SAIC 89/1026

UNITED STATES NUCLEAR REGULATORY COMMISSION

NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

H. B. ROBINSON

50-261

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Prepared for:

U.S. Nuclear Regulatory Commission
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Contract NRC-03-87-029
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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.

H. B. ROBINSON 2
RECORD OF REVISIONS

REVISION	ISSUE	COMMENTS
0	2/89	Original report

H. B. ROBINSON 2 SYSTEM SOURCEBOOK

This sourcebook contains summary information on the H. B. Robinson 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 H. B. Robinson 2 nuclear power plant is listed below:

- Docket number	50-261
- Operator	Carolina Power & Light
- Location	Hartsville, SC
- Commercial operation date	3/71
- Reactor type	PWR
- NSSS vendor	Westinghouse
- Number of loops	3
- Power (MWt/MWe)	2300/665
- Architect-engineer	Ebasco
- Containment type	Reinforced concrete cylinder with steel liner, post-tensioned vertically only

2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

H. B. Robinson 2 has a Westinghouse PWR three-loop nuclear steam supply system (NSSS). Other three-loop Westinghouse plants in the United States include:

- Beaver Valley 1
- Farley 1 and 2
- North Anna 1 and 2
- San Onofre 1
- Virgil C. Summer 1
- Surry 1 and 2
- Turkey Point 3 and 4

3. SYSTEM INFORMATION

This section contains descriptions of selected systems at H. B. Robinson 2 in terms of general function, operation, system success criteria, major components, and support system requirements. A summary of major systems at H. B. Robinson 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 H. B. Robinson 2 Systems Covered in this Report

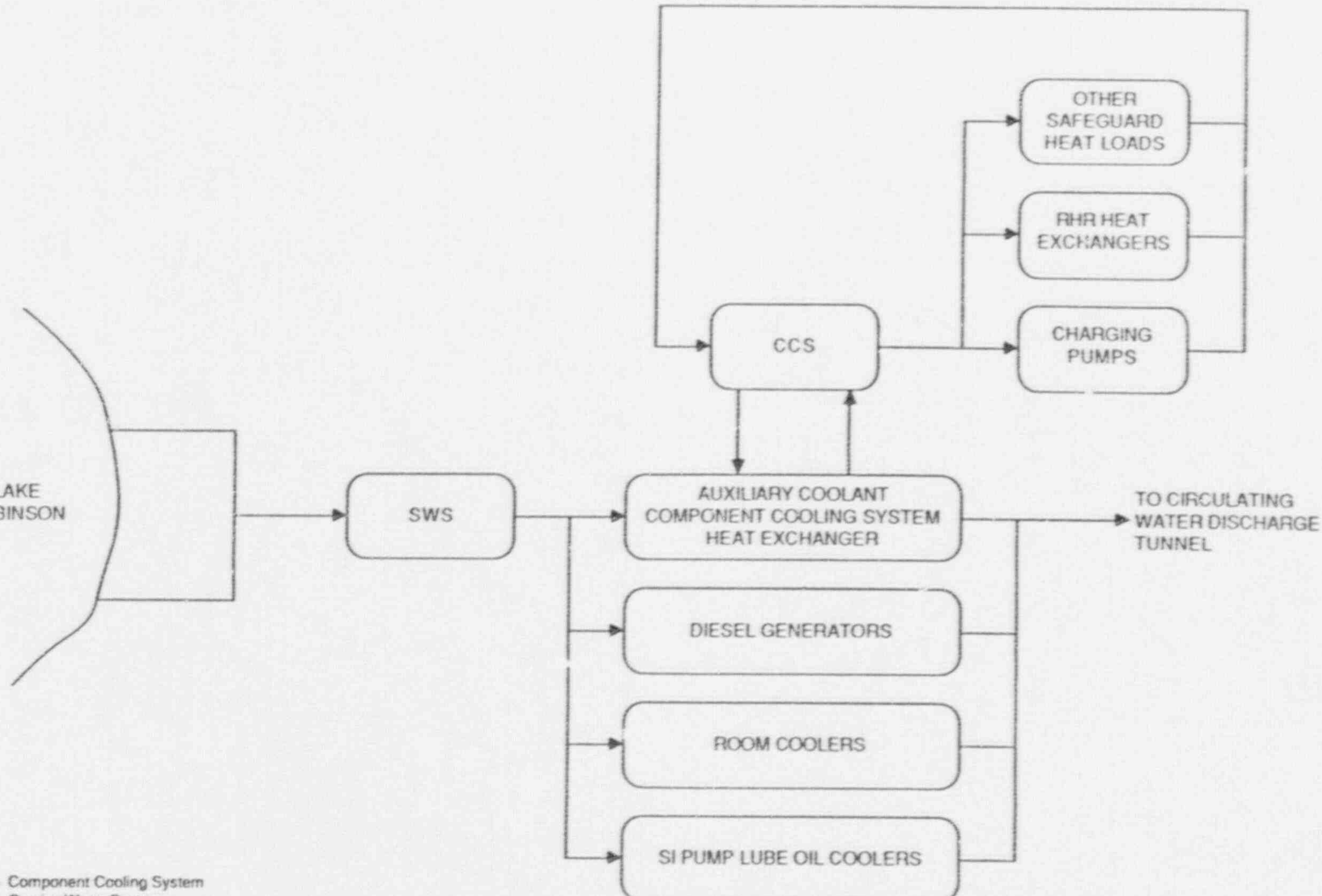
Generic System Name	Plant-Specific System Name	Report Section	USAR Section Reference
Reactor Heat Removal Systems			
- Reactor Coolant System (RCS)	Same	3.1	5
- Auxiliary Feedwater (AFW) and Secondary Steam Relief (SSR) Systems	Same	3.2	10.4.8
- Emergency Core Cooling Systems (ECCS)	Same		
- High-Pressure Injection & Recirculation	Safety Injection System (SIS)	3.3	6.3
- Low-pressure Injection & Recirculation	Residual Heat Removal System	3.3	6.3
- Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System)	(Auxiliary Coolant) Residual Heat Removal System	3.3	6.3
- Main Steam and Power Conversion Systems	Main Steam Supply System, Condensate and Feedwater System, Circulating Water System	X	10
- Other Heat Removal Systems	Main Steam Dump System	X	10.4.4
Reactor Coolant Inventory Control Systems			
- Chemical and Volume Control System (CVCS) (Charging System)	Same	3.4	9.3.4
- ECCS	See ECCS, above	-	-

Table 3-1. Summary of H. B. Robinson 2 Systems Covered in this Report (Continued)

Generic System Name	Plant-Specific System Name	Report Section	USAR Section Reference
Containment Systems			
- Containment	Same	X	6.2
- Containment Heat Removal Systems			
- Containment Spray System	Same	3.5	6.2.2., 6.5.2
- Containment Fan Cooler System	Containment Air Recirculation Cooling System	3.5	6.2.2
- Containment Normal Ventilation Systems	Reactor Containment Building Ventilation System	X	9.4.3
- Combustible Gas Control Systems	Post-Accident Venting System	X	6.2.5
- Other Containment Systems	Containment Isolation System	X	6.2.4
Reactor and Reactivity Control Systems			
- Reactor Core	Same	X	4
- Control Rod System	Control Rod Drive System	X	3.9.4, 4.6
- Boration Systems	See CVCS, above	-	-
Instrumentation & Control (I&C) Systems			
- Reactor Protection System (RPS)	Reactor Trip System (RTS)	3.6	7.2
- Engineered Safety Feature Actuation System (ESFAS)	Engineered Safety Feature Instrumentation System	3.6	7.3
- Remote Shutdown System	Dedicated Shutdown Panels, Auxiliary Feed Pump Room Controls	X	7.4

Table 3-1. Summary of H. B. Robinson 2 Systems Covered in this Report (Continued)

Generic System Name	Plant-Specific System Name	Report Section	USAR Section Reference
Instrumentation & Control (I&C) Systems (continued)			
- Other I&C Systems	Various systems	X	7.5, 7.6, 7.7
Support Systems			
- Class 1E Electric Power System	Same	3.7	8.2, 8.3
- Non-Class 1E Electric Power System	Same	3.7	8.2, 8.3
- Diesel Generator Auxiliary Systems	Same	3.7	8.3, 9.4.4
- Component Cooling Water (CCW) System	Component Cooling System (CCS)	3.8	9.2.2
- Service Water System (SWS)	Same	3.9	9.2.1
- Other Cooling Water Systems	None identified	-	-
- Fire Protection Systems	Same	X	9.5.1
- Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems	Air Conditioning, Heating, Cooling and Ventilation Systems	X	9.4
- Instrument and Service Air Systems	Station and Instrument Air Systems	X	9.3.1
- Refueling and Spent Fuel Systems	Fuel Storage and Handling	X	9.1
- Radioactive Waste Systems	Radioactive Waste Management Systems	X	11
- Radiation Protection Systems	Same	X	12



CCS = Component Cooling System
SWS = Service Water System

Figure 3-1. Cooling Water Systems Functional Diagram for Robinson 2

3.1 REACTOR COOLANT SYSTEM (RCS)

3.1.1 System Function

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

3.1.2 System Definition

The RCS includes: (a) the reactor vessel, (b) reactor coolant loops, (c) reactor coolant pumps, (d) the primary side of the steam generators, (e) pressurizer, and (f) connected piping out to a suitable isolation valve boundary. A simplified diagram of the RCS and important system interfaces is shown in Figure 3.1-1. A summary of data on selected RCS components is presented in Table 3.1-1.

3.1.3 System Operation

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

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

Following a transient or small LOCA (if RCS inventory is maintained), reactor core heat is still transferred to secondary coolant in the steam generators. Flow in the RCS is maintained by the reactor coolant pumps or by natural circulation. The heat transfer path to the ultimate heat sink can be established by using the secondary steam relief system (see Section 3.2) to vent main steam to atmosphere when the power conversion and circulating water systems are not available. If reactor core heat removal by this alternate path is not adequate, the RCS pressure will increase and a heat balance will be established in the RCS by venting steam or reactor coolant to the containment through the pressurizer relief valves. There are two power-operated relief valves and three safety valves on the pressurizer. A continued inability to establish adequate heat transfer to the steam generators will result in a LOCA-like condition (i.e., continuing loss of reactor coolant through the pressurizer relief valves). Repeated cycling of these relief valves has resulted in valve failure (i.e., relief valve stuck open).

Following a LOCA, reactor core heat is dumped to the containment as reactor coolant and ECCS makeup water spills from the break. For a short-term period, the containment can act as a heat sink; however, the containment cooling systems must operate in order to complete a heat transfer path to the ultimate heat sink (see Section 3.5).

3.1.4 System Success Criteria

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

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

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

3.1.5 Component Information

A. RCS
   1. Volume: 9343 ft^3, including pressurizer
   2. Normal operating pressure: 2235 psia

B. Pressurizer
   1. Volume: 1400 ft^3

C. Safety Valves (3)
   1. Set pressure: 2485 psig
   2. Relief capacity: 288,000 lb/hr each

D. Power-Operated Relief Valves (2)
   1. Set pressure: 2335 psig
   2. Relief capacity: 179,000 lb/hr each

E. Steam Generators
   1. Type: Vertical shell and U-Tube
   2. Model: Westinghouse 44 Series

F. Pressurizer Heaters
   1. Capacity: 1300 kW

3.1.6 Support Systems and Interfaces

A. Motive Power
   1. The pressurizer heaters are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.7.
   2. The reactor coolant pumps are supplied from Non-Class 1E switchgear.

B. Reactor Coolant Pump Seal Injection Water System
   The chemical and volume control system supplies seal water to cool the reactor coolant pump shaft seals and to maintain a controlled inleakage of seal water into the RCS. Loss of seal water flow may result in RCS leakage through the pump shaft seals which will resemble a small LOCA.

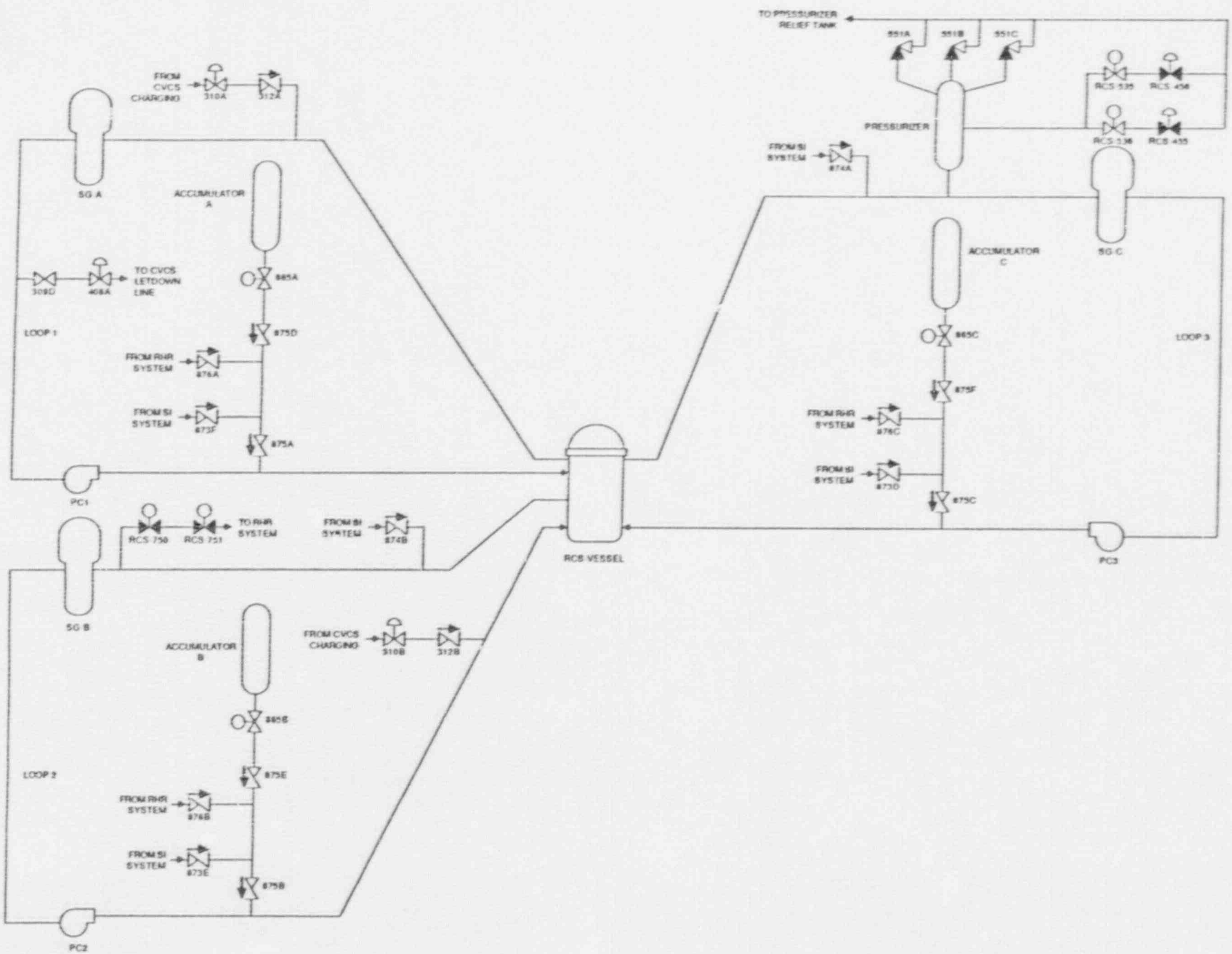


Figure 3.1-1. H.B. Robinson 2 Reactor Coolant System

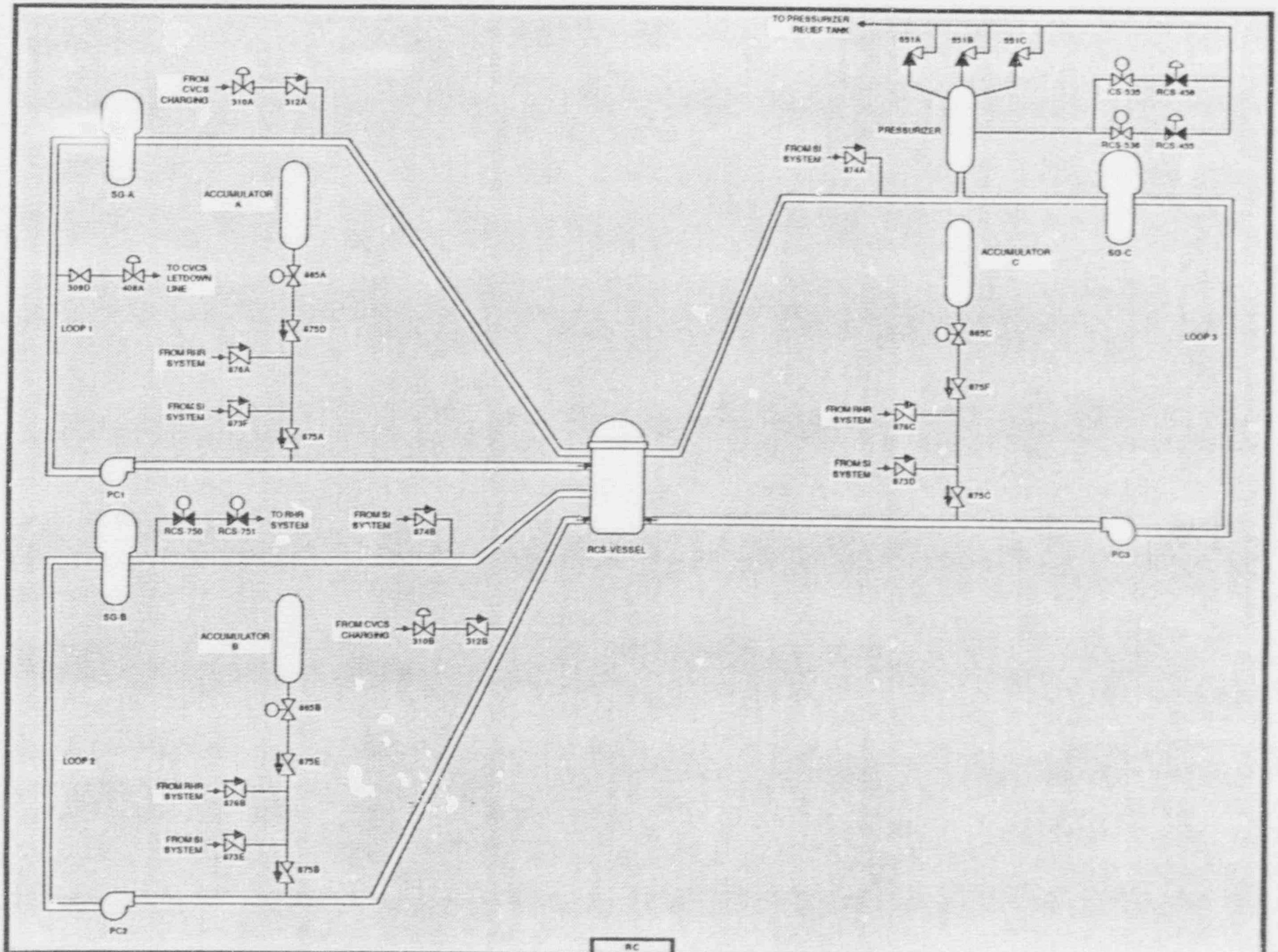


Figure 3.1-2. H.B. Robinson 2 Reactor Coolant System Showing Component Locations

Table 3.1-1. H. B. Robinson 2 Reactor Coolant System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RCS-455	NV	RC				
RCS-456	NV	RC				
RCS-535	MOV	RC	MCC6	480	EEQUIPRM	AC/B
RCS-536	MOV	RC	MCC6	480	EEQUIPRM	AC/B
RCS-750	MOV	RC	MCC5	480	MCC5	AC/A
RCS-751	MOV	RC	MCC6	480	EEQUI[illegible]	AC/B
RCS-VESSEL	RV	RC				

3.2 AUXILIARY FEEDWATER (AFW) SYSTEM AND SECONDARY STEAM RELIEF (SSR) SYSTEM

3.2.1 System Function

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

3.2.2 System Definition

The AFW system consists of two motor-driven pumps and one turbine-driven pump. The normal water sources for the pumps is the condensate storage tank. Alternate sources of water are the deep well pumps and the service water system. Each AFW pump can supply all three steam generators.

The SSR system includes four safety valves and one power-operated pressure control valve on each of the three main steam lines.

Simplified drawings of the AFW and SSR systems are shown in Figures 3.2-1 and 3.2-2. A summary of data on selected AFW system components is presented in Table 3.2-1.

3.2.3 System Operation

During normal operation the AFW system is in standby. The initiating signals for starting the motor-driven pumps are: (a) both main feedwater pump breakers open, (b) low-low water level in any steam generator, (c) a safety injection signal, or (d) blackout condition on the pump's respective emergency bus. The turbine-driven pump is automatically actuated on low-low water level in any two of three steam generators or undervoltage on 4160 buses 1 and 4. The system can also be manually started from the control room.

AFW system success can be met by any one of three pumps. The turbine driven AFW pump is capable of providing 600 gpm at 3000 feet head. The motor-driven AFW pumps are capable of providing 300 gpm at 3000 feet of head. The turbine-driven pump can be supplied with steam from all three main steam lines.

The primary source of water to the AFW pumps suction is the condensate storage tank (CST). The capacity of the CST is 132,000 gallons, with 35,000 gallons reserved for AFW use, enough for at least two hours of operation. Alternate sources of water are the service water system and the deep well pumps. The service water system is separated from the AFW system by a locked closed manual valve.

Flow from the turbine-driven pump goes to all three steam generators through independent paths. Flow from the motor driven pumps goes to a common header from which flow splits to supply all three steam generators. Flow is regulated by control valves which automatically maintain the required flow into the steam generators under varying backpressures.

3.2.4 System Success Criteria

For the decay heat removal function to be successful, both the AFW system and the SSR system must operate successfully. The AFW success criteria are the following (Ref. 1):

- Any one AFW pump can provide adequate flow.
- Water must be provided from at least one source to the AFW pump suctions. Alternative water sources include the CST or service water system.
- Makeup to any one steam generator provides adequate decay heat removal from the reactor coolant system.

The SSR system must operate to complete the heat transfer path to the environment. The number of safety valves that must open for the decay heat removal function is not known.

3.2.5 Component Information

A. Motor-driven AFW pumps A and B
  1. Rated flow: 300 gpm @ 3000 ft. head (1300 psid)
  2. Rated capacity: 100% each
  3. Type: Centrifugal

B. Turbine-driven AFW pump TP1
  1. Rated flow: 600 gpm @ 3000 ft. head (1300 psid)
  2. Rated capacity: 100%
  3. Type: Centrifugal

C. Condensate storage tank
  1. Capacity: 132,000 gallons
  2. Design pressure: Atmospheric

D. Secondary steam relief valves
  1. Four safety valves per main steam line
  2. One power-operated pressure control valve per main steam line

3.2.6 Support Systems and Interfaces

A. Control Signals
  1. Automatic
     The motor-driven AFW pumps are automatically actuated on the following signals:

     - both main feedwater pump breakers open
     - low-low water level in any one steam generator
     - safety injection signal (SIS)
     - blackout condition on the pump's respective emergency bus

     The turbine driven pump is automatically actuated on the following signals.

     - low-low water level in two of three steam generators
     - undervoltage on 4160 buses 1 and 4

  2. Remote manual
     The AFW system can be actuated by remote manual means from the main control room.

B. Motive power
  1. The AFW motor-driven pumps and motor-operated valves are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.7. Redundant loads are supplied from separate load groups.
  2. The AFW turbine-driven pump is supplied with steam from all three main steam lines

C. Other
  1. Lubrication, and ventilation are provided locally for the pumps.
  2. Bearing cooling for the pumps is provided by the service water system.

3.2.7 Section 3.2 References

1. H. B. Robinson 2 Updated Final Safety Analysis Report, Section 10.4.8.

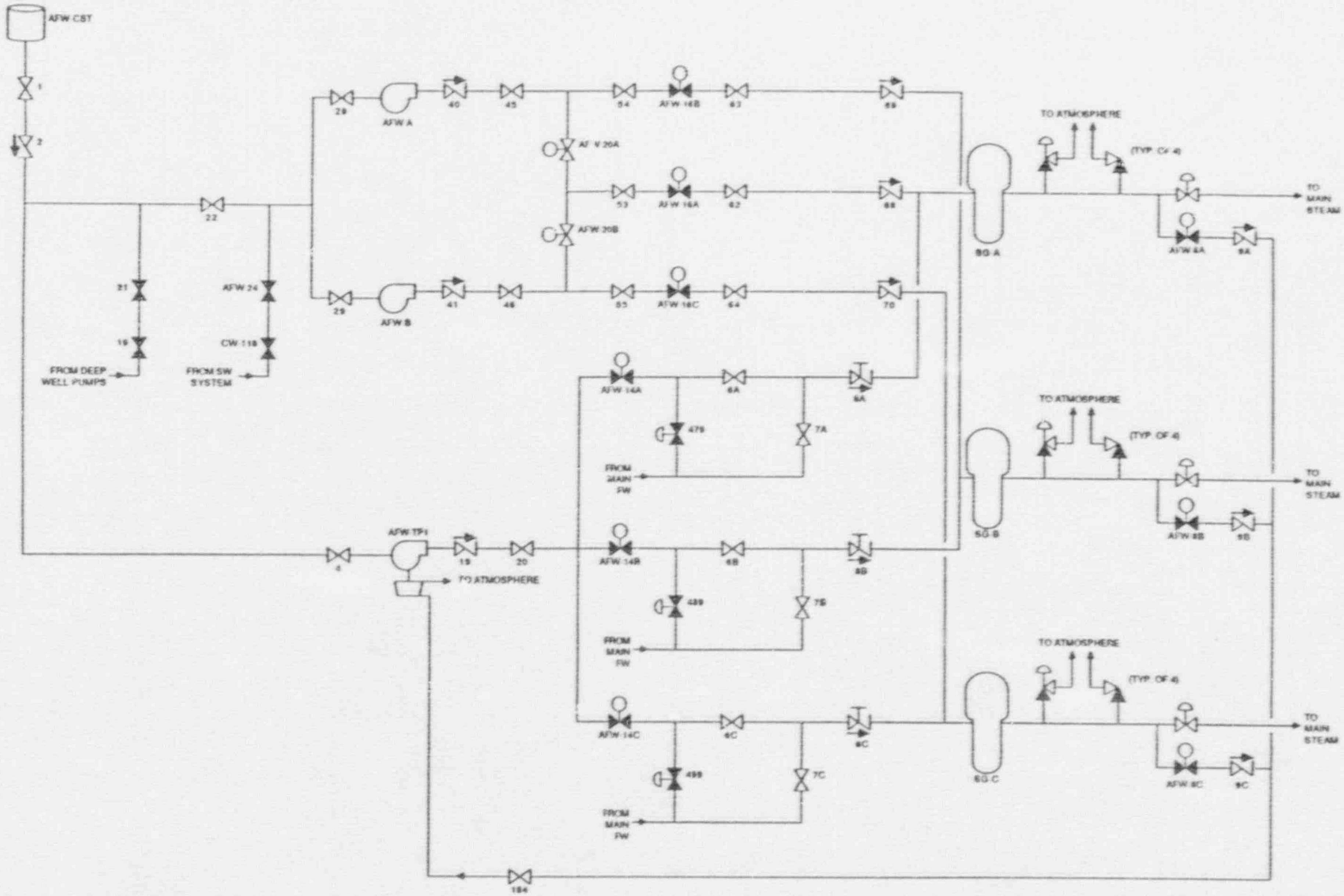


Figure 3.2-1. H.B. Robinson 2 Auxiliary Feedwater System

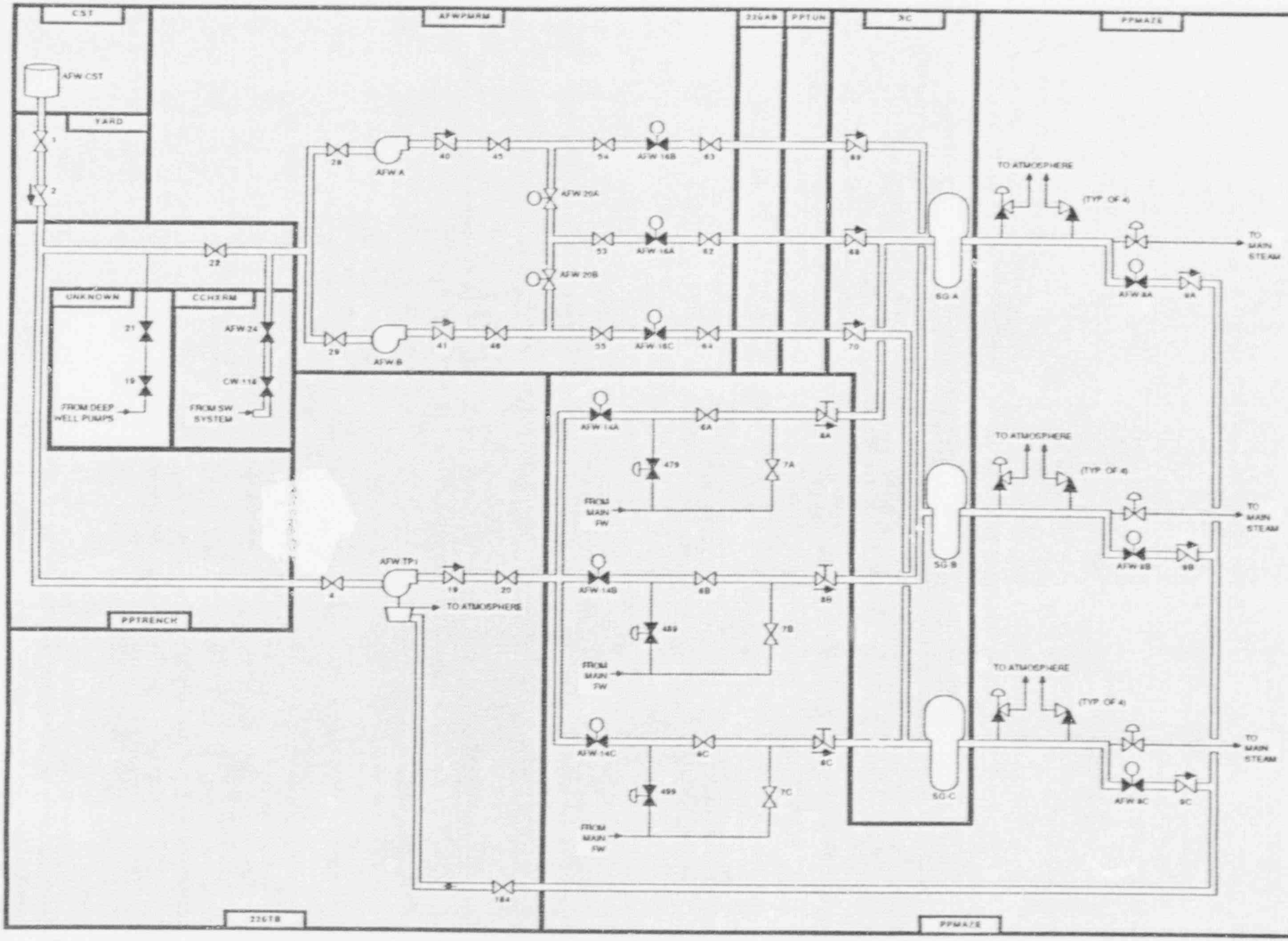


Figure 3.2-2. H.B. Robinson 2 Auxiliary Feedwater System Showing Component Locations

Table 3.2-1. H. B. Robinson 2 Auxiliary Feedwater System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
AFW-14A	MOV	PPMAZE	MCC10	120	MCC10	AC/A
AFW-14B	MOV	PPMAZE	MCC9	120	MCC9	AC/B
AFW-14C	MOV	PPMAZE	MCC10	120	MCC10	AC/A
AFW-16A	MOV	AFWPMRM	MCC10	120	MCC10	AC/A
AFW-16B	MOV	AFWPMRM	MCC10	120	MCC10	AC/A
AFW-16C	MOV	AFWPMRM	MCC9	120	MCC9	AC/B
AFW-20A	MOV	AFWPMRM	MCC9	120	MCC9	AC/B
AFW-20B	MOV	AFWPMRM	MCC10	120	MCC10	AC/A
AFW-24	XV	CCHXRM				
AFW-8A	MOV	PPMAZE	MCC5	480	MCC5	AC/A
AFW-8B	MOV	PPMAZE	MCC6	480	EEQUIPRM	AC/B
AFW-8C	MOV	PPMAZE	MCC6	480	EEQUIPRM	AC/B
AFW-A	MDP	AFWPMRM	BUS-E1	480	EEQUIPRM	AC/A
AFW-B	MDP	AFWPMRM	BUS-E2	480	EEQUIPRM	AC/B
AFW-CST	TANK	CST				
AFW-TP1	TDP	226TB				
CW-118	XV	CCHXRM				
SG-A	SG	RC				
SG-B	SG	RC				
SG-C	SG	RC				

3.3 EMERGENCY CORE COOLING SYSTEM (ECCS)

3.3.1 System Function

The ECCS is an integrated set of subsystems that perform emergency coolant injection and recirculation functions to maintain reactor core coolant inventory and adequate decay heat removal following a LOCA. The coolant injection function is performed during a relatively short-term period after LOCA initiation, followed by realignment to a recirculation mode of operation to maintain long-term, post-LOCA core cooling. Heat from the reactor core is transferred to the containment. The heat transfer path to the ultimate heat sink is completed by the containment cooling systems (see Section 3.5).

