NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

MILLSTONE 2

50-336

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50-336

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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.

MILLSTONE 2
RECORD OF REVISIONS

REVISION	ISSUE	COMMENTS
0	1/89	Original report

MILLSTONE 2 SYSTEM SOURCEBOOK

This sourcebook contains summary information on Millstone 2. 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 Millstone 2 nuclear power plant is listed below:

- Docket number	50-336
- Operator	Northeast Utilities
- Location	Waterford, Connecticu.
- Commercial operation date	12/75
- Reactor type	PWR
- NSSS vendor	Combustion Engineering, Inc.
- Number of loops	2
- Power (MWt/MWe)	2560/870
- Architect-engineer	Bechtel
- Containment type	Reinforced concrete cylinder with steel liner

2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

Millstone 2 has a Combustion Engineering PWR two loop nuclear steam supply system (NSSS). Other Combustion Engineering PWR plants in the United States include:

- Fort Calhoun
- Maine Yankee (3-loop)
- Palisades
- Palo Verde 1, 2 & 3
- Calvert Cliffs 1 & 2
- St. Lucie 1 & 2
- ANO-2
- San Onofre 2 & 3
- Waterford 3
- WNP 3

3. SYSTEM INFORMATION

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

Generic System Name	Plant-Specific System Name	Report Section	USAR Section Reference
Reactor Heat Removal Systems			
- Reactor Coolant System (RCS)	Same	3.1	4
- Auxiliary Feedwater (AFW) and Secondary Steam Relief (SSR) Systems	Same	3.2	10.4.5.3
- Emergency Core Cooling Systems (ECCS)			
- High-Pressure Injection & Recirculation - Low-pressure Injection & Recirculation	Safety Injection System (High Pressure, Low Pressure and Passive Subsystems)	3.3	6.3
- Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System)	Shutdown Cooling System	3.3	9.3
- Main Steam and Power Conversion Systems	Main Steam Supply System, Condensate and Feedwater System, Circulating Water System	X	9.7.1, 10
- Other Heat Removal Systems	None identified	X	-
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 Millstone 2 Systems Covered in this Report (Continued)

Generic System Name	Plant-Specific System Name	Report Section	USAR Section Reference
Containment Systems			
- Containment	Same	X	5.2
- Containment Heat Removal Systems - Containment Spray System	Same	3.3	6.4
- Containment Fan Cooler System	Containment Air Recirculation and Cooling System	3.3	6.5
- Containment Normal Ventilation Systems	Containment and Enclosure Building Purge System	X	9.9.2
- Combustible Gas Control Systems	Containment [illegible]t-Incident Hydrogen Control System	X	6.6
Reactor and Reactivity Control Systems			
- Reactor Core	Same	X	3
- Control Rod System	Control Element Drive System	X	7.4.2
- 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)	Same	3.5	7.[illegible]
- Remote Shutdown System	Hot Shutdown Panel	X	7.6.4

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

Generic System Name	Plant-Specific System Name	Report Section	USAR Section Reference
Instrumentation & Control (I&C) Systems (continued)			
- Other I&C Systems	Various systems	X	7.4.1, 7.4.3 thru 7.4.8, 7.5, 7.6.1 thru 7.6.3, 7.6.5
Support System			
- Class 1E Electric Power System	Same	3.6	8.2 thru 8.7
- Non-Class 1E Electric Power System	Same	3.6	8.2 thru 8.7
- Diesel Generator Auxiliary Systems	Same	3.6	8.3, 9.7.2, 9.9.11
- Component Cooling Water (CCW) System	Reactor Building Closed Cooling Water System (RBCCW)	3.7	9.4
- Service Water System (SWS)	Same	3.8	9.7.2
- Other Cooling Water Systems	Spent Fuel Pool Cooling System, Turbine Building Closed Cooling Water System (TBCCW)	X X	9.5 9.[illegible].5
- Fire Protection Systems	Same	X	9.10
- Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems	Plant Ventilation Systems	X	9.9
- Instrument and Service Air Systems	Compressed Air System	X	9.11
- Refueling and Spent Fuel Systems	Fuel Storage and Handling	X	9.8
- Radioactive Waste Systems	Radioactive Waste Processing System	X	11.1

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

Generic System Name	Plant-Specific System Name	Report Section	USAR Section Reference
Radiation Protection Systems	Same	X	11.2

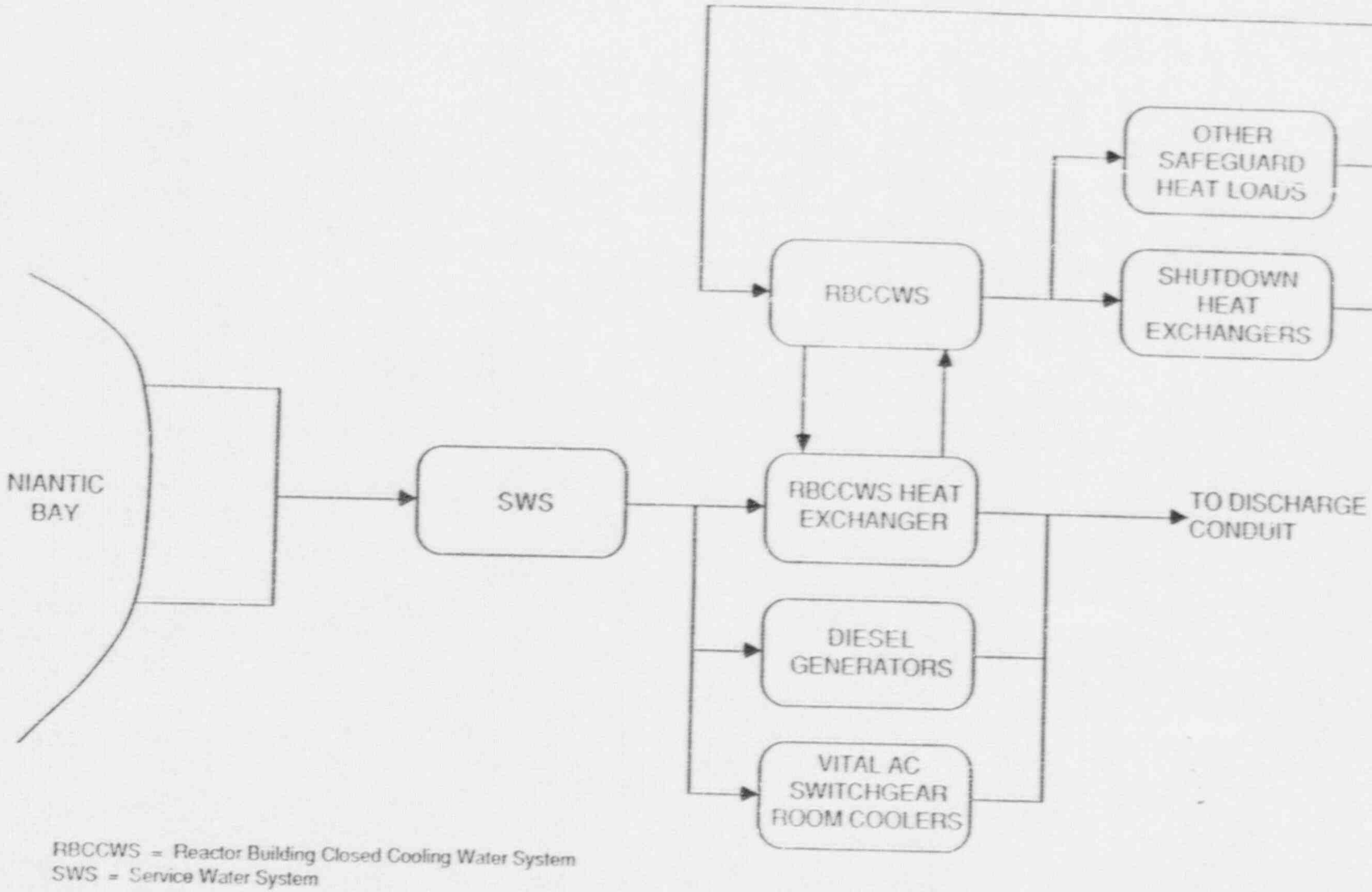


Figure 3-1. Cooling Water Systems Functional Diagram for Millstone 2

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) two parallel reactor coolant loops, each containing one steam generator and two reactor coolant pumps, (c) a pressurizer connected to one of the reactor vessel outlet pipes, and (d) associated piping out to a suitable isolation valve boundary. An elevation view of a two-loop Combustion Engineering 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 two reactor coolant pumps in each of the two 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 reactor quench tank through the pressurizer relief valves. There are two power-operated relief valves, two safety valves, and two motor-operated relief valve isolation valves on the pressurizer. The power operated relief valves are solenoid pilot type valves with a fail closed position. A continued inability to establish adequate cooling 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 valves 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 (see Section 3.3).

3.1.4 System Success Criteria

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

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

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

3.1.5 Component Information

A. RCS
1. Volume: 9435 ft^3 (without pressurizer)
2. Normal operating pressure: 2235 psig

B. Pressurizer
1. Volume: 1500 ft^3

C. Reactor Coolant Pumps (4)
1. Design flow 81,200 gpm @ 2485 psig
2. Type: Vertical Centrifugal

D. Safety Valves (2)
1. Set pressure: 2485 psig
2. Relief capacity: 294,000 lb/hr each

E. Power Operated Relief Valves (2)
1. Set Pressure: 2385 psig
2. Relief capacity: 153,000 lb/hr each

F. Steam Generators
1. Type: Vertical U-Tube

G. Pressurizer Heaters
1. Capacity: 1600 kW
2. Type: Immersion

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

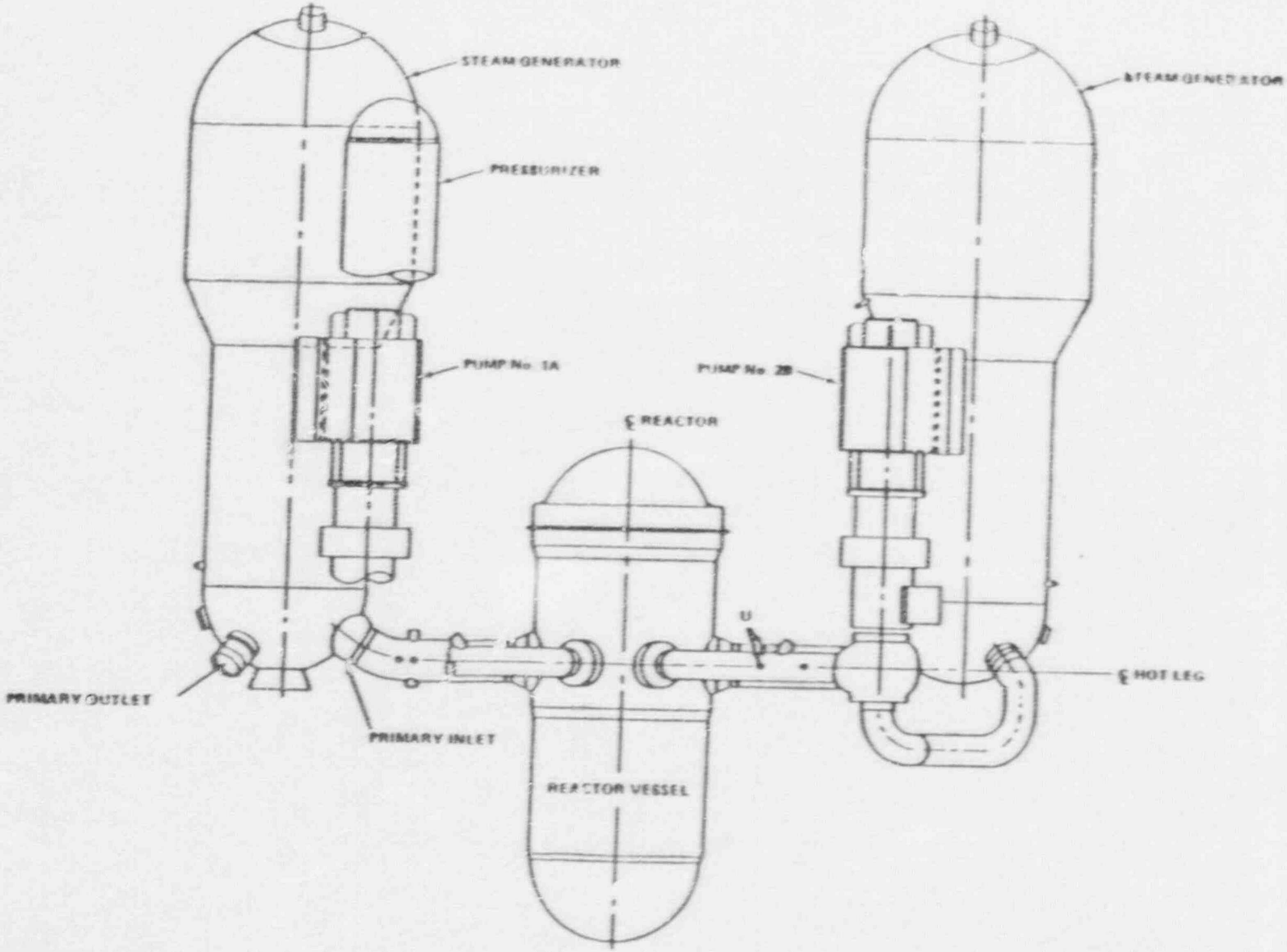


Figure 3.1-1. Elevation View of the RCS of a Typical Combustion Engineering Plant.

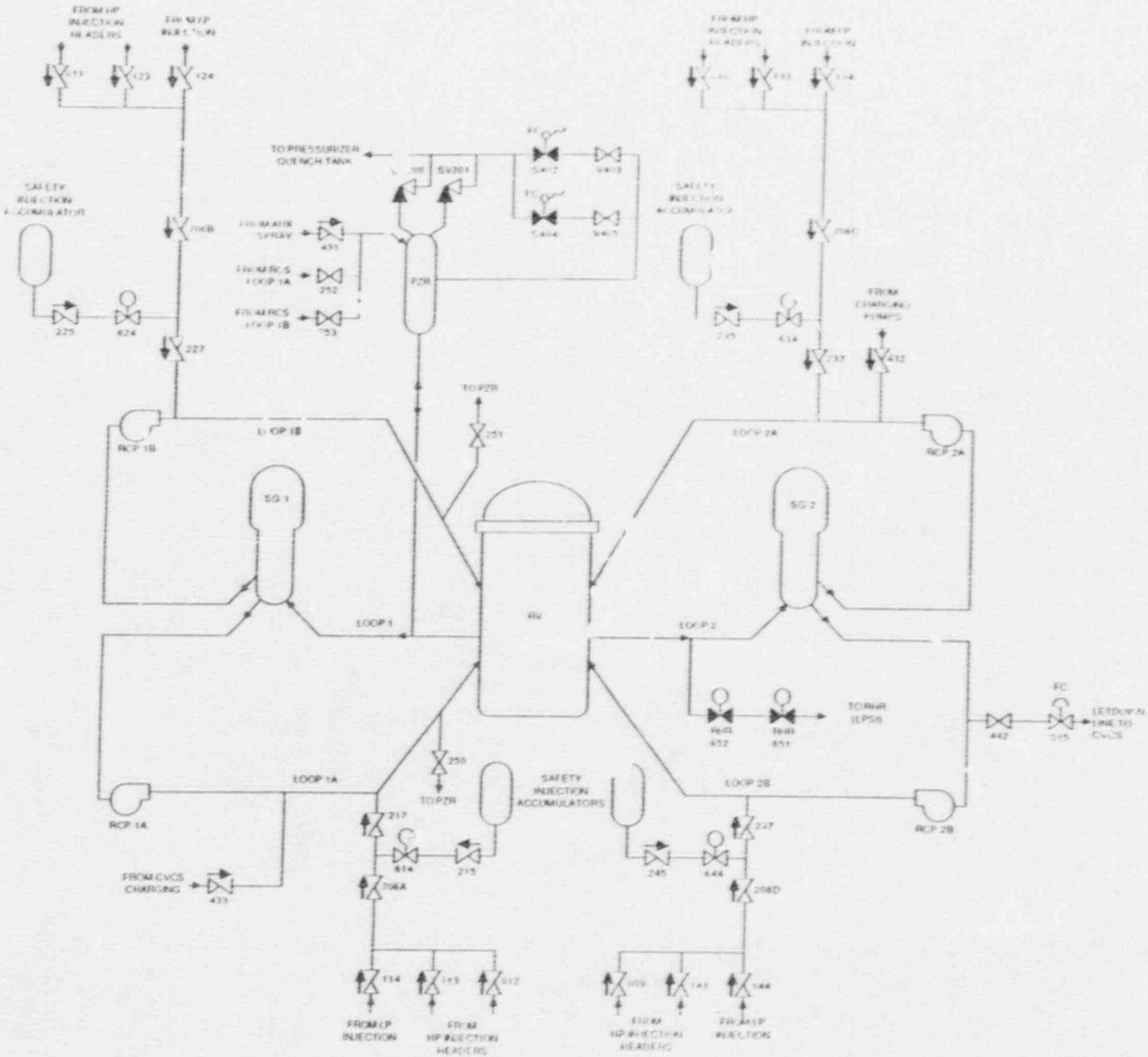


Figure 3.1-2. Millstone 2 Reactor Coolant System

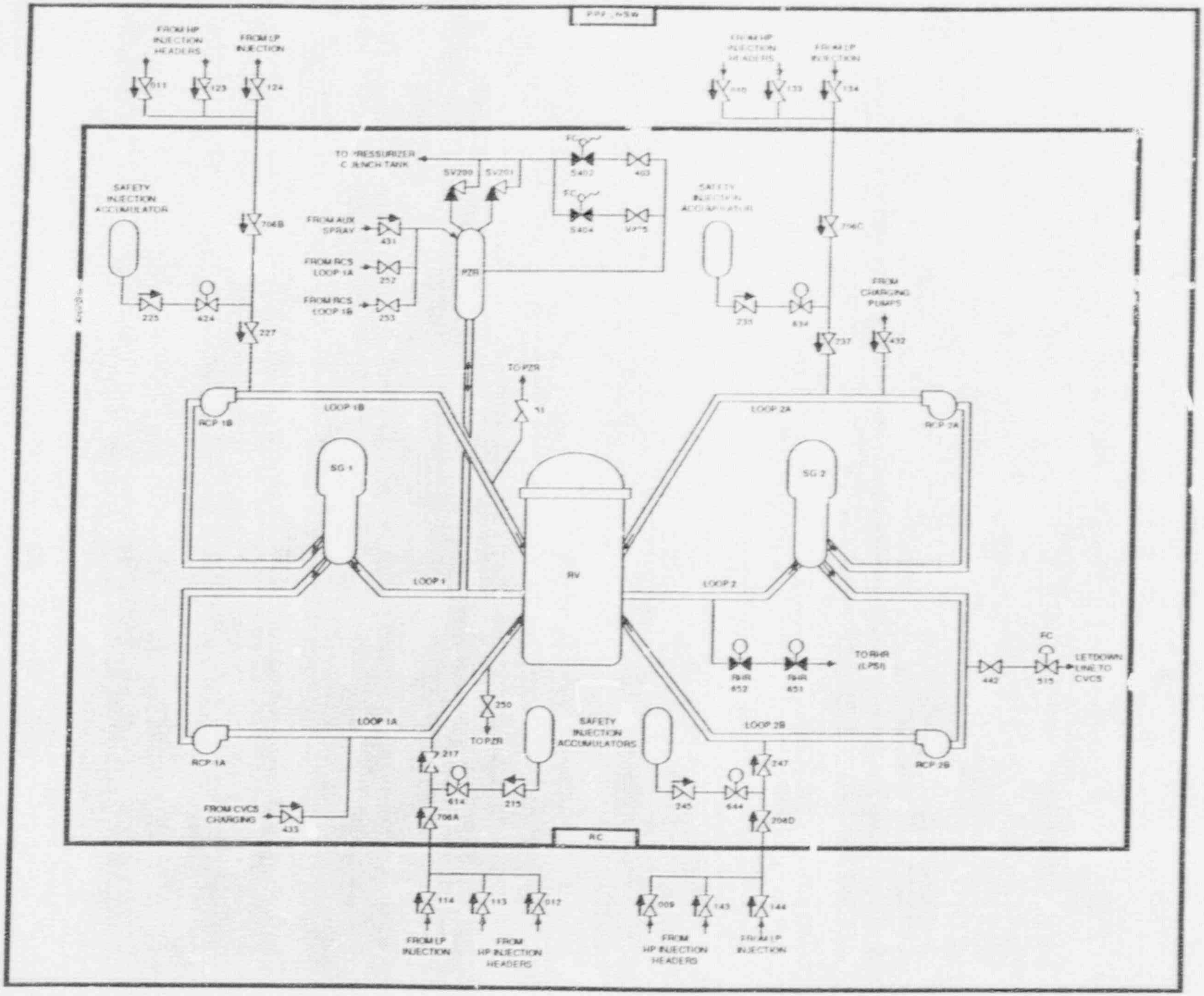


Figure 3.1-3. Millstone 2 Reactor Coolant System Showing Component Locations

Table 3.1-1. Millstone 2 Reactor Coolant System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
515	NV	RC				
516	NV	RC				
RCS-VESSEL	RV	RC				
S402	PORV	RC				
S404	PORV	RC				
V405	MOV	RC	MCC-B61	480	14GENAR	AC/B
V405	MOV	RC	MCC-B51	480	14GENAR	AC/A

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

3.2.1 System Function

The AFWS provides an independent means of supplying feedwater to the steam generators in addition to the main feedwater system. The AFWS is intended to provide a sufficient supply of feedwater to permit the plant to operate at hot standby after a transient or small break LOCA for eight hours followed by an orderly plant cooldown to the point where the shutdown cooling system may be initiated. 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. The AFWS and SSRS constitute a 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 safety-related Seismic Category I motor-driven pumps, one safety related Seismic Category I steam turbine-driven pump, associated piping, controls and instrumentation. Each pump can supply both steam generators. The primary source of auxiliary feedwater is the Seismic Category I condensate storage tank (CST). The secondary source is the primary water storage tank.

The SSRS consists of eight safety valves and one pneumatically operated atmospheric dump valve on each of the main steam lines (one per steam generator).

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 AFW system components is presented in Table 3.2-1.

3.2.3 System Operation

During normal operation the AFWS is in standby until the system pumps are manually actuated (Ref. 1 & 2) by an operator upon a steam generator low level signal from the Auxiliary Feedwater Automatic Initiation system. The operator has the capability of manually controlling the auxiliary feedwater flow.

The primary source of auxiliary feedwater is the condensate storage tank. A minimum capacity of 150,000 gallons is reserved for the AFWS during emergency shutdown conditions. This provides an orderly RCS cooldown to the shutdown cooling initiation conditions. An additional 100,000 gallons of condensate storage capacity is available. 150,000 gallons are adequate to remove decay heat for more than 10 hours at the cooldown rate of 100°F/lb (Ref. 2).

3.2.4 System Success Criteria

For the decay heat removal function to be successful, both the AFW system and the SSR system must operate successfully. The AFW success criteria are the following (Ref. 2):

- Any one AFW pump can provide adequate flow.
- Water must be provided from the condensate storage tank or the primary water storage tank to the AFW pump suctions
- Makeup to any one steam generator provides adequate decay heat removal from the reactor coolant system.

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

3.2.5 Component Information

A. Motor-driven AFW pumps (2)
  1. Rated flow: 300 gpm @ 2437 ft. head (1056 psid)
  2. Type: Centrifugal

B. Turbine-driven AFW pump
  1. Rated flow: 600 gpm @ 2437 ft. head (1056 psid)
  2. Type: Centrifugal

C. Condensate storage tank
  1. Capacity: 250,000 gallons (150,000 gallons operational low level)

3.2.6 Support Systems and Interfaces

A. Control Signals
  1. Manual
     The AFWS is manually started by an operator when needed (Ref. 1 & 2).
  2. Remote manual
     The AFWS can be operated from the control room or a remote shutdown station.

B. Motive power
  1. The safety-related motor driven AFWS pumps and AFWS motor operated valves receive 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 either steam generator upstream of the main steam line isolation valves. The valves associated with this pump receive power from the Class 1E DC bus B.

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

3.2.7 Section 3.2 References

1. "Generic Evaluation of Feedwater Transients and Small Break Loss-of-Coolant Accidents in Combustion Engineering Designed Operating Plants," NUREG-0635, January 1980.

