UNITED STATES NUCLEAR REGULATORY COMMISSION

NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

COOPER

50-298

SAIC

SAIC 88/1994

NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

COOPER

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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.

COOPER
RECORD OF REVISIONS

REVISION	ISSUE	COMMENTS
0	12/88	Original report

COOPER SYSTEM SOURCEBOOK

This sourcebook contains summary information on Cooper. 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 Cooper Nuclear Station is listed below:

- Docket number	50-298
- Operator	Nebraska Public Power District
- Location	Nebraska, 2-1/2 miles South of Brownville
- Commercial operation date	1974
- Reactor type	BWR/4
- NSSS vendor	General Electric
- Power (MWt/MWe)	2381/801
- Architect-engineer	Burns and Roe
- Containment type	Steel drywell and wetwell (Mark I)

2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

The Cooper Nuclear Station contains a General Electric BWR/4 nuclear steam supply system with a Mark I BWR containment incorporating the drywell/pressure suppression concept. The plant has a secondary containment structure of reinforced concrete. Other BWR/4 plants in the United States are as follows:

- Browns Ferry 1, 2 and 3
- Vermont Yankee
- Peach Bottom 2 and 3
- Hatch 1 and 2
- Duane Arnold
- Fitzpatrick
- Brunswick 1 and 2
- Fermi 2
- Hope Creek 1
- Limerick 1 and 2 (Mark II Containment)
- Shoreham (Mark II Containment)
- Susquehanna 1 & 2 (Mark II Containment)

3. SYSTEM INFORMATION

This section contains descriptions of selected systems at Cooper in terms of general function, operation, system success criteria, major components, and support system requirements. A summary of major systems at Cooper 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 Cooper 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	IV-2 to IV-6, IV-10
- Reactor Core Isolation Cooling (RCIC) System	Same	3.2	IV-7
- Emergency Core Cooling Systems (ECCS)	Core Standby Cooling Systems		
- High-Pressure Injection & Recirculation	High-Pressure Coolant Injection (HPCI) System	3.3	VI-4.1, VI-5
- Low-pressure Injection & Recirculation	Core Spray (CS) System,	3.3	VI-4.3, VI-5
	Low-Pressure Coolant Injection (LPCI) System (an operating mode of the RHR system)	3.3	IV-8.5.4, VI-4.4, VI-5
- Automatic Depressurization System (ADS)	Same	3.3	VI-4.2, VI-5
- Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System)	Residual Heat Removal (RHR) System (a multi-mode system)	3.3	IV-8
- Main Steam and Power Conversion Systems	Main Steam System,	X	IV-11, XI-5
	Condensate System,	X	XI-7 to XI-9
	Feedwater System,	X	IV-11, XI-8
	Circulating Water System	X	XI-6
- Other Heat Removal Systems	Steam-condensing RHR/RCIC operation	3.2	IV-[illegible].5.5

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

Generic System Name	Plant-Specific System Name	Report Section	USAR Section Reference
Reactor Coolant Inventory Control Systems			
- Reactor Water Cleanup (RWCU) System	Same	X	IV-9
- ECCS	See Core Standby Cooling Systems above	-	-
- Control Rod Drive Hydraulic System (CRDHS)	Same	3.6	III-5.5.2
Containment Systems			
- Primary Containment	Same (drywell and pressure suppression chamber)	X	V-2
- Secondary Containment	Same	X	V-3
- Standby Gas Treatment System (SGTS)	Same	X	V-3.3.4
- Containment Heat Removal Systems			
- Suppression Pool Cooling System	Same (an operating mode of the RHR system)	3.3	IV-8.5.3.2
- Containment Spray System	Same (an operating mode of the RHR system)	3.3	IV-8.5.3.1
- Containment Fan Cooler System	Primary Containment (Drywell) Cooling System (fan coolers)	X	V-2.3.7
- Containment Normal Ventilation Systems	Primary Containment (Drywell) Cooling System (fan coolers)	X	V-2.3.7
- Combustible Gas Control Systems	Nitrogen Inerting System,	X	V-2.3.8.2
	Atmospheric Containment Atmosphere Dilution (ACAD) System,	X	V-2.3.8.3
	Purge to atmosphere or to SGTS	X	V-2.3.8.4

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

Generic System Name	Plant-Specific System Name	Report Section	USAR Section Reference
Reactor and Reactivity Control Systems			
- Reactor Core	Same	X	III
- Control Rod System	Control Rod Drive Mechanisms	X	III
- Chemical Poison System	Standby Liquid Control System (SLCS)	X	III-9
Instrumentation & Control (I&C) Systems			
- Reactor Protection System (RPS)	Same	3.4	VII-2
- Engineered Safety Feature Actuation System (ESFAS)	Primary Containment and Reactor Vessel Isolation Control System, Core Standby Cooling System Control and Instrumentation, Standby Gas Treatment System Actuation	X 3.3 X	VII-3 VII-4 VII-17
- Remote Shutdown System	Local control panels	3.4	VII
- Other I&C Systems	Various other systems	X	VII-5 to VII-16
Support Systems			
- Class 1E Electric Power System	Same	3.5	VIII
- Non-Class 1E Electric Power System	Same	X	VIII
- Diesel Generator Auxiliary Systems	Same	3.5	VIII
- Component Cooling Water (CCW) System	Reactor Building Closed Cooling Water (RBCCW) System	3.7	X-6

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

Generic System Name	Plant-Specific System Name	Report Section	USAR Section Reference
Support Systems (continued)			
- Service Water System (SWS)	Service Water and RHR Service Water Booster System	3.8	X-8
- Residual Heat Removal Service Water (RHRSW) System	Service Water and RHR Service Water Booster System	3.8	X-8
- Other Cooling Water Systems	Turbine Building Closed Cooling Water (TBCCW) System	X	X-7
- Fire Protection Systems	Same	X	X-9
- Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems	Same	X	X-10
- Instrument and Service Air Systems	Same	X	X-12
- Refueling and Fuel Storage Systems	Same	X	X-2 to X-5
- Radioactive Waste Systems	Same	X	IX
- Radiation Protection Systems	Same	X	XII

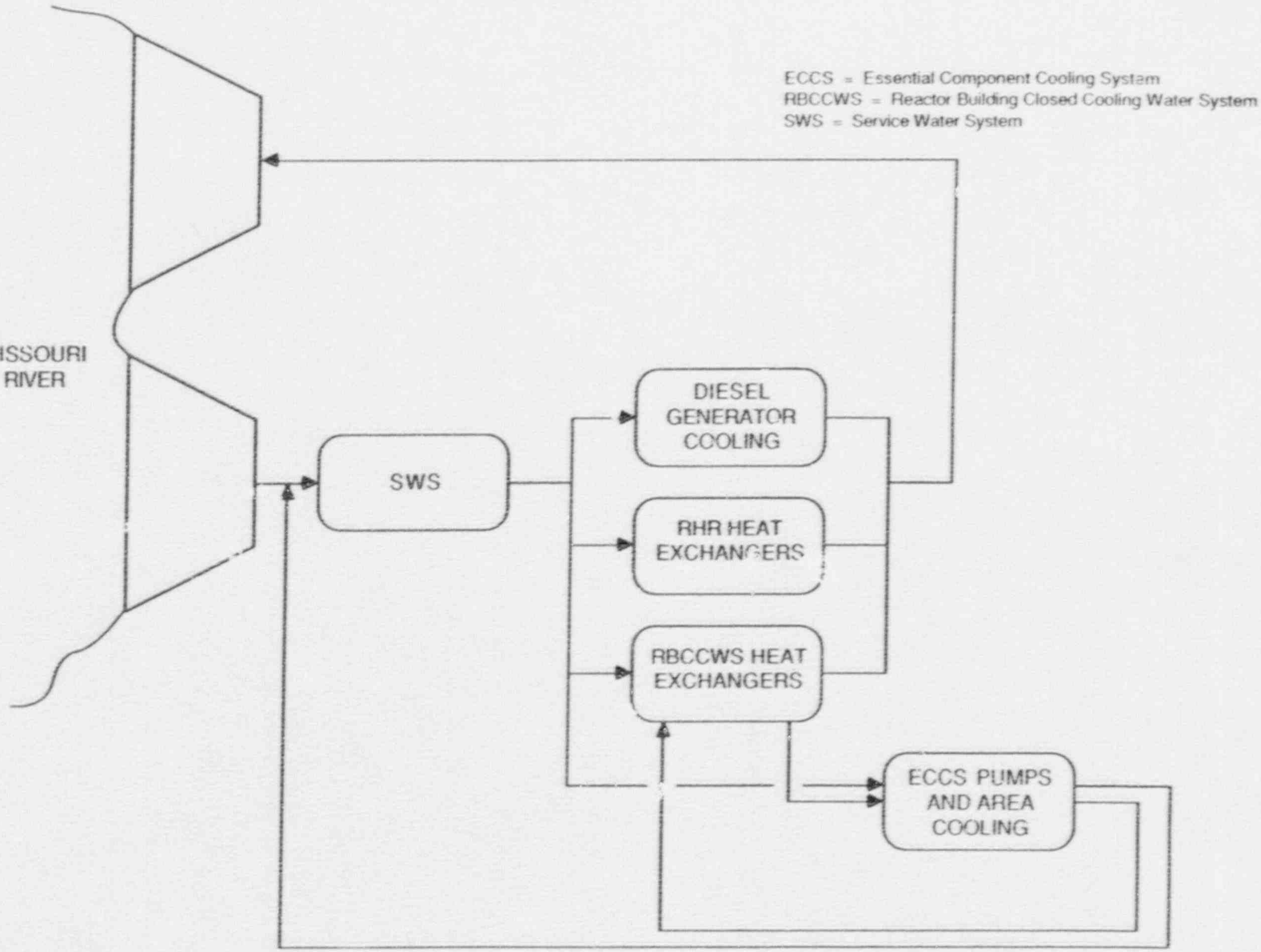


Figure 3-1. Cooling Water Systems Functional Diagram for Cooper

3.1 REACTOR COOLANT SYSTEM (RCS)

3.1.1 System Function

The RCS, also called the Nuclear Steam Supply System (NSSS), is responsible for directing the steam produced in the reactor to the turbine where it is used to rotate a generator and produce electricity. The RCS pressure boundary also establishes a boundary against the uncontrolled release of radioactive material from the reactor core and primary coolant.

3.1.2 System Definition

The RCS includes: (a) the reactor vessel, (b) two recirculation loops, (c) recirculation pumps, (d) 3 safety valves, (e) 8 safety/relief valves and (f) connected piping out to a suitable isolation valve boundary. A simplified diagram of the RCS and important system interfaces is shown in Figures 3.1-1 and 3.1-2. A summary of data on selected RCS components is presented in Table 3.1-1.

3.1.3 System Operation

During power operation, circulation in the RCS is maintained by one recirculation pump in each of the two recirculation loops and the associated jet pumps internal to the reactor vessel. The steam water mixture flows upward in the core to the steam dryers and separators where the entrained liquid is removed. The steam is piped through the main steam lines to the turbine. The separated liquid returns to the core, mixed with the feedwater and is recycled again.

About 1/3 of the liquid in the downcomer region of the reactor vessel is drawn off by the recirculation pumps. The discharge of these pumps is returned to the inlet nozzles of the jet pumps at high velocity. As the liquid enters the jet pumps the slow moving liquid in the upper region of the downcomer is induced to flow through the jet pumps, producing reactor coolant circulation.

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

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

3.1.4 System Success Criteria

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

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

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

3.1.5 Component Information

A. RCS
1. Total volume: 14,302 ft^3
2. Water volume: 8,199 ft^3 (including recirculation loops).
3. Steam volume: 6,103 ft^3
4. Steam flow: 9.56 x 10^6 lb/hr.
5. Normal operating pressure: 1020 psia

B. Safety/Relief Valves (8)
1. Set pressure: 1080 to 1100 psig
2. Relief capacity: 870,000 lb/hr each

C. Safety valves (3)
1. Set Pressure: 1240 psig
2. Capacity: 642,000 lb/hr each

D. Recirculation Pumps (2)
1. Rated flow: 45,200 gpm @ 500 ft. head (217 psid)
2. Type: Vertical centrifugal

E. Jet Pumps (20)
1. Total flow: 73.4 x 10^6 lb/hr @ 76.4 ft. head

3.1.6 Support Systems and Interfaces

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

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

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

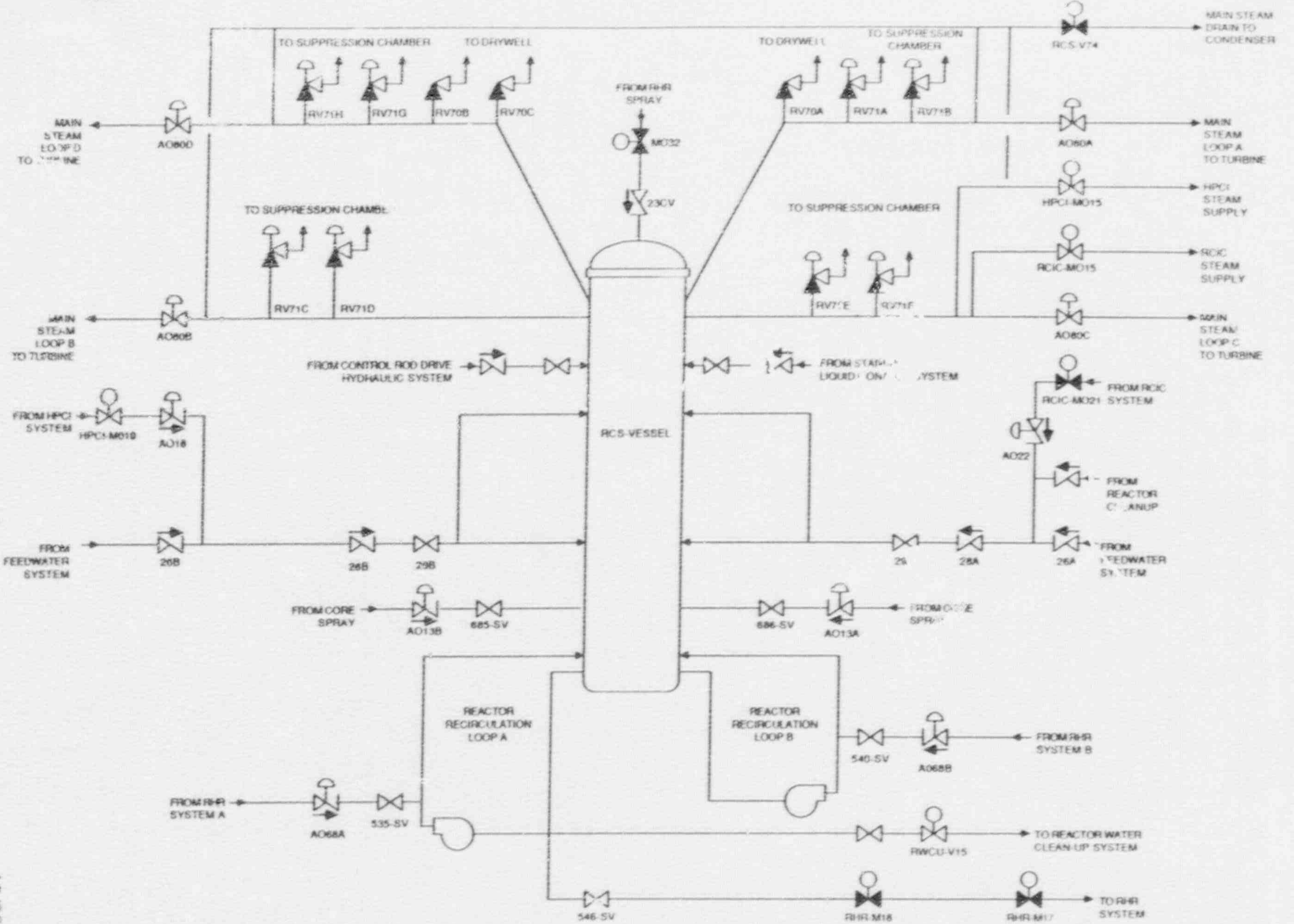


Figure 3.1-1. Cooper Nuclear Boiler System

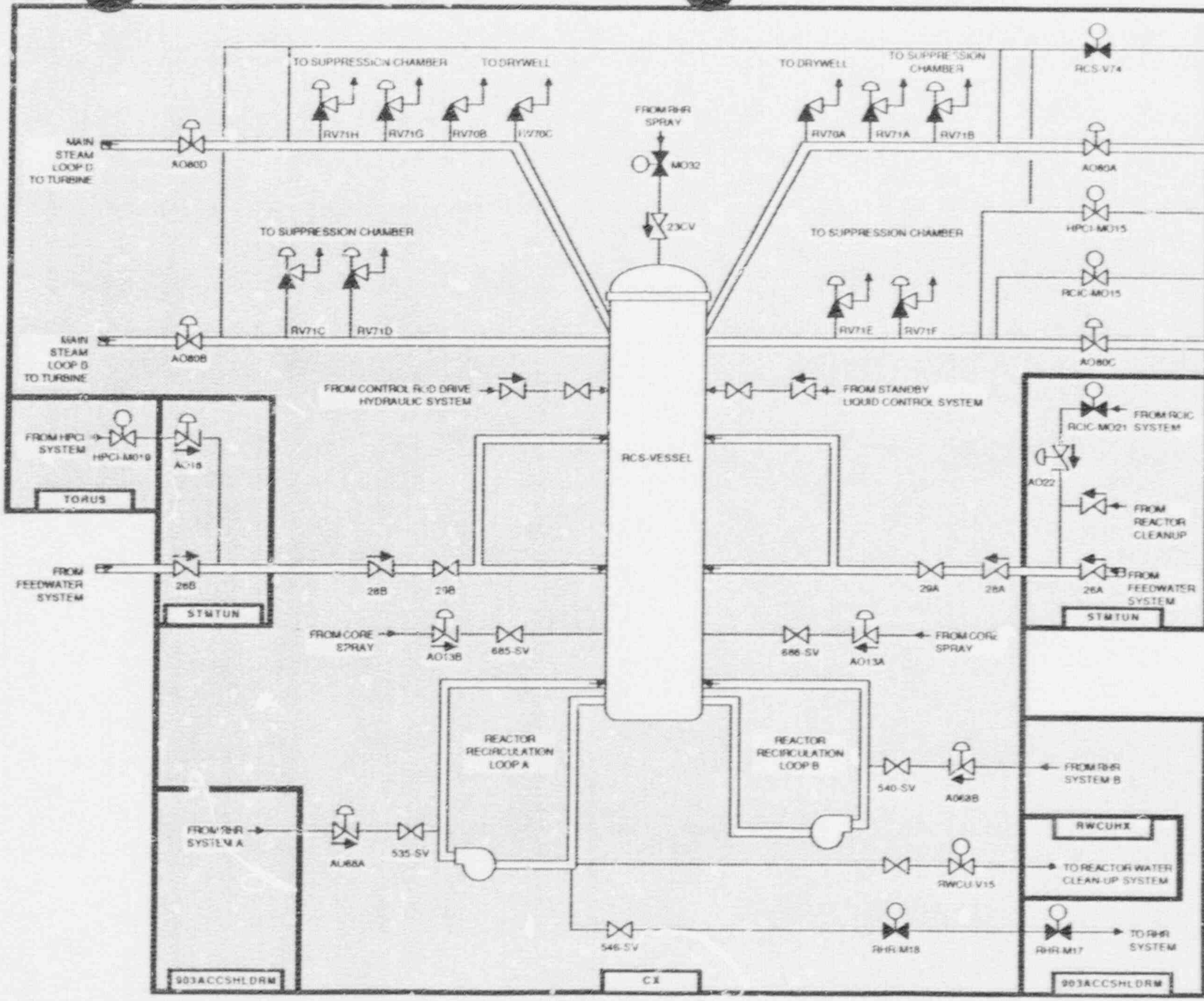


Figure 3.1-2. Cooper Nuclear Boiler System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RCIC-MO15	MOV	CX	MCC-Y	480	903RB	AC/G
RCIC-MO16	MOV	STMTUN	RCIC-RK	125	903RB	DC/A
RCS-V74	MOV	CX	MCC-R	480	903RB	AC/G
RCS-VESSEL	RV	CX				
RHR-M17	MOV	903ACCSHLDR	HPCI-RK	250	HPCIRM	DC/B
RHR-M18	MOV	CX	MCC-R	480	903RB	AC/F
RV-70A	SV	CX				
RV-70B	SV	CX				
RV-70C	SV	CX				
RV-71A	SRV	CX				
RV-71B	SRV	CX				
RV-71C	SRV	CX				
RV-71D	SRV	CX				
RV-71E	SRV	CX				
RV-71F	SRV	CX				
RV-71G	SRV	CX				
RV-71H	SRV	CX				
RWCU-V15	MOV	CX	MCC-R	480	903RB	AC/F
RWCU-V18	MOV	RWCUHXRM	STRT-RK	125	958RB	DC/B

3.2 REACTOR CORE ISOLATION COOLING (RCIC) SYSTEM

3.2.1 System Function

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

3.2.2 System Definition

The reactor core isolation cooling system consists of a steam-driven turbine pump and associated valves and piping for delivering makeup water from the condensate storage tank or the suppression pool to the reactor pressure vessel.