3.3.2 System Definition

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

- Passive cold leg accumulators
- Safety injection (SI) system
- Residual heat removal (RHR) system

The emergency coolant recirculation (ECR) function is performed by the RHR and SI systems.

The SI system provides high pressure coolant injection capability. The RHR pumps, part of the Auxiliary Coolant System, perform the low pressure injection function. The Refueling Water Storage Tank (RWST) is the water source for both the high and low pressure injection systems. Both systems inject coolant into all three RCS cold legs. The SI system can also inject into two hot legs.

After the injection phase is completed, recirculation (ECR) is performed by the RHR pumps drawing suction from the containment sump and discharging into the RCS cold legs. Heat is transferred to the component cooling water system by the RHR heat exchangers. The RHR pumps can also deliver water to the suction of the SI pumps during recirculation.

Long-term containment and core decay heat removal is performed by the containment spray system (see Section 3.5).

Simplified drawings of the safety injection system are shown in Figures 3.3-1 and 3.3-2. The RHR system is shown in Figures 3.3-3 and 3.3-4. Interfaces between the accumulators, the ECCS injection and recirculation subsystems, 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

During normal operation, the ECCS is in standby. Following a LOCA, the three cold leg injection accumulators (one for each loop) supply borated water to the RCS as soon as RCS pressure drops below accumulator pressure (approximately 660 psig). A safety injection signal automatically opens the SI system isolation valves and starts the safety injection and RHR pumps. All pumps are aligned to take suction on the RWST. The SI pumps deliver water to two headers, one for injection through the cold legs and one for injection through two of three hot legs. The header to the cold legs contains the boron injection tank. The RHR pumps deliver to the cold legs through piping between the accumulators and the cold legs.

For small breaks, operator action can be taken to augment the RCS depressurization by utilizing the secondary steam dump capability and the auxiliary feedwater (AFW) system (i.e., depressurization due to rapid heat transfer from the RCS).

When the RWST water level drops to a prescribed low level setpoint, the RHR pumps are realigned to draw a suction from the containment sump and deliver water through the residual heat exchangers to the RCS. If depressurization of the RCS proceeds slowly, high pressure recirculation can be accomplished by manually aligning the discharge of the RHR pumps to the suction of the SI pumps. The RHR pumps also deliver water to the suction of the Containment Spray pumps during recirculation (see Section 3.5).

3.3.4 System Success Criteria

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

- 2 of 3 accumulators provide makeup as RCS pressure drops below tank pressure, and
- 2 of 3 safety injection pumps inject into the RCS, and
- One RHR pump injects into the RCS

If the ECI success criteria is met, then the following large LOCA ECR success criteria will apply (Ref. 1):

- At least one RHR pump is realigned for recirculation and takes a suction on the containment sump and injects into the RCS.

The ECI success criteria for a small LOCA are as follows (Ref. 1):

- 1 of 3 safety injection pumps takes a suction on the RWST

The ECR success criteria for a small LOCA are as follows (Ref. 1):

- 1 of 2 RHR pumps takes a suction on the containment sump and delivers water to the SI pumps suction, and
- 1 of 3 SI pumps injects into the RCS cold legs

It is intended that for small breaks (4 inches and smaller), secondary-side steam dump will be employed to reduce RCS pressure to the cut-in pressure of the RHR pumps, so they can recirculate directly (Ref. 1).

3.3.5 Component Information

A. Safety injection pumps A, B, and C
   1. Rated flow: 375 gpm @ 2500 ft. head (1084 psid)
   2. Rated capacity: 100%
   3. Discharge pressure at shutoff head: 1750 psid
   4. Type: horizontal centrifugal

B. Residual heat removal pumps A and B
   1. Rated flow: 3750 gpm @ 225 ft. head (97 psid)
   2. Rated capacity: 100%
   3. Discharge pressure at shutoff head: 600 psig
   4. Type: vertical centrifugal

C. Cold leg injection accumulators (4)
1. Accumulator volume: 1200 ft^3
2. Minimum water volume: 825 ft^3
3. Normal operating pressure: 660 psig
4. Nominal boric acid concentration: 2000 ppm

D. Refueling water storage tank
1. Capacity: 353,000 gallons
2. Design pressure: Atmospheric
3. Minimum boron concentration: 2500 ppm

E. Boron injection tank
1. Capacity: 900 gallons
2. Design pressure: 2735 psig
3. Fluid: 12% boric acid solution

F. RHR heat exchangers 1 and 2
1. Design duty: 29.4 x 10^6 Btu/hr
2. Type: Vertical, shell and U-tube

3.3.6 Support Systems and Interfaces

A. Control signals
1. Automatic
The ECCS injection subsystems are automatically actuated by a safety injection signal (SIS). Conditions initiating an SIS are:

a. Low pressurizer pressure
b. High containment pressure
c. High steam line differential pressure
d. High steam flow with low Tavg or low steam line pressure
e. Manual actuation

The SIS automatically initiates the following actions:

- starts the diesel generators
- starts the SI and RHR pumps
- opens the SI system isolation valves
- trips the main feedwater pumps
- starts the motor driven AFW pumps

2. Remote manual
An SIS can be initiated by manual actuation from the control room. The transition from the injection to the recirculation phase of ECCS operation is initiated manually.

B. Motive Power
1. The ECCS motor-driven pumps and motor-operated valves are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.7.

C. Other
   1. The RHR pumps and heat exchanger and SI pumps are cooled by the ponent Cooling system (see Section 3.8).
   2. cation and ventilation are provided locally for the SI and RHR pumps a motors.

3.3.7 Section 3.3 References

1. H. B. Robinson 2 Updated Final Safety Analysis Report, Section 6.3.2.

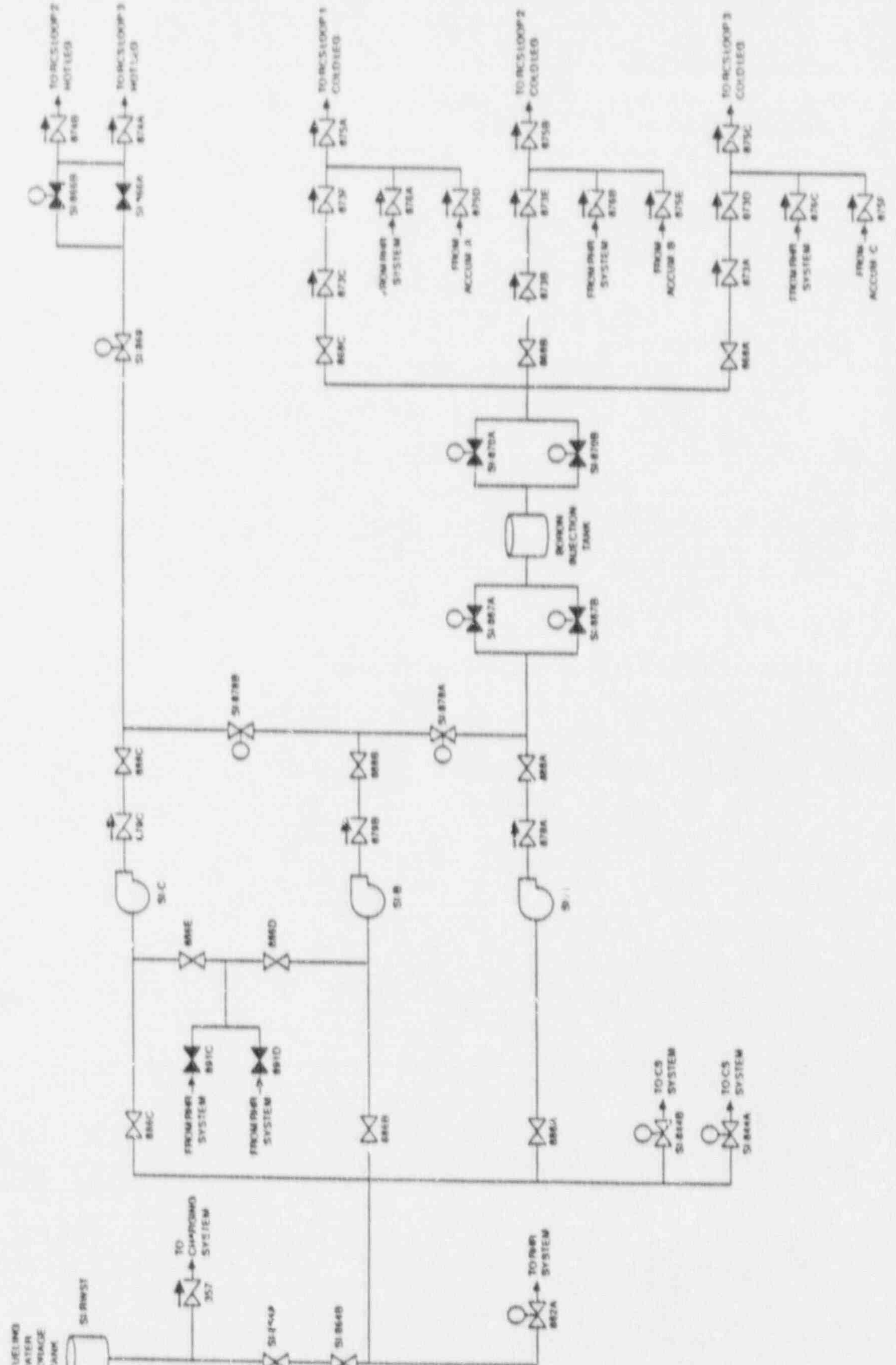


Figure 3.3-1. H.B. Robinson 2 Safety Injection System

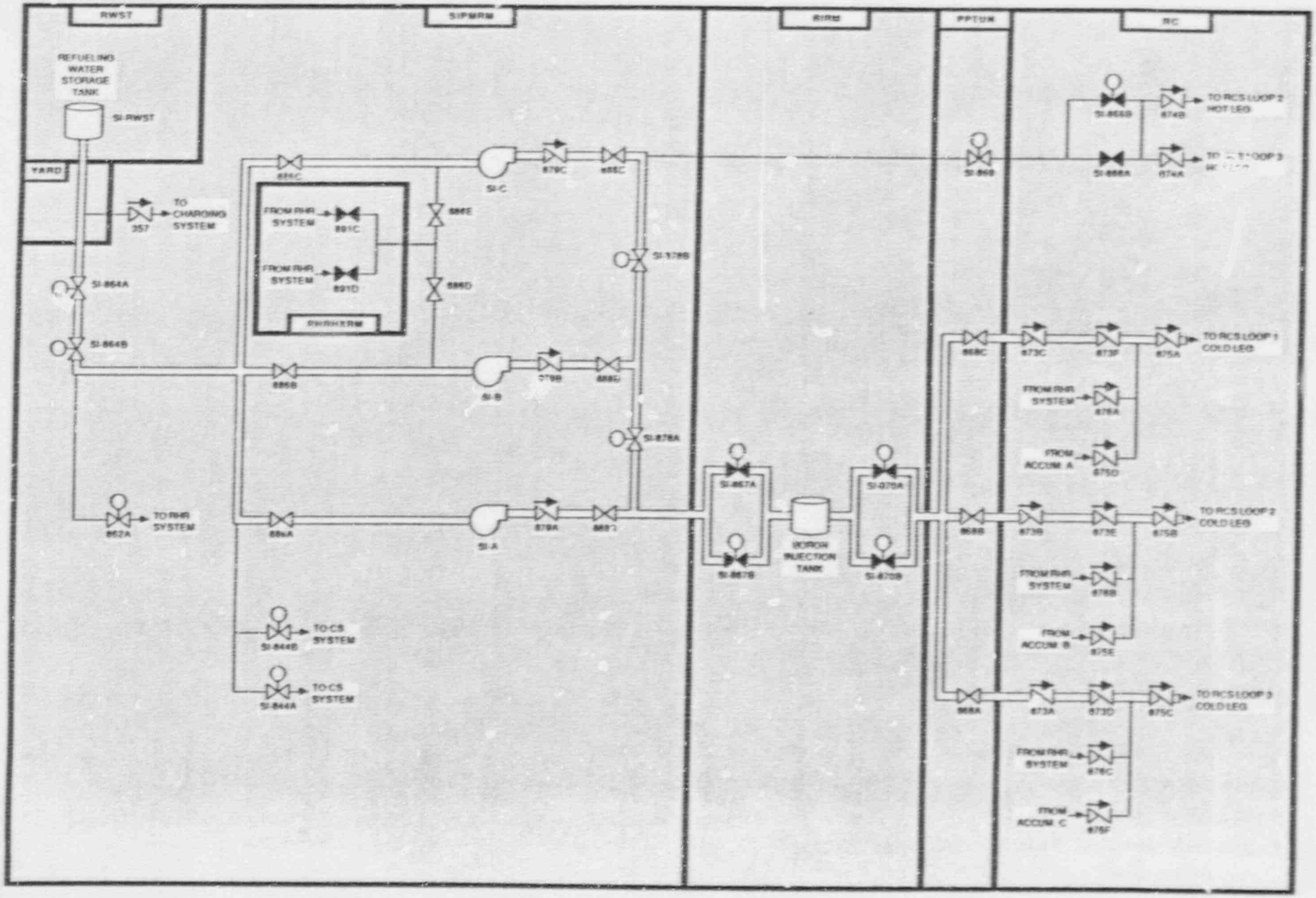


Figure 3.3-2. H.B. Robinson 2 Safety Injection System Showing Component Locations

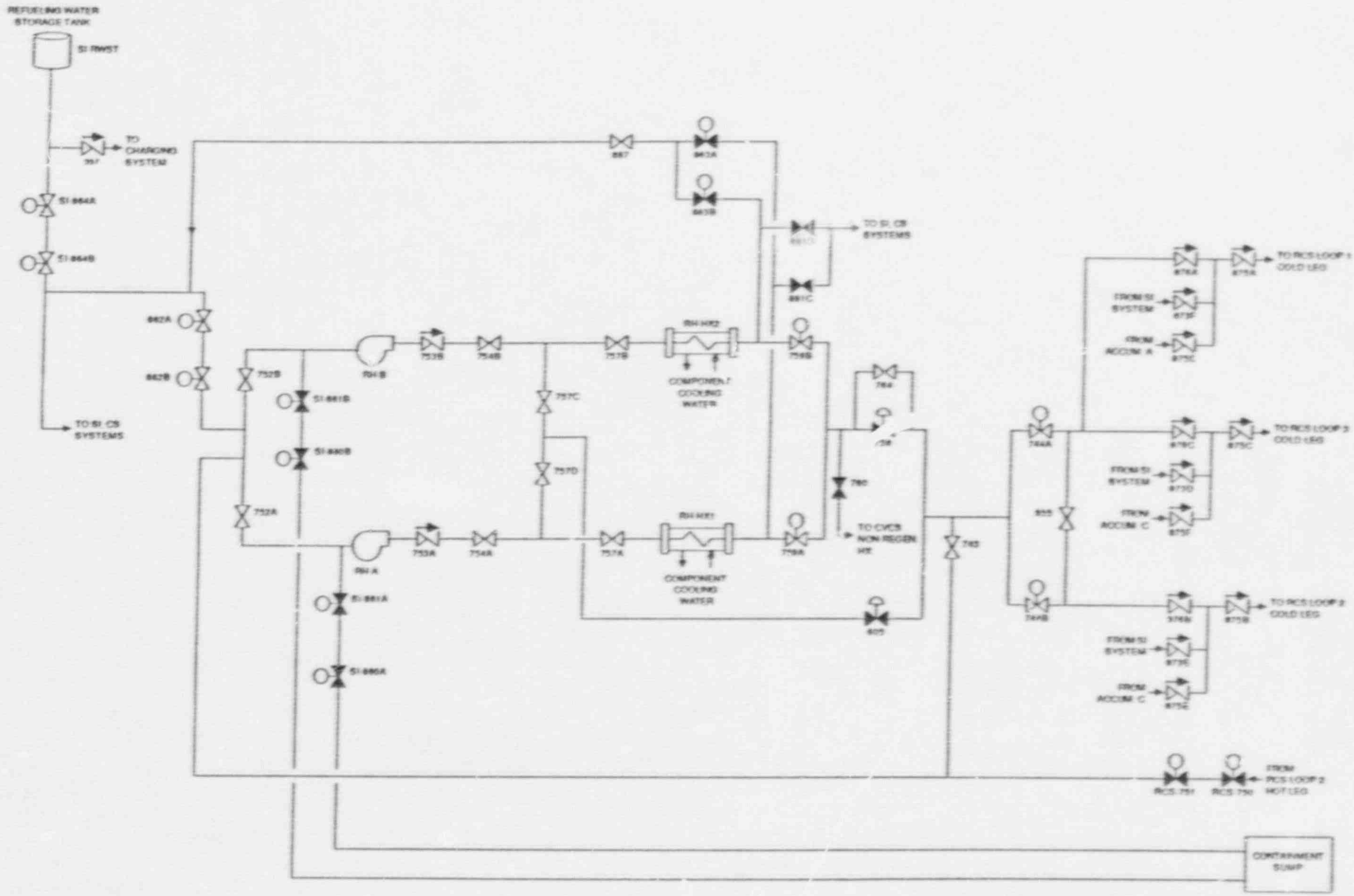


Figure 3.3-3. H.B. Robinson 2 Auxiliary Coolant Residual Heat Removal System

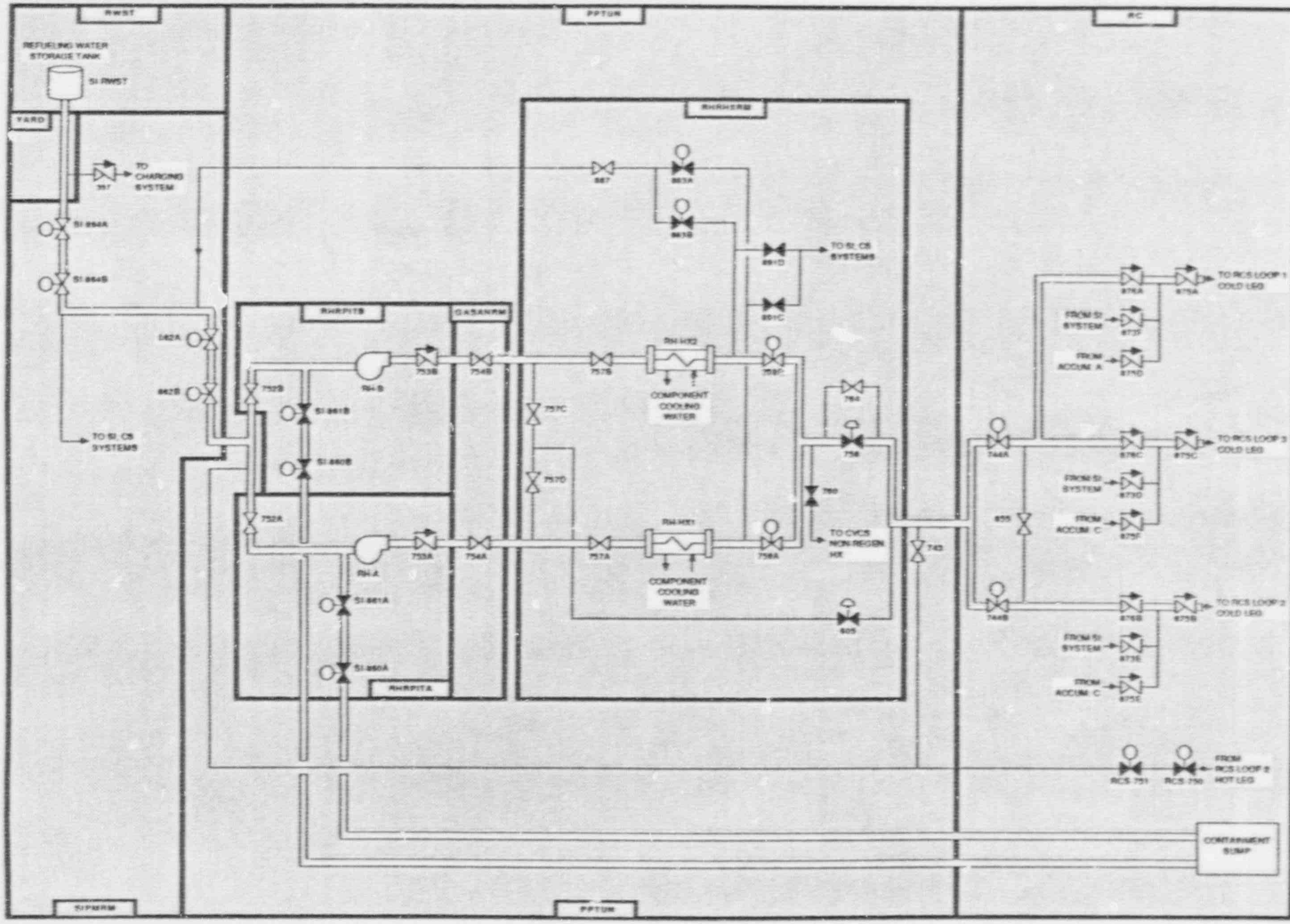


Figure 3.3-4. H.B. Robinson 2 Auxiliary Coolant Residual Heat Removal System Showing Component Locations

Table 3.3-1. H. B. Robinson 2 Emergency Core Cooling System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RH-A	MDP	RHRPITA	BUS-E1	480	EEQUIPRM	AC/A
RH-B	MDP	RHRPITB	BUS-E2	480	EEQUIPRM	AC/B
RH-HX1	HX	RHRHXRM				
RH-HX2	HX	RHRHXRM				
SI-860A	MOV	RHRPITA	MCC5	480	MCC5	AC/A
SI-860B	MOV	RHRPITB	MCC6	480	EEQUIPRM	AC/B
SI-861A	MOV	RHRPITA	MCC5	480	MCC5	AC/A
SI-861B	MOV	RHRPITB	MCC6	480	EEQUIPRM	AC/B
SI-864A	MOV	SIPMRM	MCC5	480	MCC5	AC/A
SI-864B	MOV	SIPMRM	MCC6	480	EEQUIPRM	AC/B
SI-866A	MOV	RC	MCC5	480	EEQUIPRM	AC/B
SI-866B	MOV	RC	MCC5	480	MCC5	AC/A
SI-867A	MOV	BIRM	MCC5	480	MCC5	AC/A
SI-867B	MOV	BIRM	MCC6	480	EEQUIPRM	AC/B
SI-869	MOV	PPTUN	MCC5	480	MCC5	AC/A
SI-870A	MOV	BIRM	MCC5	480	MCC5	AC/A
SI-870B	MOV	BIRM	MCC6	480	EEQUIPRM	AC/B
SI-878A	MOV	SIPMRM	MCC5	480	MCC5	AC/A
SI-878B	MOV	SIPMRM	MCC6	480	EEQUIPRM	AC/B
SI-A	MDP	SIPMRM	BUS-E1	480	EEQUIPRM	AC/A
SI-B	MDP	SIPMRM	BUS-E1	480	EEQUIPRM	AC/A
SI-B	MDP	SIPMRM	BUS-E2	480	EEQUIPRM	AC/B
SI-C	MDP	SIPMRM	BUS-E2	480	EEQUIPRM	AC/B
SI-RWST	TANK	RWST				

3.4 CHEMICAL AND VOLUME CONTROL SYSTEM (CVCS)

3.4.1 System Function

The Chemical and Volume Control System (CVCS) is responsible for maintaining the proper water inventory in the Reactor Coolant System and maintaining water purity and the proper concentration of neutron absorbing and corrosion inhibiting chemicals in the reactor coolant. The makeup function of the CVCS is assumed to be required to maintain the plant in a long-term (8 hours) hot shutdown condition.

3.4.2 System Definition

The CVCS provides a means for injection of control poison in the form of boric acid solution, chemical additions for corrosion control, and reactor coolant cleanup and degasification. This system also maintains the required water inventory in the RCS, reprocesses water that is letdown from the RCS, and provides seal water injection to the reactor coolant pump seals. The functions of the CVCS are performed by the following components: (a) three positive displacement charging pumps, (b) boric acid transfer pumps, (c) volume control tank, (d) boric acid tanks, and (e) various heat exchangers and demineralizers.

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

3.4.3 System Operation

During normal plant operation the letdown flow from RCS cold leg 1 is cooled in the shell side of the regenerative heat exchanger, then directed to the volume control tank (VCT). The reactor makeup control system maintains the desired inventory in the VCT. From the VCT the coolant flows to the charging pumps which raise the pressure above that in the RCS. The bulk of the charging flow is pumped back to the RCS through the tube side of the regenerative heat exchanger via two charging lines, one through loop 2 cold leg and one through loop 1 hot leg. Portions of the charging flow are directed to the reactor coolant pumps through a seal water injection filter, and to pressurizer spray.

Makeup for normal plant leakage is regulated by the reactor makeup control which is set by the operator to blend water from the primary water storage tank with concentrated boric acid to match the reactor coolant boron concentration. Makeup water to the RCS is provided from the primary water storage tank, the boric acid tanks, the refueling water storage tank, and the chemical mixing tank.

3.4.4 System Success Criteria

The success criteria for the CVCS are not clearly defined in the FSAR. However the following is noted (Ref. 1):

- 1 of 2 charging lines is necessary to charge to the RCS
- 1 of 3 charging pumps is adequate for normal make-up to the RCS

3.4.5 Component Information

A. Centrifugal charging pumps A, B, C
   1. Rated flow: 77 gpm @ 5500 ft head (2384 psid)
   2. Rated capacity: 100% for RCS makeup
   3. Type: positive displacement

B. Boric acid pumps (2)
   1. Rated flow: 60 gpm @ 235 ft head (102 psid)
   2. Type: canned

C. Primary water pumps (2)
   1. Rated flow: 150 gpm @ 300 ft head (130 psid)
   2. Type: centrifugal

D. Volume control tank
   1. Volume: 300 ft^3
   2. Design pressure: 75 psig

E. Boric acid tanks (2)
   1. Volume: 7500 gallons
   2. Design pressure: atmospheric

F. Primary water storage tank
   1. Volume: 150,000 gallons
   2. Design pressure: atmospheric

3.4.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      One charging pump is automatically controlled, its speed modulated in accordance with pressurizer level.
   2. Remote Manual
      The charging pumps can be actuated by remote manual means from the control room.

B. Motive Power
   1. Charging pumps B and C are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.7. Charging pump A is powered from the dedicated shutdown bus (non-safety related).

C. Other
   1. The centrifugal charging pumps are cooled by the Component Cooling system (see Section 3.8).
   2. Pump lubrication and ventilation are provided locally.

