NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

ZION 1 & 2

50-295, 50-304

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NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

ZION 1 & 2

50-295, 50-304

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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.

ZION 1 AND 2
RECORD OF REVISIONS

REVISION	ISSUE	COMMENTS
0	11/89	Original report

ZION 1 & 2 SYSTEM SOURCEBOOK

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

1. SUMMARY DATA ON PLANT

Basic information on the Zion 1 & 2 nuclear power plants is listed below:

- Docket number	50-295 (Unit 1) and 50-304 (Unit 2)
- Operator	Commonwealth Edison Company
- Location	Zion, Illinios
- Commercial operation date	10/73 (Unit 1), 11/74 (Unit 2)
- Reactor type	PWR
- NSSS vendor	Westinghouse
- Number of loops	4
- Power (MWt/MWe)	3250/1040
- Architect-engineer	Sargent & Lundy
- Containment type	Reinforced concrete cylinder with steel liner

2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

Zion 1 and 2 utilize a Westinghouse PWR four-loop nuclear steam supply system (NSSS). Other four-loop Westinghouse plants in the United States include:

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

3. SYSTEM INFORMATION

This section contains descriptions of selected systems at Zion 1 and 2 in terms of general function, operation, system success criteria, major components, and support system requirements. A summary of major systems at Zion 1 and 2 is presented in Table 3-1. In the "Report Section" column of this table, a section reference (i.e. 3.1, 3.2, etc.) is provided for all systems that are described in this report. An entry of "X" in this column means that the system is not described in this report. In the "FSAR Section Reference" column, a cross-reference is provided to the section of the Final Safety Analysis Report where additional information on each system can be found. Other sources of information on this plant are identified in the bibliography in Section 5.

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

Table 3-1. Summary of Zion 1 & 2 Systems Covered in this Report

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor Heat Removal Systems			
- Reactor Coolant System (RCS)	Same	3.1	4
- Auxiliary Feedwater (AFW) and Secondary Steam Relief (SSR) Systems	Same	3.2	6.7
- Emergency Core Cooling Systems (ECCS)	Same		
- High-Pressure Injection & Recirculation	High Pressure Safety Injection System	3.3	6.2
- Low-Pressure Injection & Recirculation	Low Pressure Safety Injection System	3.3	6.2
- Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System)	Same	X	9.4
- Main Steam and Power Conversion Systems	Steam Flow System,	X	10.3
	Condensate and Feedwater System,	X	10.4
	Circulating Water System	X	10.5
- Other Heat Removal Systems	None identified	-	-
Reactor Coolant Inventory Control Systems			
- Chemical and Volume Control System (CVCS) (Charging System)	Same	3.4	9.2
- ECCS	See ECCS, above	-	-

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Containment Systems			
- Containment	Same	X	5, 6.6
- Containment Heat Removal Systems			
- Containment Spray System	Same	X	6.4
- Containment Fan Cooler System	Same	X	6.3
- Containment Normal Ventilation Systems	Normal Containment Ventilation System	X	9.10.6
- Combustible Gas Control Systems	None noted	X	-
Reactor and Reactivity Control Systems			
- Reactor Core	Same	X	3
- Control Rod System	Same	X	7.3
- Boration Systems	See CVCS, above	-	-
Instrumentation & Control (I&C) Systems			
- Reactor Protection System (RPS)	Same	3.5	7.2
- Engineered Safety Feature Actuation System (ESFAS)	Engineered Safety Features Systems	3.5	7.5
- Remote Shutdown System	Operating Control Stations	3.5	7.7
- Other I&C Systems	Various systems	X	7.3, 7.4

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Support Systems			
- Class 1E Electric Power System	Same	3.6	8.4
- Non-Class 1E Electric Power System	Same	X	8.2, 8.3
- Diesel Generator Auxiliary Systems	Same	3.6	8.4.3, 9.10.9
- Component Cooling Water (CCW) System	Component Cooling System	3.7	9.3
- Service Water System (SWS)	Same	3.8	9.6
- Other Cooling Water Systems	None noted	X	-
- Fire Protection Systems	Plant Fire Protection System	X	9.9
- Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems	Control Room HVAC System	X	9.10.3
- Instrument and Service Air Systems	None noted	X	-
- Refueling and Spent Fuel Systems	Same	X	9.7
- Radioactive Waste Systems	Same	X	11.1
- Radiation Protection Systems	Same	X	11.2

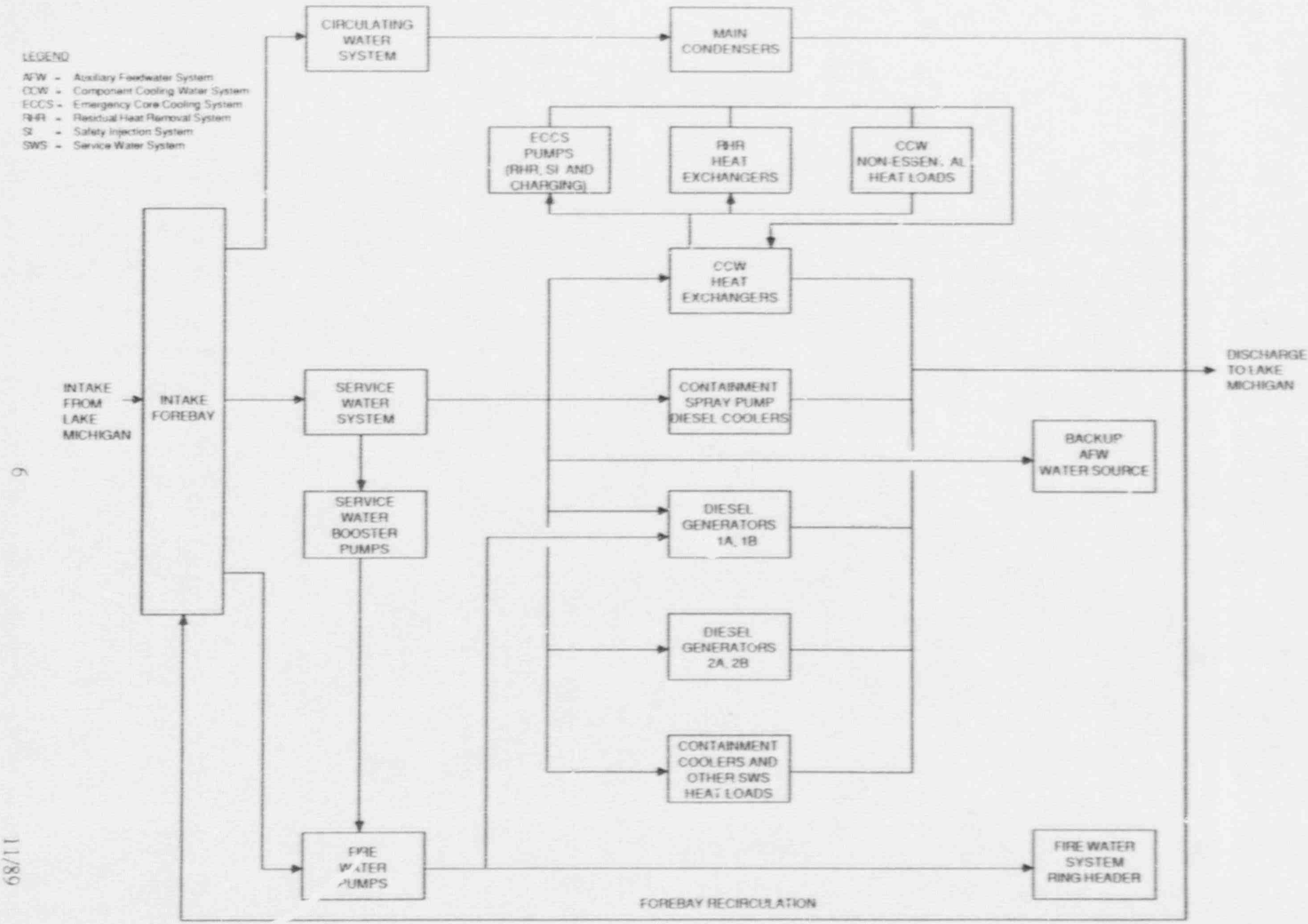


Figure 3-1. Cooling Water Systems Functional Diagram for Zion 1 and 2

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

3.1.3 System Operation

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

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

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

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

3.1.4 System Success Criteria

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

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

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

3.1.5 Component Information

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

B. Pressurizer
1. Water volume, full power: 1080 ft^3
2. Steam volume, full power: 720 ft^3

C. Reactor Coolant Pumps (4)
1. Rated flow: 87,500 gpm @ 282 ft. head
2. Type: Vertical single-stage mixed flow

D. Power-Operated Relief Valves (2)
1. Set pressure: 2335 psig
2. Relief capacity: 210,000 lb/hr (each)

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

F. Steam Generators (4)
1. Type: Vertical shell and U-Tube
2. Heat Transfer Rate: 2.772×10^9 Btu/hr

3.1.6 Support Systems and Interfaces

A. Motive Power
1. The reactor coolant pumps are supplied from Non-Class 1E switchgear.
2. The pressurizer heaters are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.6.

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 in leakage of seal water into the RCS. Loss of seal water flow may result in RCS leakage through the pump shaft seals which will resemble a small LOCA.

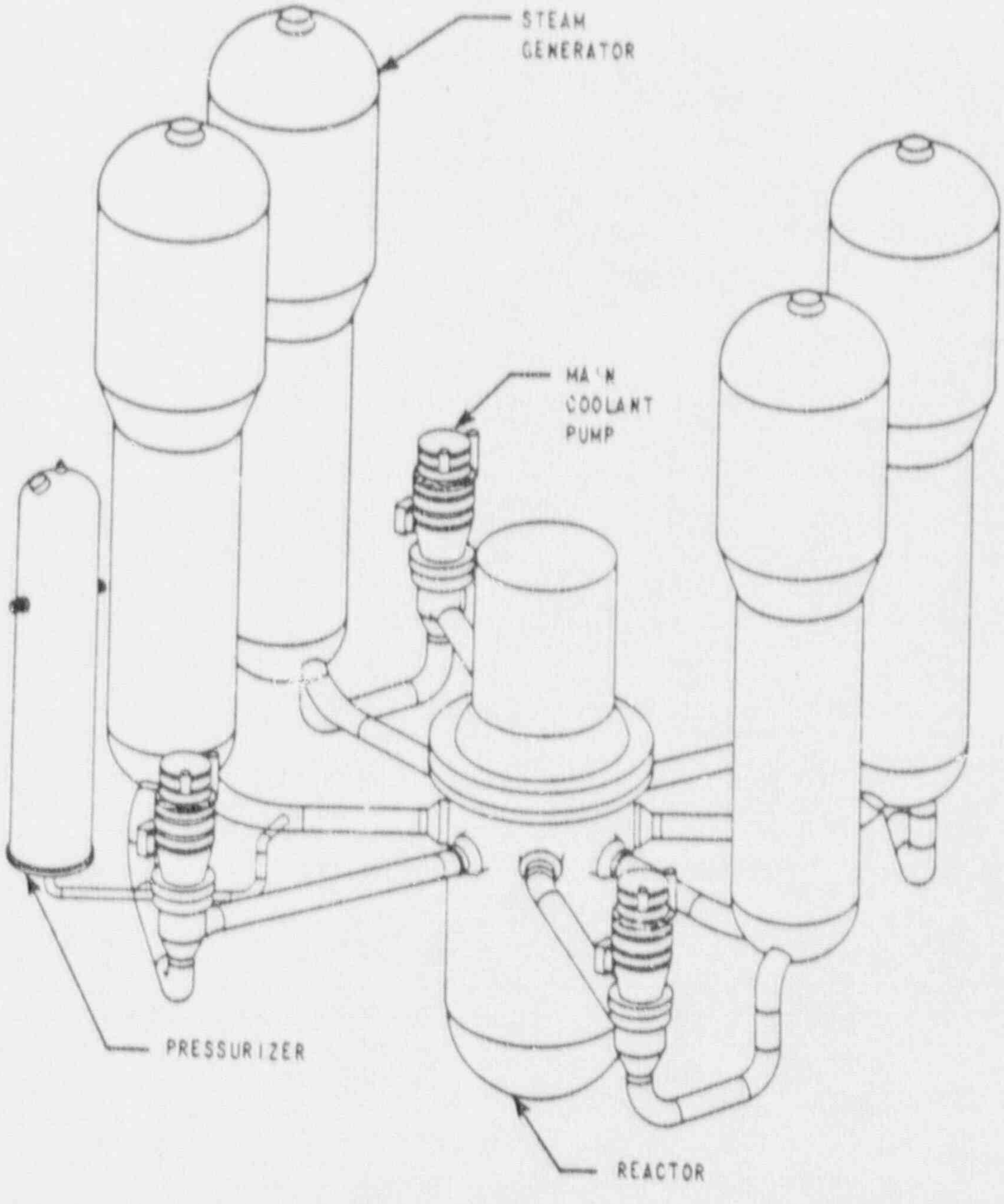


Figure 3.1-1. Isometric View of a 4-Loop Westinghouse RCS.

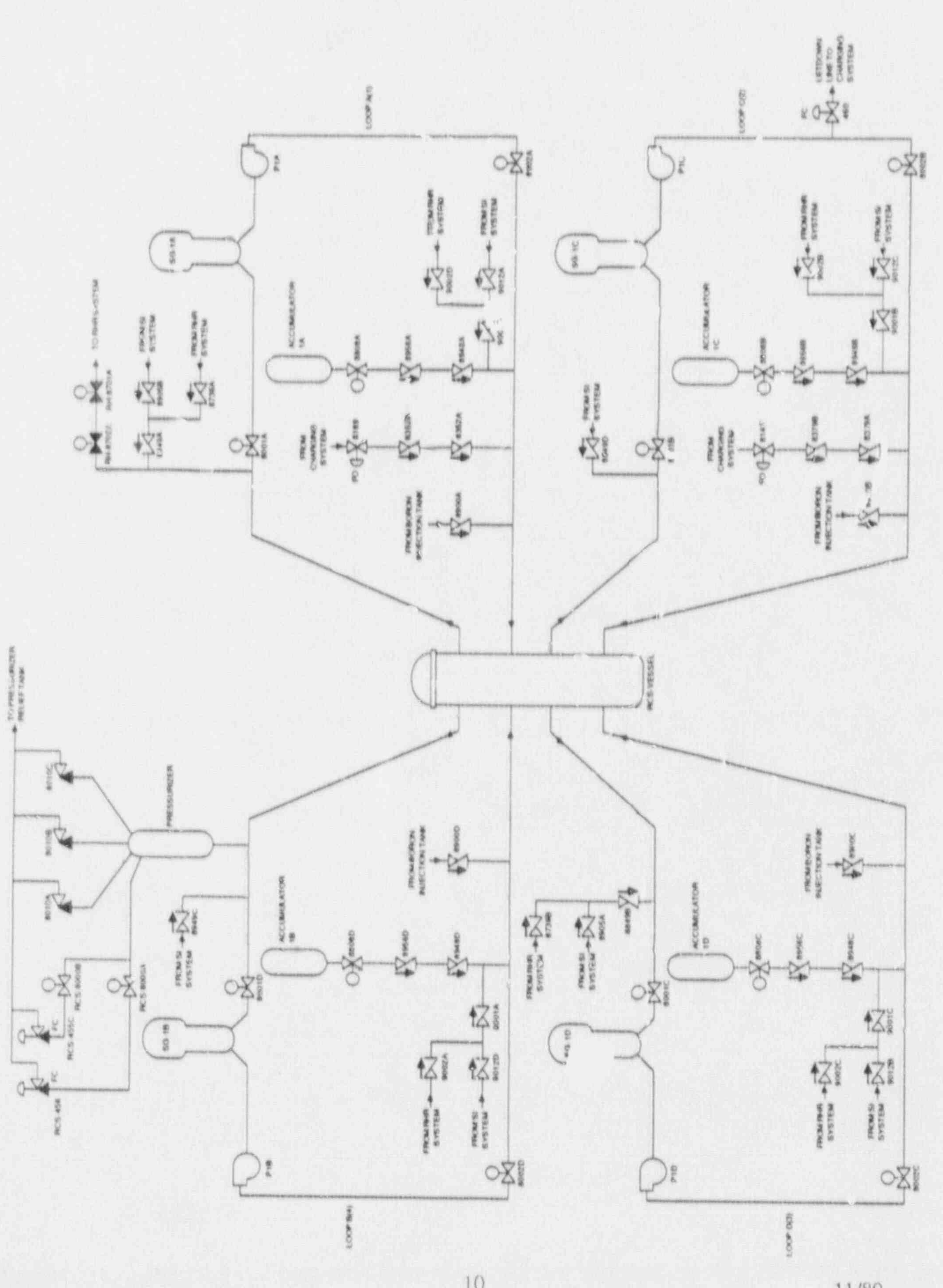


Figure 3.1-2. Zion 1 Reactor Coolant System

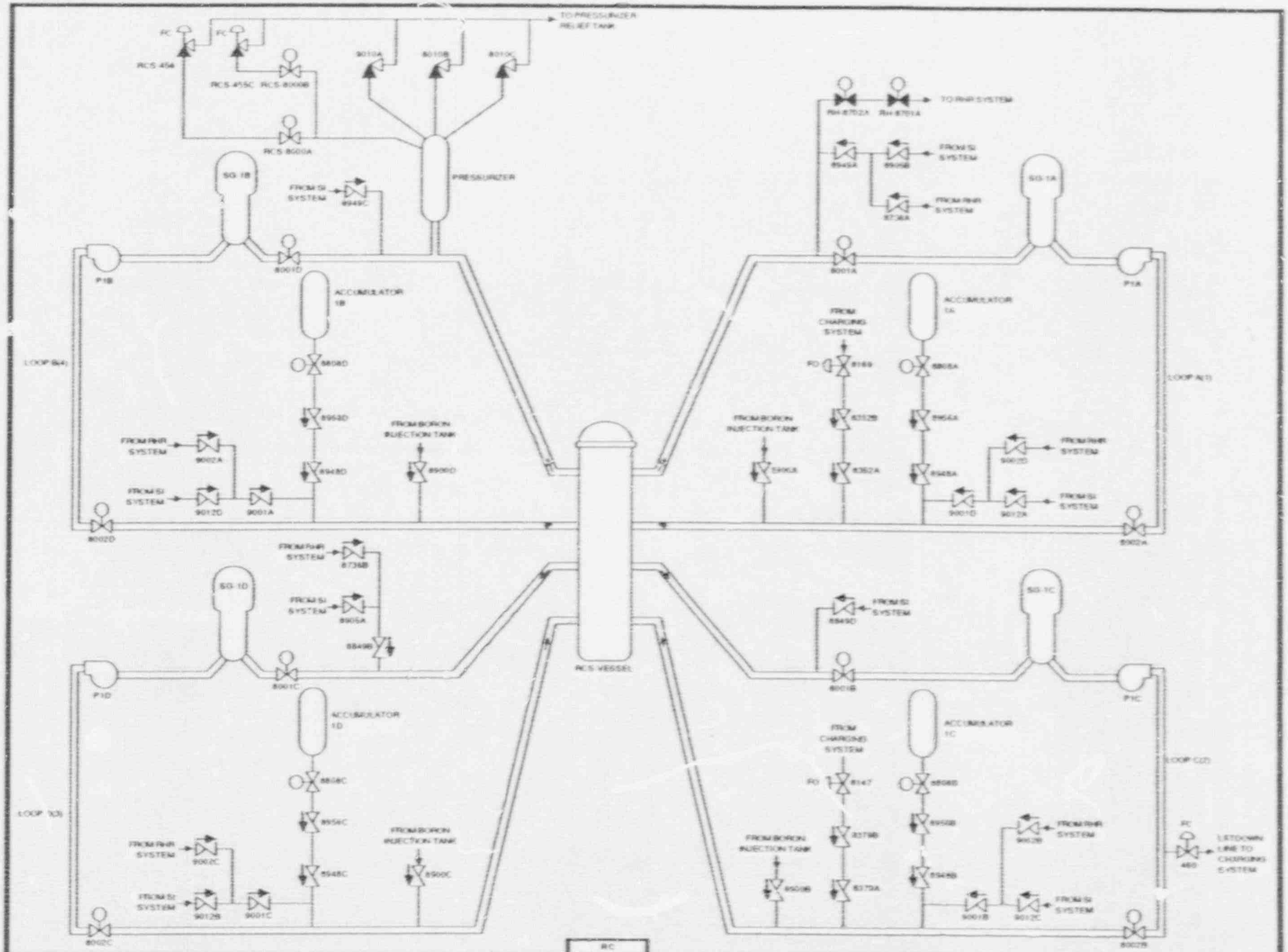


Figure 3.1-3. Zion 1 Reactor Coolant System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RCS-455C	NV	RC				
RCS-456	NV	RC				
RCS-8000A	MOV	RC	MCC-1393A	480	1393A	AC/19
RCS-8000B	MOV	RC	MCC-1393A	480	1393A	AC/19
RCS-VESSEL	RV	RC				
RH-8701	MOV	RC	MCC-1391	480	SWGRM149	AC/19
RH-8702	MOV	RC	MCC-1381A	480	SWGRM148	AC/18

3.2 AUXILIARY FEEDWATER SYSTEM (AFWS) AND SECONDARY STEAM RELIEF SYSTEM (SSRS)

3.2.1 System Function

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

3.2.2 System Definition

The AFWS consists of two subsystems. One subsystem utilizes a turbine-driven pump, the other utilizes two motor-driven pumps. Both subsystems can deliver feedwater to all four steam generators. A normally closed crossover exists between the two subsystems. The turbine-driven pump can be supplied with steam from either steam line A or D. The water supply for the pumps is the condensate storage tank (CST). As a backup, the service water system can supply water to the AFW pumps suction.

The SSRS consists of five safety valves and one pneumatically operated atmospheric dump valve on each of the four main steam lines.

Simplified drawings of the AFWS and the SSRS are shown in Figures 3.2-1 and 3.2-2. A summary of data on selected AFWS components is presented in Table 3.2-1.

3.2.3 System Operation

During normal operation the AFWS is in standby. The motor-driven pumps are started on either a low-low level in any steam generator, a safety injection signal, or a loss of electrical power. The turbine-driven pump will start on either a low-low level in any two steam generators or a complete loss of electrical power.

Suction to the pumps is provided by the CST, with the service water system as a back-up. The capacity of the CST is 500,000 gallons. A minimum of 170,000 gallons are required for 2 hours at hot standby, followed by 4 hours of cooldown at 50°F/hour. An alarm is provided on the CST to indicate that the 170,000 gallon level has been reached and that makeup to the tank is required. It should be noted that for a single motor-driven pump to maintain full flow (450 gpm) over the 8 hour extended hot shutdown period, 216,000 gallons are required. However, flow can be throttled as the decay heat is reduced.

All three pumps have sufficient head to deliver their rated capacity to the steam generators at the safety valve setpoint. At any pressure condition, steam from either line A or D will be adequate for operation of the turbine-driven pump.

Auxiliary feedwater control is accomplished manually by means of an air-operated control valve in each line to the steam generators. Should the air supply fail, motor-operated valves can be utilized for flow control.

3.2.4 System Success Criteria

For the decay heat removal function to be successful, both the AFWS and the SSRS must operate successfully. The AFWS success criteria are the following:

- Makeup to any two of four steam generators provides adequate decay heat removal from the Reactor Coolant System (Ref. 1).
- The turbine driven pump or either of the motor driven pumps can provide adequate flow.

- The condensate storage tank or the service water system is an adequate source of water for the AFWS pumps.

3.2.5 Component Information

A. Motor-driven AFWS pumps 1B, 1C
   1. Rated flow: 450 gpm @ 3099 ft. head (1344 psid)
   2. Rated capacity: 100%
   3. Type: Horizontal centrifugal

B. Turbine-driven AFWS pump 1A
   1. Rated flow: 900 gpm @ 3099 ft. head (1344 psid)
   2. Rated capacity: greater than 100%
   3. Type: Horizontal centrifugal

C. Condensate Storage Tank
   1. Capacity: 500,000 gallons

3.2.6 Support Systems and Interfaces

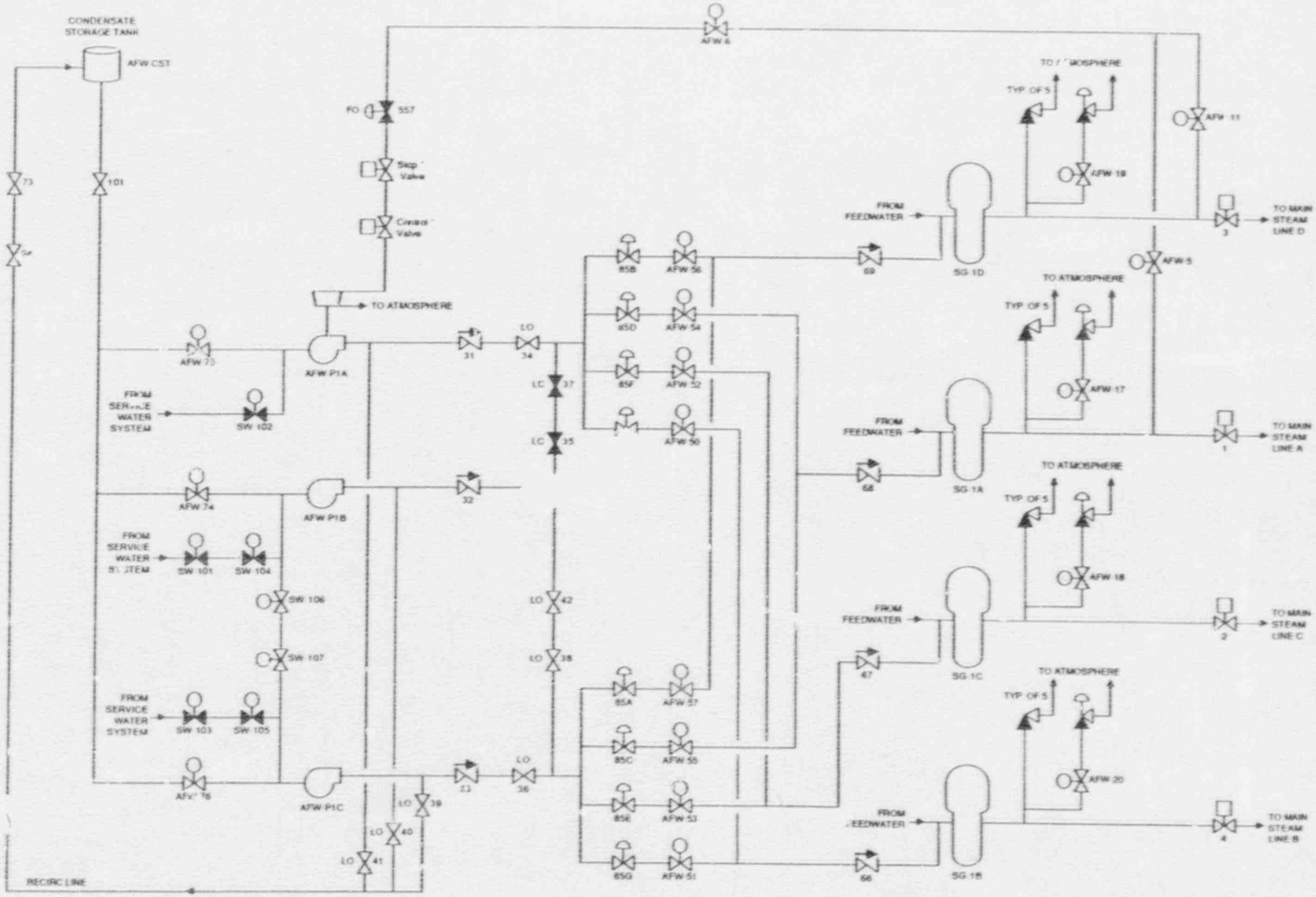
A. Control Signals
   1. Automatic
      The AFW motor-driven pumps are automatically actuated on either a low-low level in any steam generator, a safety injection signal, or a loss of electrical power. The AFW turbine-driven pump is automatically actuated on either a low-low level in any two steam generators or a complete loss of electrical power.
   2. Remote manual
      The AFWS can be operated from the control room.

B. Motive Power
   1. The motor driven AFWS pumps and motor operated valves are Class 1E loads that can be supplied from the standby diesel generators as described in Section 3.6.
   2. The turbine-driven pump is supplied with steam from the main steam lines of either steam generator A or D upstream of the main steam line isolation valves. The power and controls for the steam supply valves are assumed to be supplied from the Class 1E DC system.

C. Other
   1. Lubrication and cooling are provided locally for the AFWS pumps.
   2. Systems for AFWS pump room cooling have not been identified.