2. Millstone 2 Updated Final Safety Analysis Report, Revision 2, Section 10.4.5.3.

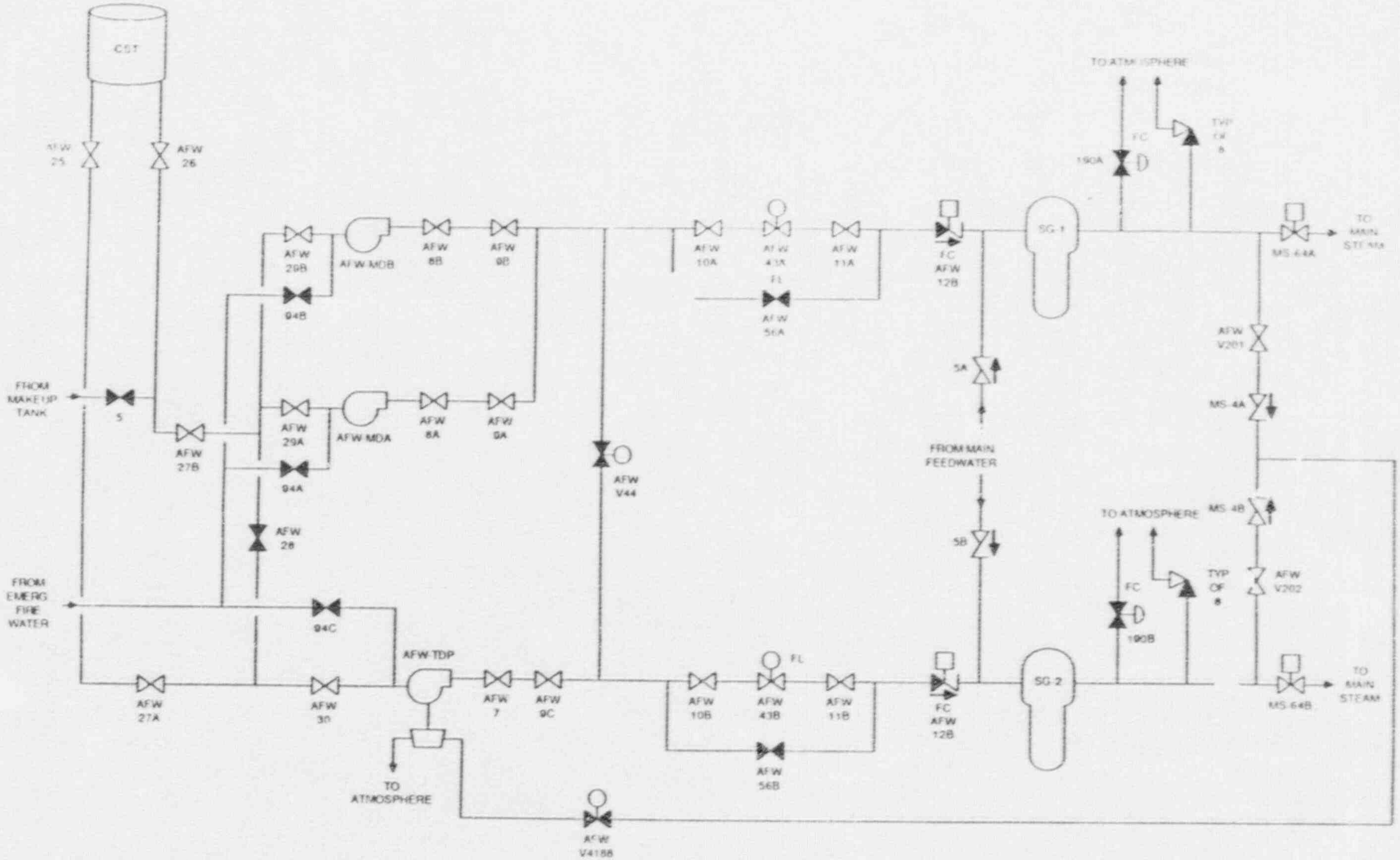


Figure 3.2-1. Millstone 2 Auxiliary Feedwater System

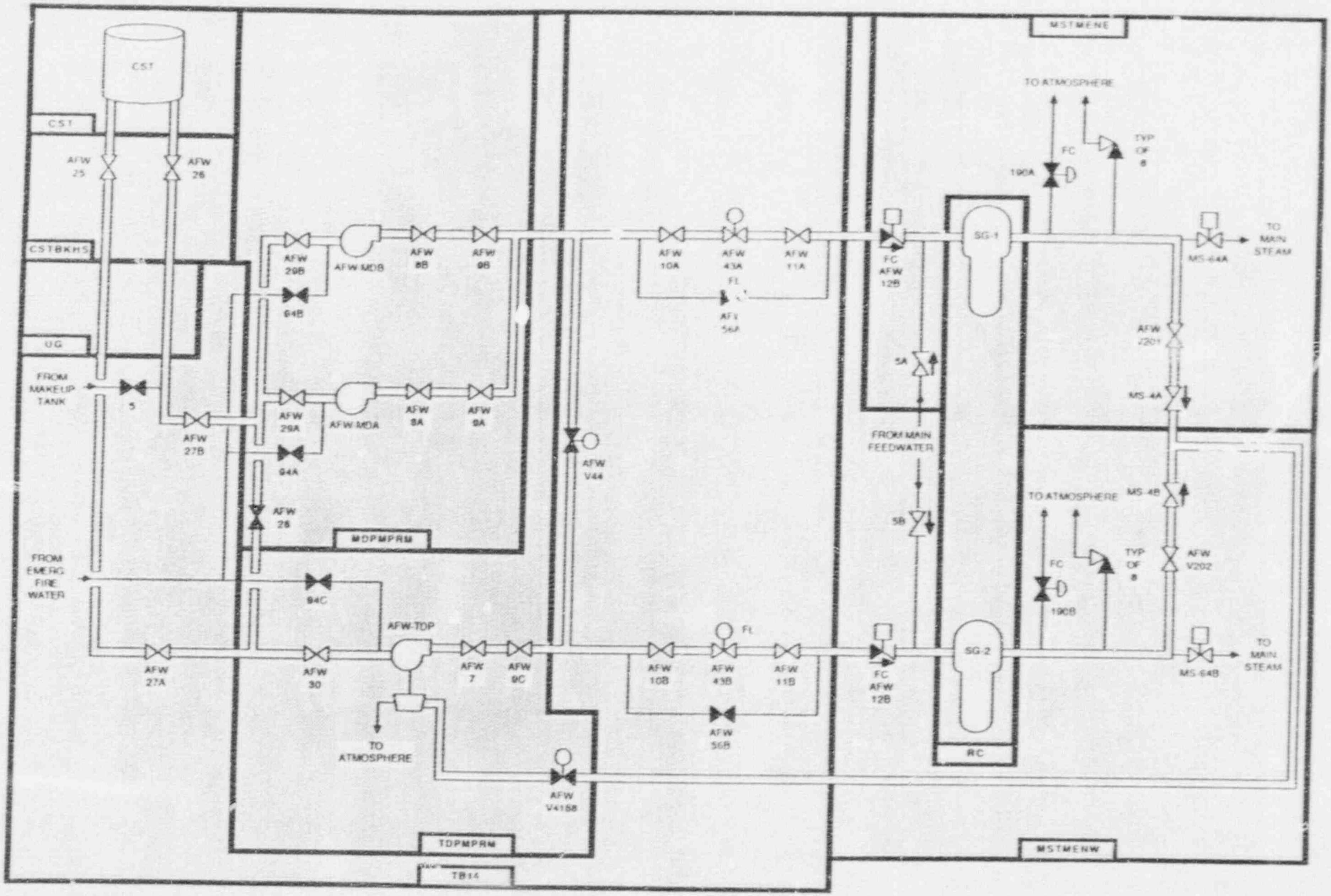


Figure 3.2-2. Millstone 2 Auxiliary Feedwater System Showing Component Locations

Table 3.2-1. Millstone 2 Auxiliary Feedwater System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
AFW-MDA	MDP	MDPMPRM	BUS-B1	4160	Z14KVRM	AC/A
AFW-MDB	MDP	MDPMPRM	BUS-B2	4160	Z24KVRM	AC/B
AFW-TDP	TDP	TDPMPRM				
AFW-V201	MOV	MSTMENE	MCC-B52	480	ENBDVTRM	AC/A
AFW-V202	MOV	MSTMENW	MCC-B62	480	CRHVACRM	AC/B
AFW-V4188	MOV	TDPMPRM	BUS-201B	125	DCSWGRMB	DC/B
AFW-V44	MOV	TB14	MCC-B62	480	CRHVACRM	AC/B
CST	TK	CST				
SG-1	HX	RC				
SG-2	HX	RC				

3.3 EMERGENCY CORE COOLING SYSTEM (ECCS)

3.3.1 System Function

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

3.3.2 System Definition

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

- Safety Injection Tanks
- High Pressure Safety Injection (HPSI) system (Train A and Train B)
- Low Pressure Safety Injection (LPSI) system (Train A and Train B)

The containment heat removal function is provided by the following systems:

- Containment Spray System
- Containment Fan Coolers

The HPSI system provides the high pressure coolant injection capability, and the LPSI system perform the low pressure injection function. The Refueling Water Storage Tank (RWST) is the water source for both the high and low pressure injection pumps.

Simplified drawings of the HPSI and LPSI systems are shown in Figures 3.3-1 and 3.3-2. The Containment Spray system is shown in Figures 3.3-3 and 3.3-4. 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. Following a large LOCA, the ECCS meets short-term cooling requirements primarily in two ways. Initially, the passive safety injection tanks discharge into the cold legs of the RCS to provide core cooling and refill when the reactor pressure falls below the tank pressure. Adequate fluid is contained in the safety injection tanks to accomplish this function with one tank discharging through the LOCA break. Secondly, each train containing one high pressure injection pump and one low pressure injection pump delivers borated makeup water from the RWST to the RCS. One ECCS train is capable of performing this short-term cooling function with one of the injection flow paths discharging through the LOCA break.

Long-term core cooling is accomplished by recirculating water in the containment sump. The switchover from injection to recirculation occurs automatically upon reaching a preset level in the RWST.

Decay heat is rejected to the containment atmosphere. Heat removal from the containment atmosphere is accomplished by the Containment Spray System and Containment Fans. Heat is removed from the shutdown cooling heat exchangers and fan coolers via the Reactor Building Closed Cooling Water System.

For long term cooling of small breaks, the high pressure safety injection pumps provide make-up while the RCS is cooled down and depressurized to shutdown cooling initiation conditions utilizing the steam generator atmospheric dump valves and the Auxiliary Feedwater System. This is followed by a normal shutdown cooling operation.

The shutdown cooling (residual heat removal) system operates when the RCS temperature and pressure are below 350°F and 40 psia respectively. This "system" is an operating mode of the LPSI system in which the pump suctions are aligned to the RCS loop 2 hot leg via the shutdown cooling suction lines. Reactor coolant is circulated through the shutdown cooling heat exchangers where heat is transferred to the Reactor Building Closed Cooling Water System and is returned to the RCS through the four cold leg injection paths.

When the RCS temperature is below 200°F, the containment spray pumps can be realigned to provide additional shutdown cooling flow.

3.3.4 System Success Criteria

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

- 3 of 4 safety injection tanks provide makeup as RCS pressure drops below tank pressure, and
- 1 of 3 high pressure safety injection pumps delivers 75% of its rated flow to the RCS, and
- 1 of 2 low pressure safety injection pumps delivers 50% of its rated flow to the RCS.

ECI success criteria for a small LOCA is the following (Ref. 2):

- 1 of 3 HPSI pumps injects into the RCS.

If the ECI success criteria is met, then the following large LOCA ECR success criteria will apply (Ref. 1 and 2):

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

3.3.5 Component Information

A. High Pressure Safety Injection pumps P41A, B and C
   1. Rated flow: 315 gpm @ 2500 ft head (1084 psid)
   2. Rated capacity: 100%
   3. Type: Multistage, horizontal, centrifugal

B. Low Pressure Safety Injection pumps P42A and B
   1. Rated flow: 3000 gpm @ 350 ft head (152 psid)
   2. Rated capacity: 100%
   3. Type: Single stage, vertical, centrifugal

C. Containment Spray Pumps P43A and B
   1. Rated flow: 1350 gpm @ 450 ft head (195 psid)
   2. Rated Capacity: 50%

D. Safety Injection Tanks (4)
   1. Volume: 2019 ft^3
   2. Normal operating pressure: 215 psig

E. Refueling water storage tank
   1. Capacity: 475,000 gallons

F. Shutdown cooling heat exchangers HX-23A and B
   1. Design duty: 27.2×10^6 Btu/hr
   2. Type: Shell & Tube

G. Containment Fans A, B, C, and D
   1. Design duty: 8×10^6 Btu/hr
   2. Capacity: 33 1/3%

3.3.6 Support Systems and Interfaces

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

      a. Low pressurizer pressure
      b. High containment pressure
      c. Manual actuation

      The SIAS automatically initiates the following actions:

      - starts the HPSI and LPSI pumps
      - aligns the pumps for injection
      - aligns the pump suction to the RWST
      - initiates the containment spray actuation signal which starts the Containment Spray Pumps
      - initiates the Containment Air Coolers

      Switch over to the low pressure recirculation mode occurs automatically on low level in the RWST.

   2. Remote manual
      An SIAS signal can be initiated by remote manual means from the main control room. ECCS operation can be initiated by remote manual means.

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

C. Other
   1. The Shutdown Cooling Heat Exchangers and the containment air coolers are cooled by the Reactor Building Closed Cooling Water System (see Section 3.7).
   2. Lubrication is provided locally for the ECCS pumps and motors.
   3. Pump room cooling is provided by the RBCCW.

3.3.7 Section 3.3 References

1. Millstone 2 Updated Final Safety Analysis Report, Section 6.3.3.1.

2. Millstone 2 Updated Final Safety Analysis Report, Section 6.3.2.2.

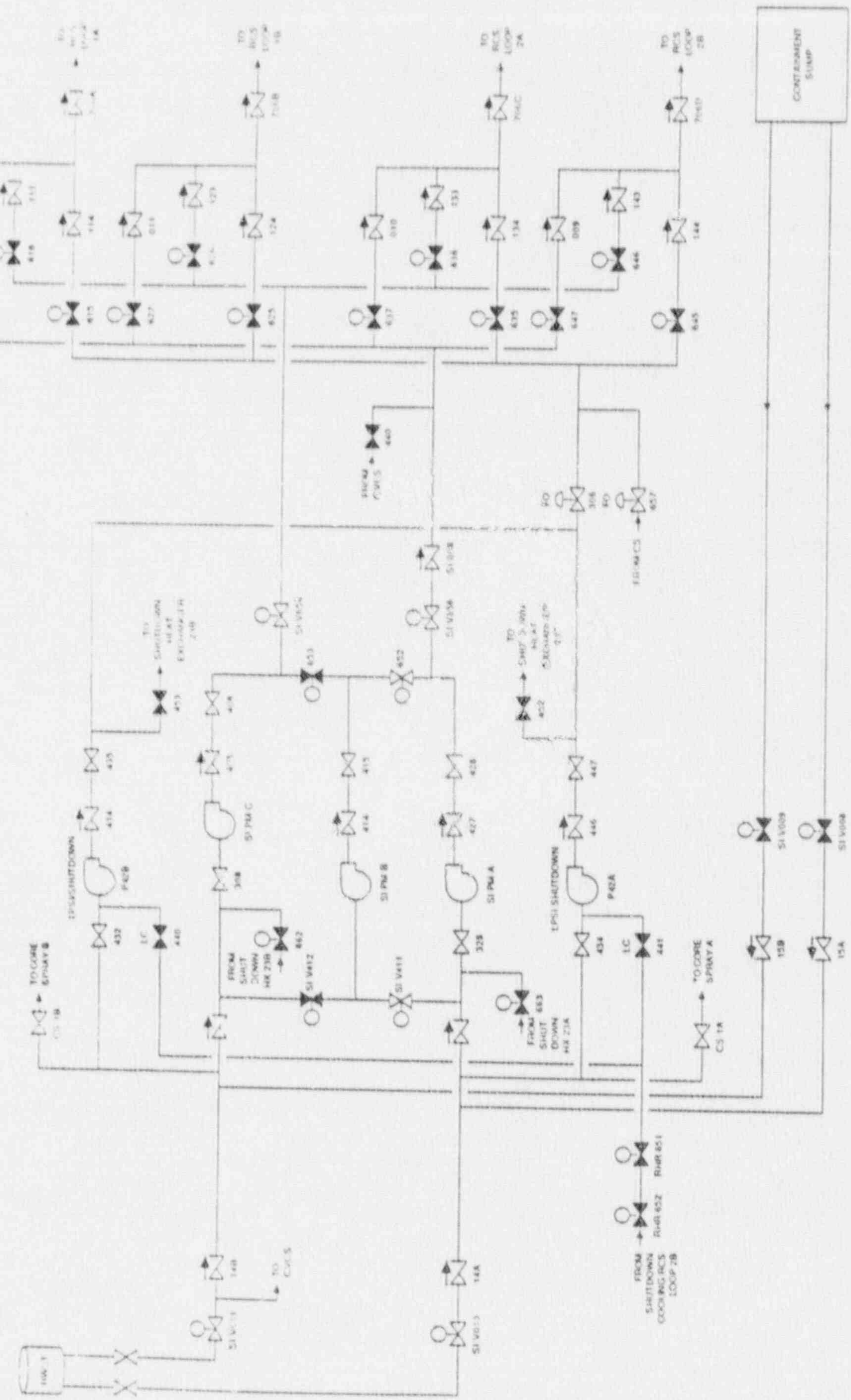


Figure 3.3-1. Millstone 2 Safety Injection System

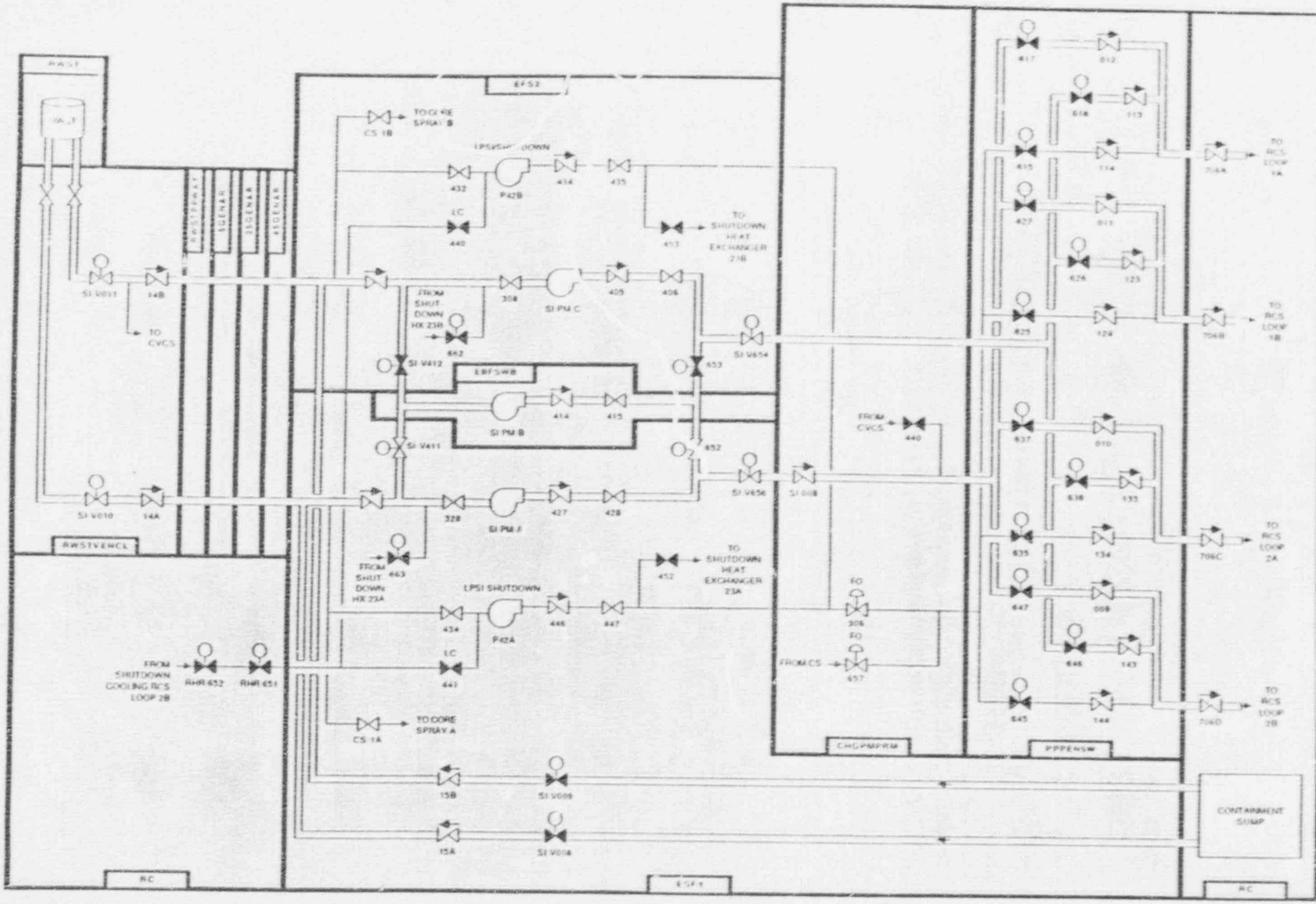


Figure 3.3-2. Millstone 2 Safety Injection System Showing Component Locations

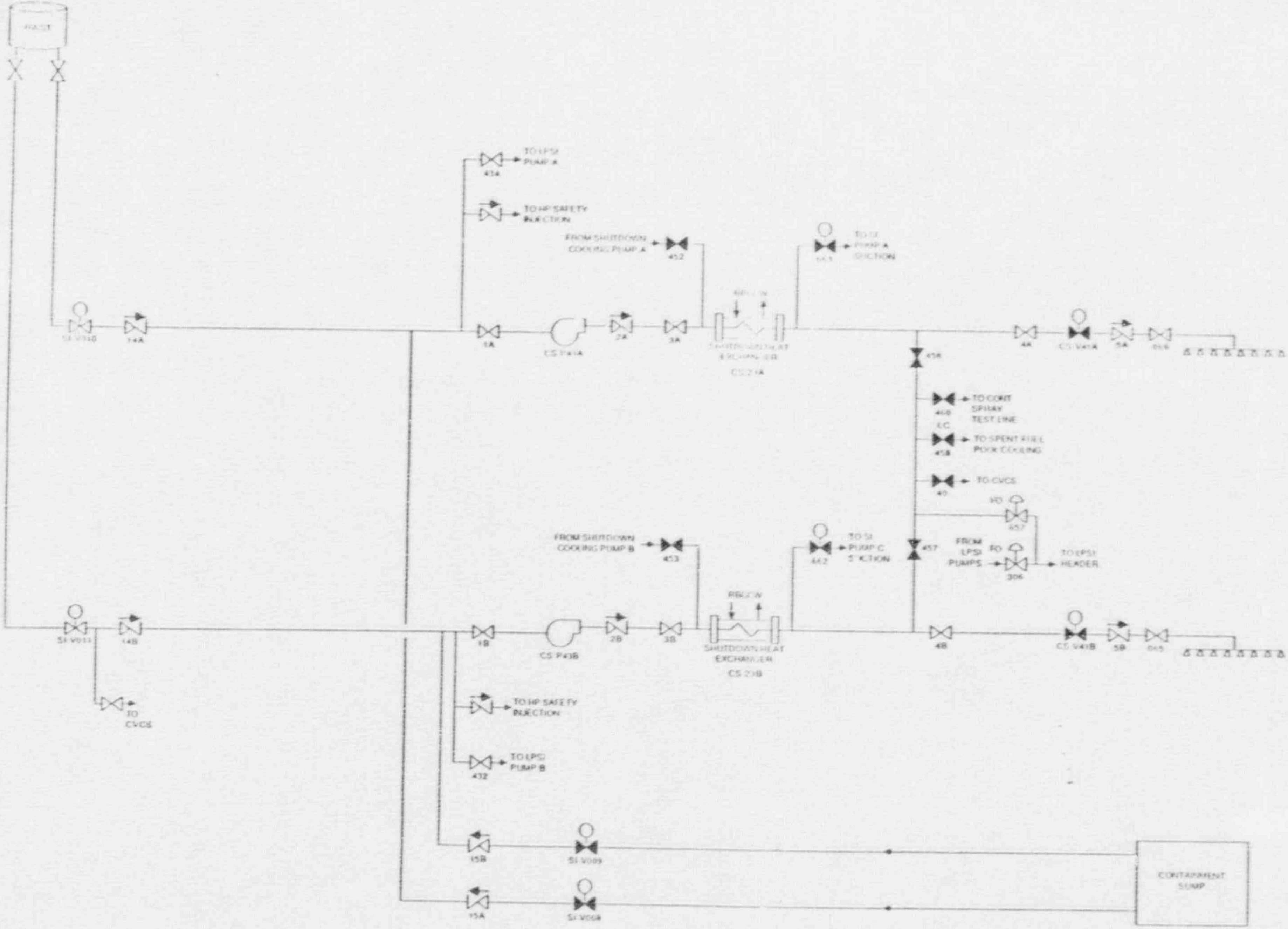


Figure 3.3-3. Millstone 2 Containment Spray System

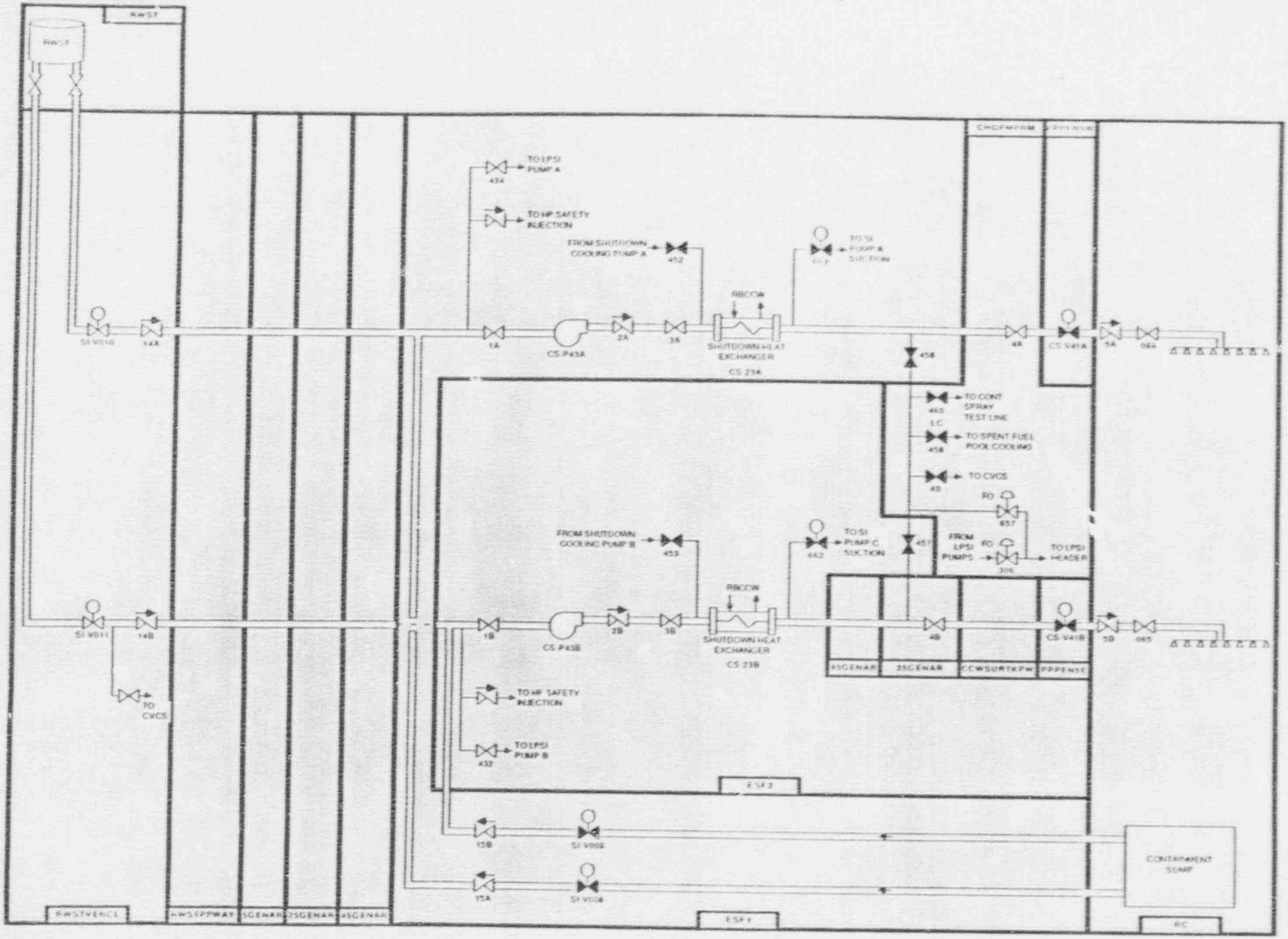


Figure 3.3-4. Millstone 2 Containment Spray System Showing Component Locations

Table 3.3-1. Millstone 2 Emergency Core Cooling System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
616	MOV	PPPEN5W	MCC-B61	480	14GENAR	AC/B
617	MOV	PPPEN5W	MCC-B51	480	14GENAR	AC/A
626	MOV	PPPEN5W	MCC-B61	480	14GENAR	AC/B
627	MOV	PPPEN5W	MCC-B51	480	14GENAR	AC/A
636	MOV	PPPEN5W	MCC-B61	480	14GENAR	AC/B
637	MOV	PPPEN5W	MCC-B51	480	14GENAR	AC/A
646	MOV	PPPEN5W	MCC-B61	480	14GENAR	AC/B
647	MOV	PPPEN5W	MCC-B51	480	14GENAR	AC/A
RWST	TK	RWST				
SI-PM-A	MDP	ESF1	BUS-B1	4160	Z14KVRM	AC/A
SI-PM-B	MDP	ESFSWB	BUS-B5	4160	Z14KVRM	AC/A
SI-PM-C	MDP	ESF2	BUS-B2	4160	Z24KVRM	AC/B
SI-V008	MOV	ESF1	MCC-B61	480	14GENAR	AC/B
SI-V009	MOV	ESF1	MCC-B51	480	14GENAR	AC/A
SI-V010	MOV	RWSTVENCL	MCC-B61	480	14GENAR	AC/B
SI-V011	MOV	RWSTVENCL	MCC-B51	480	14GENAR	AC/A
SI-V411	MOV	ESF1	MCC-B61	480	14GENAR	AC/B
SI-V412	MOV	ESF2	MCC-B51	480	14GENAR	AC/A
SI-V654	MOV	ESF2	MCC-B61	480	14GENAR	AC/B
SI-V656	MOV	ESF1	MCC-B51	480	14GENAR	AC/A

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 and maintaining water purity and the proper concentration of neutron absorbing and corrosion inhibiting chemicals in the reactor coolant. The makeup function of the CVCS is required to maintain the plant in a long-term hot standby condition following a transient.