3.4.7 Section 3.4 References

1. H. B. Robinson 2 Updated Final Safety Analysis Report, Section 9.3.4.

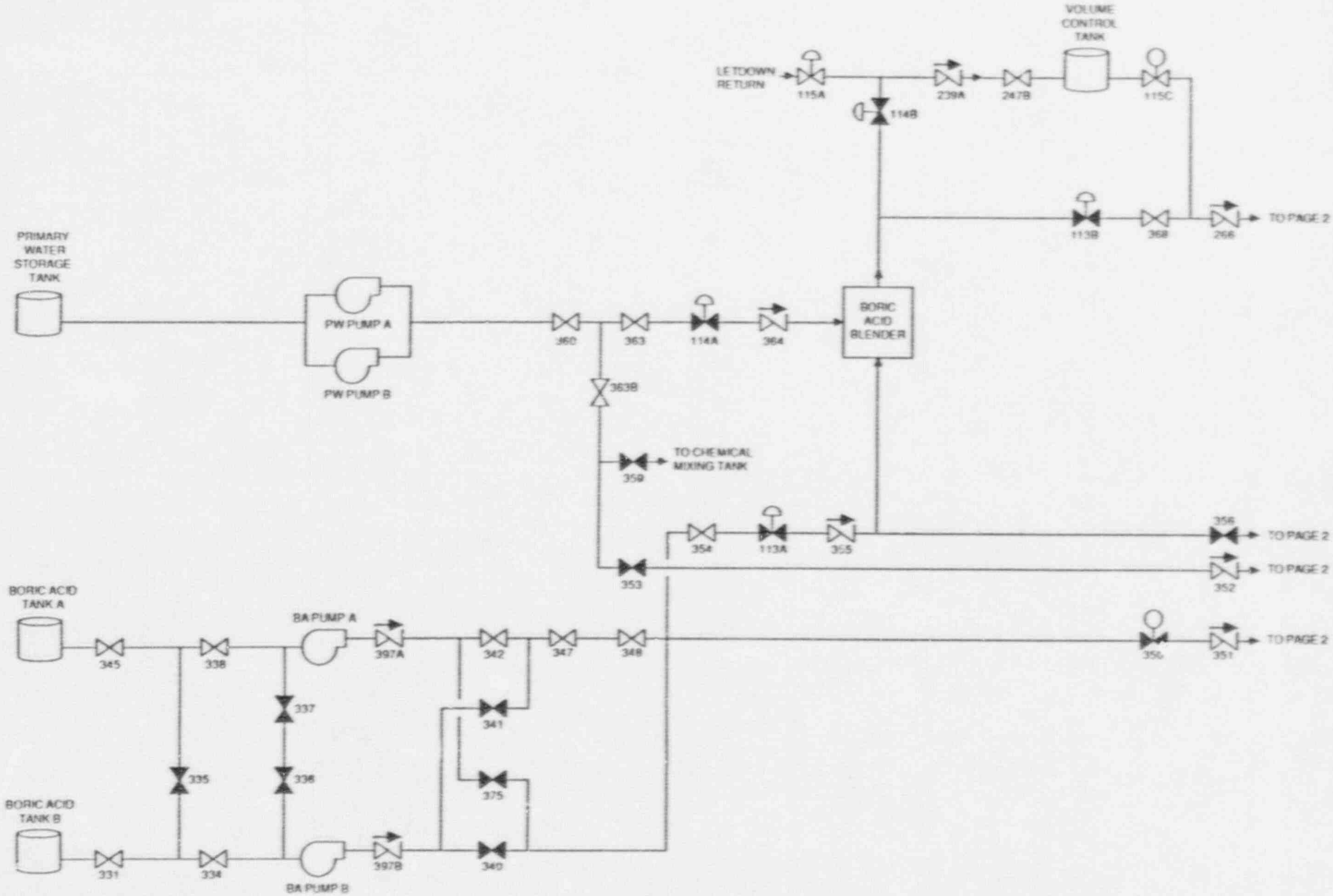


Figure 3.4-1. H.B. Robinson 2 Chemical and Volume Control System (Page 1 of 2)

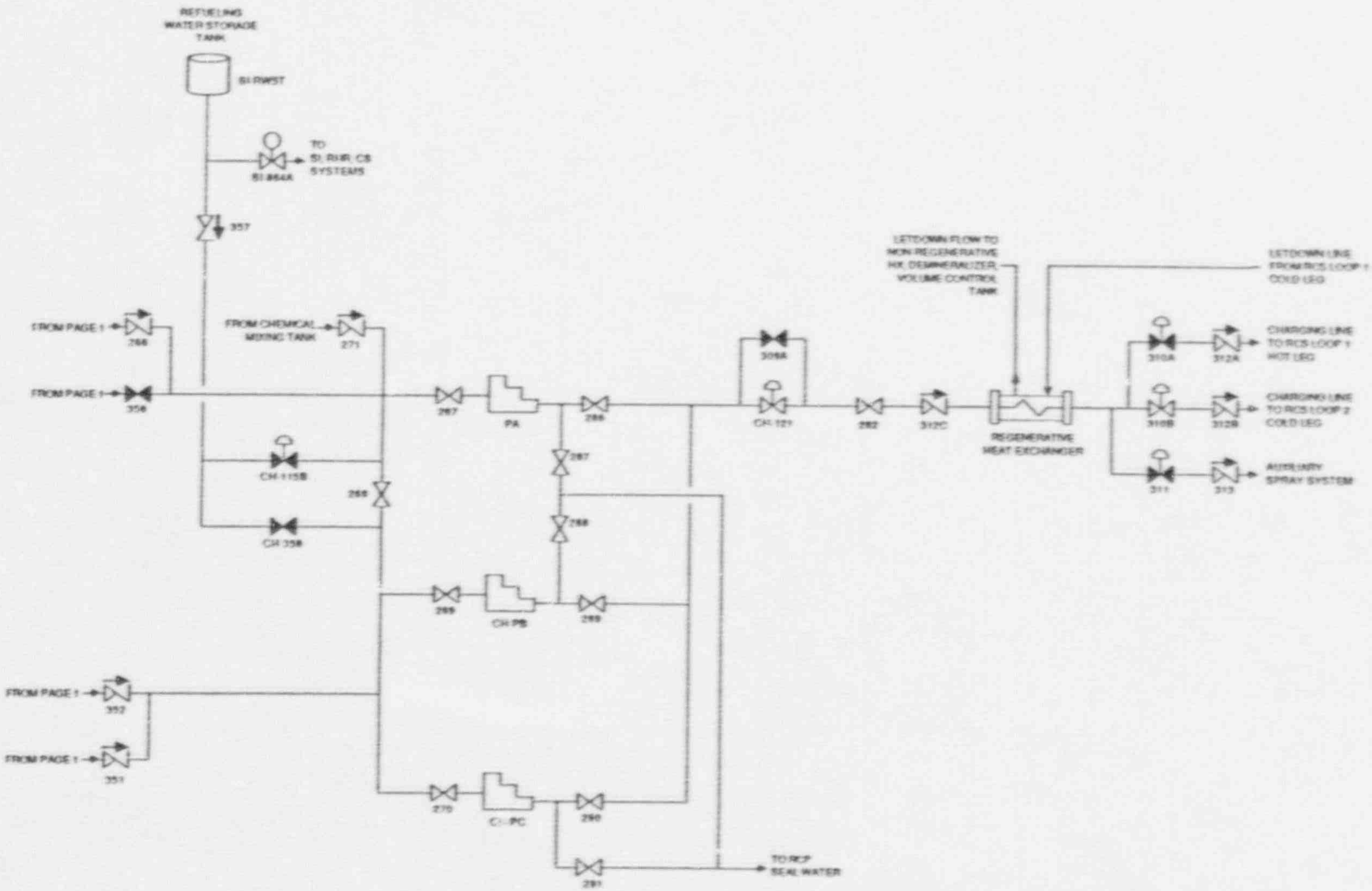


Figure 3.4-1. H.B. Robinson 2 Chemical and Volume Control System (Page 2 of 2)

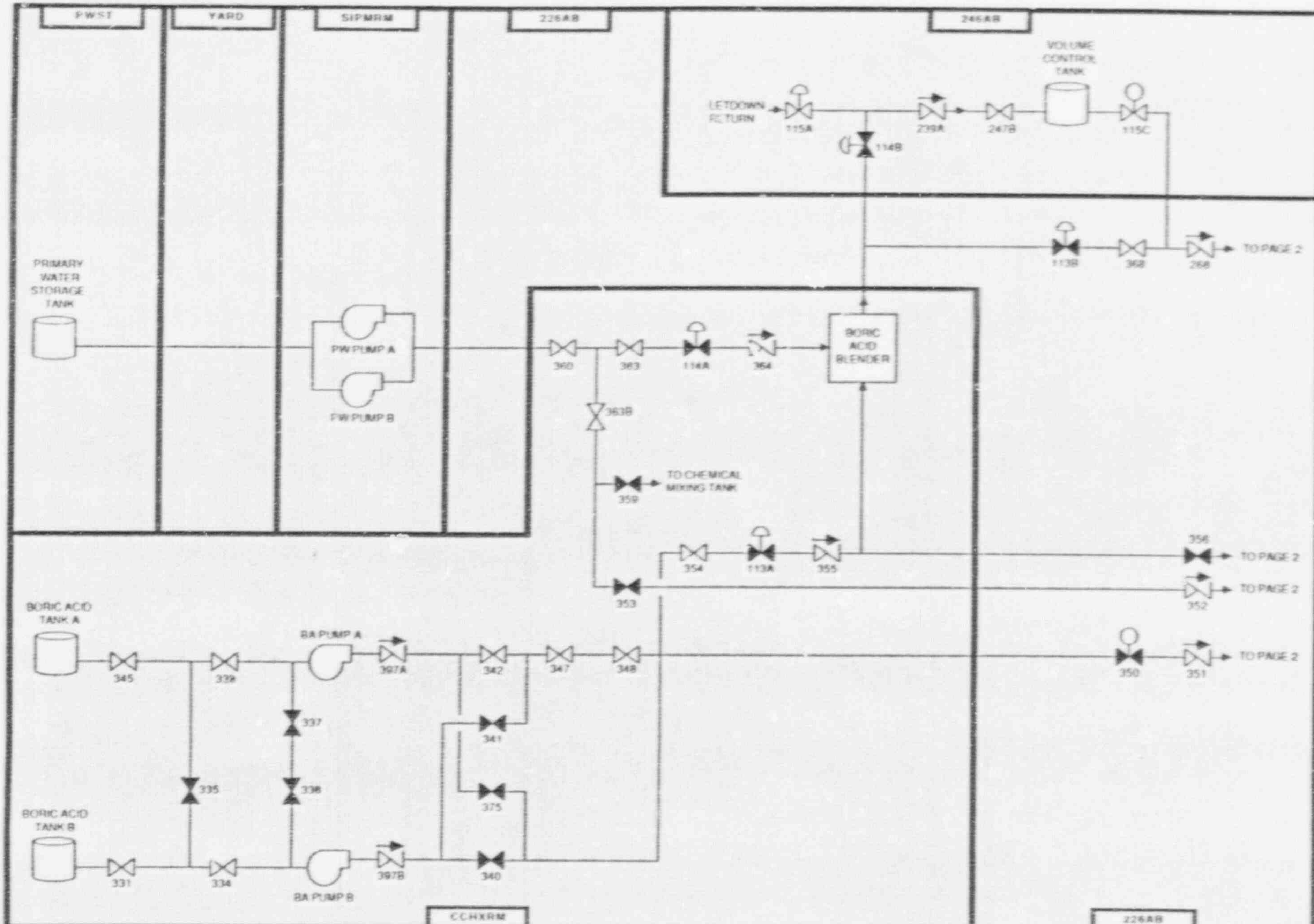


Figure 3.4-2. H.B. Robinson 2 Chemical and Volume Control System Showing Component Locations (Page 1 of 2)

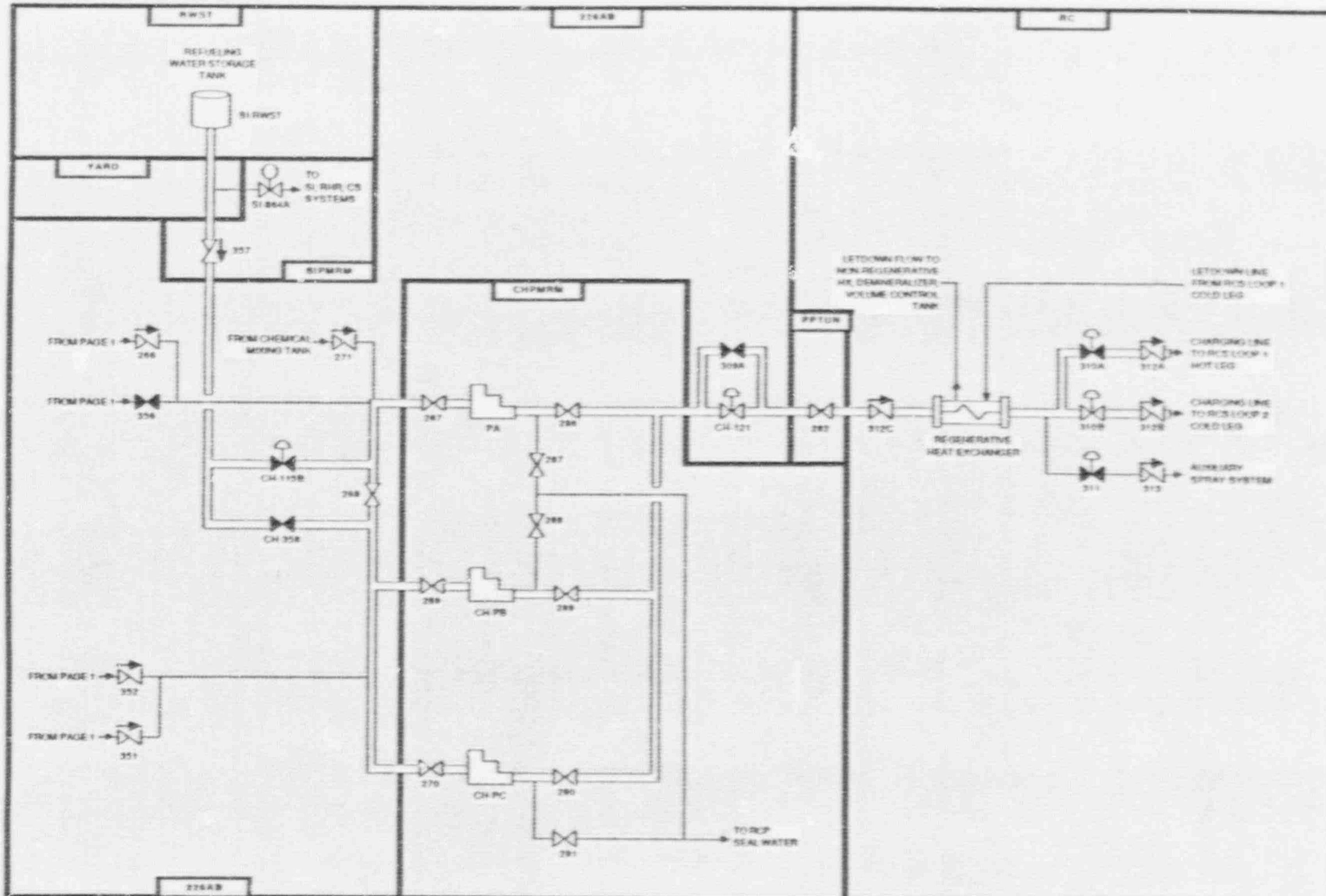


Figure 3.4-2. H.B. Robinson 2 Chemical and Volume Control System Showing Component Locations (Page 2 of 2)

Table 3.4-1. H. B. Robinson 2 Chemical and Volume Control System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CH-115B	NV	226AB				
CH-121	NV	226AB				
CH-310A	NV	RC				
CH-310B	NV	RC				
CH-358	XV	226AB				
CH-PA	MDP	CHPMRM	BUS-DS	480	SDBLDG	AC/SD
CH-PB	MDP	CHPMRM	BUS-E1	480	EEQUIPRM	AC/A
CH-PC	MDP	CHPMRM	BUS-E2	480	EEQUIPRM	AC/B

3.5 CONTAINMENT HEAT REMOVAL SYSTEMS

3.5.1 System Function

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

3.5.2 System Definition

The containment heat removal systems consists of two separate subsystems:

- Containment Spray System (CSS)
- Containment Air Recirculation Cooling (CARC) System

The CSS consists of two parallel redundant subsystems, each feeding one 360 degree spray ring header. Each CSS subsystem consists of one horizontal centrifugal pump drawing suction from the Refueling Water Storage Tank (RWST) during the injection phase of a LOCA and from the RHR pumps discharge during recirculation. The CARC system consists of four air handling units, each including air operated inlet louvers, roughing filters, cooling coils, fan and drive motor, duct distribution system, instrumentation, and controls. The cooling coils are supplied by the Service Water system.

Simplified drawings of the Containment Spray System are shown in Figures 3.5-1 and 3.5-2. The interface between the CARC units and the service water system is shown on the SW system drawings in Section 3.9. The interfaces are through motor operated valves CW-33A through CW-33F, and CW-34A through CW-34D. A summary of data on selected containment heat removal system components is presented in Table 3.5-1.

3.5.3 System Operation

Normally the CSS is in standby. The CSS is actuated on Hi-Hi containment pressure. The CSS pumps will start, and spray water from the RWST into the containment atmosphere. The contents of the spray additive tank (sodium hydroxide) are mixed with the spray stream to provide iodine removal from the containment atmosphere. Recirculation of water from the containment sump can be provided by diversion of a portion of the flow from the discharge of the RHR heat exchangers to the suction of the CSS pumps after injection from the RWST has been terminated.

The CARC units are normally in use during plant operation. The CARC system removes heat from the containment atmosphere by continuously recirculating the air-steam mixture through cooling coils to transfer heat to the service water system. There are two booster pumps in the service water supply paths to the CARC units. Each of the four fan cooler units is capable of transferring heat at a rate of 11,100 Btu/sec at design basis accident conditions. A gravity operated damper in the fan discharge opens automatically when the fan is started. Duct work distributes the cooled air to the various containment compartments and areas.

3.5.4 System Success Criteria

The containment heat removal function is satisfied by any of the following combinations of equipment (Ref. 1):

- all four containment cooling units
- both containment spray pumps providing spray
- 2 of 4 containment cooling units and 1 of 2 containment spray pumps operating

3.5.5 Component Information

A. Containment Spray Pumps A and B
   1. Rated flow: 1161 gpm @ unknown head
   2. Rated capacity: 50%
   3. Type: horizontal centrifugal

B. Containment Air Recirculation Cooler Units
   1. Design duty: 11,100 Btu/sec

3.5.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The CSS pumps are automatically actuated on coincidence of two sets of two out of three Hi-Hi containment pressure signals. An SI signal automatically starts any stopped fan cooler unit.
   2. Remote manual
      The CSS and CARC units can be actuated by remote manual means from the control room.

B. Motive Power
   1. The CSS pumps, CARC units, and related motor-operated valves are Class 1E AC loads that can be supplied from the standby diesel generators, as described in Section 3.7. Redundant loads are supplied from separate load groups.

C. Cooling Water
   1. The CSS pumps are cooled by the Component Cooling system (see Section 3.8).
   2. The CARC units are cooled by the Service Water system (see Section 3.9).

D. Other
   1. Lubrication, ventilation, and pump cooling are provided locally for the CSS pumps.

3.5.6 Section 3.5 References

1. H. B. Robinson 2 Updated Final Safety Analysis Report, Section 6.2.2.

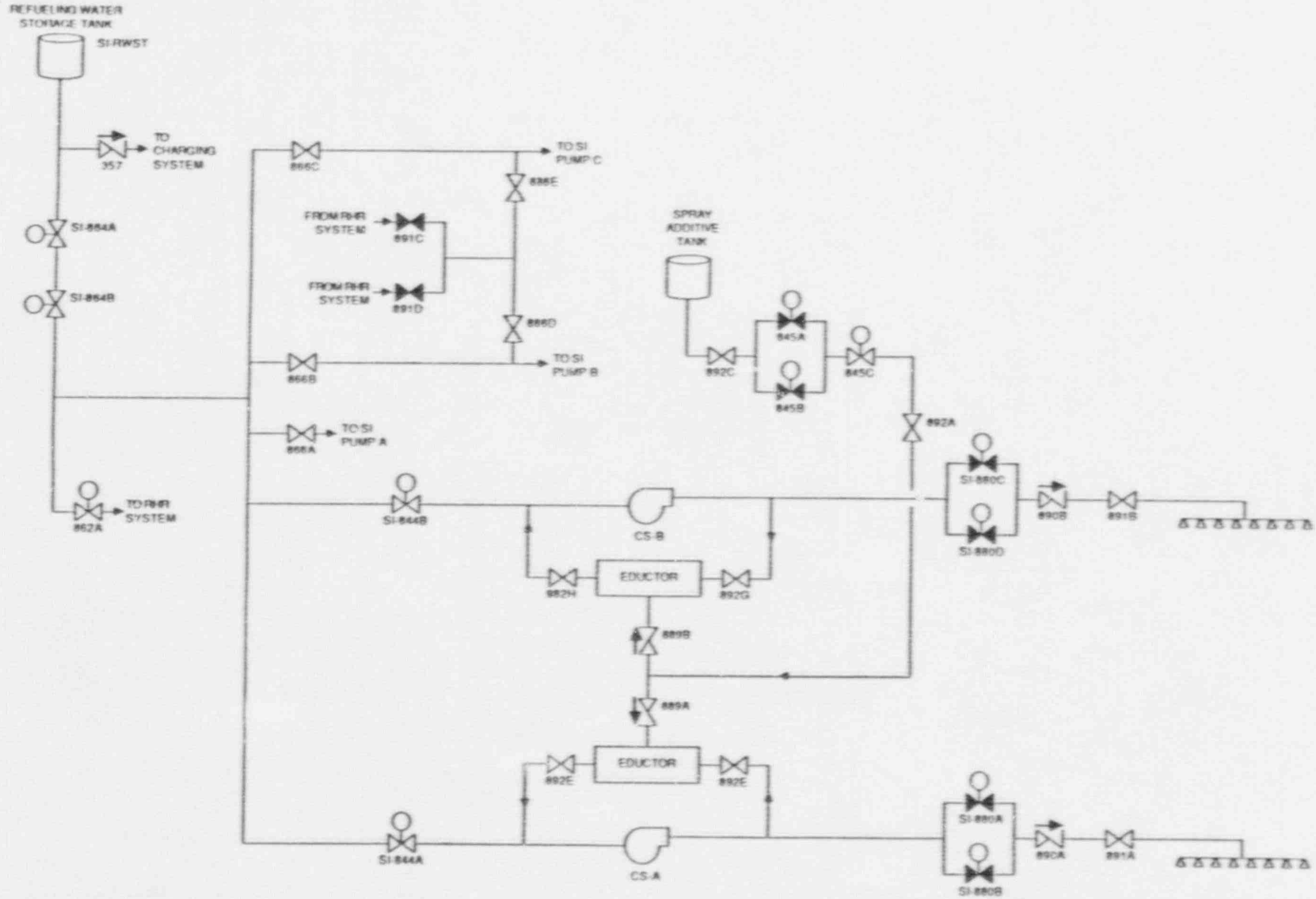


Figure 3.5-1. H.B. Robinson 2 Containment Spray System

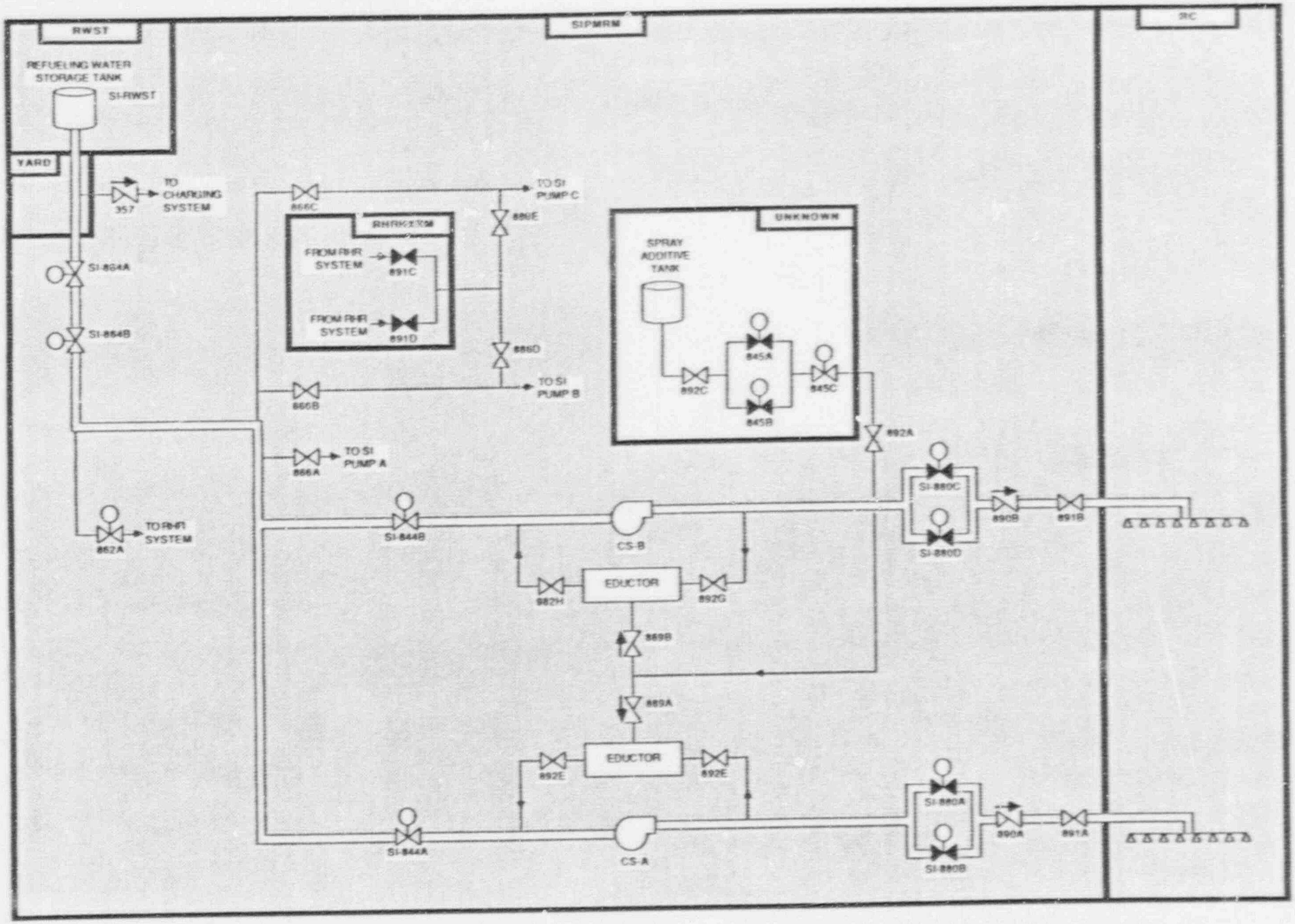


Figure 3.5-2. H.B. Robinson 2 Containment Spray System Showing Component Locations

Table 3.5-1. H. B. Robinson 2 Containment Heat Removal System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CARC-1	FAN	RC	BUS-E1	480	EEQUIPRM	AC/A
CARC-2	FAN	RC	BUS-E1	480	EEQUIPRM	AC/A
CARC-3	FAN	RC	BUS-E2	480	EEQUIPRM	AC/B
CARC-4	FAN	RC	BUS-E2	480	EEQUIPRM	AC/B
CS-A	MDP	SIPMRM	BUS-E1	480	EEQUIPRM	AC/A
CS-B	MDP	SIPMRM	BUS-E2	480	EEQUIPRM	AC/B
CW-33A	MOV	226AB	MCC5	480	MCC5	AC/A
CW-33B	MOV	226AB	MCC5	480	MCC5	AC/A
CW-33C	MOV	226AB	MCC6	480	EEQUIPRM	AC/B
CW-33D	MOV	226AB	MCC6	480	EEQUIPRM	AC/B
CW-33E	MOV	226AB	MCC5	480	MCC5	AC/A
CW-33F	MOV	226AB	MCC6	480	EEQUIPRM	AC/B
CW-34A	MOV	226AB	MCC5	480	MCC5	AC/A
CW-34B	MOV	226AB	MCC5	480	MCC5	AC/A
CW-34C	MOV	226AB	MCC6	480	EEQUIPRM	AC/B
CW-34D	MOV	226AB	MCC6	480	EEQUIPRM	AC/B
CW-BA	MDP	226AB	UNKNOWN			
CW-BB	MDP	226AB	UNKNOWN			
SI-844A	MOV	SIPMRM	MCC5	480	MCC5	AC/A
SI-844B	MOV	SIPMRM	MCC6	480	EEQUIPRM	AC/B
SI-880A	MOV	SIPMRM	MCC5	480	MCC5	AC/A
SI-880B	MOV	SIPMRM	MCC6	480	EEQUIPRM	AC/B
SI-880C	MOV	SIPMRM	MCC5	480	MCC5	AC/A
SI-880D	MOV	SIPMRM	MCC6	480	EEQUIPRM	AC/B

3.6 INSTRUMENTATION AND CONTROL (I & C) SYSTEMS

3.6.1 System Function

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

3.6.2 System Definition

The RTS includes sensor and transmitter units, logic units, and output trip relays that operate reactor trip circuit breakers to cause a reactor scram. The ESF 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 the ESF system. Operator instrumentation display systems consist of display panels in the control room that are powered by the 120 VAC electric power system (see Section 3.7). The remote shutdown capability is provided by remote panels and local equipment controls in conjunction with normal automatic systems.

3.6.3 System Operation

A. RTS

The Westinghouse RTS (or Reactor Protection System, RPS) has two to four redundant input instrument channels for each sensed parameter and two output actuation trains (A and B). The A and B logic trains independently generate a reactor trip command when prescribed parameters are outside the safe operating range. Either RTS train is capable of opening a separate and independent reactor trip circuit breaker to cause a scram. The manual scram A and B circuits bypass the RTS logic trains and send a reactor trip command directly to shunt trip circuitry in the reactor trip circuit breakers.

B. ESF Actuation System

The ESF actuation system has up to four input instrument channels for each sensed parameter, and two output actuation trains (A and B). In general, each train controls equipment powered from different Class 1E AC electrical buses. An individual component usually receives an actuation signal from only one ESF train. The ESF actuation system performs the following functions: (1) safety injection signal (SIS), (2) operation of containment cooling systems, (3) containment isolation, (4) main steam line isolation, (5) main feedwater line isolation, (6) start the AFW pumps, (7) service water system isolation from the Turbine Building, and (8) emergency diesel generator start. Although the FSAR does not explicitly state so, it is assumed that the ESF actuation system also causes a reactor trip, if one has not already been generated by the RPS and performs control room isolation. The control room operators can manually trip the various ESF logic subsystems. Details regarding ESF actuation logic are included in the system description for the actuated system.

C. Remote Shutdown

Local stop/start push button motor controls with a selector switch are provided at each of the following motors:

- Motor-Driven Auxiliary Feedwater Pumps
- Charging Pumps
- Boric Acid Transfer Pumps
- Component Cooling Water (CCW) Pump A for the DS system (at the charging pump room DS panel)
- Service Water Pump D for the DS system (at the charging pump room DS panel)

The selector switch will transfer control of the switchgear from the Control Room to the local station at the motor, or remote panel. Placing the local selector switch in the local operating position will actuate an annunciator alarm in the main control room.

Remote stop/start push button motor controls with a selector switch are provided for each of the following motors:

- Service Water Pumps
- Containment Air Recirculation Fans

These controls are grouped at two locations, as follows:

- Service Water Pumps A and B and Containment Air Recirculation Fans HVH-1 and 2 in the emergency switchgear room
- Service Water Pumps C and D and Containment Air Recirculation Fans HVH-3 and 4 in the Rod Drive Room

The selector switch will transfer control of the switchgear from the Control Room to the remote point. Placing the selector switch to local operation will initiate an annunciator alarm in the main control room and will turn out the motor control position lights on the Control Room panel.