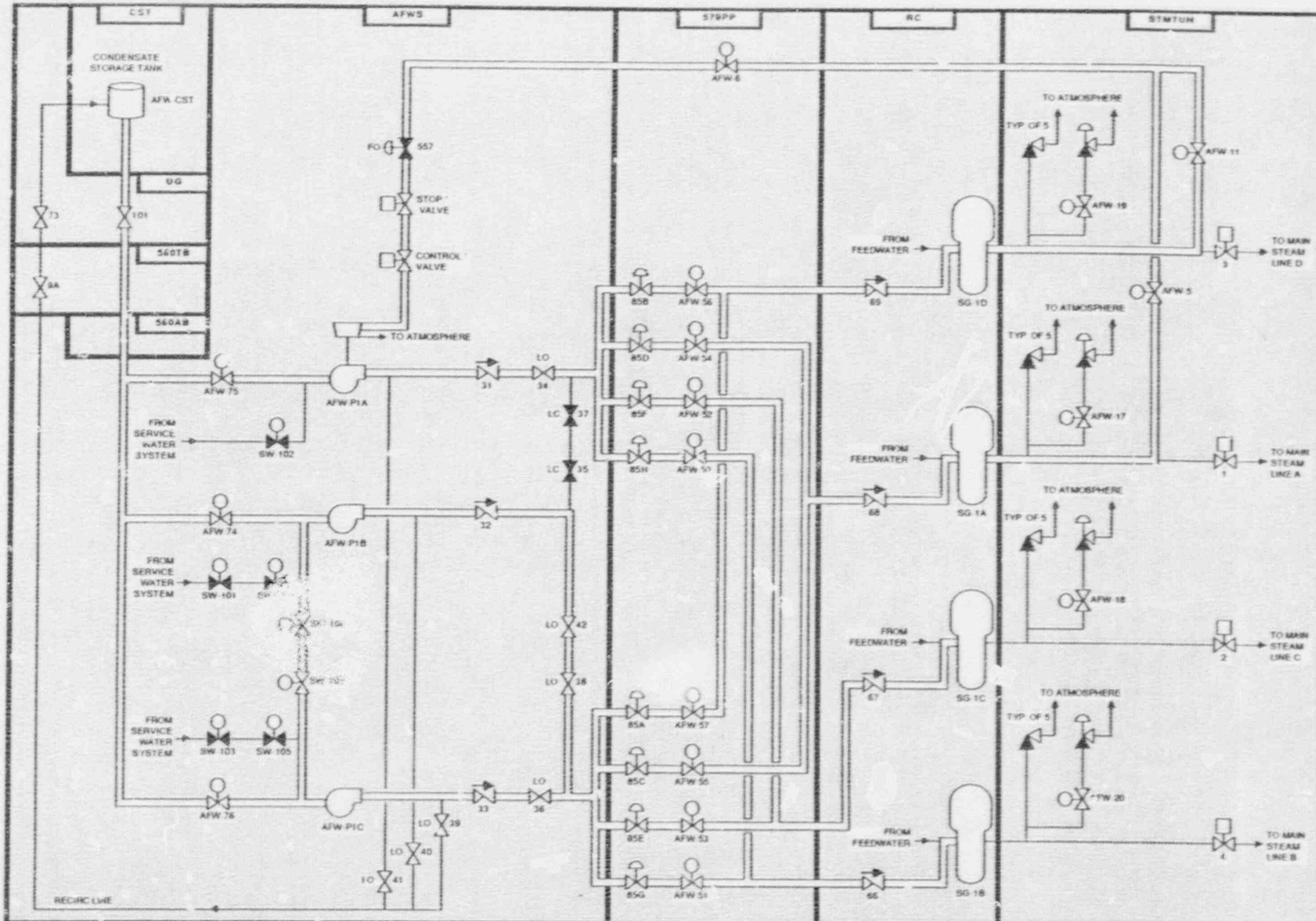
3.2.7 Section 3.2 References

1. Zion 1 and 2 Final Safety Analysis Report, Section 6.7



* VALVE TYPE IS ASSUMED TO BE HYDRAULIC

Figure 3.2-1. Zion 1 Auxiliary Feedwater System



* VALVE TYPE IS ASSUMED TO BE HYDRAULIC

Figure 3.2-2. Zion 1 Auxiliary Feedwater System Showing Component Locations

Table 3.2-1. Zion 1 Auxiliary Feedwater System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
AFW-11	MOV	STMTUN	MCC-1391	480	SWGRM149	AC/19
AFW-17	MOV	STMTUN	MCC-1371	480	SWGRM147	AC/17
AFW-18	MOV	STMTUN	MCC-1381B	480	SWGRM148	AC/18
AFW-19	MOV	STMTUN	MCC-1391	480	SWGRM149	AC/19
AFW-20	MOV	STMTUN	MCC-1391	480	SWGRM149	AC/19
AFW-5	MOV	STMTUN	MCC-1371	480	SWGRM147	AC/17
AFW-50	MOV	579PP	MCC-1383A	480	1383A	AC/18
AFW-51	MOV	579PP	MCC-1393A	480	1393A	AC/19
AFW-52	MOV	579PP	MCC-1393C	480	1393C	AC/19
AFW-53	MOV	579PP	MCC-1383A	480	1383A	AC/18
AFW-54	MOV	579PP	MCC-1393A	480	1393A	AC/19
AFW-55	MOV	579PP	MCC-1383A	480	1383A	AC/18
AFW-56	MOV	579PP	MCC-1383A	480	1383A	AC/18
AFW-57	MOV	579PP	MCC-1393C	480	1393C	AC/19
AFW-6	MOV	579PP	MCC-1381A	480	SWGRM148	AC/18
AFW-74	MOV	AFWS	MCC-1383A	480	1383A	AC/18
AFW-75	MOV	AFWS	MCC-1393B	480	1393B	AC/18
AFW-76	MOV	AFWS	MCC-1393A	480	1393A	AC/19
AFW-CST	TANK	CST				
AFW-P1A	TDP	AFWS				
AFW-P1B	MDP	AFWS	BUS-148	4160	SWGRM148	AC/18
AFW-P1C	MDP	AFWS	BUS-149	4160	SWGRM149	AC/19
SG-A	SG	RC				
SG-B	SG	RC				
SG-C	SG	RC				
SG-D	SG	RC				
SW-101	MOV	AFWS	MCC-1383A	480	1383A	AC/18

Table 3.2-1. Zion 1 Auxiliary Feedwater System Data Summary for Selected Components (Continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
SW-102	MOV	AFWS	MCC-1393A	480	1393A	AC/19
SW-103	MOV	AFWS	MCC-1393A	480	1393A	AC/19
SW-104	MOV	AFWS	MCC-1383A	480	1383A	AC/18
SW-105	MOV	AFWS	MCC-1393C	480	1393C	AC/19
SW-106	MOV	AFWS	MCC-1383A	480	1383A	AC/18
SW-107	MOV	AFWS	MCC-1383A	480	1383A	AC/18

3.3 EMERGENCY CORE COOLING SYSTEM (ECCS)

3.3.1 System Function

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

3.3.2 System Definition

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

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

There are four accumulators, one attached to each cold leg, that discharge their contents when RCS pressure drops below the tank pressure. The charging system's two centrifugal charging pumps pump through the boron injection tank to deliver borated water to the RCS. The charging pumps can also inject into the RCS through the normal charging path via the regenerative heat exchanger. The safety injection system consists of two motor driven pumps that deliver water to an injection header. The header directs flow to the four cold legs. The RHR system consists of two motor driven pumps that deliver water to the four cold legs. During the recirculation phase the RHR pumps can also deliver water to the suction of the charging and safety injection pumps. The RHR pumps also provide the shutdown cooling function. The Refueling Water Storage Tank (RWST) is the water source for the ECCS pumps during the injection phase. During recirculation the RHR pumps take suction on the containment sump.

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. The charging system is discussed in Section 3.4. A summary of data on selected ECCS components is presented in Table 3.3-1.

3.3.3 System Operation

During normal operation, the ECCS is in standby. The ECCS pumps are automatically actuated by any of the following Safety Injection Signals:

- Low pressurizer pressure coincident with low pressurizer water level
- High containment pressure
- High differential pressure between any two steam lines outside containment
- High steam flow in two of four lines in coincidence with either low T_{avg} or low steam line pressure
- Manual actuation

The accumulators constitute a passive injection system, discharging their contents automatically when RCS pressure drops below the tank pressure. Sufficient borated water is supplied in the four tanks to rapidly fill the volume outside of the core barrel below the nozzles, the bottom plenum, and a portion of the core with the contents of one tank assumed to be lost through the break. During injection, the charging, safety injection, and RHR pumps take suction on the RWST and deliver borated water to the four cold legs. The relative importance of the charging and safety injection pumps is increased for small breaks when the RCS is still at high pressure, while the RHR pumps are important in responding to large breaks.

When the RWST reaches a low level alarm setpoint, the operator takes action to begin the recirculation phase. This phase of operation has two modes, cold leg recirculation and hot leg recirculation. In both modes the RHR pumps take suction on the containment sump and deliver water through the RHR heat exchangers directly to the RCS and to the suction of the charging and safety injection pumps. Initially, the discharge of these three sets of pumps flows to the same cold leg injection points used during the injection phase. Later, the safety injection and RHR pumps are realigned to deliver to two separate hot leg injection points. The switch to hot leg recirculation is made in order that subcooling of the core may be completed.

3.3.4 System Success Criteria

The success criteria for the ECCS is not clearly defined in the Zion 1 and 2 FSAR (Ref. 1). LOCA mitigation requires both emergency coolant injection (ECI) and emergency coolant recirculation (ECR) functions. The four accumulators, two centrifugal charging pumps, two safety injection pumps, and two residual heat removal pumps are all utilized to respond to both large and small LOCAs, with the accumulators and RHR pumps more important for large LOCAs and the charging and safety injection pumps more important for small LOCAs. The ECCS is designed to be successful with a single active failure and one RCS loop assumed to be out of service due to the break.

The RWST is required for system success during the injection phase. The containment sump and one of two RHR pumps is required for system success during the recirculation phase.

For small LOCAs that do not result in RCS depressurization below the safety injection pump shutoff head the charging pumps are required (number unknown), or the RCS must be depressurized by other means if the safety injection pumps are to provide makeup. Options for depressurizing the RCS may include:

- Opening power-operated relief valves on the pressurizer (two PORVs are available, see Section 3.1)
- RCS cooldown (i.e. using auxiliary feedwater system, see Section 3.2)

The capacity of the centrifugal charging pumps is 150 gpm at RCS operating pressure.

3.3.5 Component Information

A. Safety Injection pumps 1A, 1B
   1. Rated flow: 400 gpm @ 2500 ft. head
   2. Maximum flow: 650 gpm @ 1500 ft. head (1084 psid)
   3. Shutoff head: 1500 psig (650 psid)
   4. Type: Horizontal multistage centrifugal

B. Residual Heat Removal pumps 1A, 1B
   1. Rated flow: 3000 gpm @ 350 ft. head (152 psid)
   2. Maximum flow: 4500 gpm @ 300 ft. head (130 psid)
   3. Type: Vertical single stage centrifugal

C. Centrifugal charging pumps 1A, 1B
   1. Rated flow: 150 gpm @ 5800 ft. head (2515 psid)

2. Maximum flow: 550 gpm @ 1300 ft. head (564 psid)
3. Type: Horizontal multi-stage centrifugal

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

E. Refueling Water Storage Tank
1. Capacity: 389,000 gallons
2. Operating pressure: atmospheric

F. Boron Injection Tank
1. Volume: 900 gallons
2. Operating pressure: 2340 psig

G. RHR Heat Exchangers (2)
1. Type: Vertical shell and U-tube

3.3.6 Support Systems and Interfaces

A. Control Signals
1. Automatic
The ECCS subsystems are automatically actuated on any of the following safety injection signals.

- Low pressurizer pressure coincident with low pressurizer water level
- High containment pressure
- High differential pressure between any two steam lines outside of containment
- High steam flow in two of four lines in coincidence with either low T_{avg} or low steam line pressure
- Manual actuation

The SIAS automatically initiates the following actions:

- reactor trip
- starts the diesel generators
- starts the charging, safety injection, and RHR pumps
- opens the boron injection tank isolation valves and charging pump RWST suction valves
- produces a phase A containment isolation signal

2. Remote manual
a. A safety injection signal can be initiated by remote manual means from the control room. ECCS operation can be initiated by remote manual means.

b. The switchover to the recirculation mode requires operator action.

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

C. Other
1. Lube oil cooling for the charging, safety injection, and RHR pumps is provided by the Component Cooling Water System (see Section 3.7).
2. Cooling water is provided locally for the ECCS pumps and motors.
3. Systems for ECCS pump room cooling have not been identified.
4. The RHR heat exchanges are cooled by the Component Cooling Water System.

3.3.7 Section 3.3 References

1. Zion 1 and 2 Final Safety Analysis Report, Section 6.2

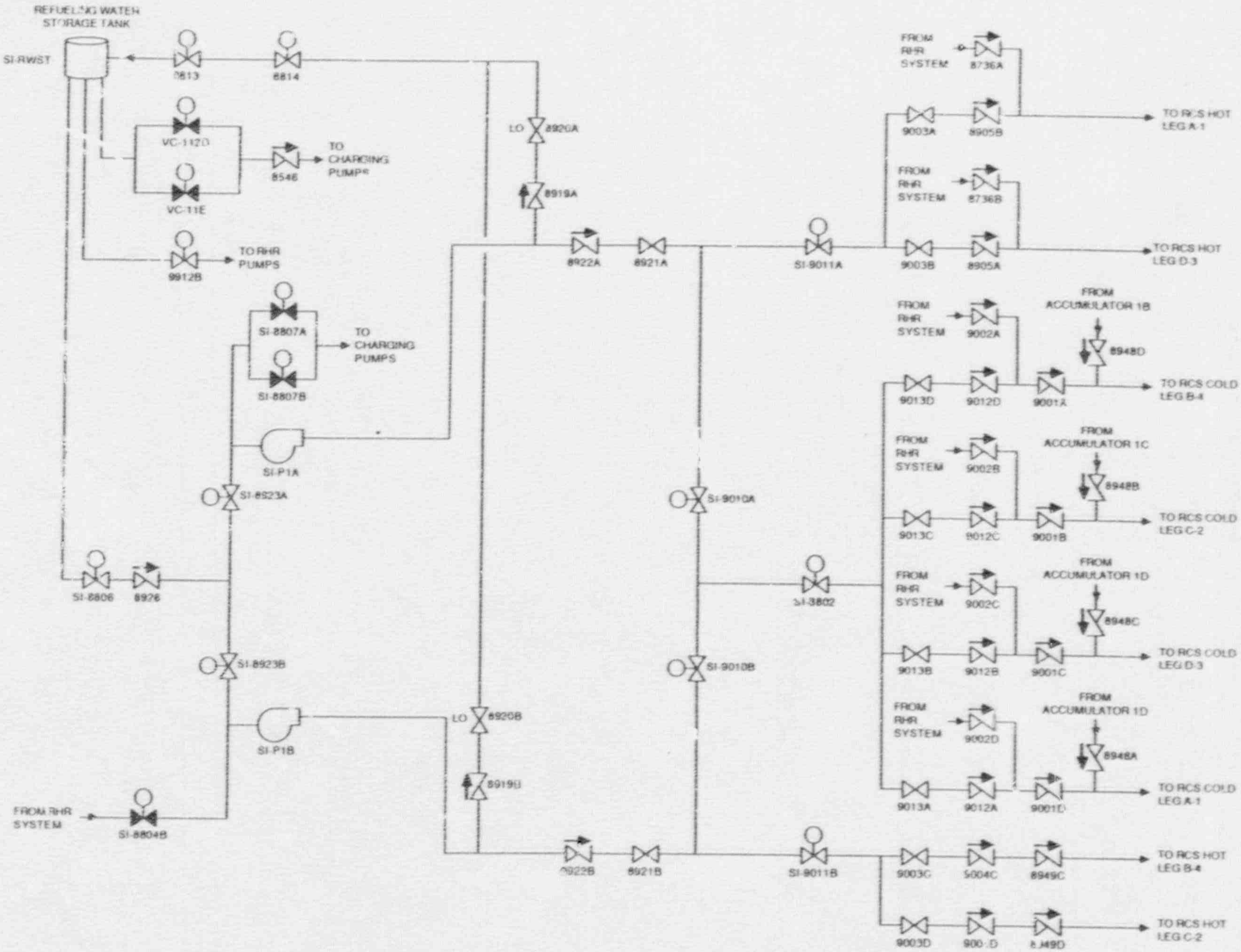


Figure 3.3-1. Zion 1 Safety Injection System

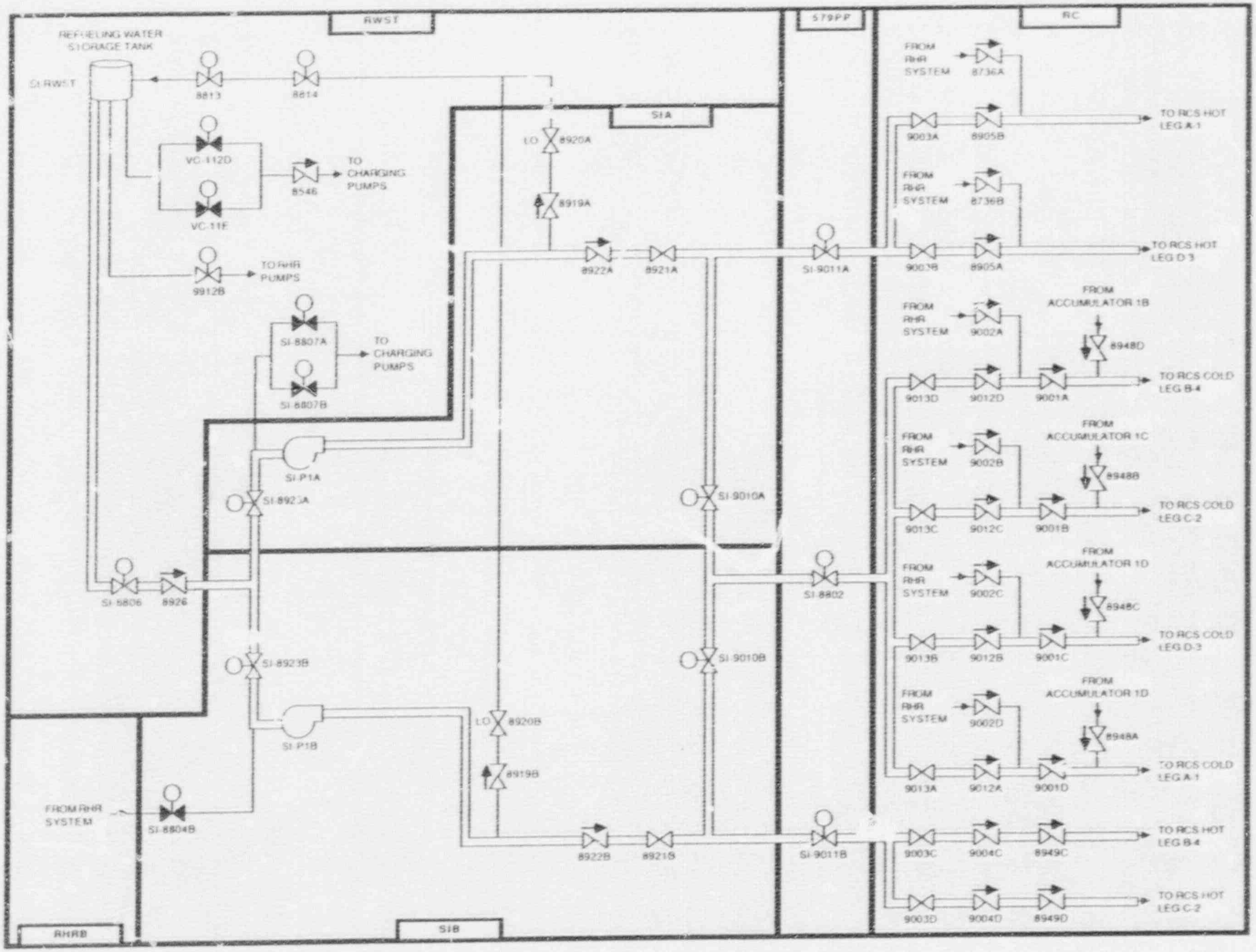


Figure 3.3-2. Zion 1 Safety Injection System Showing Component Locations

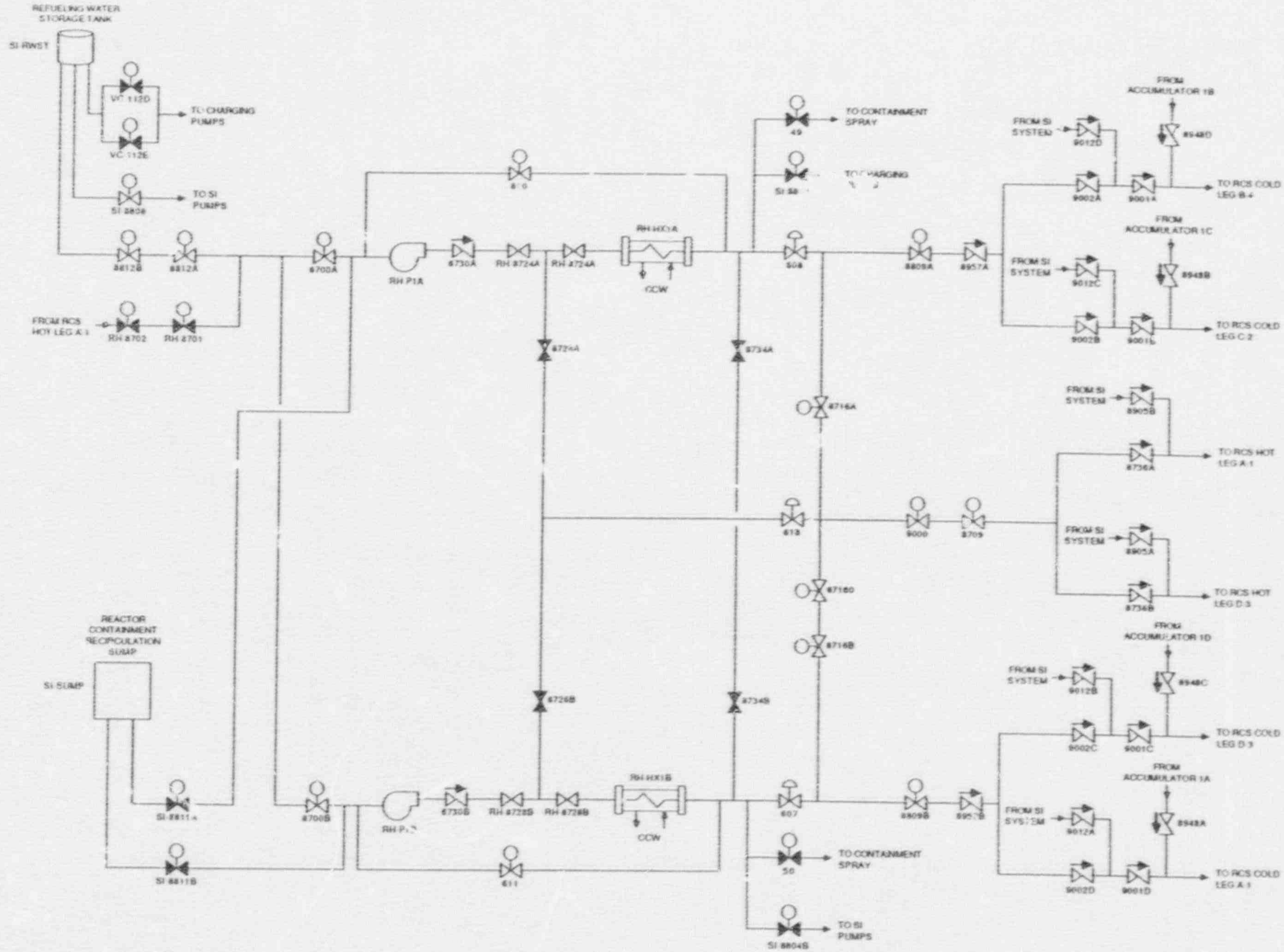


Figure 3.3-3. Zion 1 Residual Heat Removal System

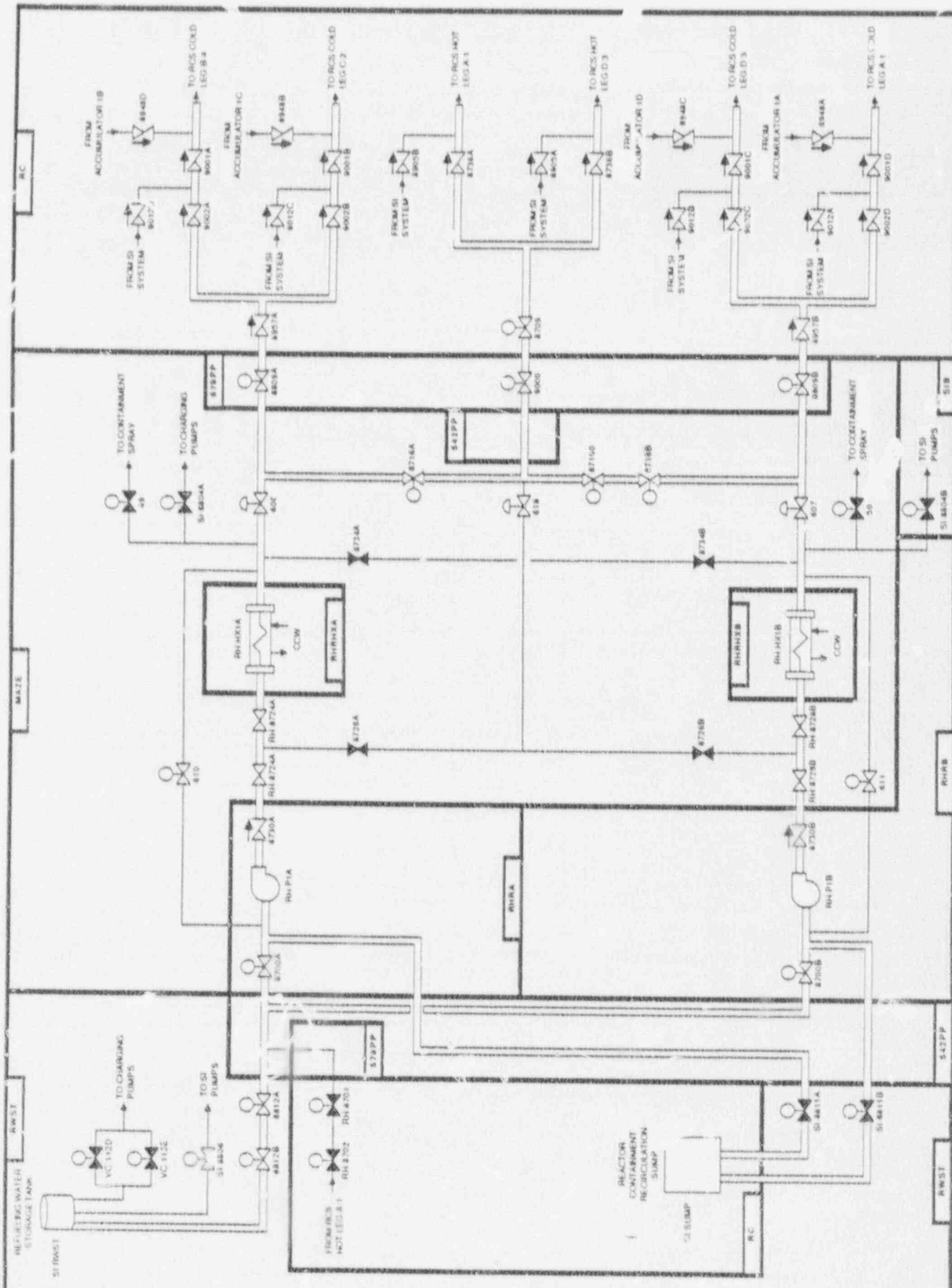


Figure 3.3-4. Zion 1 Residual Heat Removal System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CCW-9412A	MOV	RHRHXA	MCC-1391	480	SWGRM149	AC/19
CCW-9412B	MOV	RHRHXB	MCC-1381B	480	SWGRM148	AC/18
RH-8724A	XV	MAZE				
RH-8724B	XV	MAZE				
RH-8728A	XV	MAZE				
RH-8728B	XV	MAZE				
RH-HX1A	HX	RHRHXA				
RH-HX1B	HX	RHRHXB				
RH-P1A	MDP	RHRA	BUS-149	4160	SWGRM149	AC/19
RH-P1B	MDP	RHRB	BUS-148	4160	SWGRM148	AC/18
SI-8800A	MOV	RC	MCC-1371	480	SWGRM147	AC/17
SI-8800B	MOV	RC	MCC-1393A	480	1393A	AC/19
SI-8800C	MOV	RC	MCC-1371	480	SWGRM147	AC/17
SI-8800D	MOV	RC	MCC-1372	480	1372	AC/17
SI-8801A	MOV	579PP	MCC-1371	480	SWGRM147	AC/17
SI-8801B	MOV	579PP	MCC-1393B	480	1393B	AC/19
SI-8802	MOV	579PP	MCC-1383A	480	1383A	AC/18
SI-8803A	MOV	579PP	MCC-1371	480	SWGRM147	AC/17
SI-8803B	MOV	579PP	MCC-1393B	480	1393B	AC/19
SI-8804A	MOV	MAZE	MCC-1393A	480	1393A	AC/19
SI-8804B	MOV	SIB	MCC-1383A	480	1383A	AC/18
SI-8806	MOV	RWST	MCC-1383A	480	1383A	AC/18
SI-8807A	MOV	RWST	MCC-1393A	480	1393A	AC/19
SI-8807B	MOV	RWST	MCC-1383B	480	1383B	AC/18
SI-8811A	MOV	RWST	MCC-1393A	480	1393A	AC/19
SI-8811B	MOV	RWST	MCC-1383A	480	1383A	AC/18
SI-8923A	MOV	SIA	MCC-1372	480	1372	AC/17

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
SI-8923B	MOV	SIB	MCC-1383A	480	1383A	AC/18
SI-9010A	MOV	SIA	MCC-1372	480	1372	AC/[illegible]
SI-9010B	MOV	SIB	MCC-1383B	480	1383B	AC/18
SI-9011A	MOV	579PP	MCC-1372	480	1372	AC/17
SI-9011B	MOV	579PP	MCC-1383B	480	1383B	AC/18
SI-P1A	MDP	SIA	BUS-147	4160	SWGRM147	AC/17
SI-P1B	MDP	SIB	BUS-148	4160	SWGRM148	AC/18
SI-SUMP	TANK	RC				
VC-8105	MOV	579PP	MCC-1371	480	SWGRM147	AC/17
VC-8106	MOV	579PP	MCC-1393C	480	1393C	AC/19

3.4 CHARGING SYSTEM

3.4.1 System Function

The charging system is part of the Chemical and Volume Control System (CVCS). The CVCS is responsible for maintaining the proper water inventory in the Reactor Coolant System, providing required seal water flow to the reactor coolant pump seals, and maintaining water purity and the proper concentration of neutron absorbing and corrosion inhibiting chemicals in the reactor coolant. The charging system also provides borated water for safety injection (see ECCS, Section 3.3). The makeup function of the CVCS is required to maintain the plant in an extended hot shutdown condition following a transient.