3.4.2 System Definition

The CVCS provides a means for injection of control poison in the form of boric acid solution, chemical additions for corrosion control, and reactor coolant cleanup and degasification. The system also maintains the required water inventory in the RCS, reprocesses water that is letdown from the RCS, and provides auxiliary pressurizer spray and collects the bleed off from the RCP seals.

The CVCS consists of several subsystems: the charging, letdown, seal water collection system, the reactor coolant purification and chemistry control system, the reactor makeup control system, and the boron thermal regeneration system. The functions of the CVCS are performed by the following components: (a) the charging pumps, (b) boric acid transfer pumps, (c) volume control tank, (d) boric acid tanks, and (e) various heat exchangers and demineralizers.

Simplified drawings of the CVCS, focusing on the charging portion of the 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 plant operation, two charging pumps are running with suction aligned to the Volume Control Tank (VCT). The letdown flow from the RCS cold leg is cooled in the tube side of the regenerative heat exchanger, then directed to the VCT. The bulk of the charging flow is pumped back to the RCS through the shell side of the regenerative heat exchanger via the charging lines.

The charging pumps can be aligned to take a suction on the Refueling Water Storage Tank (RWST) and provide long-term makeup to the RCS following a transient. The CVCS letdown line is automatically isolated upon detection of a LOCA.

3.4.4 System Success Criteria

For post-transient makeup to the RCS the following charging system success criteria is assumed:

- A long-term water source must be available to the charging pumps.
- One of three charging pumps is available.
- A makeup path to the RCS is available.

3.4.5 Component Information

A. Charging Pumps P18A, B, and C
1. Rated capacity: 44 gpm
2. Normal discharge pressure: 2735 psig
3. Type: Positive Displacement

B. Refueling Water Storage Tank (1)
1. Volume: 475,000 gallons

C. Regenerative Heat Exchanger (1)
   1. Flow: 40 gpm (letdown), 44 gpm (charging)
   2. Type: Shell and tube, vertical (charging: shell; letdown: tube)

3.4.6 Support Systems and Interfaces

A. Control Signals
   1. Remote Manual
      The charging pumps and motor operated valves can be actuated by remote means from the control room.
   2. Manual
      Manual valves can be actuated by hand at their specific locations.

B. Motive Power
   1. The positive displacement 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. No external cooling water or lubrication systems for the charging pumps have been identified.
   2. Pump room cooling systems have not been identified.

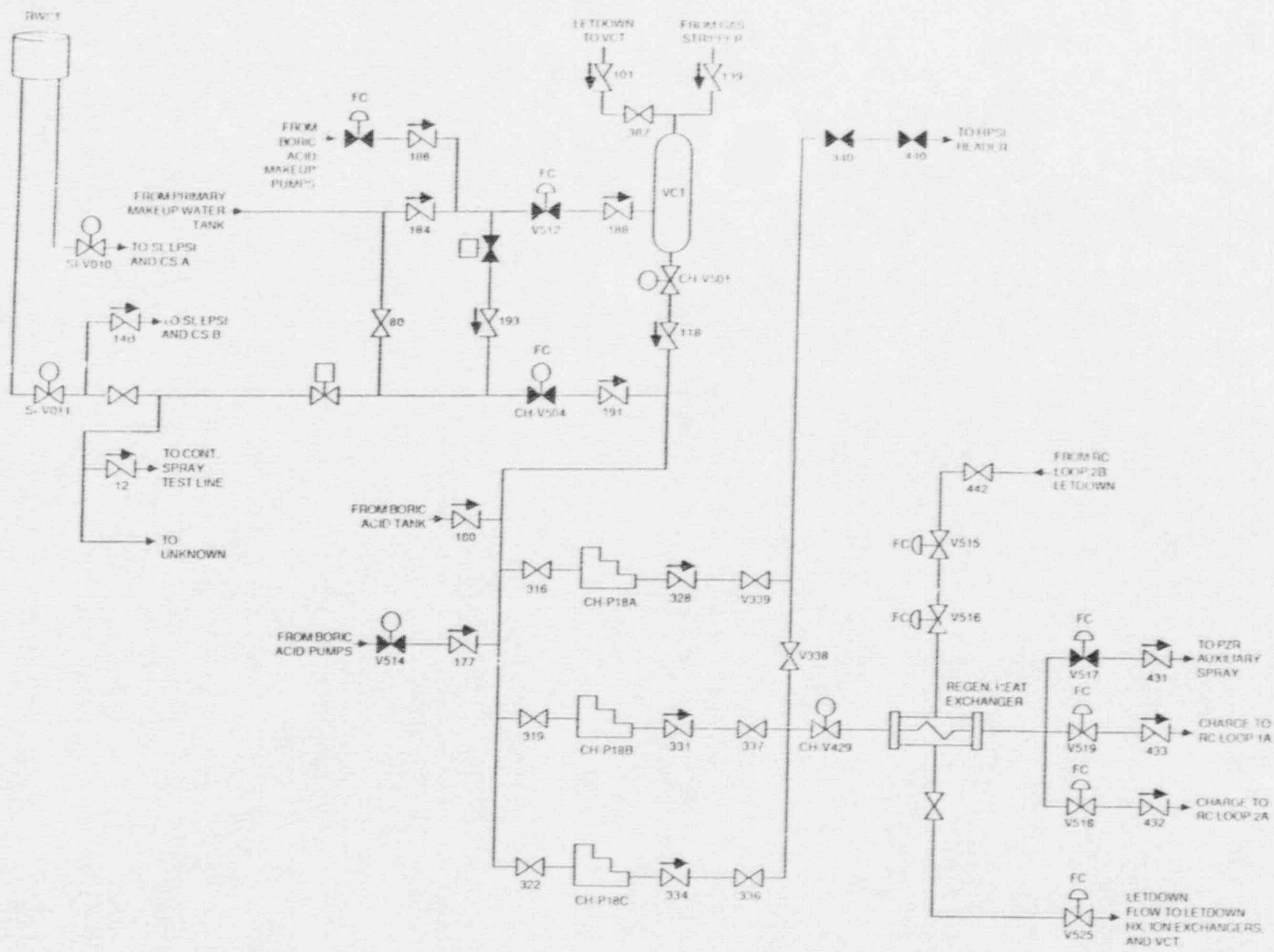


Figure 3.4-1. Millstone 2 Chemical and Volume Control System

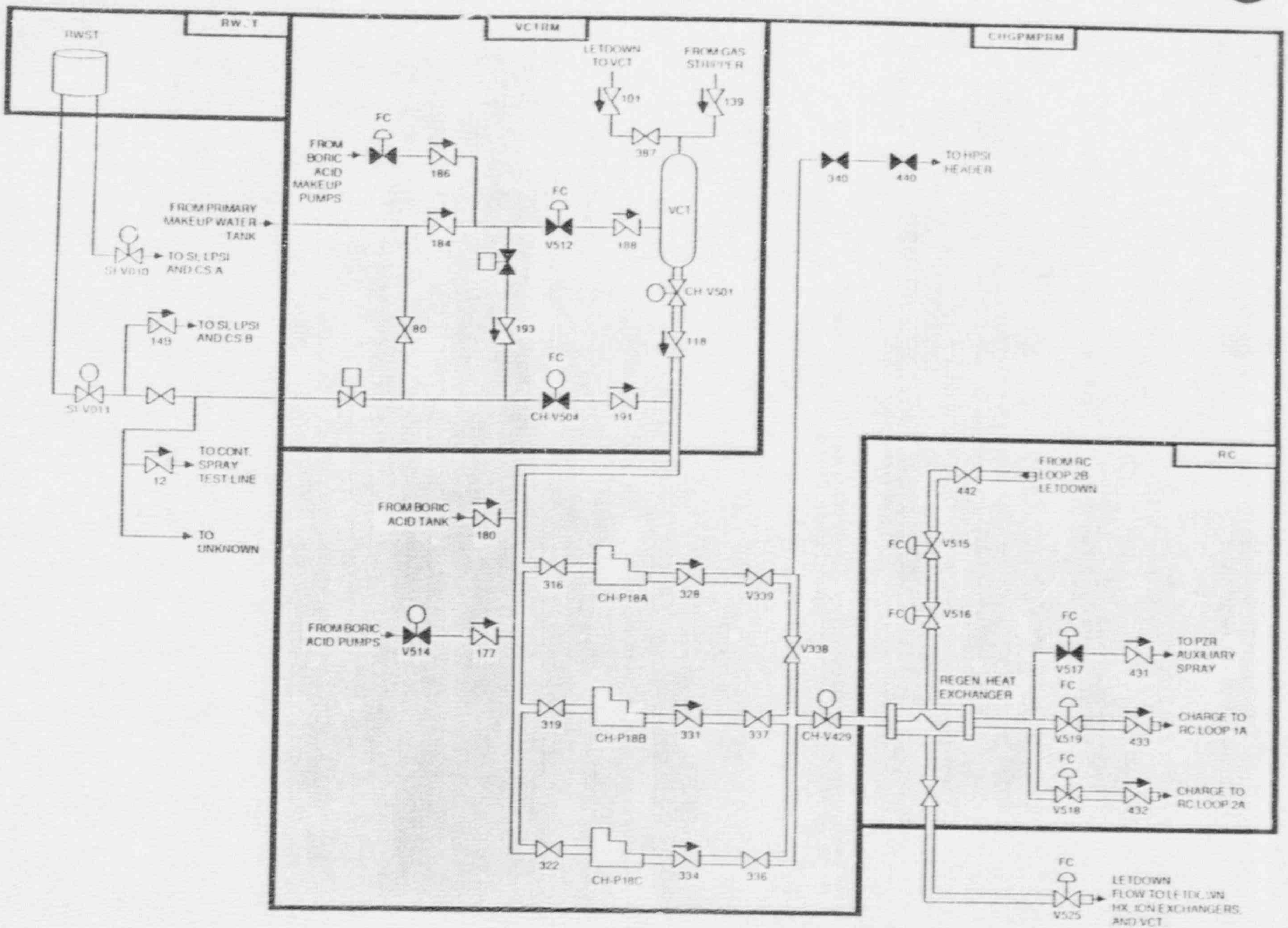


Figure 3.4-2. Millstone 2 Chemical and Volume Control System Showing Component Locations

Table 3.4-1. Millstone 2 Charging System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CH-P18A	MDP	CHGPMPRM	MCC-B51	480	14GENAR	AC/A
CH-P18B	MDP	CHGPMPRM	MCC-B61	480	14GENAR	AC/B
CH-P18C	MDP	CHGPMPRM	MCC-B61	480	14GENAR	AC/B
CH-V429	MOV	CHGPMPRM	MCC-B51	480	14GENAR	AC/A
CH-V504	MOV	VCTRM	MCC-B51	480	14GENAR	AC/A
RWST	TK	RWST				

3.5 INSTRUMENTATION AND CONTROL (I & C) SYSTEMS

3.5.1 System Function

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

3.5.2 System Definition

The RPS includes sensor and transmitter units, logic units, and output trip relays that operate reactor trip circuit breakers to cause a reactor scram. The Engineered Safety Features Actuation System includes independent sensor and transmitter units, logic units and relays that interface with the control circuits for the many different sets of components that can be actuated by this system. Operator instrumentation display systems consist of display panels in the control room that are powered by the 120 VAC electric power system (see Section 3.6). Remote shutdown capability is provided by the Hot Shutdown Panel, designated C21.

3.5.3 System Operation

A. RPS

The RPS has four redundant input instrument channels for each sensed parameter and two output actuation trains (A and B). The A and B logic trains independently generate a reactor trip command when prescribed parameters are outside the safe operating range upon a 2-out-of-4 coincidence from the input instrument channels. Either RPS train is capable of opening a separate and independent reactor trip circuit breaker to cause a scram. The manual scram A and B circuits bypass the RPS logic trains and send a reactor trip command directly to shunt trip circuitry in the reactor trip circuit breakers.

B. ESFAS

The Engineered Safety Features Actuation System has three or four input instrument channels for each sensed parameter, and two output actuation trains (A and B). In general, each train controls equipment powered from different Class 1E AC electrical load groups. An individual component usually receives an actuation signal from only one train. The Engineered Safety Features Actuation System generates the following signals: (a) safety injection actuation signal (SIAS), (b) containment isolation (CIAS), (c) containment spray actuation (CSAS), (d) enclosure building filtration actuation system (EBFAS), (e) diesel generator start, and (f) auxiliary feedwater automatic initiation signal (AFAI). The control room operators can manually trip the various logic subsystems. Details regarding actuation logic are included in the system description for the actuated system.

C. Remote Shutdown

In the event the operator is forced to abandon the control room and the reactor is tripped, it is possible for the operator to maintain the unit in the hot shutdown condition by controls and instrumentation provided on the Hot Shutdown

Panel. This panel is built and analyzed to meet seismic Class I specifications. The panel including all mounted equipment will remain structurally intact such that no equipment will become loose, separated, or dislocated when subjected to a design basis earthquake. The following controls are provided on the Hot Shutdown Panel (Ref. 1):

- Steam dump to atmosphere
- Letdown flow
- Pressurizer spray
- Charging pump
- Pressurizer heater
- Auxiliary FW valve
- Auxiliary FW pump
- Auxiliary FW pump crossover valve
- Auxiliary FW pump turbine speed
- Main Steam to Auxiliary FW
- Pump turbine stop valve

All controls and instrumentation are compatible with those provided on the main control board. Subsequent to a hot shutdown, it is possible to b ng the unit to the cold shutdown condition safely (external to the contr room) with the following additional provisions and procedures:

- Boric acid transfer pumps can be controlled by pushbuttons from the associated emergency motor control cente located in the plant.

- Low pressure safety injection pumps can be controlled by control switches provided on the associated 4160-volt emergency switch-gear cubicles.

Normally controlling instruments on this panel are set in the "By Pass" position, i.e., the main control board has direct control of the final elements. However, the system is connected in such a manner that it is possible to override the main board instruments and take control at this panel.

Since the hot shutdown panel is never used except in case of an emergency, full bright doors are provided to close off the panel front. Doors are normally closed but not locked. An open door is alarmed in the control room.

To ensure maximum availability, tow channels of controls and instrumentation are provided on this panel. One channel is capable of performing its function to maintain hot shutdown.

3.5.4 <u>System Success Criteria</u>

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 or when control power is lost. A 2-out-of-4 coincidence from the channels is required to cause a scram. When the channel is temporarily removed from service for testing or maintenance the logic can be changed to a 2-out-of-3 coincidence. A reactor scram will o r upon loss of control power to the RPS. A reactor scram usually is impleme ed 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 Millstone 2 have not been determined. (Ref. 2)

B. ESFAS
A single component usually receives a signal from only one ESFAS output train. ESFAS Trains A and B must be available in order to automatically actuate their respective components. ESFAS uses hindrance input logic (normal = 1, trip = 0) and transmission output logic (normal = 0, trip = 1). In this case, an input channel will be in a trip state when input signals are lost or when control power is lost. When the channel is temporarily removed from service for testing or maintenance, the channel can be bypassed, leaving it in a non-tripped state. Control power is needed for the ESFAS output channels to send an actuation signal. Note that there may be some ESFAS actuation subsystems that utilize hindrance output logic. For these subsystems, loss of control power will cause system or component actuation, as is the case with the RPS. Details of the ESFAS system for Millstone 2 have not been determined. (Ref. 3)

C. Manually-Initiated Protective Actions
When reasonable time is available, certain protective actions may be performed manually by plant personnel. The control room operators are capable of operating individual components using normal control circuitry, or operating groups of components by manually tripping the RPS or an ESFAS subsystem. The control room operators also may send qualified persons into the plant to operate components locally or from some other remote control location (i.e., the Hot 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
1. RPS
The RPS input instrument channels are powered from the 120 VAC instrument buses (see Section 3.6). It is assumed that the RPS A and B output logic trains are powered from separate 125 VDC distribution panels.

2. Engineered Safety Features Actuation System
The input instrument channels are powered from 120 VAC instrument buses. It is assumed that the A and B output logic trains are powered from separate 125 VDC distribution panels.

3. Operator Instrumentation
Operator instrumentation displays are powered from the 120 VAC instrument buses.

3.5.6 Section 3.5 References

1. Millstone 2 Updated Final Safety Analysis Report, Section 7.6.4.

2. Millstone 2 Updated Final Safety Analysis Report, Section 7.2.1.2.

3. Millstone 2 Updated Final Safety Analysis Report, Section 7.3.2.

3.6 ELECTRIC POWER SYSTEM

3.6.1 System Function

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

3.6.2 System Definition

The onsite Class 1E electric power system consists of two AC load groups. Diesel generator A is connected to 4160 VAC bus B1, and diesel generator B is connected to 4160 VAC bus B2. A third 4160 VAC bus (B5) can be connected to either diesel generator. There are two emergency 480 VAC buses designated buses 22E and 22F. These are connected to the B1 and B2 busses respectively through transformers UB5 and UB6 respectively. Motor control centers B51 and B52 receive their power from bus 22E and motor control centers B61 and B62 receive their power from Bus 22F.

Emergency power for vital instruments, control, and emergency lighting is supplied by two 125 VDC load groups. Two station batteries energize two DC buses, designated bus 201A and bus 201B. Four 120 VAC instrument panel buses (panels VA10, VA20, VA30, and VA40) are connected to the DC buses through inverters.

Simplified one-line diagrams of the electric power system are shown in Figures 3.6-1 and 3.6-2. A summary of data on selected electric power system components is presented in Table 3.5-1. A partial listing of electrical sources and loads is presented in Table 3.6-2.

3.6.3 System Operation

During normal operation, the Class 1E electric power system is supplied from the 345 kV switchyard. 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 sized to supply power to design loads for up to 1 hour (Ref. 1).

The 120 VAC vital buses normally receive power from the DC buses through respective inverters.

Redundant safeguards equipment such as motor driven pumps and motor operated valves are supplied by different VAC buses. For the purpose of discussion, this equipment has been grouped into "load groups". Load group AC/A contains components powered either directly or indirectly from 4160 bus B1. Load group AC/B contains components powered either directly or indirectly by bus B2. Bus B5 is a swing bus that can be manually connected to either load group AC/A or AC/B, and is located in the same area as bus B1. Components receiving DC power are assigned to load groups DC/A or DC/B, 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
- In order to maintain an extended hot shutdown condition, one diesel generator is required.

3.6.5 Component Information

A. Standby diesel generators (2)
 1. Maximum continuous rating: 2750 kW
 2. 300 hour rating: 3250 kW
 3. Rated voltage: 4160 VAC
 4. Manufacturer: Fairbanks Morse

B. Batteries (2)
 1. Type: lead-acid (60 cell)
 2. Rated voltage: 125 VDC
 3. Rating with design load: 1 hour per battery

3.6.6 Support Systems and Interfaces

A. Control Signals
 1. Automatic
 The standby diesel generators are automatically started based on:
 - Undervoltage on the normal bus, loss of offsite power (LOSPW)
 - Safety injection actuation signal (SIAS)

 2. Remote manual
 The diesel generators can be started, and many distribution circuit breakers can be operated, from the main control room.

B. Diesel Generator Auxiliary Systems
 1. Diesel Cooling Water System
 Heat from both diesel generators is transferred from a jacket water system to the Service Water System (SW, see Section 3.8).
 2. Diesel Starting System
 Each diesel has an air starting system.
 3. Diesel Fuel Oil Transfer and Storage System
 A "day tank" supplies enough fuel for about 3.5 days without replenishment. Each day tank can be replenished from a storage tank during engine operation.
 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.