The RCIC can also operate in conjunction with the RHR system in the steam condensing mode, in which condensed steam is delivered from the RHR heat exchanger outlets to the RCIC pump suction for return to the RCS.

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

3.2.3 System Operation

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

Upon receipt of a reactor pressure vessel (RPV) low water level signal, the turbine-pump steam supply valves are opened and makeup water is supplied to the RPV. The primary water supply for the RCIC is the condensate storage water tank which contains an 8-hour supply of makeup water. The suppression pool is used as a backup water supply. Reactor core heat is dumped to the suppression pool via the safety/relief valves which cycle as needed to limit RCS pressure. The RCIC turbine also exhausts to the suppression pool.

The RCIC can also operate in conjunction with the RHR system in the steam condensing mode, in which condensed steam is delivered from the RHR heat exchanger outlets to the RCIC pump suction, for return to the RCS. In this mode of operation, reactor core heat is transferred to the RHR system rather than to the suppression pool. The RCIC turbine still exhausts to the suppression pool.

3.2.4 System Success Criteria

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

3.2.5 Component Information

A. Steam turbine-driven RCIC pump:
   1. Rated Flow: 416 gpm @ 2800 ft. head (1,214 psid)
   2. Rated Capacity: 100%
   3. Type: centrifugal

B. Condensate Storage Tanks (2)
   1. Capacity: 100,000 gal reserved for RCIC and HPCI operation

3.2.6 Support System and Interfaces

A. Control Signals

1. The RCIC pump is automatically actuated on a reactor vessel low water level signal and automatically tripped on a reactor vessel high water level signal.
2. Remote Manual
   The RCIC pump can be actuated by remote manual means from the Main Control Room.

B. Motive Power

1. The RCIC turbine-driven pump is supplied with steam from main steam loop C, upstream of the main steam isolation valves.
2. The steam supply valves to the turbine-pump, RCIC-MO15, and the other MOVs required for RCIC operation are Class 1E DC-A loads supplied by station batteries as described in Section 3.5. The RCIC system is designed to be operable on DC power only.

C. Other

1. Lubrication and cooling for the turbine-driven pump is supplied locally. It should be noted that the pump lube oil cooler is cooled by water diverted from the RCIC pump discharge and returned to the barometric condenser. Design maximum lube oil cooling water temperature is 140°F.
2. A room ventilation system cooled by reactor building closed cooling water system (see Section 3.7) provides RCIC room cooling.
3. RCIC pump gland seal leak off is collected, condensed and returned to the pump suction. A vacuum pump maintains condenser vacuum.

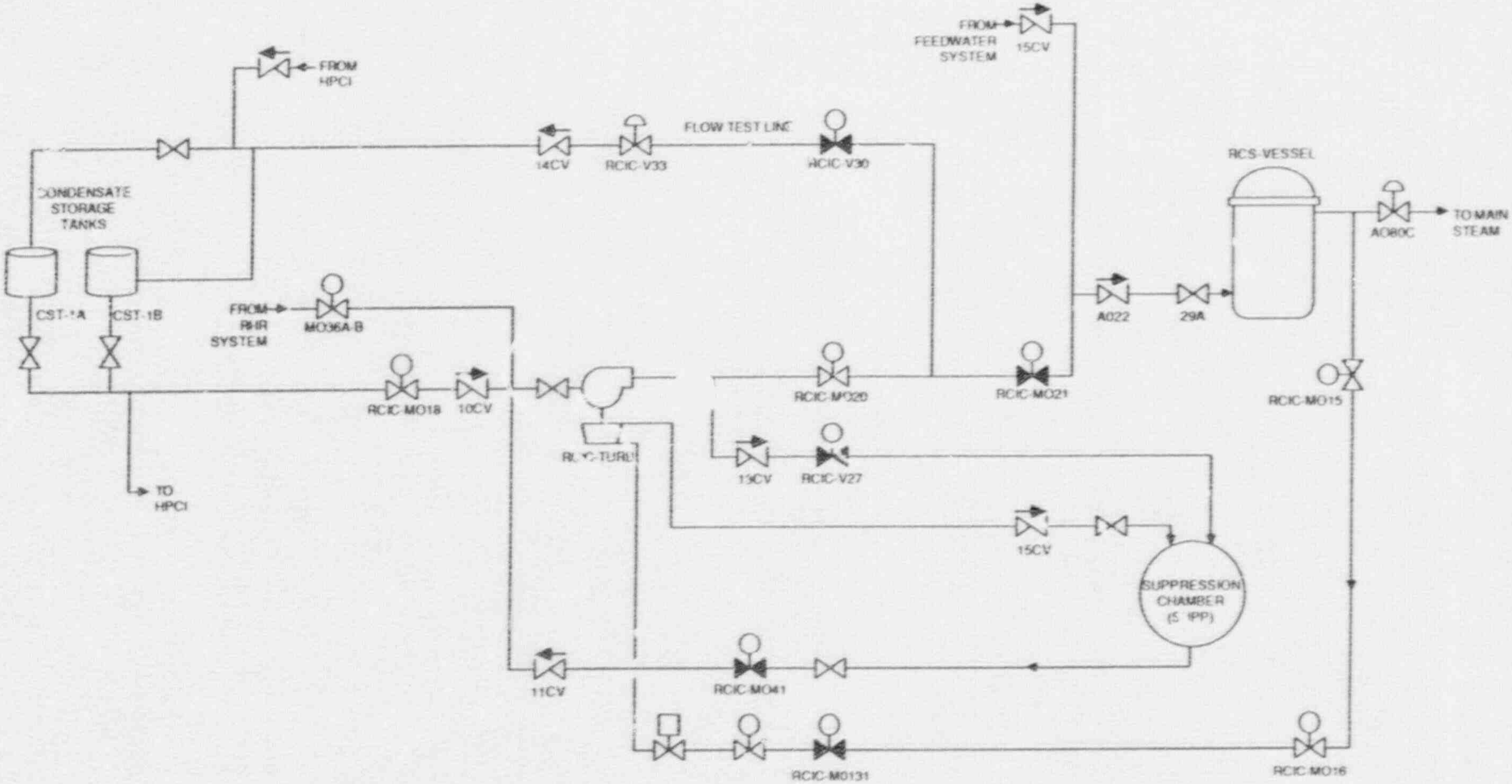


Figure 3.2-1. Cooper Reactor Core Isolation Cooling (RCIC) System

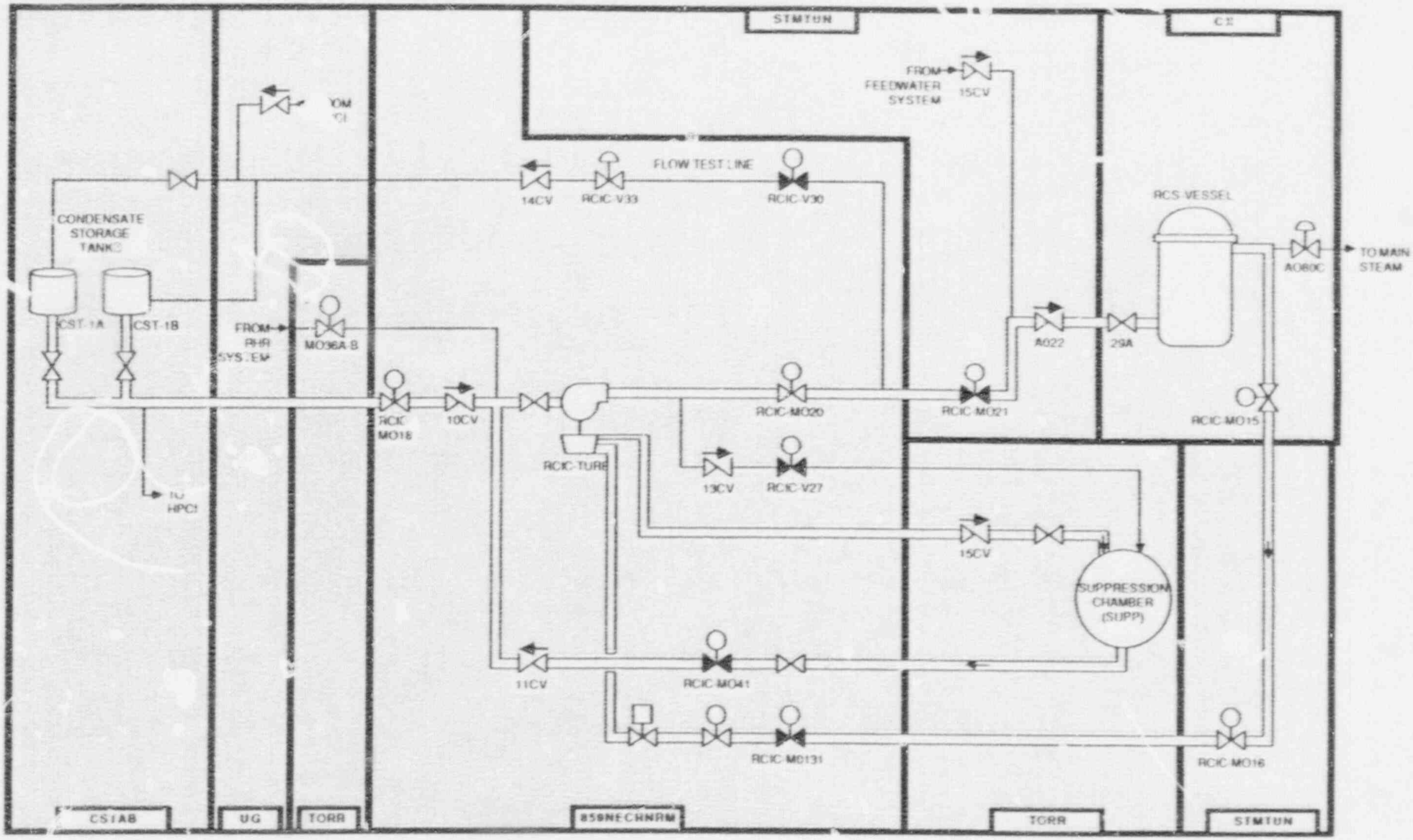


Figure 3.2-2. Cooper Reactor Core Isolation Cooling (RCIC) System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CST-1B	TANK	CSTAB				
RCIC-MO115	MOV	CX	MCC-Y	480	903RB	AC/G
RCIC-MO131	MOV	859NECRNRM	RCIC-RK	125	903RB	DC/A
RCIC-MO16	MOV	STMTUN	RCIC-RK	125	903RB	DC/A
RCIC-MO18	MOV	859NECRNRM	RCIC-RK	125	903RB	DC/A
RCIC-MO20	MOV	859NECRNRM	RCIC-RK	125	903RB	DC/A
RCIC-MO21	MOV	STMTUN	RCIC-RK	125	903RB	DC/A
RCIC-MO41	MOV	859NECRNRM	RCIC-RK	125	903RB	DC/A
RCIC-TURB	TDP	859NECRNRM				
RCIC-V27	MOV	859NECRNRM	RCIC-RK	125	903RB	DC/A
RCIC-V30	MOV	859NECRNRM	RCIC-RK	125	903RB	DC/A
RCIC-V33	MOV	859NECRNRM	RCIC-RK	125	903RB	DC/A
SUPP	PP	859NECRNRM				

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. For Cooper this system is called the Core Standby Cooling (CSC) system. The ECCS also performs suppression pool cooling and containment spray functions and has a capability for mitigating transients.

3.3.2 System Definition

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

- High-pressure Coolant Injection (HPCI) System
- Automatic Depressurization System (ADS)
- Core Spray System (CSS)
- Low-pressure Coolant Injection (LPCI) System

The HPCI system is provided to supply make-up water to the reactor pressure vessel (RPV) in the event of a small break LOCA which does not result in a rapid depressurization of the reactor vessel. The HPCI system consists of a steam-turbine driven pump, system piping, valves and controls.

The automatic depressurization system (ADS) provides automatic RPV depressurization for small breaks so that the low pressure systems (LPCI and CSS) can provide makeup to the RCS. The ADS utilize 6 of the 8 safety/relief valves that discharge the high pressure steam to the suppression pool.

The core spray system supplies make-up water to the reactor vessel at low pressure. The system consists of two independent loops, each of which has an electric driven pump to supply water from the suppression pool to a spray sparger in the reactor vessel above the core.

The low-pressure coolant injection system is an operating mode of the RHR system and provides make-up water to the reactor vessel at low pressure. The LPCI system consists of two loops designated LPCIA and LPCIB. Each loop consists of two motor driven pumps which supply water for the suppression pool into one of the two recirculation loops.

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

3.3.3 System Operation

All ECCS systems normally are in standby. The manner in which the ECCS operates to protect the reactor core is a function of the rate at which coolant is being lost from the RCS. The HPCI system is normally aligned to take a suction on the emergency condensate storage tank (CST). The HPCI system is automatically started in response to decreasing RPV water level, and will serve as the primary source of makeup if RCS pressure remains high. Operation of the HPCI system is not directly dependent on AC electric power. If the break is of such a size that the coolant loss exceeds the HPCI system capacity or if reactor pressure is too low to operate the steam turbine-driven HPCI pump, then the CSS and LPCI systems can provide higher capacity makeup to the reactor vessel.

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

3.3.4 System Success Criteria

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

- 1 of 2 core spray loops (CSA or CSB) with a suction on the suppression pool, or
- 3 of the 4 low pressure coolant injection pumps with a suction on the suppression pool.

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

- The high-pressure coolant injection (HPCI) pump with a suction on the suppression pool or the condensate storage tank, or
- The automatic depressurization system (ADS) and 3 of 4 LPCI pumps with a suction on the suppression pool, or
- The automatic depressurization system and either of the core spray loops (CSA or CSB) with a suction on the suppression pool.

The success criterion for the ADS is the use of any 1 of 2 ADS trains. All injection systems essentially are operating in a recirculation mode when drawing water from the suppression pool.

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

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

It is possible that the coolant inventory control function for some small LOCAs can be satisfied by low-capacity high-pressure injection systems such as the control rod drive hydraulic system (see Section 3.6).

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

3.3.5 Component Information

A. Steam turbine-driven HPCI pump (HPCI-TDP)
   1. Rated flow: 4250 gpm @ 2580 ft head (1,118 psid)
   2. Rated capacity: 100%
   3. Type: centrifugal

B. Low-pressure Coolant Injection Pumps (PMA, B, C, and D) (4)
   1. Rated flow: 7700 gpm @ 46 ft. head (20 psid)
   2. Rated capacity: 33 1/3%
   3. Type: centrifugal

C. Core spray pumps PM1A and PM1B
   1. Rated flow: 4500 gpm @ 260 ft. head (113 psid)
   2. Rated capacity: 100%
   3. Type: centrifugal

D. Automatic-depressurization valves (6)
   1. Rated capacity: 20%
   2. Rated flow: 3 @ 870,000 lb/hr @ 1090 psig
      3 @ 877,000 lb/hr @ 1100 psig

E. Pressure Suppression Chamber
   1. Design pressure: 56 psig
   2. Design temperature: 281°F
   3. Operating temperature: 90°F
   4. Maximum water volume: 91,100 ft^3
   5. Minimum water volume: 87,650 ft^3

3.3.6 Support Systems and Interfaces

A. Control signals
   1. Automatic
      a. The HPCI pump, core spray pumps and the LPCI pumps and all their associated valves function upon receipt of low water level in the reactor vessel or high pressure in the drywell.
      b. The ADS system is actuated upon coincident signals of the reactor vessel low water level, drywell high pressure and discharge pressure indication on any LPCI or CS pump but with a 2-min delay.

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

B. Motive Power
   1. The ECCS motor-driven pumps and motor-operated valves are Class 1E AC nd DC loads that can be supplied from the emergency diesel generator or station battery, as described in Section 3.5.
   2. The steam supply valves to the HPCI turbine are Class 1E DC-B loads.
   3. The HPCI turbine-driven pump is supplied with steam from main steam loop C, upstream of the main steam isolation valves.

C. Other
   1. Lubrication and cooling for the turbine-driven pump are supplied locally. It should be noted that the pump lube oil cooler is cooled by water diverted from the HPCI pump discharge and returned to the pump suction. Design maximum cooling water temperature for the HPCI pump is not known. For the turbine-driven RCIC pump, the limit is 140°F (see Section 3.2).
   2. The LPCI (RHR) pump are cooled by the reactor building cooling water (RBCCW) system (see Section 3.7).
   3. Room ventilation systems cooled by reactor building closed cooling water system (see Section 3.7) are provided as follows:

4. HPCI pump gland seal leakoff is collected, condensed, and returned to the pump suction. A vacuum pump maintains condenser vacuum.