3.4.2 System Definition

The CVCS consists of several subsystems that perform the functions of maintaining RCS coolant inventory control, coolant chemistry and purity control, and reactivity control. The charging system consists of two centrifugal and one positive displacement charging pumps that, during normal operation, take suction from the volume control tank and inject into the RCS. The normal charging path is through the regenerative heat exchanger. The charging pumps can also be aligned to take suction from the RWST and inject through the boron injection tank or through the regenerative heat exchanger, following a LOCA.

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

3.4.3 System Operation

During normal operation, reactor coolant flows through the letdown line and is returned by the charging pumps. Letdown flow from RCS cold leg C(2) passes through the shell side of the regenerative heat exchanger for an initial temperature reduction. The pressure is then reduced by a letdown orifice. The cooled, low pressure water leaves the containment and enters the auxiliary building where it undergoes a second temperature reduction in the tube side of the letdown heat exchanger, followed by a second pressure reduction by the low pressure letdown valve. Flow is then directed through various filters and ion exchangers before being sprayed into the volume control tank (VCT) where it is returned to the RCS by the charging pumps.

The charging flow passes through the tube side of the regenerative heat exchanger for recovery of heat from the letdown flow before being returned to the RCS. Charging flow is split into two charging lines, to cold legs A(1) and C(2). Should the charging line inside the reactor containment building be inoperative for any reason, the line may be isolated outside the containment, and the charging flow may be injected via the pressurizer auxiliary spray line. A portion of the charging flow is filtered and injected into the reactor coolant pump seals.

The centrifugal charging pumps serve as part of the ECCS following a LOCA. Suction is switched from the VCT to the RWST, and the boron injection tank isolation valves are opened. In the recirculation phase the RHR pumps deliver water from the containment sump to the suction of the charging pumps.

3.4.4 System Success Criteria

The following success criteria is assumed for CVCS makeup to the RCS following a transient:

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

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

3.4.5 Component Information

A. Centrifugal charging pumps 1A, 1B
  1. Rated flow: 150 gpm @ 5800 ft. head (2515 psid)
  2. Maximum flow: 550 gpm @ 1300 ft. head (564 psid)
  3. Type: Horizontal multi-stage centrifugal

B. Positive displacement charging pump 1C
  1. Rated flow: 98 gpm @ 5800 ft. head (2515 psid)
  2. Type: Positive displacement

C. Refueling Water Storage Tank
  1. Capacity: 389,000 gallons
  2. Operating pressure: atmospheric

D. Boron Injection Tank
  1. Volume: 900 gallons
  2. Operating pressure: 2340 psig

E. Volume control tank
  1. Volume: 400 ft^3
  2. Operating pressure: 15 psig

3.4.6 Support Systems and Interfaces

A. Control Signals
  1. Automatic
     A safety injection signal automatically starts all 3 charging pumps, causes pump suction to change from the VCT to the RWST, and opens the boron injection tank isolation valves.
  2. Remote manual
     The charging pumps and associated motor operated valves can be actuated by remote means from the control room.

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

C. Other
  1. Lube oil cooling for the charging pumps is provided by the Component Cooling Water System (see Section 3.7).
  2. Cooling water for the charging pumps is provided locally.
  3. Charging pump room cooling systems have not been identified.

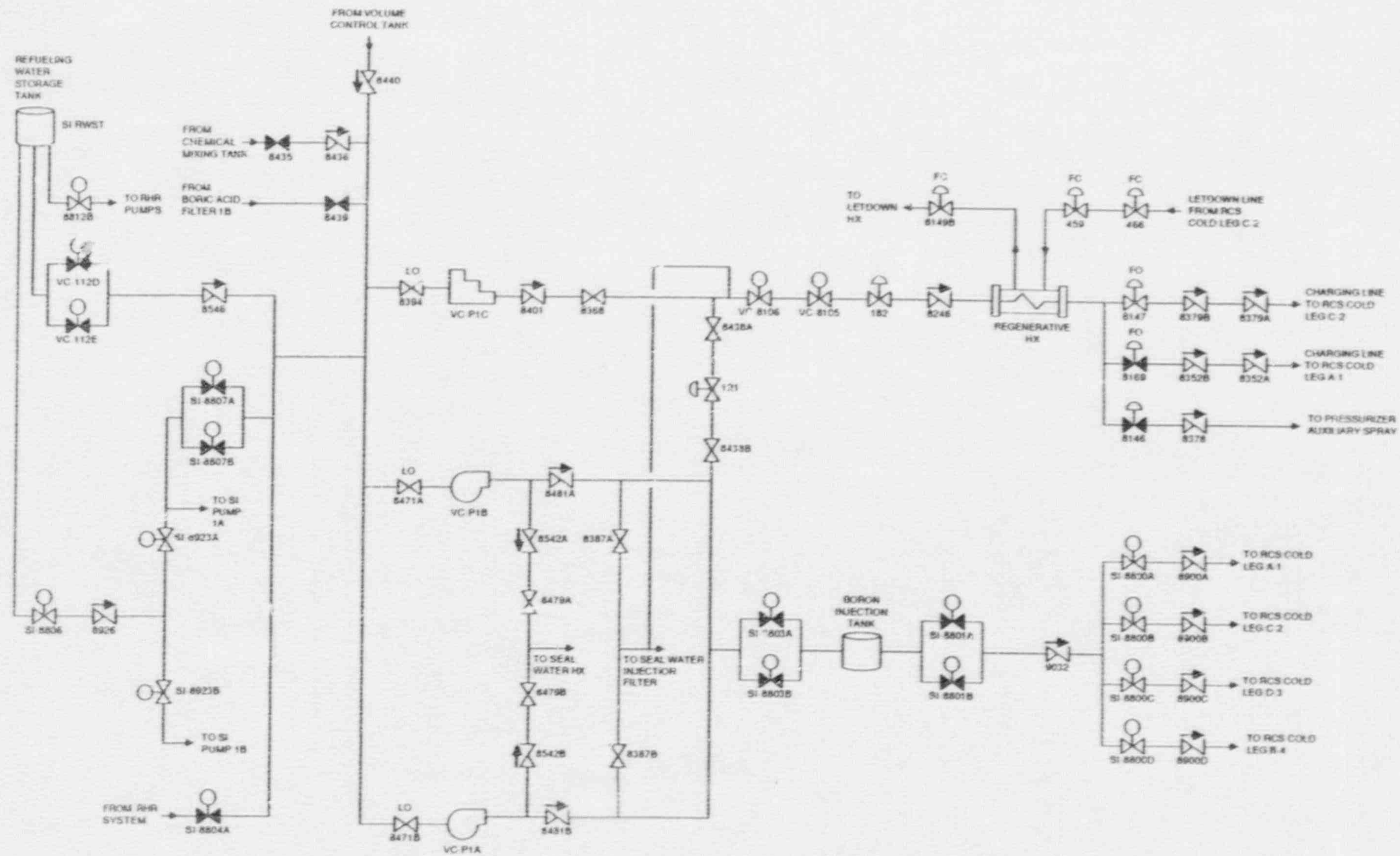


Figure 3.4-1. Zion 1 Charging System (CVCS)

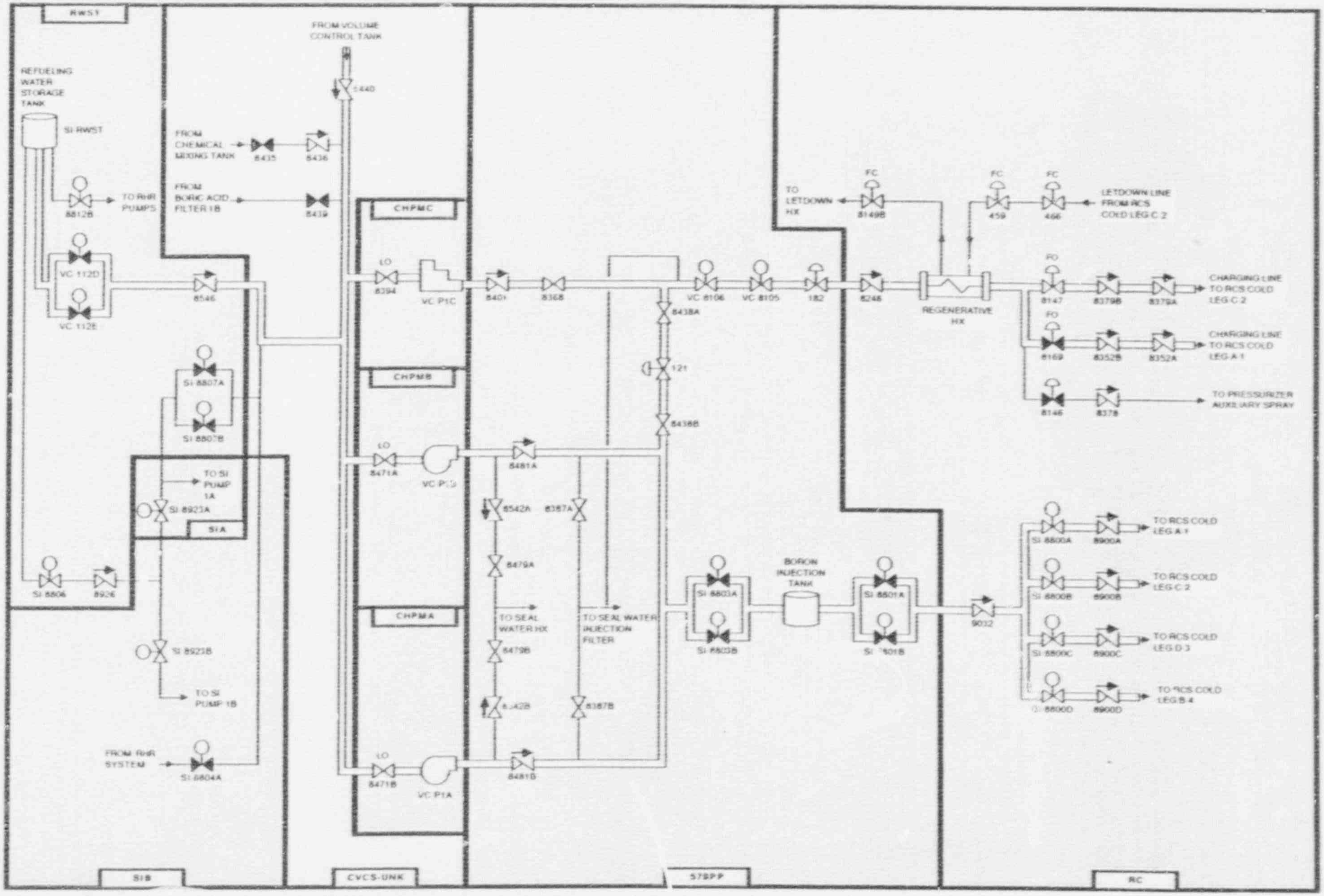


Figure 3.4-2. Zion 1 Charging System (CVCS) Showing Component Locations

Table 3.4-1. Zion 1 Charging System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
SI-8800A	MOV	RC	MCC-1371	480	SWGRM147	AC/17
SI-8800B	MOV	RC	MCC-1393A	480	1393A	AC/19
SI-8800C	MOV	RC	MCC-1371	480	SWGRM147	AC/17
SI-8800D	MOV	RC	MCC-1372	480	1372	AC/17
SI-8801A	MOV	579PP	MCC-1371	480	SWGRM147	AC/17
SI-8801B	MOV	579PP	MCC-1393B	480	1393B	AC/19
SI-8803A	MOV	579PP	MCC-1371	480	SWGRM147	AC/17
SI-8803B	MOV	579PP	MCC-1393B	480	1393B	AC/19
SI-8806	MOV	RWST	MCC-1383A	480	1383A	AC/18
SI-8807A	MOV	RWST	MCC-1393A	480	1393A	AC/19
SI-8807B	MOV	RWST	MCC-1383B	480	1383B	AC/18
SI-8923	MOV	SIA	MCC-1372	480	1372	AC/17
SI-RWST	TANK	RWST				
VC-112D	MOV	RWST	MCC-1372	480	1372	AC/17
VC-112E	MOV	RWST	MCC-1393A	480	1393A	AC/19
VC-8105	MOV	579PP	MCC-1371	480	SWGRM147	AC/17
VC-8106	MOV	579PP	MCC-1393C	480	1393C	AC/19
VC-P1A	MDP	CHPMA	BUS-149	4160	SWGRM149	AC/19
VC-P1B	MDP	CHPMB	BUS-147	4160	SWGRM147	AC/17
VC-P1C	PDP	CHPMC	BUS-138	480	SWGRM148	AC/18

3.5 INSTRUMENTATION AND CONTROL (I & C) SYSTEMS

3.5.1 System Function

The instrumentation and control systems consist of the Reactor Protection System (RPS), the Engineered Safety Features (ESF) actuation systems, and systems for the display of plant information to the operators. The RPS and the Engineered Safety Features actuation systems monitor the reactor plant, and alert the operator to take corrective action before specified limits are exceeded. The RPS will initiate an automatic reactor trip (scram) to rapidly shutdown the reactor when plant conditions exceed one or more specified limits. The Engineered Safety Features actuation systems will automatically actuate selected safety systems based on the specific limits or combinations of limits that are exceeded.

3.5.2 System Definition

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

3.5.3 System Operation

A. RPS

The RPS has four redundant input instrument channels for each sensed parameter. Two reactor trip breakers are actuated by two separate RPS logic matrices. The reactor trip breakers interrupt power to the rod cluster control assembly drive mechanisms. Certain reactor trip channels are automatically bypassed at power levels where they are not required for safety. The following conditions result in reactor trip:

- High neutron flux
- High neutron flux rate
- Negative neutron flux rate
- Overtemperature delta T
- Overpower delta T
- Low pressurizer pressure
- High pressurizer pressure
- High pressurizer water level
- Low reactor coolant flow
- Safety injection system actuation
- Turbine trip
- Low feedwater flow
- Low-low steam generator water level
- Manual

B. ESF Systems

The ESF systems are actuated by redundant logic and coincidence networks similar to those used by the RPS. Each network actuates a device that operates the associated ESF equipment, motor starters, and valve operators. Up to four independent measurement channels are used for each sensed parameter. The following vital functions are actuated:

- Safety injection system actuation
- Containment isolation
- Main steam line isolation
- Feedwater isolation
- Auxiliary feedwater actuation
- Containment spray system actuation

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

C. Remote Shutdown
Equipment is provided in appropriate locations outside the control room to allow the plant to maintain a hot shutdown condition. (Ref. 1, Section 7.7.6). To maintain a hot shutdown capability, local controls are provided for the following systems, in addition to those controls in the main control room:

1. Auxiliary Feedwater System
A local panel with three subpanels, one for each AFW pump, is provided. Selector switches on the subpanels permit transferring of pump controls from remote to local. Feedwater flow control and steam generator level control can be accomplished from the local panel. An alarm is sounded in the control room when pump controls are transferred to local.
2. Service Water
Pushbuttons are installed at the 4160 VAC buses 147, 148, and 149 for local start of the service water pumps. Some valves in the service water system are provided with local controls.
3. Atmospheric Steam Dump
The valves of the SSRS can be operated locally.
4. Component Cooling Water
Local controls are available for the CCWS pumps and valves.
5. Instrument Air
Instrument air is supplied by the service air system through filters and dryers. The service air compressors can be started and stopped locally at compressor control panels. The air filter and dryer controls can be operated locally.
6. Chemical and Volume Control System
Local controls are available for operating this system outside the control room. Valves can be operated by hand locally.

3.5.4 System Success Criteria

A. RPS
The RPS uses hindrance logic (normal = 1, trip = 0) in both the input and output logic. Therefore, a channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e. the channel has a fail-safe failure mode). A reactor scram will occur upon loss of control power to the RPS. A reactor scram usually is implemented by the scram circuit breakers which must open in response to a scram signal. Typically, there are two series scram circuit breakers in the power path to the scram rods. In this case, one of two circuit breakers must open. Details of the scram system for Zion 1 and 2 have not been determined.

B. ESF Systems
In gene al, the loss of instrument power to the sensors, instruments, or logic devices places that channel in the trip mode. The one exception is the containment spray initiating channels, which require instrument power for actuation. Details of the ESF actuation systems for Zion 1 and 2 have not been determined.

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

3.5.5 Support Systems and Interfaces

A. Control Power
Operator instrumentation displays are powered from the 120 VAC instrument buses.

3.5.6 Section 3.5 References

1. Zion 1 and 2 Final Safety Analysis Report.

3.6 ELECTRIC POWER SYSTEM

3.6.1 System Function

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

3.6.2 System Definition

All of the engineered safety features receive power from three 4160 volt buses, designated 147 (Div. 17), 148 (Div. 18), and 149 (Div. 19) for Unit 1, and 247 (Div. 27), 248 (Div. 28) and 249 (Div. 29) for Unit 2. The emergency source of power for these buses are five diesel generators. Diesel generator 1A is connected to 4160 VAC bus 148, diesel 1B is connected to bus 149, diesel 2A is connected to bus 248, diesel 2B is connected to bus 249, and diesel 0 is connected to buses 147 and 247. The fifth diesel is therefore available to both units. The generator feed breakers for buses 147 and 247 are electrically interlocked to preclude parallel operation of the two buses.

Each 4160 VAC bus feeds one 480 VAC bus through a transformer. The 480 VAC buses in turn supply power to various motor control centers.

The 125 VDC system provides power for control and instrumentation and other loads. The system consists of five buses, two for each unit and a fifth that can supply loads in either unit. Each 125 VDC bus is powered by a dedicated battery, with a battery charger that is supplied by a 480 VAC bus.

The 120 VAC system consists of four instrument buses. Each bus can be supplied from an inverter/rectifier or from a 480 VAC MCC through a transformer. Each inverter/rectifier can convert both 125 VDC and 480 VAC to 120 VAC.

Simplified one-line diagrams of the Unit 1 station electric power system are shown in Figures 3.6-1 and 3.6-2. The Unit 2 station power system is shown in Figure 3.6-3. The 4160 and 480 VAC systems for Unit 1 are shown in Figures 3.6-4 and 3.6-5, and the 125 VDC and 120 VAC systems for Unit 1 are shown in Figures 3.6-6 and 3.6-7. A summary of data on selected electric power system components is presented in Table 3.6-1. Selected loads and components supplied by the Class 1E electric power system are listed in Table 3.6-2.

3.6.3 System Operation

During normal operation, the Class 1E electric power system is supplied from the switchyard through the unit auxiliary transformer and the system auxiliary transformer. A cross-connect exists between the two units. The emergency sources of AC power are the diesel generators. The transfer from the preferred power source to the diesel generators is accomplished automatically by opening the normal source circuit breakers and then reenergizing the Class 1E portion of the electric power system from the diesel generators.

The DC power system normally is supplied through the battery chargers, with the batteries "floating" on the system, maintaining a full charge. Upon loss of AC power, the entire DC load draws from the batteries. The batteries are rated for approximately 4 hours of operation without assistance from the battery chargers.

Each 120 VAC instrumentation bus normally receives power from an inverter connected to one of the Class 1E DC buses. The 120 VAC buses can also be supplied via its respective 480/120 volt transformer if the inverter is taken out of service.

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/17 contains components powered either directly or indirectly from 4160 bus 147. Load group AC/18 contains components powered either directly or indirectly by bus 148. Load group AC/19 contains components powered by 4160 VAC bus 149. Components receiving DC power are assigned to load groups DC/1, DC/2, or DC/0, based on the battery power source.

3.6.4 System Success Criteria

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

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

3.6.5 Component Information

A. Standby diesel generators 1A, 1B, 0
1. Rated load: 4000 kW
2. Rated voltage: 4160 VAC
3. Manufacturer: Cooper Bessemer

B. Batteries 1A, 1B, 0
1. Rated voltage: 125 VDC
2. Rated capacity: approximately 4 hours with design loads

3.6.6 Support Systems and Interfaces

A. Control Signals
1. Automatic
   The standby diesel generators are automatically started based on loss of offsite power or a safety injection signal.
2. Remote manual
   The diesel generators can be started, and many distribution circuit breakers can be operated, from the control room.

B. Diesel Generator Auxiliary Systems
1. Diesel Cooling Water System
   Each diesel generator can be cooled by either the service water system or the fire water system.
2. Diesel Starting System
   Each diesel has an independent air starting system.
3. Diesel Fuel Oil Transfer and Storage System
   A "day tank" supplies short-term fuel needs of each diesel. Each day tank can be replenished from a separate 50,000 gallon fuel oil storage tank. The long-term storage tanks are located in the auxiliary building above the diesel generators.
4. Diesel Lubrication System
   Each diesel generator has its own lubrication system.
5. Diesel Room Ventilation System
   This system consists of exhaust fans which maintain the environmental conditions in the diesel room within limits for which the diesel generator

and switchgear have been qualified. This system may be needed for long-term operation of the diesel generator.