3.6.7 Section 3.6 References

1. Millstone 2 Updated Final Safety Analysis Report, Chapter 8.

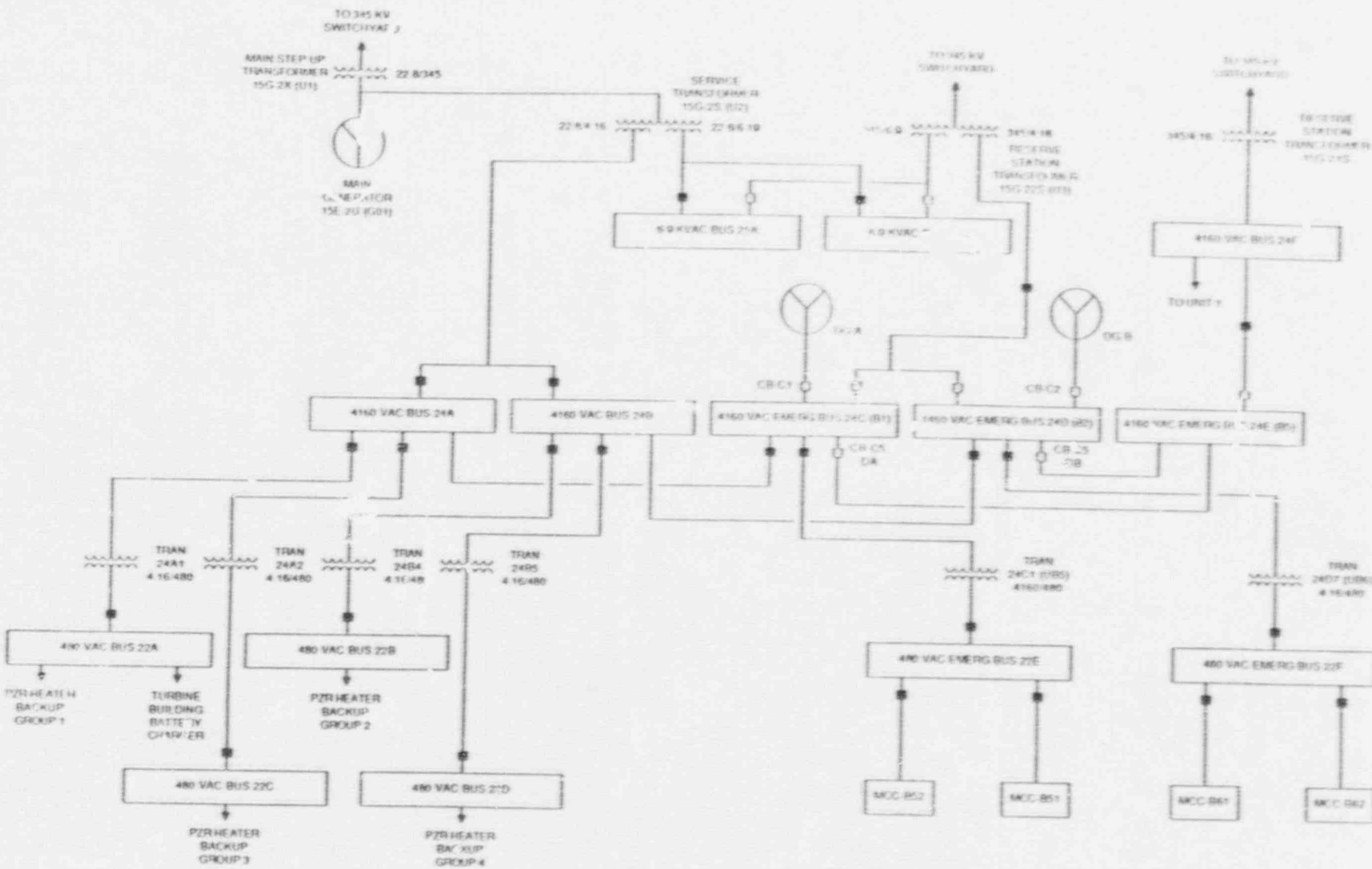
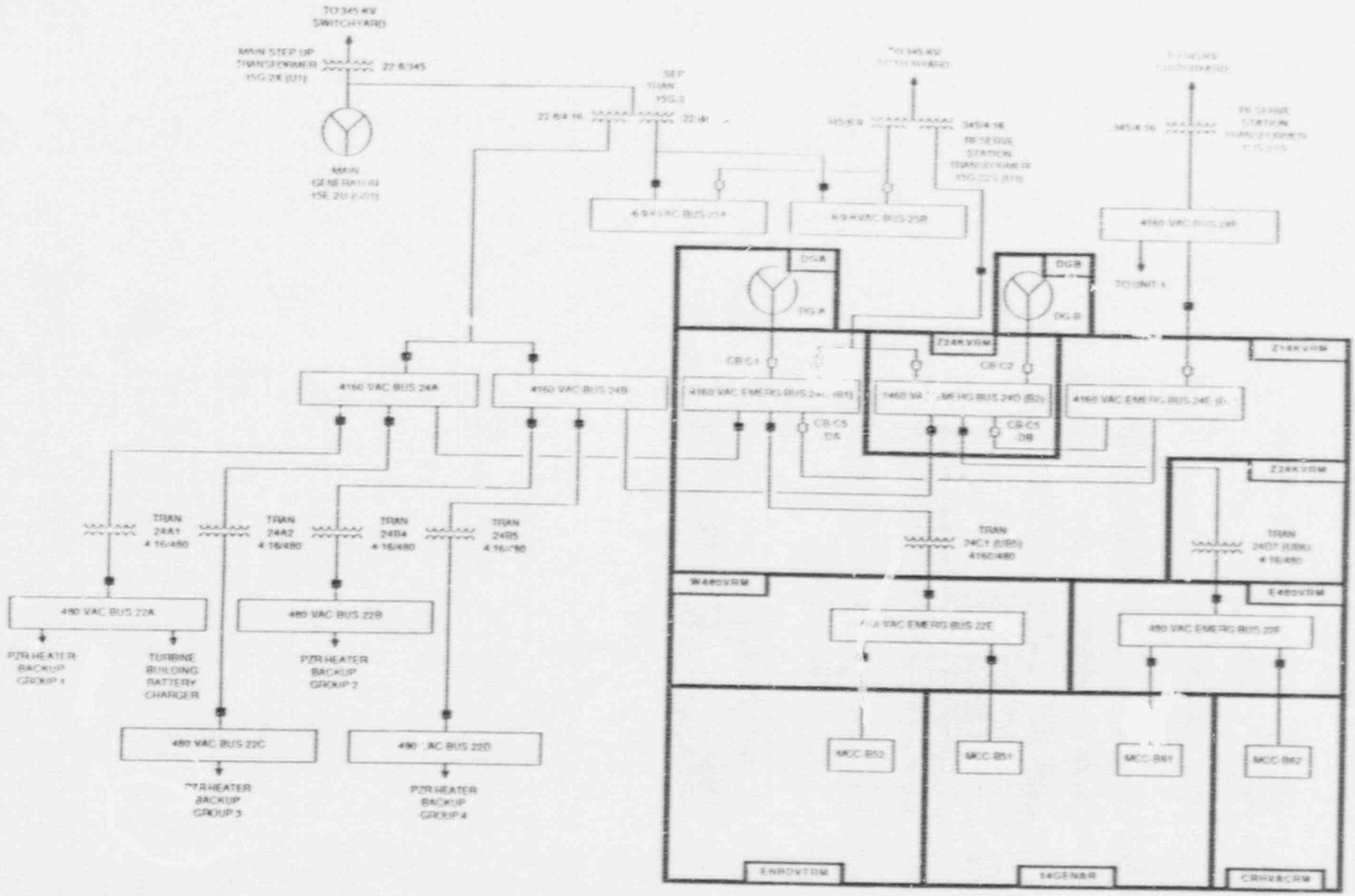


Figure 3.6-1. Millstone 2 4160 and 480 VAC Electric Power Distribution System



NOTE: LINES MAY NOT REPRESENT ACTUAL CABLE ROUTING BETWEEN ROOMS

Figure 3.6-2. Millstone 2 4160 and 480 VAC Electric Power Distribution System Showing Component Locations

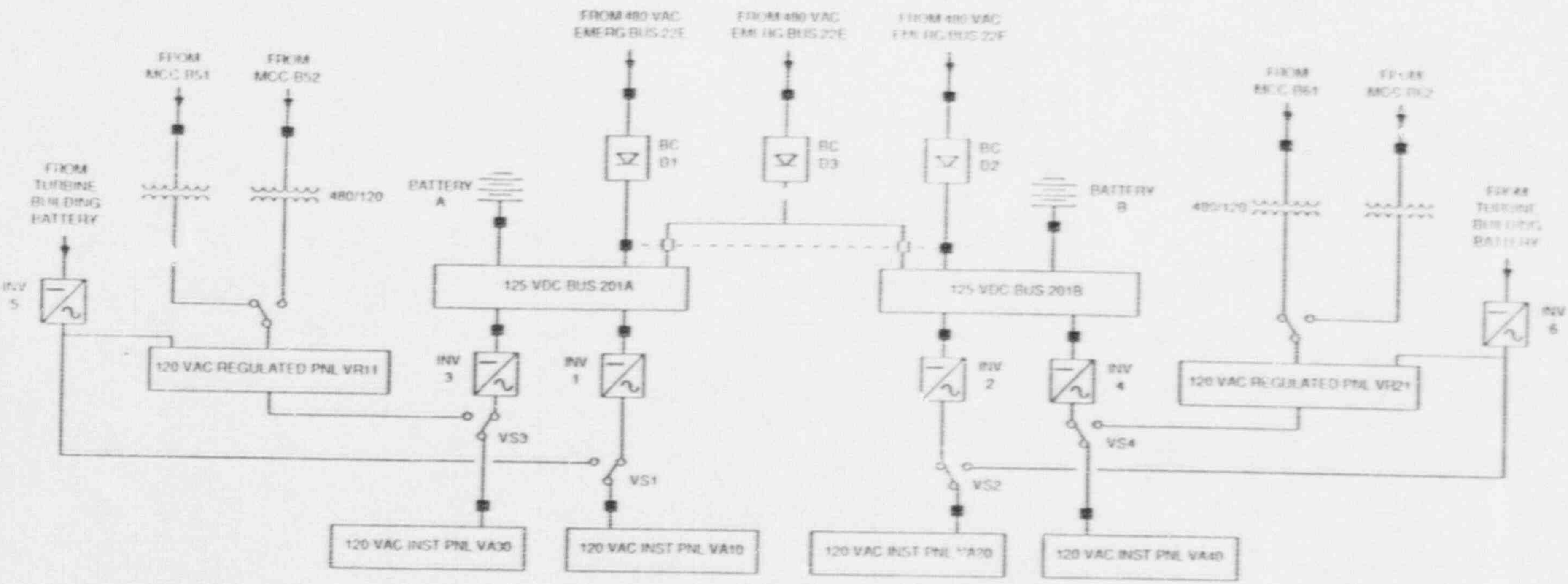
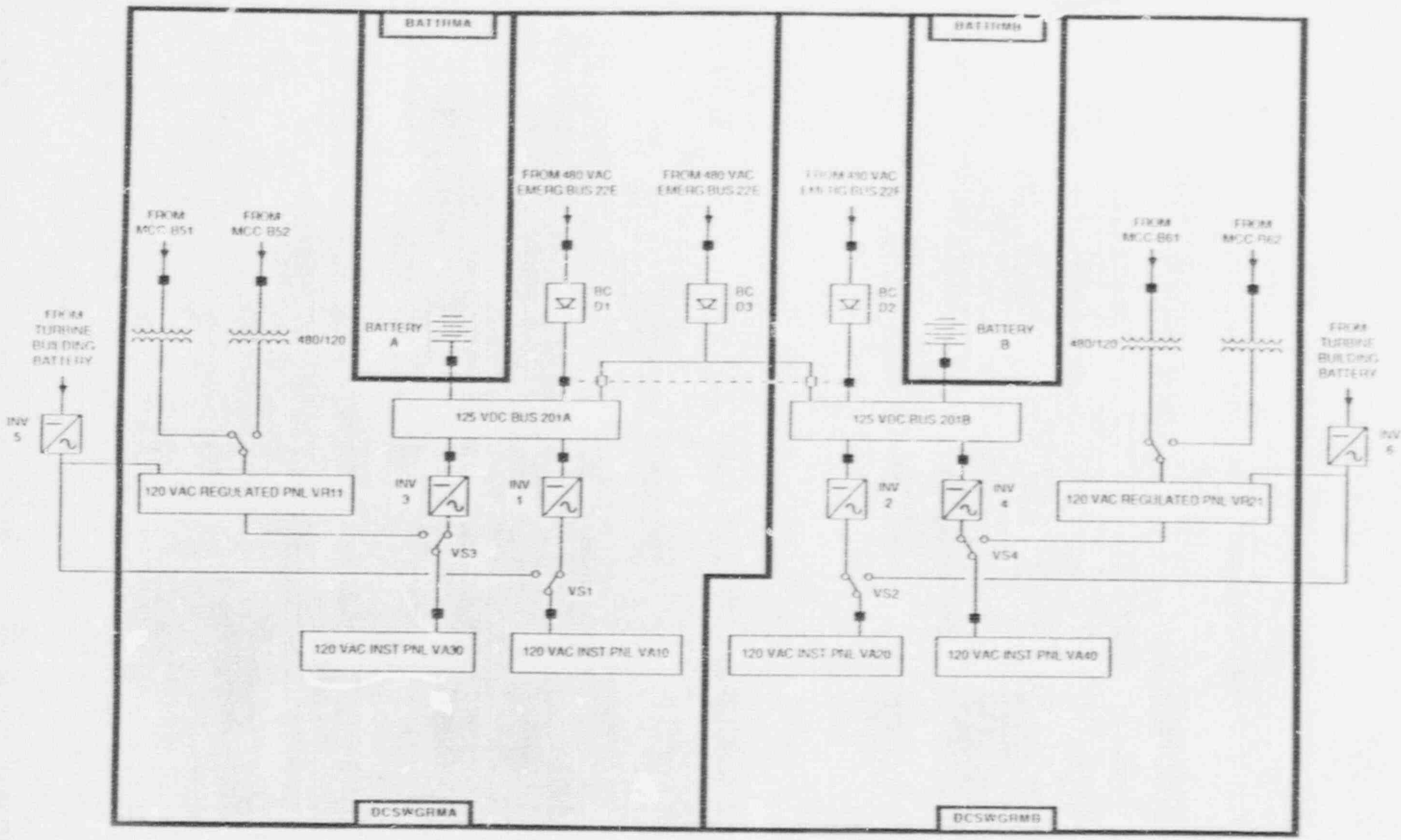


Figure 3.6-3. Millstone 2 125 VDC and 120 VAC Electric Power Distribution System



NOTE: LINES MAY NOT REPRESENT ACTUAL CABLE ROUTING BETWEEN ROOMS

Figure 3.6-4. Millstone 2 125 VDC and 120 VAC Electric Power Distribution System Showing Component Locations

Table 3.6-1. Millstone 2 Electric Power System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
BATT-A	BATT	BATTRMA		125		DC/A
BATT-B	BATT	BATTRMB		125		DC/B
BC-DC1	BC	DCSWGRMA	BUS-22E	125	W480VRM	DC/A
BC-DC2	BC	DCSWGRMB	BUS-22F	125	E480VRM	DC/B
BC-DC3	BC	DCSWGRMA	BUS-22E	125	W480VRM	DC/A
BUS 22E	BUS	W480VRM	TR-UB5	4160	Z14KVRM	AC/A
BUS 22F	BUS	E480VRM	TR-UB6	4160	Z24KVRM	AC/B
BUS B1	BUS	Z14KVRM	DG-A	4160	DGA	AC/A
BUS B2	BUS	Z24KVRM	DG-B	4160	DGB	AC/B
BUS B5	BUS	Z14KVRM	DG-A	4160	DGA	AC/A
BUS B5	BUS	Z14KVRM	DG-B	4160	DGB	AC/B
BUS-201A	BUS	DCSWGRMA	BC-DC1	125	W480VRM	DC/A
BUS-201A	BUS	DCSWGRMA	BC-DC3	125	W480VRM	DC/A
BUS-201A	BUS	DCSWGRMA	BATT-A	125	BATTRMA	DC/A
BUS-201B	BUS	DCSWGRMB	BC-DC2	125	E480VRM	DC/B
BUS-201B	BUS	DCSWGRMB	BC-DC3	125	E480VRM	DC/B
BUS-201B	BUS	DCSWGRMB	BATT-B	125	BATTRMB	DC/B
CB-C1	CB	Z14KVRM	DG-A	4160	DGA	AC/A
CB-C2	CB	Z24KVRM	DG-B	4160	DGB	AC/B
CB-C5-DA	CB	Z14KVRM	DG-A	4160	DGA	AC/A
CB-C5-DB	CB	Z24KVRM	DG-B	4160	DGB	AC/B
DG-A	DG	DGA		4160	DGA	AC/A
DG-B	DG	DGB		4160	DGB	AC/B
INV-1	INV	DCSWGRMA	BUS-201A	125	DCSWGRMA	DC/A
INV-2	INV	DCSWGRMB	BUS-201B	125	DCSWGRMB	DC/B
INV-3	INV	DCSWGRMA	BUS-201A	125	DCSWGRMA	DC/A
INV-4	INV	DCSWGRMB	BUS-201B	125	DCSWGRMB	DC/B
MCC-B51	MCC	14GENAR	BUS-22E	480	W480VRM	AC/A

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Table 3.6-1. Millstone 2 Electric Power System Data Summary for Selected Components (Continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
MCC-B52	MCC	ENBDVTRM	BUS-22E	480	W480VRM	AC/A
MCC-B61	MCC	14GENAR	BUS-22F	480	E480VRM	AC/B
MCC-B62	MCC	CRHVACRM	BUS-22F	480	E480VRM	AC/B
PNL-VA10	PNL	DCSWGRMA	INV-1	120	DCSWGRMA	DC/A
PNL-VA20	PNL	DCSWGRMB	INV-2	120	DCSWGRMB	DC/B
PNL-VA30	PNL	DCSWGRMA	INV-3	120	DCSWGRMA	DC/A
PNL-VA40	PNL	DCSWGRMB	INV-4	120	DCSWGRMB	DC/B
PNL-VR11	PNL	DCSWGRMA	MCC-B52	480	ENBDVTRM	AC/A
PNL-VR21	PNL	DCSWGRMB	MCC-B62	480	CRHVACRM	AC/B
TR-UB5	TRAN	Z14KVRM	BUS-B1	4160	Z14KVRM	AC/A
TR-UB6	TRAN	Z24KVRM	BUS-B2	4160	Z24KVRM	AC/B

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
BATT-A	125	DC/A	BATTRMA	EP	BUS-201A	BUS	DCSWGRMA
BATT-B	125	DC/B	BATTRMB	EP	BUS-201B	BUS	DCSWGRMB
BC-DC1	125	DC/A	W480VRM	EP	BUS-201A	BUS	DCSWGRMA
BC-DC2	125	DC/B	E480VRM	EP	BUS-201B	BUS	DCSWGRMB
BC-DC3	125	DC/A	W480VRM	EP	BUS-201A	BUS	DCSWGRMA
BC-DC3	125	DC/B	E480VRM	EP	BUS-201B	BUS	DCSWGRMB
BUS-201A	125	DC/A	DCSWGRMA	EP	INV-1	INV	DCSWGRMA
BUS-201A	125	DC/A	DCSWGRMA	EP	INV-3	INV	DCSWGRMA
BUS-201B	125	DC/B	DCSWGRMB	AFW	AFW-V4188	MOV	TDPMPRM
BUS-201B	125	DC/B	DCSWGRMB	EP	INV-2	INV	DCSWGRMB
BUS-201B	125	DC/B	DCSWGRMB	EP	INV-4	INV	DCSWGRMB
BUS-22E	480	AC/A	W480VRM	ECCS		ACU	RC
BUS-22E	480	AC/A	W480VRM	ECCS		ACU	RC
BUS-22E	125	DC/A	W480VRM	EP	BC-DC1	BC	DCSWGRMA
BUS-22E	125	DC/A	W480VRM	EP	BC-DC3	BC	DCSWGRMA
BUS-22E	480	AC/A	W480VRM	EP	MCC-B51	MCC	14GENAR
BUS-22E	480	AC/A	W480VRM	EP	MCC-B52	MCC	ENBDVTRM
BUS-22F	480	AC/B	E480VRM	ECCS		ACU	RC
BUS-22F	480	AC/B	E480VRM	ECCS		ACU	RC
BUS-22F	125	DC/B	E480VRM	EP	BC-DC2	BC	DCSWGRMB
BUS-22F	480	AC/B	E480VRM	EP	MCC-B61	MCC	14GENAR
BUS-22F	480	AC/B	E480VRM	EP	MCC-B62	MCC	CRHVACRM
BUS-B1	4160	AC/A	Z14KVRM	AFW	AFW-MDA	MDP	MDPMPRM
BUS-B1	4160	AC/A	Z14KVRM	CCW	CCW-P11A	MDP	25GENAR
BUS-B1	4160	AC/A	Z14KVRM	CS	CS-P42A	MDP	ESF1
BUS-B1	4160	AC/A	Z14KVRM	ECCS	SI-PM-A	MDP	ESF1
BUS-B1	4160	AC/A	Z14KVRM	EP	TR-UB5	TRAN	Z14KVRM
BUS-B1	4160	AC/A	Z14KVRM	SW	SW-P5A	MDP	INTSTR
BUS-B2	4160	AC/B	Z24KVRM	AFW	AFW-MDB	MDP	MDPMPRM
BUS-B2	4160	AC/B	Z24KVRM	CCW	CCW-P11C	MDP	25GENAR
BUS-B2	4160	AC/B	Z24KVRM	CS	CS-P42B	MDP	ESF2

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
BUS-B2	4160	AC/B	Z24KVRM	ECCS	SI-PM-C	MDP	ESF2
BUS-B2	4160	AC/B	Z24KVRM	EP	TR-UB6	TRAN	Z24KVRM
BUS-B2	4160	AC/B	Z24KVRM	SW	SW-P5C	MDP	INTSTR
BUS-B5	4160	AC/A	Z14KVRM	CCW	CCW-P11B	MDP	25GENAR
BUS-B3	4160	AC/A	Z14KVRM	ECCS	SI-PM-B	MDP	ESFSWB
BUS-B5	4160	AC/A	Z14KVRM	SW	SW-P5B	MDP	INTSTR
DG-A	4160	AC/A	DGA	EP	BUS B1	BUS	Z14KVRM
DG-A	4160	AC/A	DGA	EP	BUS B5	BUS	Z14KVRM
DG-A	4160	AC/A	DGA	EP	CB-C1	CB	Z14KVRM
DG-A	4160	AC/A	DGA	EP	CB-C5-DA	CB	Z14KVRM
DG-B	4160	AC/B	DGB	EP	BUS B2	BUS	Z24KVRM
DG-B	4160	AC/B	DGB	EP	BUS B5	BUS	Z14KVRM
DG-B	4160	AC/B	DGB	EP	CB-C2	CB	Z24KVRM
DG-B	4160	AC/B	DGB	EP	CB-C5-DB	CB	Z24KVRM
INV-1	120	DC/A	DCSWGRMA	EP	PNL-VA10	PNL	DCSWGRMA
INV-2	120	DC/B	DCSWGRMB	EP	PNL-VA20	PNL	DCSWGRMB
INV-3	120	DC/A	DCSWGRMA	EP	PNL-VA30	PNL	DCSWGRMA
INV-4	120	DC/B	DCSWGRMB	EP	PNL-VA40	PNL	DCSWGRMB
MCC-B51	480	AC/A	14GENAR	CS	CS-V41A	MOV	PPPEN5W
MCC-B51	480	AC/A	14GENAR	CS	SI-V009	MOV	ESF1
MCC-B51	480	AC/A	14GENAR	CVCS	CH-P18A	MDP	CHGPMPRM
MCC-B51	480	AC/A	14GENAR	CVCS	CH-V429	MOV	CHGPMPRM
MCC-B51	480	AC/A	14GENAR	CVCS	CH-V504	MOV	VCTRM
MCC-B51	480	AC/A	14GENAR	CVCS	SI-V011	MOV	RWSTVENCL
MCC-B51	480	AC/A	14GENAR	ECCS	617	MOV	PPPEN5W
MCC-B51	480	AC/A	14GENAR	ECCS	627	MOV	PPPEN5W
MCC-B51	480	AC/A	14GENAR	ECCS	637	MOV	PPPEN5W
MCC-B51	480	AC/A	14GENAR	ECCS	647	MOV	PPPEN5W
MCC-B51	480	AC/A	14GENAR	ECCS	SI-V009	MOV	ESF1
MCC-B51	480	AC/A	14GENAR	ECCS	SI-V011	MOV	RWSTVENCL
MCC-B51	480	AC/B	14GENAR	ECCS	SI-V412	MOV	ESF2

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC-B51	480	AC/A	14GENAR	ECCS	SI-V412	MOV	ESF2
MCC-B51	480	AC/A	14GENAR	ECCS	SI-V656	MOV	ESF1
MCC-B51	480	AC/A	14GENAR	RCS	V405	MOV	RC
MCC-B52	480	AC/A	ENBDVTRM	AFW	AFW-V201	MOV	MSTMENE
MCC-B52	480	AC/A	ENBDVTRM	EP	PNL-VR11	PNL	DCSWGRMA
MCC-B61	480	AC/B	14GENAR	CS	CS-V41B	MOV	PPPEN5E
MCC-B61	480	AC/B	14GENAR	CS	SI-V008	MOV	ESF1
MCC-B61	480	AC/B	14GENAR	CVCS	CH-P18B	MDP	CHGPMPRM
MCC-B61	480	AC/B	14GENAR	CVCS	CH-P18C	MDP	CHGPMPRM
MCC-B61	480	AC/B	14GENAR	ECCS	616	MOV	PPPEN5W
MCC-B61	480	AC/B	14GENAR	ECCS	626	MOV	PPPEN5W
MCC-B61	480	AC/B	14GENAR	ECCS	636	MOV	PPPEN5W
MCC-B61	480	AC/B	14GENAR	ECCS	646	MOV	PPPEN5W
MCC-B61	480	AC/B	14GENAR	ECCS	SI-V008	MOV	ESF1
MCC-B61	480	AC/B	14GENAR	ECCS	SI-V010	MOV	RWSTVENCL
MCC-B61	480	AC/B	14GENAR	ECCS	SI-V411	MOV	ESF1
MCC-B61	480	AC/B	14GENAR	ECCS	SI-V411	MOV	ESF1
MCC-B61	480	AC/B	14GENAR	ECCS	SI-V654	MOV	ESF2
MCC-B61	480	AC/B	14GENAR	RCS	V405	MOV	RC
MCC-B62	480	AC/B	CRHVACRM	AFW	AFW-V202	MOV	MSTMENW
MCC-B62	480	AC/B	CRHVACRM	AFW	AFW-V44	MOV	TB14
MCC-B62	480	AC/B	CRHVACRM	EP	PNL-VR21	PNL	DCSWGRMB
TR-UB5	4160	AC/A	Z14KVRM	EP	BUS 22E	BUS	W480VRM
TR-UB6	4160	AC/B	Z24KVRM	EP	BUS 22F	BUS	E480VRM

3.7 REACTOR BUILDING CLOSED COOLING WATER SYSTEM (RBCCW)

3.7.1 System Function

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

3.7.2 System Definition

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

A simplified drawing of the RBCCW is shown in Figures 3.7-1 and 3.7-2. A summary of the data on selected CCW system components is presented in Table 3.7-1.

3.7.3 System Operation

During normal operation and shutdown, one component cooling pump and one heat exchanger accommodate the heat removal loads. The remaining pump and one heat exchanger serve as a spare. Cooling water is circulated by the pumps through the shell side of the heat exchangers to the components being cooled, then back to the pump suction. Demineralized or primary water can be supplied to the system into the surge tank as a source of makeup water.

Heat loads supported by the RBCCW include the following:

- Shutdown heat exchangers and pumps
- Engineered Safety Features Room air coolers
- Seal coolers for Core Spray and SI pumps
- Containment coolers A, B, C, and D
- Spent fuel pit heat exchanger
- Non-regenerative heat exchanger

Component cooling is also provided for additional components, such as the Reactor Coolant Pumps and Degasifier Coolers.

3.7.4 System Success Criteria

The success criteria for normal operation is one pump and one heat exchanger in each loop (Ref. 1).

During a LOCA, one pump and one heat exchanger in one loop can carry the required load.

3.7.5 Component Information

A. Component Cooling Water Pumps P11A, B, and C
   1. Rated flow: 7000 gpm @ 150 ft head (65 psid)
   2. Rated capacity: 100%
   3. Type: horizontal centrifugal

B. Component Cooling Heat Exchangers 18A, B and C
   1. Design duty: 26.3×10^6 Btu/hr
   2. Type: shell and straight tube

3.7.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      Automatically actuated by SIAS.
   2. Remote Manual
      The RBCCW pumps can be actuated by remote manual means from the control room.