3.3.7 Section 3.3 References

1. Cooper FSAR, Section 6.

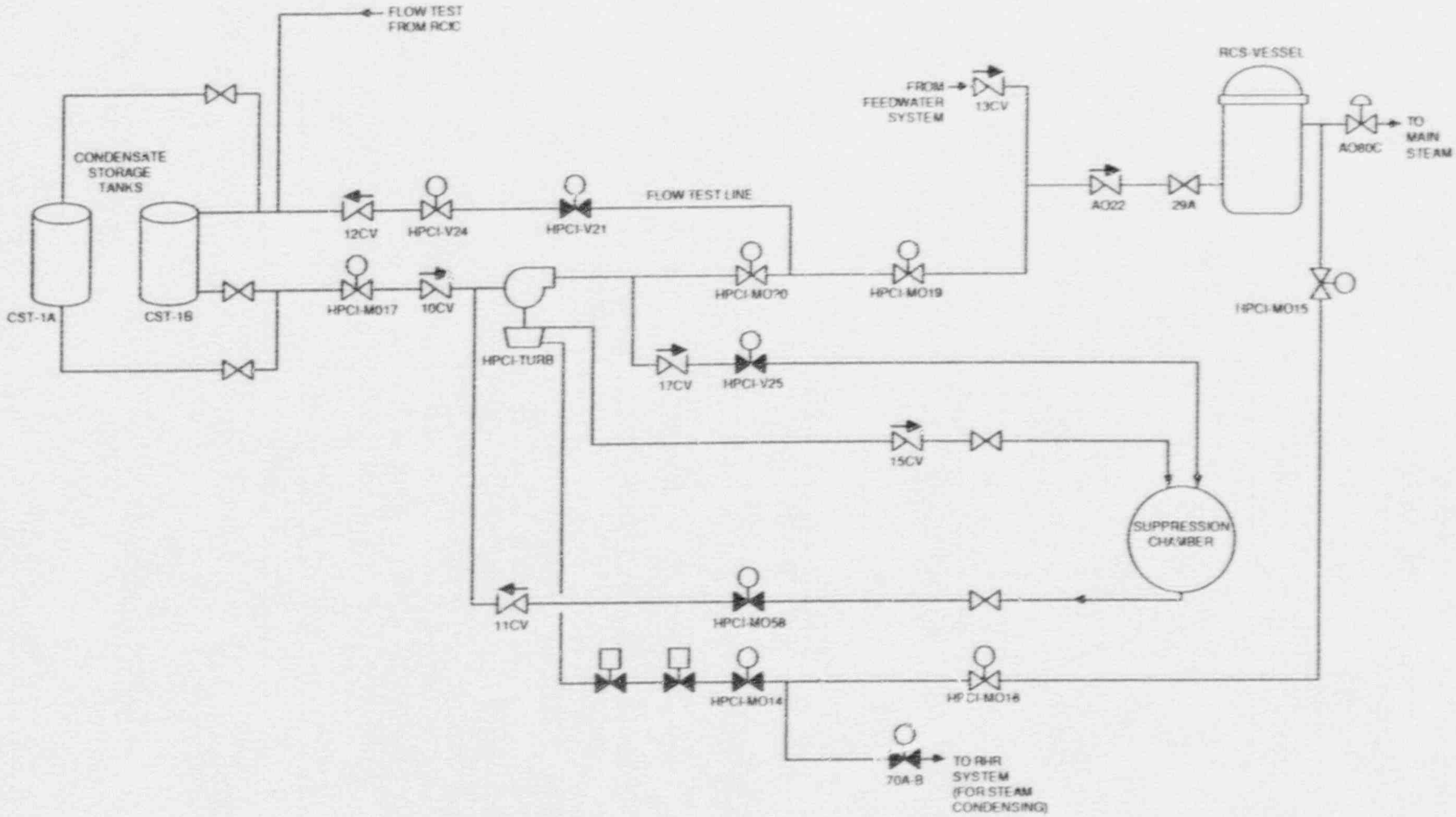


Figure 3.3-1. Cooper High Pressure Coolant Injection (HPCI) System

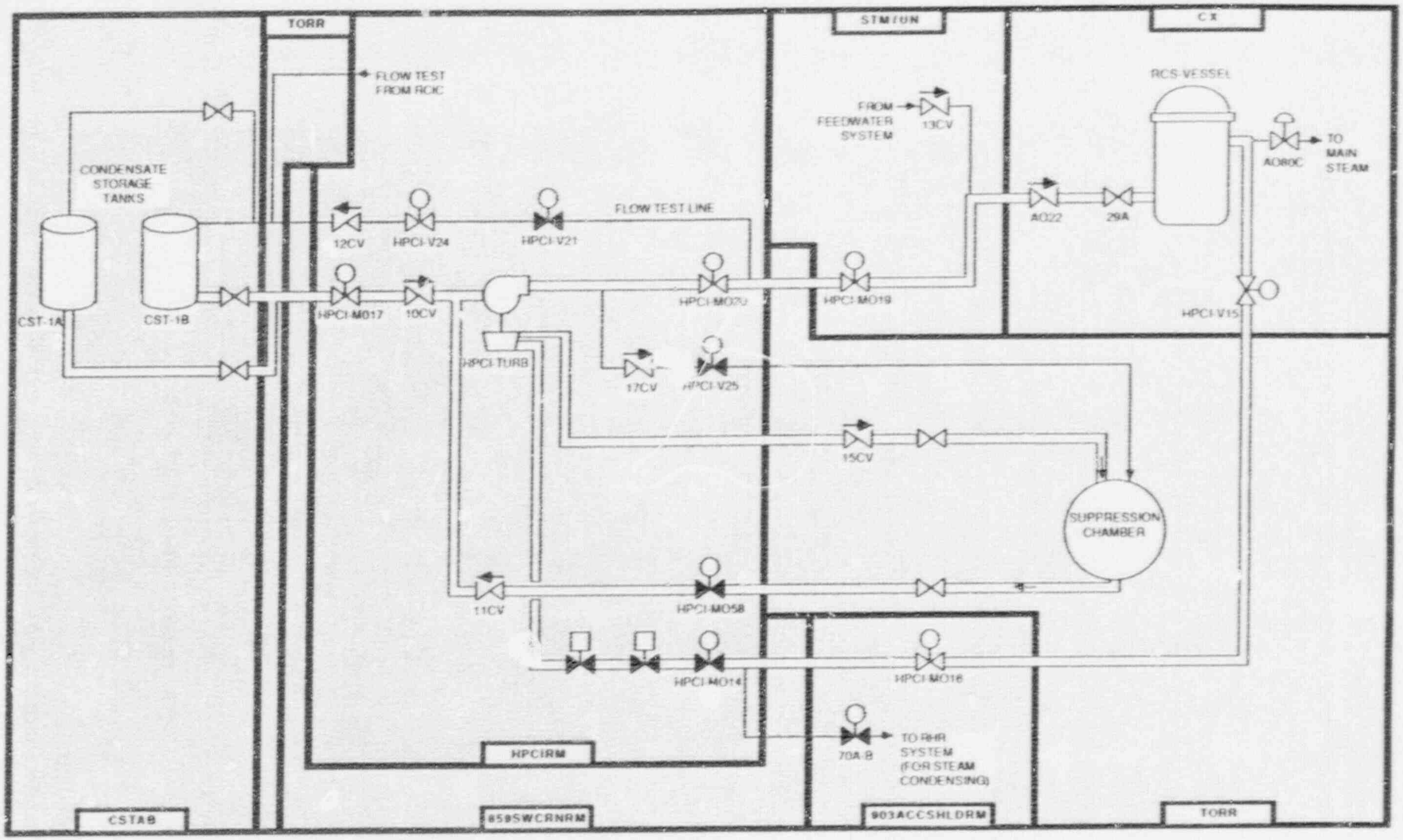


Figure 3.3-2. Cooper High Pressure Coolant Injection (HPCI) System Showing Component Locations

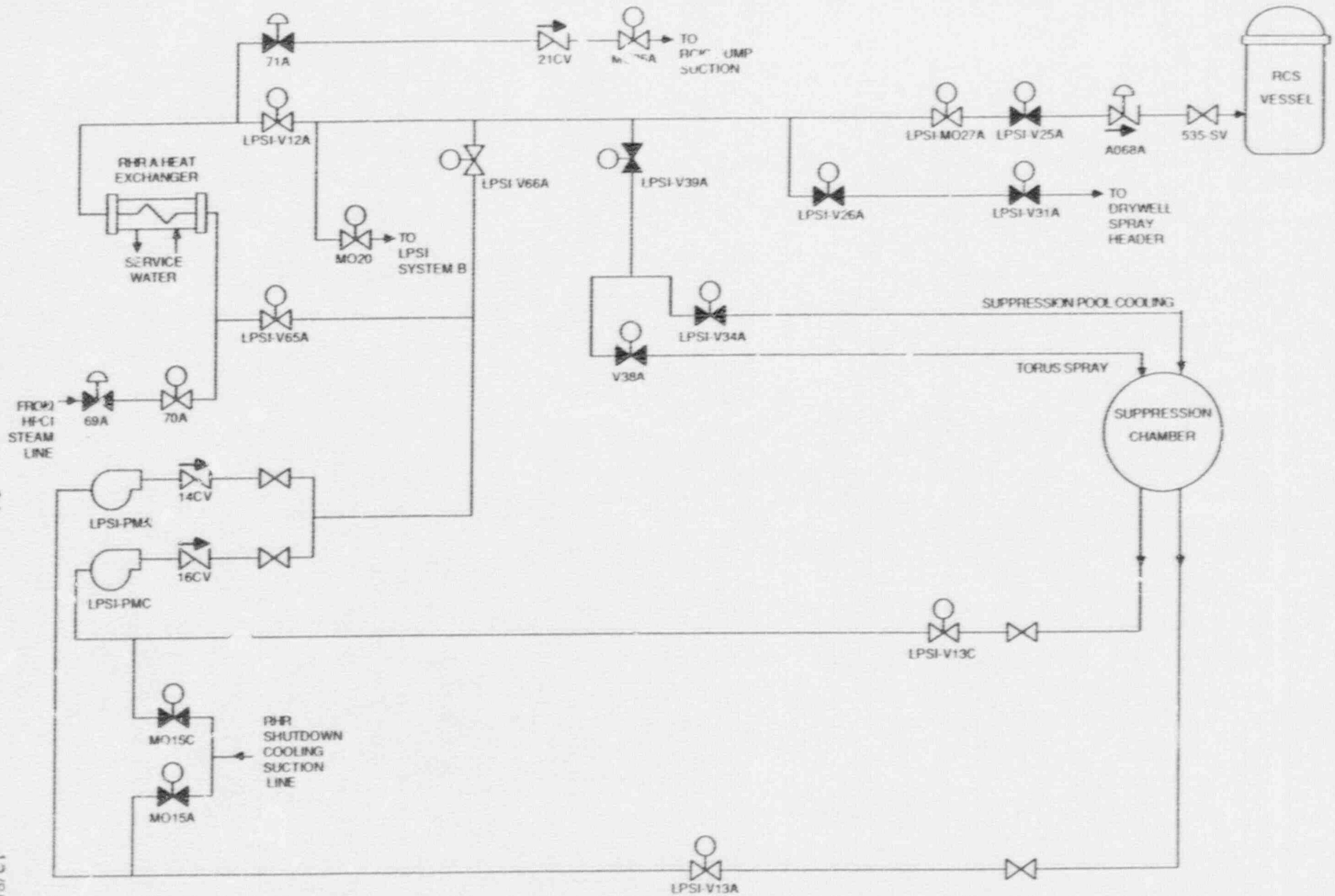


Figure 3.3-3. Cooper Low Pressure Coolant Injection - System A

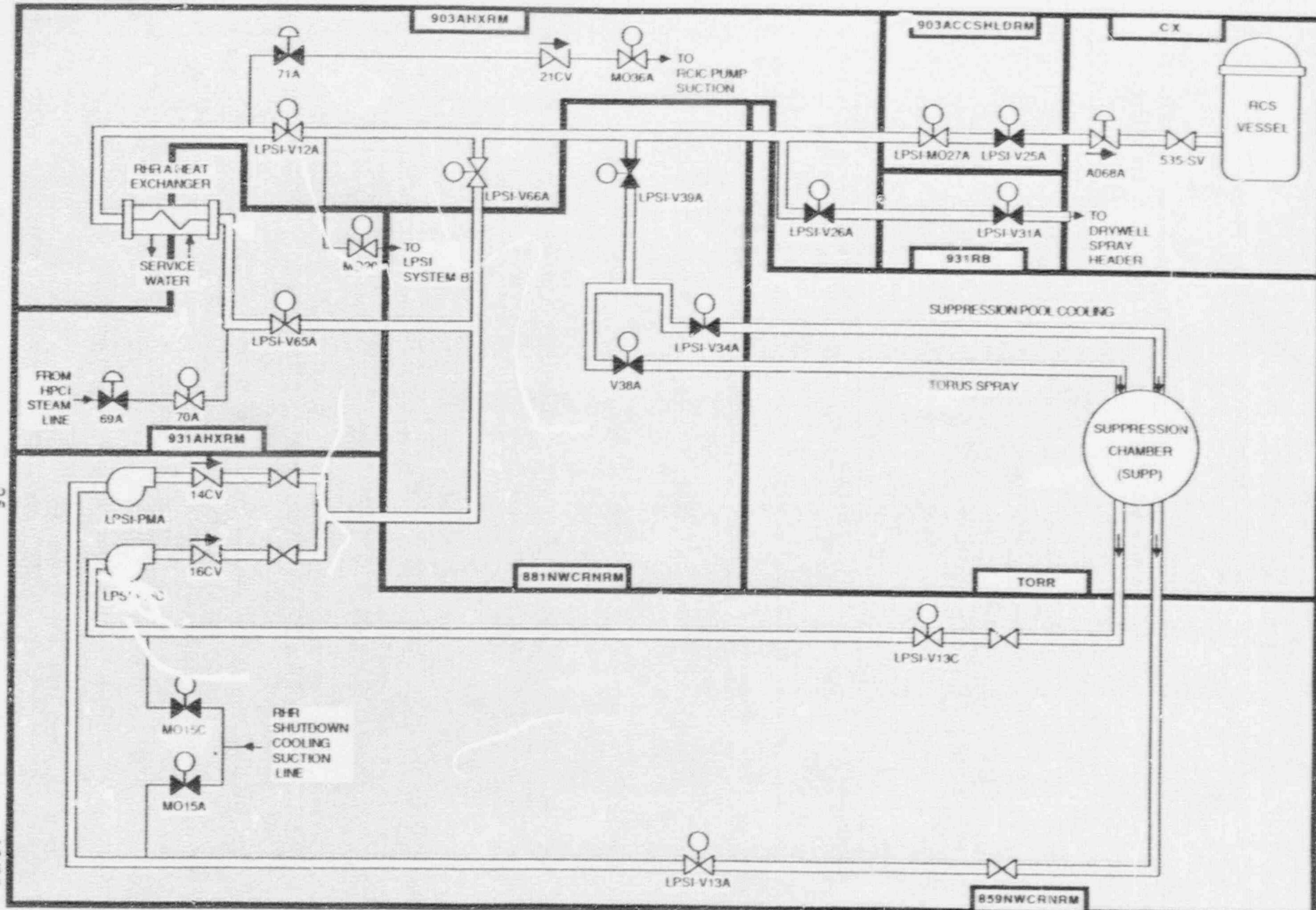
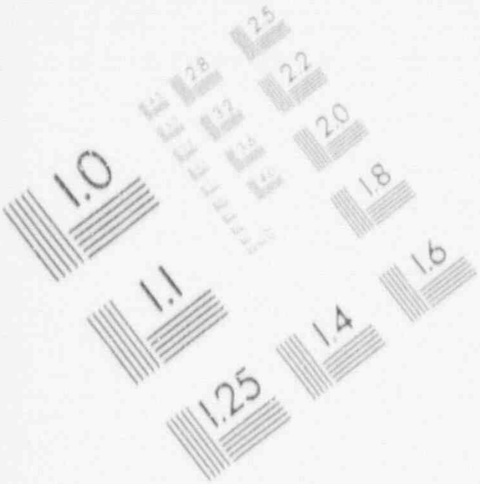


Figure 3.3-4. Cooper Low Pressure Coolant Injection - System A Showing Component Locations

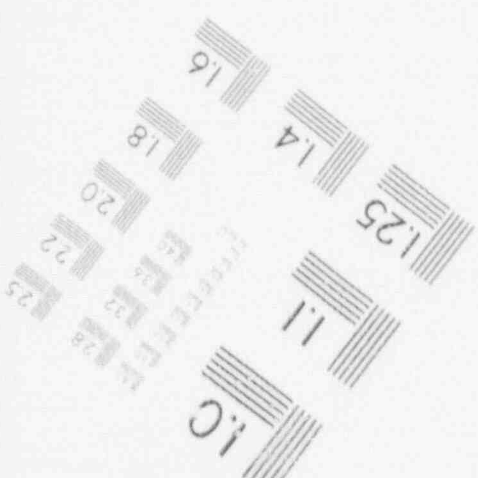
2

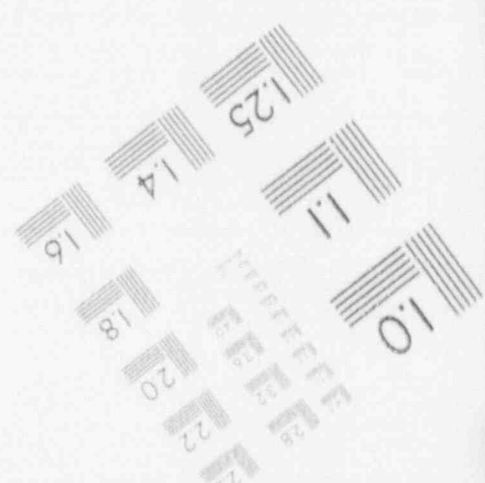
IMAGE EVALUATION TEST TARGET (MT-3)



150mm

6″





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(716) 265-1600

2

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

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(716) 265-1600

2

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

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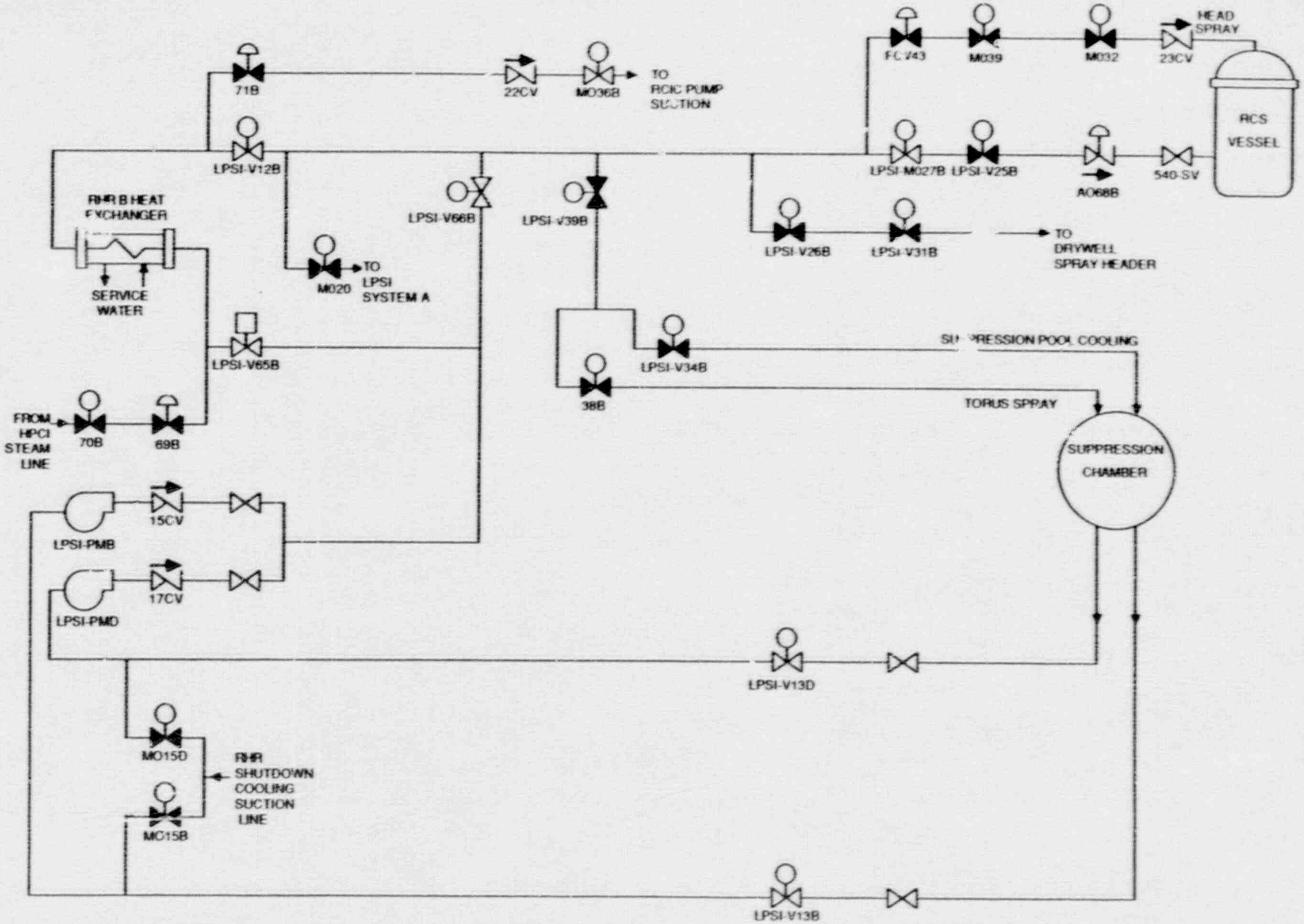

Figure 3.3-5. Cooper Low Pressure Coolant Injection - System B

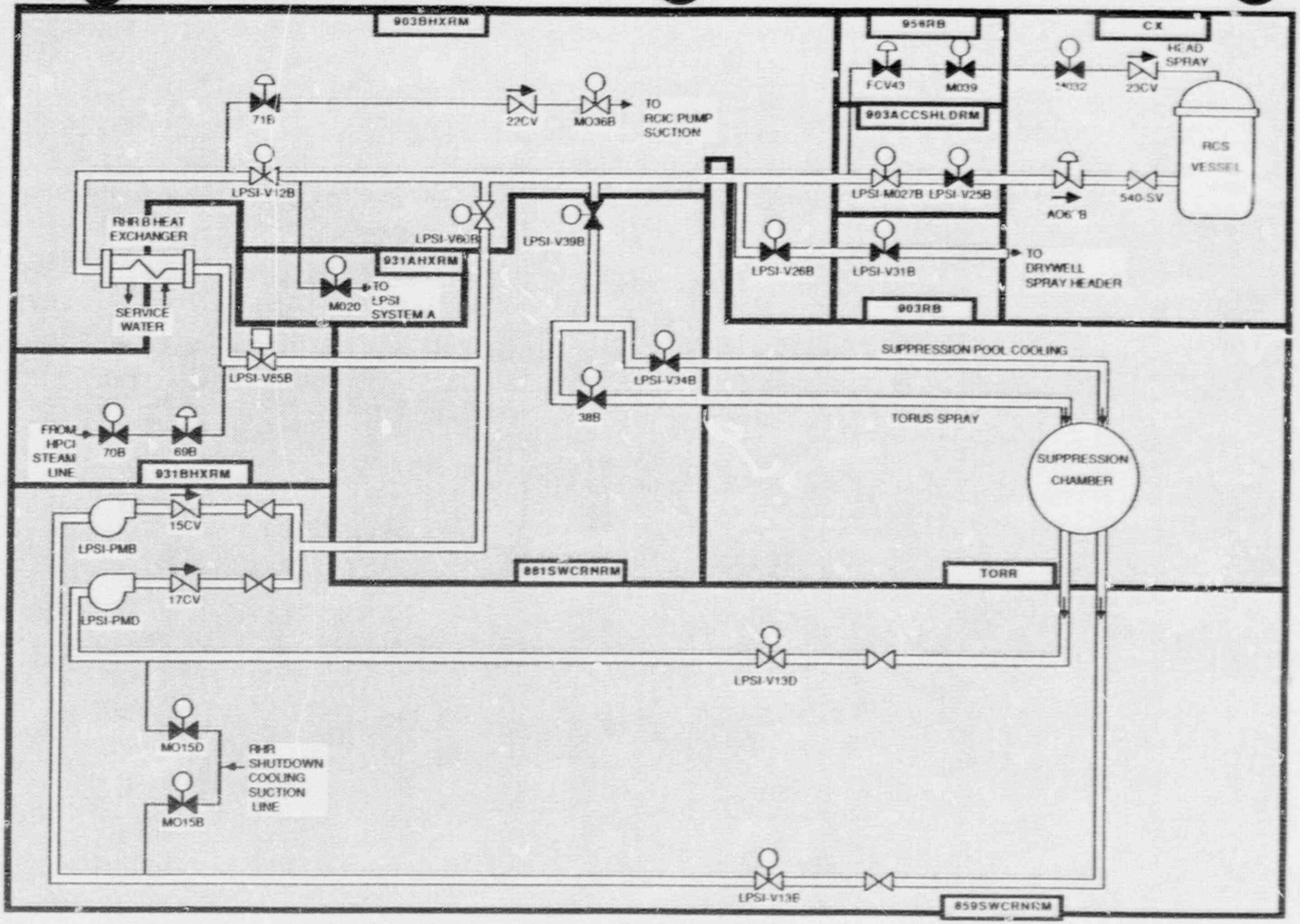

Figure 3.3-6. Cooper Low Pressure Coolant Injection - System B Showing Component Locations