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

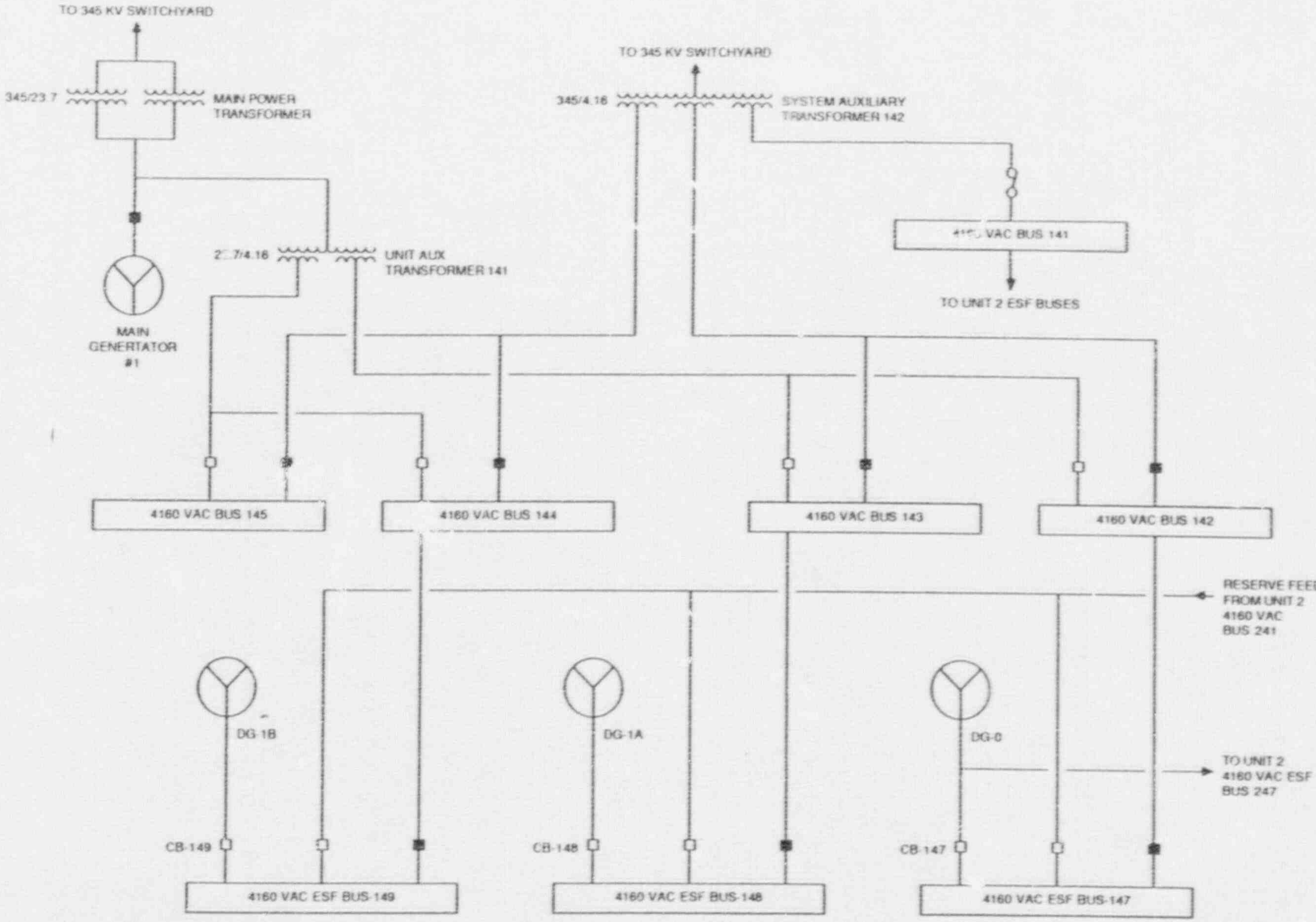


Figure 3.6-1. Zion 1 Station Electric Power System

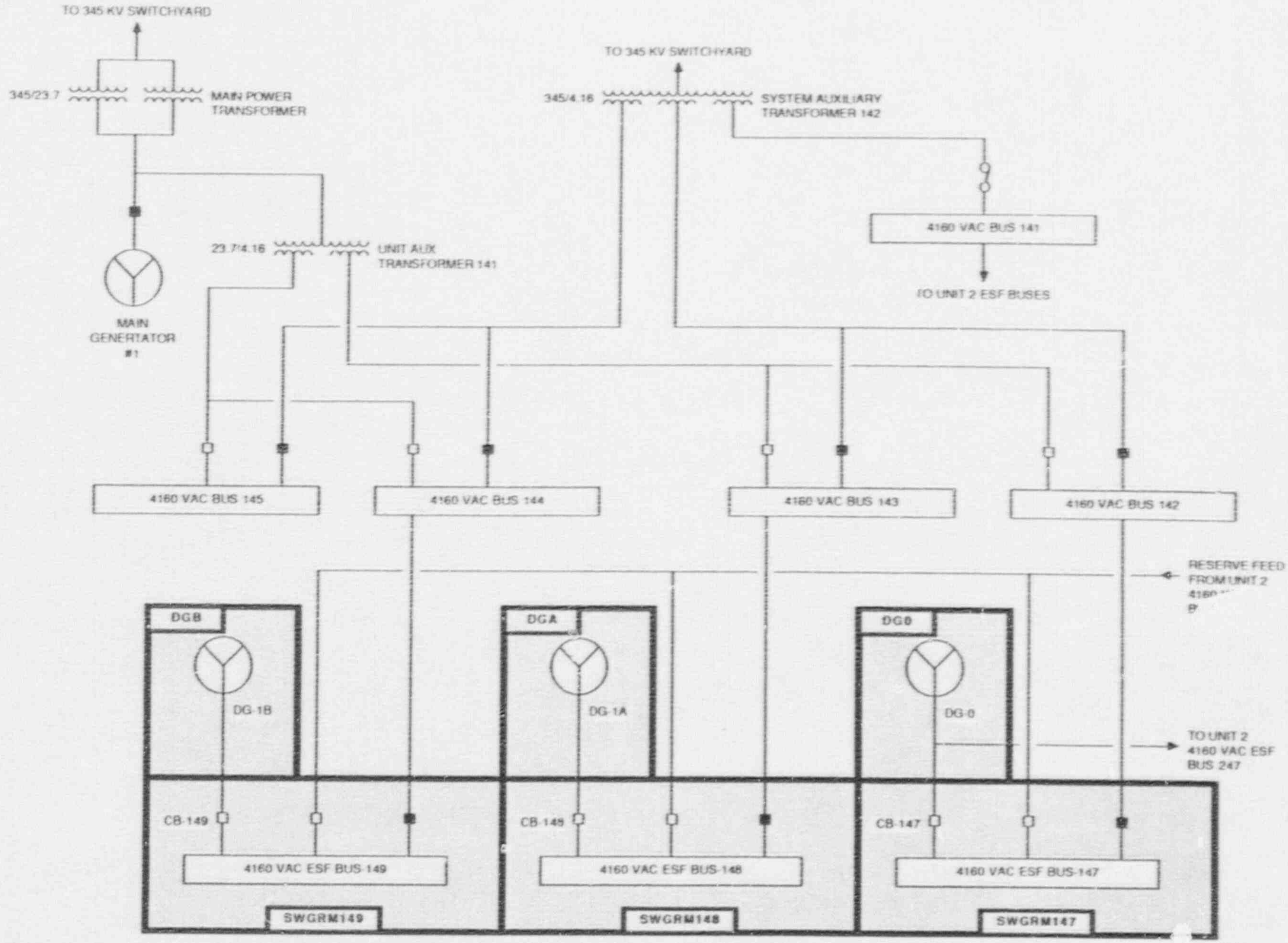


Figure 3.6-2. Zion 1 Station Electric Power System Showing Component Locations

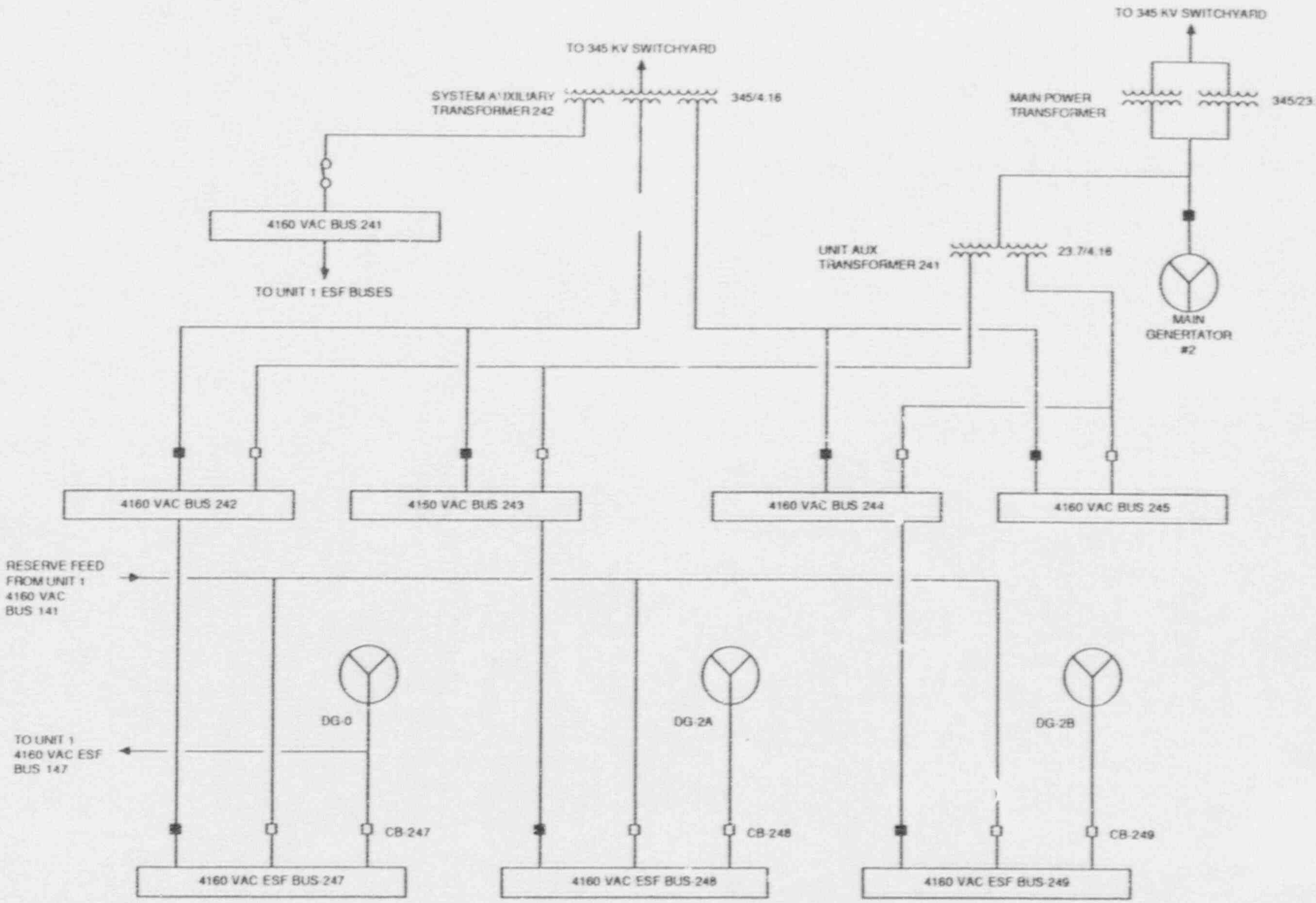


Figure 3.6-3. Zion 2 Station Electric Power System

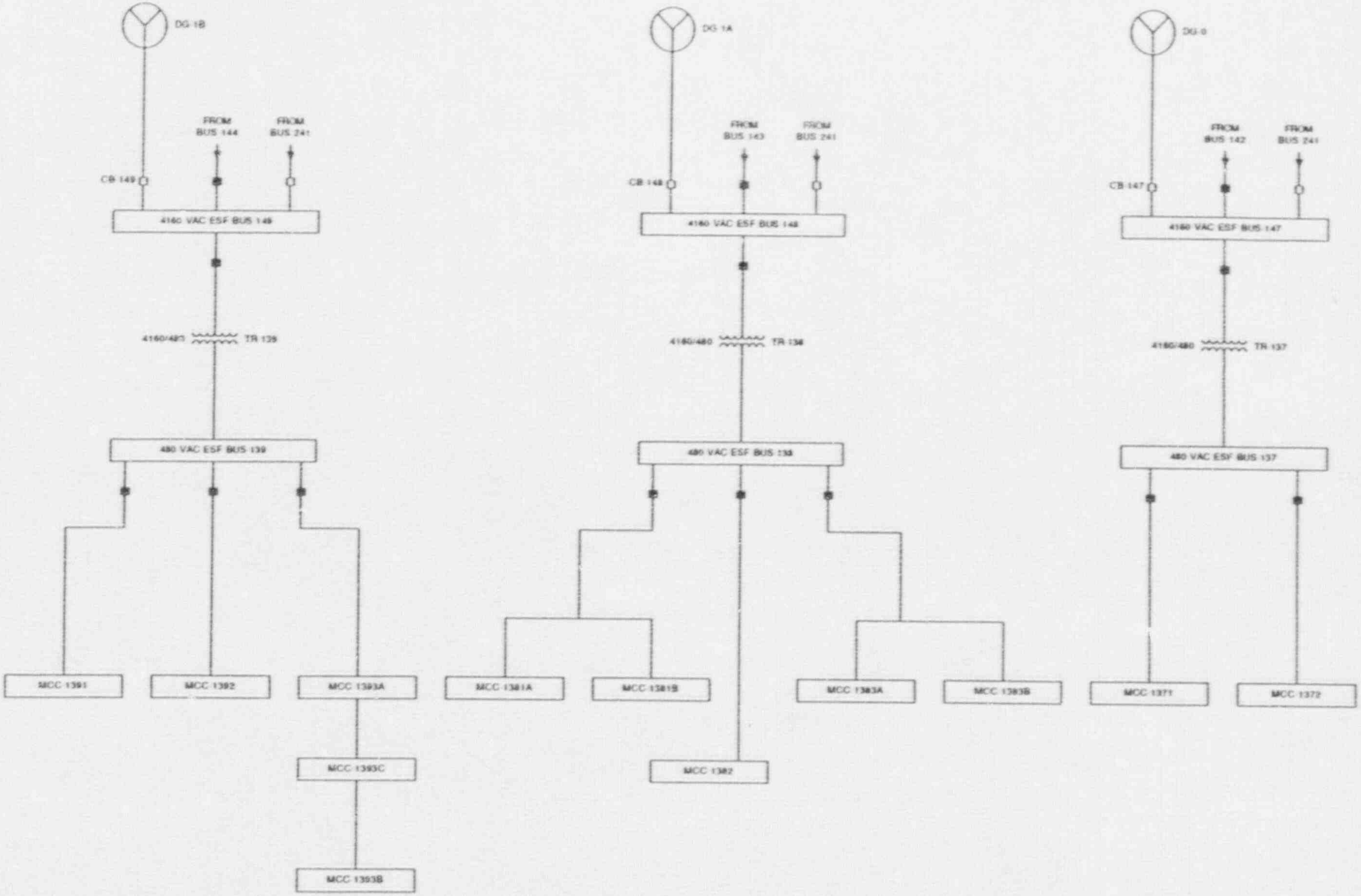


Figure 3.6-4. Zion 1 4160 and 480 VAC Electric Power Systems

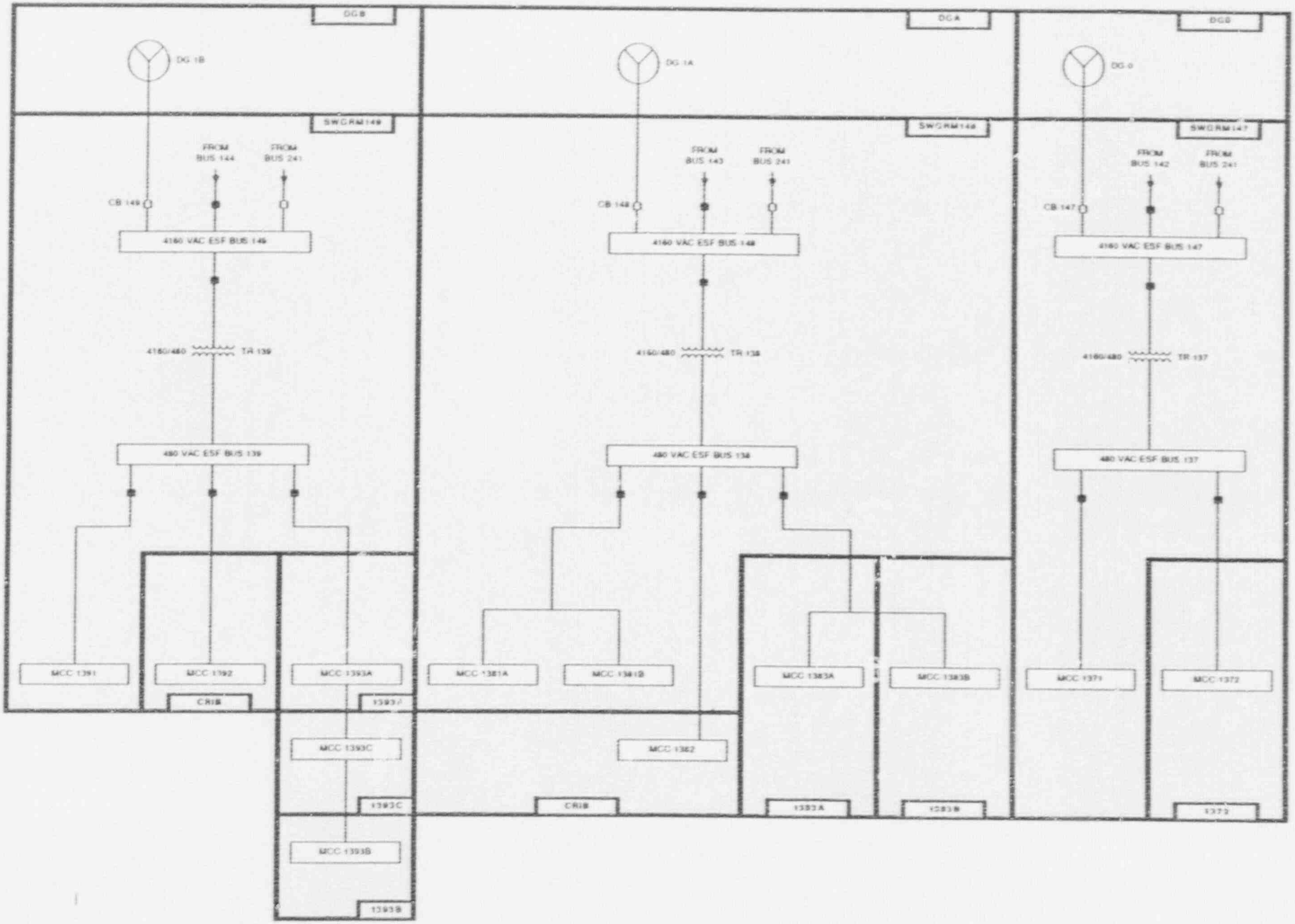


Figure 3.6-5. Zion 1 4160 and 480 VAC Electric Power Systems Showing Component Locations

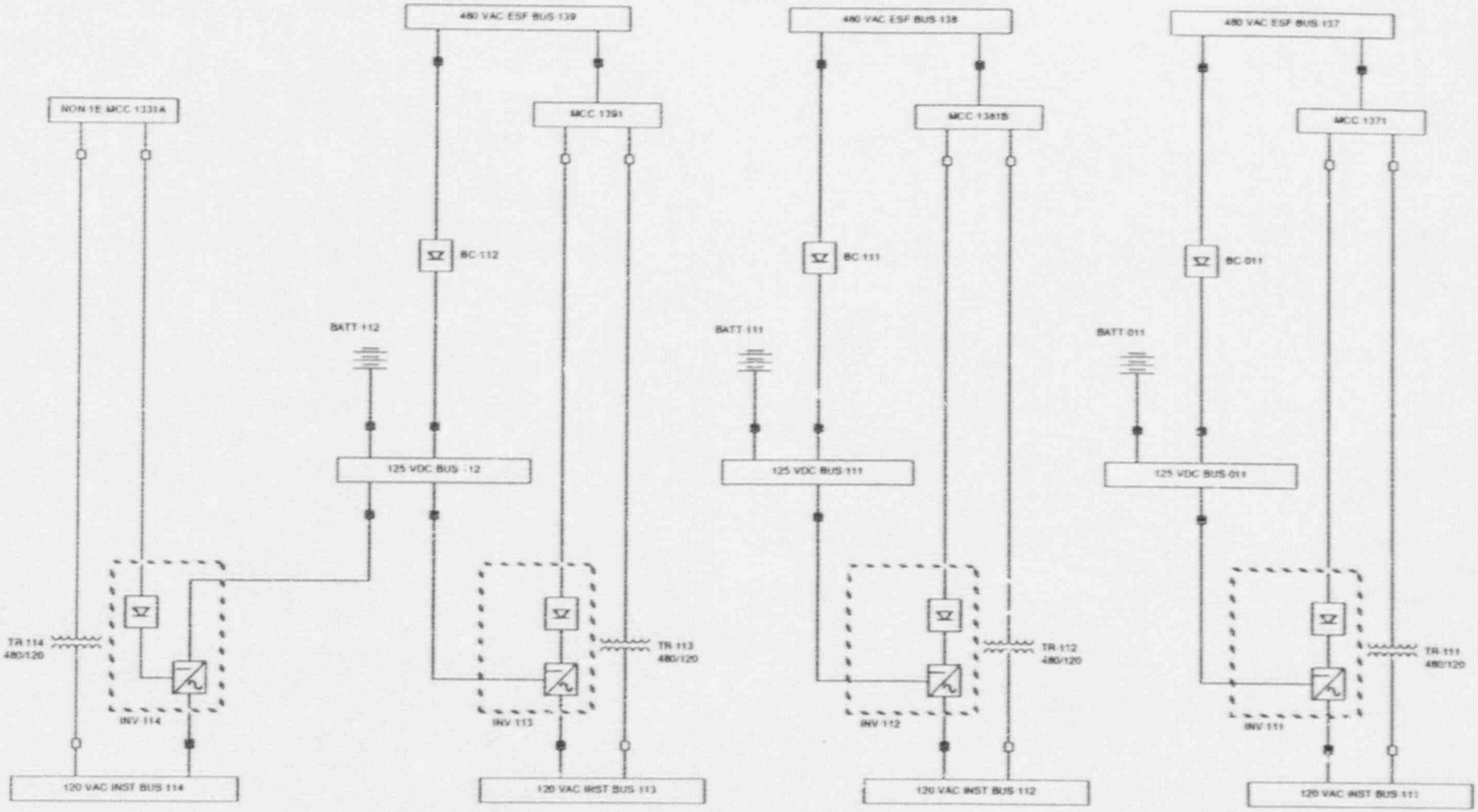


Figure 3.6-6. Zion 1 125 VDC and 120 VAC Electric Power Systems

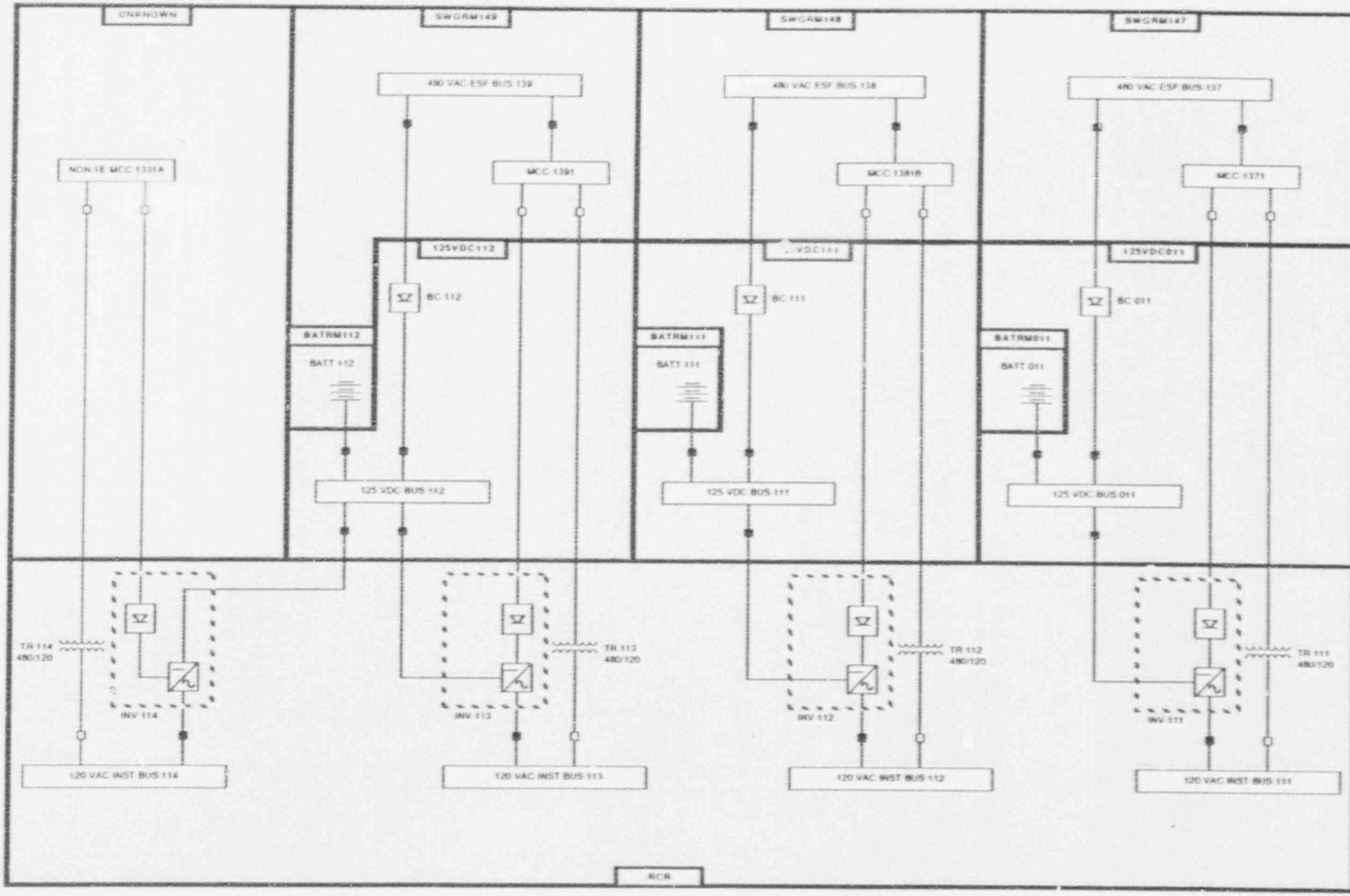


Figure 3.6-7. Zion 1 125 VDC and 120 VAC Electric Power Systems Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
BATT-011	BATT	BATRM011		125		DC/0
BATT-111	BATT	BATRM111		125		DC/1
BATT-112	BATT	BATRM112		125		DC/2
BC-011	BC	125VDC011	BUS-137	125	SWGRM147	DC/0
BC-111	BC	125VDC111	BUS-138	125	SWGRM148	DC/1
BC-112	BC	125VDC112	BUS-139	125	SWGRM149	DC/2
BUS-111	BUS	RCR	INV-111	120	RCR	AC/17
BUS-111	BUS	RCR	TR-111	120	RCR	AC/17
BUS-112	BUS	RCR	INV-112	120	RCR	AC/18
BUS-112	BUS	RCR	TR-112	120	RCR	AC/18
BUS-113	BUS	RCR	INV-113	120	RCR	AC/19
BUS-113	BUS	RCR	TR-113	120	RCR	AC/19
BUS-114	BUS	RCR	INV-114	120	RCR	AC/19
BUS-137	BUS	SWGRM147	TR-137	480	SWGRM147	AC/17
BUS-138	BUS	SWCRM148	TR-138	480	SWGRM148	AC/18
BUS-139	BUS	SWGRM149	TR-139	480	SWGRM149	AC/19
BUS-147	BUS	SWGRM147	DG-0	4160	DG0	AC/17
BUS-148	BUS	SWGRM148	DG-1A	4160	DGA	AC/18
BUS-149	BUS	SWGRM149	DG-1B	4160	DGB	AC/19
CB-147	CB	SWGRM147	DG-0	4160	DG0	AC/17
CB-148	CB	SWGRM148	DG-1A	4160	DGA	AC/18
CB-149	CB	SWGRM149	DG-1B	4160	DGB	AC/19
DC-BUS-011	BUS	125VDC011	BATT-011	125	BATRM011	DC/0
DC-BUS-011	BUS	125VDC011	BC-011	125	125VDC011	DC/0
DC-BUS-111	BUS	125VDC111	BATT-111	125	BATRM111	DC/1
DC-BUS-111	BUS	125VDC111	BC-111	125	125VDC111	DC/1
DC-BUS-112	BUS	125VDC112	BATT-112	125	BATRM112	DC/2

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
DC-BUS-112	BUS	125VDC112	BC-112	125	125VDC112	DC/2
DG-0	DG	DG0		4160		AC/17
DG-1A	DG	DGA		4160		AC/18
DG-1B	DG	DGB		4160		AC/19
INV-111	INV	RCR	DC-BUS-011	120	125VDC011	DC/0
INV-111	INV	RCR	MCC-1371	120	SWGRM147	DC/0
INV-112	INV	RCR	DC-BUS-111	120	125VDC111	DC/1
INV-112	INV	RCR	MCC-1381B	120	SWGRM148	DC/1
INV-113	INV	RCR	DC-BUS-112	120	125VDC112	DC/2
INV-113	INV	RCR	MCC-1391	120	SWGRM149	DC/2
INV-114	INV	RCR	DC-BUS-112	120	125VDC112	DC2
MCC-1371	MCC	SWGRM147	BUS-137	480	SWGRM147	AC/17
MCC-1372	MCC	1372	BUS-137	480	SWGRM147	AC/17
MCC-1381B	MCC	SWGRM148	BUS-138	480	SWGRM148	AC/18
MCC-1383A	MCC	1383A	BUS-138	480	SWGRM148	AC/18
MCC-1383B	MCC	1383B	BUS-138	480	SWGRM148	AC/18
MCC-1391	MCC	SWGRM149	BUS-139	480	SWGRM149	AC/19
MCC-1393A	MCC	1393A	BUS-139	480	SWGRM149	AC/19
MCC-1393B	MCC	1393B	BUS-139	480	SWGRM149	AC/19
MCC-1393C	MCC	1393C	BUS-139	480	SWGRM149	AC/19
MCC-2393C	MCC	2393C	BUS-239	480	SWGRM249	AC/29
TR-111	TRAN	RCR	MCC-1371	120	SWGRM147	AC/17
TR-112	TRAN	RCR	MCC-1381B	120	SWGRM148	AC/18
TR-113	TRAN	RCR	MCC-1391	120	SWGRM149	AC/19
TR-137	TRAN	SWGRM147	BUS-147	480	SWGRM147	AC/17
TR-138	TRAN	SWGRM148	BUS-148	480	SWGRM148	AC/18
TR-139	TRAN	SWGRM149	BUS-149	480	SWGRM149	AC/19

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
BATT-011	125	DC/0	BATRM011	EP	DC-BUS-011	BUS	125VDC011
BATT-111	125	DC/1	BATRM111	EP	DC-BUS-111	BUS	125VDC111
BATT-112	125	DC/2	BATRM112	EP	DC-BUS-112	BUS	125VDC112
BC-011	125	DC/0	125VDC011	EP	DC-BUS-011	BUS	125VDC011
BC-111	125	DC/1	125VDC111	EP	DC-BUS-111	BUS	125VDC111
BC-112	125	DC/2	125VDC112	EP	DC-BUS-112	BUS	125VDC112
BUS-137	125	DC/0	SWGRM147	EP	BC-011	BC	125VDC011
BUS-137	480	AC/17	SWGRM147	EP	MCC-1371	MCC	SWGRM147
BUS-137	480	AC/17	SWGRM147	EP	MCC-1372	MCC	1372
BUS-138	480	AC/18	SWGRM148	CVCS	VC-P1C	PDP	CHPMC
BUS-138	125	DC/1	SWGRM148	EP	BC-111	BC	125VDC111
BUS-138	480	AC/18	SWGRM148	EP	MCC-1381B	MCC	SWGRM148
BUS-139	480	AC/18	SWGRM148	EP	MCC-1383A	MCC	1383A
BUS-138	480	AC/18	SWGRM148	EP	MCC-1383B	MCC	1383B
BUS-138	480	AC/18	SWGRM148	FW	FW-P8	MDP	CRIB
BUS-139	125	DC/2	SWGRM149	EP	BC-112	BC	125VDC112
BUS-139	480	AC/19	SWGRM149	EP	MCC-1391	MCC	SWGRM149
BUS-139	480	AC/19	SWGRM149	EP	MCC-1393A	MCC	1393A
BUS-139	480	AC/19	SWGRM149	EP	MCC-1393B	MCC	1393B
BUS-139	480	AC/19	SWGRM149	EP	MCC-1393C	MCC	1393C
BUS-147	4160	AC/17	SWGRM147	CCW	CCW-OE	MDP	560AB
BUS-147	4160	AC/17	SWGRM147	CVCS	VC-P1B	MDP	CHPMB
BUS-147	4160	AC/17	SWGRM147	ECCS	SI-P1A	MDP	SIA
BUS-147	4160	AC/17	SWGRM147	ECCS	SI-P1A	MDP	SIA
BUS-147	4160	AC/17	SWGRM147	ECCS	VC-P1B	MDP	CHPMB
BUS-147	4160	AC/17	SWGRM147	ECCS	VC-P1B	MDP	CHPMB
BUS-147	480	AC/17	SWGRM147	EP	TR-137	TRAN	SWGRM147
BUS-147	4160	AC/17	SWGRM147	SW	SW-P1A	MDP	CRIB
BUS-148	4160	AC/18	SWGRM148	AFW	AFW-P1B	MDP	AFWS
BUS-148	4160	AC/18	SWGRM148	CCW	CCW-OD	MDP	560AB
BUS-148	4160	AC/18	SWGRM148	ECCS	RH-P1B	MDP	RHRB

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
BUS-148	4160	AC/18	SWGRM148	ECCS	SI-P1B	MDP	SIB
BUS-148	4160	AC/18	SWGRM148	ECCS	SI-P1B	MDP	SIB
BUS-148	480	AC/18	SWGRM148	EP	TR-138	TRAN	SWGRM148
BUS-148	4160	AC/18	SWGRM148	SW	SW-P1B	MDP	CRIB
BUS-149	4160	AC/19	SWGRM149	AFW	AFW-P1C	MDP	AFWS
BUS-149	4160	AC/19	SWGRM149	CCW	CCW-OC	MDP	560AB
BUS-149	4160	AC/19	SWGRM149	CVCS	VC-P1A	MDP	CHPMA
BUS-149	4160	AC/19	SWGRM149	ECCS	RH-P1A	MDP	RHRA
BUS-149	4160	AC/19	SWGRM149	ECCS	VC-P1A	MDP	CHPMA
BUS-149	4160	AC/19	SWGRM149	ECCS	VC-P1A	MDP	CHPMA
BUS-149	480	AC/19	SWGRM149	EP	TR-139	TRAN	SWGRM149
BUS-149	4160	AC/19	SWGRM149	SW	SW-P1C	MDP	CRIB
BUS-239	480	AC/29	SWGRM249	EP	MCC-2393C	MCC	2393C
DC-BUS-011	120	DC/0	125VDC011	EP	INV-111	INV	RCR
DC-BUS-111	120	DC/1	125VDC111	EP	INV-112	INV	RCR
DC-BUS-112	120	DC/2	125VDC112	EP	INV-113	INV	RCR
DC-BUS-112	120	DC2	125VDC112	EP	INV-114	INV	RCR
DG-0	4160	AC/17	DG0	EP	BUS-147	BUS	SWGRM147
DG-0	4160	AC/17	DG0	EP	CB-147	CB	SWGRM147
DG-1A	4160	AC/18	DGA	EP	BUS-148	BUS	SWGRM148
DG-1A	4160	AC/18	DGA	EP	CB-148	CB	SWGRM148
DG-1B	4160	AC/19	DGB	EP	BUS-149	BUS	SWGRM149
DG-1B	4160	AC/19	DGB	EP	CB-149	CB	SWGRM149
DIESEL			CRIB	FW	FW-P7	DDP	CRIB
INV-111	120	AC/17	RCR	EP	BUS-111	BUS	RCR
INV-112	120	AC/18	RCR	EP	BUS-112	BUS	RCR
INV-113	120	AC/19	RCR	EP	BUS-113	BUS	RCR
INV-114	120	AC/19	RCR	EP	BUS-114	BUS	RCR
MCC-1371	480	AC/17	SWGRM147	AFW	AFW-17	MOV	STMTUN
MCC-1371	480	AC/17	SWGRM147	AFW	AFW-5	MOV	STMTUN
MCC-1371	480	AC/17	SWGRM147	CVCS	SI-8800A	MOV	RC