Alternate motor control points are not required for the following:

- Component Cooling Water Pumps B and C. (Automatically restarted on a loss of offsite power once the diesel generators are operating.)
- Instrument Air Compressors and Cooling Pumps. (These will start automatically on low pressure in the air and water services, once the diesel automatically energizes the bus, and the motor control centers are manually energized. Instrument Air Compressors must be reset and restarted upon reenergizing motor control centers. The control point is local to the compressors.)

Speed control is provided locally for:

- Steam-Driven Auxiliary Feed Pump
- Charging Pumps

Valve control is provided locally for:

- Main Feed Regulators
- Main Feed Bypass Regulators
- Auxiliary Feed Control Valves. (These are located local to the auxiliary feed pumps and turbine building mezzanine DS panel)
- Steam generator power operated relief valves
- All other valves requiring operation during hot shutdown can be locally operated at the valve
- Letdown orifices isolation valves locally to the charging pumps which have local open and close buttons with selector switch and position lamp

Stop and start buttons with selector switch and position lamp locally in the Rod Drive Room adjacent to containment for two 450 kW backup heater groups.

3.6.4 System Success Criteria

A. RTS

The RTS uses hindrance logic (normal = 1, trip = 0) in both the input and output logic. Therefore, a channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e. the channel has a fail-safe failure mode). A reactor scram will occur upon loss of control power to the RTS. A reactor scram usually is implemented by the scram circuit breakers which must open in response to a scram signal. 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 H. B. Robinson 2 have not been determined (Ref. 2).

B. ESF Actuation System

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. An ESF actuation system typically uses 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 RTS. Details of the ESF actuation system for H. B. Robinson 2 have not been determined (Ref. 3).

C. Manually-Initiated Protective Actions

When reasonable time is available, certain protective actions may be performed manually by plant personnel. The control room operators are capable of operating individual components using normal control circuitry, or operating groups of components by manually tripping the RTS or an 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., a remote shutdown panel or a motor control center). To make these judgments, data on key plant parameters must be available to the operators.

3.6.5 Support Systems and Interfaces

A. Control Power

1. RPS
   The RPS input instrument channels are powered from the 120 VAC instrument buses (see Section 3.7). The RPS A and B output logic trains are powered from separate 125 VDC distribution panels.
2. ESF
   The ESF system input instrument channels are powered from 120 VAC instrument buses. The ESF A and B output logic trains are powered from separate 125 VDC distribution panels.
3. Operator Instrumentation
   Operator instrumentation displays are powered from the 120 VAC instrument buses.

3.6.6 Section 3.6 References

1. H.B. Robinson 2 Updated Final Safety Analysis Report, Section 7.4.1.1.4.

2. H.B. Robinson 2 Updated Final Safety Analysis Report, Section 7.2.1.

3. H.B. Robinson 2 Updated Final Safety Analysis Report, Section 7.3.1.

3.7 ELECTRIC POWER SYSTEM

3.7.1 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.

3.7.2 System Definition

The non-Class 1E portion of the onsite electric power system consists of four 4160 volt buses (1, 2, 3, and 4) and five 480 volt buses (1, 2A, 2B, 3 and 4). The onsite Class 1E electric power system consists of two 480 volt AC buses, designated E1 and E2. There are two standby diesel generators connected to the buses. Diesel generator A is connected to bus E1, and diesel generator B is connected to bus E2. Motor control centers 5 and 6 receive their power from buses E1 and E2, respectively, and supply power to motor operated valves in engineered safety systems.

Emergency power for vital instruments, control, and emergency lighting is supplied by two 125 VDC station batteries. The batteries energize two DC buses. There are eight 120 VAC instrument buses in the plant.

The 480 volt system also includes one dedicated shutdown bus, DS, that can be supplied from dedicated diesel generator DS. This is a non-safety related portion of the electric power system.

Simplified one-line diagrams of the electric power system are shown in Figures 3.7-1 and 3.7-2. A summary of data on selected electric power system components is presented in Table 3.7-1. A partial listing of electrical sources and loads is presented in Table 3.7-2.

3.7.3 System Operation

The onsite 4160 volt system is divided into four buses, as shown in Figure 3.7-1. During normal operation, buses 1, 2 and 4 are supplied from the output of the main generator via unit auxiliary transformer 2. Bus 3 is supplied from the 115 kV system via startup transformer 2. A main generator trip causes buses 1, 2 and 4 to be automatically transferred to the 115 kV system. Bus supply breakers and the tie breakers between 4160 volt buses 1 and 2, and between buses 3 and 4 are equipped with stored energy closing mechanisms to provide fast dead transfers.

The normal power sources for the Class 1E portion of the electric power system:

- 4160 VAC bus 2 and station service transformer 2A supply 480 VAC bus E1
- 4160 VAC bus 3 and station service transformer 2C supply 480 VAC bus E2 and the non-safety dedicated shutdown bus DS

The emergency sources of AC power are the diesel generators. The transfer from the normal power source to the diesel generators is accomplished automatically by opening the normal source circuit breakers and then reenergizing the Class 1E portion of the electric power system from the diesel generators. The dedicated shutdown diesel generator also will start automatically on loss of power at bus DS. The dedicated shutdown bus DS is an alternate source of power for Class E1 MCC-5.

The DC power system normally is supplied through the battery chargers, with the batteries "floating" on the system, maintaining a full charge. Upon loss of AC power, the entire DC load draws from the batteries. The batteries are sized to supply the expected shutdown loads for a period of eight hours without the use of the battery chargers.

The 120 VAC instrument supply is split into eight buses. Buses 1 and 4 are normally fed from 480 volt MCC-5 and MCC-6, respectively, via transformers. Buses 2 and 3 are normally fed from 125 VDC buses MCCA and MCCB, respectively, via inverters. Instrument buses 6, 7, 8, and 9 are fed from instrument buses 1, 2, 3, and 4, respectively.

Redundant safeguards equipment such as motor driven pumps and motor operated valves are supplied by different VAC buses. For the purpose of discussion, this equipment has been grouped into "load groups". Load group "AC/A" contains components receiving electric power either directly or indirectly from 480 bus E1. Load group "AC/B" contains components powered either directly or indirectly from 480 bus E2. Components receiving DC power are assigned to load groups "DC/1" or "DC/2", based on the battery power source.

3.7.4 System Success Criteria

Basic system success criteria for initigating 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 starting diesels A and B)
- Each Class 1E AC load group (buses E1 and E2) is isolated from the non-Class 1E system and is supplied from its respective emergency power source (i.e. diesel generator A and B)
- Power distribution paths to essential loads are intact
- Power to the battery chargers is restored before the batteries are exhausted

In order to maintain a hot shutdown condition, one diesel generator (A or B) must be operating. The capability of the dedicated shutdown diesel to maintain a long-term hot shutdown condition is not known.

3.7.5 Component Information

A. Standby diesel generators A and B
   1. Maximum continuous rating: 2500 kW
   2. 2 hour rating: 2750 kW
   3. Rated voltage: 480 VAC
   4. Manufacturer: Fairbanks Morse

B. Dedicated shutdown diesel generators DS
   1. Maximum continuous rating: 2450 kW
   2. Maximum power supply capability: 2000 kW (due to bus current capacity limitations)
   3. Rated voltage: 4160 VAC
   4. Manufacturer: unknown

C. Batteries (2)
   1. Rated voltage: 125 VDC
   2. Type: 60 cell
   3. Rated capacity: 8 hours with design loads

3.7.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The standby diesel generators A and B are automatically started based on:
      - Undervoltage on the normal bus
      - Safety injection signal (SIS, see Section 3.3)

   2. Remote manual
      Diesel generators A, B and DS can be started, and many distribution circuit breakers can be operated, from the main control room.

B. Diesel Generator A and B Auxiliary Systems
   1. Diesel Cooling Water System
      Diesel generator cooling water is supplied by the Service Water System, (see Section 3.9).
   2. Diesel Starting System
      Each diesel has an independent air starting system with sufficient air storage for eight cold starts. The respective station battery is required for diesel starting.
   3. Diesel Fuel Oil Transfer and Storage System
      A 275 gallon "day tank" supplies the relatively short-term (approximately 2 hours) fuel needs of each diesel. Each day tank is replenished from the 25,000 gallon storage tank during engine operation. The long-term fuel supply is sufficient for operating one diesel at full load for seven days. Additional fuel oil storage is available onsite if needed.
   4. Diesel Lubrication System
      Each diesel generator has its own lubrication system.
   5. Combustion Air Intake and Exhaust System
      This system supplies fresh air to the diesel intake via louvers in the diesel room wall. Diesel exhaust is directed outside of the diesel room via exhaust silencers on the roof.
   6. Diesel Room Ventilation System
      Each diesel room has an independent ventilation system consisting of supply and exhaust fans.

C. Diesel Generator DS
   1. Diesel Generator DS
      Diesel DS has a jacket cooling water system that rejects heat to the atmosphere via a radiator.
   2. Diesel Starting System
      An independent air starting system and starting battery is provided for diesel DS.
   3. Diesel Fuel Oil Transfer and Storage System
      Diesel DS is believed to have a fuel supply that is independent of diesels A and B, details have not been determined.
   4. Diesel Lubrication System
      Diesel DS is a skid-mounted unit that has an independent lubrication system.
   5. Combustion Air Intake and Exhaust System
      Details have not been determined.

6. Diesel Room Ventilation System
   The "diesel room" for diesel generator DS is an outdoor, weatherproof, skid mounted enclosure. Ventilation is provided by two ventilation fans powered from 480 VAC MCC 24 and power panel 51.

D. Switchgear and Battery Room Ventilation
   Details on the ventilation system serving the Class 1E switchgear and battery rooms have not been determined.

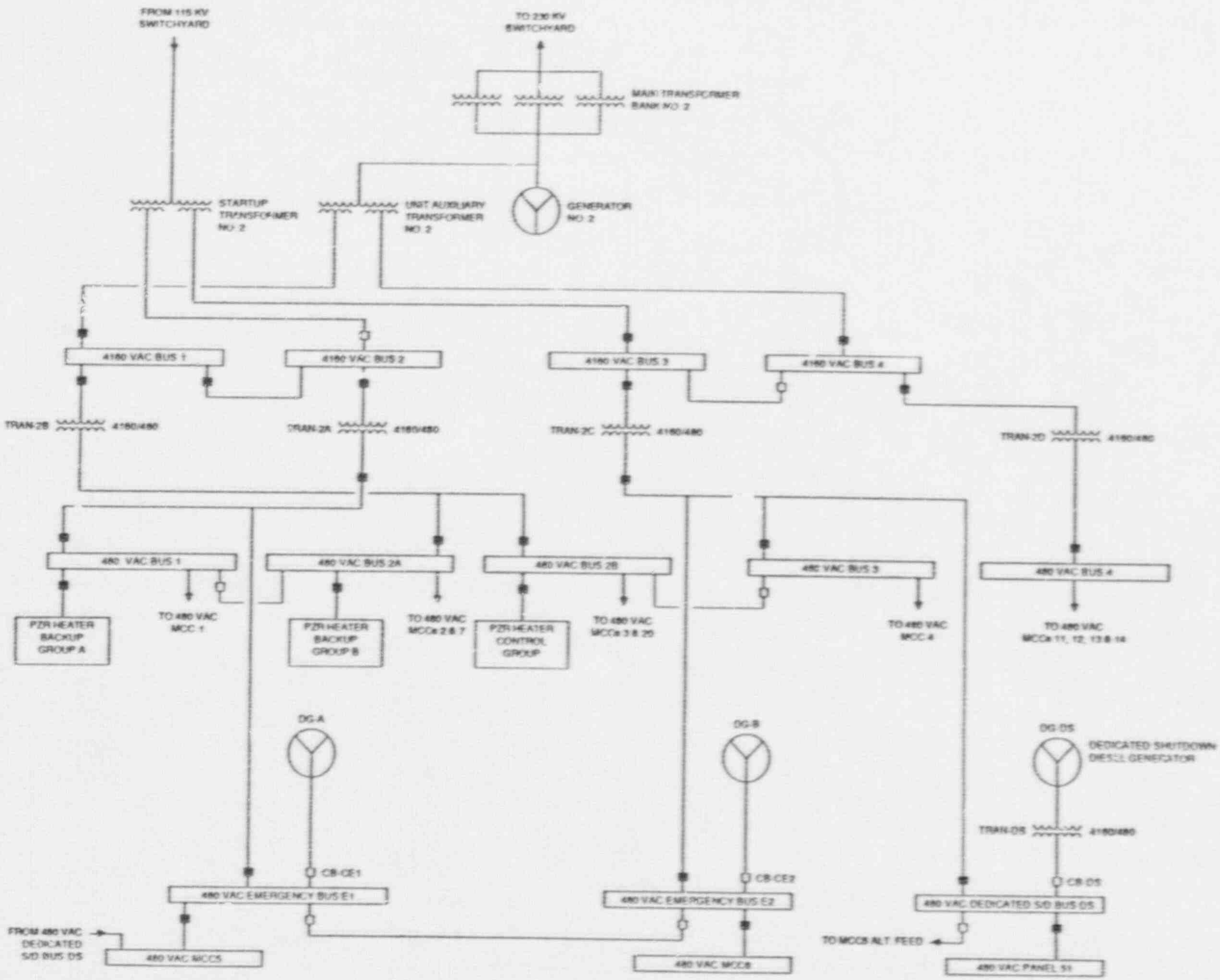


Figure 3.7-1. H.B. Robinson 2 4160 and 480 VAC Electric Power Distribution System

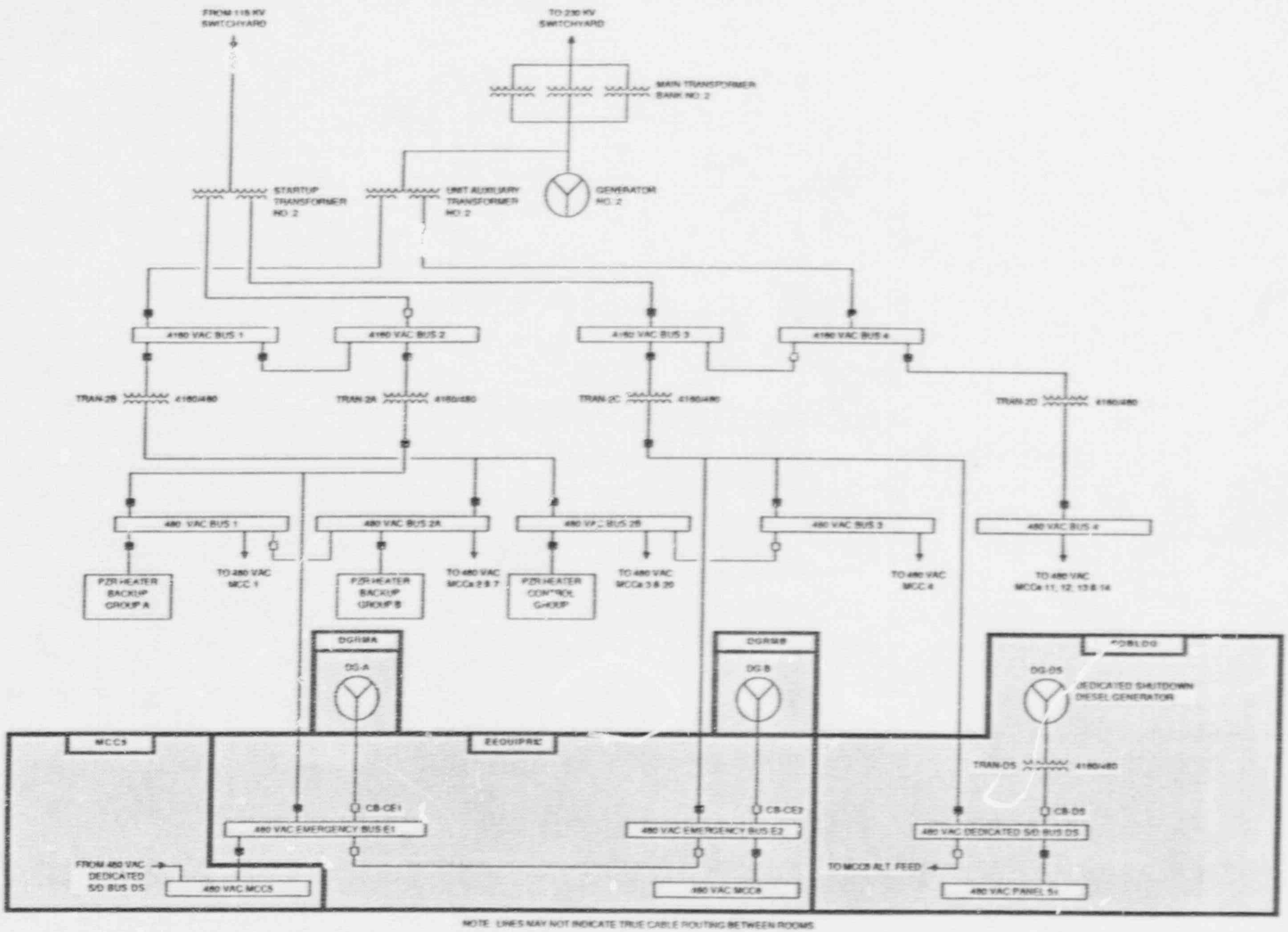


Figure 3.7-2. H.B. Robinson 2 4160 and 480 VAC Electric Power Distribution System Showing Component Locations

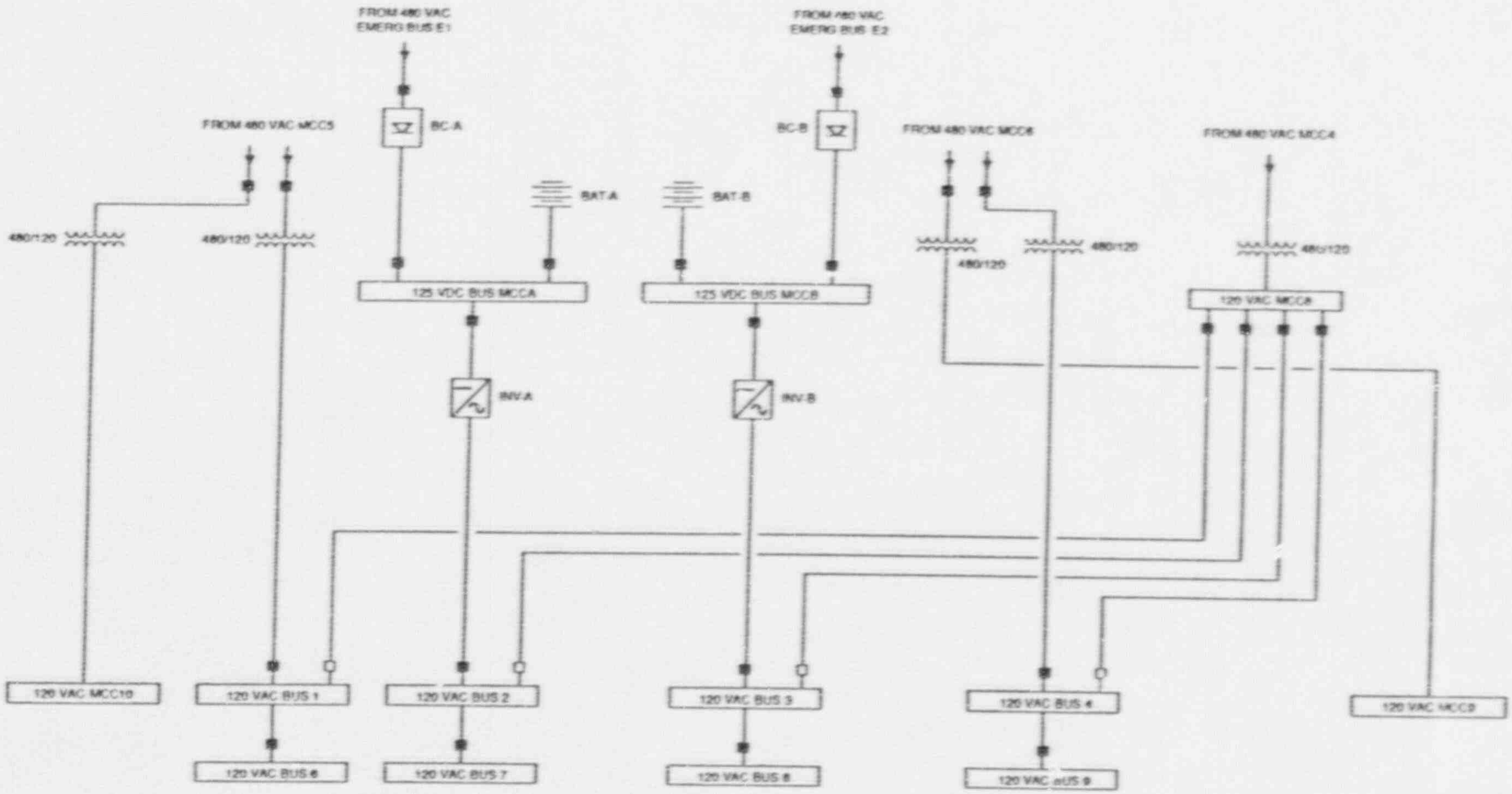
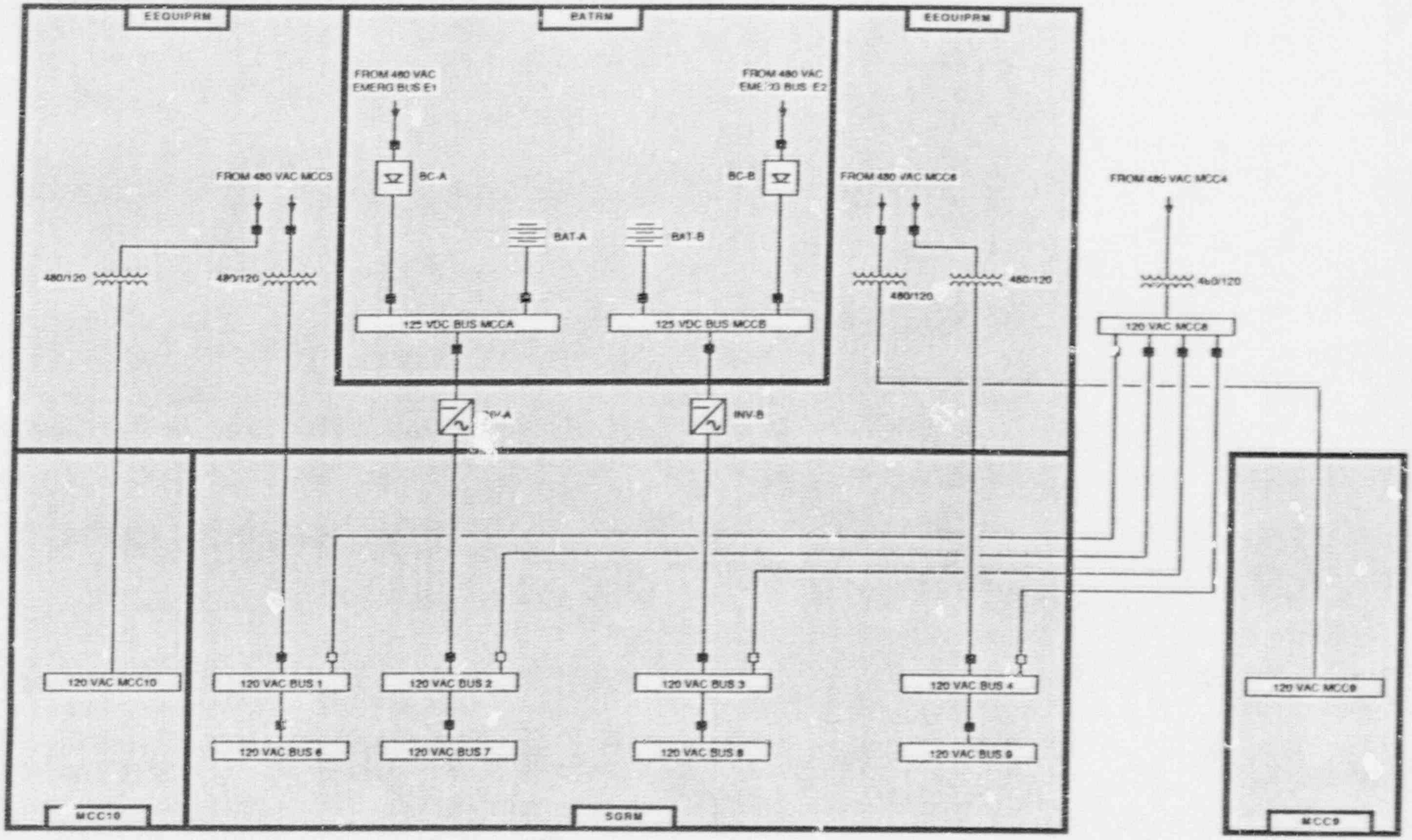


Figure 3.7-3. H.B. Robinson 2 125 VDC and 120 VAC Electric Power Distribution System



NOTE: LINES MAY NOT INDICATE TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.7-4. H.B. Robinson 2 125 VDC and 120 VAC Electric Power Distribution System Showing Component Locations

Table 3.7-1. H. B. Robinson 2 Electric Power System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
120 BUS-1	BUS	SGRM	MCC5	120	MCC5	AC/A
120 BUS-1	BUS	SGRM	MCC8	120	UNKNOWN	
120 BUS-2	BUS	SGRM	INV-A	120	EEQUIPRM	AC/A
120 BUS-2	BUS	DGRM	MCC8	120	UNKNOWN	
120 BUS-3	BUS	SGRM	INV-B	120	EEQUIPRM	AC/B
120 BUS-3	BUS	DGRM	MCC8	120	UNKNOWN	
120 BUS-4	BUS	SGRM	MCC6	120	EEQUIPRM	AC/B
120 BUS-4	BUS	SGRM	MCC8	120	UNKNOWN	
120 BUS-6	BUS	SGRM	120 BUS-1	120	SGRM	AC/A
120 BUS-7	BUS	SGRM	120 BUS-2	120	SGRM	AC/A
120 BUS-8	BUS	SGRM	120 BUS-3	120	SGRM	AC/B
120 BUS-9	BUS	SGRM	120 BUS-4	120	SGRM	AC/B
BAT-A	BATT	BATRM		125		DC/A
BAT-B	BATT	BATRM		125		DC/B
BC-A	BC	BATRM	BUS-E1	125	EEQUIPRM	DC/A
BC-B	BC	BATRM	BUS-E2	125	EEQUIPRM	DC/B
BUS-DS	BUS	SDBLDG	TRAN-DS	480	SDBLDG	AC/SD
BUS-DS	BUS	SDBLDG	TRAN-2C	480	UNKNOWN	OSP
BUS-E1	BUS	EEQUIPRM	DG-A	480	DGRMA	AC/A
BUS-E2	BUS	EEQUIPRM	DG-B	480	DGRMB	AC/B
BUS-F1	BUS	EEQUIPRM	TRAN-2A	480	UNKNOWN	OSP
BUS-F2	BUS	EEQUIPRM	TRAN-2C	480	UNKNOWN	OSP
BUS-MCCA	BUS	BATRM	BAT-A	125	BATRM	DC/A
BUS-MCCA	BUS	BATRM	BC-A	125	BATRM	DC/A
BUS-MCCB	BUS	BATRM	BAT-B	125	BATRM	DC/B
BUS-MCCB	BUS	BATRM	BC-B	125	BATRM	DC/B
CB-CE1	CB	EEQUIPRM	DG-A	480	DGRMA	AC/A

Table 3.7-1. H. B. Robinson 2 Electric Power System Data Summary for Selected Components (Continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CB-CF2	CB	EEQUIPRM	DG-B	480	DGRMB	AC/B
[illegible]	CB	SDBLDG	TRAN-DS	480	SDBLDG	AC/SD
DG-A	DG	DGRMA		480		AC/A
DG-B	DG	DGRMB		480		AC/B
DG-DS	DG	SDBLDG		4160		AC/SD
INV-A	INV	EEQUIPRM	BUS-MCCA	125	BATRM	DC/A
INV-B	INV	EEQUIPRM	BUS-MCCB	125	BATRM	DC/B
MCC10	MCC	MCC10	MCC5	120	MCC5	AC/A
MCC5	MCC	MCC5	BUS-E1	480	EEQUIPRM	AC/A
MCC5	MCC	MCC5	BUS-DS	480	SDBLDG	AC/SD
MCC6	MCC	EEQUIPRM	BUS-E2	480	EEQUIPRM	AC/B
MCC9	MCC	MCC9	MCC8	120	EEQUIPRM	AC/B
PNL-51	MCC	SDBLDG	BUS-DS	480	SDBLDG	AC/SD
TRAN-DS	TRAN	SDBLDG	DG-DS	480	SDBLDG	AC/SD

Table 3.7-2. Partial Listing of Electrical Sources and Loads at H. B. Robinson 2

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
120 BUS-1	120	AC/A	SGRM	EP	120 BUS-6	BUS	SGRM
120 BUS-2	120	AC/A	SGRM	EP	120 BUS-7	BUS	SGRM
120 BUS-3	120	AC/B	SGRM	EP	120 BUS-8	BUS	SGRM
120 BUS-4	120	AC/B	SGRM	EP	120 BUS-9	BUS	SGRM
BAT-A	125	DC/A	BATRM	EP	BUS-MCCA	BUS	BATRM
BAT-B	125	DC/B	BATRM	EP	BUS-MCCB	BUS	BATRM
BC-A	125	DC/A	BATRM	EP	BUS-MCCA	BUS	BATRM
BC-B	125	DC/B	BATRM	EP	BUS-MCCB	BUS	BATRM
BUS-DS	480	AC/SD	SDBLDG	CCS	CC-A	MDP	CCHXRM
BUS-DS	480	AC/SD	SDBLDG	CVCS	CH-PA	MDP	CHPMRM
BUS-DS	480	AC/SD	SDBLDG	EP	MCC5	MCC	MCC5
BUS-DS	480	AC/SD	SDBLDG	EP	PNL-51	MCC	SDBLDG
BUS-DS	480	AC/SD	SDBLDG	SW	CW-PD	MDP	SWPMRM
BUS-E1	480	AC/A	EEQUIPRM	AFW	AFW-A	MDP	AFWPMRM
BUS-E1	480	AC/A	EEQUIPRM	CCS	CC-B	MDP	CCHXRM
BUS-E1	480	AC/A	EEQUIPRM	CVCS	CH-PB	MDP	CHPMRM
BUS-E1	480	AC/A	EEQUIPRM	ECCS	RH-A	MDP	RHRPITA
BUS-E1	480	AC/A	EEQUIPRM	ECCS	SI-A	MDP	SIPMRM
BUS-E1	480	AC/A	EEQUIPRM	ECCS	SI-A	MDP	SIPMRM
BUS-E1	480	AC/A	EEQUIPRM	ECCS	SI-B	MDP	SIPMRM
BUS-E1	480	AC/A	EEQUIPRM	ECCS	SI-B	MDP	SIPMRM
BUS-E1	480	AC/A	EEQUIPRM	EP		MDP	SWPMRM
BUS-E1	480	AC/A	EEQUIPRM	EP		MDP	SWPMRM
BUS-E1	480	AC/A	EEQUIPRM	EP		MDP	SWPMRM
BUS-E1	480	AC/A	EEQUIPRM	EP		MDP	SWPMRM
BUS-E1	125	DC/A	EEQUIPRM	EP	BC-A	BC	BATRM
BUS-E1	480	AC/A	EEQUIPRM	EP	MCC5	MCC	MCC5
BUS-E1	480	AC/A	EEQUIPRM	PAHRS	CARC-1	FAN	RC
BUS-E1	480	AC/A	EEQUIPRM	PAHRS	CARC-2	FAN	RC
BUS-E1	480	AC/A	EEQUIPRM	PAHRS	CS-A	MDP	SIPMRM
BUS-E1	480	AC/A	EEQUIPRM	SW	CW-PA	MDP	SWPMRM