B. Motive Power
   1. RBCCW pumps A, B, and C are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.6.

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

3.7.7 Section 3.7 References

1. Millstone 2 Updated Final Safety Analysis Report, Section 9.4.3.1.

2. Millstone 2 Updated Final Safety Analysis Report, Section 9.4.3.2.

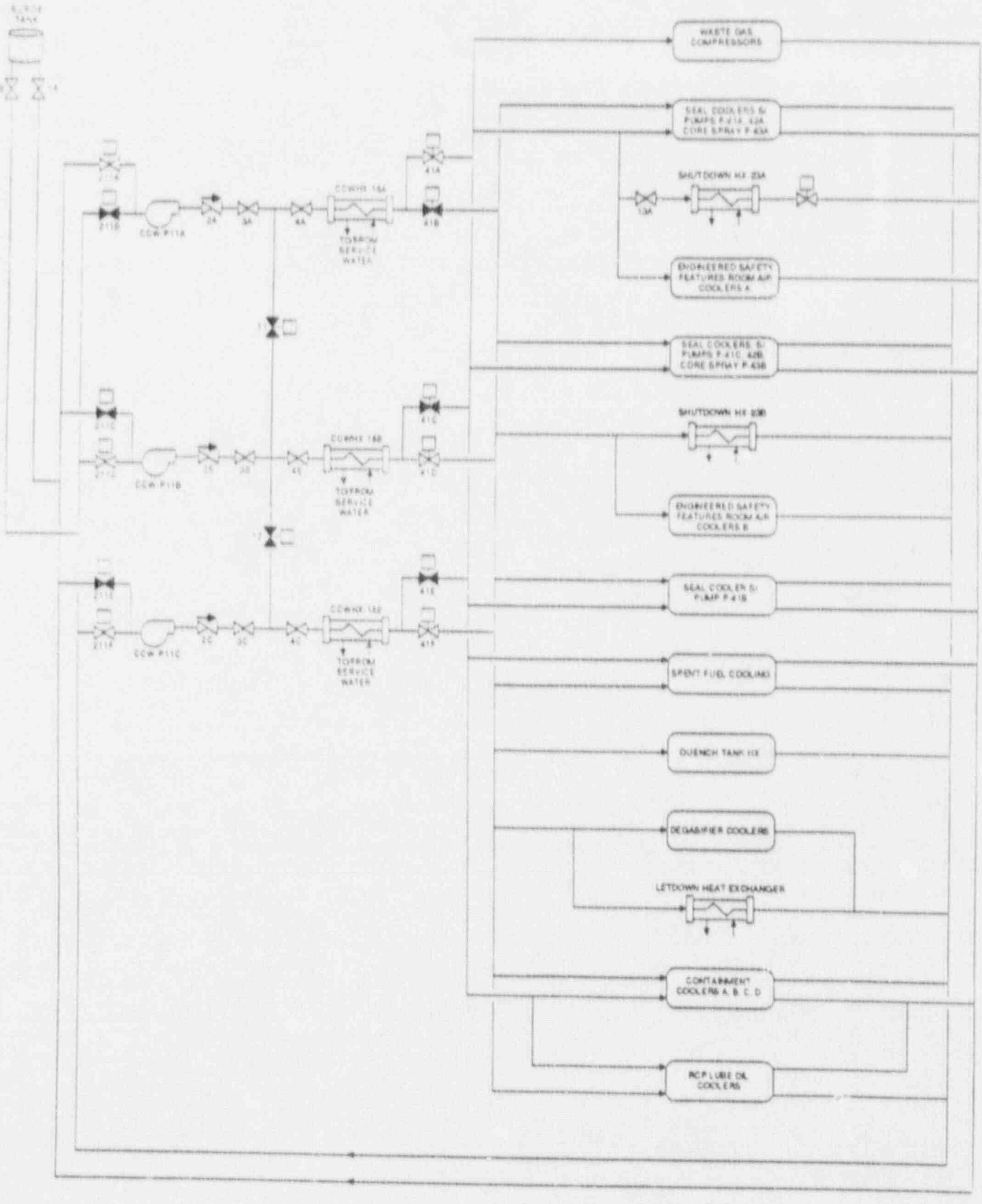

Figure 3.7-1. Millstone 2 Reactor Building Closed Cooling Water System (RBCCW)

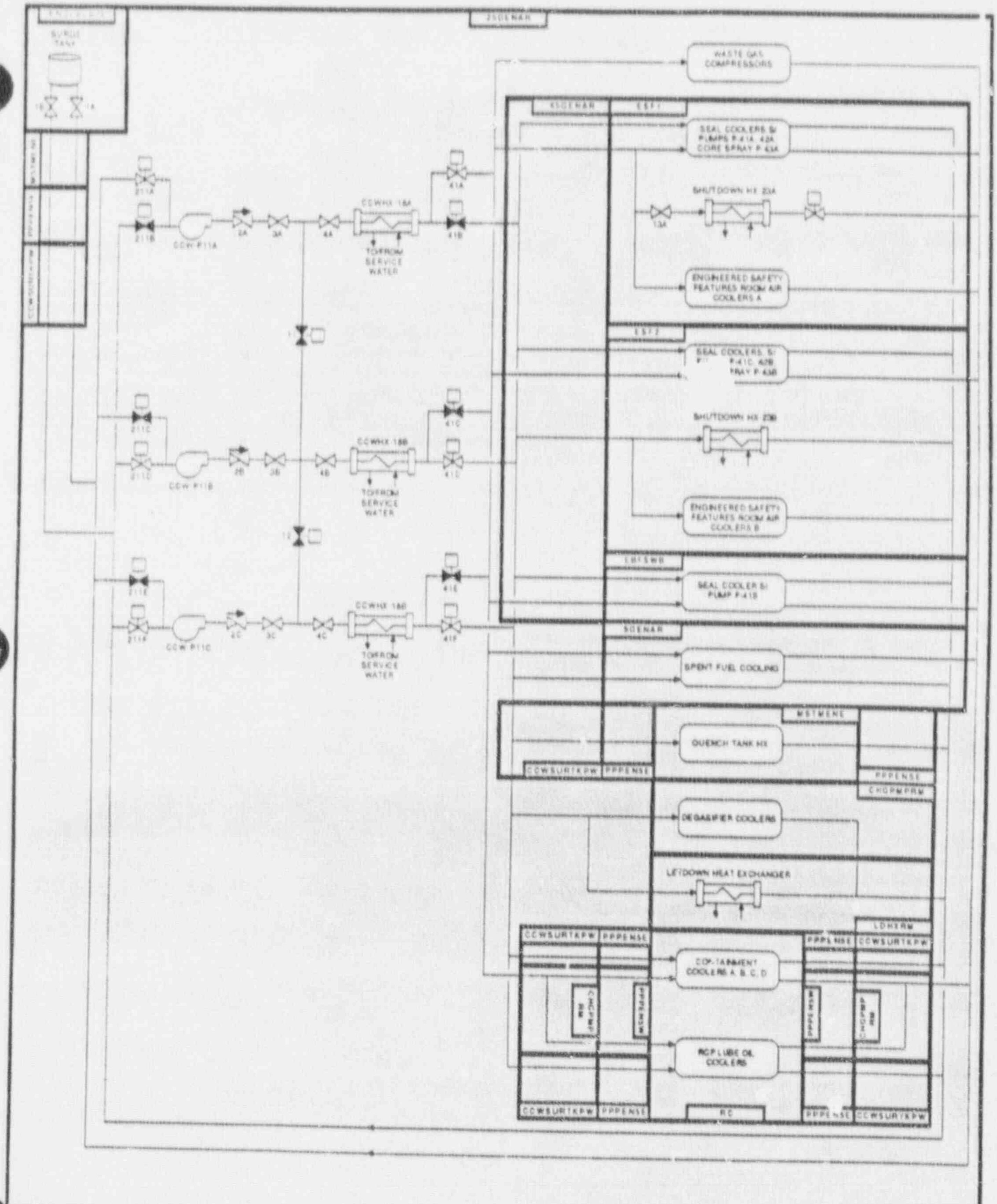

Figure 3.7-2. Millstone 2 Reactor Building Closed Cooling Water System (RBCCW) Showing Component Locations

Table 3.7-1. Millstone 2 Reactor Building Closed Cooling Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP
CCW-HX18A	HX	25GENAR				
CCW-HX18B	HX	25GENAR				
CCW-HX18C	HX	25GENAR				
CCW-P11A	MDP	25GENAR	BUS-B1	4160	Z14KVRM	AC/A
CCW-P11B	MDP	25GENAR	BUS-B5	4160	Z14KVRM	AC/A
CCW-P11C	MDP	25GENAR	BUS-B2	4160	Z24KVRM	AC/B
COOLERS	HX	RC				

3.8 SERVICE WATER SYSTEM (SWS)

3.8.1 System Function

The Service Water System removes heat from the diesel generators, the Reactor Building Closed Cooling Water System, the Turbine Building Closed Cooling Water System, and the vital AC switchgear room cooling coils to the ultimate heat sink, Long Island Sound.

3.8.2 System Definition

The SW system consists of three pumps. Two independent cross-connected supply headers feed all the heat exchangers. Two discharge headers are used for RBCCW and diesel cooling with a third discharge header for the Turbine Building Closed Cooling System. Simplified drawings of the SW system are shown in Figures 3.8-1 and 3.8-2. A summary of the data on selected SW system components is presented in Table 3.8-1.

3.8.3 System Operation

During normal operation, two pumps are operating providing RBCCW, TBCWW, and vital switchgear cooling. The third pump is in standby. Each SWS train is capable of supporting 100% of the cooling functions required for a safe reactor shutdown or following a LOCA. During an emergency operation, a normal reactor shutdown, or each time the standby diesel generators are started and there is a loss of offsite power, the SWS provides cooling water directly to the cooling systems of the diesel generators and to the RBCCW indirectly through the RBCCW heat exchangers. The SIAS signal isolates the TBCCW portion of this system. Cooling water for the SWS is supplied from the ultimate heat sink. Return flow from components serviced by the SWS is returned to the discharge canal.

3.8.4 System Success Criteria

During normal operation 2 of 3 SWS pumps are required to be operating in one in each loop.

Following a LOCA, one SWS pump and service water header can supply all necessary cooling after manual alignment to components normally supplied by the other service water header. If both pumps and both headers are operating, no manual alignment is necessary.

3.8.5 Component Information

A. SWS pumps P5A, B, and C
   1. Rated flow: 12,000 gpm @ 100 ft head (45 psid)
   2. Type: vertical wet pit

B. Ultimate Heat Sink - Long Island Sound

3.8.6 Support System and Interfaces

A. Control Signals
   1. Automatic
      Two pumps are normally operating - SIAS isolates the TBCCW.
   2. Remote Manual
      The system is controlled from the control room.

3. Manual
   Valves in supply lines from the SWS pumps and in the return lines to the discharge canal or the heat exchangers are locked open.

B. Motive Power
   Each SWS pump is a Class 1E load that can be supplied from the standby diesel generators as described in Section 3.6.

C. Other
   1. No external systems for SWS pump lubrication and cooling water have been identified.

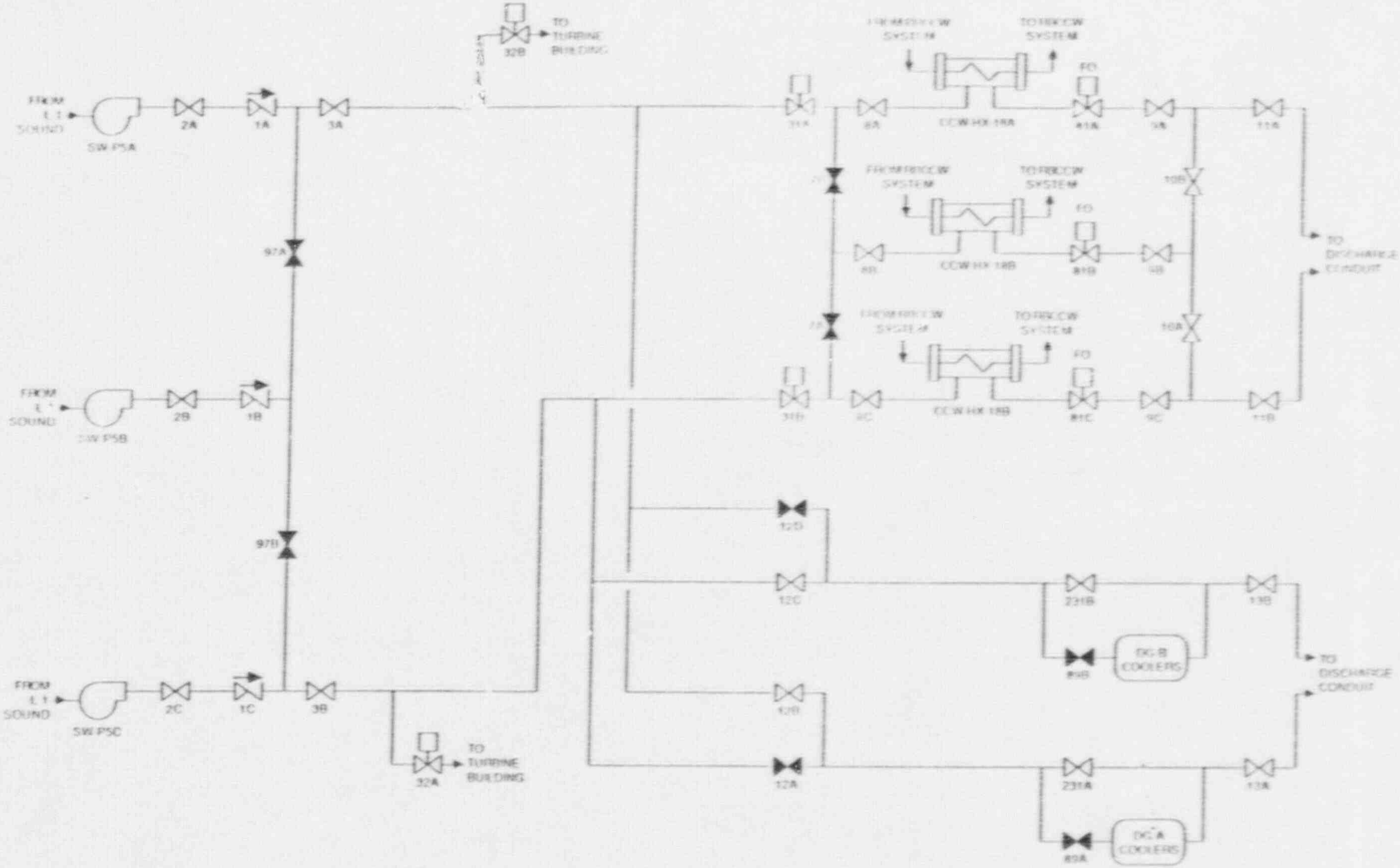

Figure 3.8-1. Millstone 2 Service Water System

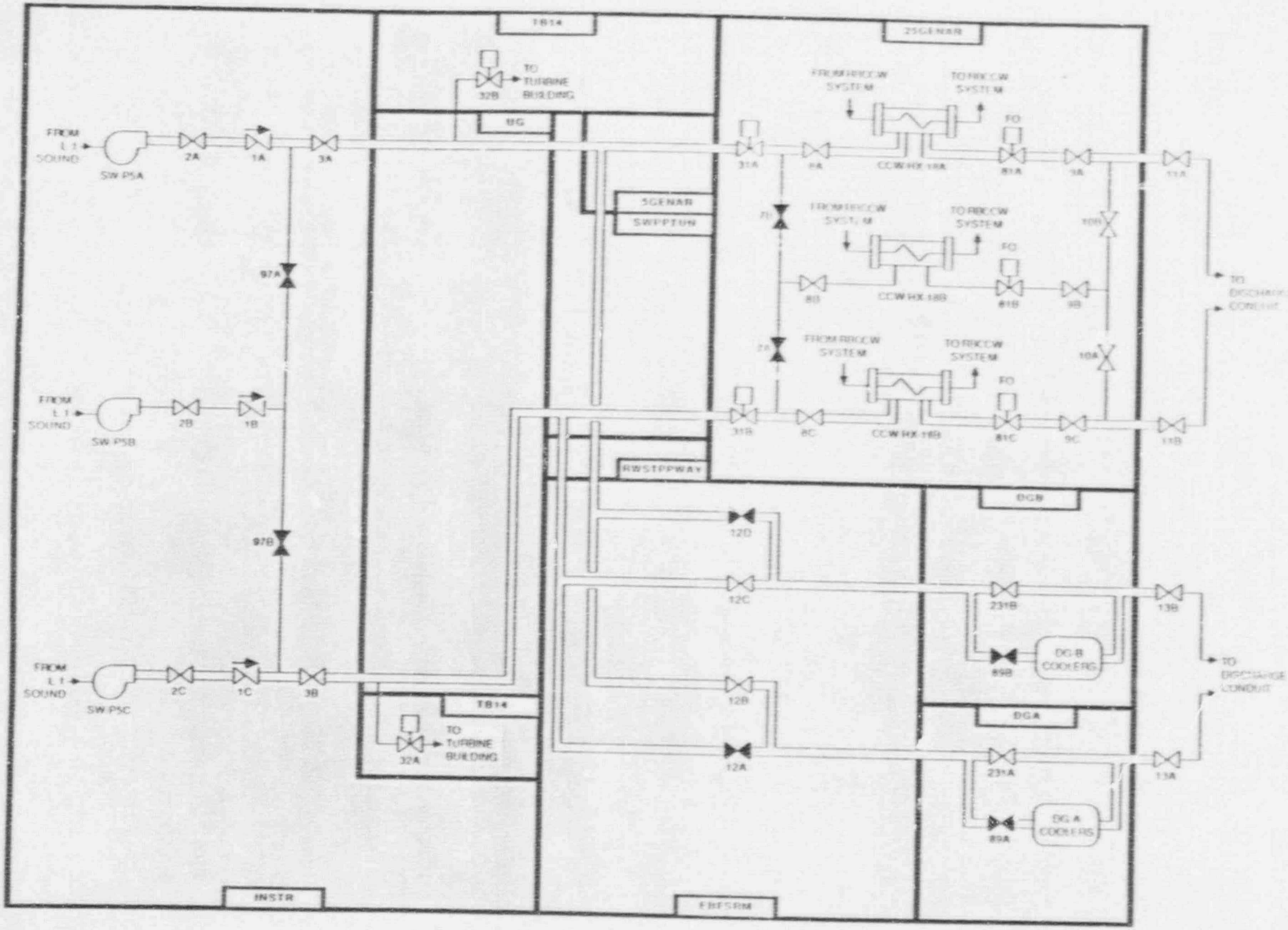

Figure 3.8-2. Millstone 2 Service Water System Showing Component Locations

Table 3.8-1. Millstone 2 Service Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
SW-P5A	MDP	INTSTR	BUS-B1	4160	Z14KVRM	AC/A
SW-P5B	MDP	INTSTR	BUS-B5	4160	Z14KVRM	AC/A
SW-P5C	MDP	INTSTR	BUS-B2	4160	Z24KVRM	AC/B

4. PLANT INFORMATION

4.1 SITE AND BUILDING SUMMARY

The Millstone Nuclear Power Station is located in the town of Waterford, New London County, Connecticut, on the north shore of Long Island Sound. The site occupies 500 acres on the tip of Millstone Point between Niantic Bay to the west and Jordan Cove to the east. The site is situated 3.2 miles west-southwest of New London and 40 miles southeast of Hartford.

The Millstone Station consists of three operating units. Unit 2 is located immediately north of Unit 1 and just south of Unit 3. No systems are shared between Unit 2 and the other two units on the site. Figure 4-1 (from Ref. 1) is a general view of the plant and vicinity.

The major structures of the unit include the containment building, turbine building, auxiliary and control building, diesel generator building, and the intake structure. A site plan is shown in Figure 4-2.

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

The turbine building, located west of the containment, houses the turbine generator with its associated power generating auxiliaries, the auxiliary feedwater pumps and piping, the 4 kV switchgear, and some of the 480 V switchgear.

The auxiliary and control building is located south of the containment and contains components of the safety injection, core spray, CVCS, and electric power systems, the control room, and the spent and new fuel pools. The main steam piping is located between the containment and the auxiliary and control structure.

The diesel generator building is located east of the containment and contains the emergency diesel generators and diesel oil fuel tanks.

The intake structure is located southwest of the containment on Long Island Sound and contains the service water pumps.

The RWST and primary water storage tanks are located east of the containment.

4.2 FACILITY LAYOUT DRAWINGS

Figures 4-3 through 4-9 are simplified building layout drawings for the Millstone 2 containment, auxiliary building and intake structure. The turbine and service building, maintenance shop, and technical support building are not shown on these drawings. Major rooms, stairways, elevators, and doorways are shown in the simplified layout drawings, however, many interior walls have been omitted for clarity. Labels printed in uppercase correspond to the location codes listed in Table 4-1 and used in the component data listings and system drawings in Section 3. Some additional labels are included for information and are printed in lowercase type.

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

4.3 SECTION 4 REFERENCES

1. Heddleson, F.A., "Design Data and Safety Features of Commercial Nuclear Power Plants.", ORNL-NSIC-55, Volume 2, Oak Ridge National Laboratory, Nuclear Safety Information Center, January 1972.