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC-1371	480	AC/17	SWGRM147	CVCS	SI-8800C	MOV	RC
MCC-1371	480	AC/17	SWGRM147	CVCS	SI-8801A	MOV	579PP
MCC-1371	480	AC/17	SWGRM147	CVCS	SI-8803A	MOV	579PP
MCC-1371	480	AC/17	SWGRM147	CVCS	VC-8105	MOV	579PP
MCC-1371	480	AC/17	SWGRM147	ECCS	SI-8800A	MOV	RC
MCC-1371	480	AC/17	SWGRM147	ECCS	SI-8800C	MOV	RC
MCC-1371	480	AC/17	SWGRM147	ECCS	SI-8801A	MOV	579PP
MCC-1371	480	AC/17	SWGRM147	ECCS	SI-8803A	MOV	579PP
MCC-1371	480	AC/17	SWGRM147	ECCS	VC-8105	MOV	579PP
MCC-1371	120	DC/0	SWGRM147	EP	INV-111	INV	RCR
MCC-1371	120	AC/17	SWGRM147	EP	TR-111	TRAN	RCR
MCC-1371	480	AC/17	SWGRM147	FW	SW-110	MOV	DG0
MCC-1371	480	AC/17	SWGRM147	SW	SW-17	MOV	DGLOB
MCC-1371	480	AC/17	SWGRM147	SW	SW-19	MOV	DGLOA
MCC-1372	480	AC/17	1372	CVCS	SI-8800D	MOV	RC
MCC-1372	480	AC/17	1372	CVCS	SI-8923	MOV	SIA
MCC-1372	480	AC/17	1372	CVCS	VC-112D	MOV	RWST
MCC-1372	480	AC/17	1372	ECCS	SI-8800D	MOV	RC
MCC-1372	480	AC/17	1372	ECCS	SI-8923A	MOV	SIA
MCC-1372	480	AC/17	1372	ECCS	SI-9010A	MOV	SIA
MCC-1372	480	AC/17	1372	ECCS	SI-9011A	MOV	579PP
MCC-1372	480	AC/17	1372	ECCS	VC-112D	MOV	RWST
MCC-1372	480	AC/17	1372	ECCS	VC-112D	MOV	RWST
MCC-1381A	480	AC/18	SWGRM148	AFW	AFW-6	MOV	579PP
MCC-1381A	480	AC/18	SWGRM148	FW	SW-108	MOV	DGA
MCC-1381A	480	AC/18	SWGRM148	RCS	RH-8702	MOV	RC
MCC-1381A	480	AC/18	SWGRM148	SW	SW-16	MOV	DGLOB
MCC-1381B	480	AC/18	SWGRM148	AFW	AFW-18	MOV	STMTUN
MCC-1381B	480	AC/18	SWGRM148	ECCS	CCW-9412B	MOV	RHRHXB
MCC-1381B	120	DC/1	SWGRM148	EP	INV-112	INV	RCR
MCC-1381B	120	AC/18	SWGRM148	EP	TR-112	TRAN	RCR

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC-1383A	480	AC/18	1383A	AFW	AFW-50	MOV	579PP
MCC-1383A	480	AC/18	1383A	AFW	AFW-53	MOV	579PP
MCC-1383A	480	AC/18	1383A	AFW	AFW-55	MOV	579PP
MCC-1383A	480	AC/18	1383A	AFW	AFW-56	MOV	579PP
MCC-1383A	480	AC/18	1383A	AFW	AFW-74	MOV	AFWS
MCC-1383A	480	AC/18	1383A	AFW	SW-101	MOV	AFWS
MCC-1383A	480	AC/18	1383A	AFW	SW-104	MOV	AFWS
MCC-1383A	480	AC/18	1383A	AFW	SW-106	MOV	AFWS
MCC-1383A	480	AC/18	1383A	AFW	SW-107	MOV	AFWS
MCC-1383A	480	AC/18	1383A	CVCS	SI-8806	MOV	RWST
MCC-1383A	480	AC/18	1383A	ECCS	SI-8802	MOV	579PP
MCC-1383A	480	AC/18	1383A	ECCS	SI-8804B	MOV	SIB
MCC-1383A	480	AC/18	1383A	ECCS	SI-8804B	MOV	RWST
MCC-1383A	480	AC/18	1383A	ECCS	SI-8806	MOV	RWST
MCC-1383A	480	AC/18	1383A	ECCS	SI-8811B	MOV	RWST
MCC-1383A	480	AC/18	1383A	ECCS	SI-8923B	MOV	SIB
MCC-1383A	480	AC/18	1383A	SW	SW-3	MOV	CRIB
MCC-1383A	480	AC/18	1383A	SW	SW-3	MOV	CRIB
MCC-1383A	480	AC/18	1383A	SW	SW-7	MOV	542AB
MCC-1383B	480	AC/18	1383B	CVCS	SI-8807B	MOV	RWST
MCC-1383B	480	AC/18	1383B	ECCS	SI-8807B	MOV	RWST
MCC-1383B	480	AC/18	1383B	ECCS	SI-9010B	MOV	SIB
MCC-1383B	480	AC/18	1383B	ECCS	SI-9011B	MOV	579PP
MCC-1391	480	AC/19	SWGRM149	AFW	AFW-11	MOV	STMTUN
MCC-1391	480	AC/19	SWGRM149	AFW	AFW-19	MOV	STMTUN
MCC-1391	480	AC/19	SWGRM149	AFW	AFW-20	MOV	STMTUN
MCC-1391	480	AC/19	SWGRM149	ECCS	CCW-9412A	MOV	RHRHXA
MCC-1391	120	DC/2	SWGRM149	EP	INV-113	INV	RCR
MCC-1391	120	AC/19	SWGRM149	EP	TR-113	TRAN	RCR
MCC-1391	480	AC/19	SWGRM149	FW	SW-109	MOV	DGB
MCC-1391	480	AC/19	SWGRM149	RCS	RH-8701	MOV	RC

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC-1391	480	AC/19	SWGRM149	SW	SW-18	MOV	DGLOA
MCC-1393A	480	AC/19	1393A	AFW	AFW-51	MOV	579PP
MCC-1393A	480	AC/19	1393A	AFW	AFW-54	MOV	579PP
MCC-1393A	480	AC/19	1393A	AFW	AFW-76	MOV	AFWS
MCC-1393A	480	AC/19	1393A	AFW	SW-102	MOV	AFWS
MCC-1393A	480	AC/19	1393A	AFW	SW-103	MOV	AFWS
MCC-1393A	480	AC/19	1393A	CVCS	SI-8800B	MOV	RC
MCC-1393A	480	AC/19	1393A	CVCS	SI-8807A	MOV	RWST
MCC-1393A	480	AC/19	1393A	CVCS	VC-112E	MOV	RWST
MCC-1393A	480	AC/19	1393A	ECCS	SI-8800B	MOV	RC
MCC-1393A	480	AC/19	1393A	ECCS	SI-8804A	MOV	MAZE
MCC-1393A	480	AC/19	1393A	ECCS	SI-8804A	MOV	MAZE
MCC-1393A	480	AC/19	1393A	ECCS	SI-8807A	MOV	RWST
MCC-1393A	480	AC/19	1393A	ECCS	SI-8811A	MOV	RWST
MCC-1393A	480	AC/19	1393A	ECCS	VC-112E	MOV	RWST
MCC-1393A	480	AC/19	1393A	ECCS	VC-112E	MOV	RWST
MCC-1393A	480	AC/19	1393A	RCS	RCS-8000A	MOV	RC
MCC-1393A	480	AC/19	1393A	RCS	RCS-8000B	MOV	RC
MCC-1393A	480	AC/19	1393A	SW	SW-12	MOV	560AB
MCC-1393A	480	AC/19	1393A	SW	SW-12	MOV	560AB
MCC-1393A	480	AC/19	1393A	SW	SW-14	MOV	560AB
MCC-1393A	480	AC/19	1393A	SW	SW-14	MOV	560AB
MCC-1393A	480	AC/19	1393A	SW	SW-2	MOV	560AB
MCC-1393A	480	AC/19	1393A	SW	SW-8	MOV	542AB
MCC-1393B	480	AC/18	1393B	AFW	AFW-75	MOV	AFWS
MCC-1393B	480	AC/19	1393B	CVCS	SI-8801B	MOV	579PP
MCC-1393B	480	AC/19	1393B	CVCS	SI-8803B	MOV	579PP
MCC-1393B	480	AC/19	1393B	ECCS	SI-8801B	MOV	579PP
MCC-1393B	480	AC/19	1393B	ECCS	SI-8803B	MOV	579PP
MCC-1393C	480	AC/19	1393C	AFW	AFW-52	MOV	579PP
MCC-1393C	480	AC/19	1393C	AFW	AFW-57	MOV	579PP

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC-1393C	480	AC/19	1393C	AFW	SW-105	MOV	AFWS
MCC-1393C	480	AC/19	1393C	CVCS	VC-8106	MOV	579PP
MCC-1393C	480	AC/19	1393C	ECCS	VC-8106	MOV	579PP
MCC-1393C	480	AC/19	1393C	SW	SW-4	MOV	CRIB
MCC-1393C	480	AC/19	1393C	SW	SW-4	MOV	CRIB
MCC-2393C	480	AC/29	2393C	SW	SW-13	MOV	560AB
MCC-2393C	480	AC/29	2393C	SW	SW-13	MOV	560AB
MCC-2393C	480	AC/29	2393C	SW	SW-15	MOV	560AB
MCC-2393C	480	AC/29	2393C	SW	SW-15	MOV	560AB
TR-111	120	AC/17	RCR	EP	BUS-111	BUS	RCR
TR-112	120	AC/18	RCR	EP	BUS-112	BUS	RCR
TR-113	120	AC/19	RCR	EP	BUS-113	BUS	RCR
TR-137	480	AC/17	SWGRM147	EP	BUS-137	BUS	SWGRM147
TR-138	480	AC/18	SWGRM148	EP	BUS-138	BUS	SWGRM148
TR-139	480	AC/19	SWGRM149	EP	BUS-139	BUS	SWGRM149

3.7 COMPONENT COOLING WATER SYSTEM (CCWS)

3.7.1 System Function

The CCWS serves to remove heat from the reactor auxiliaries and RHR heat exchangers and to transfer it to the Service Water System for rejection to the ultimate heat sink. The CCWS ensures continuous operation or safe shutdown of the plant under all modes of operation. The CCWS serves as an intermediate system between the RCS and SWS, thereby reducing the probability of leakage of potentially radioactive coolant.

3.7.2 System Definition

The CCWS is a closed loop cooling water system designed to remove heat from residual, spent fuel pit, seal water, letdown, excess letdown, and sample heat exchangers, and various other components (e.g., ECCS and charging pumps). The system is shared by the two units. The system consists of five pumps, three heat exchangers, and two surge tanks. Flow to the cooled components is arranged in parallel flow circuits. There are three main loops for each unit, one serves Train A ECCS components, one serves Train B ECCS components, and a third serves other components. Heat is rejected in the CCWS heat exchangers to the Service Water System.

Simplified drawings of the CCWS are shown in Figures 3.7-1 and 3.7-2. A summary of data on selected CCWS components is presented in Table 3.7-1

3.7.3 System Operation

During normal operation two pumps and two heat exchangers are capable of serving all operating components in both units. Three pumps and two heat exchangers are required for the removal of residual and sensible heat from the RCS via the RHR system during cooldown of one unit with the other unit remaining at full power operation.

In the event of LOCA in one plant, one pump and one heat exchanger are capable of fulfilling system requirements. The remaining components serve as backup and/or additional capacity.

CCW pumps A and B and heat exchanger 2 are normally aligned to serve Unit 2 components. Pumps D and E and heat exchanger 1 normally serve Unit 1 components. Pump C and heat exchanger 0 serve either unit. However, all five pumps supply a common header to the heat exchangers, which in turn supply a common header to the cooling loops, so any pump and heat exchanger can cool any component in either unit.

The CCW heat exchangers transfer heat to the Service Water System. The CCW surge tanks are connected to the suction side of the pumps, and accommodate fluid expansion and contraction in the system.

3.7.4 System Success Criteria

Following a LOCA in one unit, one CCW pump and one heat exchanger are capable of fulfilling system requirements (Ref.1, Section 9.3.2). The Service Water System (see Section 3.8) is required to remove heat from the CCWS.

3.7.5 Component Information

A. Component Cooling Water pumps A, B, C, D, E
   1. Rated flow: 4600 gpm @ 200 ft head (87 psid)
   2. Rated capacity: 100%
   3. Type: Horizontal centrifugal

B. Component Cooling Water heat exchangers 0, 1, 2
   1. Heat transferred: 53×10^6 Btu/hr
   2. Type: Shell and U-tube

C. Surge tanks (2)
   1. Total Volume: 2000 gallons
   2. Normal water volume: 1000 gallons

3.7.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      CCWS lines into containment are automatically isolated following a LOCA. The CCWS pumps are not automatically actuated.
   2. Remote manual
      The CCWS can be operated from the control room.

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

C. Other
   Lubrication, cooling, and ventilation are assumed to be provided locally for the CCWS pumps.

3.7.7 Section 3.7 References

1. Zion 1 and 2 Final Safety Analysis Report.

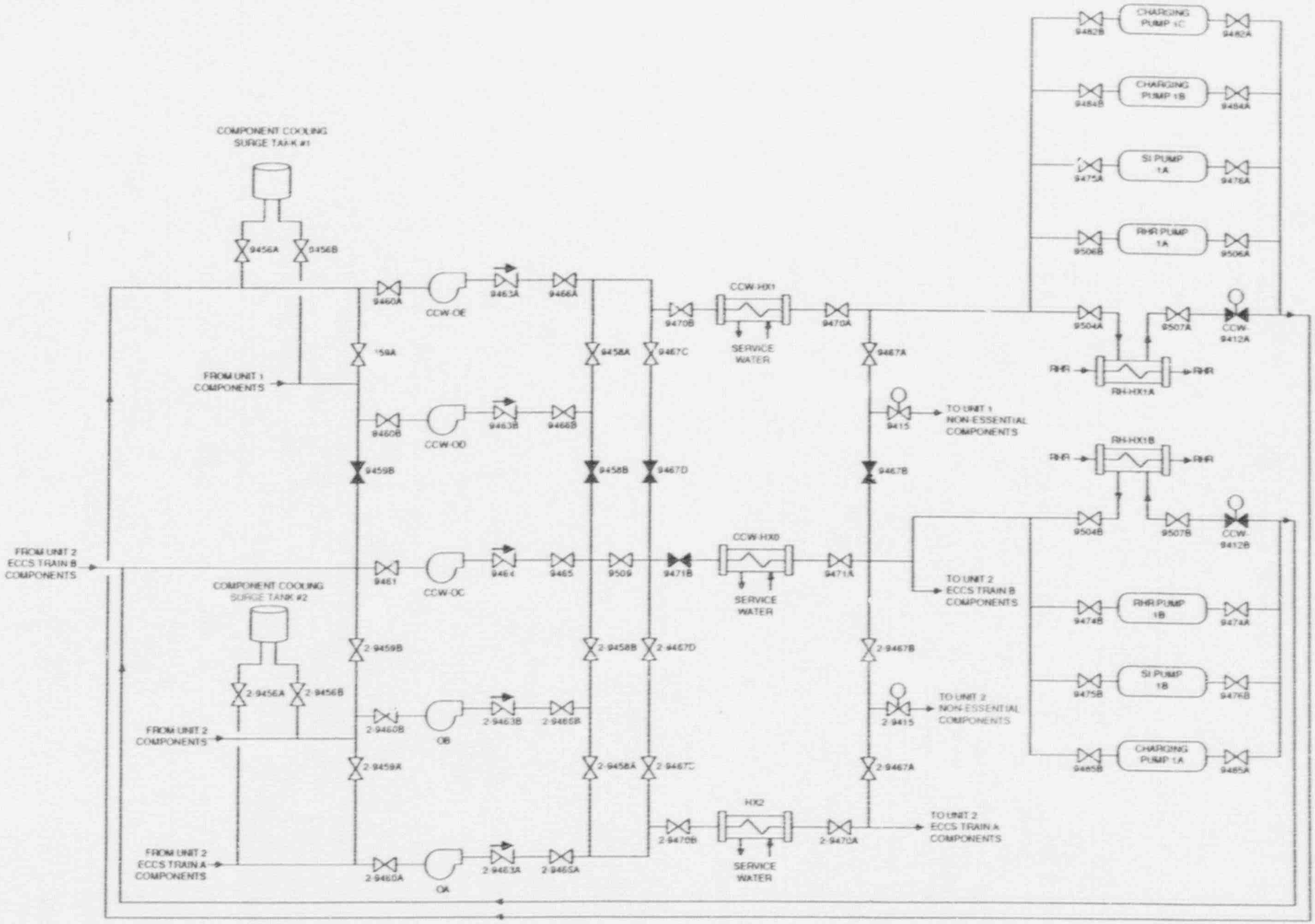


Figure 3.7-1. Zion 1 and 2 Component Cooling Water System

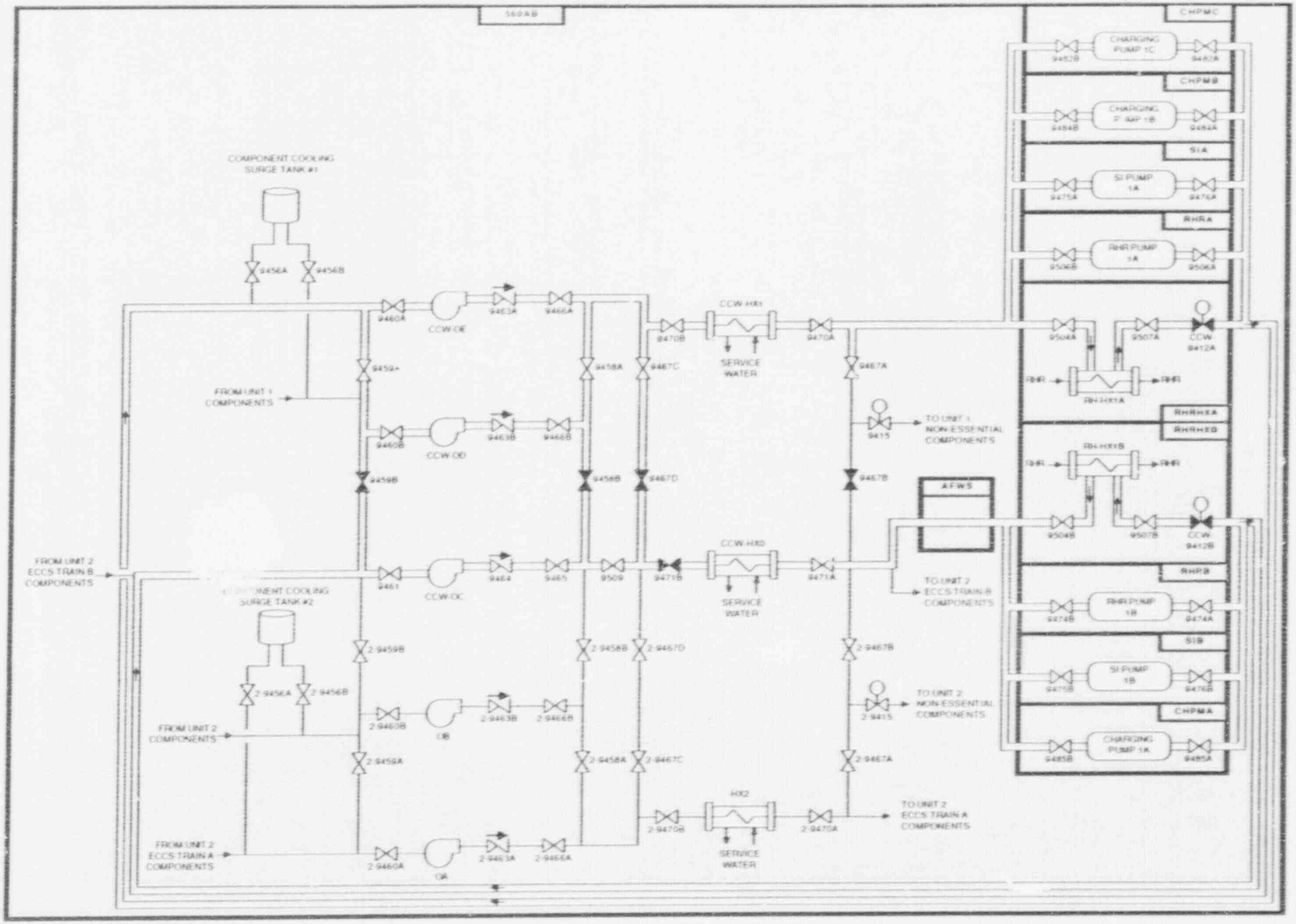


Figure 3.7-2. Zion 1 and 2 Component Cooling Water System Showing Component Locations

Table 3.7-1. Zion 1 Component Cooling Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CCW-HX0	HX	560AB				
CCW-HX1	HX	560AB				
CCW-OC	MDP	560AB	BUS-149	4160	SWGRM149	AC/19
CCW-OD	MDP	560AB	BUS-148	4160	SWGRM148	AC/18
CCW-OE	MDP	560AB	BUS-147	4160	SWGRM147	AC/17

3.8 SERVICE WATER SYSTEM (SWS)

3.8.1 System Function

The SWS supplies all the equipment cooling water for the plant, including the emergency shutdown requirements. Equipment cooled by the SWS includes the diesel generators, the component cooling water heat exchangers, containment coolers, and various air conditioning and ventilation coolers and condensers. The SWS can also deliver water to the suction of the auxiliary feedwater pumps, thereby serving as a backup water source to the condensate storage tank.

3.8.2 System Definition

The SWS is an open loop system that serves both units. The system consists of six pumps that feed two separate main supply headers, one header for each unit and three pumps on each header. The headers are crosstied so that any combination of pumps can serve both units during normal operating conditions. The pumps take suction from the crib house forebay.

Cooling water to the diesel generators and CCW heat exchangers can be provided by both supply headers.

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

3.8.3 System Operation

During normal operation two pumps on each unit are running with the third pump serving as a standby. The system pressure is maintained at 55-75 psig in the main supply header. The third pump will automatically start if header pressure decreases to 50 psig. Under emergency shutdown and accident conditions, one pump is required for each unit.

Each service water pump is powered by a separate 4160 VAC bus. The five diesel generators are sized to accommodate one service water pump in addition to the other engineered safeguards loads.

3.8.4 System Success Criteria

Under emergency shutdown and accident conditions, system success can be achieved by one service water pump in each unit (Ref 1, Section 9.6.3).

3.8.5 Component Information

A. Service Water pumps 1A, 1B, 1C
   1. Rated flow: 22,000 gpm @ 210 ft head (91 psid)
   2. Rated capacity: 100%

3.8.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      During normal operation with two SWS pumps running per unit, the third pump will be automatically started if system pressure decreases to 50 psig.
   2. Remote Manual
      The SWS pumps can be operated from the control room.

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

C. Other
Lubrication, cooling, and ventilation are assumed to be provided locally for the SWS pumps.

3.8.7 Section 3.8 References

1. Zion 1 and 2 Final Safety Analysis Report.

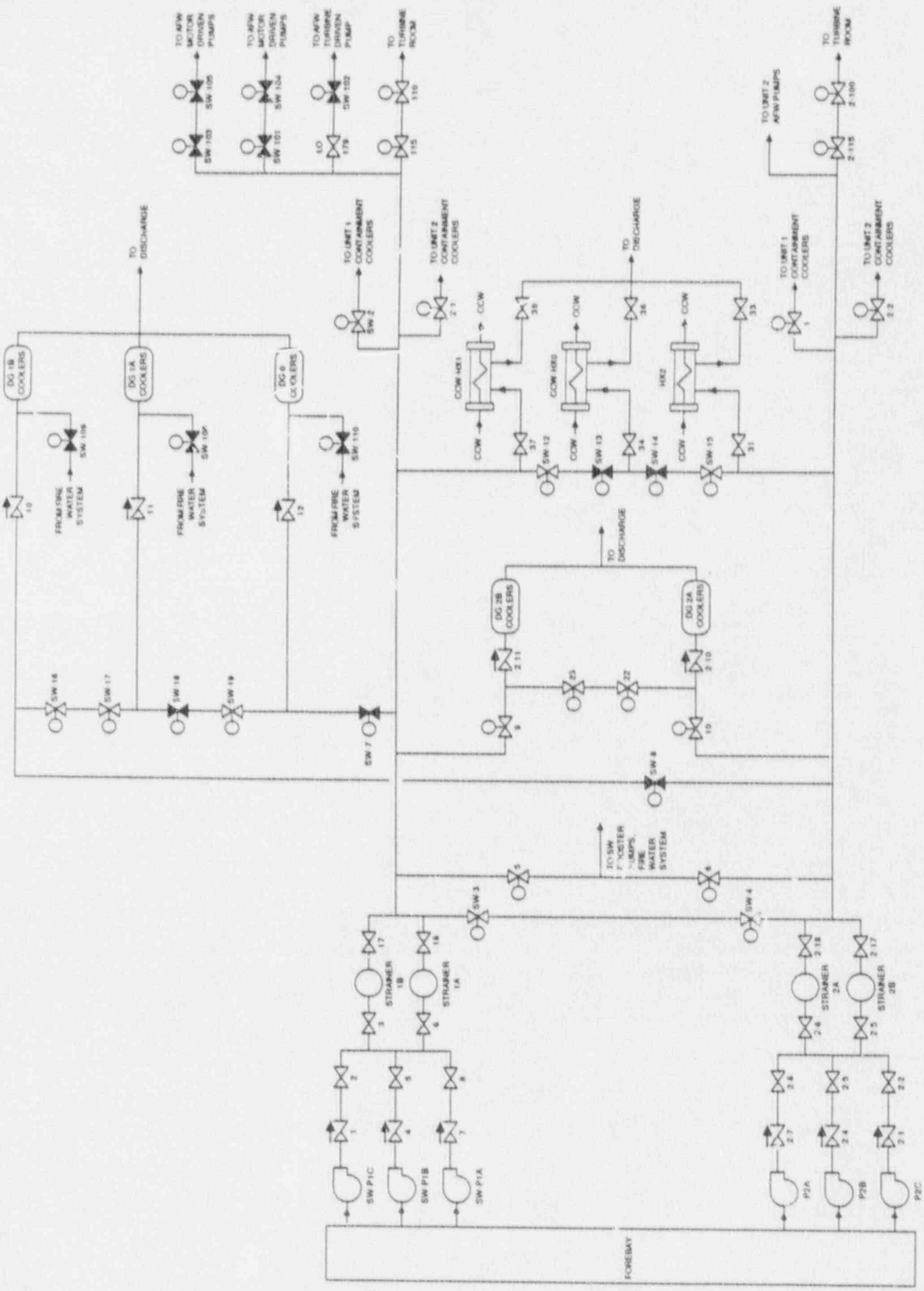


Figure 3.8-1. Zion 1 and 2 Service Water System

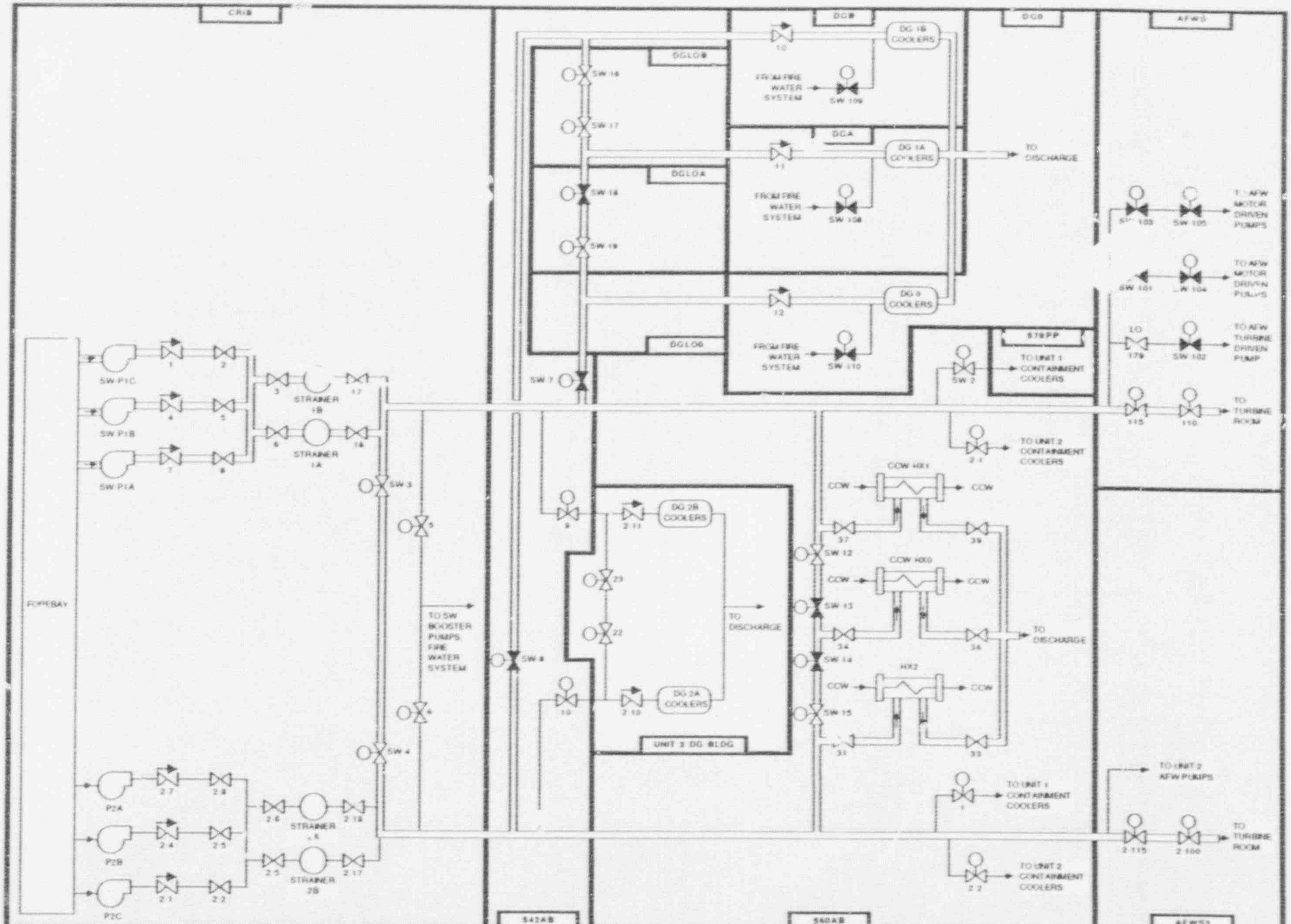


Figure 3.8-2. Zion 1 and 2 Service Water System Showing Component Locations

Table 3.8-1. Zion 1 Service Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
SW-12	MOV	560AB	MCC-1393A	480	1393A	AC/19
SW-12	MOV	560AB	MCC-1393A	480	1393A	AC/19
SW-13	MOV	560AB	MCC-2393C	480	2393C	AC/29
SW-13	MOV	560AB	MCC-2393C	480	2393C	AC/29
SW-14	MOV	560AB	MCC-1393A	480	1393A	AC/19
SW-14	MOV	560AB	MCC-1393A	480	1393A	AC/19
SW-15	MOV	560AB	MCC-2393C	480	2393C	AC/29
SW-15	MOV	560AB	MCC-2393C	480	2393C	AC/29
SW-16	MOV	DGLOB	MCC-1381A	480	SWGRM148	AC/18
SW-17	MOV	DGLOB	MCC-1371	480	SWGRM147	AC/17
SW-18	MOV	DGLOA	MCC-1391	480	SWGRM149	AC/19
SW-19	MOV	DGLOA	MCC-1371	480	SWGRM147	AC/17
SW-2	MOV	560AB	MCC-1393A	480	1393A	AC/19
SW-3	MOV	CRIB	MCC-1383A	480	1383A	AC/18
SW-3	MOV	CRIB	MCC-1383A	480	1383A	AC/18
SW-4	MOV	CRIB	MCC-1393C	480	1393C	AC/19
SW-4	MOV	CRIB	MCC-1393C	480	1393C	AC/19
SW-7	MOV	542AB	MCC-1383A	480	1383A	AC/18
SW-8	MOV	542AB	MCC-1393A	480	1393A	AC/19
SW-P1A	MDP	CRIB	BUS-147	4160	SWGRM147	AC/17
SW-P1B	MDP	CRIB	BUS-148	4160	SWGRM148	AC/18
SW-P1C	MDP	CRIB	BUS-149	4160	SWGRM149	AC/19

3.9 FIRE WATER SYSTEM (SWS)

3.8.1 System Function

The fire water system provides fire protection throughout the plant. Plant fire protection is provided by a loop fire header distribution system utilizing fire hydrants, fire hose reels, fixed water sprinkler spray systems, and water deluge systems. The fire water system can also provide cooling water to the emergency diesel generators when normal cooling from the service water system is unavailable.