Table 3.7-2. Partial Listing of Electrical Sources and Loads at H. B. Robinson 2 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
BUS-E1	480	AC/A	EEQUIPRM	SW	CW-PB	MDP	SWPMRM
BUS-E2	480	AC/B	EEQUIPRM	AFW	AFW-B	MDP	AFWPMRM
BUS-E2	480	AC/B	EEQUIPRM	CCS	CC-C	MDP	CCHXRM
BUS-E2	480	AC/B	EEQUIPRM	CVCS	CH-PC	MDP	CHPMRM
BUS-E2	480	AC/B	EEQUIPRM	ECCS	RH-B	MDP	RHRPITB
BUS-E2	480	AC/B	EEQUIPRM	ECCS	S[illegible]	MDP	SIPMRM
BUS-E2	480	AC/B	EEQUIPRM	ECCS	SI-B	MDP	SIPMRM
BUS-E2	480	AC/B	EEQUIPRM	ECCS	SI-C	MDP	SIPMRM
BUS-E2	480	AC/B	EEQUIPRM	ECCS	SI-C	MDP	SIPMRM
BUS-E2	480	AC/B	EEQUIPRM	EP		MDP	SWPMRM
BUS-E2	480	AC/B	EEQUIPRM	EP		MDP	SWPMRM
BUS-E2	480	AC/B	EEQUIPRM	EP		MDP	SWPMRM
BUS-E2	180	AC/B	EEQUIPRM	EP		MDP	SWPMRM
BUS-E2	125	DC/B	EEQUIPRM	EP	BC-B	BC	BATRM
BUS-E2	480	AC/B	EEQUIPRM	EP	MCC6	MCC	EEQUIPRM
BUS-E2	480	AC/B	EEQUIPRM	PAHRS	CARC-3	FAN	RC
BUS-E2	480	AC/B	EEQUIPRM	PAHRS	CARC-4	FAN	RC
BUS-E2	480	AC/B	EEQUIPRM	PAHRS	CS-B	MDP	SIPMRM
BUS-E2	480	AC/B	EEQUIPRM	SW	CW-PC	MDP	SWPMRM
BUS-E2	480	AC/B	EEQUIPRM	SW	CW-PD	MDP	SWPMRM
BUS-MCCA	125	DC/A	BATRM	EP	INV-A	INV	EEQUIPRM
BUS-MCCB	125	DC/B	BATRM	EP	INV-B	INV	EEQUIPRM
DG-A	480	AC/A	DGRMA	EP	BUS-E1	BUS	EEQUIPRM
DG-A	480	AC/A	DGRMA	EP	CB-CE1	CB	EEQUIPRM
DG-B	480	AC/B	DGRMB	EP	BUS-E2	BUS	EEQUIPRM
DG-B	480	AC/B	DGRMB	EP	CB-CE2	CB	EEQUIPRM
DG-DS	480	AC/SD	SDBLDG	EP	TRAN-DS	TRAN	SDBLDG
INV-A	120	AC/A	EEQUIPRM	EP	120 BUS-2	BUS	SGRM
INV-B	120	AC/B	EEQUIPRM	EP	120 BUS-3	BUS	SGRM
MCC10	120	AC/A	MCC10	AFW	AFW-14A	MOV	PPMAZE
MCC10	120	AC/A	MCC10	AFW	AFW-14C	MOV	PPMAZE

Table 3.7-2. Partial Listing of Electrical Sources and Loads at H. B. Robinson 2 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC10	120	AC/A	MCC10	AFW	AFW-16A	MOV	AFWPMRM
MCC10	120	AC/A	MCC10	AFW	AFW-16B	MOV	AFWPMRM
MCC10	120	AC/A	MCC10	AFW	AFW-20B	MOV	AFWPMRM
MCC5	480	AC/A	MCC5	AFW	AFW-8A	MOV	PPMAZE
MCC5	480	AC/A	MCC5	ECCS	SI-860A	MOV	RHRPITA
MCC5	480	AC/A	MCC5	ECCS	SI-861A	MOV	RHRPITA
MCC5	480	AC/A	MCC5	ECCS	SI-864A	MOV	SIPMRM
MCC5	480	AC/A	MCC5	ECCS	SI-866B	MOV	RC
MCC5	480	AC/A	MCC5	ECCS	SI-866B	MOV	RC
MCC5	480	AC/A	MCC5	ECCS	SI-867A	MOV	BIRM
MCC5	480	AC/A	MCC5	ECCS	SI-867A	MOV	BIRM
MCC5	480	AC/A	MCC5	ECCS	SI-869	MOV	PPTUN
MCC5	480	AC/A	MCC5	ECCS	SI-869	MOV	PPTUN
MCC5	480	AC/A	MCC5	ECCS	SI-870A	MOV	BIRM
MCC5	480	AC/A	MCC5	ECCS	SI-870A	MOV	BIRM
MCC5	480	AC/A	MCC5	ECCS	SI-878A	MOV	SIPMRM
MCC5	480	AC/A	MCC5	ECCS	SI-878A	MOV	SIPMRM
MCC5	480	AC/A	MCC5	EP		MOV	CCHXRM
MCC5	480	AC/A	MCC5	EP		MOV	CCHXRM
MCC5	120	AC/A	MCC5	EP	120 BUS-1	BUS	SGRM
MCC5	120	AC/A	MCC5	EP	MCC10	MCC	MCC10
MCC5	480	AC/A	MCC5	PAHRS	CW-33A	MOV	226AB
MCC5	480	AC/A	MCC5	PAHRS	CW-33B	MOV	226AB
MCC5	480	AC/A	MCC5	PAHRS	CW-33E	MOV	226AB
MCC5	480	AC/A	MCC5	PAHRS	CW-34A	MOV	226AB
MCC5	480	AC/A	MCC5	PAHRS	CW-34B	MOV	226AB
MCC5	480	AC/A	MCC5	PAHRS	SI-844A	MOV	SIPMRM
MCC5	480	AC/A	MCC5	PAHRS	SI-880A	MOV	SIPMRM
MCC5	480	AC/A	MCC5	PAHRS	SI-880C	MOV	SIPMRM
MCC5	480	AC/A	MCC5	RCS	RCS-750	MOV	RC
MCC5	480	AC/A	MCC5	SW	CW-12A	MOV	VVPIT

Table 3.7-2. Partial Listing of Electrical Sources and Loads at H. B. Robinson 2 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC5	480	AC/A	MCC5	SW	CW-12B	MOV	SWPMRM
MCC5	480	AC/A	MCC5	SW	CW-16A	MOV	CCHXRM
MCC5	480	AC/A	MCC5	SW	CW-16A	MOV	CCHXRM
MCC6	480	AC/B	EEQUIPRM	AFW	AFW-8B	MOV	PPMAZE
MCC6	480	AC/B	EEQUIPRM	AFW	AFW-8C	MOV	PPMAZE
MCC6	480	AC/B	EEQUIPRM	ECCS	SI-860B	MOV	RHRPITB
MCC6	480	AC/B	EEQUIPRM	ECCS	SI-861B	MOV	RHRPITB
MCC6	480	AC/B	EEQUIPRM	ECCS	SI-864B	MOV	SIPMRM
MCC6	480	AC/B	EEQUIPRM	ECCS	SI-866A	MOV	RC
MCC6	480	AC/B	EEQUIPRM	ECCS	SI-866A	MOV	RC
MCC6	480	AC/B	EEQUIPRM	ECCS	SI-867B	MOV	BIRM
MCC6	480	AC/B	EEQUIPRM	ECCS	SI-867B	MOV	BIRM
MCC6	480	AC/B	EEQUIPRM	ECCS	SI-870B	MOV	BIRM
MCC6	480	AC/B	EEQUIPRM	ECCS	SI-870B	MOV	BIRM
MCC6	480	AC/B	EEQUIPRM	ECCS	SI-878B	MOV	SIPMRM
MCC6	480	AC/B	EEQUIPRM	ECCS	SI-878B	MOV	SIPMRM
MCC6	480	AC/B	EEQUIPRM	EP		MOV	CCHXRM
MCC6	480	AC/B	EEQUIPRM	EP		MOV	CCHXRM
MCC6	480	AC/B	EEQUIPRM	EP		MOV	CCHXRM
MCC6	480	AC/B	EEQUIPRM	EP		MOV	CCHXRM
MCC6	120	AC/B	EEQUIPRM	EP	120 BUS-4	BUS	SGRM
MCC6	480	AC/B	EEQUIPRM	PAHRS	CW-33C	MOV	226AB
MCC6	480	AC/B	EEQUIPRM	PAHRS	CW-33D	MOV	226AB
MCC6	480	AC/B	EEQUIPRM	PAHRS	CW-33F	MOV	226AB
MCC6	480	AC/B	EEQUIPRM	PAHRS	CW-34C	MOV	226AB
MCC6	480	AC/B	EEQUIPRM	PAHRS	CW-34D	MOV	226AB
MCC6	480	AC/B	EEQUIPRM	PAHRS	SI-844B	MOV	SIPMRM
MCC6	480	AC/B	EEQUIPRM	PAHRS	SI-880B	MOV	SIPMRM
MCC6	480	AC/B	EEQUIPRM	PAHRS	SI-880D	MOV	SIPMRM
MCC6	480	AC/B	EEQUIPRM	RCS	RCS-535	MOV	RC
MCC6	480	AC/B	EEQUIPRM	RCS	RCS-536	MOV	RC

Table 3.7-2. Partial Listing of Electrical Sources and Loads at H. B. Robinson 2 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC6	480	AC/B	EEQUIPRM	RCS	RCS-751	MOV	RC
MCC6	480	AC/B	EEQUIPRM	SW	CW-12C	MOV	SWPMRM
MCC6	480	AC/B	EEQUIPRM	SW	CW-12D	MOV	VVPIT
MCC6	480	AC/B	EEQUIPRM	SW	CW-16B	MOV	CCHXRM
MCC6	480	AC/B	EEQUIPRM	SW	CW-16B	MOV	CCHXRM
MCC6	480	AC/B	EEQUIPRM	SW	CW-16C	MOV	CCHXRM
MCC8	120		UNKNOWN	EP	120 BUS-1	BUS	SGRM
MCC8	120		UNKNOWN	EP	120 BUS-2	BUS	DGRM
MCC8	120		UNKNOWN	EP	120 BUS-3	BUS	DGRM
MCC8	120		UNKNOWN	EP	120 BUS-4	BUS	SGRM
MCC8	120	AC/B	EEQUIPRM	EP	MCC9	MCC	MCC9
MCC9	120	AC/B	MCC9	AFW	AFW-14B	MOV	PPMAZE
MCC9	120	AC/B	MCC9	AFW	AFW-16C	MOV	AFWPMRM
MCC9	120	AC/B	MCC9	AFW	AFW-20A	MOV	AFWPMRM
TRAN-2A	480	OSP	UNKNOWN	EP	BUS-F1	BUS	EEQUIPRM
TRAN-2C	480	OSP	UNKNOWN	EP	BUS-DS	BUS	SDBLDG
TRAN-2C	480	OSP	UNKNOWN	EP	BUS-F2	BUS	EEQUIPRM
TRAN-DS	480	AC/SD	SDBLDG	EP	BUS-DS	BUS	SDBLDG
TRAN-DS	480	AC/SD	SDBLDG	EP	CB-DS	CB	SDBLDG
UNKNOWN				PAHRS	CW-BA	MDP	226AB
UNKNOWN				PAHRS	CW-BB	MDP	226AB

3.8 COMPONENT COOLING SYSTEM (CCS)

3.8.1 System Function

The CCS, part of the Auxiliary Coolant System, provides cooling water to various plant components during normal operation, plant shutdown, and after an accident to act as an intermediate system between the components being cooled and the Service Water system. Separation is required to minimize the possible release of radioactive material. The CCS also serves to remove residual and sensible heat from the RCS during plant shutdown by cooling the RHR heat exchangers, and to cool the letdown flow from the CVCS during power operation.

3.8.2 System Definition

The CCS is a closed loop system consisting of three motor driven pumps, two heat exchangers, one surge tank, and associated piping and valves. The heat loads in the plant that are cooled by the CCS are served by piping coming off the main loop. The heat exchangers transfer heat to the Service Water system. The surge tank accommodates expansion, contraction, and in-leakage of water.

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

3.8.3 System Operation

During normal operation, one component cooling pump and one heat exchanger accommodate the heat removal loads. The remaining two pumps and one heat exchanger serve as backups. During plant shutdown three pumps and two heat exchangers are utilized to remove the residual and sensible heat. If one of the pumps or heat exchangers is not operative safe shutdown is not affected, but the time for cooldown is extended. Cooling water is circulated by the pumps through the shell side of the heat exchangers to the components being cooled, then back to the pump suction. Demineralized or primary water can be supplied to the system into the surge tank as a source of makeup water.

Heat loads supported by the CCS include the following:

- RHR heat exchangers and pumps
- Safety injection pumps
- Containment spray pumps
- Charging pumps
- Spent fuel pit heat exchanger
- Non-regenerative heat exchanger

Component cooling is also provided for additional components, such as the reactor coolant pumps and other components of the Chemical and Volume Control System.

3.8.4 System Success Criteria

Following a LOCA the success criteria for the CCS are (Ref. 1):

- 1 of 3 CCS pumps operating, and
- 1 of 2 CCS heat exchangers available and being cooled by the service water system

3.8.5 Component Information

A. Component Cooling Water Pumps A, B, and C
   1. Rated flow: 6000 gpm @ 180 ft head (78 psid)
   2. Rated capacity: 100%
   3. Type: horizontal centrifugal

B. Component Cooling Heat Exchangers A and B
   1. Design duty: 29.4×10^6 Btu/hr
   2. Type: shell and straight tube

3.8.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The CCS pumps are not automatically actuated.
   2. Remote Manual
      The CCS pumps can be actuated by remote manual means from the control room.

B. Motive Power
   1. CCS pumps B and C are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.7. CCS pump A is supplied from the dedicated shutdown bus.

C. Other
   1. The CCS heat exchangers are cooled by the Service Water system.
   2. Lubrication, ventilation, and cooling are provided locally for the CCS pumps.

3.8.7 Section 3.8 References

1. H. B. Robinson 2 Updated Final Safety Analysis Report, Section 9.2.2.3.2.

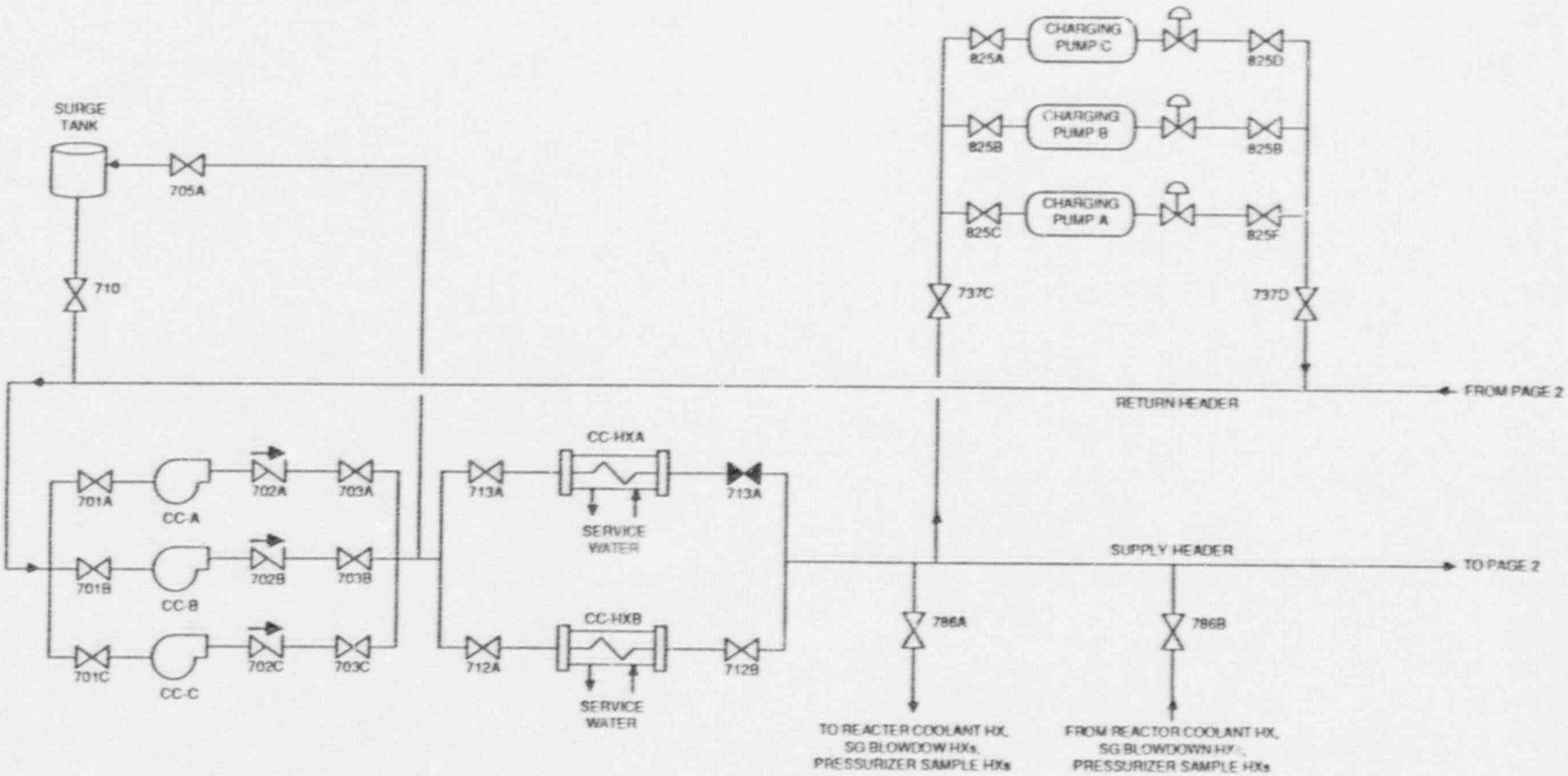


Figure 3.8-1. H.B. Robinson 2 Auxiliary Coolant Component Cooling System (Page 1 of 2)

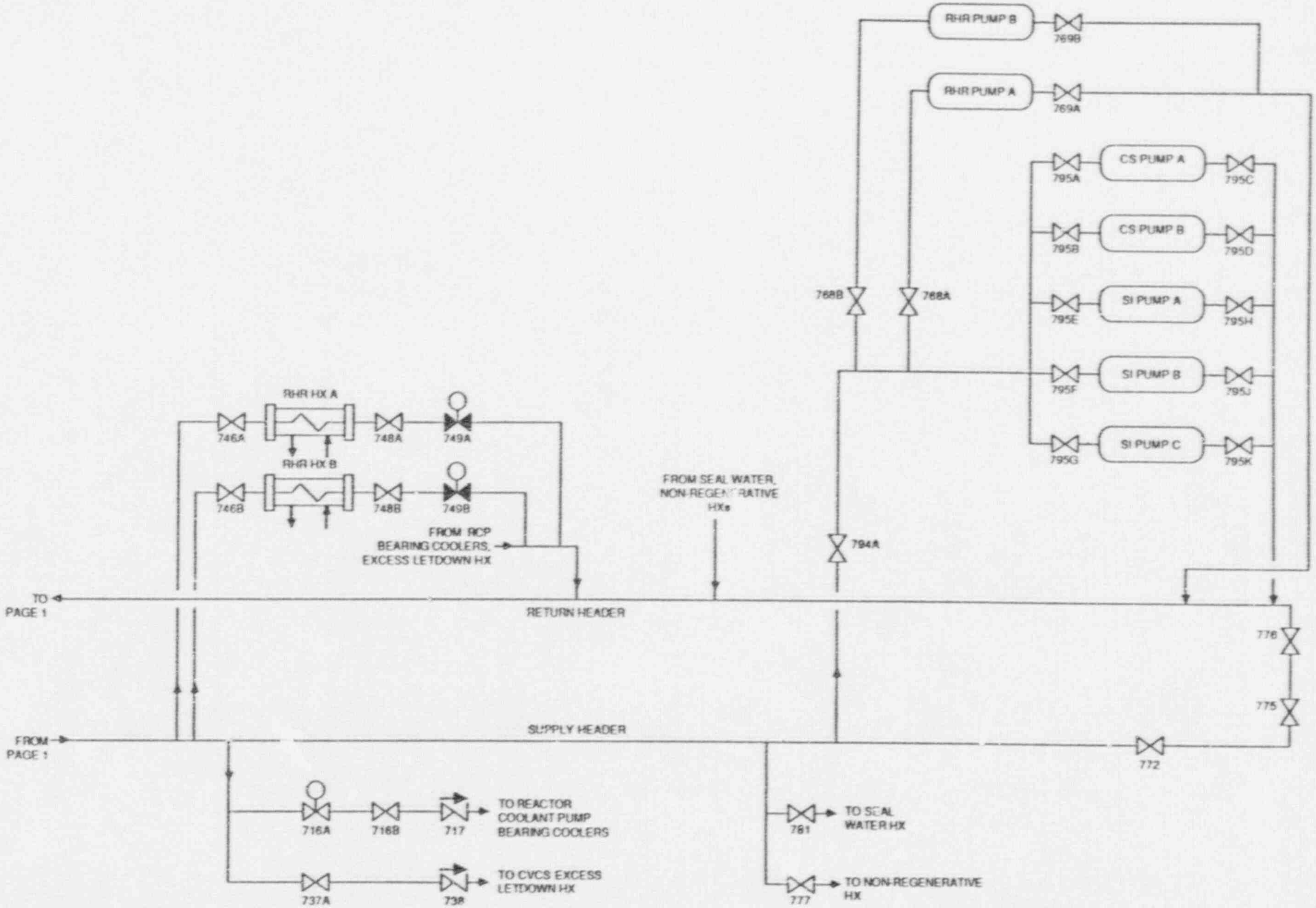


Figure 3.8-1. H.B. Robinson 2 Auxiliary Coolant Component Cooling System (Page 2 of 2)

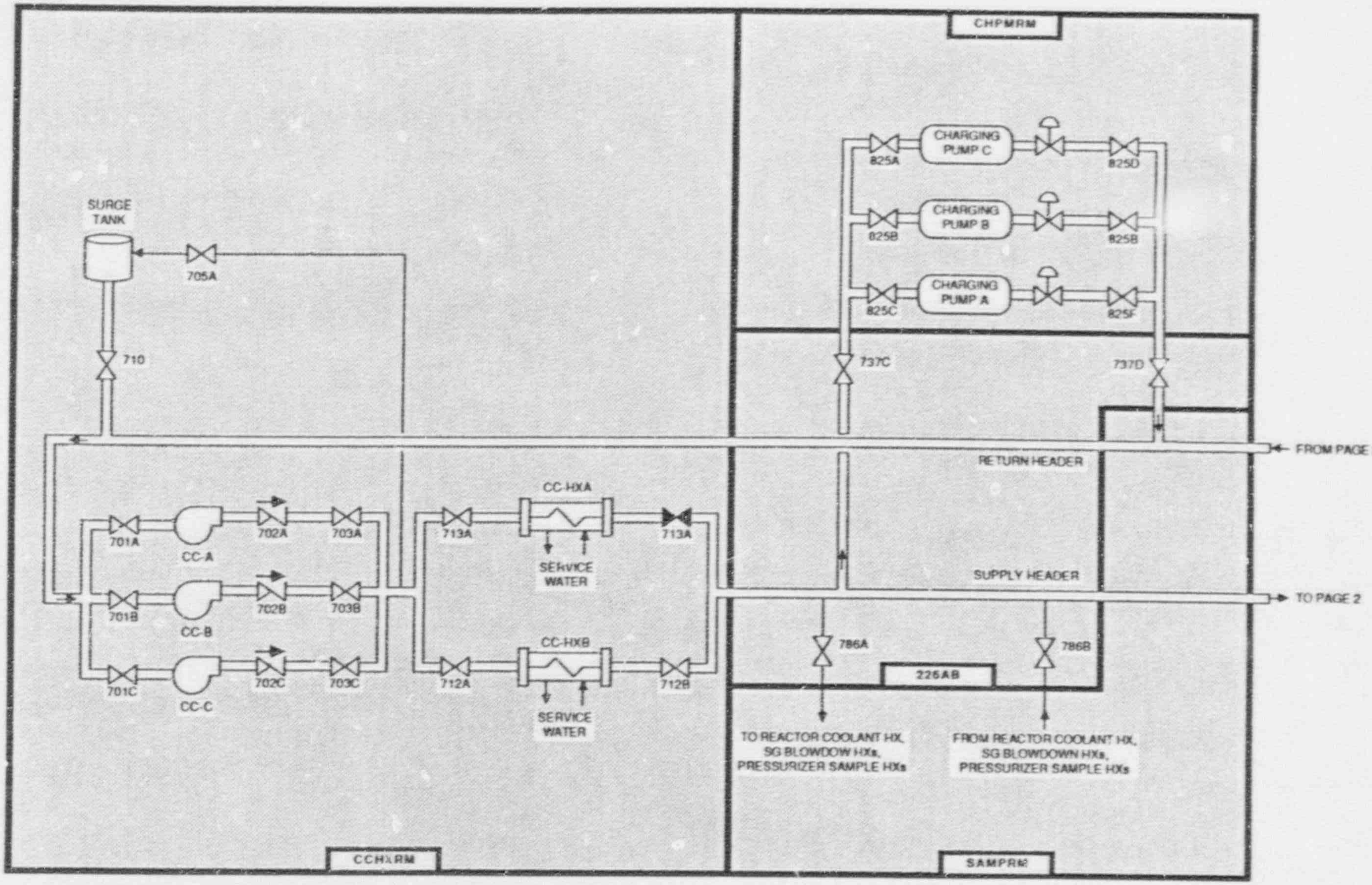


Figure 3.8-2. H.B. Robinson 2 Auxiliary Coolant Component Cooling System Showing Component Locations (Page 1 of 2)

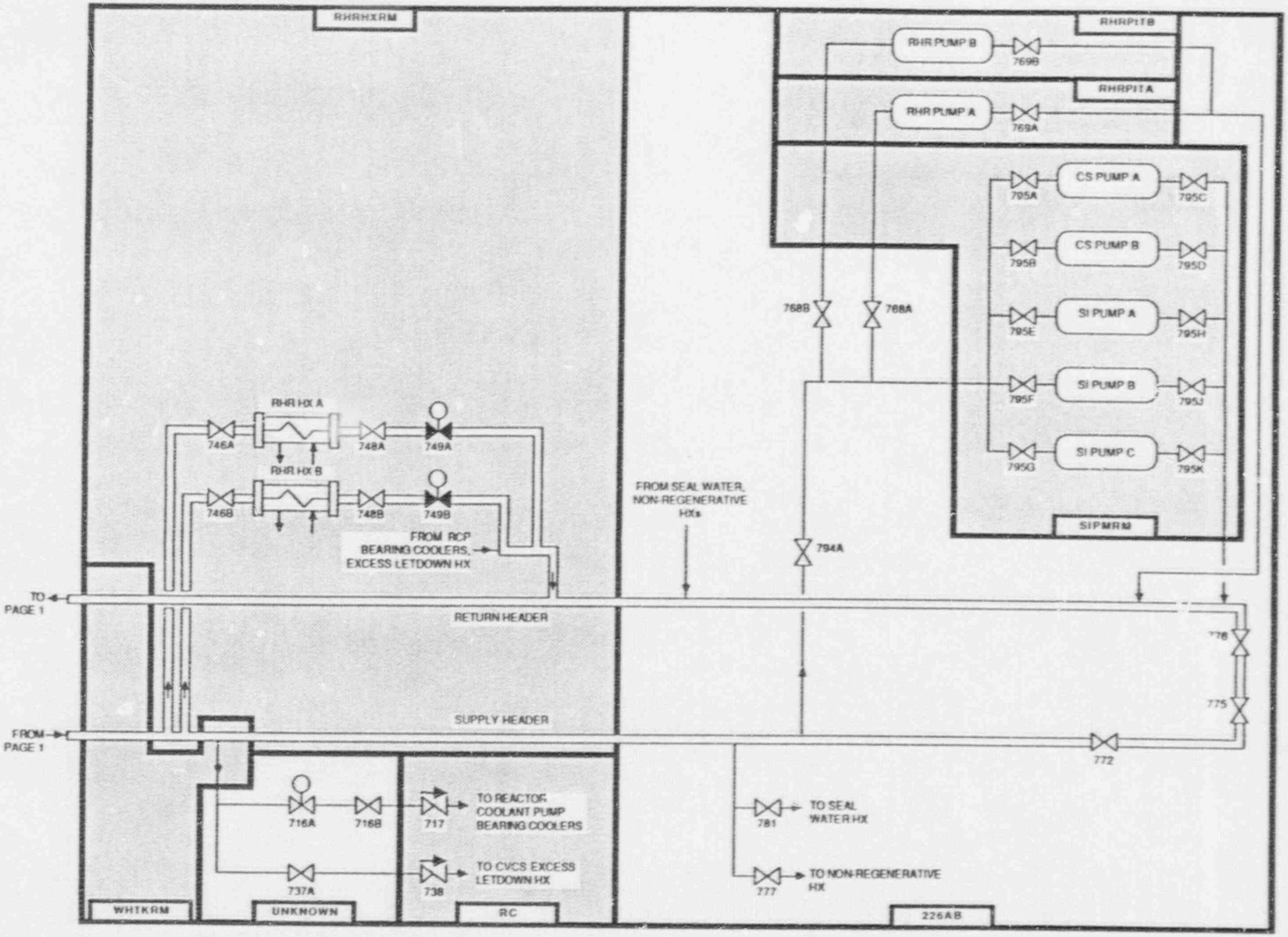


Figure 3.8-2. H.B. Robinson 2 Auxiliary Coolant Component Cooling System Showing Component Locations (Page 2 of 2)

Table 3.8-1. H. B. Robinson 2 Auxiliary Coolant Component Cooling System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CC-A	MDP	CCHXRM	BUS-DS	480	SDBLDG	AC/SD
CC-B	MDP	CCHXRM	BUS-E1	480	EEQUIPRM	AC/A
CC-C	MDP	CCHXRM	BUS-E2	480	EEQUIPRM	AC/B
CC-HXA	HX	CCHXRM				
CC-HXB	HX	CCHXRM				

3.9 SERVICE WATER (SW) SYSTEM

3.9.1 System Function

The Service Water System supplies cooling water from the ultimate heat sink to those components that are necessary for plant safety during either normal operation or under accident conditions. The system also supplies cooling water to various other heat loads in both the primary and secondary portions of the plant. The system is also capable of supplying water to the suction of the auxiliary feedwater pumps.