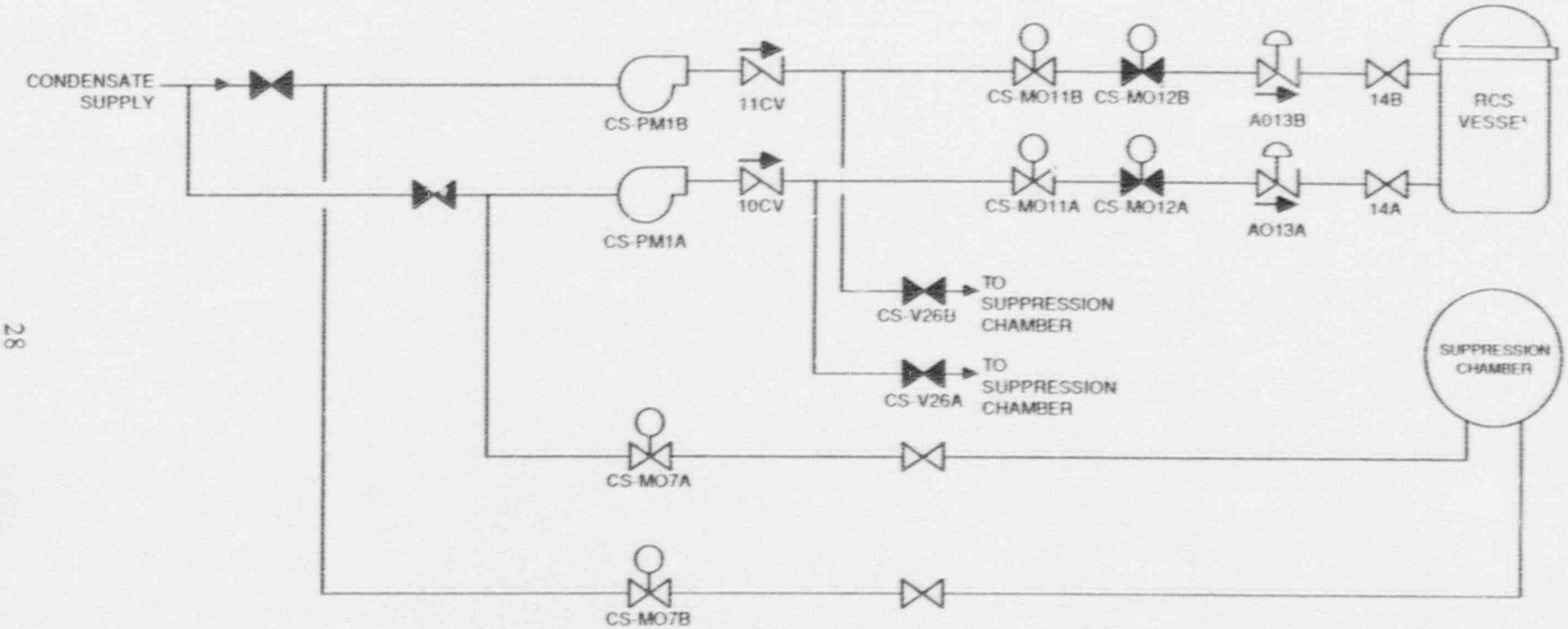

Figure 5.?-7. Cooper Core Spray System (CSS)

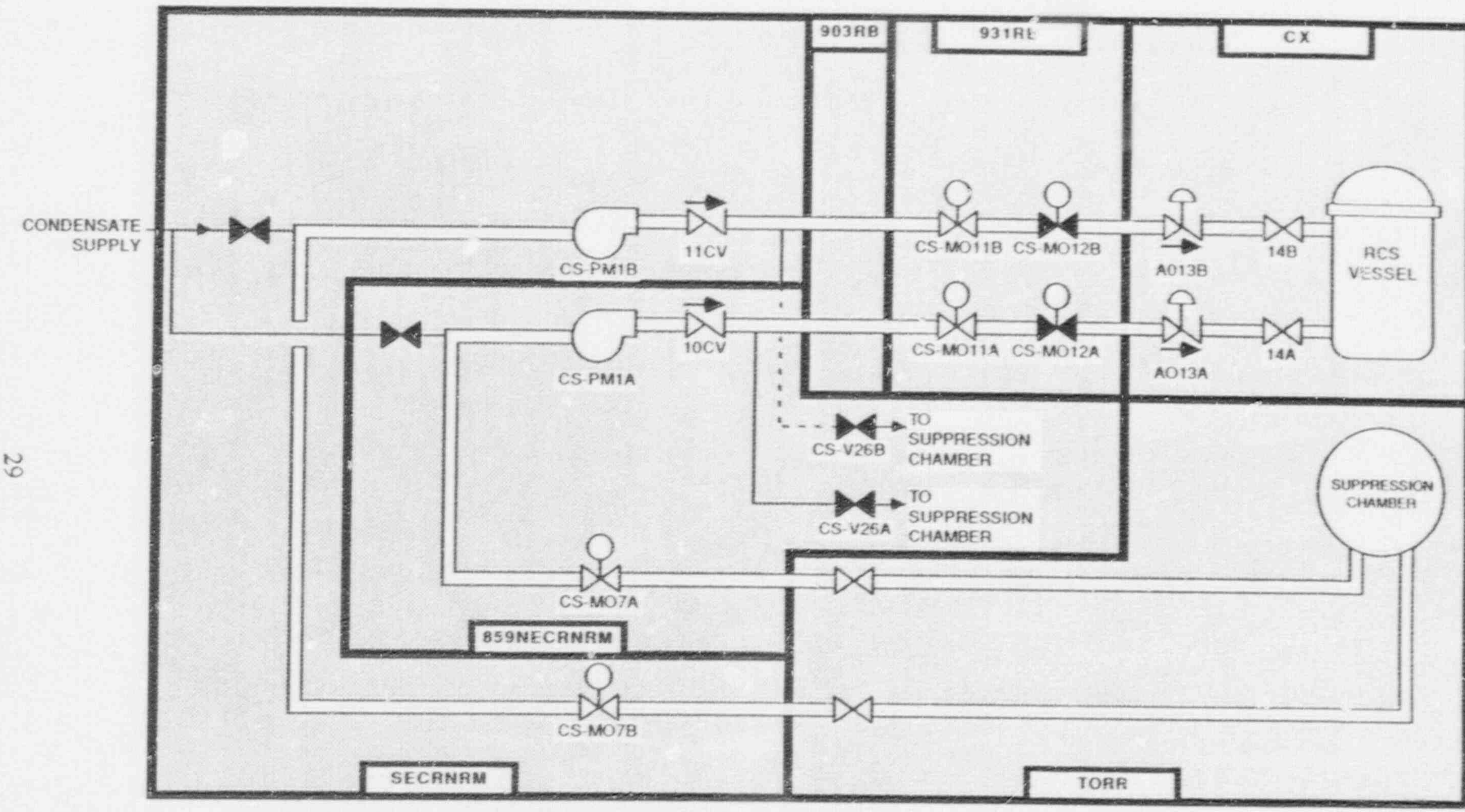

Figure 3.3-8. Cooper Core Spray System (CSS) Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CS-MO11B	MOV	931RB	MCC-Y	480	903RB	AC/G
CS-MO12B	MOV	931RB	MCC-Y	480	903RB	AC/E
CS-MO7A	MOV	859NECRNRM	MCC-Q	480	903RB	AC/F
CS-MO7B	MOV	SECRNRM	MCC-Y	480	903RB	AC/G
CS-MO11A	MOV	931RB	MCC-Q	480	903RB	AC/F
CS-MO12A	MOV	931RB	MCC-Q	480	903RB	AC/F
CS-PM1A	MDP	859NECRNRM	BUS-1F	4160	B1F	AC/F
CS-PM1B	MDP	SECRNRM	BUS-1G	4160	B1G	AC/G
CS-V26A	MOV	859NECRNRM	MCC-Q	480	903RB	AC/F
CS-V26B	MOV	SECRNRM	MCC-Y	480	903RB	AC/G
CST-1A	TANK	CSTAB				
CST-1B	TANK	CSTAB				
HPCI-MO14	MOV	HPCIRM	HPCI-RK	250	HPCIRM	DC/B
HPCI-MO15	MOV	CX	MCC-R	480	903RB	AC/F
HPCI-MO15	MOV	CX	MCC-R	480	903RB	AC/F
HPCI-MO16	MOV	903ACCSHLDR	HPCI-RK	125	HPCIRM	DC/B
HPCI-MO16	MOV	903ACCSHLDR	HPCI-RK	125	HPCIRM	DC/B
HPCI-MO17	MOV	HPCIRM	HPCI-RK	125	HPCIRM	DC/B
HPCI-MO19	MOV	STMTUN	HPCI-RK	250	HPCIRM	DC/B
HPCI-MO20	MOV	HPCIRM	HPCI-RK	250	HPCIRM	DC/B
HPCI-MO58	MOV	HPCIRM	HPCI-RK	125	HPCIRM	DC/B
HPCI-TURB	TDP	HPCIRM				
HPCI-V21	MOV	HPCIRM	HPCI-RK	250	HPCIRM	DC/B
HPCI-V24	MOV	HPCIRM	HPCI-RK	250	HPCIRM	DC/B
HPCI-V25	MOV	HPCIRM	HPCI-RK	250	HPCIRM	DC/B
LPSI-MO27A	MOV	903ACCSHLDR	MCC-R	480	903RB	AC/F
LPSI-MO27B	MOV	903ACCSHLDR	MCC-RB	480	903RB	AC/G

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CS-M011B	MOV	931RB	MCC-Y	480	903RB	AC/G
CS-M012B	MOV	931RB	MCC-Y	480	903RB	AC/E
CS-M07A	MOV	859NECRNRM	MCC-Q	480	903RB	AC/F
CS-M07B	MOV	SECRNRM	MCC-Y	480	903RB	AC/G
CS-MO11A	MOV	931RB	MCC-Q	480	903RB	AC/F
CS-MO12A	MOV	931RB	MCC-Q	480	903RB	AC/F
CS-PM1A	MDP	859NECRNRM	BUS-1F	4160	B1F	AC/F
CS-PM1B	MDP	SECRNRM	BUS-1G	4160	B1G	AC/G
CS-V26A	MOV	859NECRNRM	MCC-Q	480	903RB	AC/F
CS-V26B	MOV	SECRNRM	MCC-Y	480	903RB	AC/G
CST-1A	TANK	CSTAB				
CST-1B	TANK	CSTAB				
HPCI-MO14	MOV	HPCIRM	HPCI-RK	250	HPCIRM	DC/B
HPCI-MO15	MOV	CX	MCC-R	480	903RB	AC/F
HPCI-MO15	MOV	CX	MCC-R	480	903RB	AC/F
HPCI-MO16	MOV	903ACCSHLDR	HPCI-RK	125	HPCIRM	DC/B
HPCI-MO16	MOV	903ACCSHLDR	HPCI-RK	125	HPCIRM	DC/B
HPCI-MO17	MOV	HPCIRM	HPCI-RK	125	HPCIRM	DC/B
HPCI-MO19	MOV	STMTUN	HPCI-RK	250	HPCIRM	DC/B
HPCI-MO20	MOV	HPCIRM	HPCI-RK	250	HPCIRM	DC/B
HPCI-MO58	MOV	HPCIRM	HPCI-RK	125	HPCIRM	DC/B
HPCI-TURB	TDP	HPCIRM				
HPCI-V21	MOV	HPCIRM	HPCI-RK	250	HPCIRM	DC/B
HPCI-V24	MOV	HPCIRM	HPCI-RK	250	HPCIRM	DC/B
HPCI-V25	MOV	HPCIRM	HPCI-RK	250	HPCIRM	DC/B
LPSI-MO27A	MOV	903ACCSHLDR	MCC-R	480	903RB	AC/F
LPSI-MO27B	MOV	903ACCSHLDR	MCC-RB	480	903RB	AC/G

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
LPSI-PMA	MDP	859NWCRNRM	BUS-1F	4160	B1F	AC/F
LPSI-PMB	MDP	859SWCRNRM	BUS-1F	4160	B1F	AC/F
LPSI-PMC	MDP	859NWCRNRM	BUS-1G	4160	B1G	AC/G
LPSI-PMD	MDP	859SWCRNRM	BUS-1G	4160	B1G	AC/G
LPSI-V12A	MOV	903AHXRM	MCC-Q	480	903RB	AC/F
LPSI-V12B	MOV	903BHXRM	MCC-Y	480	903RB	AC/G
LPSI-V13A	MOV	859NWCRNRM	MCC-Q	480	903RB	AC/F
LPSI-V13B	MOV	859SWCRNRM	MCC-Y	480	903RB	AC/G
LPSI-V13C	MOV	859NWCRNRM	MCC-Q	480	903RB	AC/F
LPSI-V13D	MOV	859SWCRNRM	MCC-Y	480	903RB	AC/G
LPSI-V25A	MOV	903ACCSHLDR **	RHRA-RK	250	903RB	DC/A
LPSI-V25A	MOV	903ACCSHLDR **	RHRB-RK	250	903RB	DC/B
LPSI-V26A	MOV	903AHXRM	MCC-Q	480	903RB	AC/F
LPSI-V26B	MOV	903BHXRM	MCC-Y	480	903RB	AC/G
LPSI-V31A	MOV	931RB	MCC-Q	480	903RB	AC/F
LPSI-V31B	MOV	903RB	MCC-Y	480	903RB	AC/G
LPSI-V34A	MOV	881NWCRNRM	MCC-Q	480	903RB	AC/F
LPSI-V34B	MOV	881SWCRNRM	MCC-Y	480	903RB	AC/G
LPSI-V39A	MOV	881NWCRNRM	MCC-Q	480	903RB	AC/F
LPSI-V39B	MOV	881SWCRNRM	MCC-Y	480	903RB	AC/G
LPSI-V65A	MOV	931AHXRM	MCC-Q	480	903RB	AC/F
LPSI-V65B	MOV	931BHXRM	MCC-Y	480	903RB	AC/G
LPSI-V66A	MOV	903AHXRM	MCC-Q	480	903RB	AC/F
LPSI-V66B	MOV	903BHXRM	MCC-Y	480	903RB	AC/G

3.4 INSTRUMENTATION AND CONTROL (I&C) SYSTEMS

3.4.1 System Function

The instrumentation and control systems consist of the Reactor Protection System (RPS) and systems for the display of plant information to the operators. The RPS monitors the reactor plant, and alerts 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. It will also automatically cause actuation of selected safety systems based on the specific limits or combinations of limits that are exceeded.

3.4.2 System Definition

The RPS includes sensor and transmitter units, logic units, and output trip relays that interface with the control circuits for components in the Control Rod Drive Hydraulic System (see Section 3.6) Under certain circumstances components in other safety systems will also be actuated. Operator instrumentation display systems consist of display panels that are powered by 120 VAC power (see Section 3.5).

3.4.3 System Operation

A. RPS

The RPS has four input instrument channels and two output actuation trains. RPS inputs are listed below:

- Neutron monitoring system
- Reactor pressure
- Low water level in reactor vessel
- Turbine stop valve closure
- Turbine control valve fast closure
- Main steam line isolation signal
- Scram discharge header high water level
- Drywell high pressure
- Main steam line radiation
- Manual

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

B. Other Safety Systems

Other actuation systems include the following:

- Primary containment and reactor vessel isolation system
- Core standby cooling system control and instrumentation system

C. Remote Shutdown

No information was found in the FSAR regarding a remote shutdown capability. Such a capability is expected to exist.

3.4.4 System Success Criteria

A. RPS

The RPS uses hindrance logic (normal = 1, trip = 0) in both the input and output logic. Therefore, a channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e. the channel has a fail-safe failure mode). A reactor scram will occur upon loss of control power to the RPS. A reactor scram is implemented by the scram pilot valves in the control rod drive hydraulic system (see Section 3.6). Details of the RPS for Cooper have not been determined.

B. Other Actuation Systems
A single component usually receives a signal from only one actuation system output train. Trains A and B must be available in order to automatically actuate their respective components. Actuation systems other than the RPS typically uses hindrance input logic (normal = 1, trip = 0) and transmission output logic (normal = 0, trip = 1). In this case, an input channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e. the channel has a fail-safe failure mode). Control power is needed for the actuation system output channels to send an actuation signal. Note that there may be some actuation subsystems that utilize hindrance output logic. For these subsystems, loss of control power will cause system or component actuation, as is the case with the RPS. Details of the other actuation systems for Cooper 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 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 remote shutdown panel or a motor control center). To make these judgments, data on key plant parameters must be available to the operators.

3.4.5 Support Systems and Interfaces

A. Control Power
1. RPS
The RPS is powered from two 120 VAC buses (see Section 3.5).
2. Other Actuation Systems
Control power sources for the actuation logic of various safety systems are summarized in Table 3.4-1.
3. Operator Instrumentation
Operator instrumentation displays are powered from instrumentation power sources as described in Section 3.5.

Table 3.4-1. Matrix of Cooper Control Power Sources

SYSTEM	125 VDC Division	
	A	B
RCIC	■	
HPCI		■
ADS A	■	
ADS B		■
RHR (LPCI) A	■	
RHR (LPCI) B		■
CS A	■	
CS B		■
DIESEL 1A & AUXILIARIES	■	
DIESEL 1B & AUXILIARIES		■
SW A	■	
SW B		■

3.5 ELECTRIC POWER SYSTEM

3.5.1 System Function

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

3.5.2 System Definition

The onsite Class 1E electric power system consists of two diesel generators and 4160 VAC buses. The Class 1E electric power system consists of two 4160 VAC trains, two 480 VAC trains, a 125/250 VDC subsystem, and a 120 VAC subsystem. Two sets of station batteries supply power to the 125/250 VDC system for normal switchgear control, turbine control, annunciators, and various emergency functions. These batteries have adequate capacity for eight hours of operation without recharging (Ref. 1). The 120 VAC system supplies power to the reactor instrumentation and protection circuits.

Simplified one-line diagrams of the electric power system are shown in Figures 3.5-1 and 3.5-2. 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 3.5-2.

3.5.3 System Operation

The normal power system supplies AC power to all station auxiliaries and is the normal source of power when the main generator is operating. The start-up station offsite AC power source provides power when the main generator is off-line.

Upon loss of both normal and start-up (offsite) power, each emergency diesel generator is automatically started and is aligned to supply power to the respective AC power load groups. The 480 VAC buses 1F and 1G constitute the two separate 480 VAC trains distributing power to the rest of the 480 VAC motor control centers electrical system.

The normal source of power for the 125/250 VDC system are the battery chargers. The station batteries 1A and 1B float on their respective buses. These DC buses supply 125/250 VDC to the essential cabinets 1A and 1B which supply Division I engineered safeguard system (ESS) and Division II ESS loads.

120/240 VAC instrument power is supplied from the 480V buses (1F and 1G) as are the RPS motor-generator (MG) sets.

Redundant safeguards equipment such as motor driven pumps and motor operated valves are supplied by different 4160 VAC buses. For the purpose of discussion, this equipment has been grouped into "load groups". Load group 1F contains components receiving electric power from Bus 1F. Load group 1G contains components powered by bus 1G. Load groups DCA and DCB contains components receiving DC power from DC bus 1A and 1B respectively.

3.5.4 System Success Criteria

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

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

3.5.5 Component Information

A. Standby diesel generators 1A, 1B
   1. Power rating: 4000 kW continuous
   2. Rated voltage: 4160 VAC
   3. Manufacturer: Cooper Bessemer
   4. Day tank capacity: 2500 gals (8 hours operation @ full load).

B. Station batteries
   1. Type: Lead-acid
   2. Rated voltage: 125/250
   3. Cells: 60
   4. Design Capacity: 8 hours with design load.

3.5.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The standby diesel generator is automatically started based on loss of start-up power, low reactor water level, or high drywell pressure.
   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. Cooling
      The service water system (see Section 3.8) provides diesel cooling.
   2. Fueling
      An independent day tank is provided for each diesel. A day tank will support eight hours of diesel operation with design loads.
   3. Lubrication
      Each diesel generator has a self-contained lubrication system.
   4. Starting
      An independent starting air accumulator is provided for each diesel generator
   5. Ventilation
      Details on diesel room ventilation are not known.