3.9.2 System Definition

The fire system consists of two pumps, one-diesel-driven and one motor-driven. The pumps supply water to the plant fire header distribution loop. The fire protection system is normally supplied with water by the service water booster pumps, which take their suction from the service water system.

Simplified drawings of the portion of the fire water system that provides backup diesel generator cooling are shown in Figures 3.9-1 and 3.9-2. A summary of data on selected fire water system components is presented in Table 3.9-1.

3.9.3 System Operation

A looped 10 inch yard main encircles the entire plant with fire hydrants spaced at approximately 250 foot intervals. The various buildings are supplied from headers off of the main sprinklers and deluge systems are actuated by heat detecting devices. Alarms and interlocks are provided to indicate operation of the system.

The fire system is normally supplied with water and maintained at a pressure of 125 to 140 psig by the service water booster pumps. Under LOCA conditions the suction lines to these pumps are isolated from the service water header by motor-operated valves.

Whenever the fire protection system header falls to 110 psig, the motor-driven fire pump will automatically start. If this pump fails to start or is unable to satisfy the demands of the fire system the diesel-driven fire pump will automatically start at a header pressure of 100 psig. The diesel-driven pump is battery started and does not require any external electrical power for operation. Both pumps take their suction from the crib house forebay.

If both fire pumps and both service water booster pumps are unavailable, water can be supplied to the fire system headers through a bypass around the service water booster pumps.

3.9.4 System Success Criteria

The Zion 1 and 2 FSAR (Ref. 1, Section 9.9.3) implies that either the motor-driven or the diesel-driven fire water pump can successfully supply the needs of the fire system, including providing cooling water to the diesel generators.

3.9.5 Component Information

A. Fire water pumps P7, P8
   1. Rated flow: 2000 gpm @ 141 ft head (61 psid)
   2. Rated capacity: 100%

3.9.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The motor-driven fire pump is automatically started when system pressure decreases to 110 psig. The diesel-driven fire pump is automatically started when system pressure decreases to 100 psig.

2. Remote Manual
The fire pumps can be operated from the control room.

B. Motive Power
1. The motor-driven fire pump is a Class 1E load that can be supplied from the standby diesel generators as described in Section 3.6.
2. The diesel-driven fire pump is powered by its own diesel engine.

C. Other
Lubrication, cooling, and ventilation are assumed to be provided locally for the fire pumps.

3.9.7 Section 3.9 References

1. Zion 1 and 2 Final Safety Analysis Report.

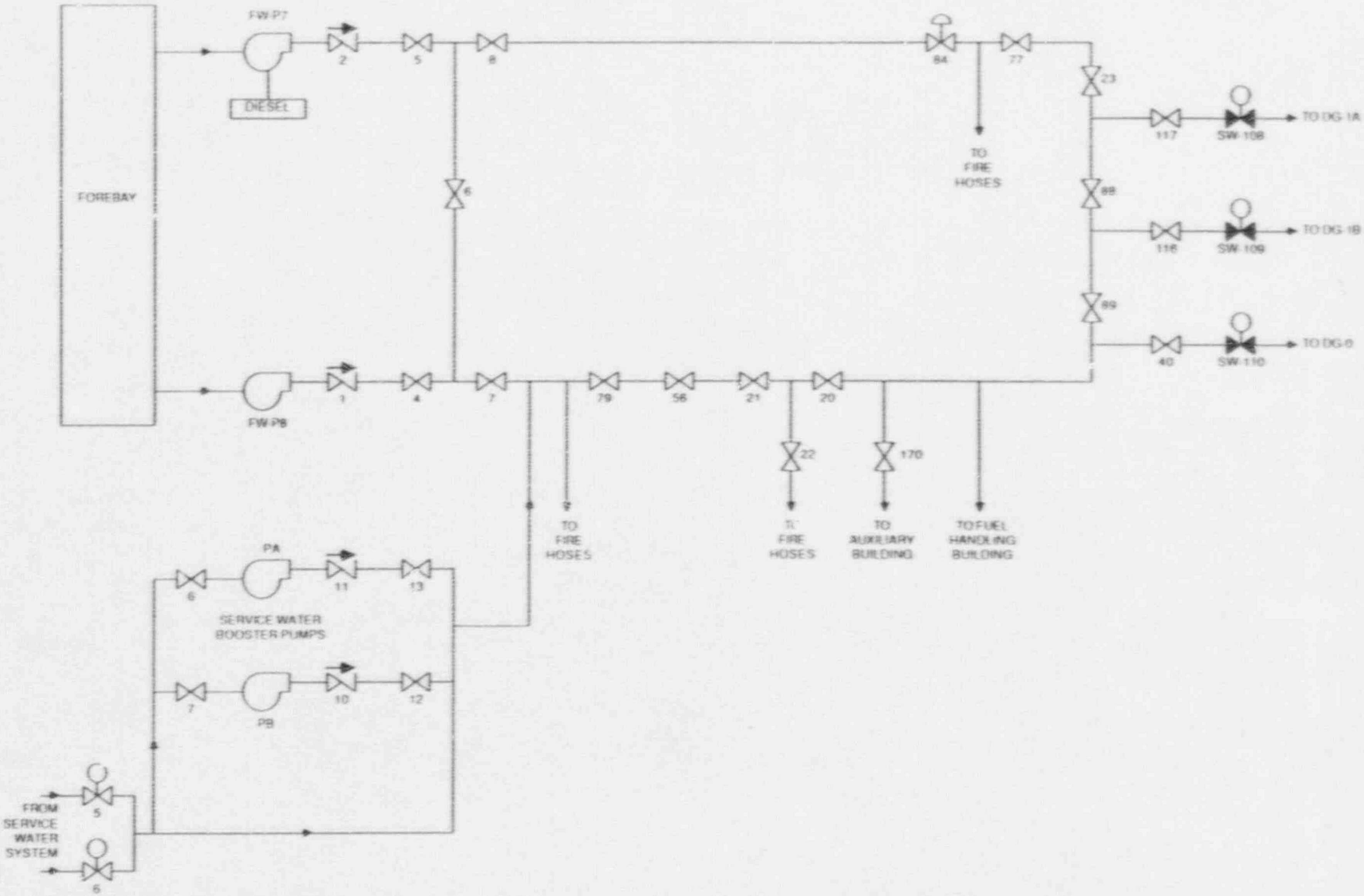


Figure 3.9-1. Zion 1 and 2 Fire Water System Flow Paths For Backup Diesel Generator Cooling

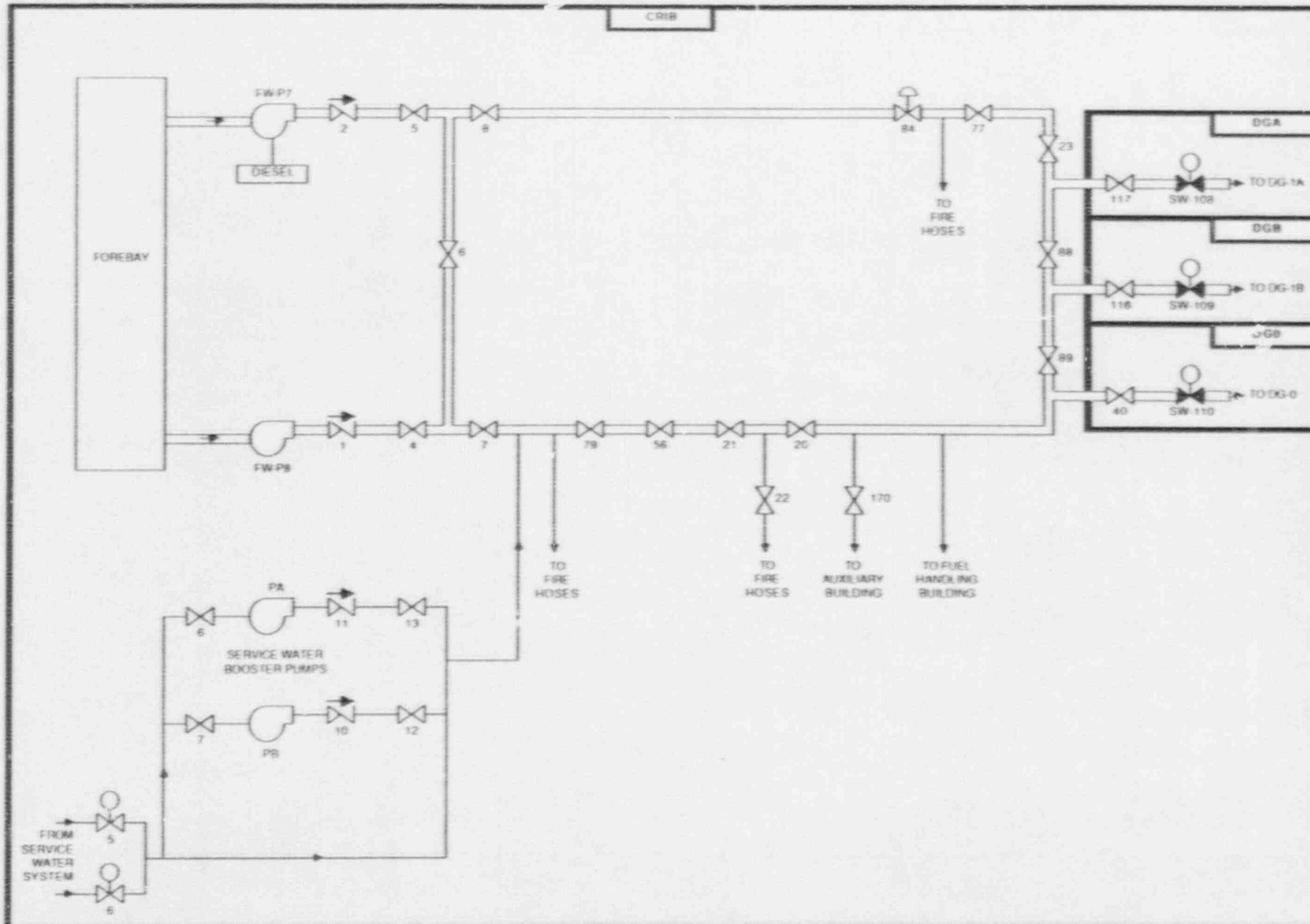


Figure 3.9-2. Zion 1 and 2 Fire Water System Flow Paths For Backup Diesel Generator Cooling Showing Component Locations

Table 3.9-1. Zion 1 Fire Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
FW-P7	DDP	CRIB	DIESEL		CRIB	
FW-P8	MDP	CRIB	BUS-138	480	SWGRM148	AC/18
SW-108	MOV	DGA	MCC-1381A	480	SWGRM148	AC/18
SW-109	MOV	DGB	MCC-1391	480	SWGRM149	AC/19
SW-110	MOV	DG0	MCC-1371	480	SWGRM147	AC/17

4. PLANT INFORMATION

4.1 SITE AND BUILDING SUMMARY

The Zion 1 and 2 site is located in the city of Zion, Illinois, on the west shore of Lake Michigan, approximately 6 miles north-northeast of the center of the city of Waukegan, Illinois, and 8 miles south of the center of the city of Kenosha, Wisconsin. The site is about 40 miles north of Chicago and about 42 miles south of Milwaukee. Figure 4-1 (from Ref. 1) shows a general view of the site, while Figure 4-2 shows a simplified plot plan.

The major structures include a separate and independent containment for each reactor, a common auxiliary building, a common fuel handling building, a common turbine building, and a common administrative and service building.

The reactor containments contain the RCS and portions of the AFWS, ECCS, and CVCS for each unit. The Unit 2 containment is located north of the Unit 1 containment.

The auxiliary building, located east of the containments, contains the major engineered safety features components. Components of the AFWS, ECCS, CVCS, CCWS, and electric power system are located in the auxiliary building. The control room is also located in the auxiliary building.

The fuel handling building is located between the two containments and contains the spent fuel pool. The turbine building is located east of the auxiliary building and contains components of the power conversion system.

The crib house is located on Lake Michigan and contains the service water pumps for both units, as well as the fire water pumps.

4.2 FACILITY LAYOUT DRAWINGS

Section views of the Zion plant are shown in Figure 4-3. Figures 4-4 through 4-10 are simplified building layout drawings for the Zion 1 and 2 containment, auxiliary building, fuel handling building and control building. The intake structure is shown in Figure 4-11. 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 I, Oak Ridge National Laboratory, Nuclear Safety Information Center, December 1973.

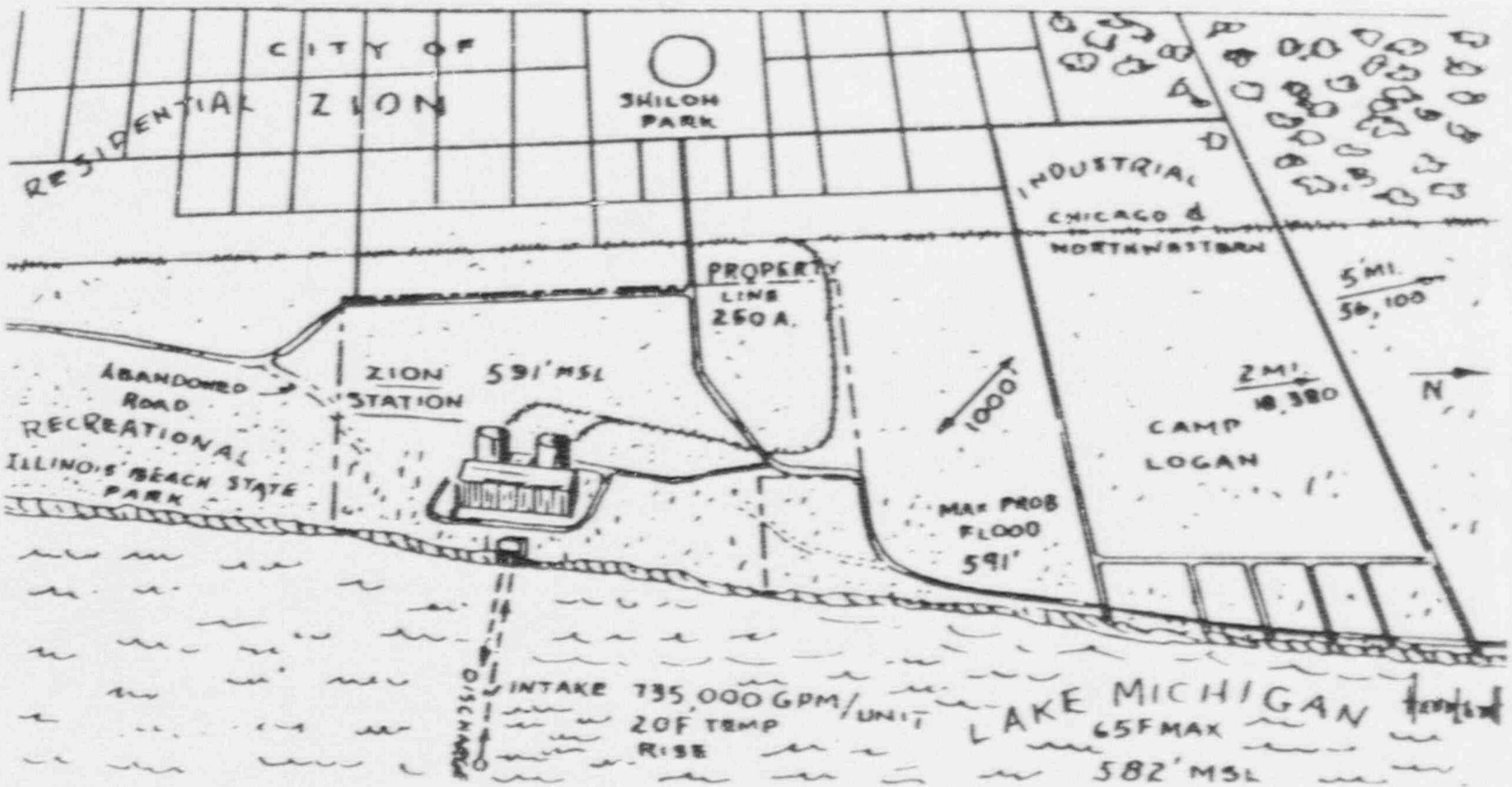


Figure 4-1. General View of Zion 1 and 2 Site and Vicinity

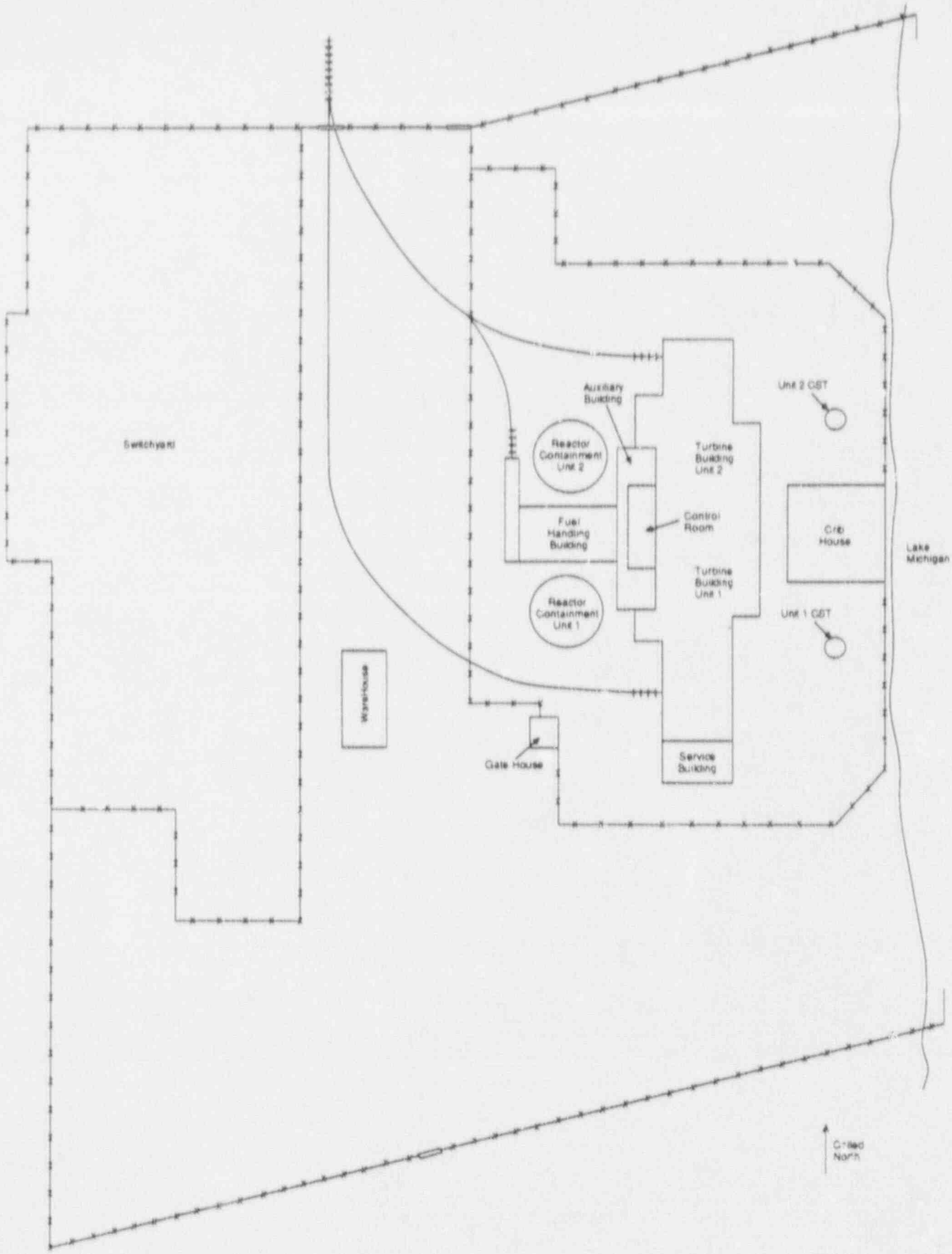


Figure 4-2. Zion 1 and 2 Plot Plan

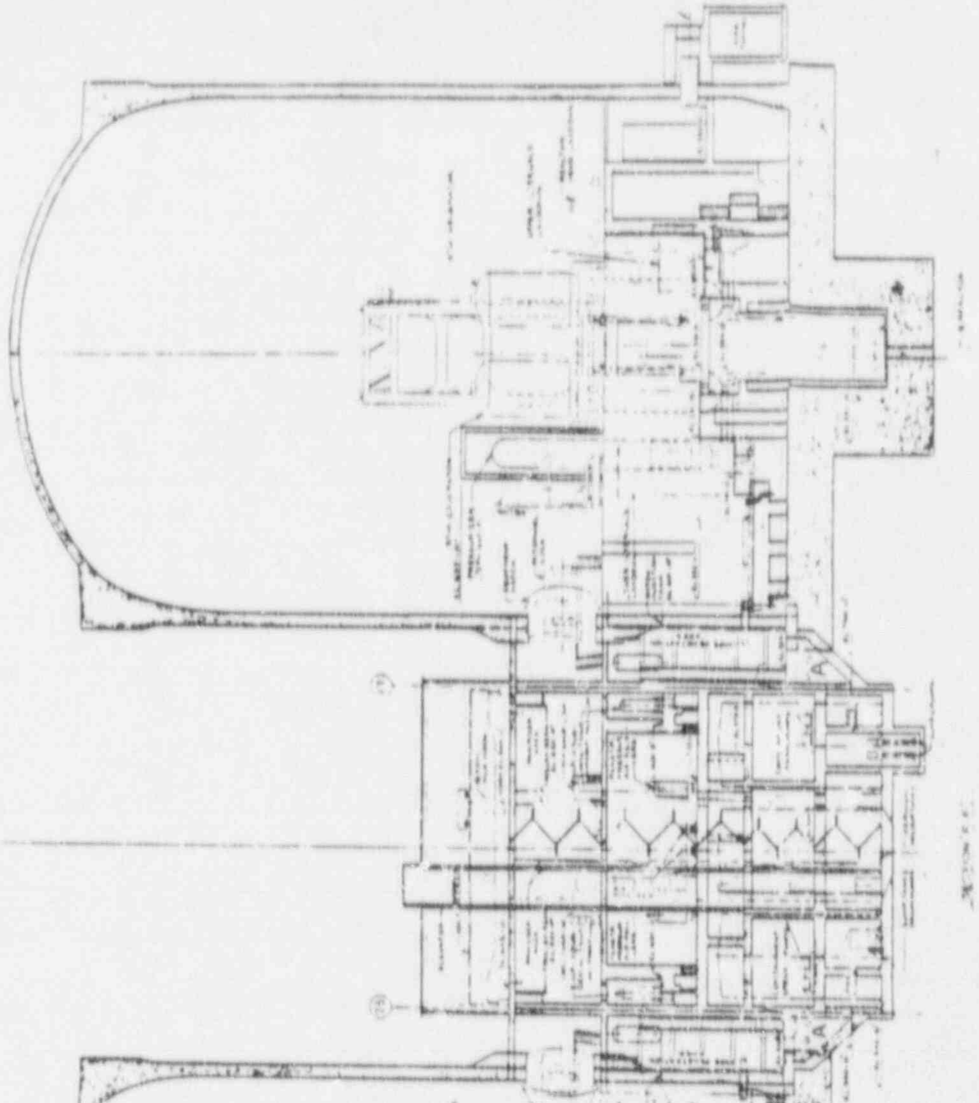


Figure 4-3. Zion 1 and 2 Section Drawings (Page 1 of 2)

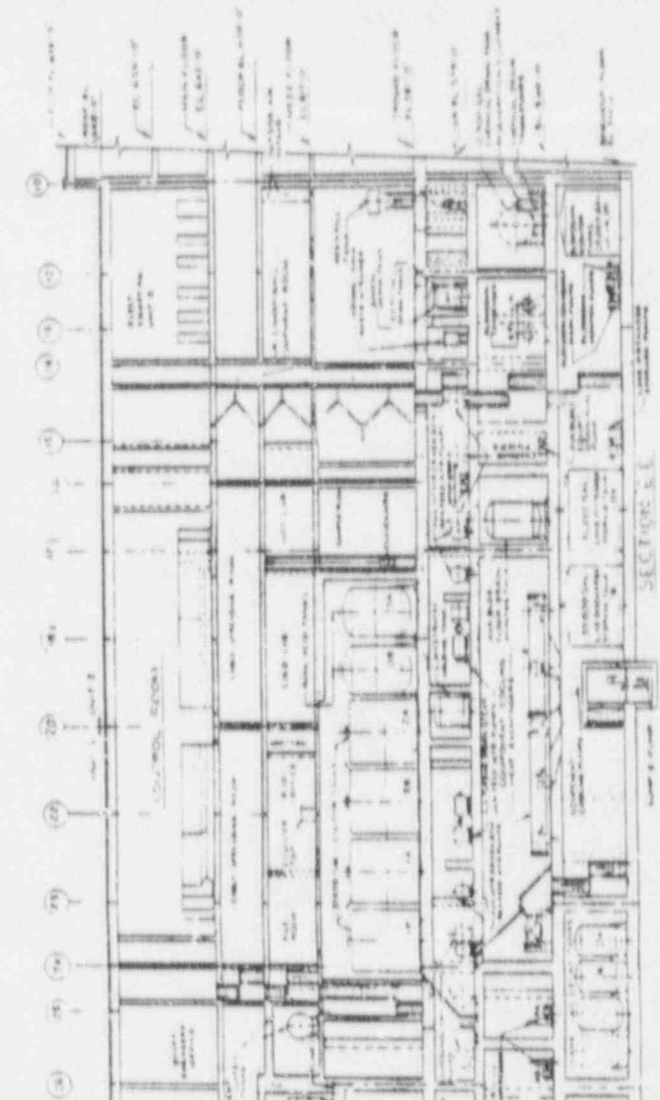


Figure 4-3. Zion 1 and 2 Section Drawings (Page 2 of 2)