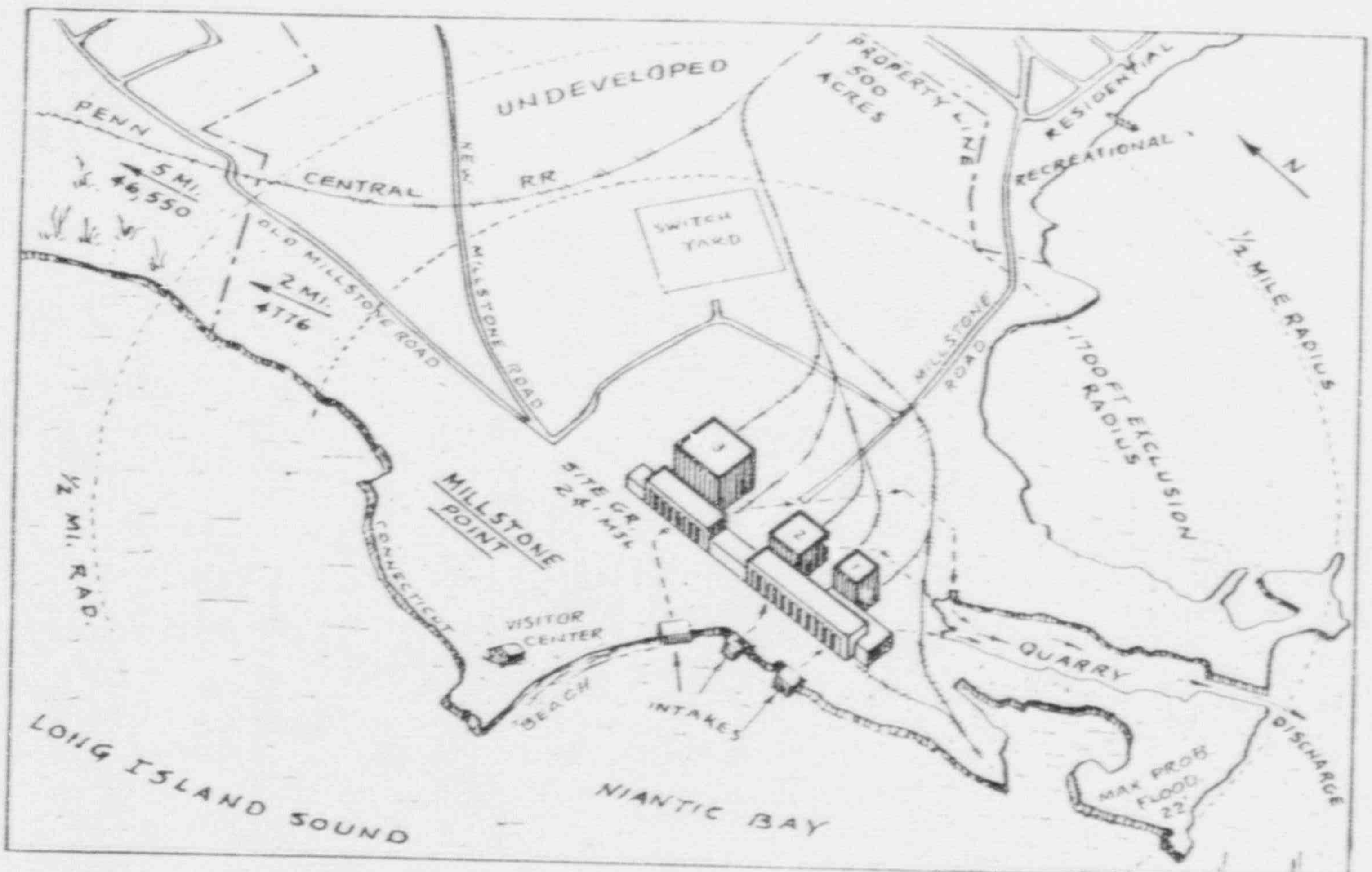

Figure 4-1 General View of Millstone Site and Vicinity

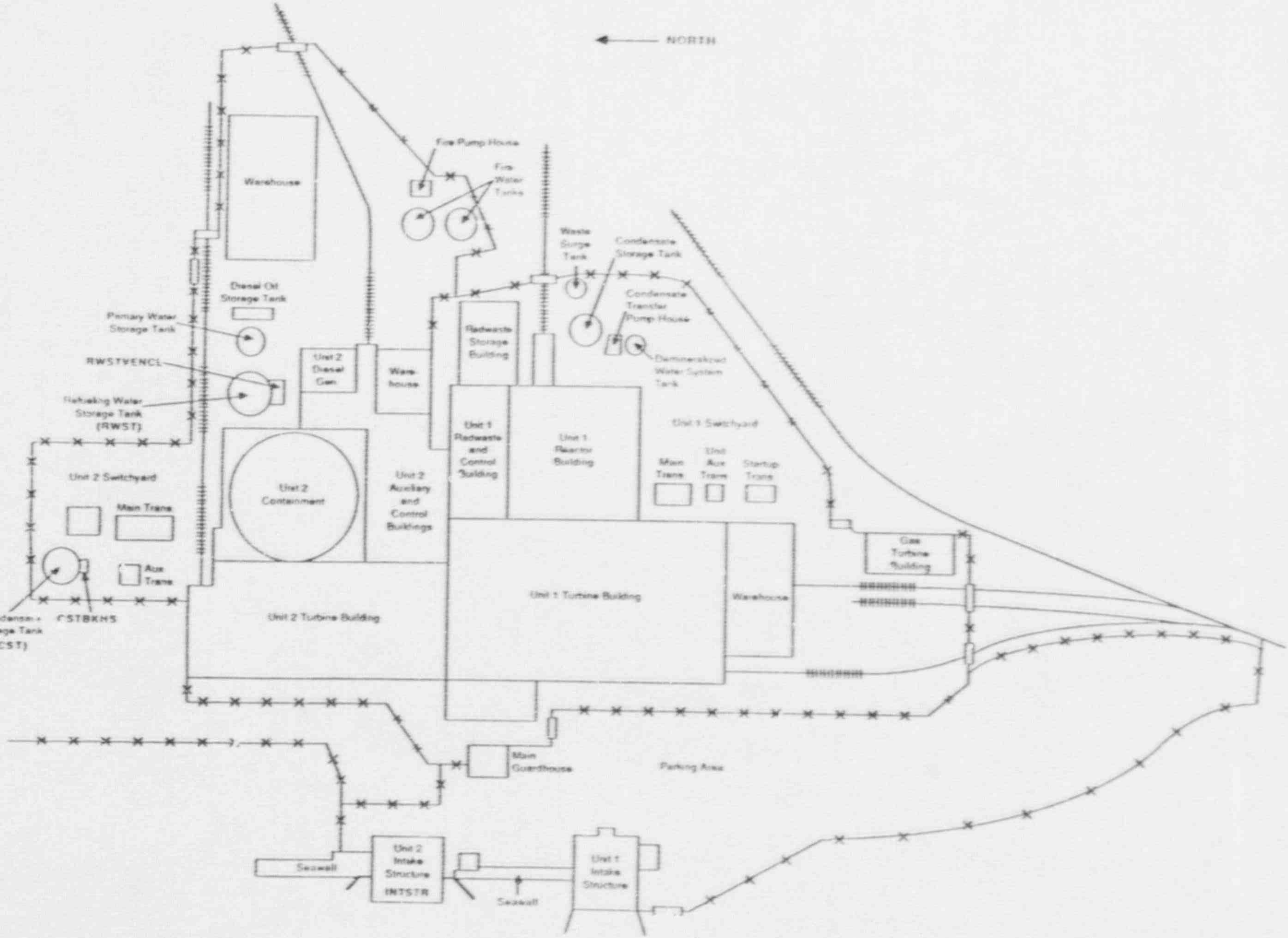

Figure 4-2 Simplified Site Plan for Millstone 1 and 2

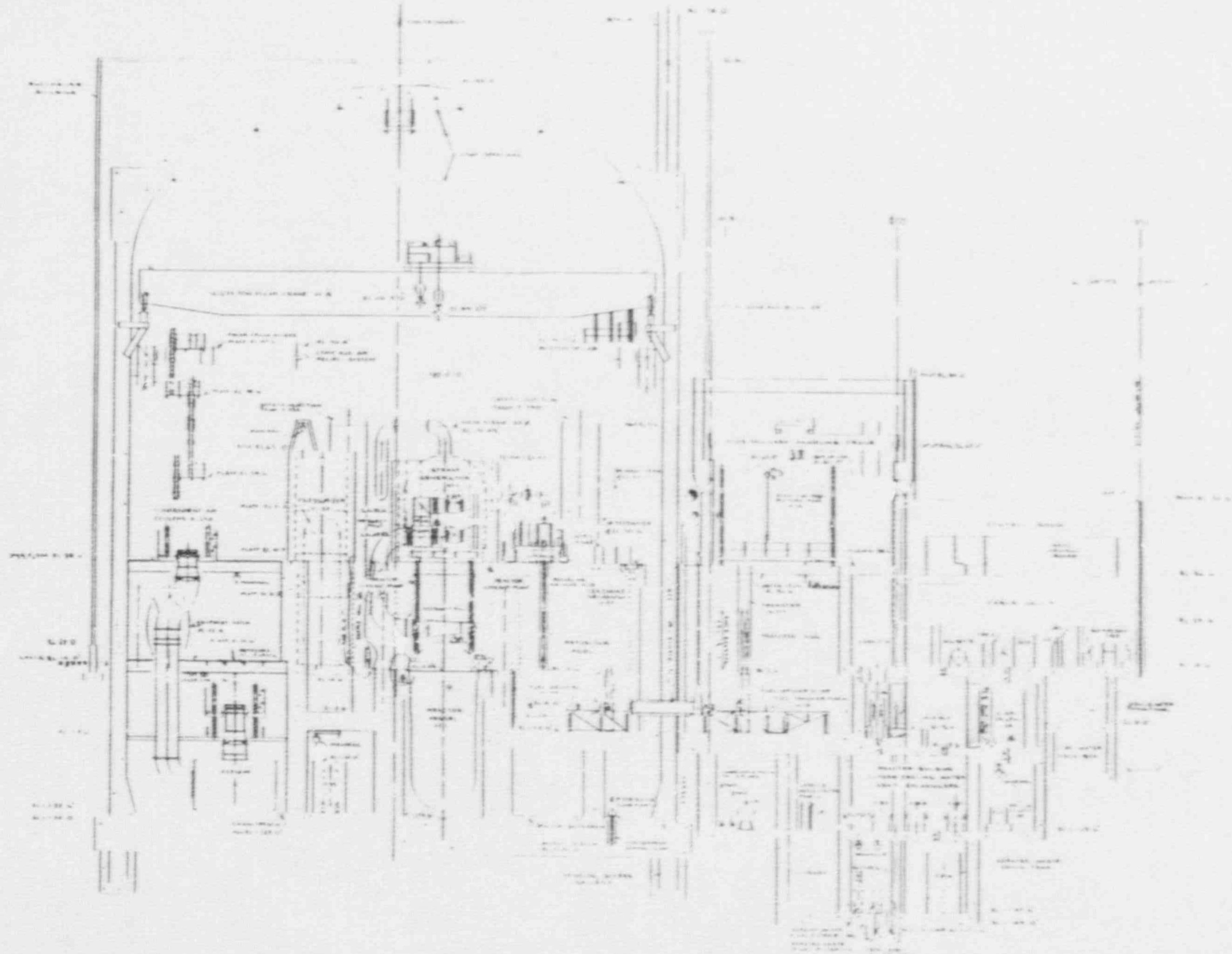

Figure 4-3 Elevation View of Millstone 2 Containment, Auxiliary, and Control Buildings

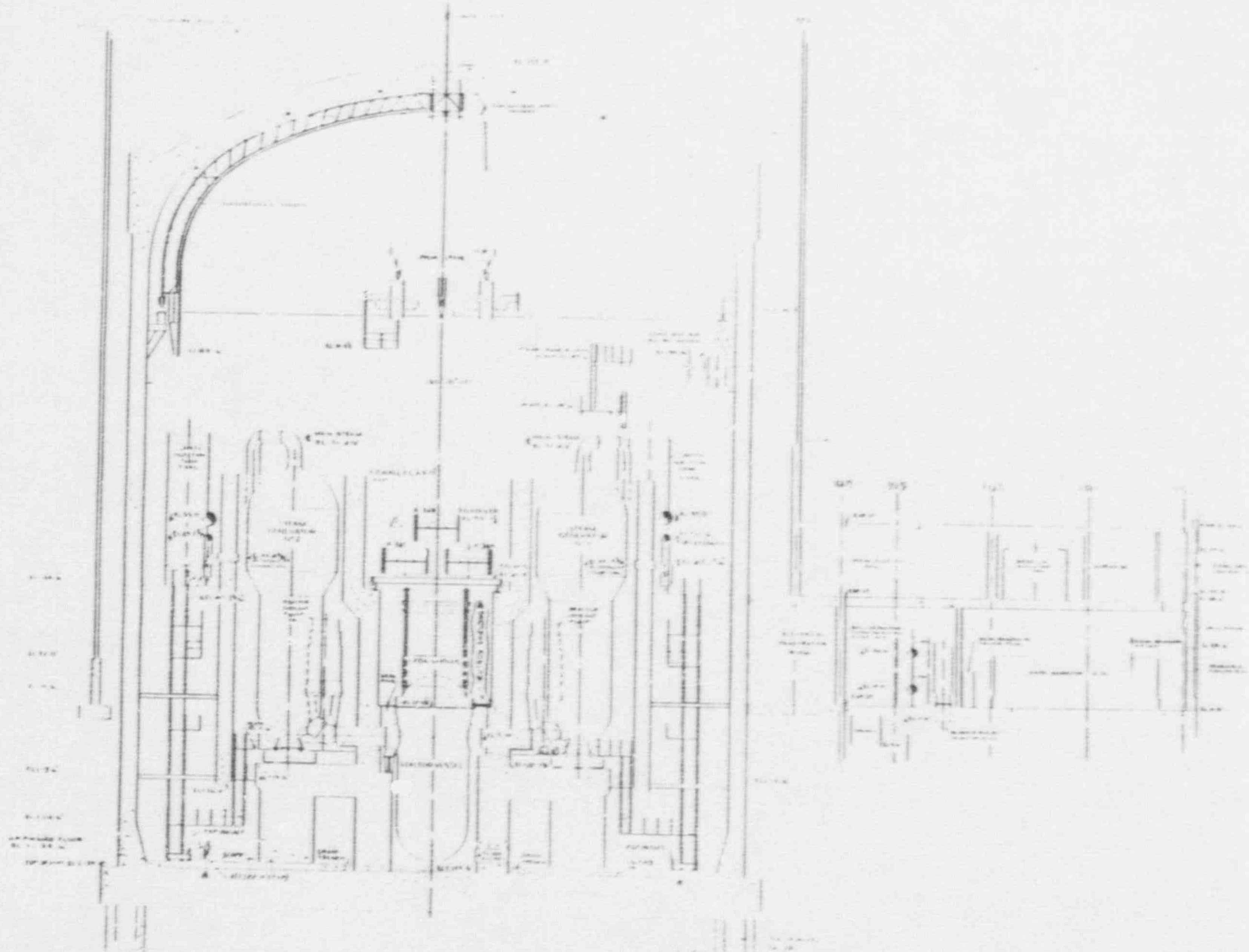

Figure 4-4 Elevation View of Millstone 2
Containment, Auxiliary, and Diesel Generator Buildings

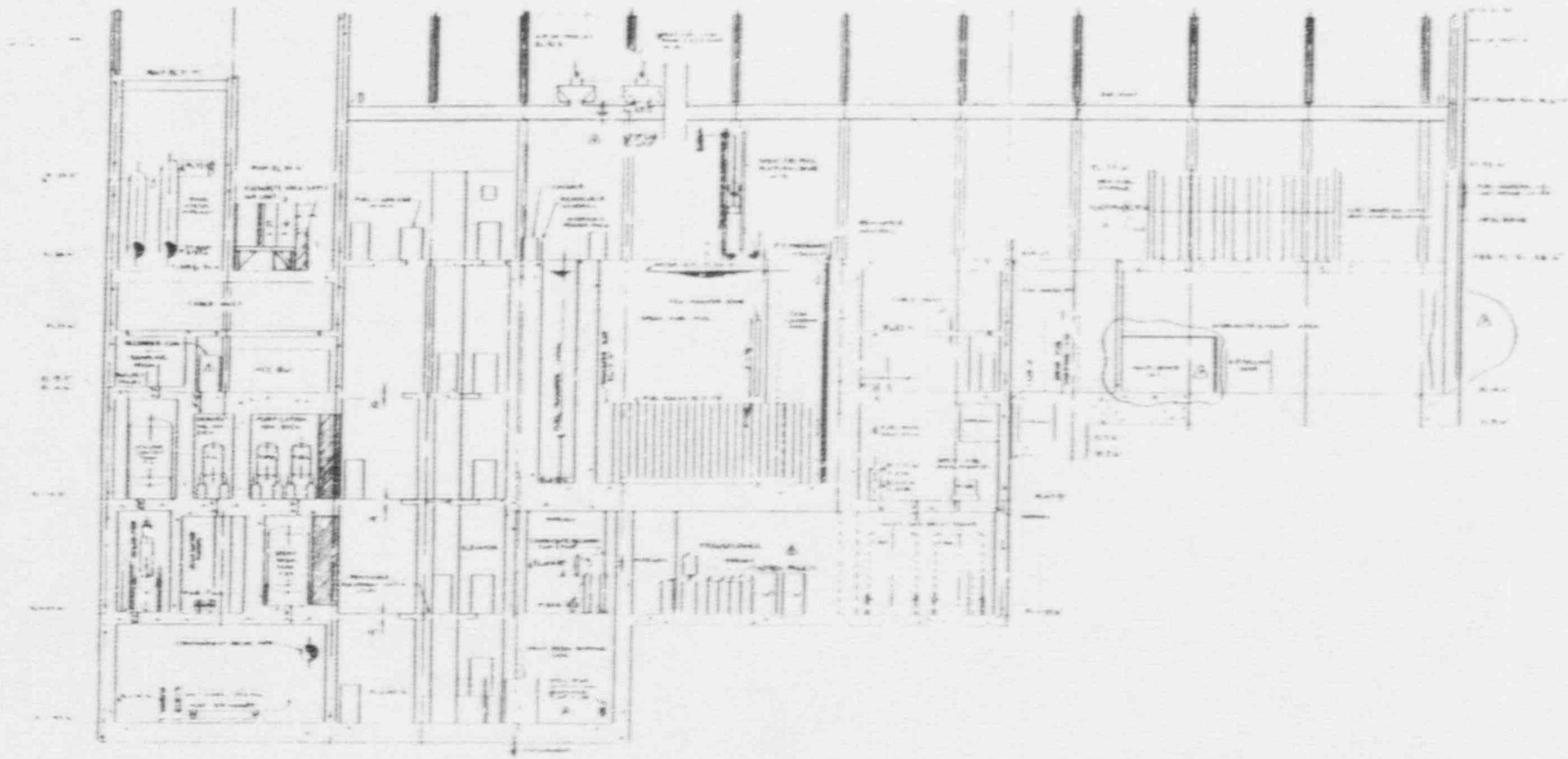

Figure 4-5 Elevation View of Millstone 2 Auxiliary Building
(Spent and New Fuel Storage Areas)

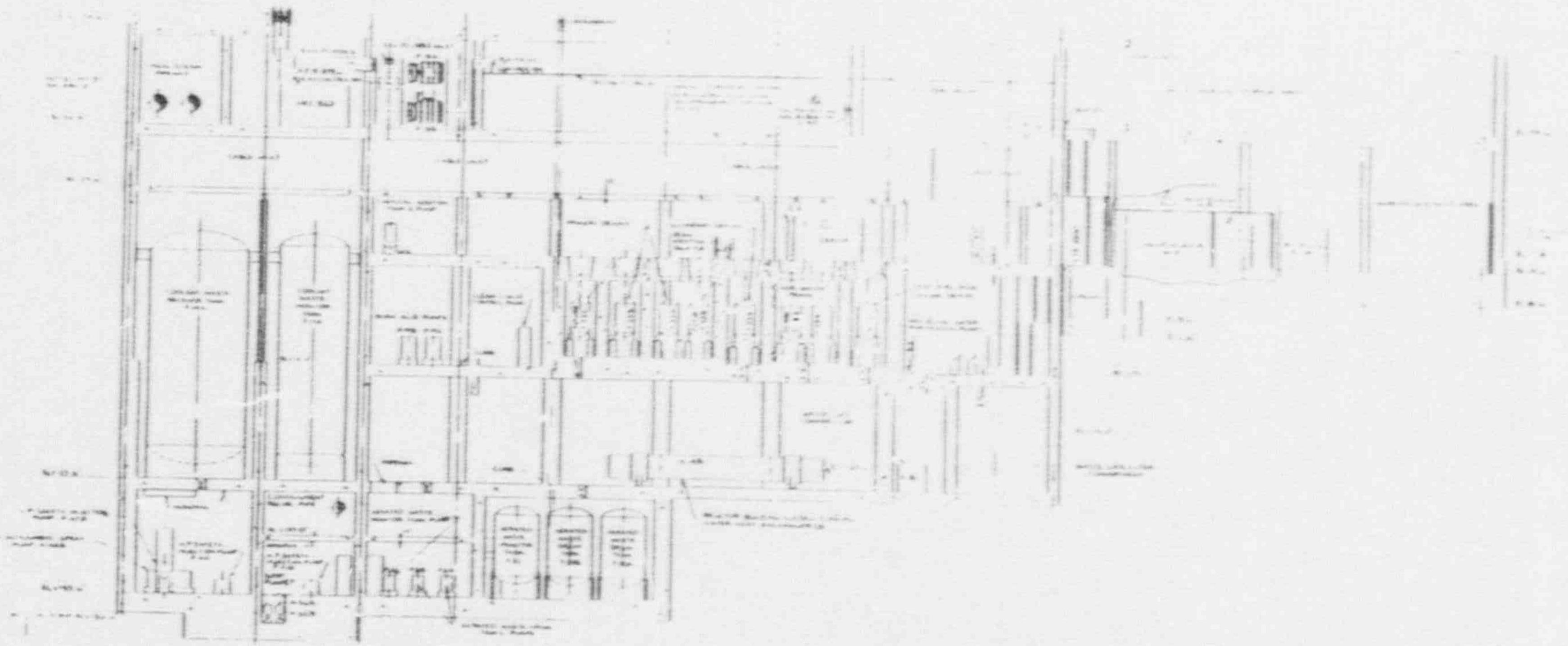

Figure 4-6 Elevation View of Millstone 2 Auxiliary Building (Radioactive Waste Areas)

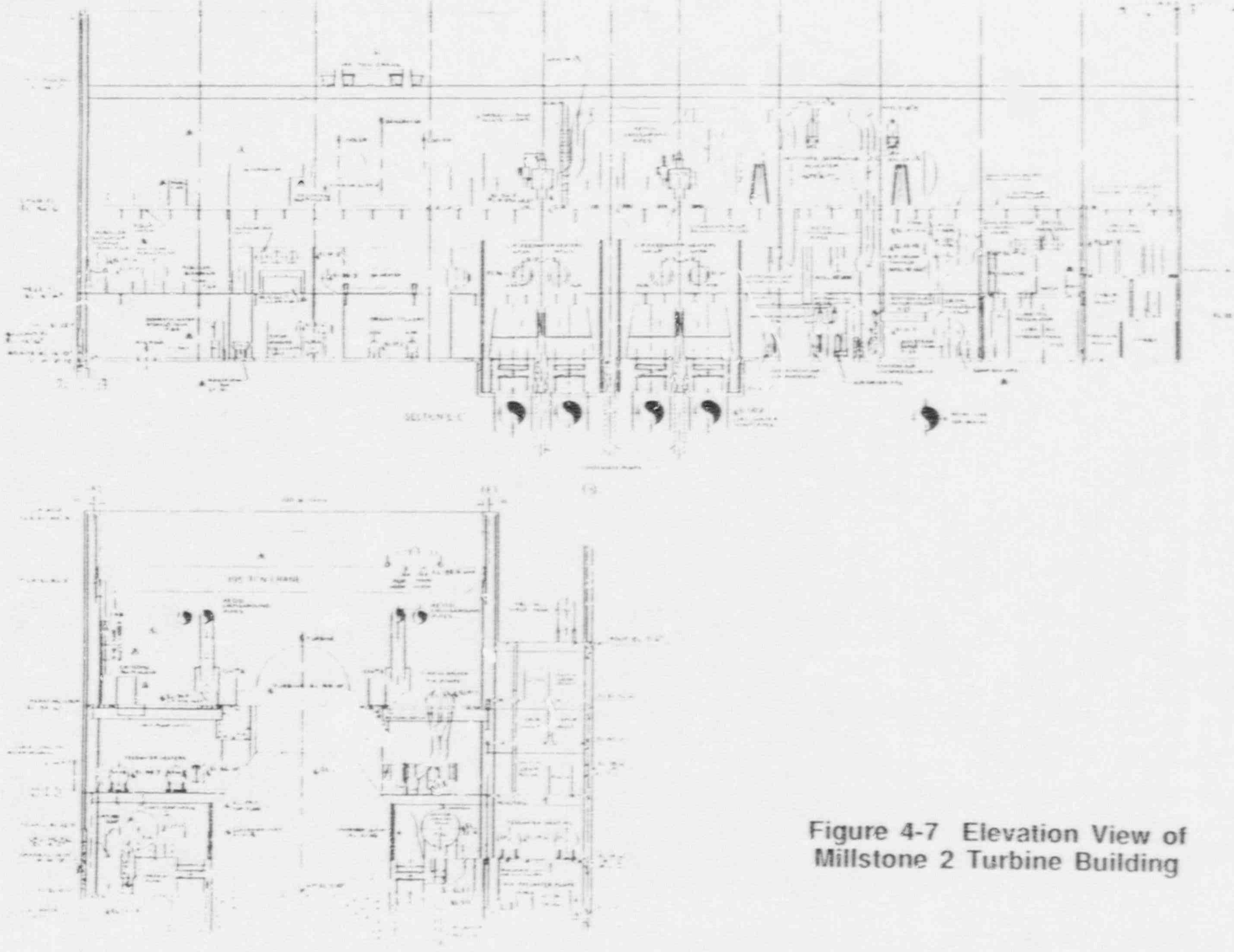

Figure 4-7 Elevation View of Millstone 2 Turbine Building

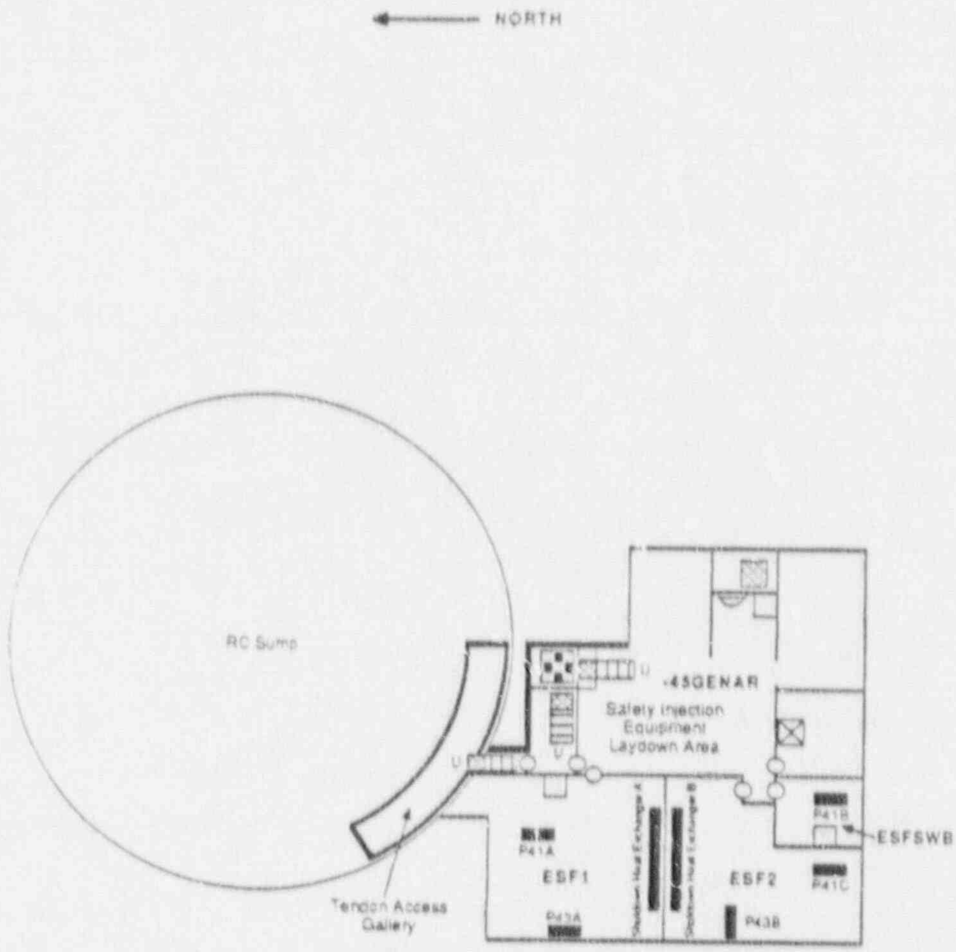

Figure 4-8 Millstone 2 Containment and Auxiliary Buildings, Elevation -45' 6"