C. Switchgear and Battery Room Ventilation System.
   Details on switchgear and battery room ventilation are not known.

3.5.7 Section 3.5 References

1. Cooper FSAR, Section 8.6.4.

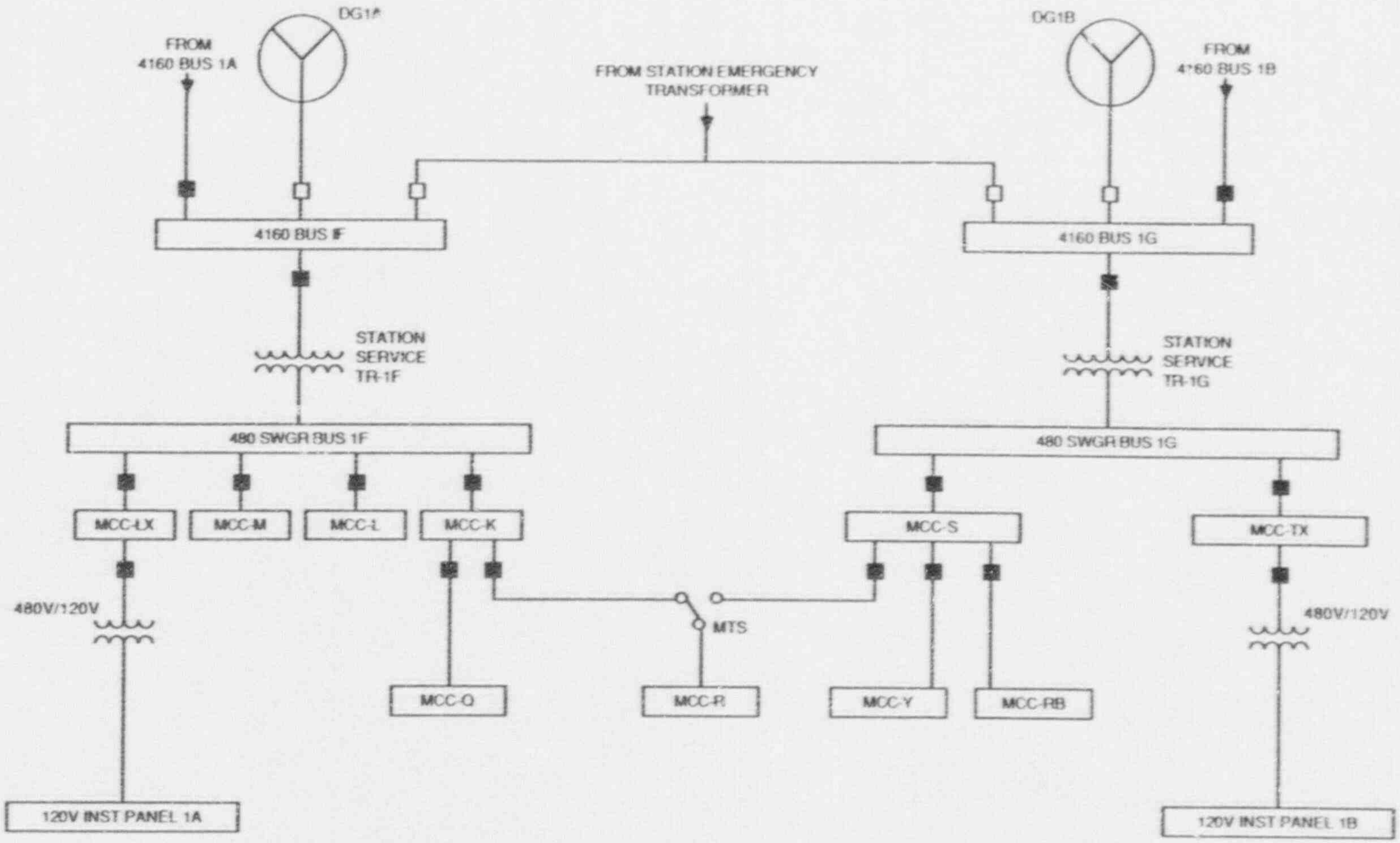

Figure 3.5-1. Cooper 4160, 480, and 120 VAC Electric Power Distribution System

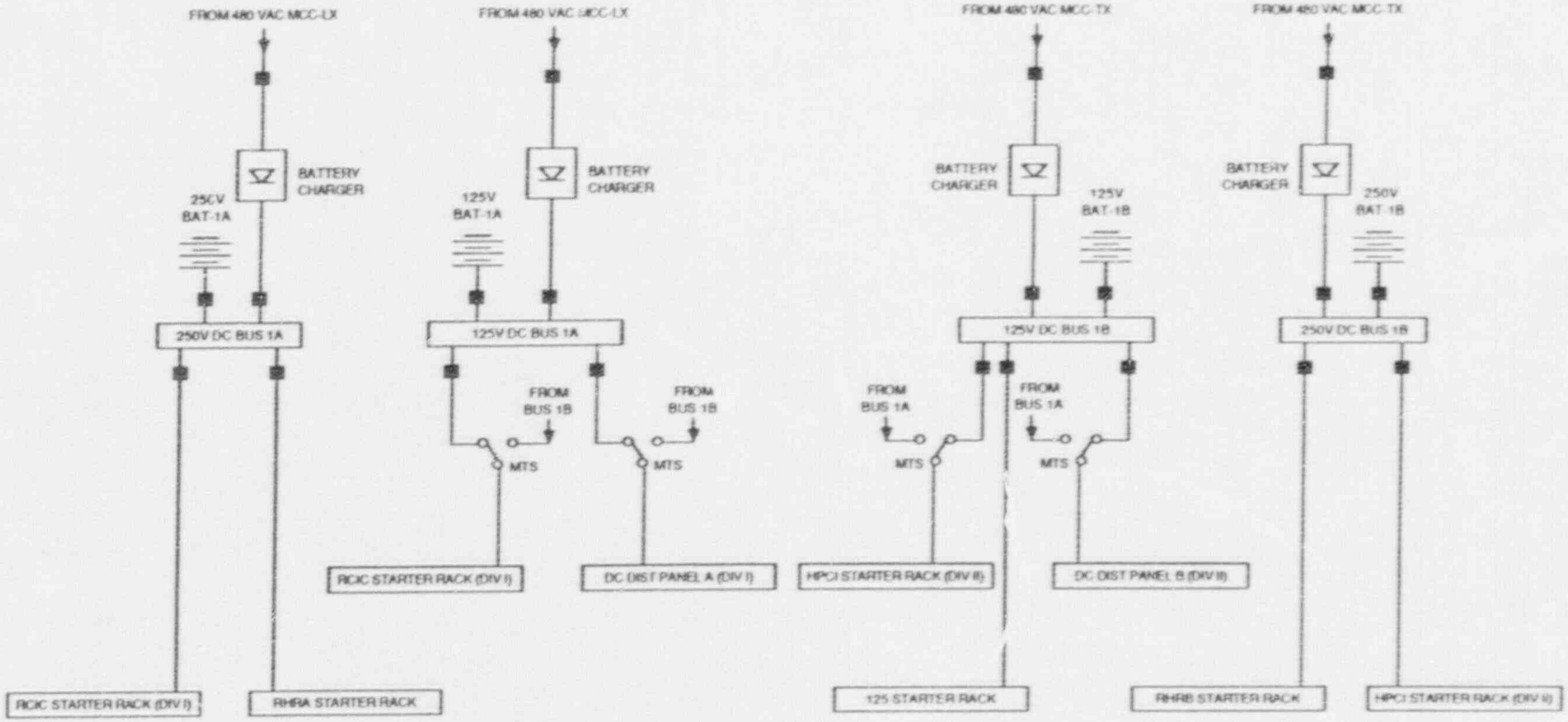

Figure 3.5-2. Cooper 250 and 125 VDC Electric Power Distribution System

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
BAT-1A	BATT	BTRMA		125		DC/A
BAT-1B	BATT	BTRMB		125		DC/B
BC-1A	BC	DCSGRMA	MCC-LX	480	ARLY	AC/F
BC-1B	BC	DCSGRMB	MCC-TX	480	ARLY	AC/G
BUS-1A	BUS	DCSGRMA	BT-1A	125	BTRMA	DC/A
BUS-1A	BUS	DCSGRMA	BC-1A	125/250	DCSGRMA	DC/A
BUS-1B	BUS	DCSGRMB	BT-1B	125	BTRMB	DC/B
BUS-1B	BUS	DCSGRMB	BC-1B	125/250	DCSGRMB	DC/B
BUS-1F	BUS	B1F	DG-1A	4160	DG1A	AC/F
BUS-1G	BUS	B1G	DG-1B	4160	DG1B	AC/G
CB-1F	CB	B1F	DG-1A	4160	DG1A	AC/F
CB-1G	CB	B1G	DG-1B	4160	DG1B	AC/G
DC-PNL-A	PNL	DCSGRMA	BUS-1A	125	DCSGRMA	DC/A
DC-PNL-B	PNL	DCSGRMB	BUS-1B	125	DCSGRMB	DC/B
DG-1A	DG	DG1A		4160	DG1A	AC/F
DG-1B	DG	DG1B		4160	DG1B	AC/G
HPCI-RK	MCC	HPCIRM	BUS-1B	125	DCSGRMB	DC/B
HPCI-RK	MCC	HPCIRM	BUS-1B	250	DCSGRMB	DC/B
IDBUS-1F	BUS	B1F	TR-1F	480	B1F	AC/F
IDBUS-1G	BUS	B1G	TR-1G	480	B1G	AC/G
INSPNL-1A	PNL	CSR	ITR480/120	120	DCSGRMA	AC/F
INSPNL-1B	PNL	CSR	ITR480/120	120	DCSGRMB	AC/G
ITR480/120	XFMR	DCSGRMA	MCC-LX	480	ARLY	AC/F
ITR480/120	XFMR	DCSGRMB	MCC-TX	480	ARLY	AC/G
MCC-K	MCC	903RB	IDBUS-1F	480	B1F	AC/F
MCC-L	MCC	882CB	IDBUS-1F	480	B1F	AC/F
MCC-LX	MCC	ARLY	IDBUS-1F	480	B1F	AC/F

Table 3.5-1. Cooper Electric Power System Data Summary for Selected Components (Continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
MCC-M	MCC	958RB	IDBUS-1F	480	B1F	AC/F
MCC-Q	MCC	903RB	MCC-K	480	903RB	AC/F
MCC-R	MCC	903RB	MCC-K	480	903RB	AC/F
MCC-RB	MCC	903RB	MCC-S	480	903RB	AC/G
MCC-S	MCC	903RB	IDBUS-1G	480	B1G	AC/G
MCC-TX	MCC	ARLY	IDBUS-1G	480	B1G	AC/G
MCC-Y	MCC	903RB	MCC-S	480	903RB	AC/G
RCIC-RK	MCC	859NECRNRM	BUS-1A	250	DCSGRMA	DC/A
RCIC-RK	MCC	903RB	BUS-1A	125	DCSGRMA	DC/A
RHRA-RK	MCC	903RB	BUS-1A	250	DCSGRMA	DC/A
RHRB-RK	MCC	903RB	BUS-1B	250	DCSGRMB	DC/B
STRT-RK	MCC	958RB	BUS-1B	125	DCSGRMB	DC/B
TR-1F	XFMR	B1F	BUS-1F	4160	B1F	AC/F
TR-1G	XFMR	B1G	BUS-1G	4160	B1G	AC/G

TABLE 3.5-2. PARTIAL LISTING OF ELECTRICAL SOURCES AND LOADS AT COOPER

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
BC-1A	125/250	DC/A	DCSGRMA	EP	BUS-1A	BUS	DCSGRMA
BC-1B	125/250	DC/B	DCSGRMB	EP	BUS-1B	BUS	DCSGRMB
BT-1A	125	DC/A	BTRMA	EP	BUS-1A	BUS	DCSGRMA
BT-1B	125	DC/B	BTRMB	EP	BUS-1B	BUS	DCSGRMB
BUS-1A	125	DC/A	DCSGRMA	EP	DC-PNL-A	PNL	DCSGRMA
BUS-1A	250	DC/A	DCSGRMA	EP	RCIC-RK	MCC	859NECRNRM
BUS-1A	125	DC/A	DCSGRMA	EP	RCIC-RK	MCC	903RB
BUS-1A	250	DC/A	DCSGRMA	EP	RHRA-RK	MCC	903RB
BUS-1B	125	DC/B	DCSGRMB	EP	DC-PNL-B	PNL	DCSGRMB
BUS-1B	125	DC/B	DCSGRMB	EP	HPCI-RK	MCC	HPCIRM
BUS-1B	250	DC/B	DCSGRMB	EP	HPCI-RK	MCC	HPCIRM
BUS-1B	250	DC/B	DCSGRMB	EP	RHRB-RK	MCC	903RB
BUS-1B	125	DC/B	DCSGRMB	EP	STRT-RK	MCC	958RB
BUS-1F	4160	AC/F	B1F	ECCS	CS-PM1A	MDP	859NECRNRM
BUS-1F	4160	AC/F	B1F	ECCS	LPSI-PMA	MDP	859NWCRNRM
BUS-1F	4160	AC/F	B1F	ECCS	LPSI-PMB	MDP	859SWCRNRM
BUS-1F	4160	AC/F	B1F	EP	TR-1F	XFMR	B1F
BUS-1F	4160	AC/F	B1F	SW	SW-PMA	MDP	ISPUMPRM
BUS-1F	4160	AC/F	B1F	SW	SW-PMC	MDP	ISPUMPRM
BUS-1G	4160	AC/G	B1G	ECCS	CS-PM1B	MDP	SECRNRM
BUS-1G	4160	AC/G	B1G	ECCS	LPSI-PMC	MDP	859NWCRNRM
BUS-1G	4160	AC/G	B1G	ECCS	LPSI-PMD	MDP	859SWCRNRM
BUS-1G	4160	AC/G	B1G	EP	TR-1G	XFMR	B1G
BUS-1G	4160	AC/G	B1G	SW	SW-PMB	MDP	ISPUMPRM
BUS-1G	4160	AC/G	B1G	SW	SW-PMD	MDP	ISPUMPRM
DG-1A	4160	AC/F	DG1A	EP	BUS-1F	BUS	B1F
DG-1A	4160	AC/F	DG1A	EP	CB-1F	CB	B1F
DG-1B	4160	AC/G	DG1B	EP	BUS-1G	BUS	B1G
DG-1B	4160	AC/G	DG1B	EP	CB-1G	CB	B1G
HPCI-RK	250	DC/B	HPCIRM	ECCS	HPCI-MO14	MOV	HPCIRM
HPCI-RK	125	DC/B	HPCIRM	ECCS	HPCI-MO16	MOV	903ACCSHLDRM

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
HPCI-RK	125	DC/B	HPCIRM	ECCS	HPCI-MO16	MOV	903ACCSHLDR M
HPCI-RK	125	DC/B	HPCIRM	ECCS	HPCI-MO17	MOV	HPCIRM
HPCI-RK	250	DC/B	HPCIRM	ECCS	HPCI-MO19	MOV	STMTUN
HPCI-RK	250	DC/B	HPCIRM	ECCS	HPCI-MO20	MOV	HPCIRM
HPCI-RK	125	DC/B	HPCIRM	ECCS	HPCI-MO58	MOV	HPCIRM
HPCI-RK	250	[illegible]/B	HPCIRM	ECCS	HPCI-V21	MOV	HPCIRM
HPCI-RK	250	[illegible]/B	HPCIRM	ECCS	HPCI-V24	MOV	HPCIRM
HPCI-RK	250	DC/B	HPCIRM	ECCS	HPCI-V25	MOV	HPCIRM
HPCI-RK	250	DC/B	HPCIRM	RCS	RHR-M17	MOV	903ACCSHLDR M
IDBUS-1F	480	AC/F	B1F	EP	MCC-K	MCC	903RB
IDBUS-1F	480	AC/F	B1F	EP	MCC-L	MCC	882CB
IDBUS-1F	480	AC/F	B1F	EP	MCC-LX	MCC	ARLY
IDBUS-1F	480	AC/F	B1F	EP	MCC-M	MCC	958RB
IDBUS-1G	480	AC/G	B1G	EP	MCC-S	MCC	903RB
IDBUS-1G	480	AC/G	B1G	EP	MCC-TX	MCC	ARLY
INSPNL-1A	120	AC/F	CSR	I&C		PNL	CR
INSPNL-1B	120	AC/G	CSR	I&C		PNL	CR
ITR480/120	120	AC/F	DCSGRMA	EP	INSPNL-1A	PNL	CSR
ITR480/120	120	AC/G	DCSGRMB	EP	INSPNL-1B	PNL	CSR
MCC-K	480	AC/F	903RB	EP	MCC-Q	MCC	903RB
MCC-K	480	AC/F	903RB	EP	MCC-R	MCC	903RB
MCC-LX	480	AC/F	ARLY	EP	BC-1A	BC	DCSGRMA
MCC-LX	480	AC/F	ARLY	EP	ITR480/120	XFMR	DCSGRMA
MCC-Q	480	AC/F	903RB	ECCS	CS-MO7A	MOV	859NECRNRM
MCC-Q	480	AC/F	903RB	ECCS	CS-MO11A	MOV	931RB
MCC-Q	480	AC/F	903RB	ECCS	CS-MO12A	MOV	931RB
MCC-Q	480	AC/F	903RB	ECCS	CS-V26A	MOV	859NECRNRM
MCC-Q	480	AC/F	903RB	ECCS	LPSI-V12A	MOV	903AHXRM
MCC-Q	480	AC/F	903RB	ECCS	LPSI-V13A	MOV	859NWCRNRM
MCC-Q	480	AC/F	903RB	ECCS	LPSI-V13C	MOV	859NWCRNRM
MCC-Q	480	AC/F	903RB	ECCS	LPSI-V26A	MOV	903AHXRM

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC-Q	480	AC/F	903RB	ECCS	LPSI-V31A	MOV	931RB
MCC-Q	480	AC/F	903RB	ECCS	LPSI-V34A	MOV	881NWCRNRM
MCC-Q	480	AC/F	903RB	ECCS	LPSI-V39A	MOV	881NWCRNRM
MCC-Q	480	AC/F	903RB	ECCS	LPSI-V65A	MOV	931AHXRM
MCC-Q	480	AC/F	903RB	ECCS	LPSI-V66A	MOV	903AHXRM
MCC-R	480	AC/F	903RB	ECCS	HPCI-MO15	MOV	CX
MCC-R	480	AC/F	903RB	ECCS	HPCI-MO15	MOV	CX
MCC-R	480	AC/F	903RB	ECCS	LPSI-MO27A	MOV	903ACCSHLDR M
MCC-R	480	AC/G	903RB	RCS	RCS-V74	MOV	CX
MCC-R	480	AC/F	903RB	RCS	RHR-M18	MOV	CX
MCC-R	480	AC/F	903RB	RCS	RWCU-V15	MOV	CX
MCC-RB	480	AC/G	903RB	ECCS	LPSI-MO27B	MOV	903ACCSHLDR M
MCC-S	480	AC/G	903RB	EP	MCC-RB	MCC	903RB
MCC-S	480	AC/G	903RB	EP	MCC-Y	MCC	903RB
MCC-TX	480	AC/G	ARLY	EP	BC-1B	BC	DCCGRMB
MCC-TX	480	AC/G	ARLY	EP	ITR480/120	XFMR	DCSGRMB
MCC-Y	480	AC/G	903RB	ECCS	CS-M011B	MOV	931RB
MCC-Y	480	AC/E	903RB	ECCS	CS-M012B	MOV	931RB
MCC-Y	480	AC/G	903RB	ECCS	CS-M07B	MOV	SECRNRM
MCC-Y	480	AC/G	903RB	ECCS	CS-V26B	MOV	SECRNRM
MCC-Y	480	AC/G	903RB	ECCS	LPSI-V12B	MOV	903BHXRM
MCC-Y	480	AC/G	903RB	ECCS	LPSI-V13B	MOV	859SWCRNRM
MCC-Y	480	AC/G	903RB	ECCS	LPSI-V13D	MOV	859SWCRNRM
MCC-Y	480	AC/G	903RB	ECCS	LPSI-V26B	MOV	903BHXRM
MCC-Y	480	AC/G	903RB	ECCS	LPSI-V31B	MOV	903RB
MCC-Y	480	AC/G	903RB	ECCS	LPSI-V34B	MOV	881SWCRNRM
MCC-Y	480	AC/G	903RB	ECCS	LPSI-V39B	MOV	881SWCRNRM
MCC-Y	480	AC/G	903RB	ECCS	LPSI-V65B	MOV	931BHXRM
MCC-Y	480	AC/G	903RB	ECCS	LPSI-V66B	MOV	903BHXRM
MCC-Y	480	AC/G	903RB	RCIC	RCIC-MO115	MOV	CX
MCC-Y	480	AC/G	903RB	RCS	RCIC-MO15	MOV	CX

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
RCIC-RK	125	DC/A	903RB	RCIC	RCIC-MO131	MOV	859NECRNRM
RCIC-RK	125	DC/A	903RB	RCIC	RCIC-MO16	MOV	STMTUN
RCIC-RK	125	DC/A	903RB	RCIC	RCIC-MO18	MOV	859NECRNRM
RCIC-RK	125	DC/A	903RB	RCIC	RCIC-MO20	MOV	859NECRNRM
RCIC-RK	125	DC/A	903RB	RCIC	RCIC-MO21	MOV	STMTUN
RCIC-RK	125	DC/A	903RB	RCIC	RCIC-MO41	MOV	859NECRNRM
RCIC-RK	125	DC/A	903RB	RCIC	RCIC-V27	MOV	859NECRNRM
RCIC-RK	125	DC/A	903RB	RCIC	RCIC-V30	MOV	859NECRNRM
RCIC-RK	125	DC/A	903RB	RCIC	RCIC-V33	MOV	859NECRNRM
RCIC-RK	125	DC/A	903RB	RCS	RCIC-MO16	MOV	STMTUN
RHRA-RK	250	DC/A	903RB	ECCS	LPSI-V25A	MOV	903ACCSHLDRM
RHRB-RK	250	DC/B	903RB	ECCS	LPSI-V25A	MOV	903ACCSHLDRM
STRT-RK	125	DC/B	958RB	RCS	RWCU-V18	MOV	RWCUHXRM
TR-1F	480	AC/F	B1F	EP	IDBUS-1F	BUS	B1F
TR-1G	480	AC/G	B1G	EP	IDBUS-1G	BUS	B1G

3.6 CONTROL ROD DRIVE HYDRAULIC SYSTEM (CRDHS)

3.6.1 System Function

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

3.6.2 System Definition

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

Details of the scram portion of typical BWR CRDHS is shown in Figure 3.6-1 (adapted from Ref 1).