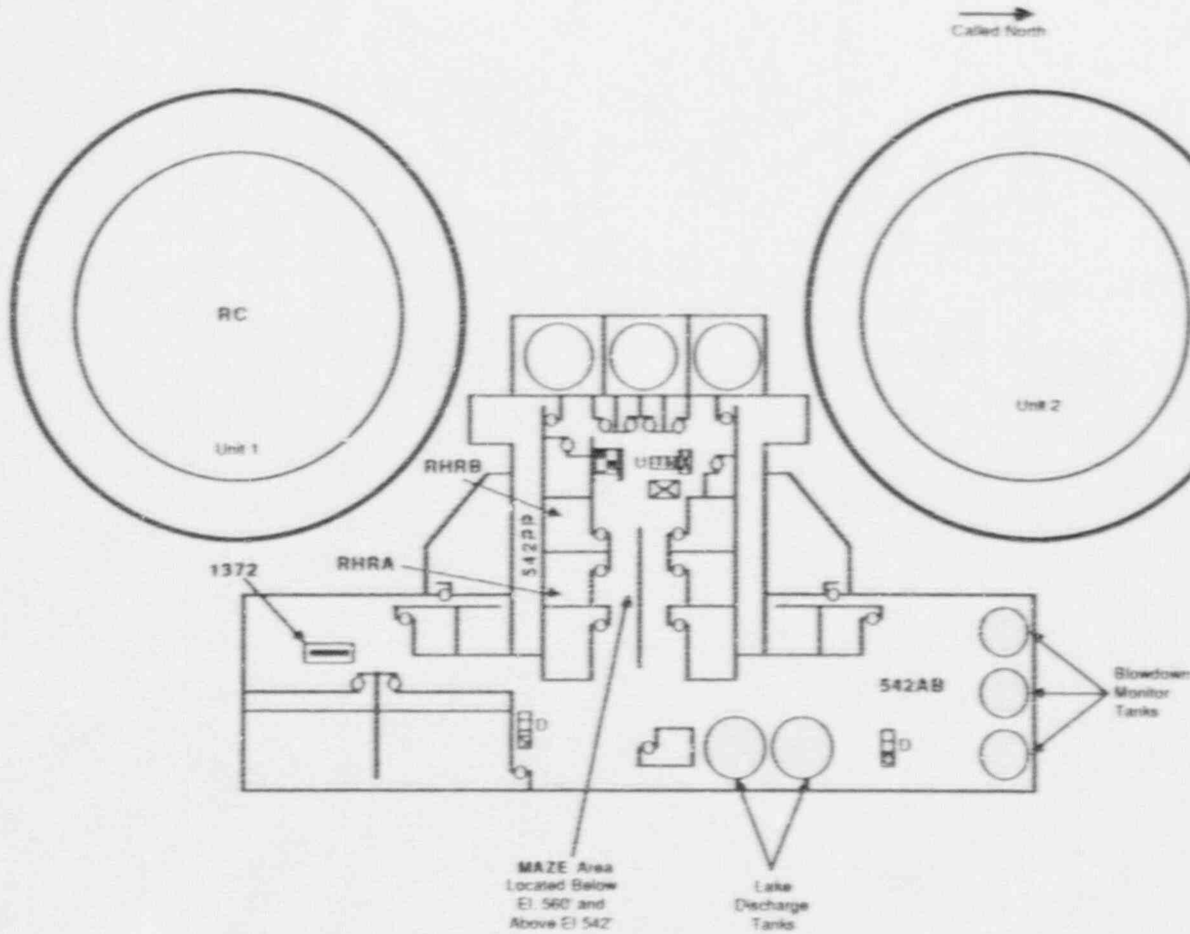


Figure 4-4. Zion 1 and 2 General Arrangement, Elevation 542'

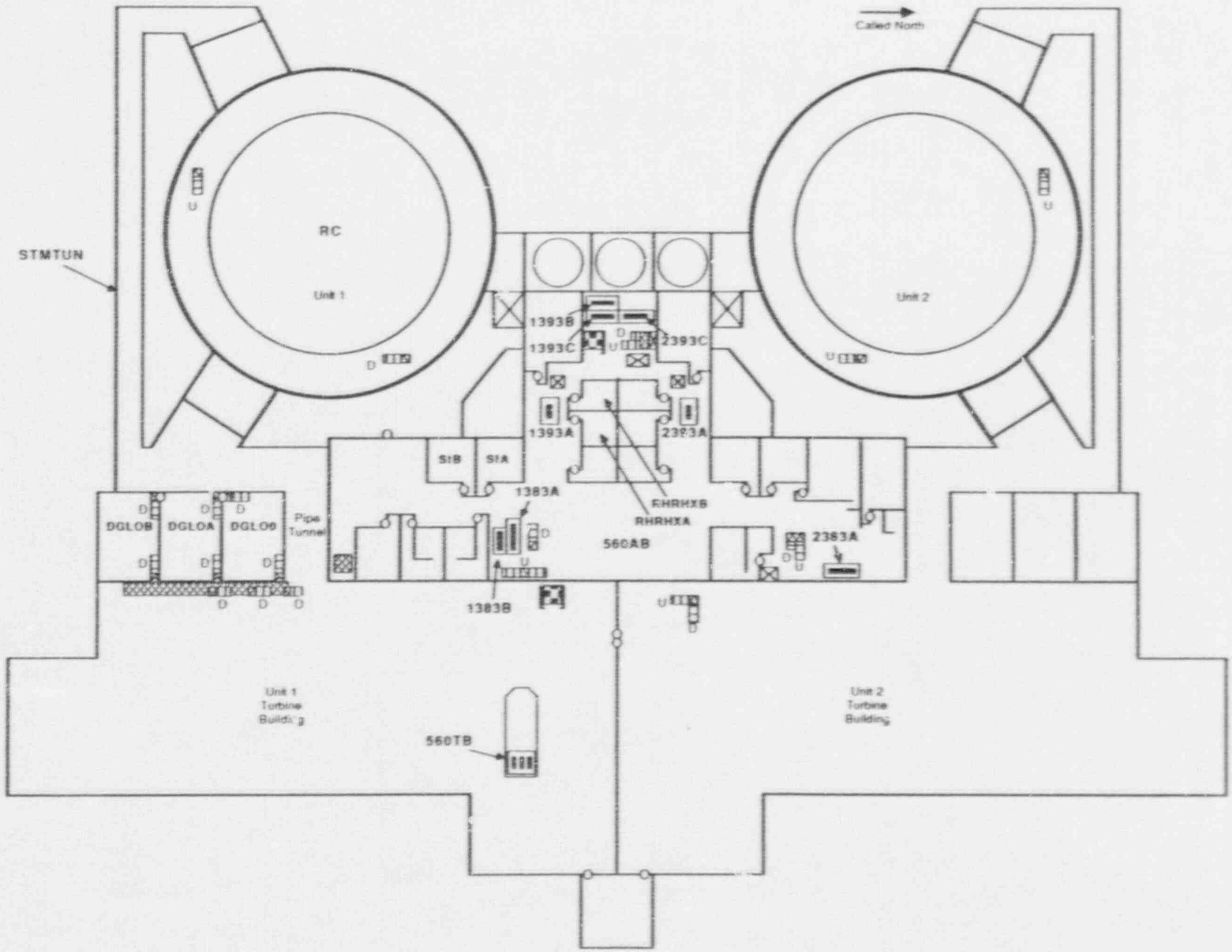


Figure 4-5. Zion 1 and 2 General Arrangement, Elevation 560'

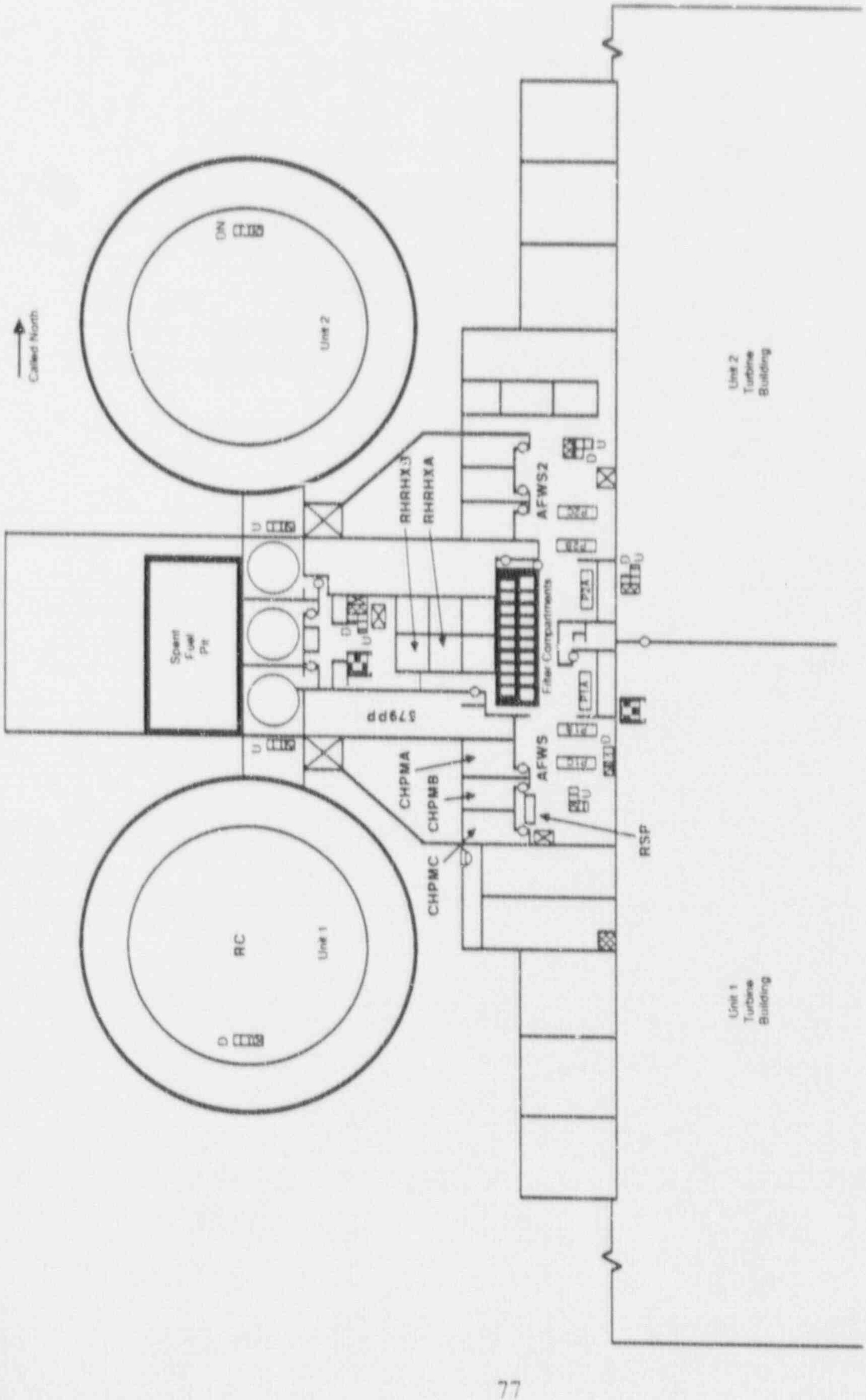


Figure 4-6. Zion 1 and 2 General Arrangement, Elevation 579'

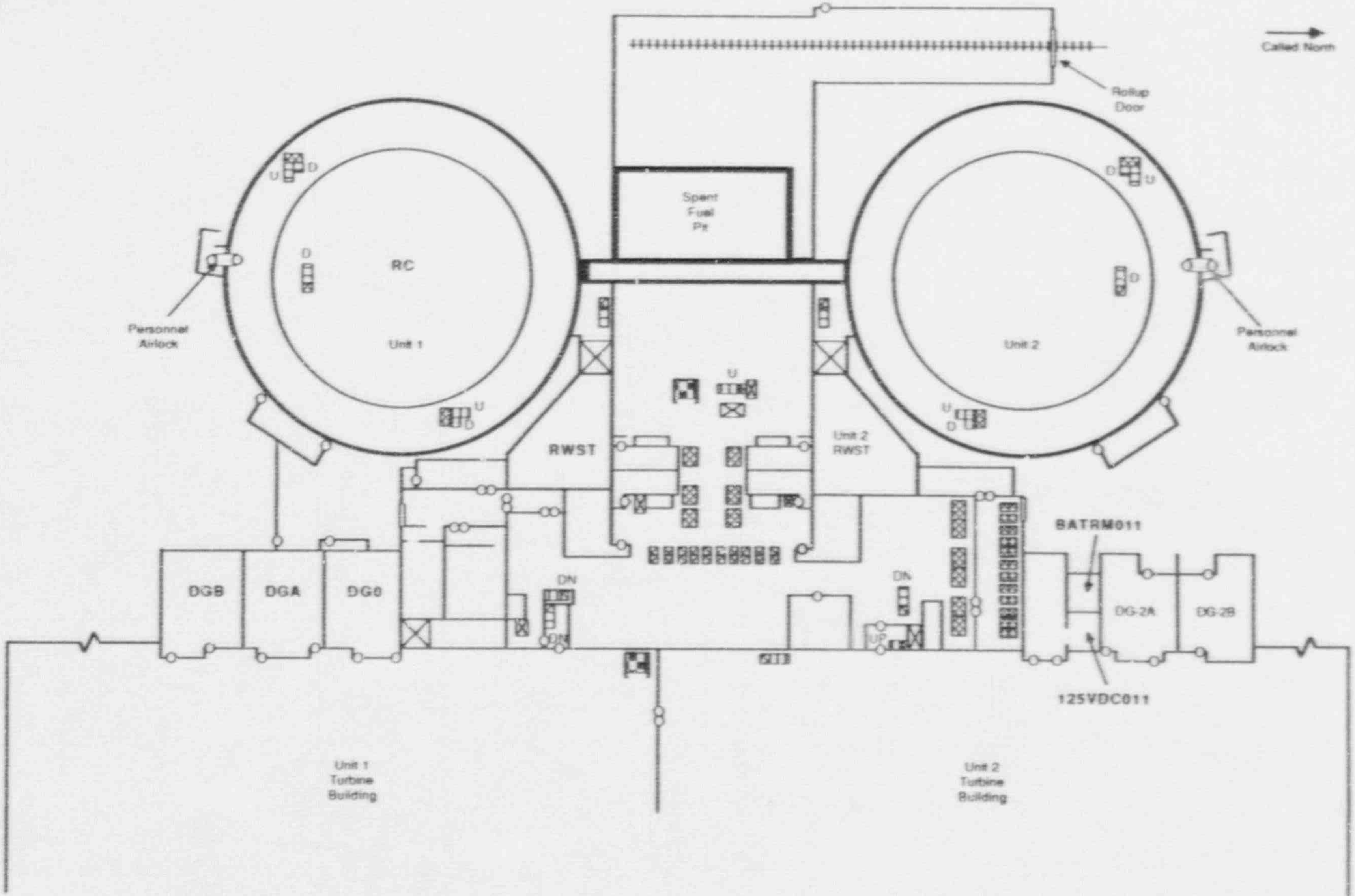


Figure 4-7. Zion 1 and 2 General Arrangement, Elevation 592'

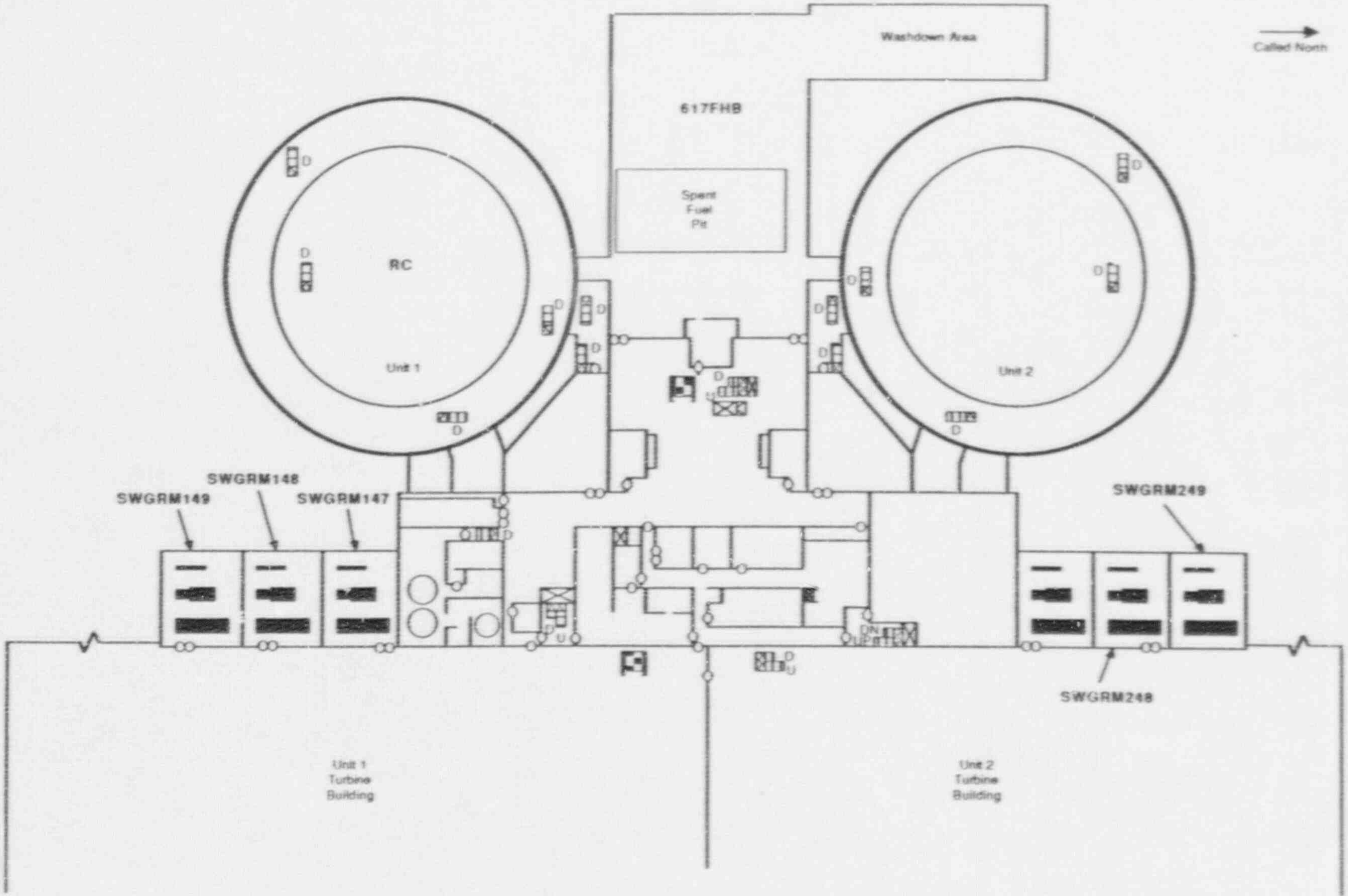


Figure 4-8. Zion 1 and 2 General Arrangement, Elevation 617'

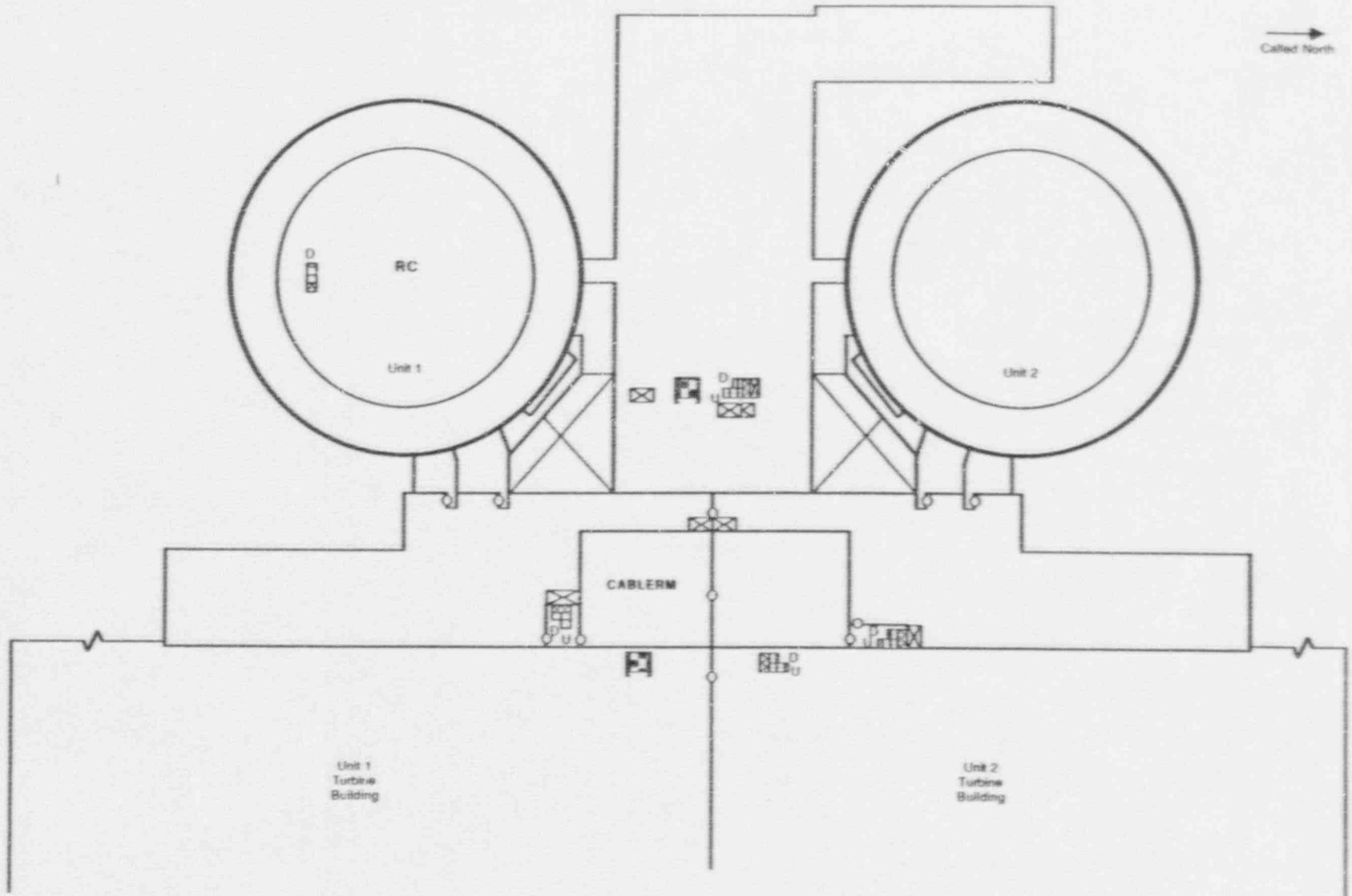


Figure 4-9. Zion 1 and 2 General Arrangement, Elevation 630'

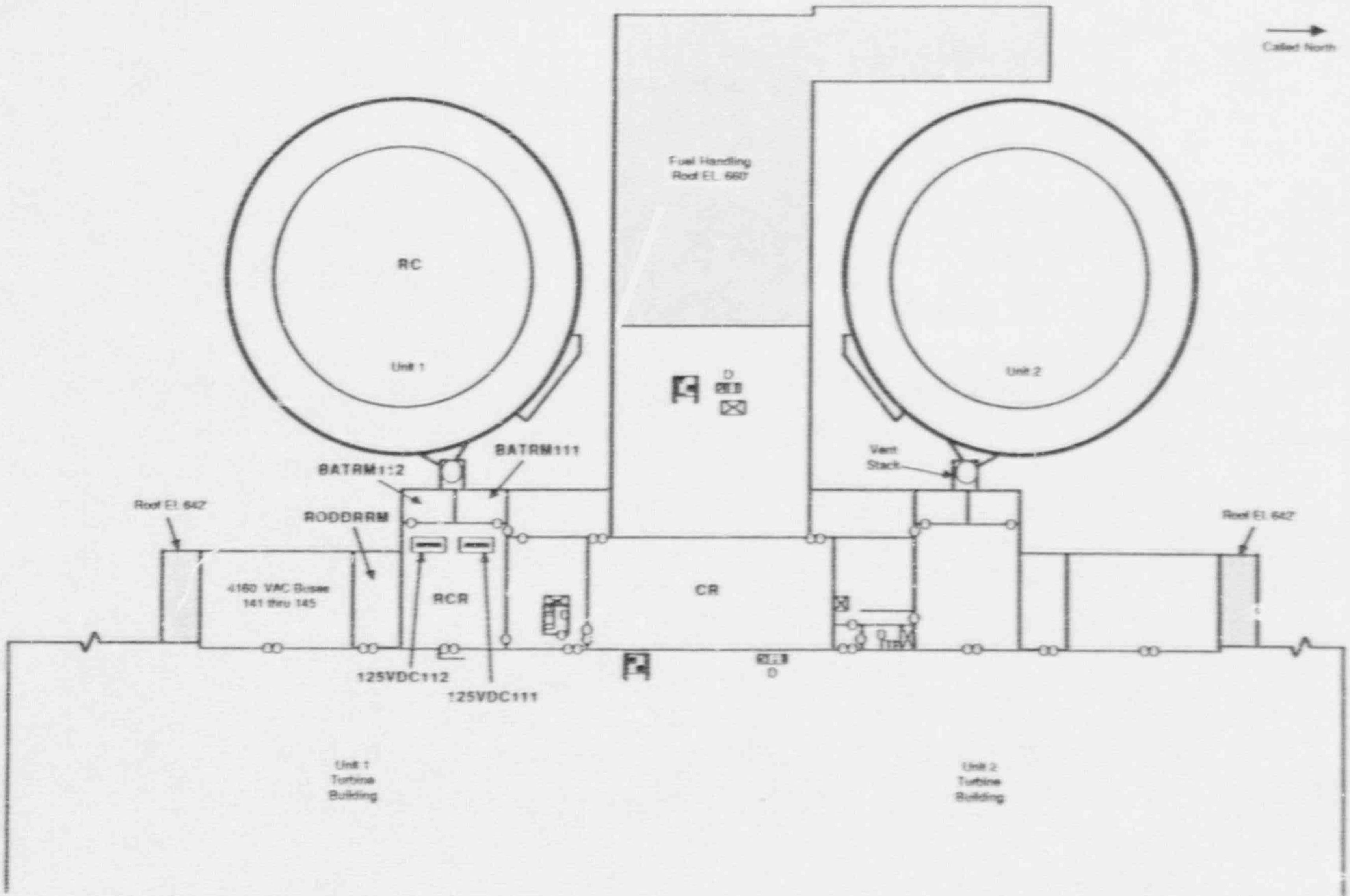


Figure 4-10. Zion 1 and 2 General Arrangement, Elevation 642'

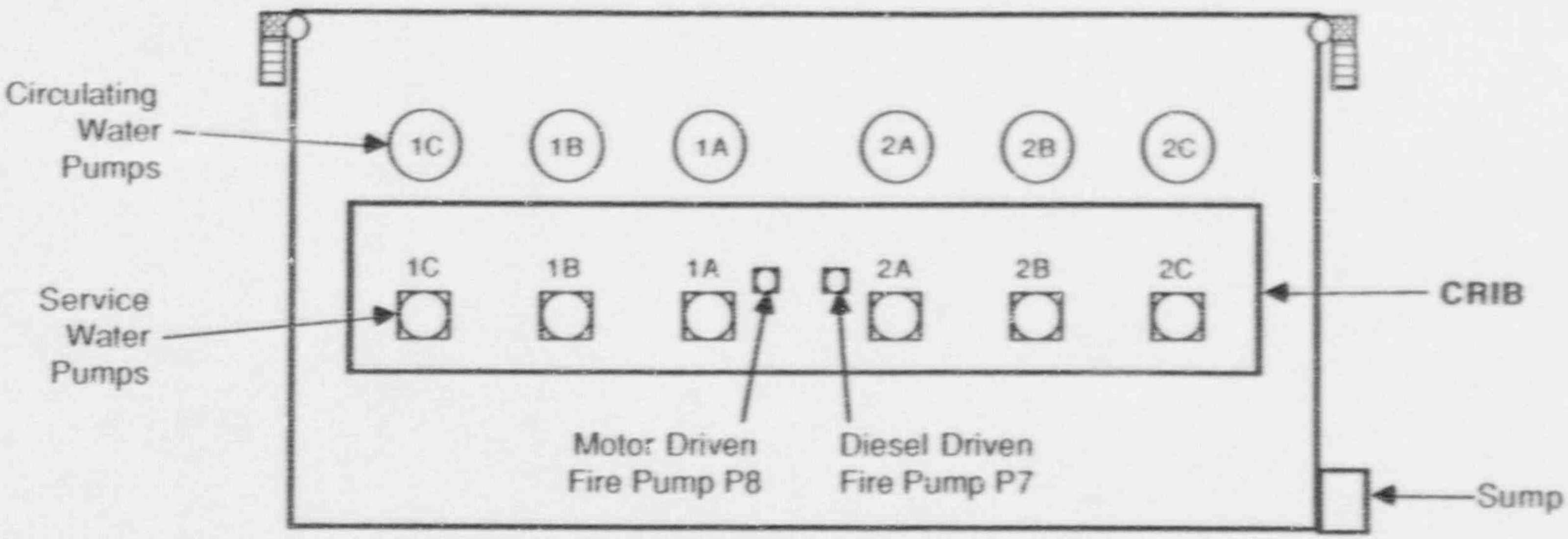


Figure 4-11. Zion 1 and 2 General Arrangement, Crib House

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

	Codes	Descriptions
1.	AFWS	Auxiliary Feedwater System room, located in the Auxiliary Building at elevation 579'. Contains auxiliary feedwater pumps 1A, 1B, and 1C.
2.	AFWS2	Auxiliary Feedwater System room, located in the Auxiliary Building at elevation 579', Unit 2.
3.	BATRM011	Battery Room 011, located in the Auxiliary Building at elevation 592' (Swing Battery).
4.	BATRM111	Battery Room 111, located in the Auxiliary Building at elevation 642'. Contains the battery set for 125 VDC Bus 111.
5.	BATRM112	Battery Room 112, located in the Auxiliary Building at elevation 642'. Contains the battery set for 125 VDC Bus 112.
6.	CABLERM	Cable Room, located in the Auxiliary Building at elevation 630' directly below Control Room.
7.	CHPMA	Charging Pump Room A located in the Auxiliary Building at elevation 579'. Contains charging pump A.
8.	CHPMB	Charging Pump Room B located in the Auxiliary Building at elevation 579'. Contains charging pump B.
9.	CHPMC	Charging Pump Room C located in the Auxiliary Building at elevation 579'. Contains charging pump C.
10.	CR	Control Room, located in the Auxiliary Building at elevation 642'.
11.	CRIB	Crib House. Contains the service water pumps.
12.	CST	Condensate Storage Tank, located south of the Crib House.
13.	DGA	Diesel Generator Room A, located in the Auxiliary Building at elevation 592'. Contains diesel generator unit 1A.
14.	DGB	Diesel Generator Room B, located in the Auxiliary Building at elevation 592'. Contains diesel generator unit 1B.
15.	DG0	Diesel Generator Room 0, located in the Auxiliary Building at elevation 592'. Contains diesel generator unit 0.