3.9.2 System Definition

The Service Water System contains four motor-driven pumps that supply water to two independent supply lines. The source of water for the system is Lake Robinson. Traveling screens are provided to remove impurities from the raw water before it enters the SW pumps. Two booster pumps are in the supply path to the containment air recirculation coolers. After serving the various heat load in the plant, service water is discharged to the circulating water discharge tunnel.

Simplified drawings of the SW system are shown in Figures 3.9-1 and 3.9-2. A summary of the data on selected SW system components is presented in Table 3.9-1.

3.9.3 System Operation

During normal operation, the cooling loads are supplied by three of the four SW pumps. Following a LOCA with loss of offsite power the cooling requirements for the essential loads can be supplied by two of four pumps (Ref. 1). Heat loads supported by the SW system include the following:

- Diesel generator coolers
- Containment air recirculation coolers
- Component Cooling heat exchangers
- Auxiliary Feedwater pumps.

The SW system can also be aligned to supply water to the suction of the AFW pumps. It also provides an emergency source of makeup water to the fuel pool.

3.9.4 System Success Criteria

Following a LOCA and loss of offsite power, the SW system success criteria for heat removal are (Ref. 1):

- 2 of 4 SW pumps operating and supplying water to heat loads via 1 of 2 supply headers

When needed as an AFW water source, the SW system success criteria are (Ref. 1):

- 1 of 4 SW pumps operating and supplying water to the AFW pump suctions

3.9.5 Component Information

A. Service Water Pumps A, B, C and D
   1. Rated flow: 8000 gpm @ 120 ft head (52 psid)
   2. Rated capacity: 50%
   3. Type: vertical centrifugal

B. Service Water Booster Pumps A and B
   1. Rated flow: 3200 gpm @ 100 ft head (43 psid)
   2. Rated capacity: 100%
   3. Type: vertical centrifugal

C. Ultimate Heat Sink - Lake Robinson

3.9.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The SW pumps are not automatically actuated.
   2. Remote Manual
      The SW pumps can be actuated by remote manual means from the control room.

B. Motive Power
   1. The SW motor driven pumps and motor operated valves are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.7.
   2. SW pump D has an alternate AC power feed from the dedicated shutdown bus.

C. Other
   1. Lubrication, ventilation, and cooling are provided locally for the SW pumps.

3.9.7 Section 3.9 References

1. H.B. Robinson 2 Updated Final Safety Analysis Report, Section 9.2.1.2.

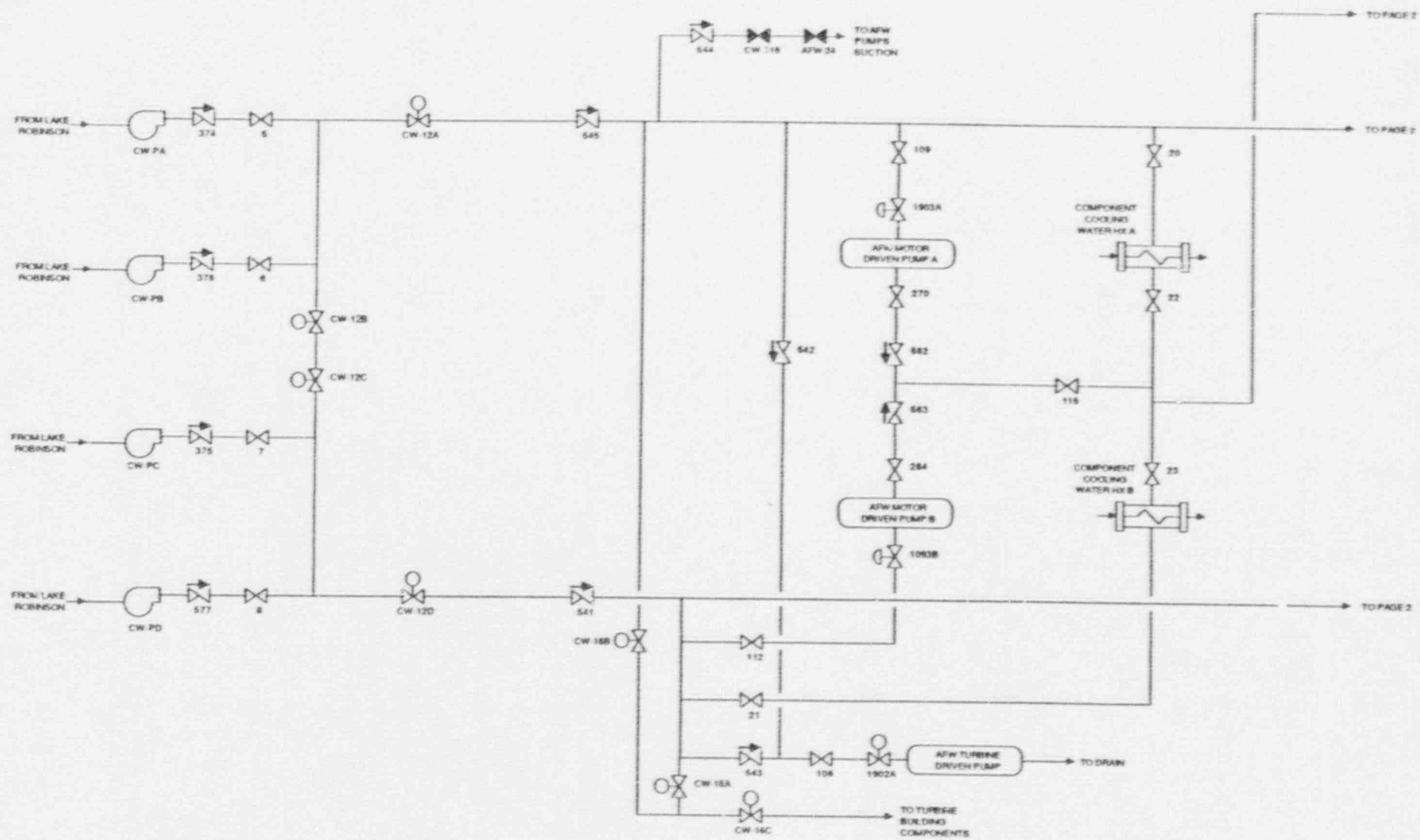


Figure 3.9-1. H.B. Robinson 2 Service and Cooling Water System (Page 1 of 2)

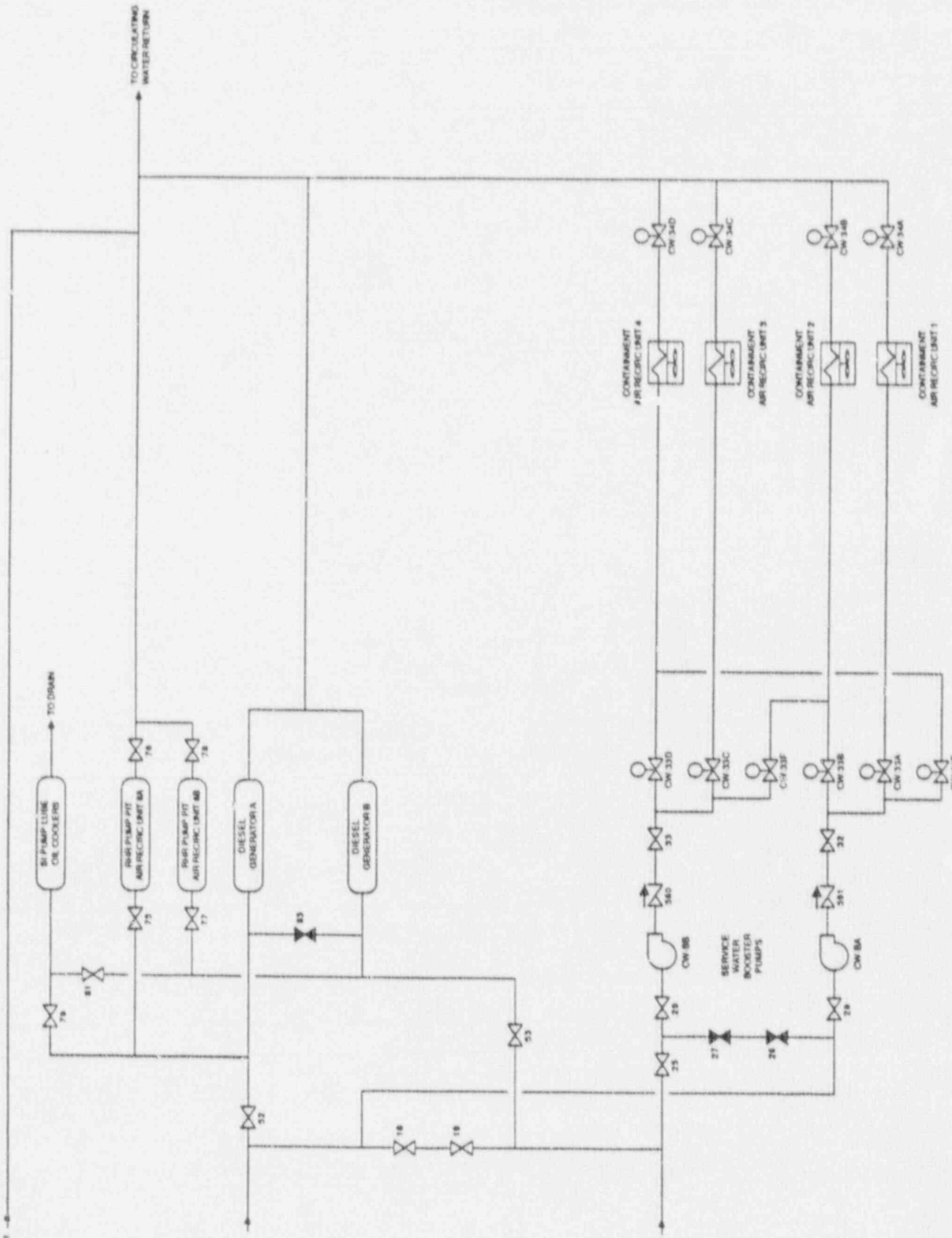


Figure 3.9-1. H.B. Robinson 2 Service and Cooling Water System (Page 2 of 2)

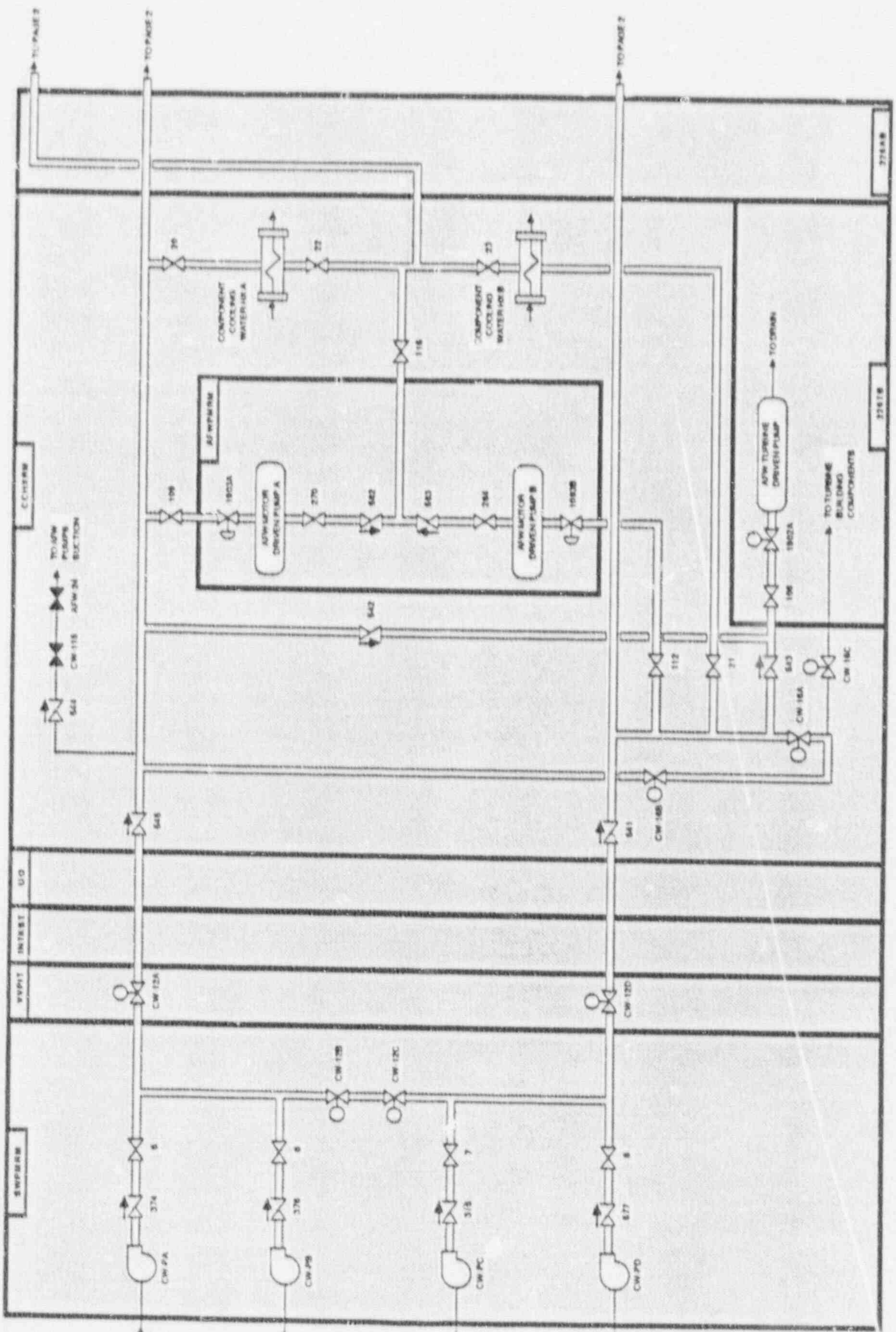


Figure 3.9-2. H.B. Robinson 2 Service and Cooling Water System Showing Component Locations (Page 1 of 2)

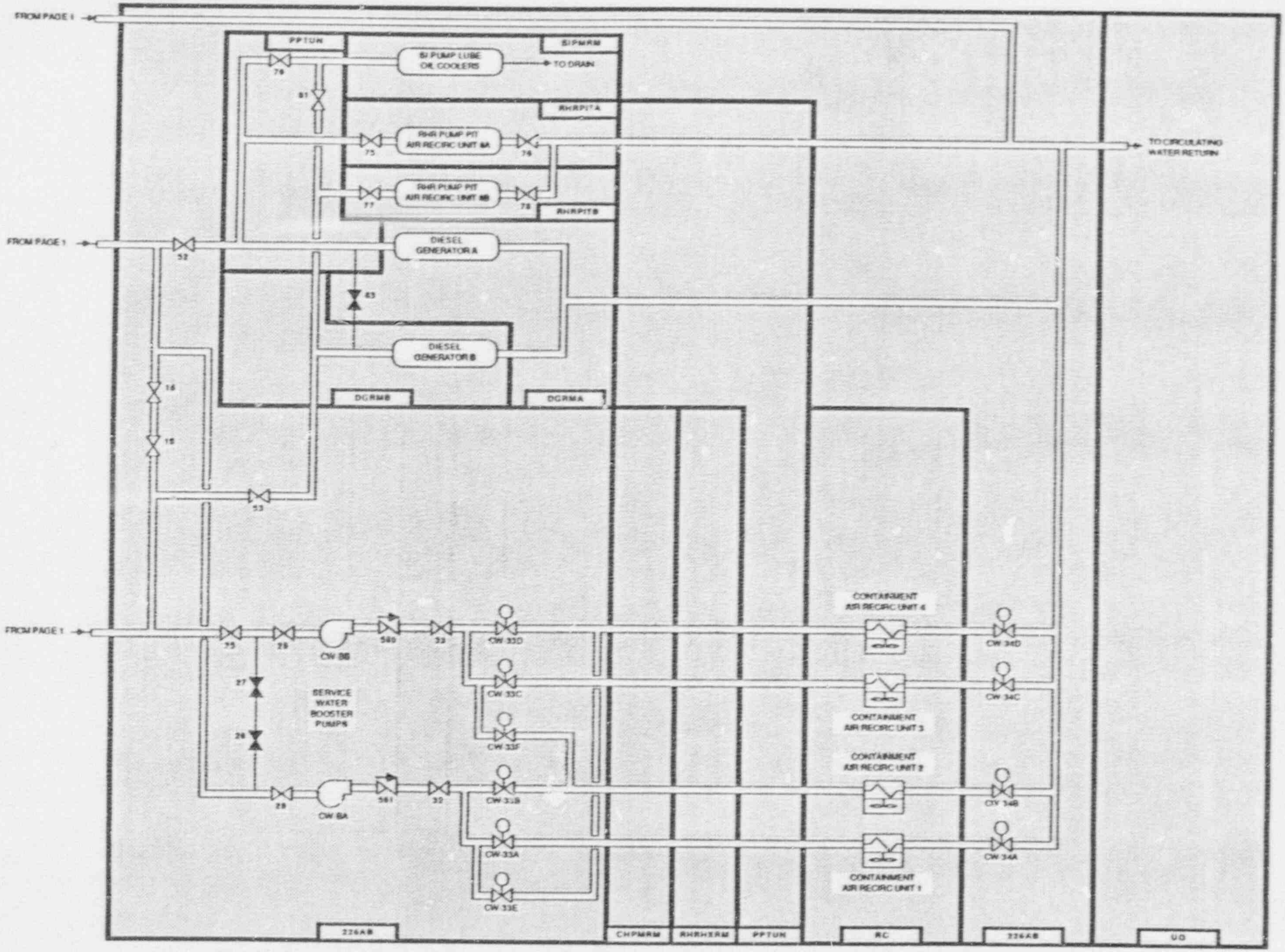


Figure 3.9-2. H.B. Robinson 2 Service and Cooling Water System Showing Component Locations (Page 2 of 2)

Table 3.9-1. H. B. Robinson 2 Service Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CW-12A	MOV	VVPIT	MCC5	480	MCC5	AC/A
CW-12B	MOV	SWPMRM	MCC5	480	MCC5	AC/A
CW-12C	MOV	SWPMRM	MCC6	480	EEQUIPRM	AC/B
CW-12D	MOV	VVPIT	MCC6	480	EEQUIPRM	AC/B
CW-16A	MOV	CCHXRM	MCC5	480	MCC5	AC/A
CW-16A	MOV	CCHXRM	MCC5	480	MCC5	AC/A
CW-16B	MOV	CCHXRM	MCC6	480	EEQUIPRM	AC/B
CW-16B	MOV	CCHXRM	MCC6	480	EEQUIPRM	AC/B
CW-16C	MOV	CCHXRM	MCC6	480	EEQUIPRM	AC/B
CW-PA	MDP	SWPMRM	BUS-E1	480	EEQUIPRM	AC/A
CW-PB	MDP	SWPMRM	BUS-E1	480	EEQUIPRM	AC/A
CW-PC	MDP	SWPMRM	BUS-E2	480	EEQUIPRM	AC/B
CW-PD	MDP	SWPMRM	BUS-E2	480	EEQUIPRM	AC/B
CW-PD	MDP	SWPMRM	BUS-DS	480	SDBLDG	AC/SD

4. PLANT INFORMATION

4.1 SITE AND BUILDING SUMMARY

The Robinson plant is located in northwest Darlington County, South Carolina, approximately 3 miles west-northwest of Hartsville and 54 miles east-northeast of Columbia, the state capitol. The site occupies approximately 2500 acres of land on the southwest shore of Lake Robinson, a cooling impoundment of Black Creek.

The Robinson plant also contains a 185 MWe fossil-fueled generating plant (Unit 1) adjacent to the nuclear unit (Unit 2). No systems are shared between the two units. Figure 4-1 (from Ref. 1) is a general view of the plant and vicinity.

The major structures at Unit 2 include the containment building, turbine building, auxiliary building, and fuel building. A site plot plan is shown in Figure 4-2.

The containment structure is a reinforced concrete cylinder with a steel liner. The containment contains the reactor vessel, reactor coolant pumps, steam generators, and pressurizer. Pumps, piping, and valving for the reactor coolant system is completely contained within the containment structure. Piping and electrical penetration areas are on various levels of the auxiliary building.

The turbine building, located south of the containment, houses the turbine generator and the associated power generating auxiliaries.

The auxiliary building is located east of the containment and contains the control room, diesel rooms A and B, and components of the engineered safety systems. The dedicated shutdown diesel building is located southwest of the turbine building.

The fuel building is north of the containment and houses the spent fuel pool.

The intake structure is located southeast of the containment on Lake Robinson and contains the service water pumps and intake structure.

4.2 FACILITY LAYOUT DRAWINGS

Figures 4-3 to 4-6 are section views of the major building at H. B. Robinson 2. Simplified layout drawings are shown in Figures 4-7 to 4-10. Details of many of the outlying buildings are not shown on these drawings. Major rooms, stairways, elevators, and doorways are shown in the simplified layout drawings, however, many interior walls have been omitted for clarity. Labels printed in uppercase correspond to the location codes listed in Table 4-1 and used in the component data listings and system drawings in Section 3. Some additional labels are included for information and are printed in lowercase type.

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

4.3 SECTION 4 REFERENCES

1. Heddleson, F.A., "Design Data and Safety Features of Commercial Nuclear Power Plants", ORNL-NSIC-55, Volume 1, Oak Ridge National Laboratory, December 1973.

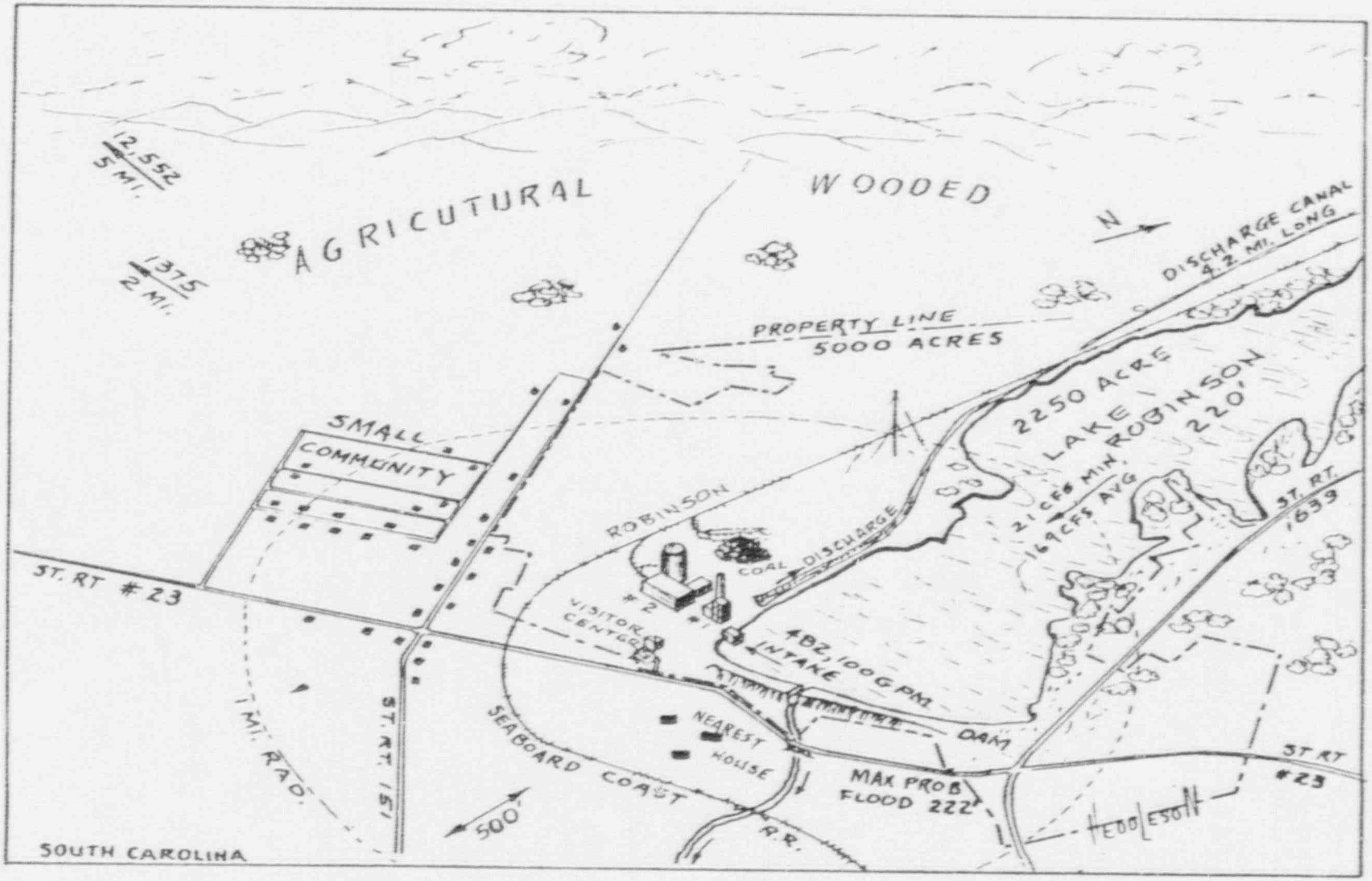


Figure 4-1. General View of Robinson Plant and Vicinity

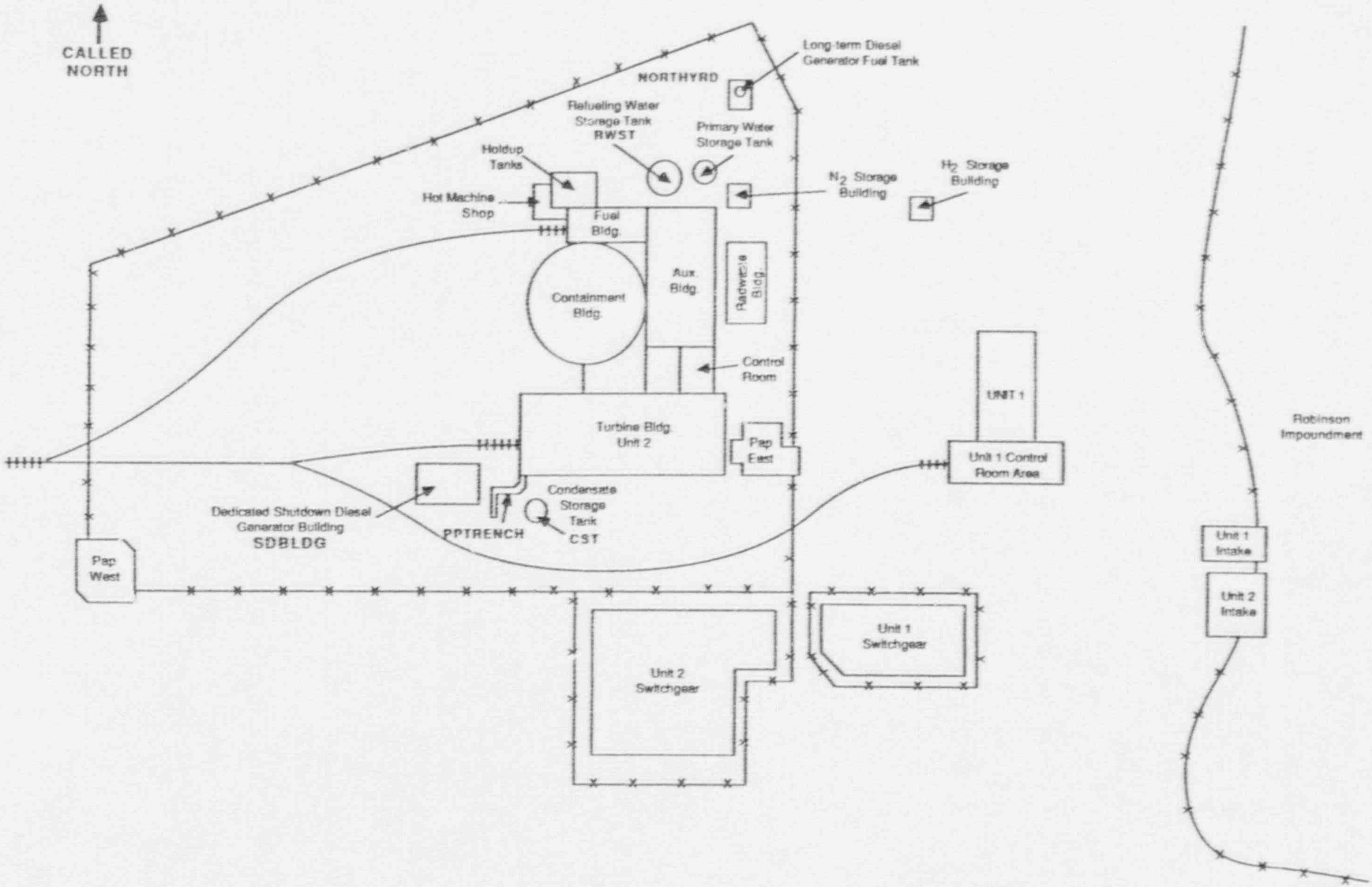


Figure 4-2. H. B. Robinson: 2 Plot Plan

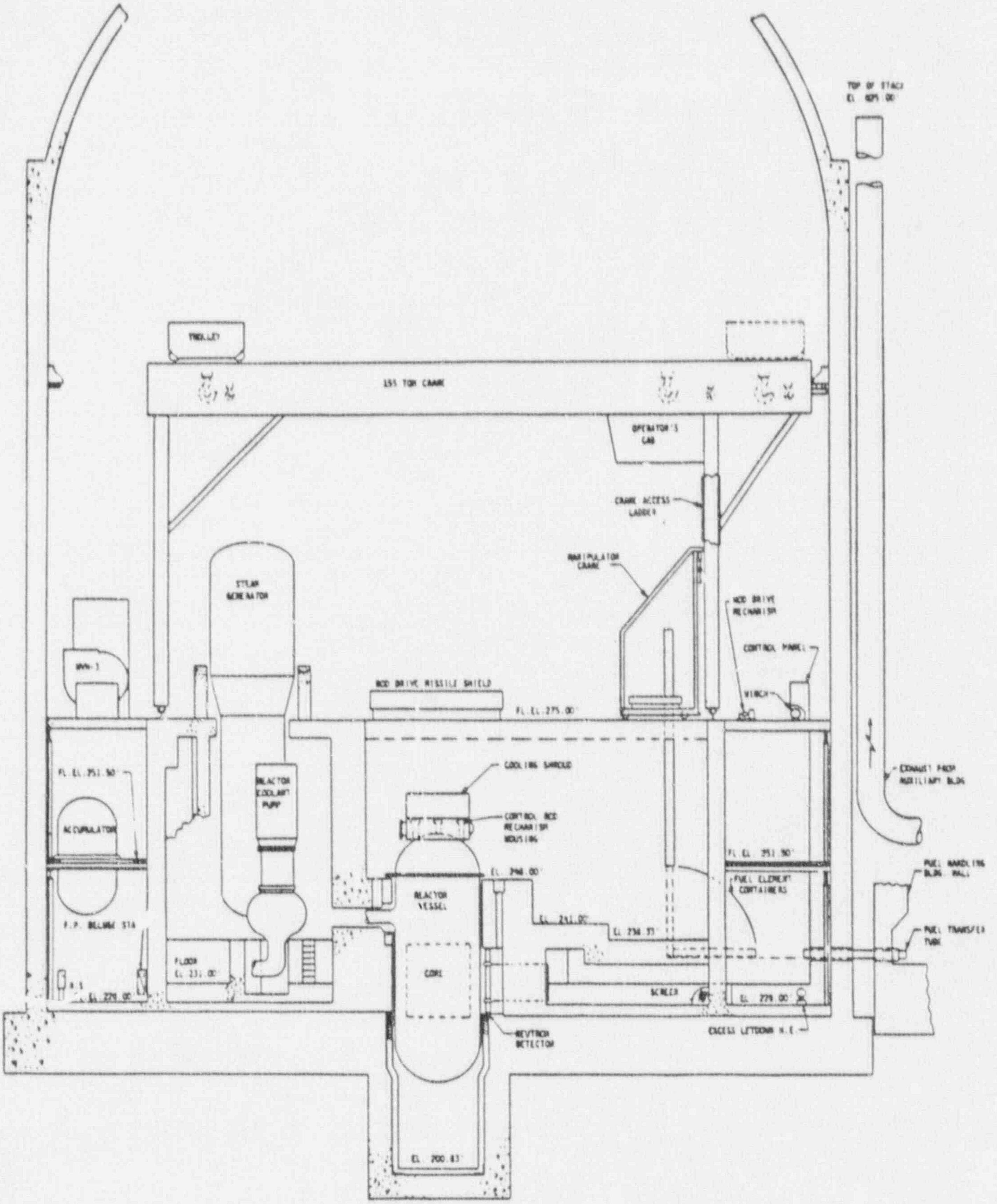


Figure 4-3. H. B. Robinson 2 Containment Section Views (Sheet 1 of 2)