3.6.3 System Operation

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

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

Although not intended as a makeup system, the CRDHS can provide a source of cooling water to the RCS during vessel isolation. It is noted in NUREG-0626 (Ref. 2), that this function is particularly important for some BWR/1 and BWR/2 plants for which the CRDHS is the primary source of makeup on vessel isolation. In later model BWR plants, RCS makeup at high pressure is performed by the RCIC (see Section 3.2) and HPCI (see Section 3.3) systems. The maximum RCS makeup rate of the CRDHS is about 200 gpm with both pumps operating (Ref. 3).

3.6.4 System Success Criteria

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

- A scram signal must be transmitted by the RPS to the actuated devices (i.e., pilot valves) in the CRDHS.
- The pneumatic inlet scram valve and outlet scram valve must open in the hydraulic control units (HCUs) for the individual control rod drives. This is accomplished by venting the instrument air supply to each valve as follows:
  - Both scram pilot valves in each HCU must be deenergized, or
  - Either backup scram pilot valve must be energized.
- A high-pressure water source must be available from the scram accumulator in each HCU.
- A hydraulic vent path to the scram discharge volume must be available and sufficient collection volume must exist in the scram discharge volume.
- A specified number of control rods must responds and insert into the reactor core (specific number needed is not known).

3.6.5 Component Information

A. Control rod drive pumps (2)
   1. Rated capacity: 100% (for control rod drive function)
   2. Flow rate: about 120 gpm @ 1500 psig
   3. Type: centrifugal

B. Condensate Storage Tank
   1. Capacity: 500,000 gal

3.6.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The RPS transmits scram commands to solenoid pilot valves which control the pneumatic scram valves

   2. Remote Manual
      a. A reactor scram can be initiated manually from the control room
      b. The CRDHS can be operated manually from the control room to insert and withdraw rods, or to inject water into the RCS

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

3.6.7 Section 3.6 References

1. NEDO-24708A, "Additional Information Required for NRC Staff Generic Report on Boiling Water Reactors," General Electric Company, December 1980.

2. NUREG-0626, "Generic Evaluation of Feedwater Transients and Small Break Loss-of-Coolant-Accidents in GE-designed Operating Plants and Near-term Operating License Applications," USNRC, January 1980.

3. Harrington, R.M., and Ott, L.J., "The Effect of Small-Capacity, High-Pressure Injection Systems on TQUV Sequences at Browns Ferry Unit One," NUREG/CR-31 9, Oak Ridge National Laboratory, September 1983.

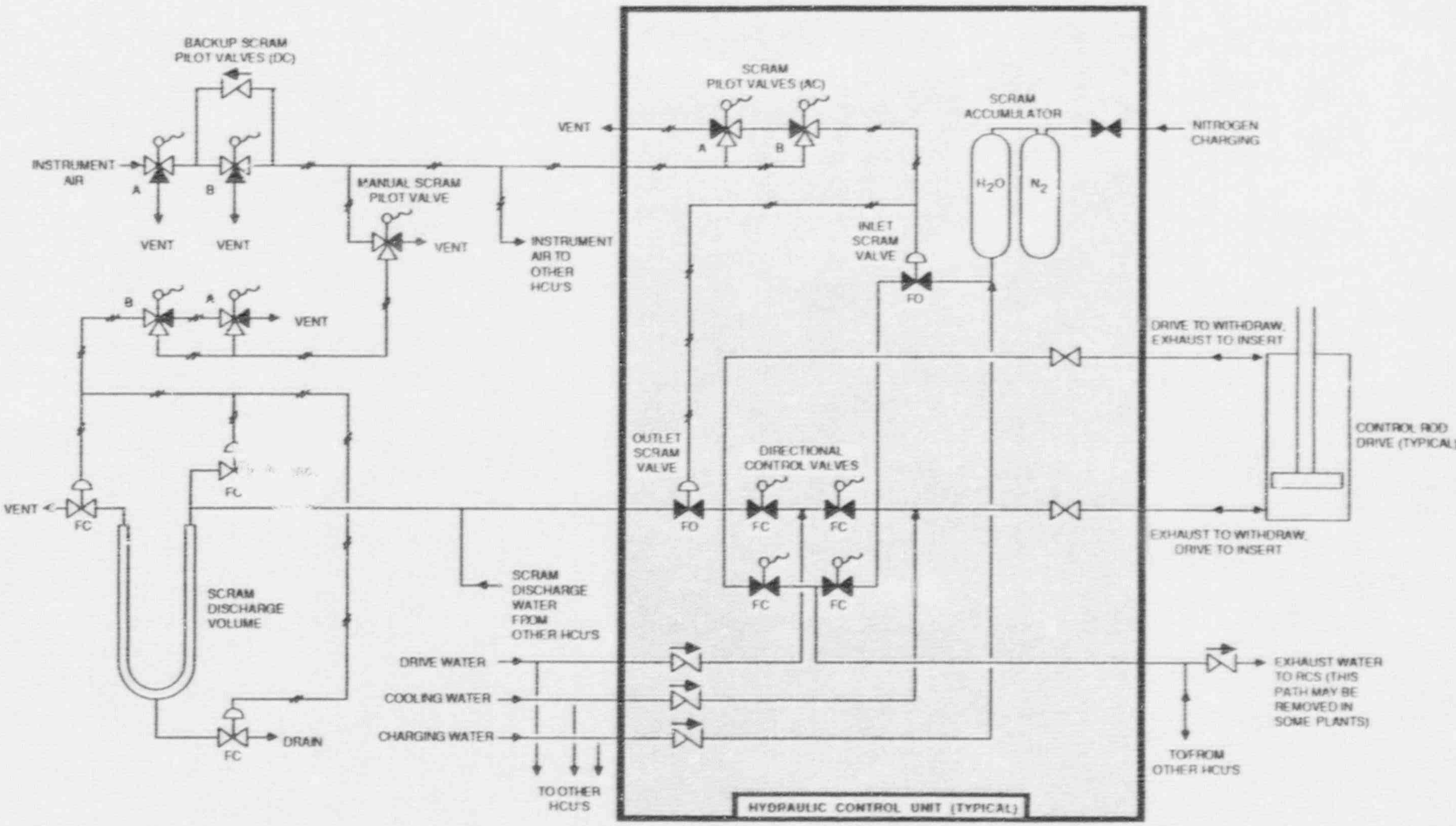

Figure 3.6-1. Simplified Diagram Of Portions Of The Control Rod Drive Hydraulic System That Are Related To The Scram Function

3.7 REACTOR BUILDING CLOSED COOLING WATER (RBCCW) SYSTEM

3.7.1 System Function

The reactor building closed cooling water system provides cooling to the core standby cooling system areas and the RHR pumps. Heat is transferred from the system to the service water system via the RBCCW heat exchangers.

3.7.2 System Definition

The RBCCW system consists of two independent closed loops. Each loop contains two pumps and one heat exchanger for cooling of essential equipment and a non-essential header which is isolated during accident conditions.

Simplified drawings of the RBCCW are shown in Figures 3.7-1 and 3.7-2.

3.7.3 System Operation

The RBCCW is normally operating, supplying heat loads in the essential and non-essential loops. One pump in each RBCCW loop is capable of supplying sufficient water to transfer the essential service design cooling load to the service water system. These pumps operate normally with the essential cooling service valved off. Upon receipt of signals indicating operation of the core standby cooling function following a LOCA, the non-essential loads are isolated and two motor operated valves (one on each loop) are opened to supply cooling for the essential loads. The equipment supplied by the RBCCW are as follows:

	Loop A	Loop B
- Two RHR pump seal coolers	X	X
- HPCI pump area cooling	X	
- RHR pump area cooling	X	X
- Core spray pump area cooling	X	X

3.7.4 System Success Criteria

Following a design basis accident (DBA), the following success criteria applies to the RBCCW system (Ref. 1).

- One-out-of-four RBCCW pumps operate successfully
- The appropriate RBCCW heat exchanger is available
- The appropriate train of the service water system is successful (see Section 3.8)

Note that the Service Water System is a redundant cooling water source for most of the components served by the RBCCW system, therefore the SW system can perform the same function as the RBCCW. Since RBCCW success is dependent on SW success, the RBCCW pumps and heat exchangers is actually unnecessary under emergency conditions.

3.7.5 Component Information

A. RBCCW Pumps (1A, 1B, 1C, and 1D)
  1. Rated flow: 1350 gpm @ 150 ft. head (65 psid)
  2. Rated capacity: 100%
  3. Type: centrifugal

B. RBCCW Heat Exchangers (1A and 1B)
  1. Design heat transfer: 33×10^6 Btu/hr
  2. Rated capacity: 100%

3.7.6 Support Systems and Interfaces

A. Control Signals

1. Automatic

Upon receipt of the following signals the pumps are started and the essential supply valves are opened.

- Starting of any RHR pump motor
- Starting of any core spray pump motor
- Opening of HPCI turbine steam supply valve
- Opening of RCIC turbine steam supply valve
- Drywell isolation

2. Remote manual

The pumps and valves can be actuated by remote manual means from the control room.

B. Motive Power

1. The RBCCW pumps are Class 1E AC loads supplied by the 480V emergency buses. Pumps 1A and 1B are supplied by Bus 1F and pumps 1C and 1D are supplied by Bus 1G.

3.7.7 Section 3.7 References

1. Cooper FSAR, Section 10.6.

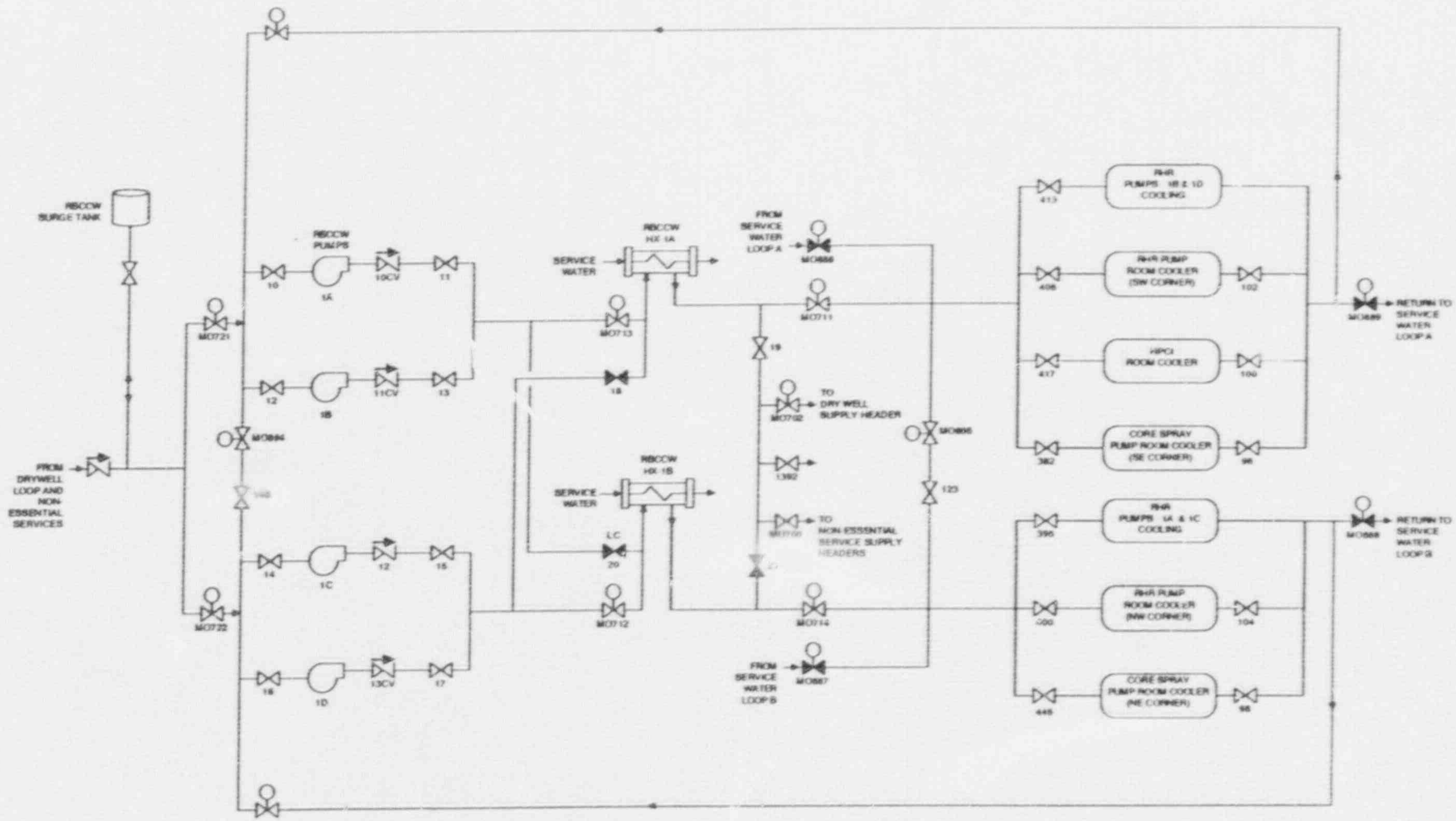

Figure 3.7-1. Cooper Reactor Building Closed Cooling Water System

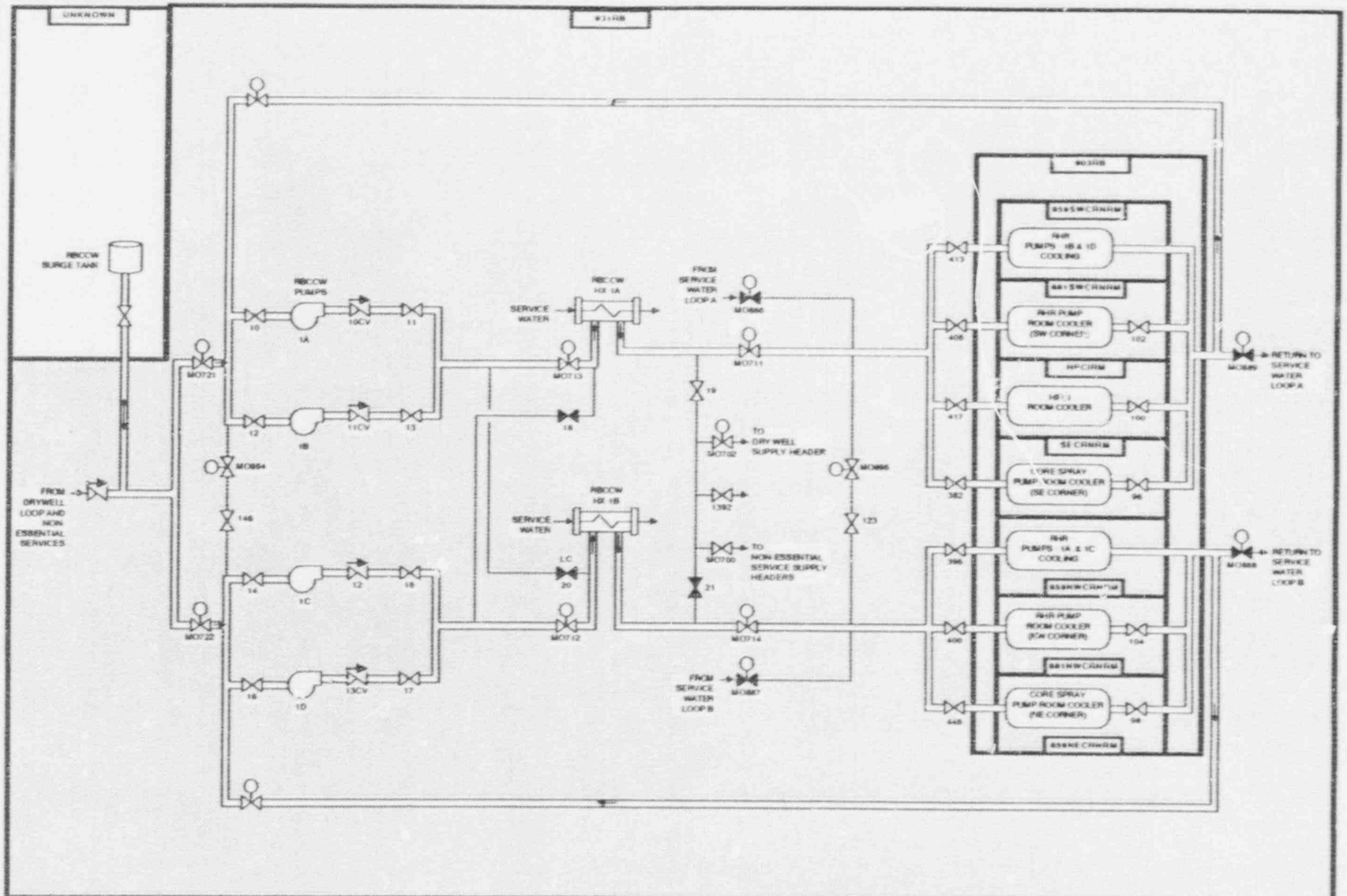

Figure 3.7-2. Cooper Reactor Building Closed Cooling Water System Showing Component Locations

3.8 SERVICE WATER (SW) AND RHR SERVICE WATER BOOSTER SYSTEM

3.8.1 System Function

The Service Water and RHR Service Water Booster System provides cooling water from ultimate heat sink, the Missouri River, to the secondary side of the RBCCW heat exch... and the RHR service water booster pumps. This system also can perform a core flood function in an emergency.

3.8.2 System Definition

The system contains four motor driven service water pumps which take suction through strainers at the intake structure. The pumps supply two headers from which the RBCCW heat exchangers, diesel heat exchangers, and RHR Service Water Booster Pumps are supplied.

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

3.8.3 System Operation

During normal operation three service water pumps are required to cool the operating heat loads. One pump per SW train is sufficient for the emergency loads supported by that train as follows:

- Diesel generator
- RBCCW heat exchangers
- RHR service water pumps

The diesel generator and the RBCCW heat exchangers can be supplied by either loop of service water

3.8.4 System Success Criteria

One pump per SW train will support the heat loads served by that train.

3.8.5 Component Information

A. Service Water Pumps (A, B, C and D)
   1. Rated flow: 8000 gpm @ 125 ft. head (54 psid)
   2. Rated capacity: 100% (accident loads)
   3. Type: vertical turbine

B. RHR Service Water Booster Pumps
   1. Rated flow: 4000 gpm @ 800 ft. head (347 psid)
   2. Rated Capacity: 50%

3.8.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      Upon receipt of a LOCA or LOSP signal, one pump in each division is started.
   2. Remote manual
      The SW pumps can be actuated by remote manual means from the control room.

B. Motive Power

1. The SW pumps are Class 1E AC loads that can be supplied from the emergency diesel generator as described in Section 3.5.