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

16.	DGLOA	Diesel Generator Oil Storage Tank Room A, located in the Auxiliary Building at elevation 560'. Contains the oil supply for diesel generator 1A.
17.	DGLOB	Diesel Generator Oil Storage Tank Room B, located in the Auxiliary Building at elevation 560'. Contains the oil supply for diesel generator 1B.
18.	DGLO0	Diesel Generator Oil Storage Tank Room 0, located in the Auxiliary Building at elevation 560'. Contains the oil supply for diesel generator 0.
19.	MAZE	Maze of piping between the 542' and 579' elevations of the Auxiliary Building.
20.	RC	Reactor Containment
21.	RCR	Rod Control Room, located in the Auxiliary Building at elevation 642'.
22.	RHRA	Residual Heat Removal Room A, located in the Auxiliary Building at elevation 542'. Contains RHR pump 1A.
23.	RHRB	Residual Heat Removal Room B, located in the Auxiliary Building at elevation 542'. Contains RHR pump 1B.
24.	RHRHXA	Residual Heat Removal Heat Exchanger Room A, located in the Auxiliary Building at elevation 579'. Contains RHR heat exchanger 1A.
25.	RHRHXB	Residual Heat Removal Heat Exchanger Room B, located in the Auxiliary Building at elevation 579'. Contains RHR heat exchanger 1B.
26.	RODDRRM	Rod Drive Room, located in the Auxiliary Building at elevation 642'.
27.	RSP	Remote Shutdown Panel, located in the Auxiliary Building at elevation 579'.
28.	RWST	Refueling Water Storage Tank Vault, located directly northeast of the containment building. Contains the refueling water storage tank.
29.	SIA	Safety Injection Room A, located in the Auxiliary Building at elevation 560'. Contains safety injection pump 1A.
30.	SIB	Safety Injection Room B, located in the Auxiliary Building at elevation 560'. Contains safety injection pump 1B.

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

31.	STMTUN	Steam Tunnel, located south of the Reactor Containment at elevation 560'. Contains main steam and feedwater lines.
32.	SWGRM147	Switchgear Room 147, located in the Auxiliary Building at elevation 617'. Contains the switchgear for buses 137 and 147 and MCC 1371.
33	SWGRM148	Switchgear Room 148, located in the Auxiliary Building at elevation 617'. Contains the switchgear for buses 138 and 148 and MCC 1381.
34.	SWGRM149	Switchgear Room 149, located in the Auxiliary Building at elevation 617'. Contains the switchgear for buses 139 and 149 and MCC 1391.
35.	SWGRM248	Switchgear Room 248, located in the Auxiliary Building at elevation 617', Unit 2.
36.	SWGRM249	Switchgear Room 249, located in the Auxiliary Building at elevation 617', Unit 2.
37.	125VDC011	125 DC Bus 011, located in the Auxiliary Building at elevation 642'.
38.	125VDC111	125 DC Bus 111, located in the Auxiliary Building at elevation 642'.
39.	125VDC112	125 DC Bus 112, located in the Auxiliary Building at elevation 642'.
40.	1372	Motor Control Center 1372, located in the Auxiliary Building at elevation 542', south end.
41.	1383A	Motor Control Center 1383A, located in the Auxiliary Building at elevation 560', east side.
42.	1383B	Motor Control Center 1383B, located in the Auxiliary Building at elevation 560', east side.
43.	1393A	Motor Control Center 1393A, located in the Auxiliary Building at elevation 560', northwest of Safety Injection Pump Room 1A.
44.	1393B	Motor Control Center 1393B, located in the Auxiliary Building at elevation 560', west end.
45.	1393C	Motor Control Center 1393C located in the Auxiliary Building at elevation 560', west end.

Table 4-1. Definition of Zion 1 Building and Locatio Codes (Continued)

46.	2383A	Motor Control Center 2383A, located in the Auxiliary Building at elevation 560', Unit 2.
47.	2393A	Motor Control Center 2393A, located in the Auxiliary Building at elevation 560', Unit 2.
48.	2393C	Motor Control Center 2393C, located in the Auxiliary Building at elevation 560', Unit 2.
49.	542AB	542' elevation of the Auxiliary Building.
50.	542PP	Pipe Tunnel at elevation 542', located in the Auxiliary Building at elevation 542'. Contains piping from containment building to the RHR pump rooms.
51.	560AB	560' elevation of the Auxiliary Building.
52.	560TB	560' elevation of the Turbine Building.
53.	579PP	Pipe Penetration Area, located in the Auxiliary Building at elevation 579'.
54.	617FHB	617' elevation of the Fuel Handling Building.

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
125VDC011	EP	DC-BUS-011	BUS
125VDC011	EP	BC-011	BC
125VDC011	EP	DC-BUS-011	BUS
125VDC111	EP	DC-BUS-111	BUS
125VDC111	EP	BC-111	BC
125VDC111	EP	DC-BUS-111	BUS
125VDC112	EP	DC-BUS-112	BUS
125VDC112	EP	BC-112	BC
125VDC112	EP	DC-BUS-112	BUS
1372	EP	MCC-1372	MCC
1383A	EP	MCC-1383A	MCC
1383B	EP	MCC-1383B	MCC
1393A	EP	MCC-1393A	MCC
1393B	EP	MCC-1393B	MCC
1393C	EP	MCC-1393C	MCC
2393C	EP	MCC-2393C	MCC
542AB	SW	SW-7	MOV
542AB	SW	SW-8	MOV
560AB	CCW	CCW-HX0	HX
560AB	CCW	CCW-HX1	HX
560AB	CCW	CCW-OC	MDP
560AB	CCW	CCW-OD	MDP
560AB	CCW	CCW-OE	MDP
560AB	SW	SW-2	MOV
560AB	SW	SW-13	MOV
560AB	SW	SW-12	MOV
560AB	SW	SW-14	MOV
560AB	SW	SW-15	MOV
560AB	SW	SW-12	MOV
560AB	SW	SW-13	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
560AB	SW	SW-14	MOV
560AB	SW	SW-15	MOV
579PP	AFW	AFW-50	MOV
579PP	AFW	AFW-51	MOV
579PP	AFW	AFW-52	MOV
579PP	AFW	AFW-53	MOV
579PP	AFW	AFW-54	MOV
579PP	AFW	AFW-55	MOV
579PP	AFW	AFW-56	MOV
579PP	AFW	AFW-57	MOV
579PP	AFW	AFW-6	MOV
579PP	CVCS	SI-8801A	MOV
579PP	CVCS	SI-8801B	MOV
579PP	CVCS	SI-8803A	MOV
579PP	CVCS	SI-8803B	MOV
579PP	CVCS	VC-8105	MOV
579PP	CVCS	VC-8106	MOV
579PP	ECCS	SI-8801A	MOV
579PP	ECCS	SI-8801B	MOV
579PP	ECCS	SI-8802	MOV
579PP	ECCS	SI-8803A	MOV
579PP	ECCS	SI-8803B	MOV
579PP	ECCS	SI-9011A	MOV
579PP	ECCS	SI-9011B	MOV
579PP	ECCS	VC-8105	MOV
579PP	ECCS	VC-8106	MOV
AFWS	AFW	AFW-75	MOV
AFWS	AFW	AFW-74	MOV
AFWS	AFW	AFW-76	MOV
AFWS	AFW	SW-101	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
AFWS	AFW	SW-102	MOV
AFWS	AFW	SW-103	MOV
AFWS	AFW	SW-104	MOV
AFWS	AFW	SW-105	MOV
AFWS	AFW	SW-106	MOV
AFWS	AFW	SW-107	MOV
AFWS	AFW	AFW-P1A	TDP
AFWS	AFW	AFW-P1B	MDP
AFWS	AFW	AFW-P1C	MDP
BATRM011	EP	BATT-011	BATT
BATRM111	EP	BATT-111	BATT
BATRM112	EP	BATT-112	BATT
CHPMA	CVCS	VC-P1A	MDP
CHPMA	ECCS	VC-P1A	MDP
CHPMA	ECCS	VC-P1A	MDP
CHPMB	CVCS	VC-P1B	MDP
CHPMB	ECCS	VC-P1B	MDP
CHPMB	ECCS	VC-P1B	MDP
CHPMC	CVCS	VC-P1C	PDP
CRIB	FW	FW-P7	DDP
CRIB	FW	FW-P8	MDP
CRIB	SW	SW-P1A	MDP
CRIB	SW	SW-P1B	MDP
CRIB	SW	SW-P1C	MDP
CRIB	SW	SW-3	MOV
CRIB	SW	SW-4	MOV
CRIB	SW	SW-3	MOV
CRIB	SW	SW-4	MOV
CST	AFW	AFW-CST	TANK
DG0	EP	DG 0	DG

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
DG0	FW	DG-0	DG
DG0	FW	SW-110	MOV
DGA	EP	DG-1A	DG
DGA	FW	DG-1A	DG
DGA	FW	SW-108	MOV
DGB	EP	DG-1B	DG
DGB	FW	DG-1B	DG
DGB	FW	SW-109	MOV
DGLOA	SW	SW-18	MOV
DGLOA	SW	SW-19	MOV
DGLOB	SW	SW-16	MOV
DGLOB	SW	SW-17	MOV
MAZE	ECCS	SI-8804A	MOV
MAZE	ECCS	SI-8804A	MOV
MAZE	ECCS	RH-8724A	XV
MAZE	ECCS	RH-8724B	XV
MAZE	ECCS	RH-8728A	XV
MAZE	ECCS	RH-8728B	XV
RC	AFW	SG-A	SG
RC	AFW	SG-B	SG
RC	AFW	SG-C	SG
RC	AFW	SG-D	SG
RC	CVCS	RCS-VESSEL	RV
RC	CVCS	SI-8800A	MOV
RC	CVCS	SI-8800B	MOV
RC	CVCS	SI-8800C	MOV
RC	CVCS	SI-8800D	MOV
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	RCS-VESSEL	RV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	SI-SUMP	TANK
RC	ECCS	SI-SUMP	TANK
RC	ECCS	SI-8800A	MOV
RC	ECCS	SI-8800B	MOV
RC	ECCS	SI-8800C	MOV
RC	ECCS	SI-8800D	MOV
RC	RCS	RH-8701	MOV
RC	RCS	RH-8702	MOV
RC	RCS	RCS-VESSEL	RV
RC	RCS	RCS-455C	NV
RC	RCS	RCS-456	NV
RC	RCS	RCS-8000A	MOV
RC	RCS	RCS-8000B	MOV
RCR	EP	BUS-111	BUS
RCR	EP	BUS-112	BUS
RCR	EP	BUS-113	BUS
RCR	EP	BUS-114	BUS
RCR	EP	INV-111	INV
RCR	EP	INV-112	INV
RCR	EP	INV-113	INV
RCR	EP	INV-114	INV
RCR	EP	TR-111	TRAN
RCR	EP	TR-112	TRAN
RCR	EP	TR-113	TRAN
RCR	EP	BUS-111	BUS

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RCR	EP	BUS-112	BUS
RCR	EP	BUS-113	BUS
RCR	EP	INV-111	INV
RCR	EP	INV-112	INV
RCR	EP	INV-113	INV
RHRA	ECCS	RH-P1A	MDP
RHRB	ECCS	RH-P1B	MDP
RHRHXA	ECCS	RH-HX1A	HX
RHRHXA	ECCS	CCW-9412A	MOV
RHRHXB	ECCS	RH-HX1B	HX
RHRHXB	ECCS	CCW-9412B	MOV
RWST	CVCS	SI-RWST	TANK
RWST	CVCS	VC-112D	MOV
RWST	CVCS	VC-112E	MOV
RWST	CVCS	SI-8807A	MOV
RWST	CVCS	SI-8807B	MOV
RWST	CVCS	SI-8806	MOV
RWST	ECCS	SI-8807A	MOV
RWST	ECCS	SI-8807B	MOV
RWST	ECCS	SI-8806	MOV
RWST	ECCS	SI-RWST	TANK
RWST	ECCS	VC-112D	MOV
RWST	ECCS	VC-112E	MOV
RWST	ECCS	SI-RWST	TANK
RWST	ECCS	VC-112D	MOV
RWST	ECCS	VC-112E	MOV
RWST	ECCS	SI-RWST	TANK
RWST	ECCS	SI-RWST	TANK
RWST	ECCS	SI-8804B	MOV
RWST	ECCS	SI-8811A	MOV

Table 4-2. Partial Listing of Components b' Location at Zion 1 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RWST	ECCS	SI-8811B	MOV
SIA	CVCS	SI-8923	MOV
SIA	ECCS	SI-8923A	MOV
SIA	ECCS	SI-9010A	MOV
SIA	ECCS	SI-P1A	MDP
SIA	ECCS	SI-P1A	MDP
SIB	ECCS	SI-8923B	MOV
SIB	ECCS	SI-9010B	MOV
SIB	ECCS	SI-P1B	MDP
SIB	ECCS	SI-8804B	MOV
SIB	ECCS	SI-P1B	MDP
STMTUN	AFW	AFW-11	MOV
STMTUN	AFW	AFW-5	MOV
STMTUN	AFW	AFW-17	MOV
STMTUN	AFW	AFW-18	MOV
STMTUN	AFW	AFW-19	MOV
STMTUN	AFW	AFW-20	MOV
SWGRM147	EP	CB-147	CB
SWGRM147	EP	BUS-147	BUS
SWGRM147	EP	BUS-137	BUS
SWGRM147	EP	TR-137	TRAN
SWGRM147	EP	MCC-1371	MCC
SWGRM148	EP	CB-148	CB
SWGRM148	EP	BUS-148	BUS
SWGRM148	EP	BUS-138	BUS
SWGRM148	EP	TR-138	TRAN
SWGRM148	EP	MCC-1381B	MCC
SWGRM149	EP	CB-149	CB
SWGRM149	EP	BUS-149	BUS
SWGRM149	EP	BUS-139	BUS

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
SWGRM149	EP	TR-139	TRAN
SWGRM149	EP	MCC-1391	MCC

5. BIBLIOGRAPHY FOR ZION 1 AND 2

1. NUREG-0611, "Generic Evaluation of Feedwater Transients and Small Break Loss of Coolant Accidents in Westinghouse-Designed Operating Plants," Appendix X.21, "Zion 1 and 2 Auxiliary Feedwater System," USNRC, January 1980.

2. NUREG-0850, "Preliminary Assessment of Core Melt Accidents at the Zion and Indian Point Nuclear Power Plants, and Strategies for Mitigating Their Effects," USNRC, November 1981.

3. NUREG/CR-0715, "In-Plant Source Term Measurements at Zion Station," EG&G Idaho, Inc., March 1979.

4. NUREG/CR-0755, "Gamma Dose Measurements at Zion and Fort Calhoun Station," EG&G Idaho, Inc., April 1979.

5. NUREG/CR-1410, "Report of the Zion/Indian Point Study," Sandia National Laboratories, August 1980.

6. NUREG/CR-1411 Vols. 1 and 2, "Report of the Zion/Indian Point Study," Los Alamos National Laboratory, September 1980 (Vol. 1) and July 1980 (Vol. 2).

7. NUREG/CR-1703, "Preliminary Failure Mode Predictions for the SSMRP Reference Plant (Zion 1), Seismic Safety Margins Research Program," Lawrence Livermore National Laboratory, March 1981.

8. NUREG/CR-1704, "Potential Seismic Structural Failure Modes Associated with the Zion Nuclear Plant," Lawrence Livermore National Laboratory, March 1981.

9. NUREG/CR-1988, "Analysis of a Hypothetical Core Meltdown Accident Initiated by Loss of Offsite Power for the Zion 1 Pressurized Water Reactor," Sandia National Laboratories, November 1981.

10. NUREG/CR-1989, "Analysis of Hypothetical Severe Core Damage Accidents for Zion Pressurized Water Reactor," Sandia National Laboratories, December 1982.

11. NUREG/CR-2228, "Containment Response During Degraded Core Accidents Initiated by Transients and Small Break LocA in the Zion/Indian Point Reactor Plants," Brookhaven National Laboratory, July 1981.

12. NUREG/CR-2320, "Seismic Structural Fragility Investigation for Zion Nuclear Power Plant, Seismic Safety Margins Research Program (Phase 1)," Lawrence Livermore National Laboratory, October 1981.

13. NUREG/CR-2385, "CSQ Calculations of Hydrogen Detonations in the Zion and Sequoyah Nuclear Plants," Sandia National Laboratories, September 1982.

14. NUREG/CR-2656, "Loss-of-Feedwater Transients for the Zion-1 Pressurized Water Reactor," Los Alamos National Laboratory, July 1982.

15. NUREG/CR-2888, "Operator Action Event Trees for the Zion 1 Pressurized Water Reactor," EG&G, Inc., October 1982.

16. NUREG/CR-3300, "Review and Evaluation of the Zion Probabilistic Safety Study: Plant Analysis," Sandia National Laboratories, May 1984.

17. NUREG/CR-3428, "Application of the SSMRP Methodology to the Seismic Risk at the Zion Nuclear Power Plant," Lawrence Livermore National Laboratory, January 1984.

18. NUREG/CR-4550, Vol. 7, "Analysis of Core Damage Frequency from Internal Initiating Events: Zion Power Plant," Sandia National Laboratories, 1987 (Draft).

19. NUREG/CR-4551, Vol. 5, "Evaluation of Severe Accident Risks and the Potential for Risk Reduction: Zion Power Plant," Brookhaven National Laboratory, 1987 (Draft).

20. "Zion Probabilistic Safety Study," Commonwealth Edison Company of Chicago, September 1981.

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)

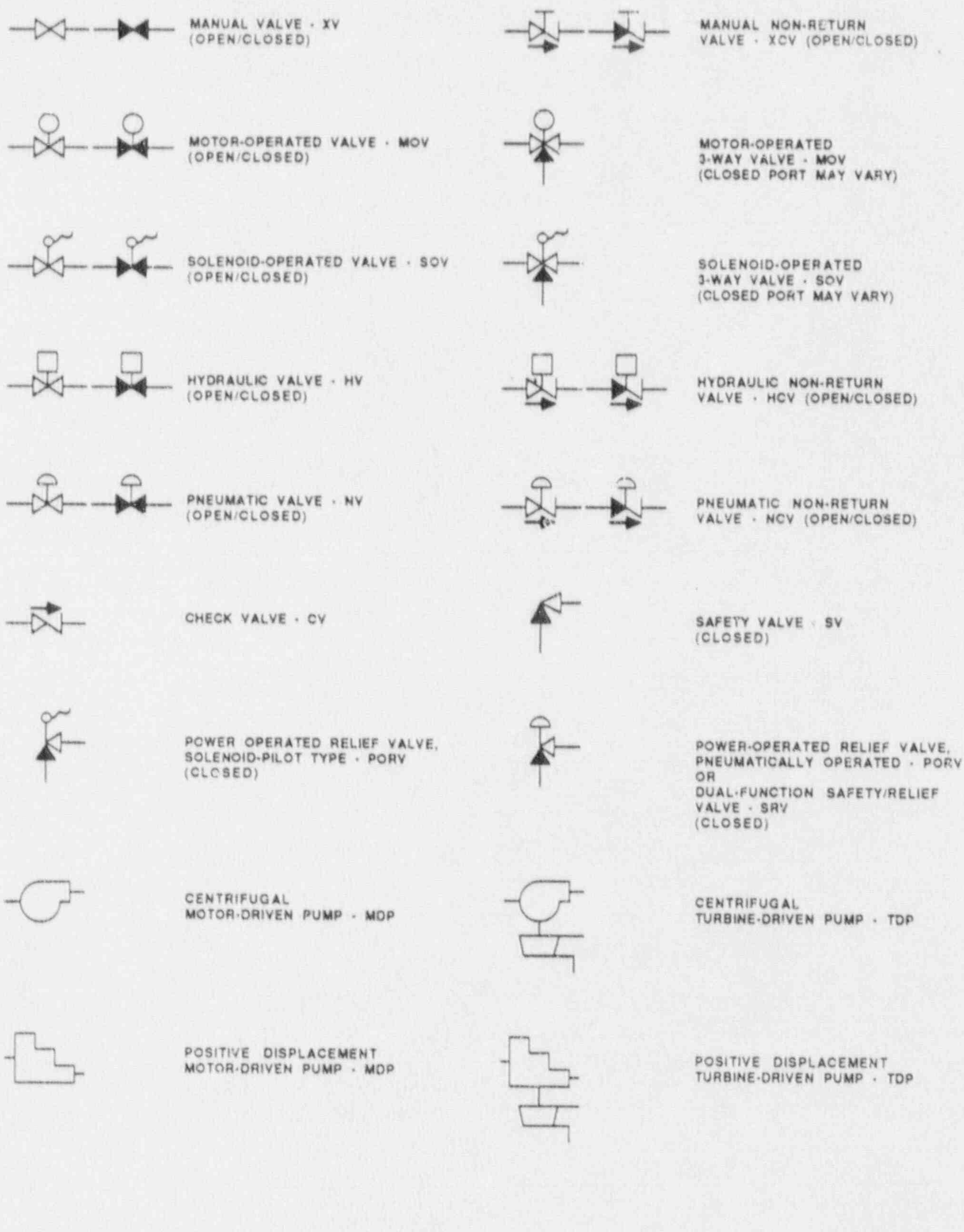
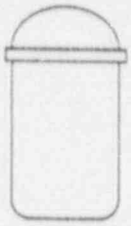
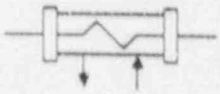


Figure A-1. Key To Symbols In Fluid System Drawings



PWR/BWR
REACTOR VESSEL - RV

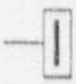


HEAT EXCHANGER - HX

STEAM-TO-WATER
OR WATER-TO-STEAM HEAT
EXCHANGER (I.E. FEEDWATER
HEATER, DRAIN COOLER, ETC.) - HX

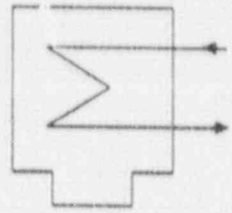
OR

TANK - TK

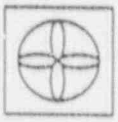


RUPTURE DISK - RD

ORIFICE - OR



MAIN CONDENSER - COND



MECHANICAL DRAFT
COOLING TOWER

AIR COOLING UNIT - ACU

SPRAY NOZZLES - SN

FILTER - FLT

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

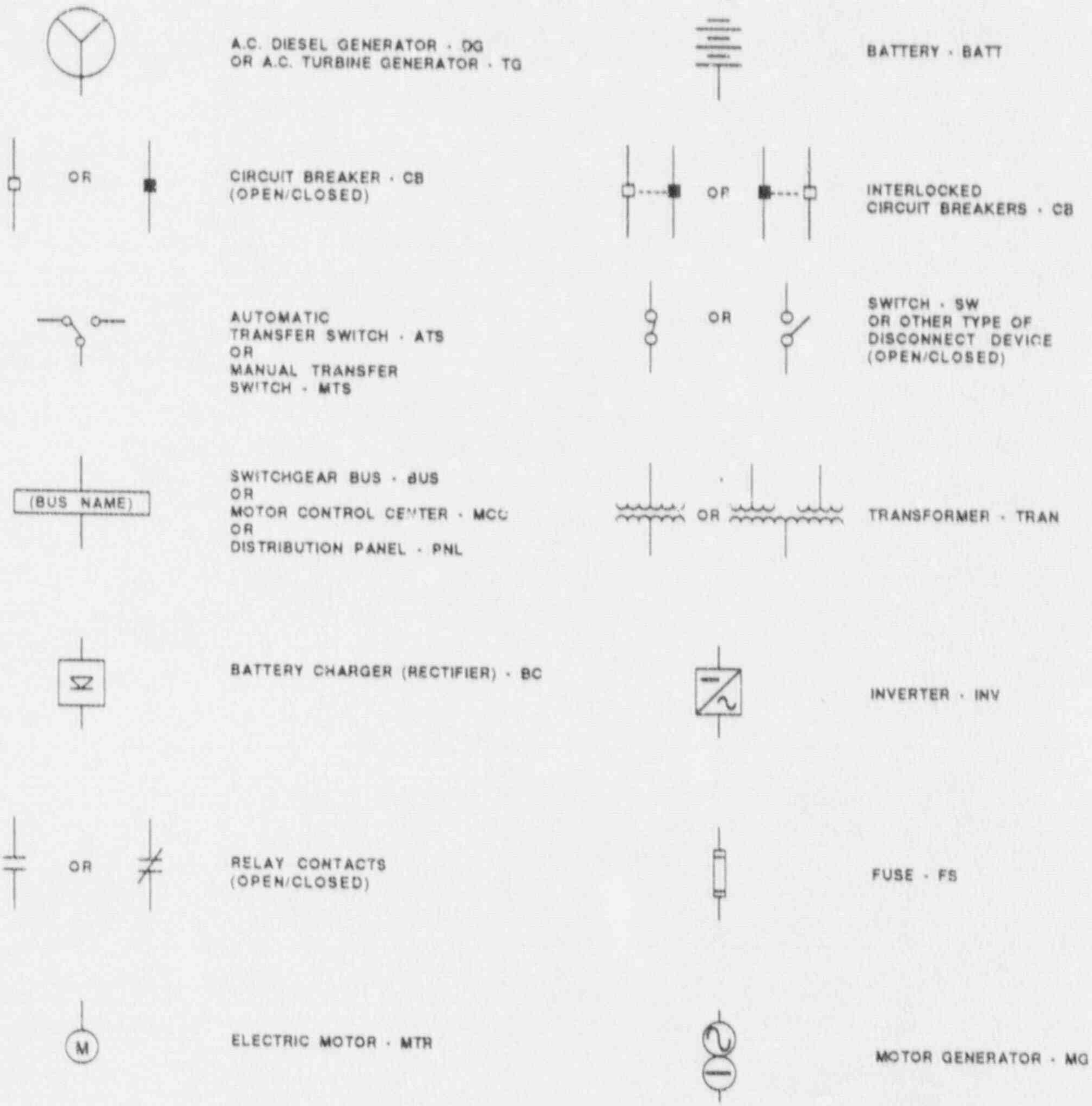


Figure A-2. Key To Symbols In Electrical System Drawings

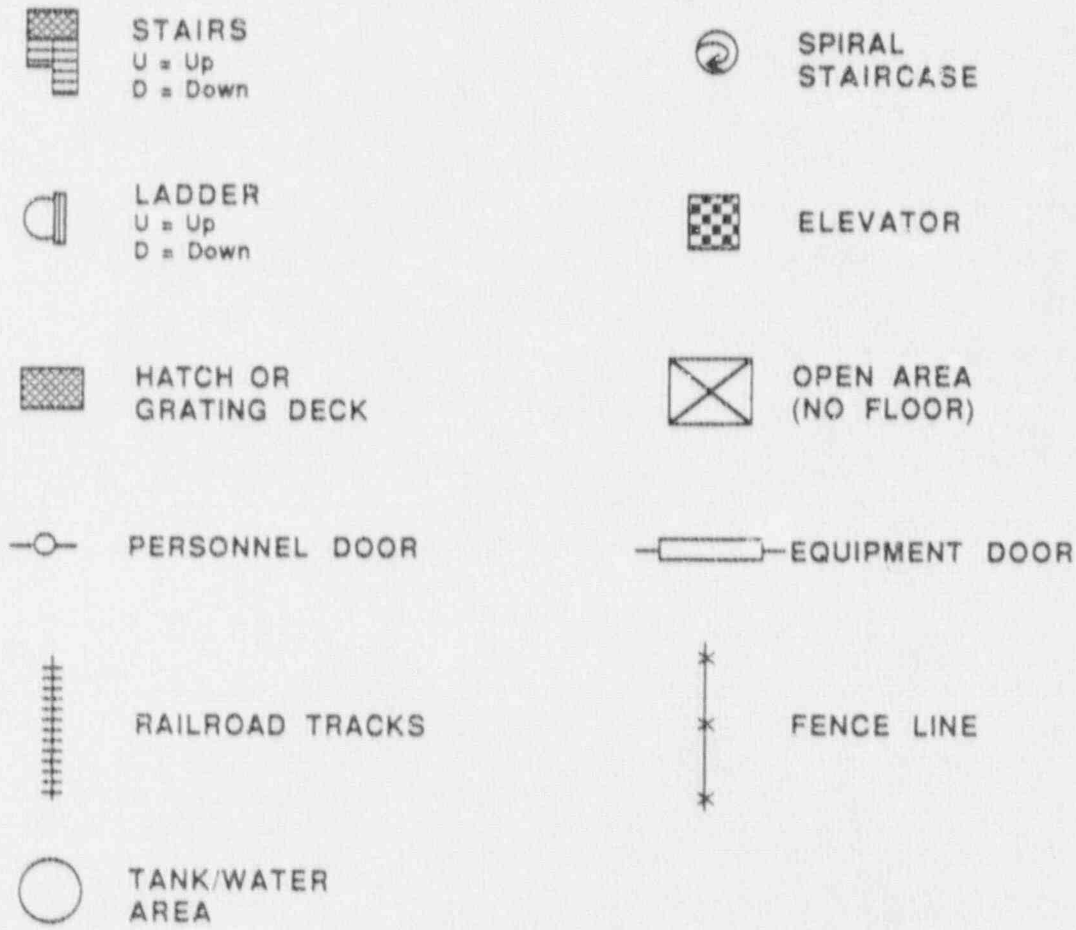


Figure A-3. Key To Symbols In Facility Layout Drawings

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 Systems (including HPSI, LPSI)
CVCS	Chemical and Volume Control (Charging) System
EP	Electric Power System
CCW	Component Cooling Water System
SW	Service Water System
FW	Fire 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