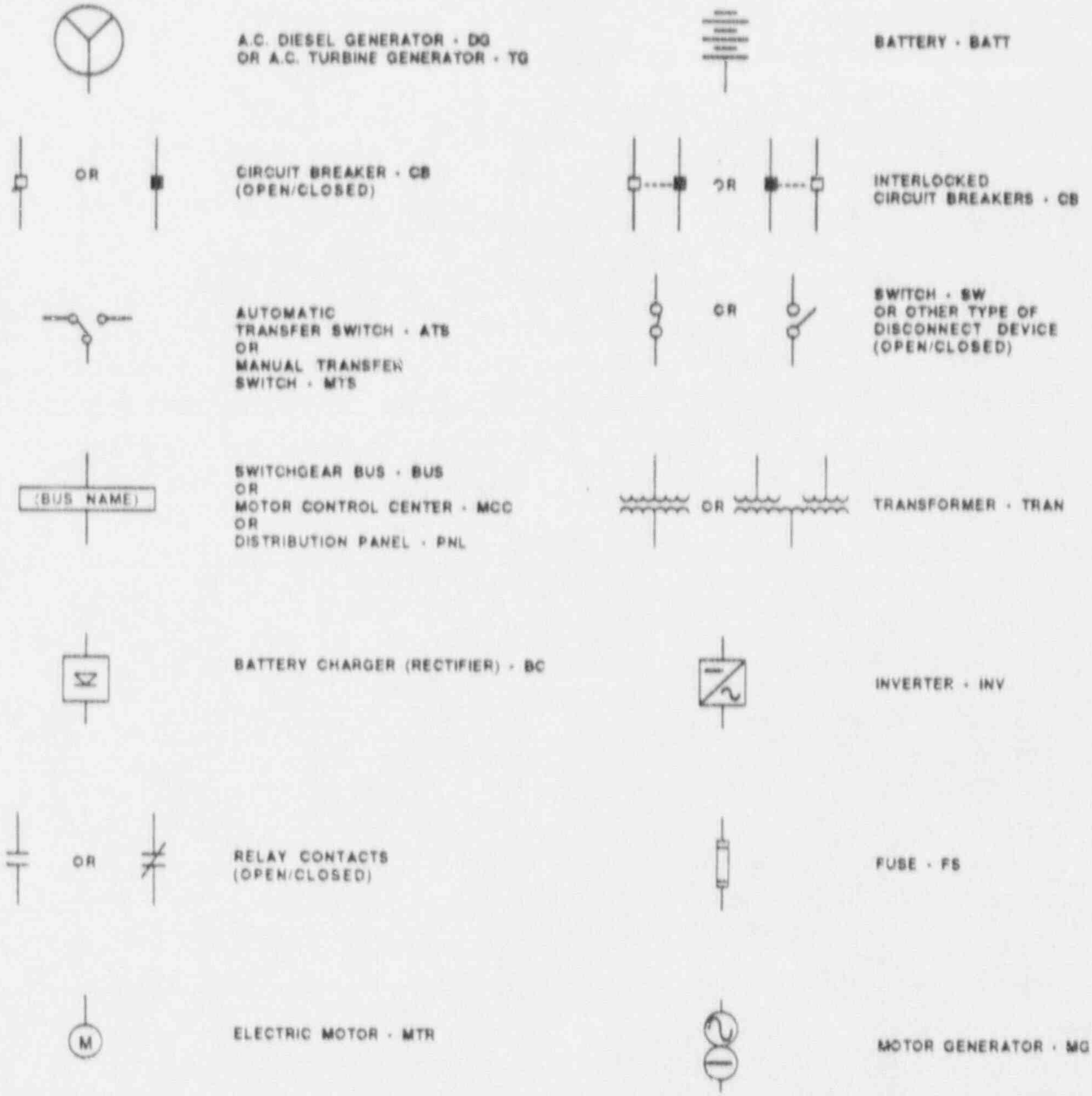

Figure A-2. Key To Symbols In Electrical System Drawings

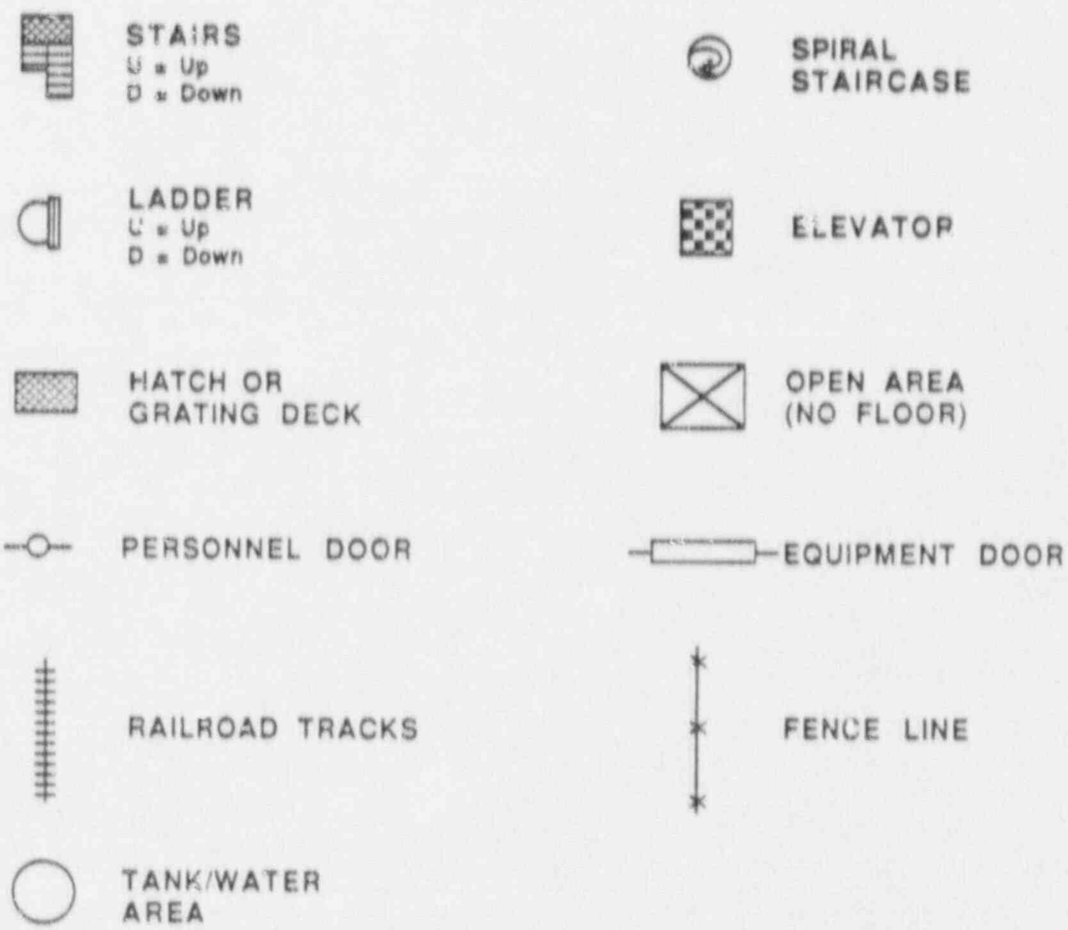

Figure A-3. Key To Symbols In Facility Layout Drawings

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 Systems (including HPCI, LPCI, LPCS and ADS)
EP	Electric Power System
ESW	Emergency 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