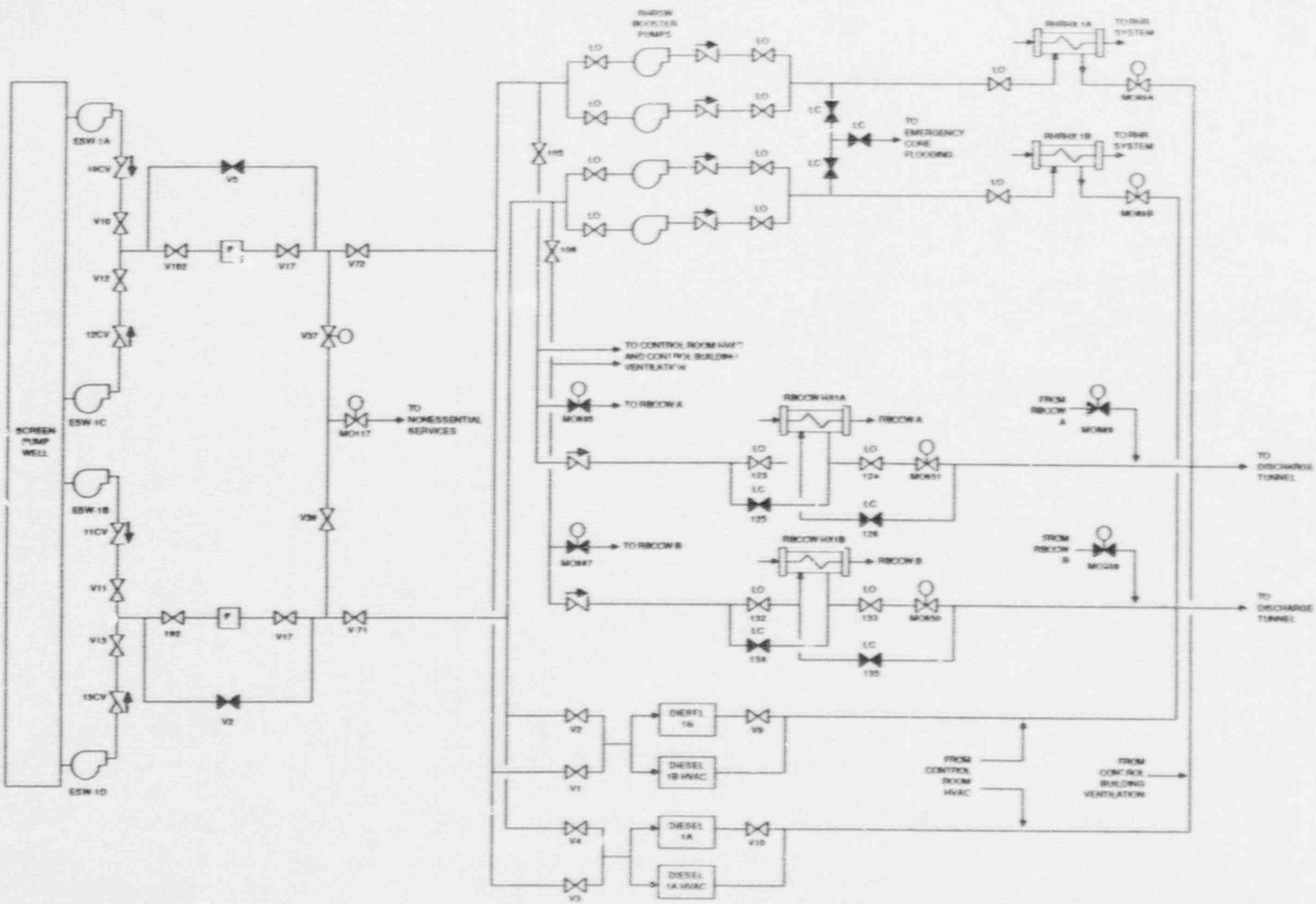

Figure 3.8-1. Cooper Service Water (SW) and RHR Service Water Booster System

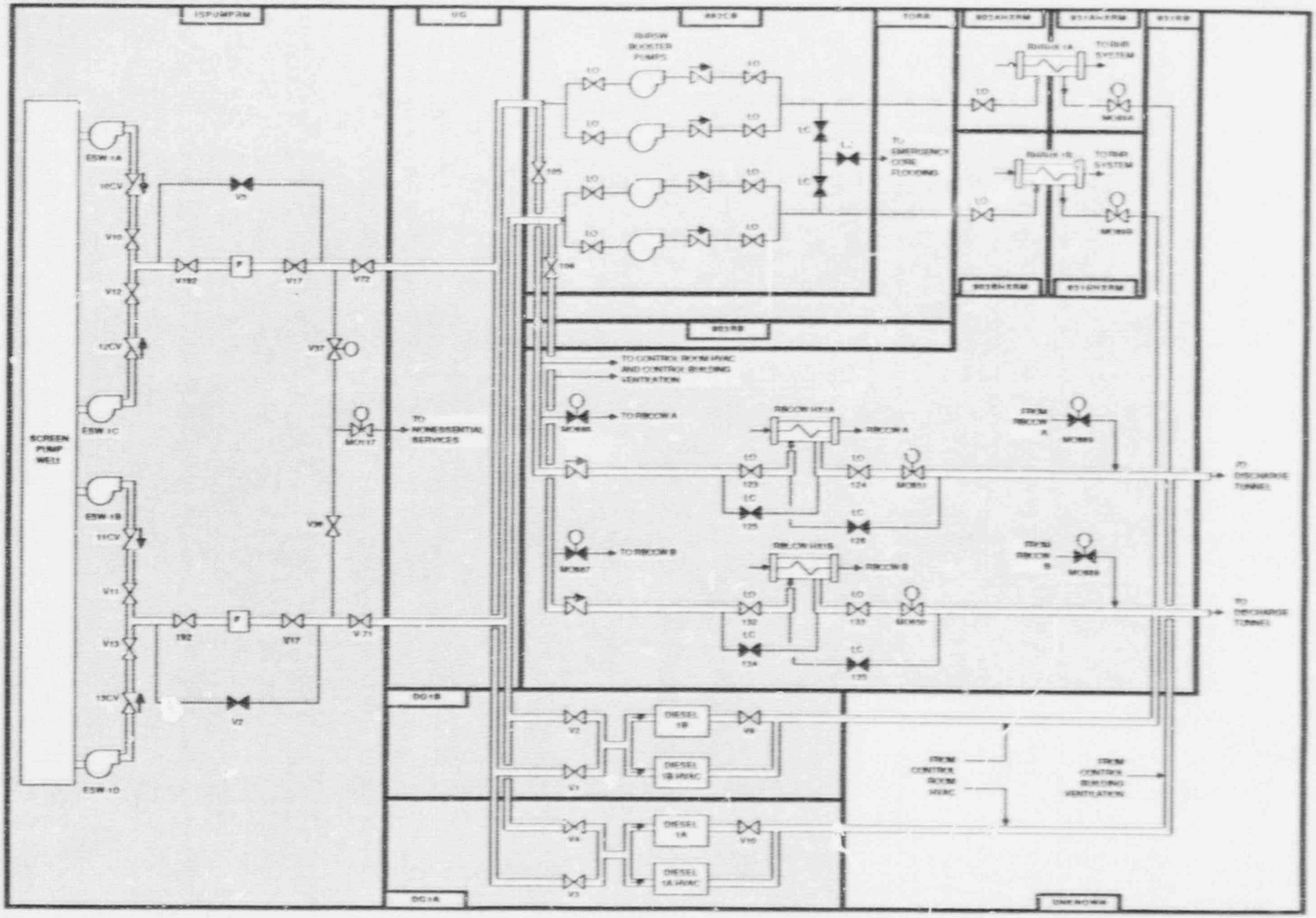

Figure 3.8-2. Cooper Service Water (SW) and RHR Service Water Booster System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
SW-PMA	MDP	ISPUMPRM	BUS-1F	4160	B1F	AC/F
SW-PMB	MDP	ISPUMPRM	BUS-1G	4160	B1G	AC/G
SW-PMC	MDP	ISPUMPRM	BUS-1F	4160	B1F	AC/F
SW-PMD	MDP	ISPUMPRM	BUS-1G	4160	B1G	AC/G

4. PLANT INFORMATION

4.1 SITE AND BUILDING SUMMARY

The Cooper Nuclear Station is located on a 1351 acre site on the west bank of the Missouri River near the towns of Brownville and Nemaha, Nebraska in Nemaha County. The plant is at river mile 532.5 in an area of the river know as the Lower Brownville Bend. Figure 4-1 (from Ref. 1) shows a general view of the site and the surrounding area.

The major structures at this facility include the reactor building, the turbine building, the control building, the diesel generator building, the intake structure, the radioactive waste building and various support structures. The site general arrangement is shown in Figure 4-2.

The reactor building is located on the west side of the turbine building. The building contains the primary containment drywell and torus housing, the reactor vessel, and recirculation piping, the fuel pool and the emergency core cooling system. An elevation drawing of the Cooper reactor building is shown in Figure 4-3.

The control building, located to the west of the turbine building and north of the reactor building contains the control room, computer room, cable spreading rooms, the DC batteries and switchgear, the auxiliary relay room and the emergency condensate storage tanks.

The diesel generator building is located on the east side of the turbine building. This structure houses both emergency diesel generator and their associated fuel day tanks.

The intake structure is to the east of the diesel generator building and is located on the west bank of the Missouri River. The Missouri River is the normal heat sink during power operation and also is the ultimate heat sink for safety-related heat loads.

4.2 FACILITY LAYOUT DRAWINGS

Figures 4-4 thru 4-15 are simplified building layout drawings for the Cooper reactor and turbine buildings and intake structure. Some outlying buildings are not shown on these drawings. Major rooms, stairways, elevators, and doorways are shown in the simplified layout drawings however, many interior walls have been omitted for clarity. Labels printed in uppercase correspond to the location codes listed in Table 4-1 and used in the component data listings and system drawings in Section 3. Some additional labels are included for information and are printed in lowercase type.

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

4.3 SECTION 4 REFERENCES

1. Heddleson, F.A., "Design Data and Safety Features of Commercial Nuclear Power Plants," ORNL-NSIC-55, Volume 2, Oak Ridge National Laboratory, Nuclear Safety Information Center, January1972.

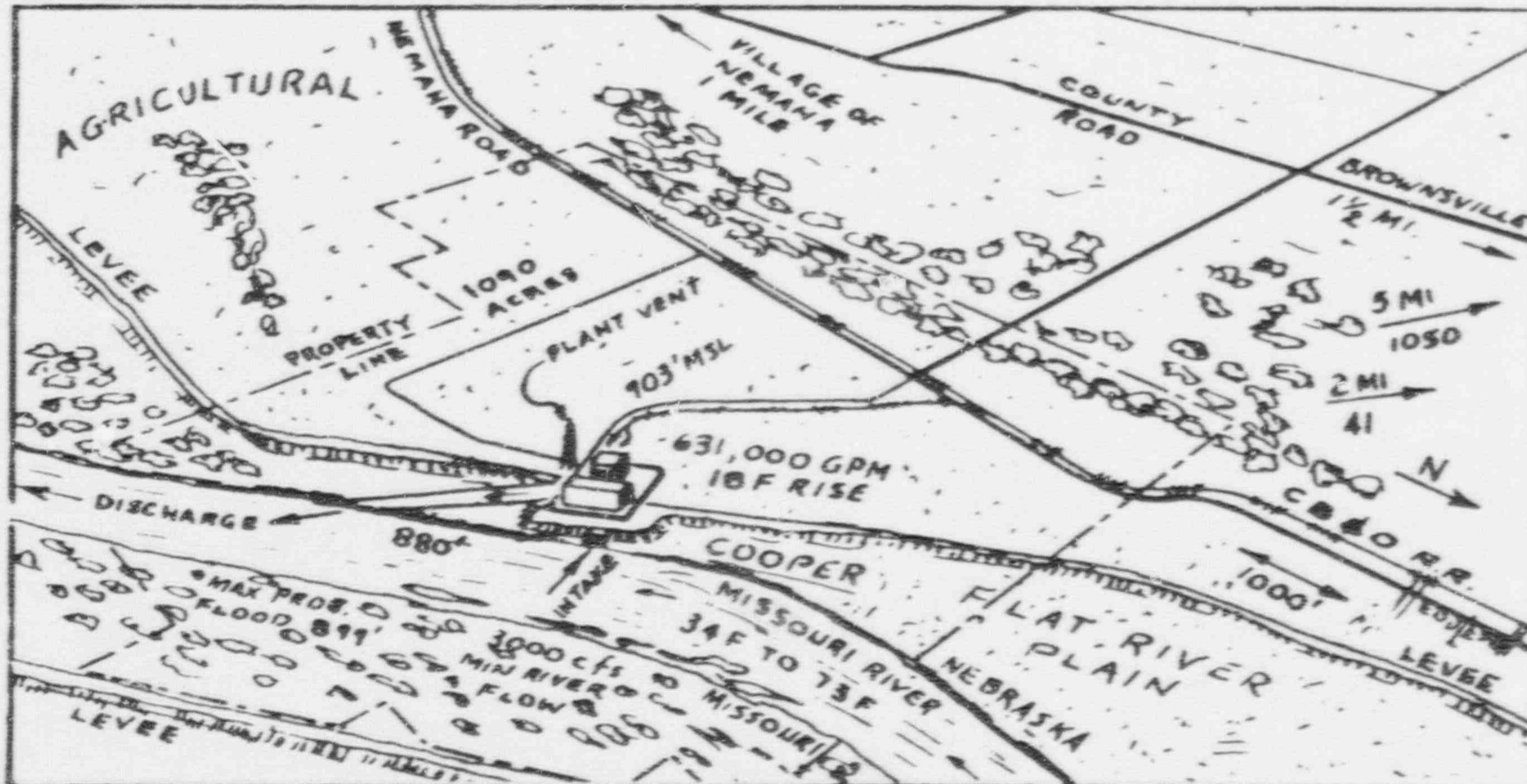

Figure 4-1. General View of Cooper Nuclear Station and Vicinity

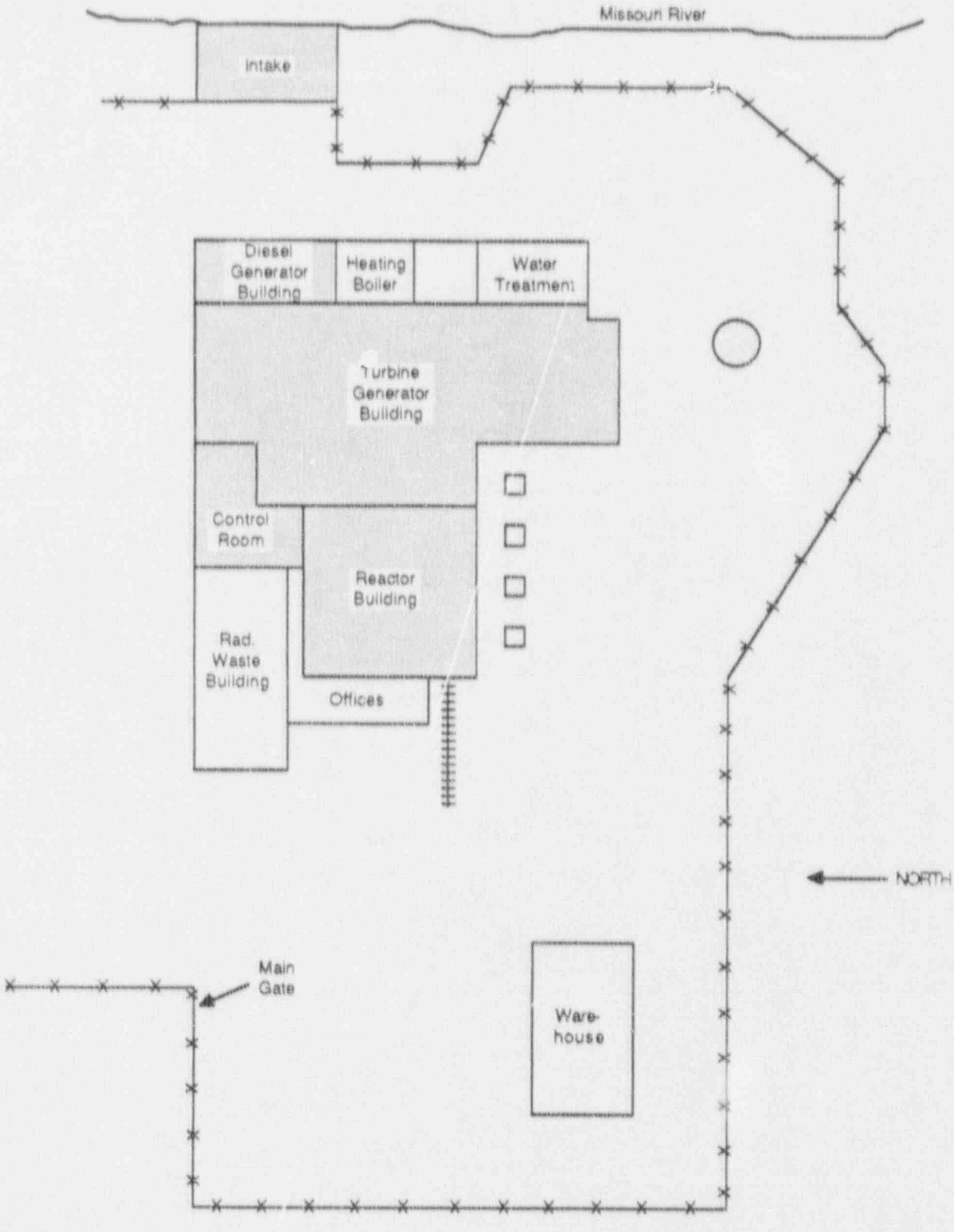

Figure 4-2. Cooper Nuclear Station Site Plan

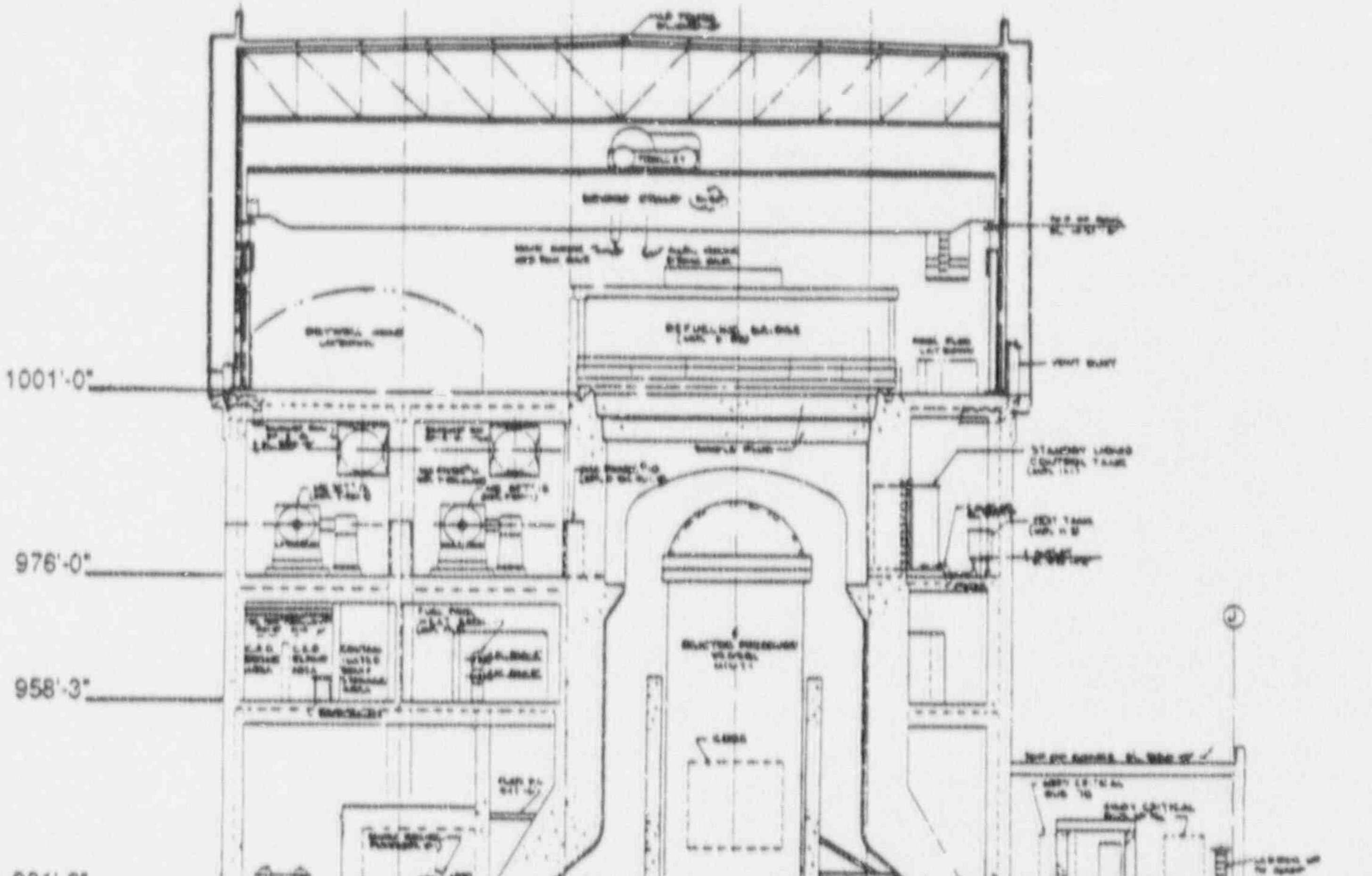

Figure 4-3. Cooper Nuclear Station Reactor Building Section

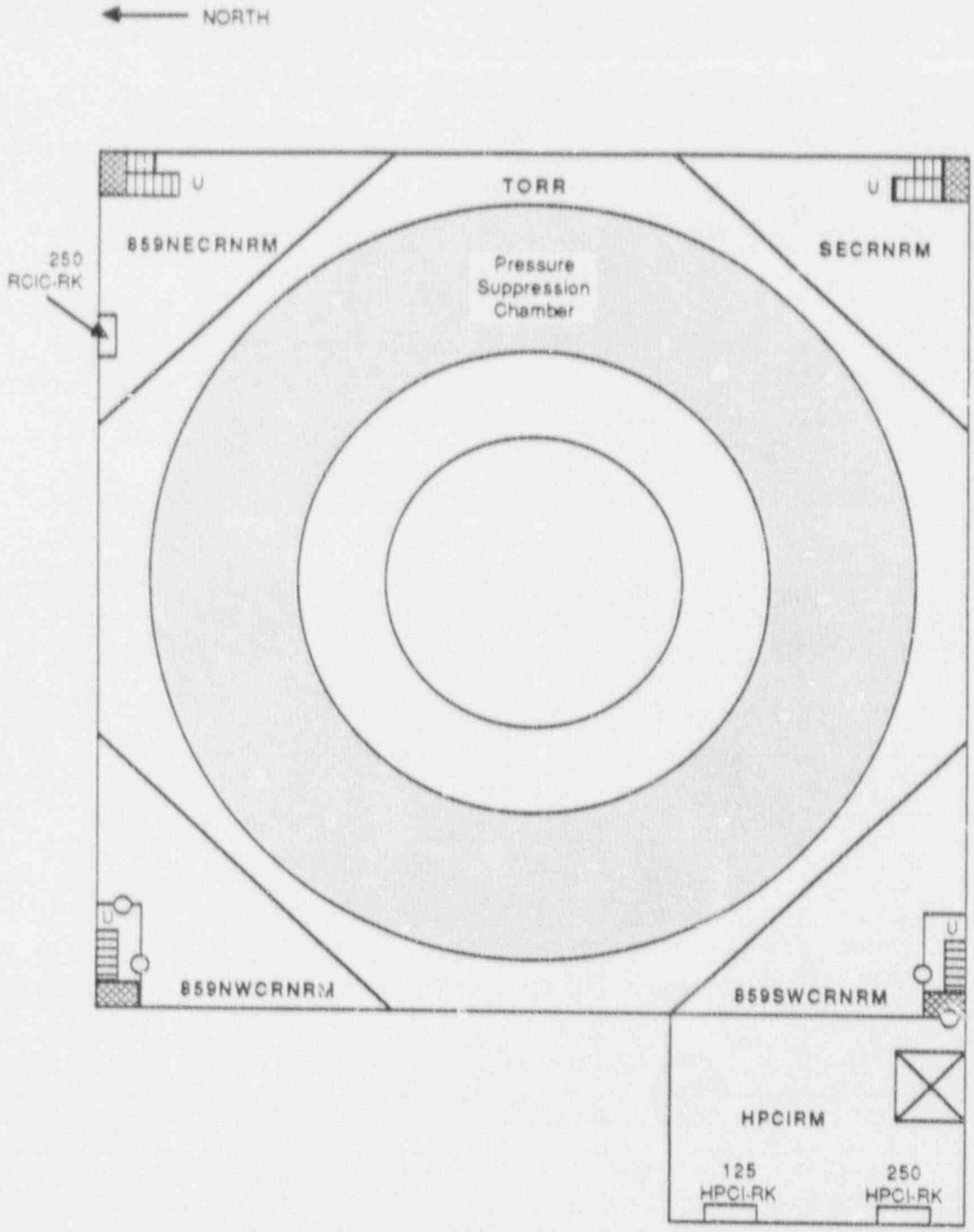

Figure 4-4. Cooper Nuclear Station Reactor Building, Elevation 859'-9"