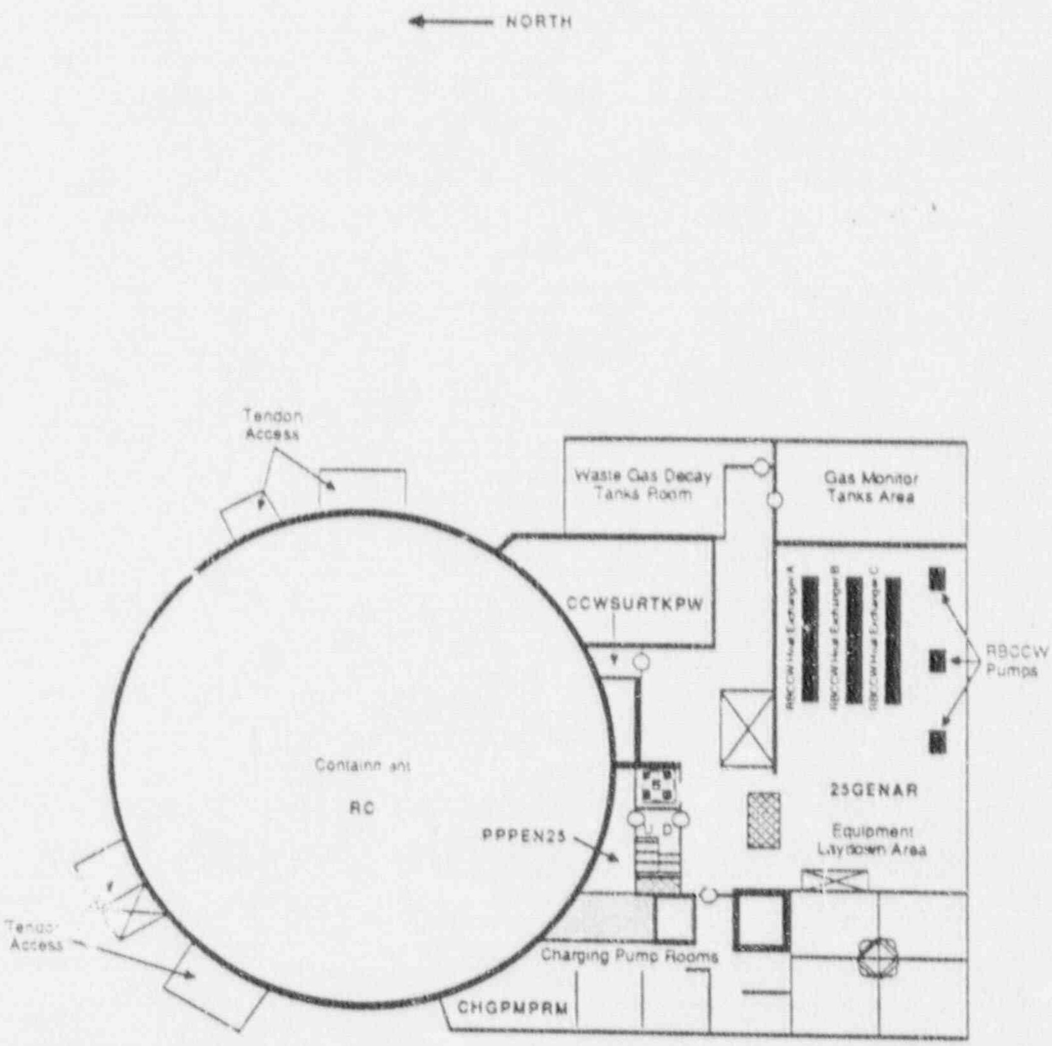

Figure 4-9 Millstone 2 Containment and Auxiliary Buildings, Elevation -25' 6"

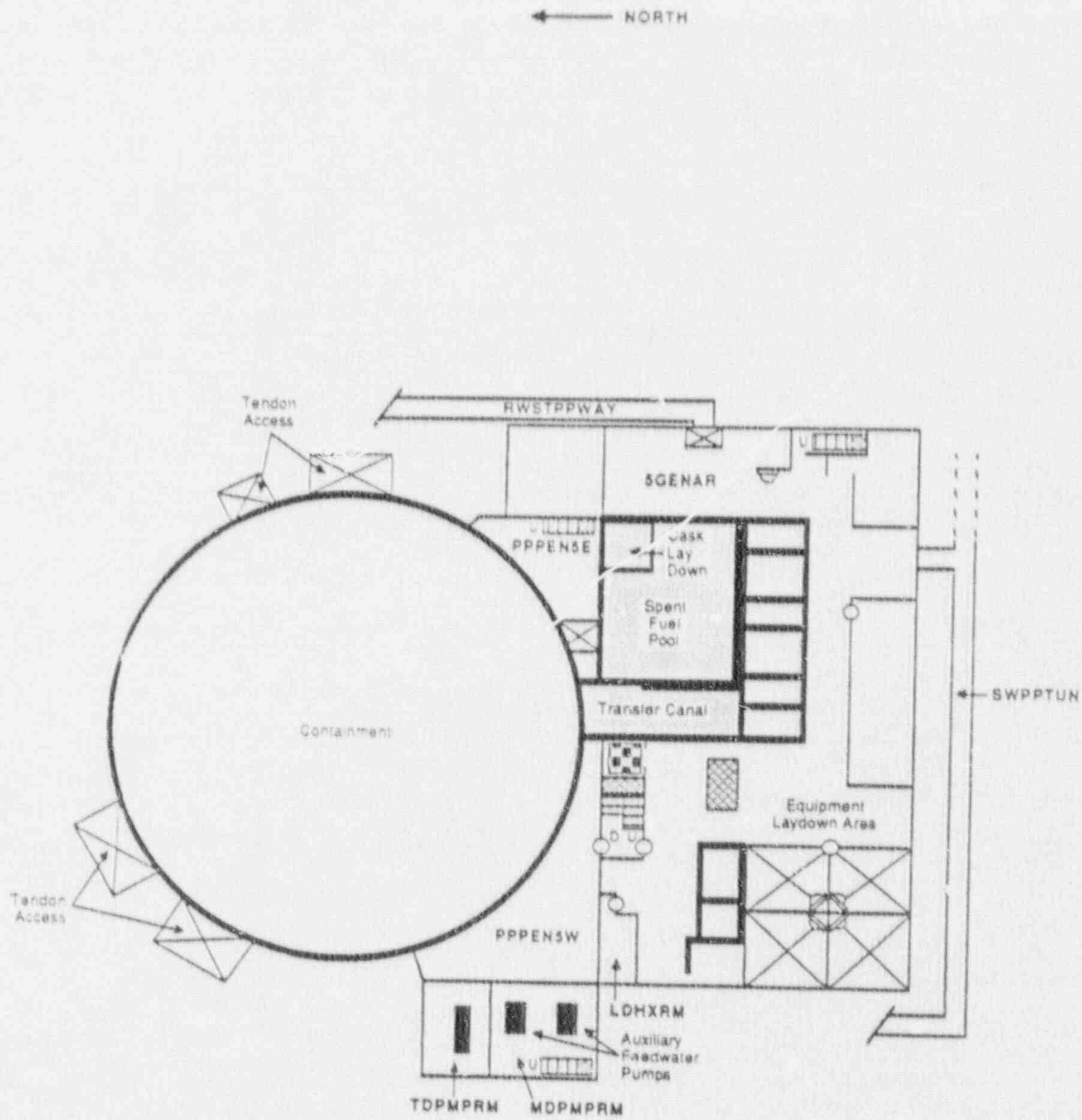

Figure 4-10 Millstone 2 Containment and Auxiliary Buildings, Elevation -5' 0", and Turbine Building, Elevation 1' 6"

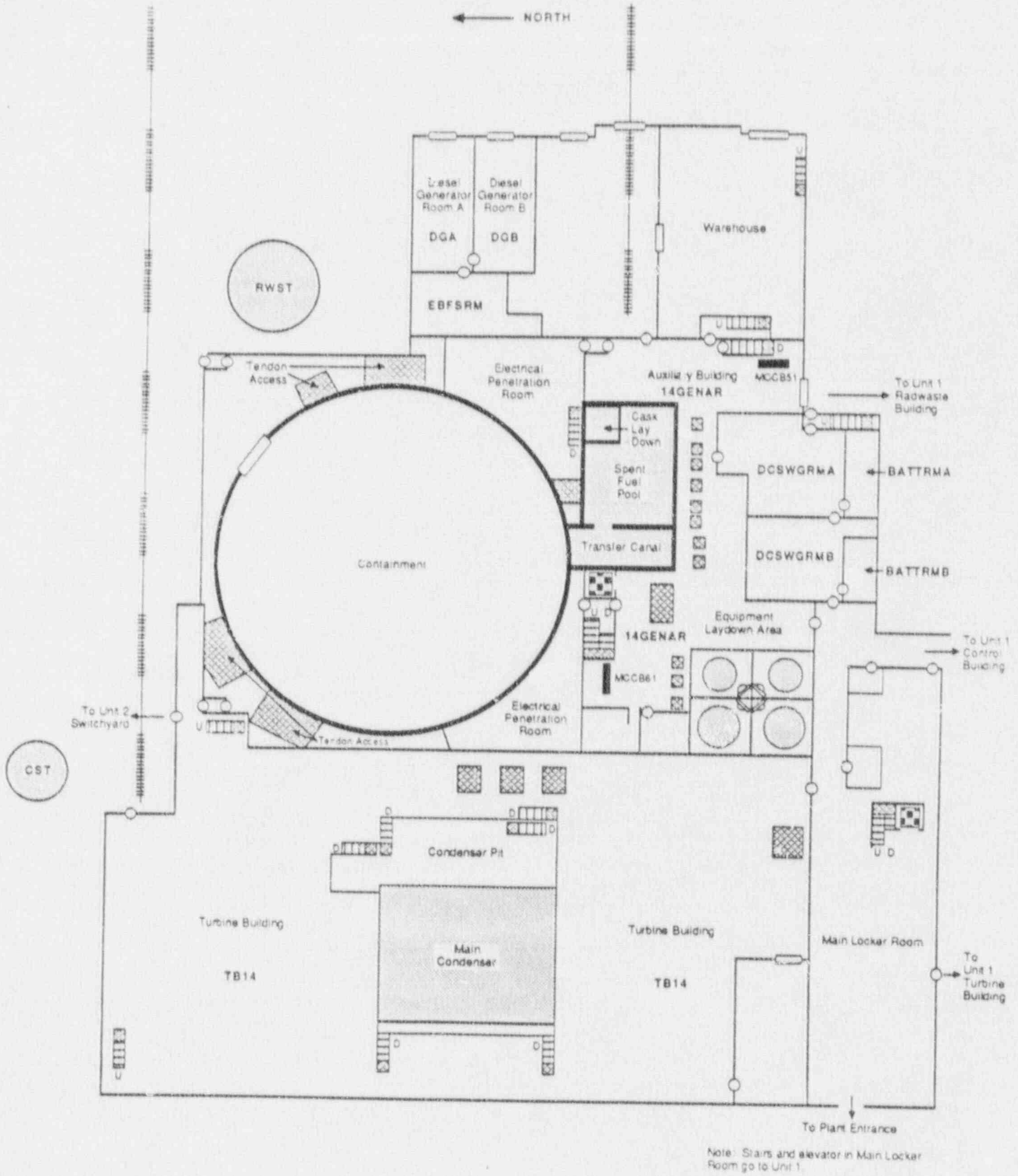

Figure 4-11 Millstone 2 Containment, Auxiliary, and Turbine Buildings
Elevation 14' 6"

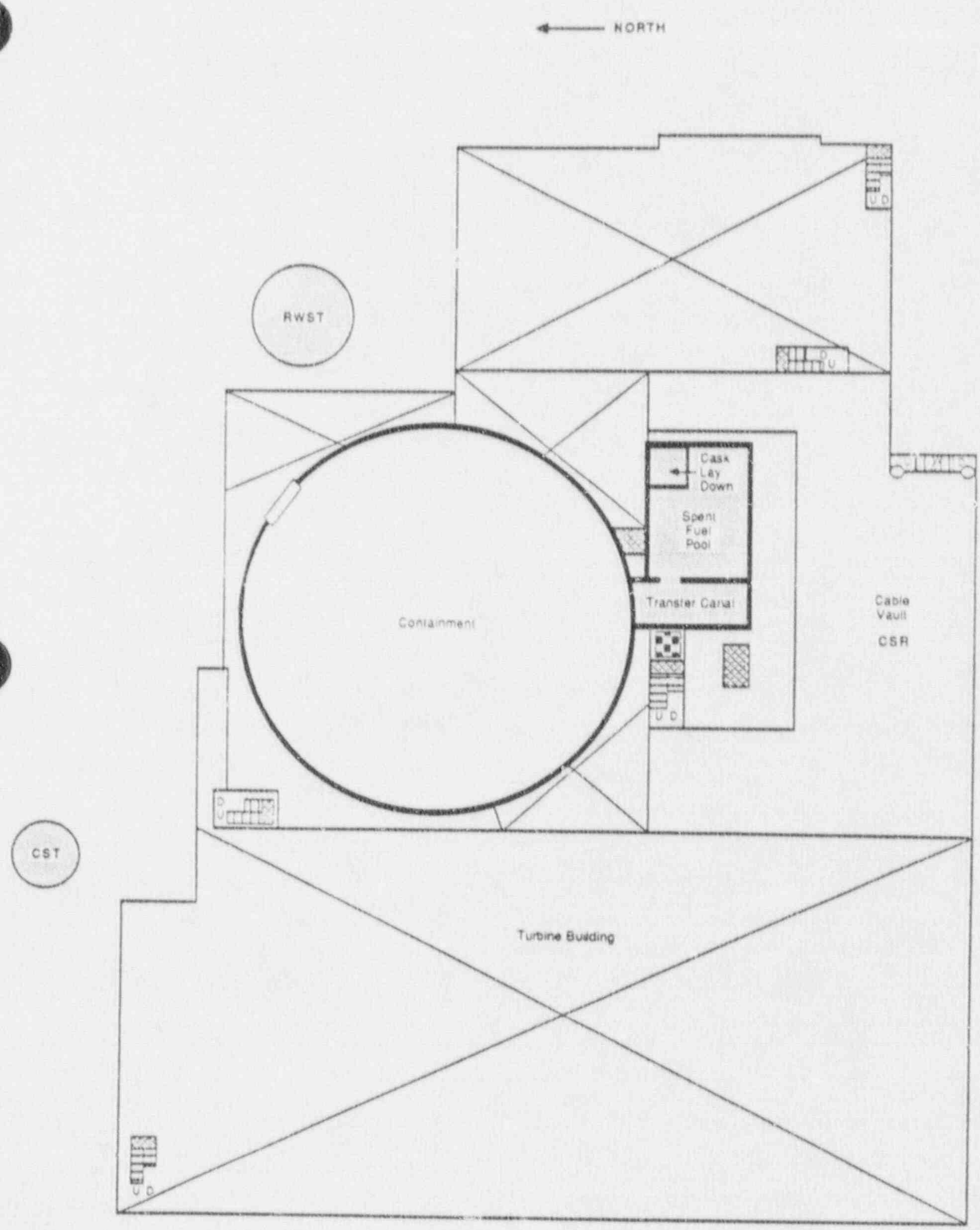

Figure 4-12 Millstone 2 Containment, Auxiliary, and Turbine Buildings
Elevation 25' 6"

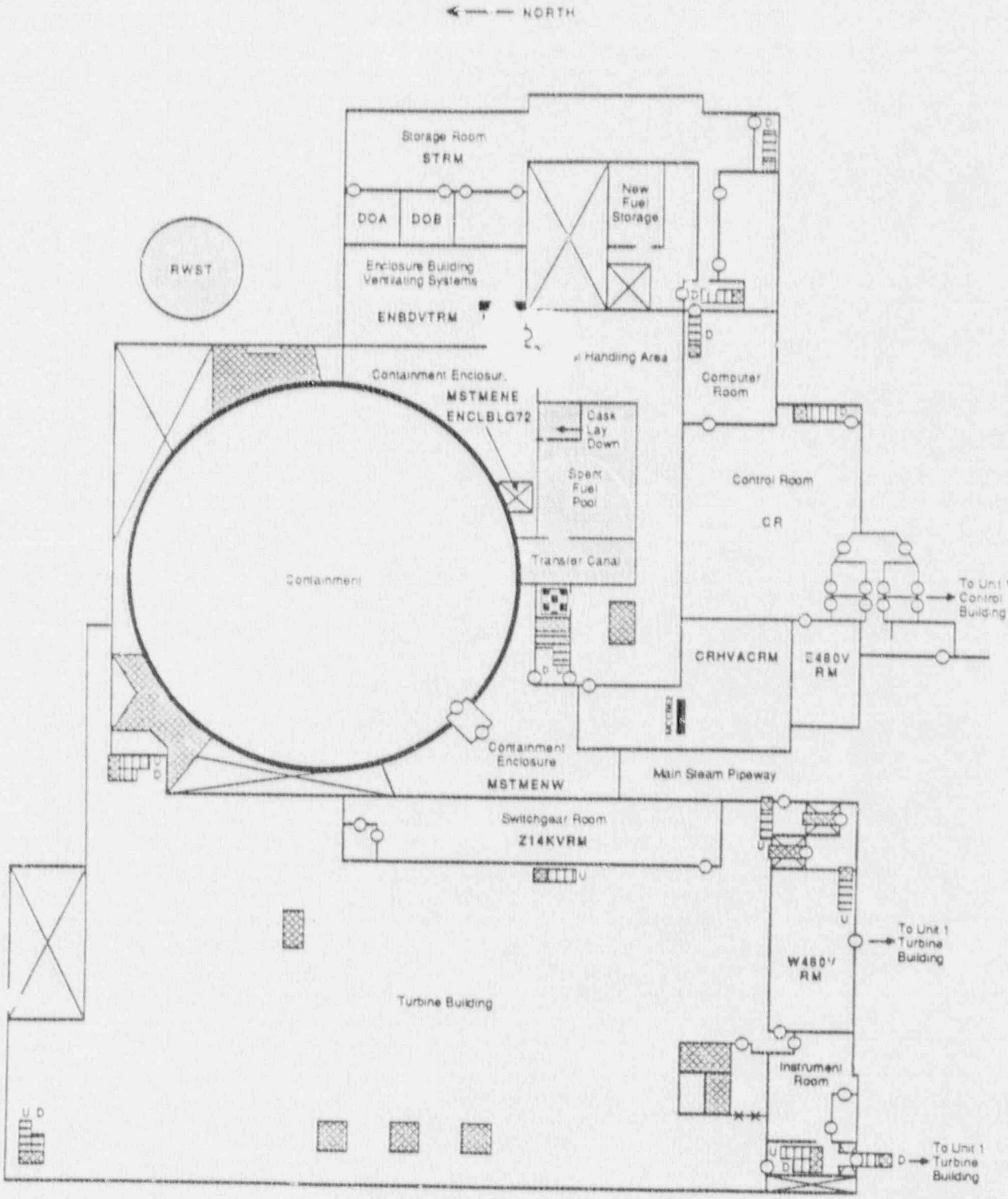

Figure 4-13 Millstone 2 Containment and Auxiliary Buildings, Elevation 38' 6", and Turbine Building, Elevation 31' 6"

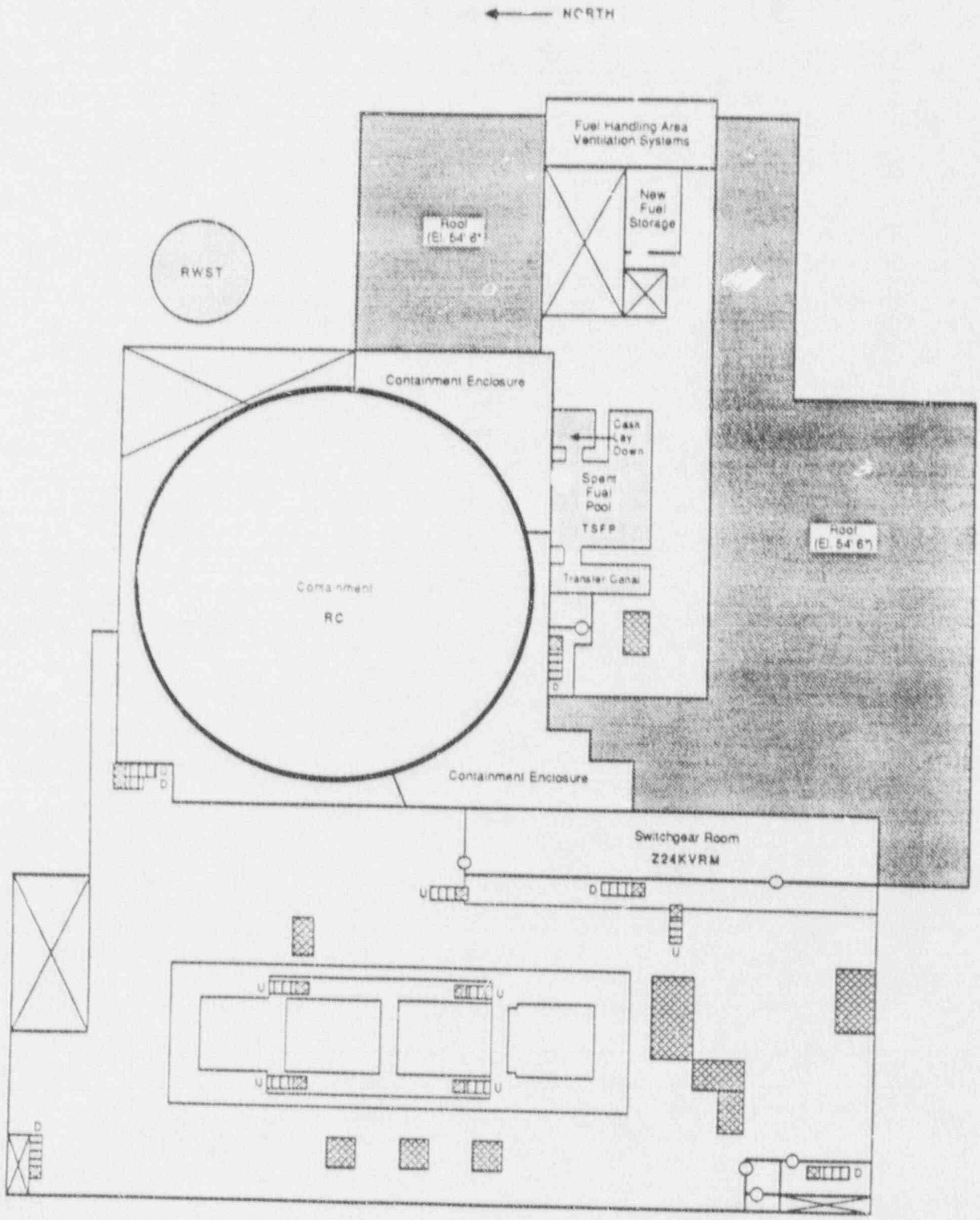

Figure 4-14 Millstone 2 Containment, Auxiliary, and Turbine Buildings, Elevation 54' 6"

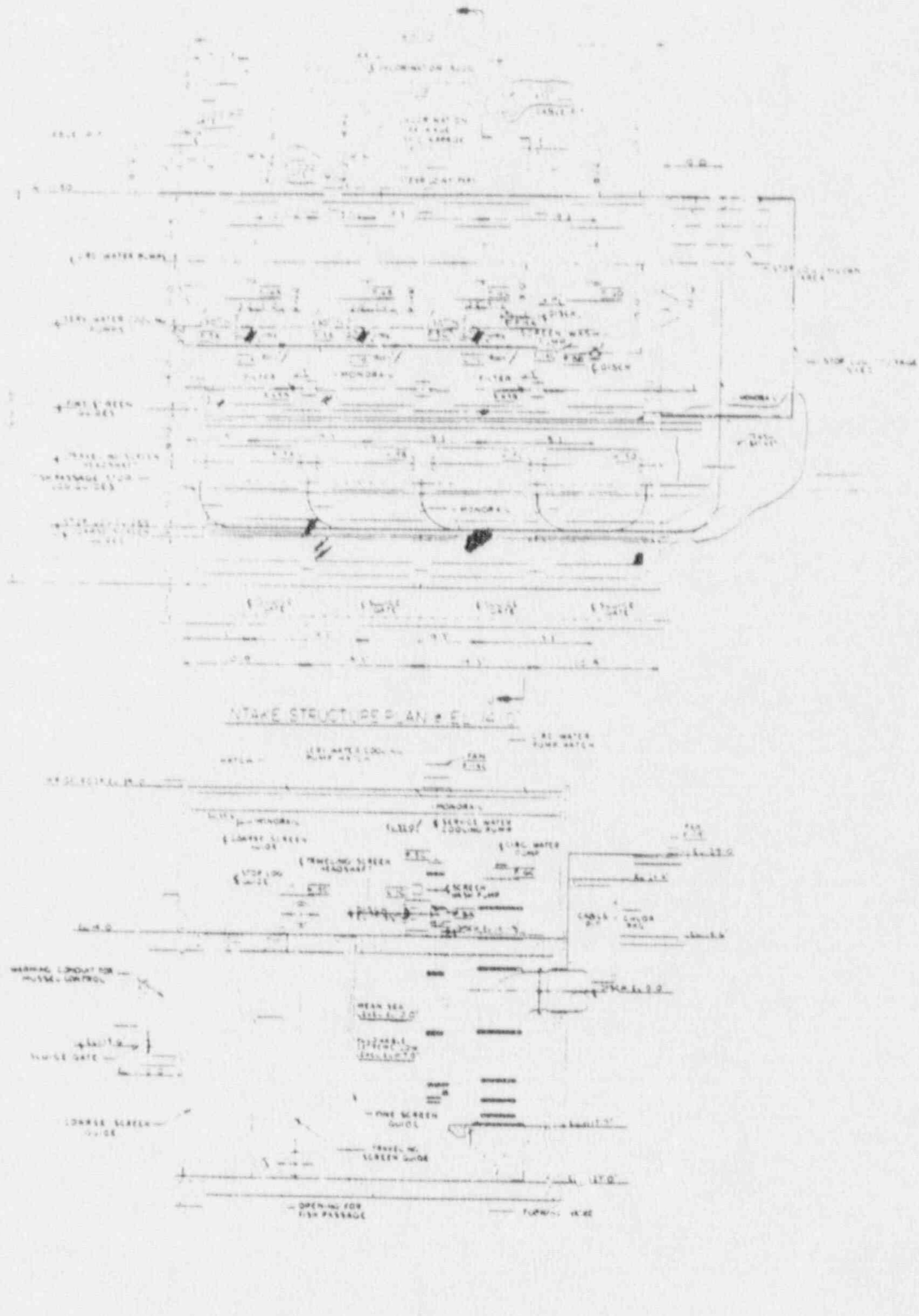

Figure 4-15 Plan and Elevation Views of Millstone 2 Intake Structure

Table 4-1. Definition of Millstone 2 Building and Location Codes

	Codes	Descriptions
1.	5GENAR	General Area, located on the -5' elevation of the Auxiliary Building
2.	14GENAR	General Area, located on the 15' elevation of the Auxiliary Building. Includes MCC B51, MCC B61
3.	25GENAR	General Area, located on the -25' elevation of the Auxiliary Building
4.	45GENAR	General Area, located on the -45' elevation of the Auxiliary Building
5.	BATTRMA	Battery Room A, located on the 14' elevation of the Auxiliary Building
6.	BATTRMB	Battery Room B, located on the elevation 14' of the Auxiliary Building
7.	CCWSURTKPW	Component Cooling Water Surge Tank Pipeway, located on the -5' to -25' elevations of the Auxiliary Building
8.	CHGPMPRM	Charging Pump Room, located on the -25 elevation of the Auxiliary Building
9.	CR	Control Building, located on the 36' elevation of the Auxiliary Building
10.	CRHVACRM	Control Room HVAC Room, located on the 38' elevation of the Auxiliary Building. Includes MCC B62
11.	CSR	Cable Spreading Room Cable Vault, located on the 25' elevation of the Auxiliary Building
12.	CST	Condensate Storage Tank
13.	CSTBKHS	CST Blockhouse - adjacent to CST
14.	DCSWGRMA	DC Switchgear Room A, located on the 14' elevation of the Auxiliary Building
15.	DCSWGRMB	DC Switchgear Room B, located on the 14' elevation of the Auxiliary Building
16.	DGA	Diesel Generator Room A, located on the 14' of the Auxiliary Building