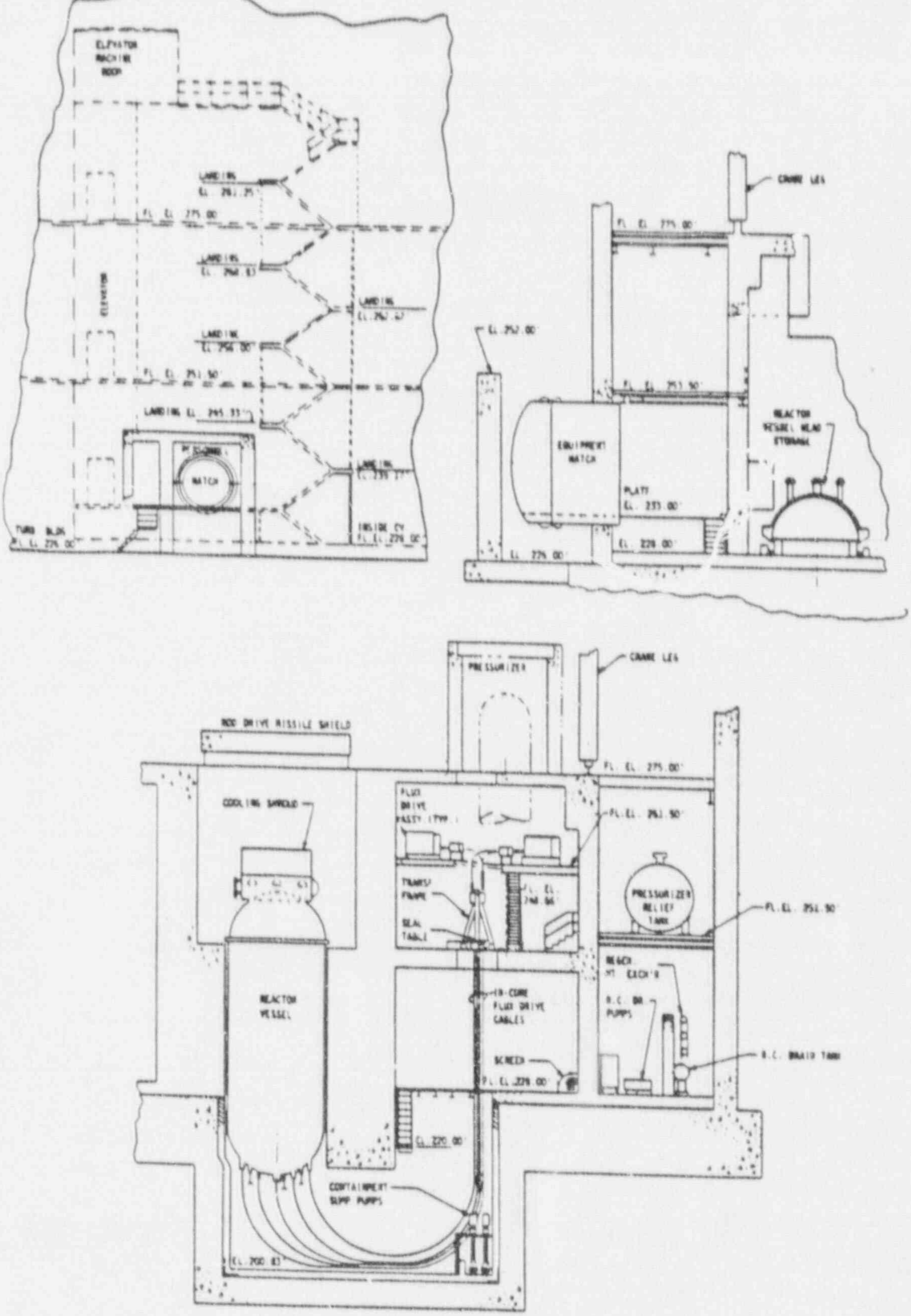


Figure 4-3. H. B. Robinson 2 Containment Section Views (Sheet 2 of 2)

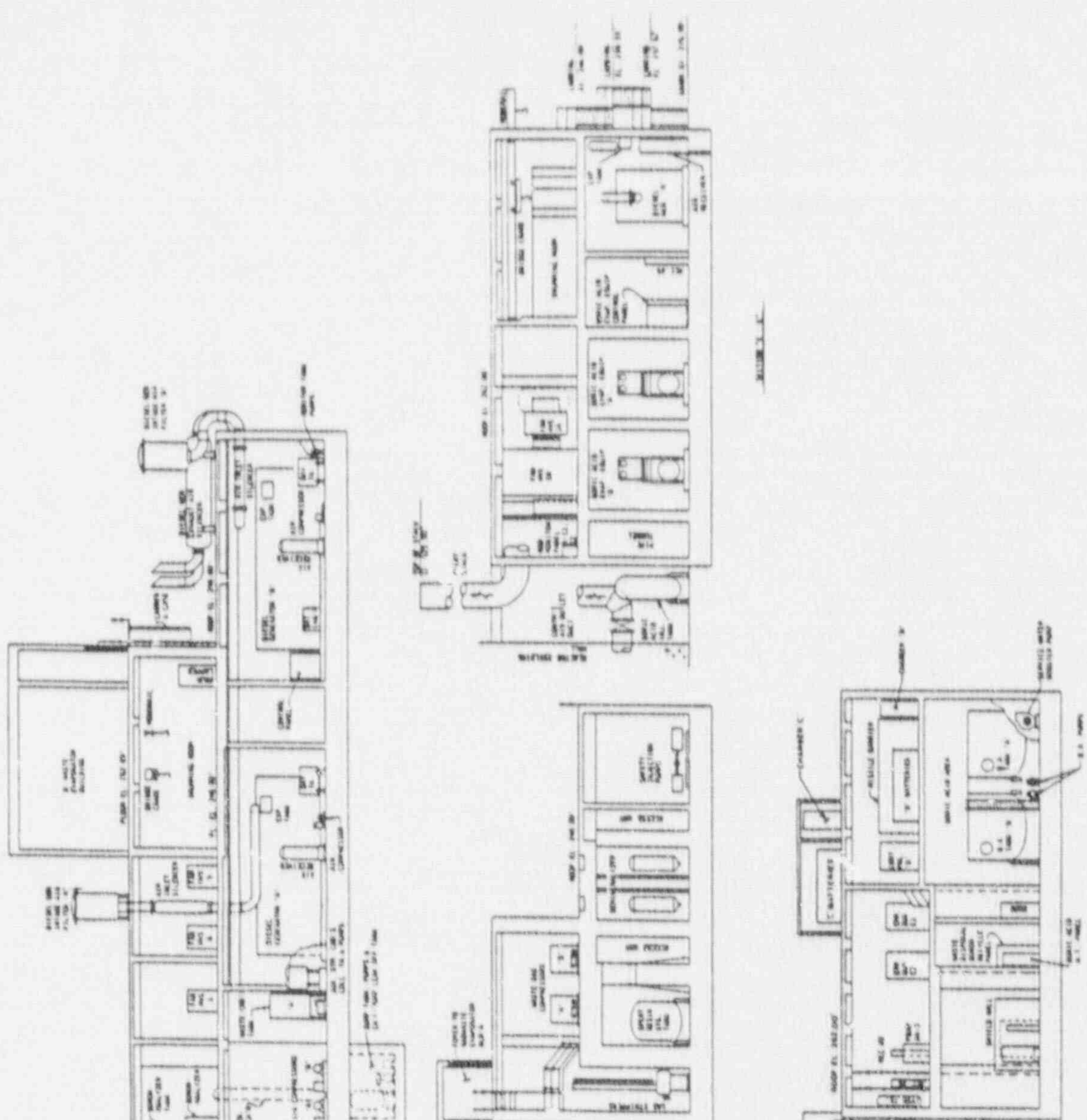


Figure 4-4. H. B. Robinson 2 Reactor Auxiliary Building Section Views

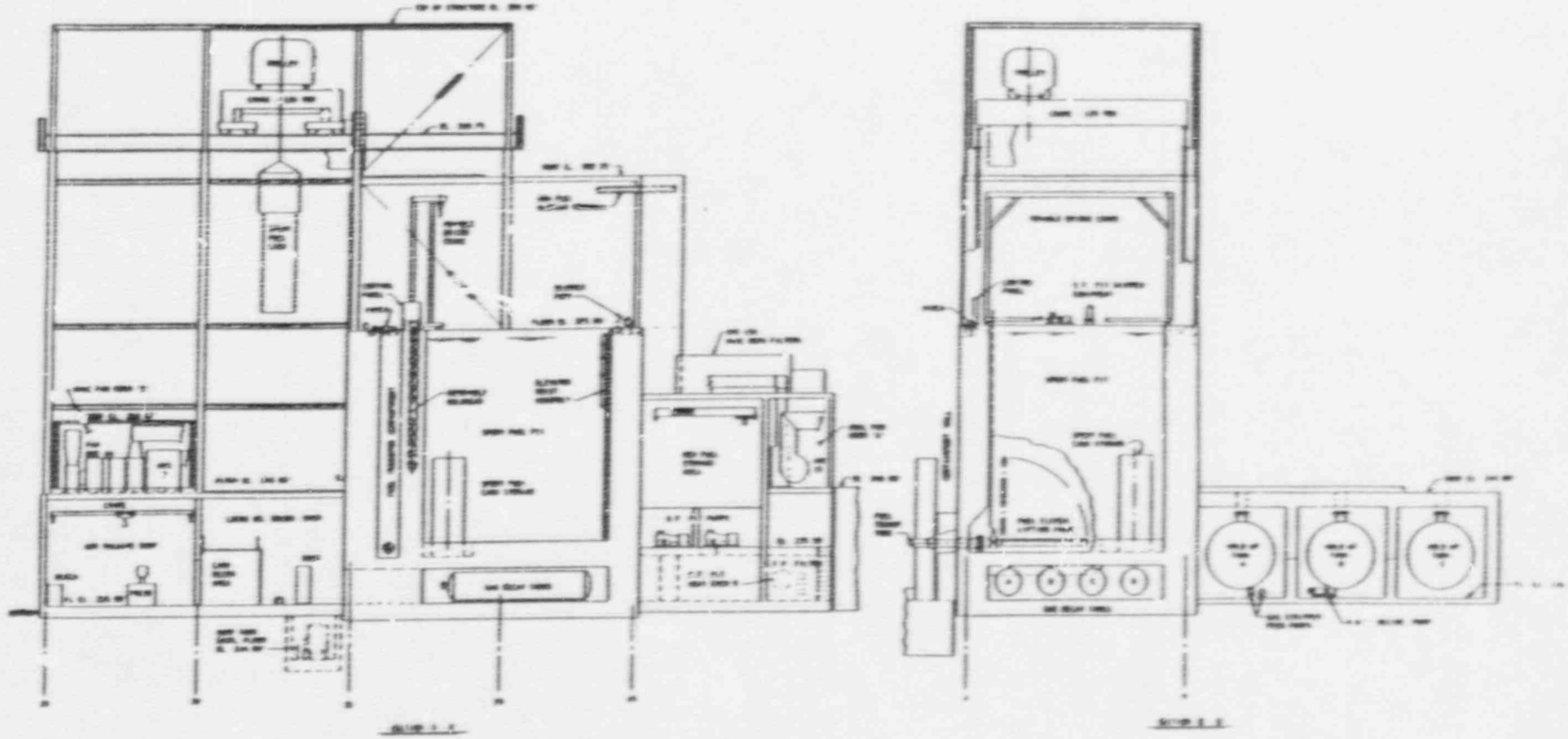


Figure 4-5. H. B. Robinson 2 Fuel Handling Building and Machine Shop Section Views

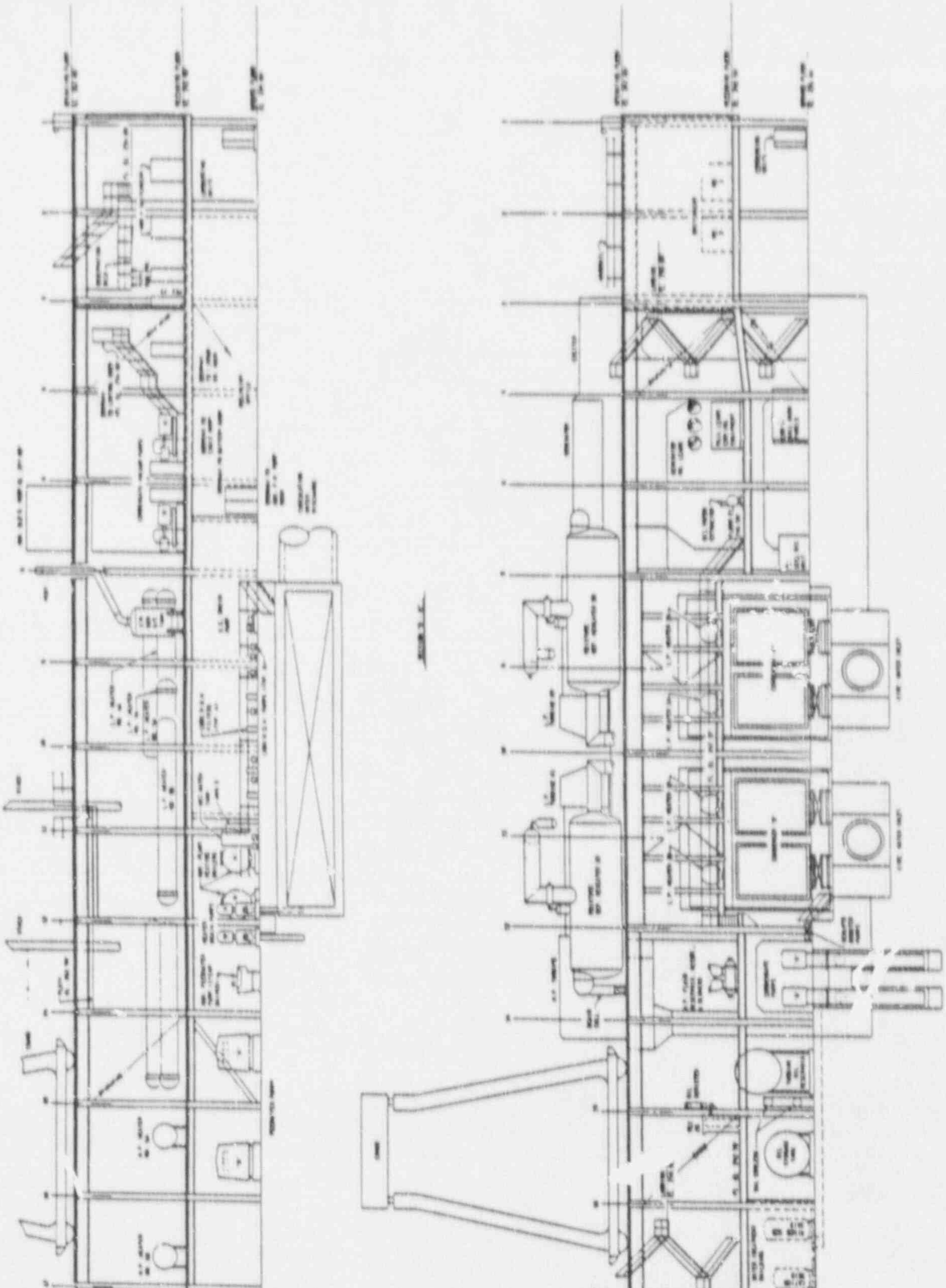


Figure 4-6. H. B. Robinson 2 Turbine Building Section Views

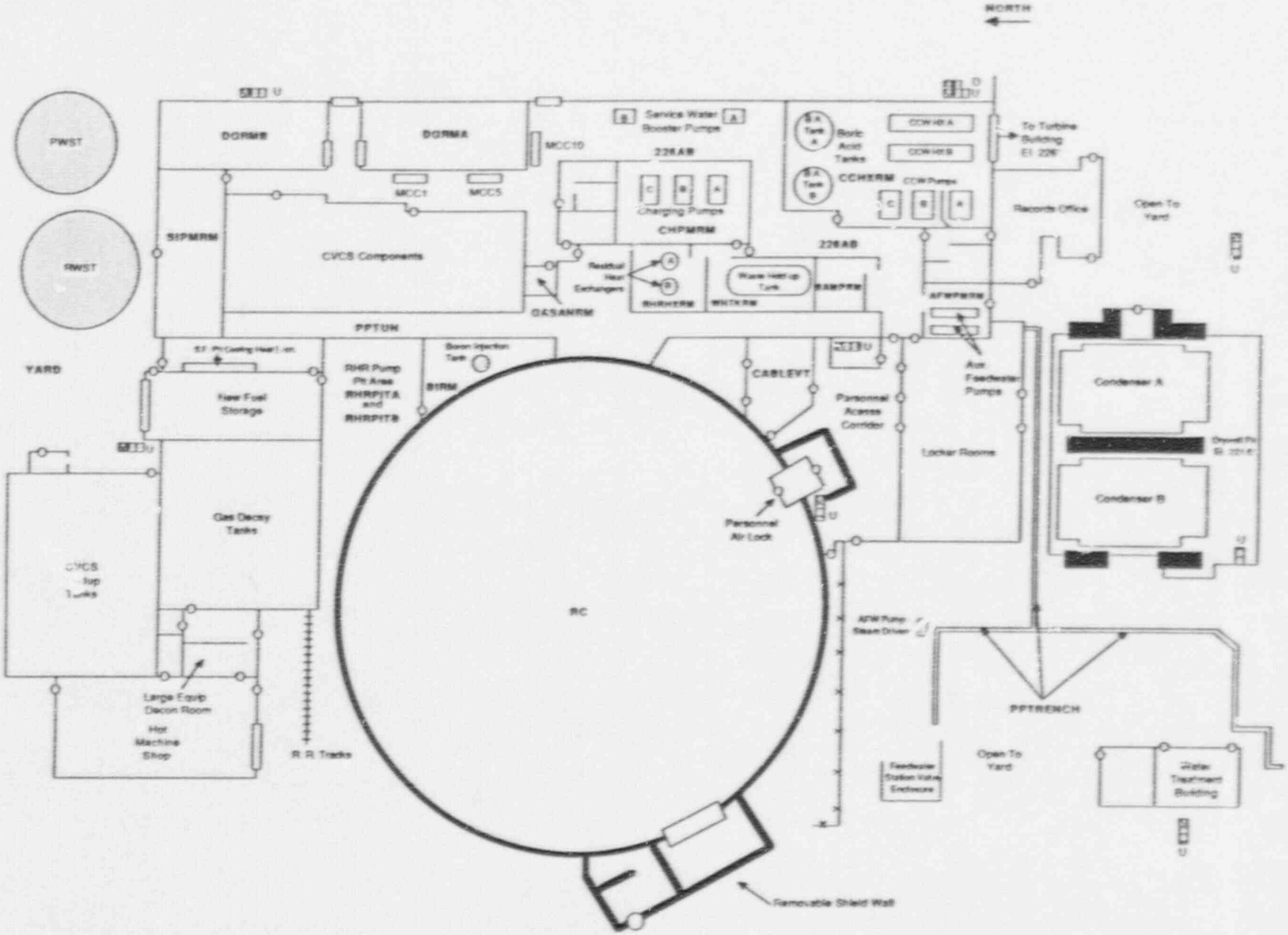


Figure 4-7. H. B. Robinson 2 Reactor Auxiliary, Fuel Handling and Turbine Buildings, El. 226'

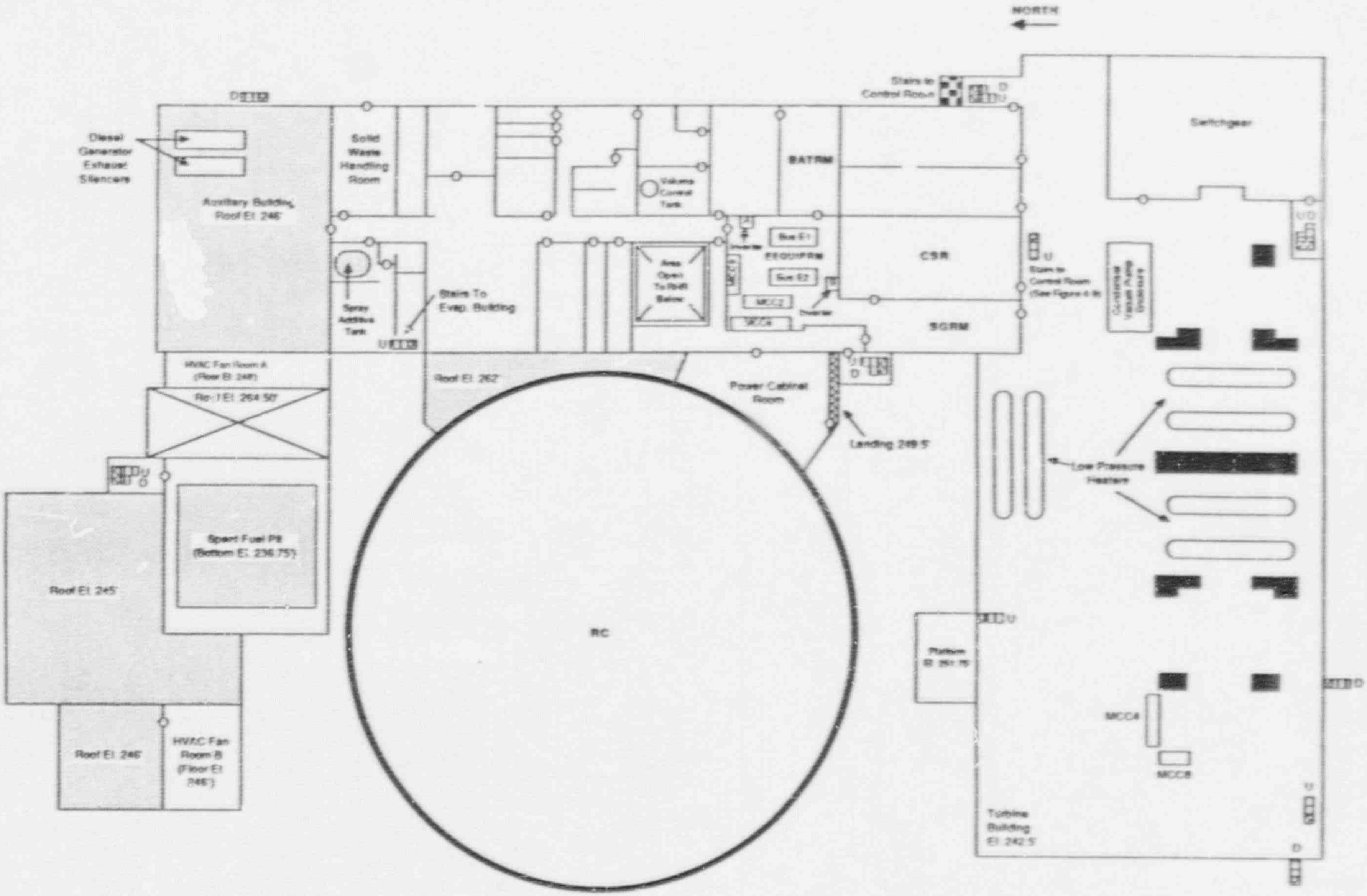


Figure 4-8. H. B. Robinson 2 Reactor Auxiliary, Fuel Handling and Turbine Buildings, El. 246'

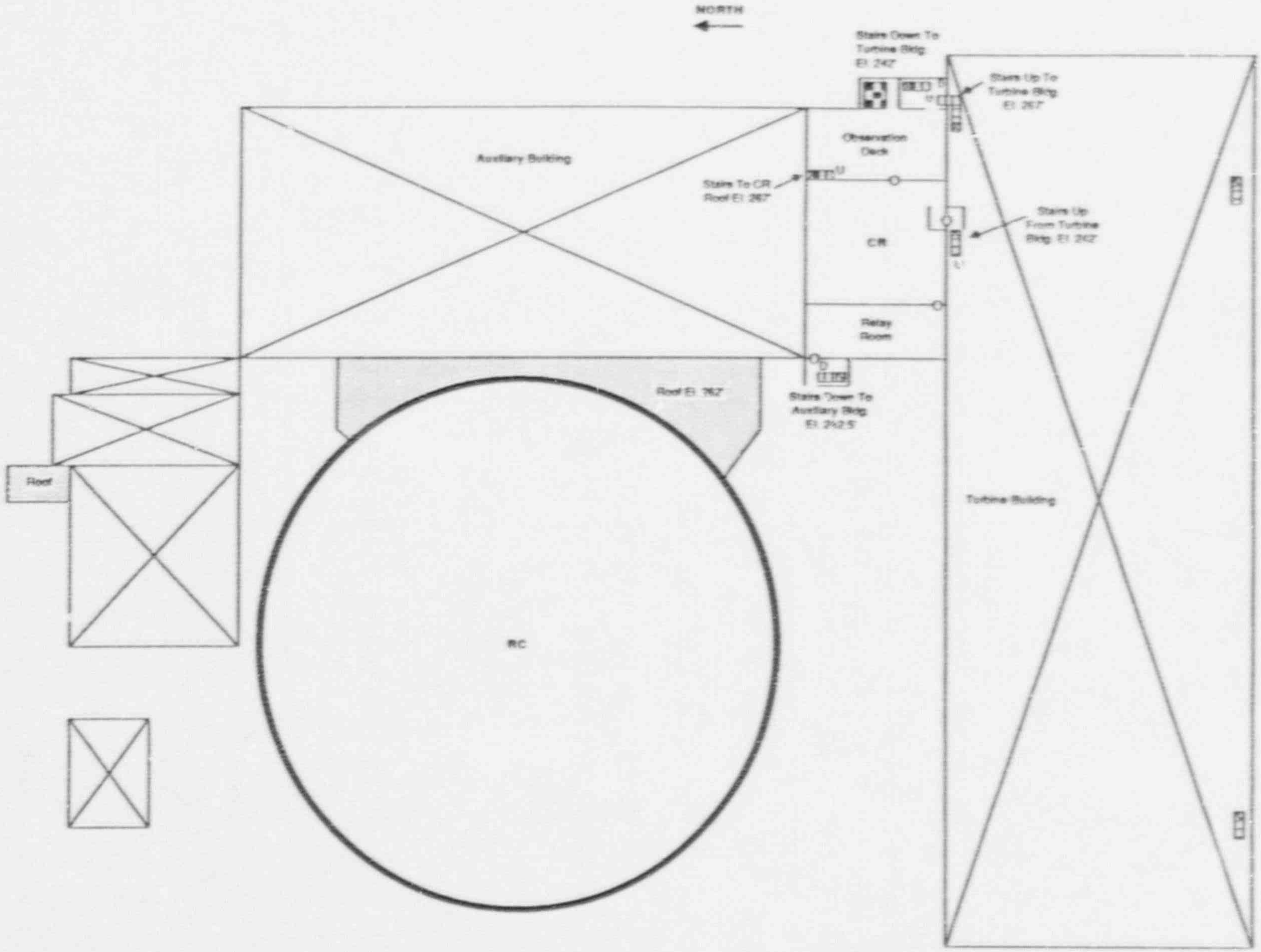


Figure 4-9. H. B. Robinson 2 Reactor Auxiliary, Fuel Handling and Turbine Buildings, El. 254'

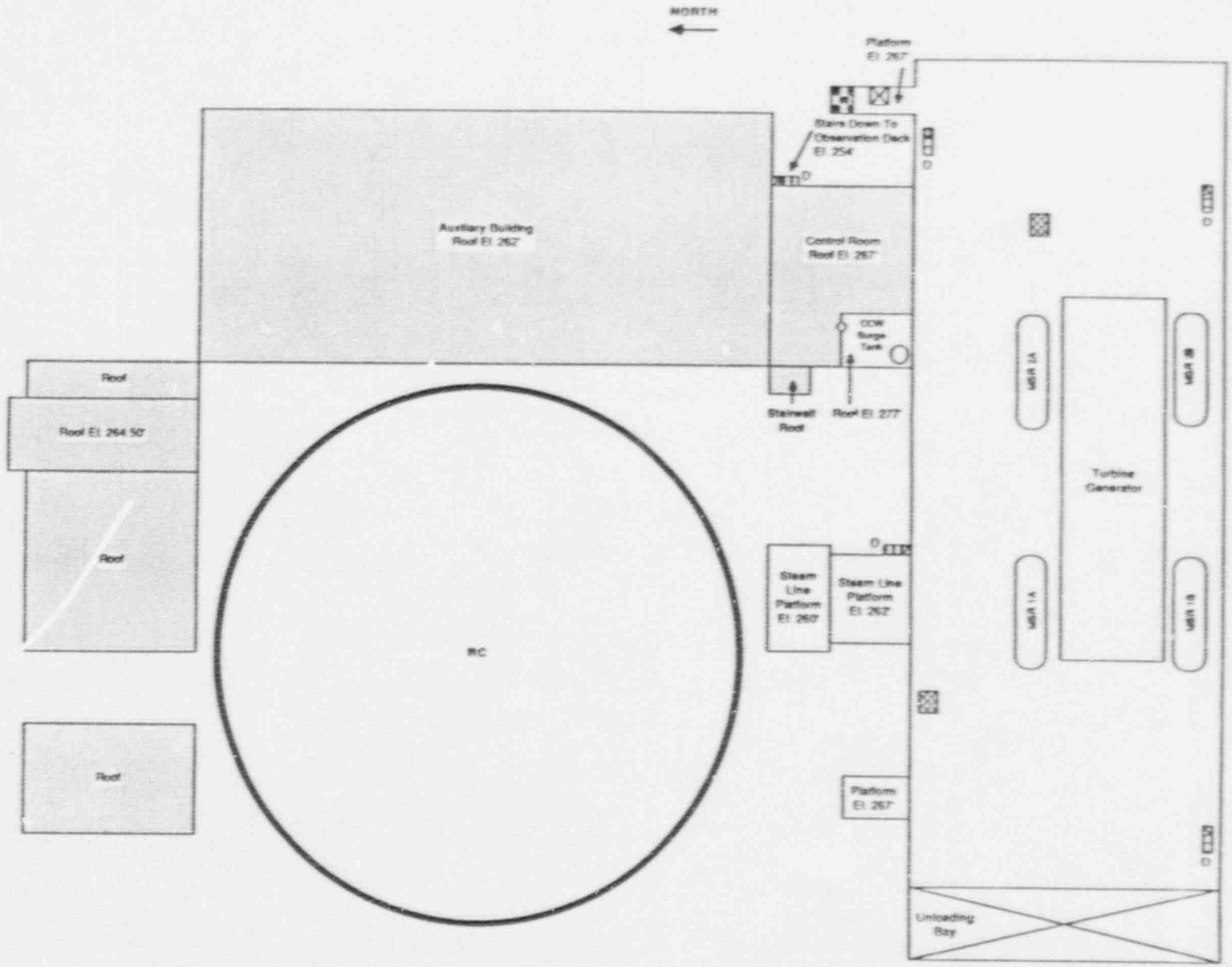


Figure 4-10. H. B. Robinson 2 Reactor Auxiliary, Fuel Handling and Turbine Buildings, El. 267'

Table 4-1. Definition of H.B. Robinson 2 Building and Location Codes

	Codes	Descriptions
1.	226AB	226' elevation of the Auxiliary Building
2.	226TB	226' elevation of the Turbine Building
3.	AFWPMRM	Auxiliary Feedwater Pump Room, located on the 226' elevation of the Auxiliary Building
4.	BIRM	Boron Injection Tank Room, located on the 225' elevation between the Auxiliary and Reactor Building
5.	BATRM	Battery Room, located on the 248' elevation of the Auxiliary Building.
6.	CABLEVT	Cable Vault, located on the 226' elevation of the Auxiliary Building.
3.	CASPRM	Cable Spreading Room, located on the 242' elevation of the Auxiliary Building
8.	CCHXRM	Component Cooling Heat Exchanger Room, located on the 226' elevation of the Auxiliary Building
9.	CHPMRM	Charging Pump Room, located on the 226' elevation of the Auxiliary Building
10.	CR	Control Room
11.	CST	Condensate Water Storage Tank, located in service water yard area
12.	DGRMA	Diesel Generator Room A, located on the 226' elevation of the Auxiliary Building
13.	DGRMB	Diesel Generator Room B, located on the 226' elevation of the Auxiliary Building
14.	EEQUIPRM	Electrical Equipment Room, located on the 246' elevation of the Auxiliary Building
15.	GASANRM	Gas Analyzer Room, located on the 226' elevation of the Auxiliary Building
16.	INTKST	Intake Structure
17.	MCC5	480V Motor Control Center No. 5, located on the 266' elevation of the Auxiliary Building

Table 4-1. Definition of H.B. Robinson 2 Building and Location Codes (Continued)

Codes	Descriptions
18. MCC9	120/208V Motor Control Center No. 9, located on the 246' elevation of the Auxiliary Building
19. MCC10	120/208V Motor Control Center No. 10, located on the 226' elevation of the Auxiliary Building
20. NORTHYRD	North Yard Area containing the long term diesel fuel tank
21. PPMAZE	Pipe Maze, located in the Turbine Building - adjacent to the Reactor Containment
22. PPTRENCH	Pipe Trench, located on the 226' elevation of the Turbine Building
23. PPTUN	Pipe Tunnel, located on the 226' elevation of the Auxiliary Building
24. RC	Reactor Containment
25. RHRHXRM	Residual Heat Exchanger Room, located on the 226' elevation of the Auxiliary Building
26. RHRPITA	Residual Heat Removal Pump Pit A, located on the 226' elevation of the Auxiliary Building
27. RHRPITB	Residual Heat Removal Pump Pit B, located on the 226' elevation of the Auxiliary Building
28. RWST	Refueling Water Storage Tank, located in the yard area
29. SAMPRM	Sample Room, located on the 226' elevation of the Auxiliary Building
30. SDBLDG	Dedicated shutdown building located southwest of the turbine building
31 SGRM	Safeguards Room, located on the 242' elevation of the Auxiliary Building. Contains Vital Relay Racks for Safety Related Equipment
32. SIPMRM	Safety Injection Pump Motor Room, located on the 226' elevation of the Auxiliary Building
33. SWPMRM	Service Water Pump Motor Room
34. TLSF	Spent fuel operating floor
35. VVPIT	Valve Pit, contains service water valves

Table 4-1. Definition of H.B. Robinson 2 Building and Location Codes (Continued)

Codes	Descriptions
36. WHTKRM	Waste Holdup Tank Room, located on the 226' elevation of the Auxiliary Building
37. YARD	Yard area, outside major buildings

Table 4-2. Partial Listing of Components by Location at H. B. Robinson 2

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
226AB	CVCS	CH-121	NV
226AB	CVCS	CH-115B	NV
226AB	CVCS	CH-358	XV
226AB	PAHRS	CW-33A	MOV
226AB	PAHRS	CW-34A	MOV
226AB	PAHRS	CW-34B	MOV
226AB	PAHRS	CW-33C	MOV
226AB	PAHRS	CW-34C	MOV
226AB	PAHRS	CW-34D	MOV
226AB	PAHRS	CW-33D	MOV
226AB	PAHRS	CW-33F	MOV
226AB	PAHRS	CW-33B	MOV
226AB	PAHRS	CW-33E	MOV
226AB	PAHRS	CW-BA	MDP
226AB	PAHRS	CW-BB	MDP
226TB	AFW	AFW-TP1	TDP
AFWPMRM	AFW	AFW-16B	MOV
AFWPMRM	AFW	AFW-20A	MOV
AFWPMRM	AFW	AFW-16A	MOV
AFWPMRM	AFW	AFW-20B	MOV
AFWPMRM	AFW	AFW-16C	MOV
AFWPMRM	AFW	AFW-A	MDP
AFWPMRM	AFW	AFW-B	MDP
BATRM	EP	BUS-MCCA	BUS
BATRM	EP	BAT-A	BATT
BATRM	EP	BUS-MCCB	BUS
BATRM	EP	BAT-B	BATT
BATRM	EP	BUS-MCCA	BUS
BATRM	EP	BUS-MCCB	BUS
BATRM	EP	BC-A	BC

Table 4-2. Partial Listing of Components by Location at H. B. Robinson 2 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
BATRM	EP	BC-B	BC
BIRM	ECCS	SI-867A	MOV
BIRM	ECCS	SI-867B	MOV
BIRM	ECCS	SI-870A	MOV
BIRM	ECCS	SI-870B	MOV
BIRM	ECCS	SI-867A	MOV
BIRM	ECCS	SI-867B	MOV
BIRM	ECCS	SI-870A	MOV
BIRM	ECCS	SI-870B	MOV
CCHXRM	AFW	AFW-24	XV
CCHXRM	AFW	CW-118	XV
CCHXRM	CCS	CC-HXB	HX
CCHXRM	CCS	CC-B	MDP
CCHXRM	CCS	CC-C	MDP
CCHXRM	CCS	CC-A	MDP
CCHXRM	CCS	CC-HXA	HX
CCHXRM	SW	CW-16B	MOV
CCHXRM	SW	CW-16C	MOV
CCHXRM	SW	CW-16A	MOV
CCHXRM	SW	CW-16A	MOV
CCHXRM	SW	CW-16B	MOV
CHPMRM	CVCS	CH-PB	MDP
CHPMRM	CVCS	CH-PC	MDP
CHPMRM	CVCS	CH-PA	MDP
CST	AFW	AFW-CST	TANK
DGRM	EP	120 BUS-2	BUS
DGRM	EP	120 BUS-3	BUS
DGRMA	EP	DG-A	DG
DGRMB	EP	DG-B	DG
EEQUIPRM	EP	BUS-E1	BUS

Table 4-2. Partial Listing of Components by Location at H. B. Robinson 2 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
EEQUIPRM	EP	CB-CE1	CB
EEQUIPRM	EP	CB-CE2	CB
EEQUIPRM	EP	BUS-E2	BUS
EEQUIPRM	EP	INV-A	INV
EEQUIPRM	EP	INV-B	INV
EEQUIPRM	EP	MCC6	MCC
EEQUIPRM	EP	BUS-F1	BUS
EEQUIPRM	EP	BUS-F2	BUS
MCC10	EP	MCC10	MCC
MCC5	EP	MCC5	MCC
MCC5	EP	MCC5	MCC
MCC9	EP	MCC9	MCC
PPMAZE	AFW	AFW-6A	MOV
PPMAZE	AFW	AFW-14B	MOV
PPMAZE	AFW	AFW-6B	MOV
PPMAZE	AFW	AFW-14C	MOV
PPMAZE	AFW	AFW-6C	MOV
PPMAZE	AFW	AFW-14A	MOV
PPTUN	ECCS	SI-869	MOV
PPTUN	ECCS	SI-863	MOV
RC	AFW	SG-A	SG
RC	AFW	SG-A	SG
RC	AFW	SG-B	SG
RC	AFW	SG-C	SG
RC	AFW	SG-B	SG
RC	AFW	SG-C	SG
RC	CVCS	CH-310B	NV
RC	CVCS	CH-310A	NV
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	SI-866A	MOV

Table 4-2. Partial Listing of Components by Location at H. B. Robinson 2 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RC	ECCS	SI-866B	MOV
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	SI-866A	MOV
RC	ECCS	SI-866B	MOV
RC	PAHRS	CARC-1	FAN
RC	PAHRS	CARC-2	FAN
RC	PAHRS	CARC-3	FAN
RC	PAHRS	CARC-4	FAN
RC	PAHRS	RCS-VESSEL	RV
RC	PAHRS	RCS-VESSEL	RV
RC	RCS	RCS-VESSEL	RV
RC	RCS	RCS-750	MOV
RC	RCS	RCS-751	MOV
RC	RCS	RCS-455	NV
RC	RCS	RCS-536	MOV
RC	RCS	RCS-535	MOV
RC	RCS	RCS-456	NV
RHRHXRM	ECCS	RH-HX1	HX
RHRHXRM	ECCS	RH-HX2	HX
RHRPITA	ECCS	RH-A	MDP
RHRPITA	ECCS	SI-860A	MOV
RHRPITA	ECCS	SI-861A	MOV
RHRPITB	ECCS	RH-B	MDP
RHRPITB	ECCS	SI-860B	MOV
RHRPITB	ECCS	SI-861B	MOV
RWST	CVCS	SI-RWST	TANK
RWST	ECCS	SI-RWST	TANK
SDBLDG	EP	DG-DS	DG
SDBLDG	EP	TRAN-[illegible]	TRAN
SDBLDG	EP	BUS-DS	BUS

Table 4-2. Partial Listing of Components by Location at H. B. Robinson 2 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
SDBLDG	EP	CB-DS	CB
SDBLDG	EP	BUS-DS	BUS
SDBLDG	EP	PNL-51	MCC
SGRM	EP	120 BUS-1	BUS
SGRM	EP	120 BUS-2	BUS
SGRM	EP	120 BUS-3	BUS
SGRM	EP	120 BUS-4	BUS
SGRM	EP	120 BUS-1	BUS
SGRM	EP	120 BUS-4	BUS
SGRM	EP	120 BUS-6	BUS
SGRM	EP	120 BUS-7	BUS
SGRM	EP	120 BUS-8	BUS
SGRM	EP	120 BUS-9	BUS
SIPMRM	ECCS	SI-A	MDP
SIPMRM	ECCS	SI-B	MDP
SIPMRM	ECCS	SI-C	MDP
SIPMRM	ECCS	SI-878A	MOV
SIPMRM	ECCS	SI-878B	MOV
SIPMRM	ECCS	SI-864A	MOV
SIPMRM	ECCS	SI-864B	MOV
SIPMRM	ECCS	SI-A	MDP
SIPMRM	ECCS	SI-B	MDP
SIPMRM	ECCS	SI-C	MDP
SIPMRM	ECCS	SI-878A	MOV
SIPMRM	ECCS	SI-878B	MOV
SIPMRM	ECCS	SI-B	MDP
SIPMRM	ECCS	SI-B	MDP
SIPMRM	PAHRS	SI-880A	MOV
SIPMRM	PAHRS	SI-880B	MOV
SIPMRM	PAHRS	SI-844A	MOV

Table 4-2. Partial Listing of Components by Location at H. B. Robinson 2 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
SIPMRM	PAHRS	CS-A	MDP
SIPMRM	PAHRS	SI-880C	MOV
SIPMRM	PAHRS	SI-860D	MOV
SIPMRM	PAHRS	SI-844B	MOV
SIPMRM	PAHRS	CS-B	MDP
SWPMRM	SW	CW-PA	MDP
SWPMRM	SW	CW-12B	MOV
SWPMRM	SW	CW-12C	MOV
SWPMRM	SW	CW-PB	MDP
SWPMRM	SW	CW-PC	MDP
SWPMRM	SW	CW-PD	MDP
SWPMRM	SW	CW-PD	MDP
VVPIT	SW	CW-12A	MOV
VVPIT	SW	CW-12D	MOV

5. BIBLIOGRAPHY FOR H. B. ROBINSON 2

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4. NUREG/CR-2822, "Concentrations of Copper-binding Proteins in the Livers of Bluegills from the Cooling Lake at the H.B. Robinson Nuclear Power Station," Lawrence Livermore National Laboratory, November 1982.

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9. NUREG/CR-4439, "LEPRICON Analysis of Pressure Vessel Surveillance Dosimetry Inserted into H.B. Robinson-2 During Cycle 9," Oak Ridge National Laboratory, September 1986.

10. NUREG/CR-4452, "Review of RELAP5 Calculations for H.B. Robinson Unit 2 Pressurized Thermal Shock Study," Brookhaven National Laboratory, December 1985.

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)

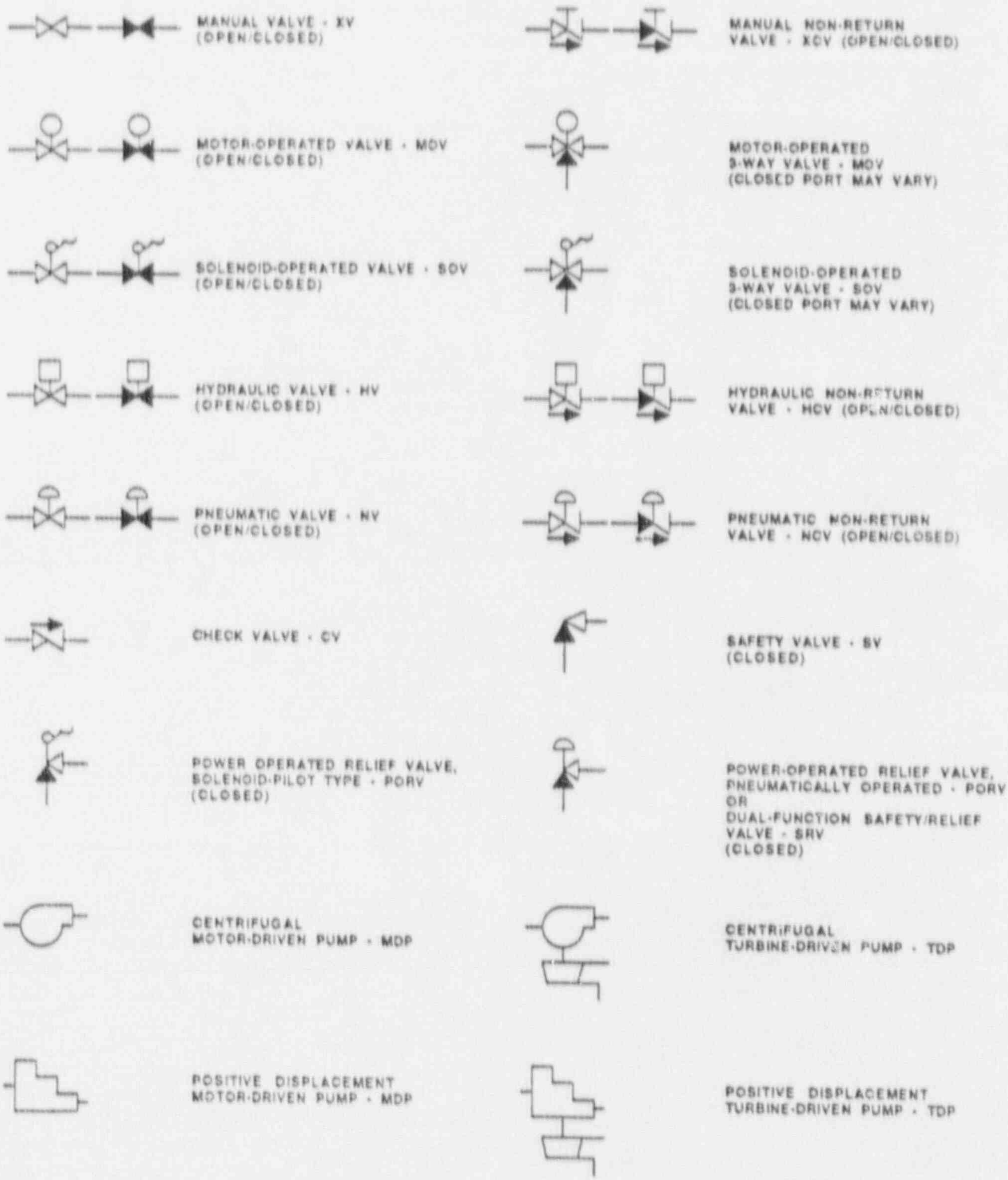

Figure A-1. Key To Symbols In Fluid System Drawings

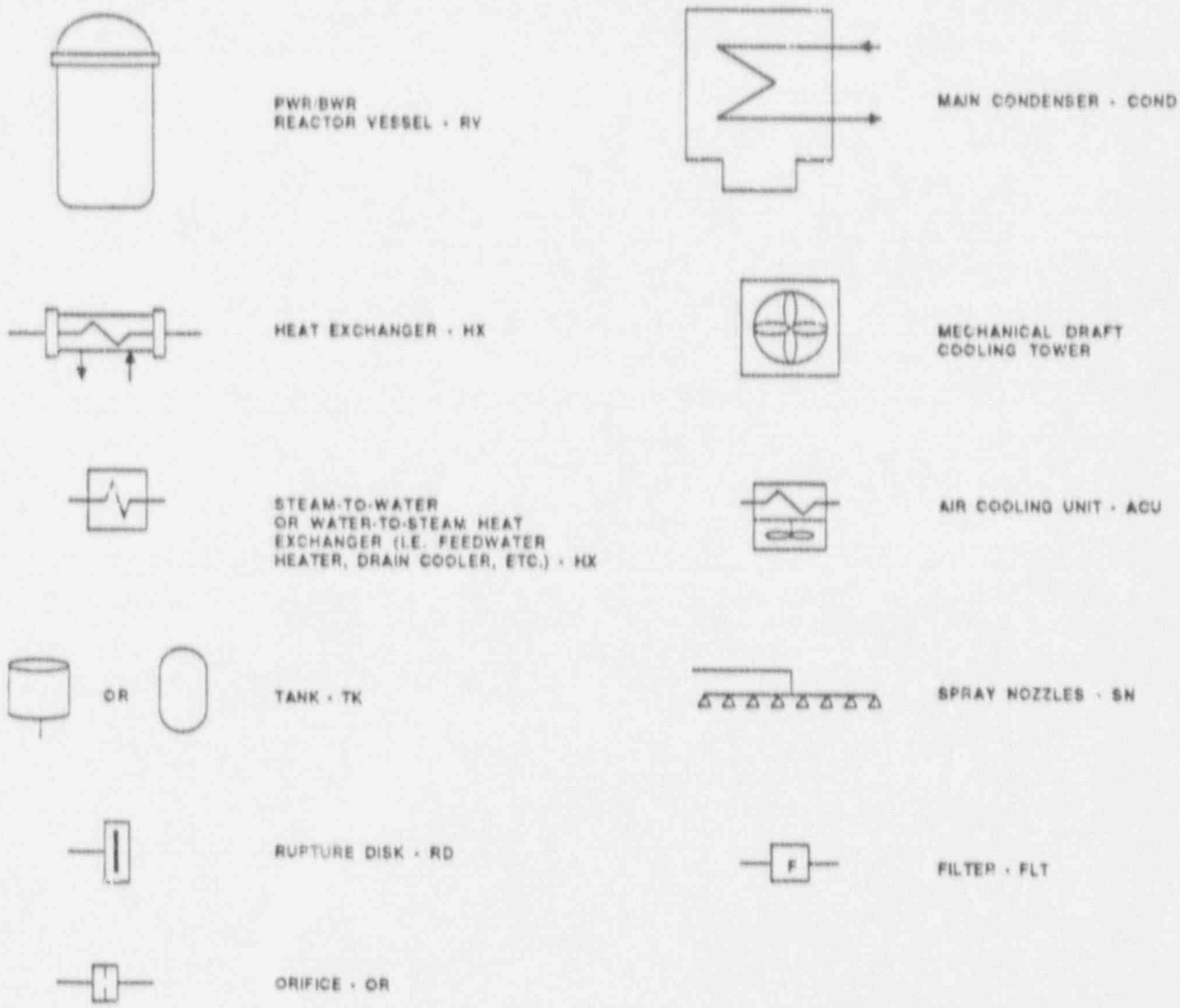

Figure A-1. Key To Symbols In Fluid System Drawings
(Continued)

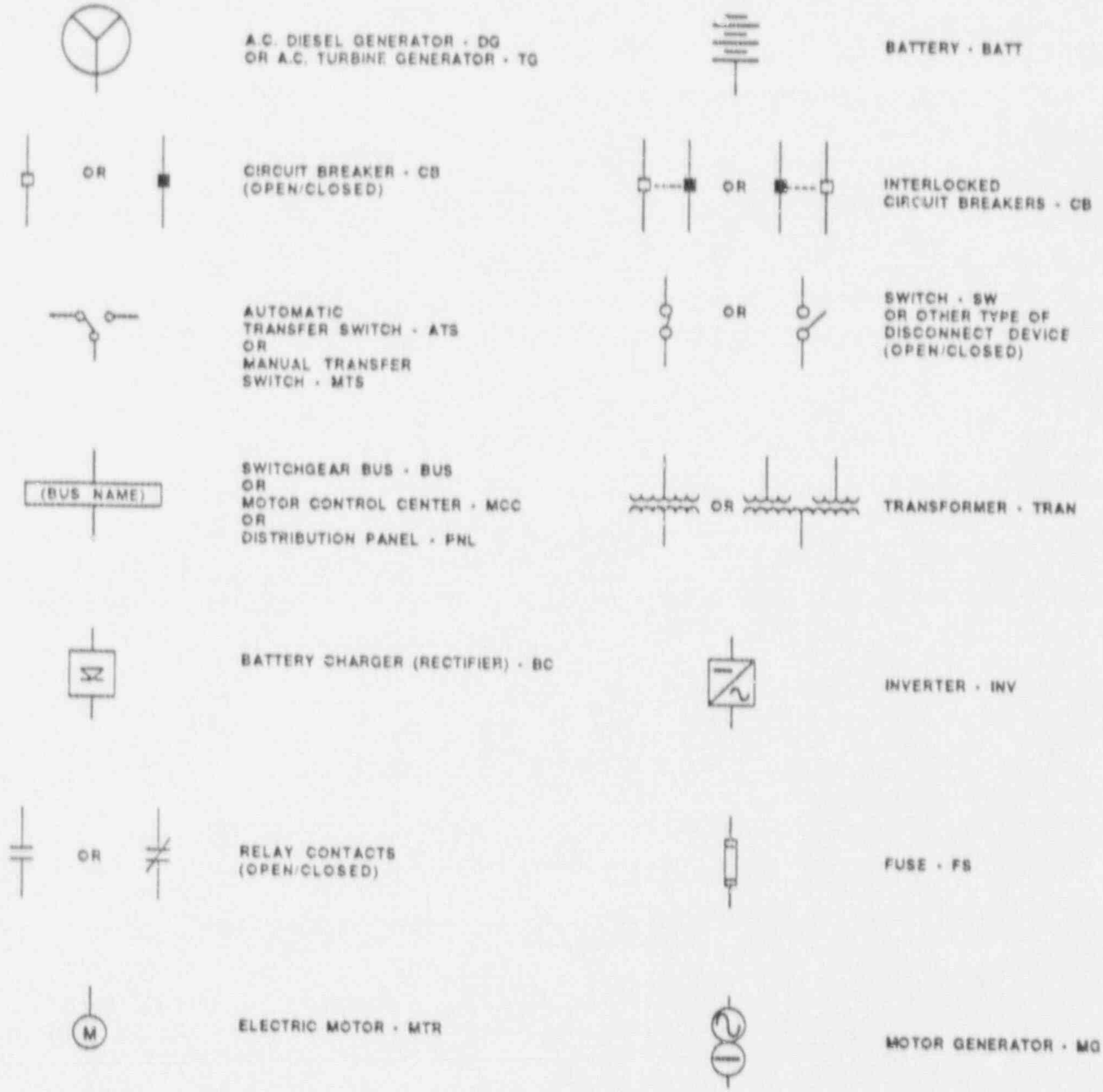

Figure A-2. Key To Symbols In Electrical System Drawings

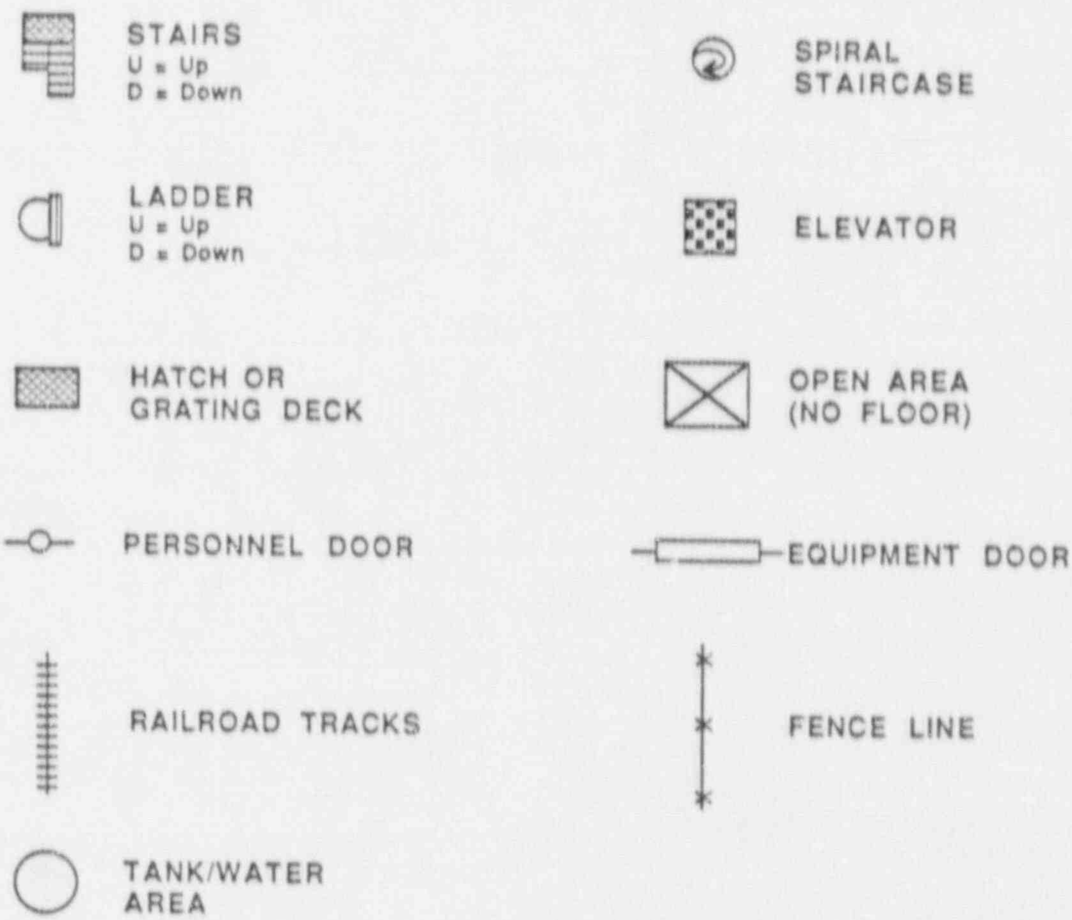

Figure A-3. Key To Symbols In Facility Layout Drawings

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
AFW	Auxiliary Feedwater System
ECCS	Emergency Core Cooling System (including HPSI and LPSI)
CVCS	Chemical and Volume Control (Charging) System
PAHRS	Containment Heat Removal Systems (including containment spray system and containment air recirculation cooling system)
EP	Electric Power System
CCS	Component Cooling System
SW	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