Table 4-1. Definition of Millstone 2 Building and Location Codes (Continued)

Codes	Descriptions
17. DGB	Diesel Generator Room B, located on the 14' of the Auxiliary Building
18. DOA	Diesel Oil Day Tank A, located on the 38' elevation of the Auxiliary Building
19. DOB	Diesel Oil Day Tank B, located on the 38' elevation of the Auxiliary Building
20. EBFSRM	Enclsoure Building Filteration Room, located on the 14' elevation of the Auxiliary Building
21. ENBDVTRM	Enclosure Building Ventilation Room, located on the 38' elevation of the Auxiliary Building. Includes MCC B52
22. ENCLBLG72	Enclosure Building - 72' elevation
23. ESFSWB	Engineered Safety Features Room Swing B Pump, located on the -45' elevation of the Auxiliary Building
24. ESF1	Engineered Safety Features Room 1, located on the -45 elevation of the Auxiliary Building
25. ESF1	Engineered Safety Features Room 2, located on th -45 elevation of the Auxiliary Building
26. E480VRM	East 480V Switchgear Room , located on the 38' elevation of the Turbine Building. Includes Bus 22F
27. INTSTR	Intake Structure
28. LDHXRM	Letdown Heat Exchanger Room, located on the -5 elevation of the Auxiliary Building
29. MDPMPRM	Motor Driven Pump Room, located on the 1' elevation of the Turbine Building
30. MSTMENE	Main Steam Enclosure, located on the 38' elevation of the Auxiliary Building - east
31. MSTMENW	Main Steam Enclosure, located on the 38' elevation of the Auxiliary Building - west
32. PPPEN5E	Piping Penetration Area, located on the -5' elevation of the Auxiliary Building - east

Table 4-1. Definition of Millstone 2 Building and Location Codes (Continued)

Codes	Descriptions
33. PPPEN5W	Piping Penetration Area, located on the -5' elevation of the Auxiliary Building - west
34. PPPEN25	Piping Penetration Area, located on the -25' elevation of the Auxiliary Building
35. RC	Reactor Containment
36. RWST	Refueling Water Storage Tank
37. RWSTPPWAY	Refueling Water Storage Tank Pipeway, located on the -5' elevation of the Auxiliary Building
37. RWSTVENCL	RWST Valve Enclosure - adjacent to RWST
38. STRM	Miscellaneous Storage Room, located on the 38' elevation of the Auxiliary Building
39. SWPPTUN	Service Water Pipe Tunnel, located on the -5'elevation
40. TB14	14' elevation of the Turbine Building
41. TDPMPRM	Turbine Driven Pump Room, located on the 1' elevation of the Turbine Building
42. TSFP	Spent fuel pool operating floor, located on th 54' elevation of the Auxiliary Building
43. W480VRM	West 480V Switchgear Room, located on the 31' elevation of the Turbine Building. Includes Bus 22E and Hot Shutdown Panel
44. Z14KVRM	4KV Switchgear Room, located on the 31' elevation of the Turbine Building. Includes Bus Z1 and Bus Z5
45. Z24KVRM	4KV Switchgear Room, located on the 31' elevation of the Turbine Building. Includes Bus Z1 and Bus Z5

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
14GENAR	EP	MCC-B51	MCC
14GENAR	EP	MCC-B61	MCC
25GENAR	CCW	CCW-HX18A	HX
25GENAR	CCW	CCW-P11A	MDP
25GENAR	CCW	CCW-P11B	MDP
25GENAR	CCW	CCW-P11C	MDP
25GENAR	CCW	CCW-HX18B	HX
25GENAR	CCW	CCW-HX18C	HX
25GENAR	SW	CCW-HX18A	HX
25GENAR	SW	CCW-HX18B	HX
25GENAR	SW	CCW-HX18C	HX
BATTRMA	EP	BATT-A	BATT
BATTRMB	EP	BATT-B	BATT
CHGPMPRM	CVCS	CH-V429	MOV
CHGPMPRM	CVCS	CH-P18A	MDP
CHGPMPRM	CVCS	CH-P18C	MDP
CHGPMPRM	CVCS	CH-P18B	MDP
CRHVACRM	EP	MCC-B62	MCC
CST	AFW	CST	TK
DCSWGRMA	EP	BC-DC3	BC
DCSWGRMA	EP	BUS-201A	BUS
DCSWGRMA	EP	BC-DC1	BC
DCSWGRMA	EP	BUS-201A	BUS
DCSWGRMA	EP	BUS-201A	BUS
DCSWGRMA	EP	INV-1	INV
DCSWGRMA	EP	INV-3	INV
DCSWGRMA	EP	PNL-VA10	PNL
DCSWGRMA	EP	PNL-VA30	PNL
DCSWGRMA	EP	PNL-VR11	PNL
DCSWGRMB	EP	BUS-201B	BUS

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
DCSWGRMB	EP	BC-DC2	BC
DCSWGRMB	EP	BUS-201B	BUS
DCSWGRMB	EP	BUS-201B	BUS
DCSWGRMB	EP	INV-2	INV
DCSWGRMB	EP	INV-4	INV
DCSWGRMB	EP	PNL-VA20	PNL
DCSWGRMB	EP	PNL-VA40	PNL
DCSWGRMB	EP	PNL-VR21	PNL
DGA	EP	DG-A	DG
DGB	EP	DG-B	DG
E480VRM	EP	BUS 22F	BUS
ENBDVTRM	EP	MCC-B52	MCC
ESF1	CS	CS-23A	HX
ESF1	CS	SI-V009	MOV
ESF1	CS	CS-P42A	MDP
ESF1	CS	SI-V008	MOV
ESF1	ECCS	SI-V009	MOV
ESF1	ECCS	SI-V411	MOV
ESF1	ECCS	SI-PM-A	MDP
ESF1	ECCS	SI-V411	MOV
ESF1	ECCS	SI-V656	MOV
ESF1	ECCS	SI-V008	MOV
ESF2	CS	CS-23B	HX
ESF2	CS	CS-P42B	MDP
ESF2	ECCS	SI-V412	MOV
ESF2	ECCS	SI-PM-C	MDP
ESF2	ECCS	SI-V412	MOV
ESF2	ECCS	SI-V654	MOV
ESFSWB	ECCS	SI-PM-B	MDP
INTSTR	SW	SW-P5B	MDP

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
INTSTR	SW	SW-P5C	MDP
INTSTR	SW	SW-P5A	MD
MDPMPRM	AFW	AFW-MDA	MDP
MDPMPRM	AFW	AFW-MDB	MDP
MSTMENE	AFW	AFW-V	MOV
MSTMENW	AFW	AFW-V202	MOV
PPPEN5E	CS	CS-V41B	MOV
PPPEN5W	CS	CS-V41A	MOV
PPPEN5W	ECCS	617	MOV
PPPEN5W	ECCS	616	MOV
PPPEN5W	ECCS	627	MOV
PPPEN5W	ECCS	637	MOV
PPPEN5W	ECCS	647	MOV
PPPEN5W	ECCS	626	MOV
PPPEN5W	ECCS	636	MOV
PPPEN5W	ECCS	646	MOV
RC	AFW	SG-2	HX
RC	AFW	SG-1	HX
RC	AFW	SG-1	HX
RC	AFW	SG-2	HX
RC	AFW	SG-1	HX
RC	AFW	SG-2	HX
RC	CCW	COOLERS	HX
RC	ECCS	RCS-VESSEL	VES
RC	RCS	RCS-VESSEL	RV
RC	RCS	S404	PORV
RC	RCS	S402	PORV
RC	RCS	V405	MOV
RC	RCS	V405	MOV
RC	RCS	515	NV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RC	RCS	516	NV
RWST	CVCS	RWST	TK
RWST	ECCS	RWST	TK
RWSTVENCL	CVCS	SI-V011	MOV
RWSTVENCL	ECCS	SI-V011	MOV
RWSTVENCL	ECCS	SI-V010	MOV
TB14	AFW	AFW-V44	MOV
TDPMPRM	AFW	AFW-TDP	TDP
TDPMPRM	AFW	AFW-V4188	MOV
TDPMPRM	AFW	AFW-TDP	TDP
VCTRM	CVCS	CH-V504	MOV
W480VRM	EP	BUS 22E	BUS
Z14KVRM	EP	BUS B1	BUS
Z14KVRM	EP	CB-C1	CB
Z14KVRM	EP	BUS B5	BUS
Z14KVRM	EP	CB-C5-DA	CB
Z14KVRM	EP	TR-UB5	TRAN
Z14KVRM	EP	BUS B5	BUS
Z24KVRM	EP	BUS B2	BUS
Z24KVRM	EP	CB-C2	CB
Z24KVRM	EP	CB-C5-DB	CB
Z24KVRM	EP	TR-UB6	TRAN

5. BIBLIOGRAPHY FOR MILLSTONE 2

1. NUREG-0635, "Generic Evaluation of Feedwater Transients and Small Break Loss of Coolant Accidents in Combustion Engineering Designed Operating Plants," Section X.5, "Millstone 2 Auxiliary Feedwater System," USNRC, January 1980.

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 vie / the reactor site is obtained from ORNL-NSIC-55 (Ref. 1). The site drawings are approximately to scale, but should not be used to estimate distances on the site. As-built scale drawings should be consulted for this purpose.

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

A2.2 Layout Drawings

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

Symbols used in the simplified layout drawings are defined in Figure A-3. Major rooms, stairways, elevators, and doorways are shown in the simplified layout drawings however, many interior walls have been omitted for clarity. The building layout drawings,

are approximately to scale, should not be used to estimate room size or distances. As-built scale drawings for should be consulted his purpose.

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

A3. APPENDIX A REFERENCES

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

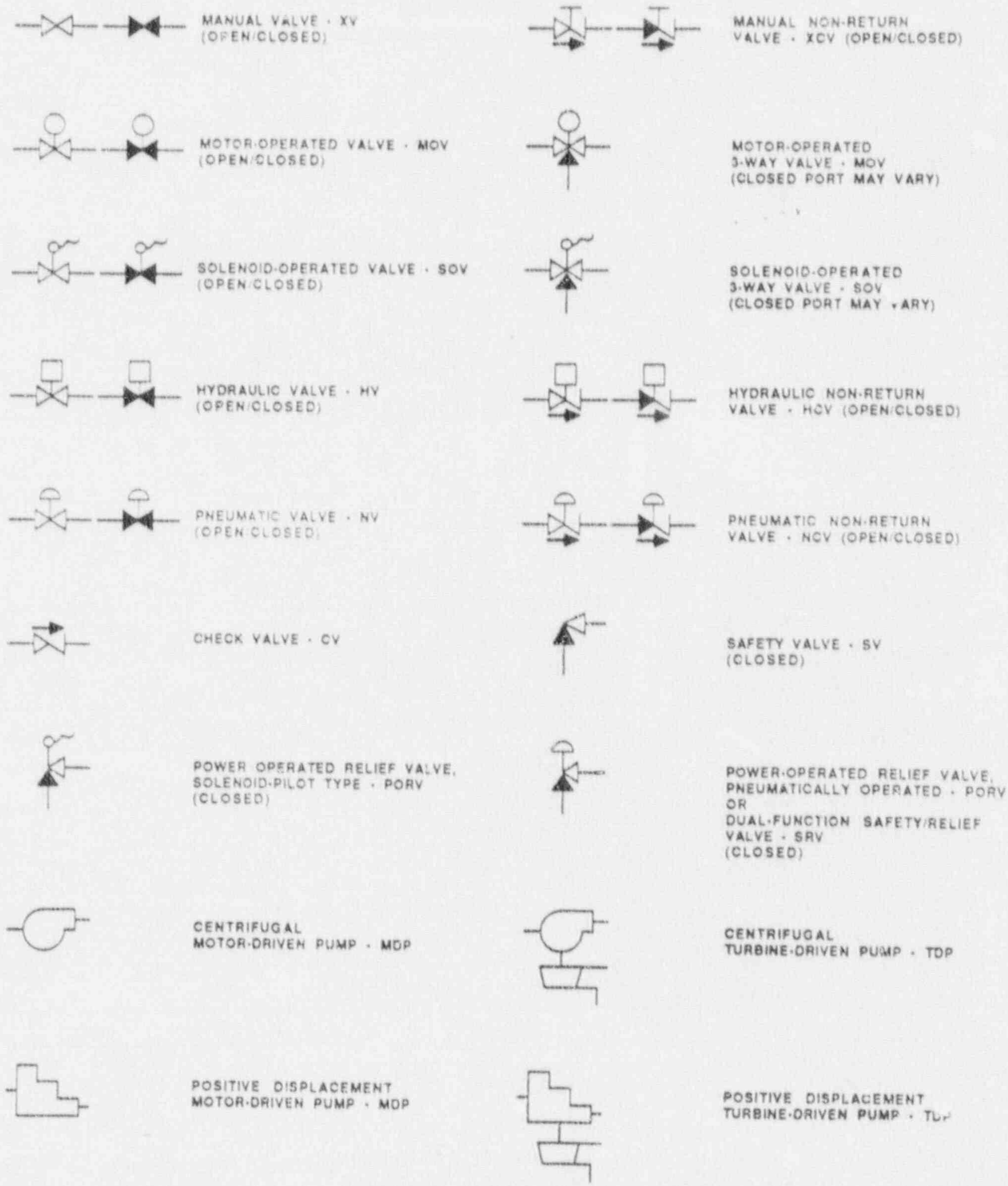

Figure A-1. Key To Symbols In Fluid System Drawings

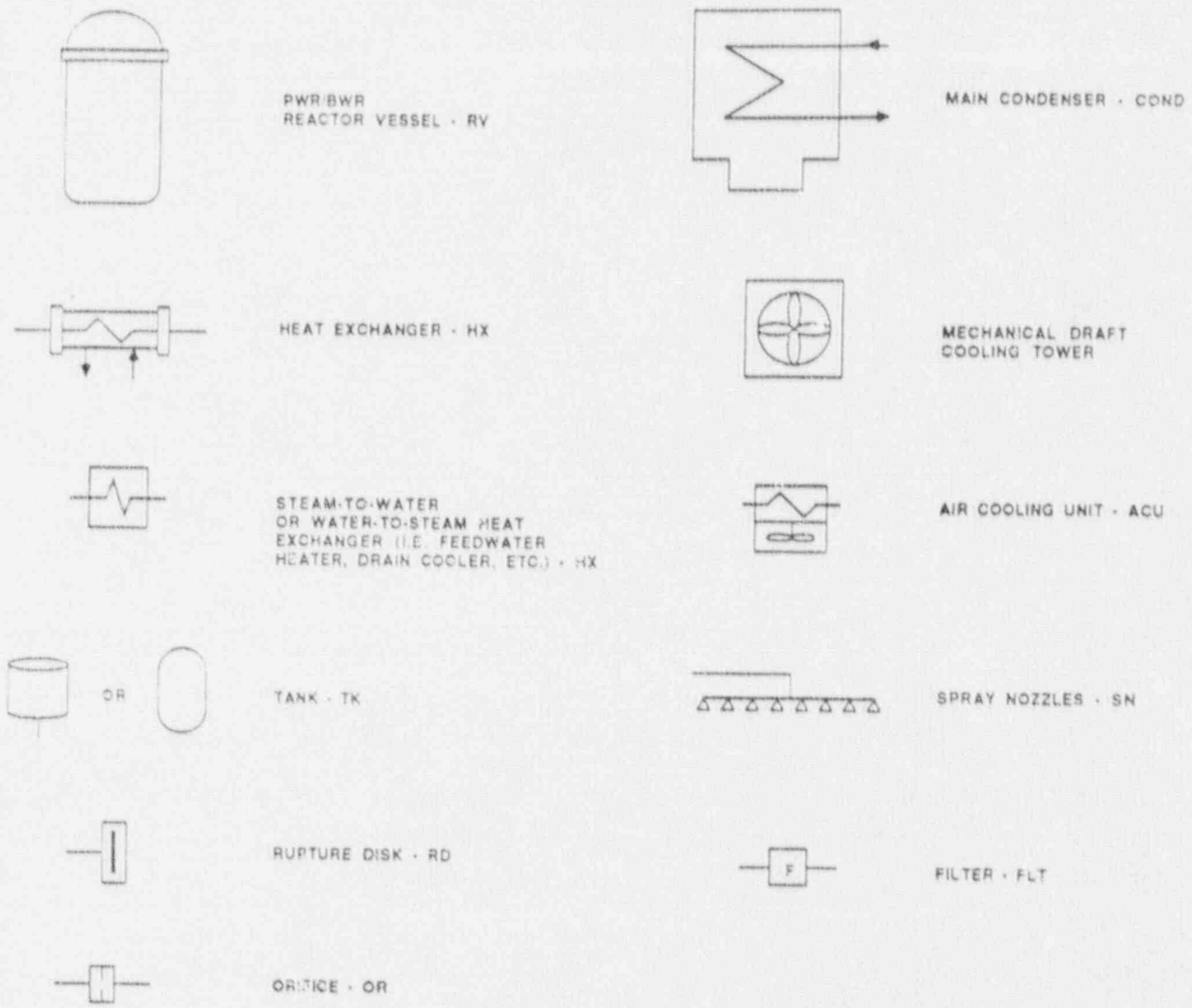

Figure A-1. Key To Symbols In Fluid System Drawings (Continued)

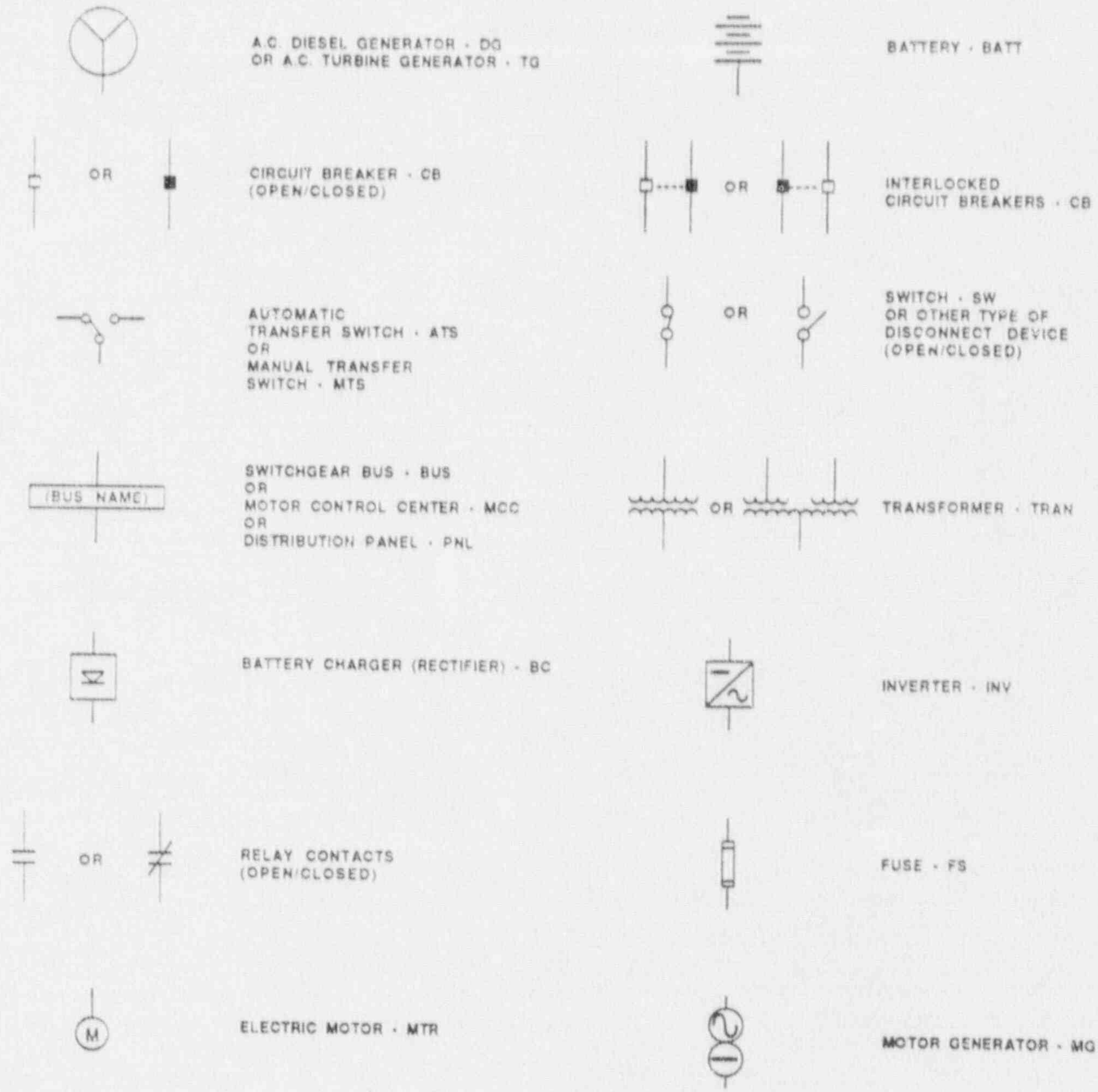

Figure A-2. Key To Symbols In Electrical System Drawings

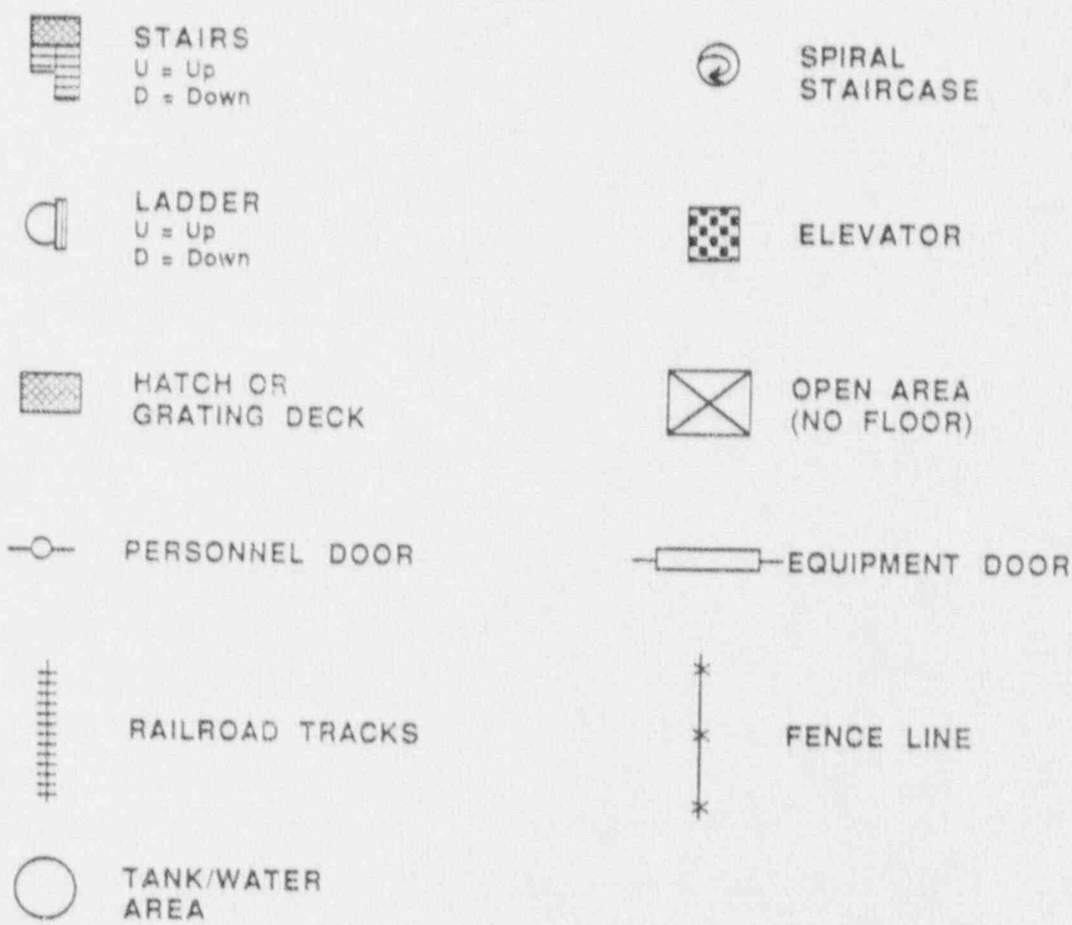

Figure A-3. Key To Symbols In Facility Layout Drawings

APPENDIX B
DEFINITION OF TERMS USED IN THE DATA TABLES

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

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

Code	Definition
RCS	Reactor Coolant System
AFW	Auxiliary Feedwater System
ECCS	Emergency Core Cooling System (including HPSI and LPSI)
CS	Containment Spray
CVCS	Charging System
EP	Electric Power System
CCW	Reactor Building Closed Cooling Water System
SW	Service Water System

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

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

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

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

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

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

TABLE B-1. COMPONENT TYPE CODES

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