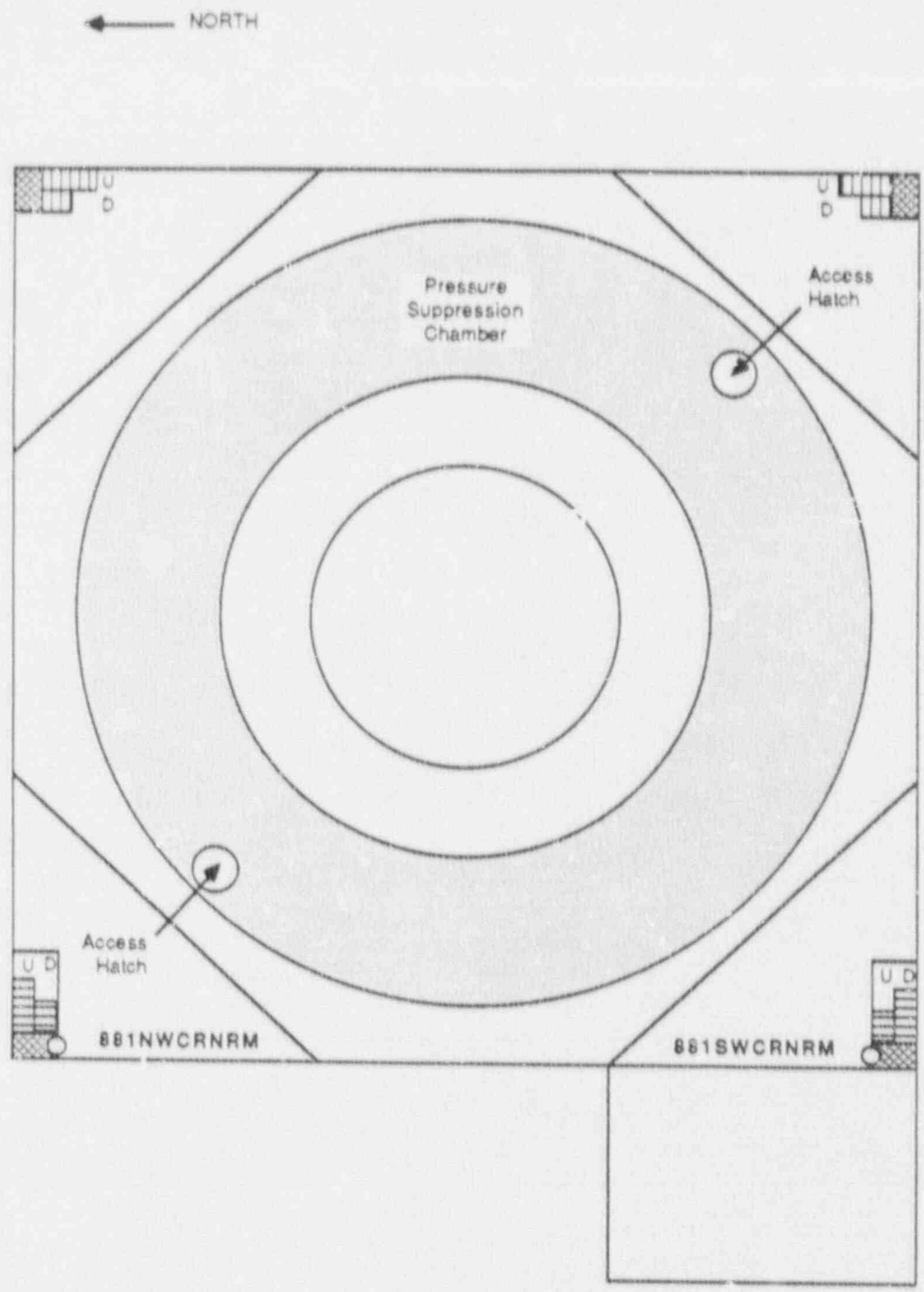

Figure 4-5. Cooper Nuclear Station Reactor Building, Elevation 881'-9"

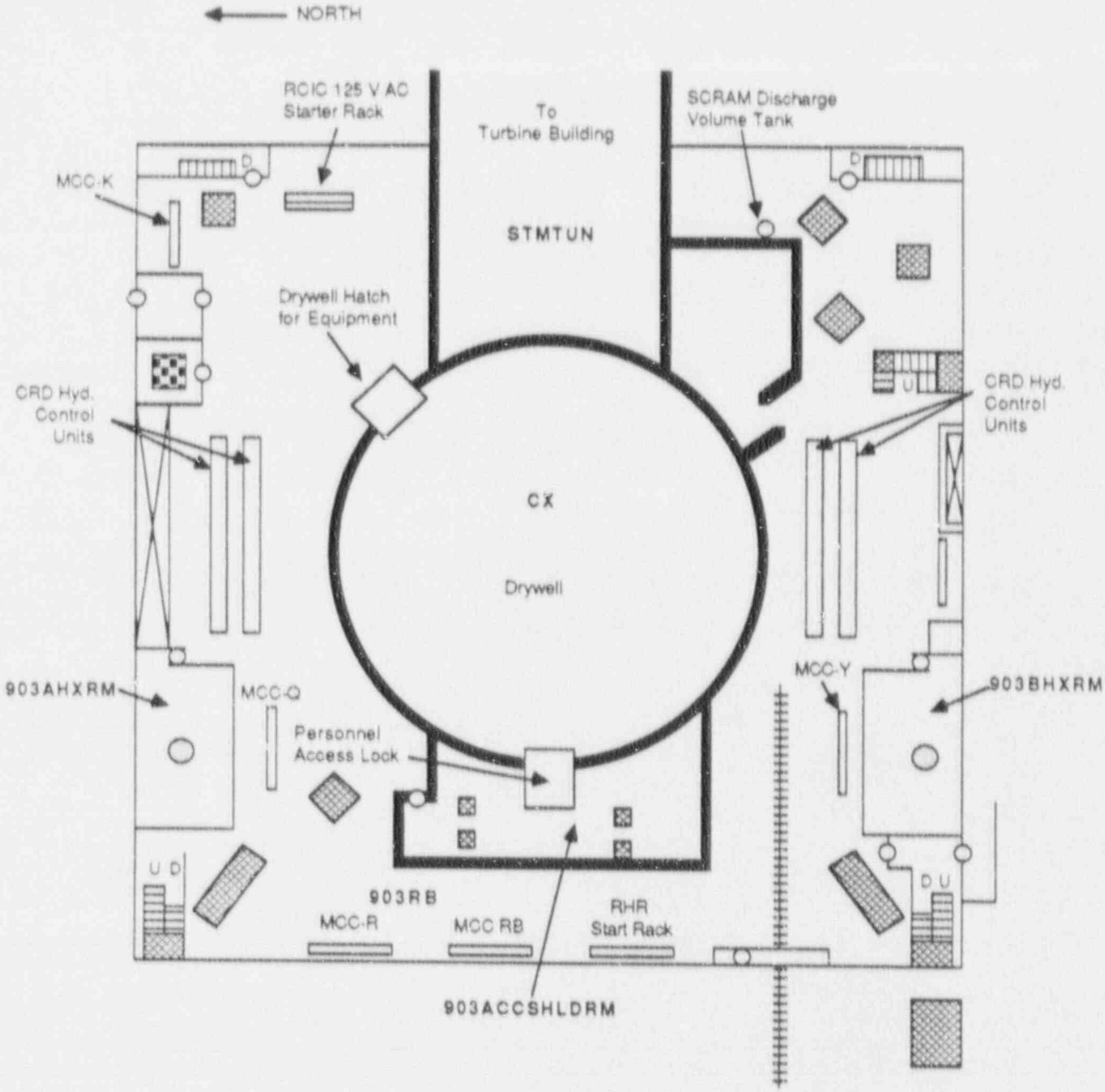

Figure 4-6. Cooper Nuclear Station Reactor Building, Elevation 903'-6"

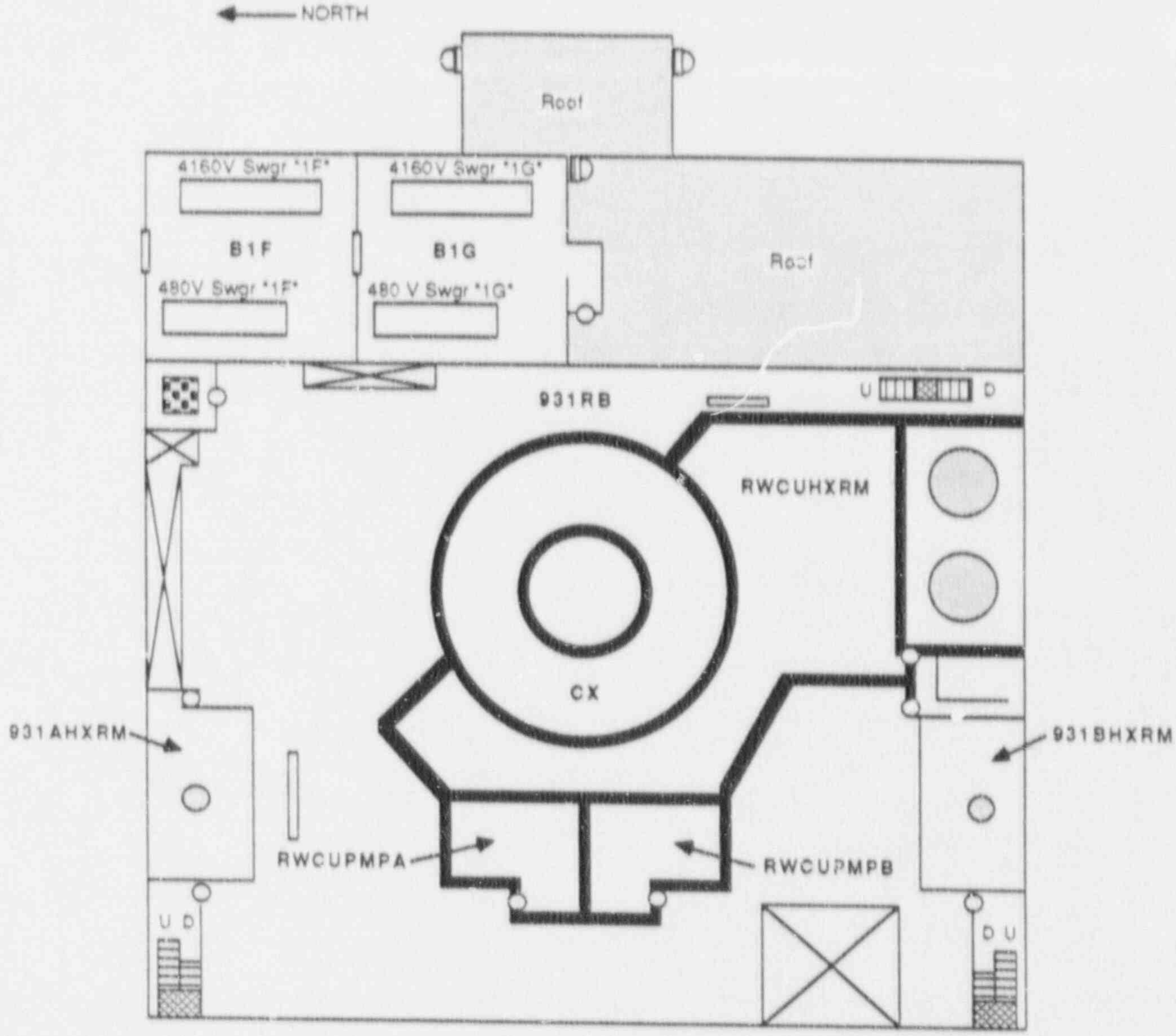

Figure 4-7. Cooper Nuclear Station Reactor Building, Elevation 931'-6"

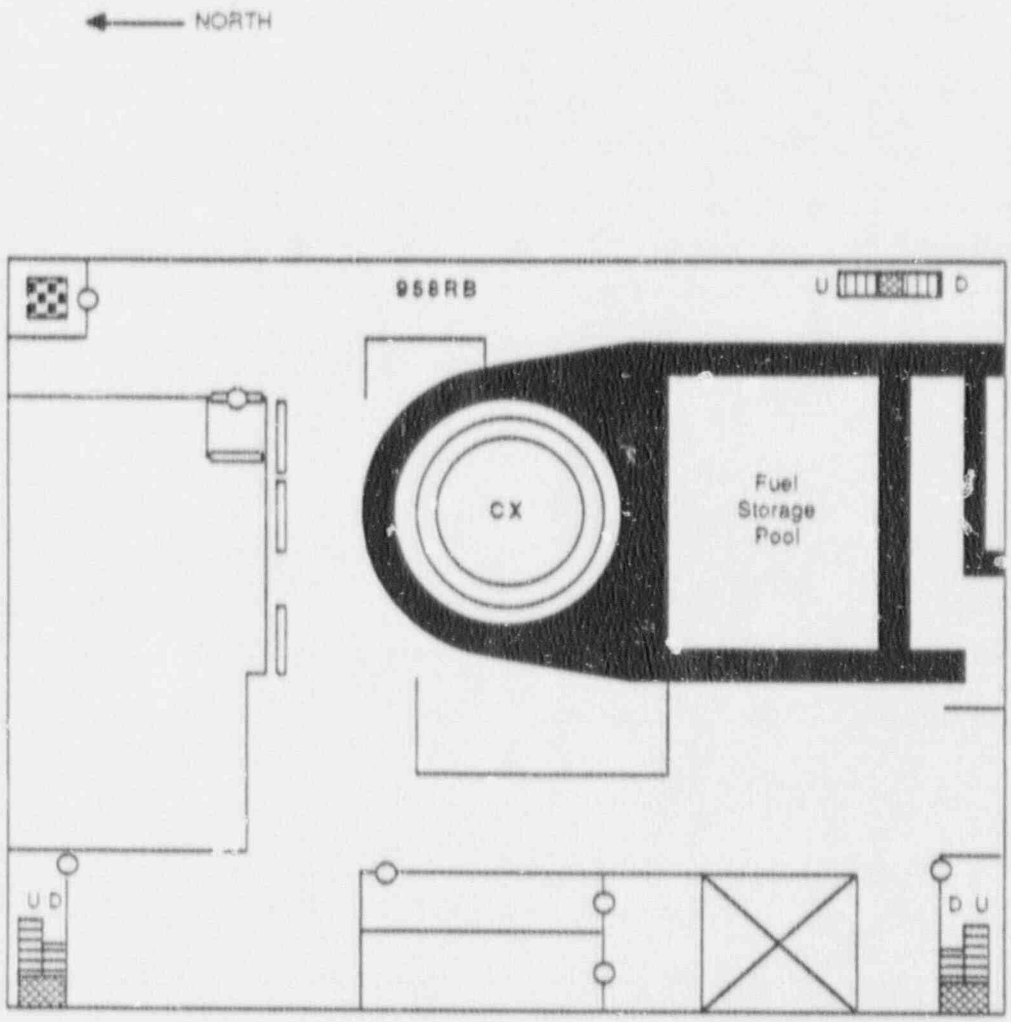

Figure 4-8. Cooper Nuclear Station Reactor Building, Elevation 958'-3"

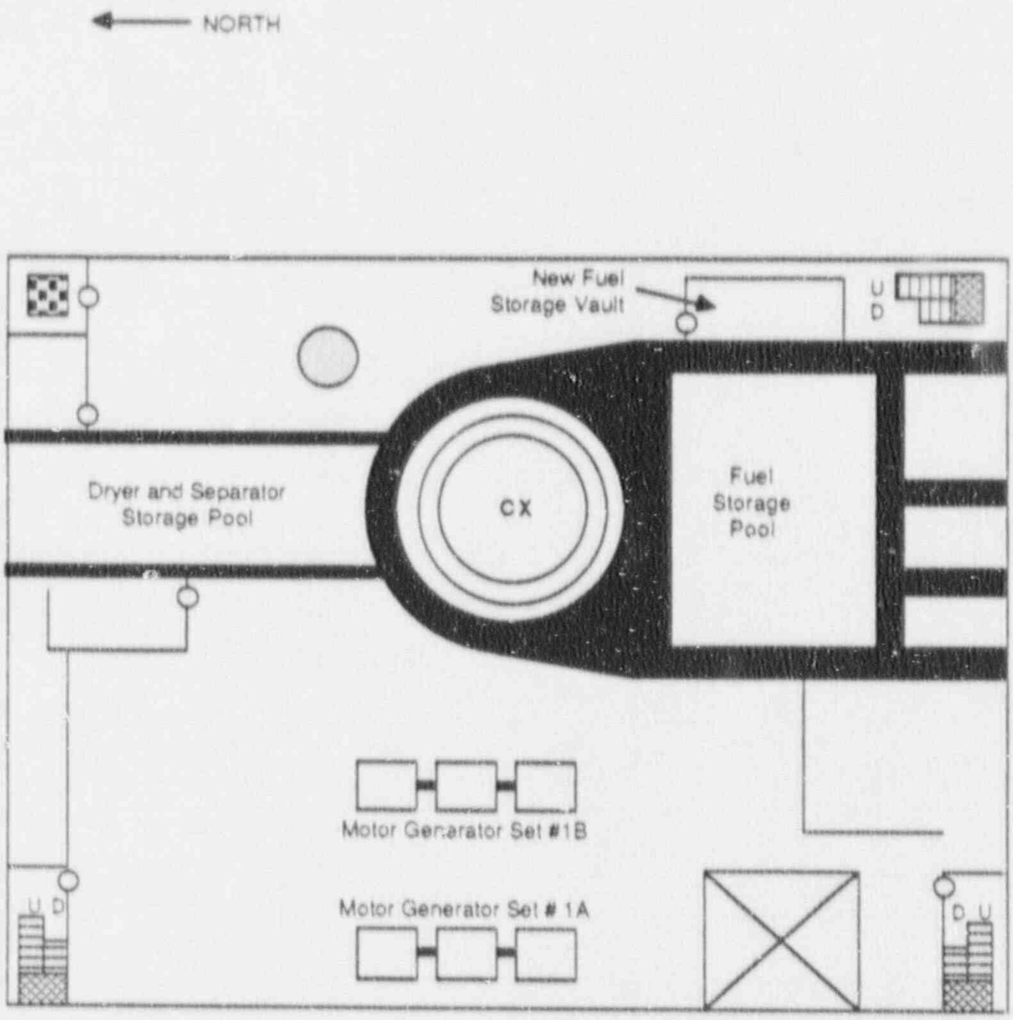

Figure 4-9. Cooper Nuclear Station Reactor Building, Elevation 976'-0"

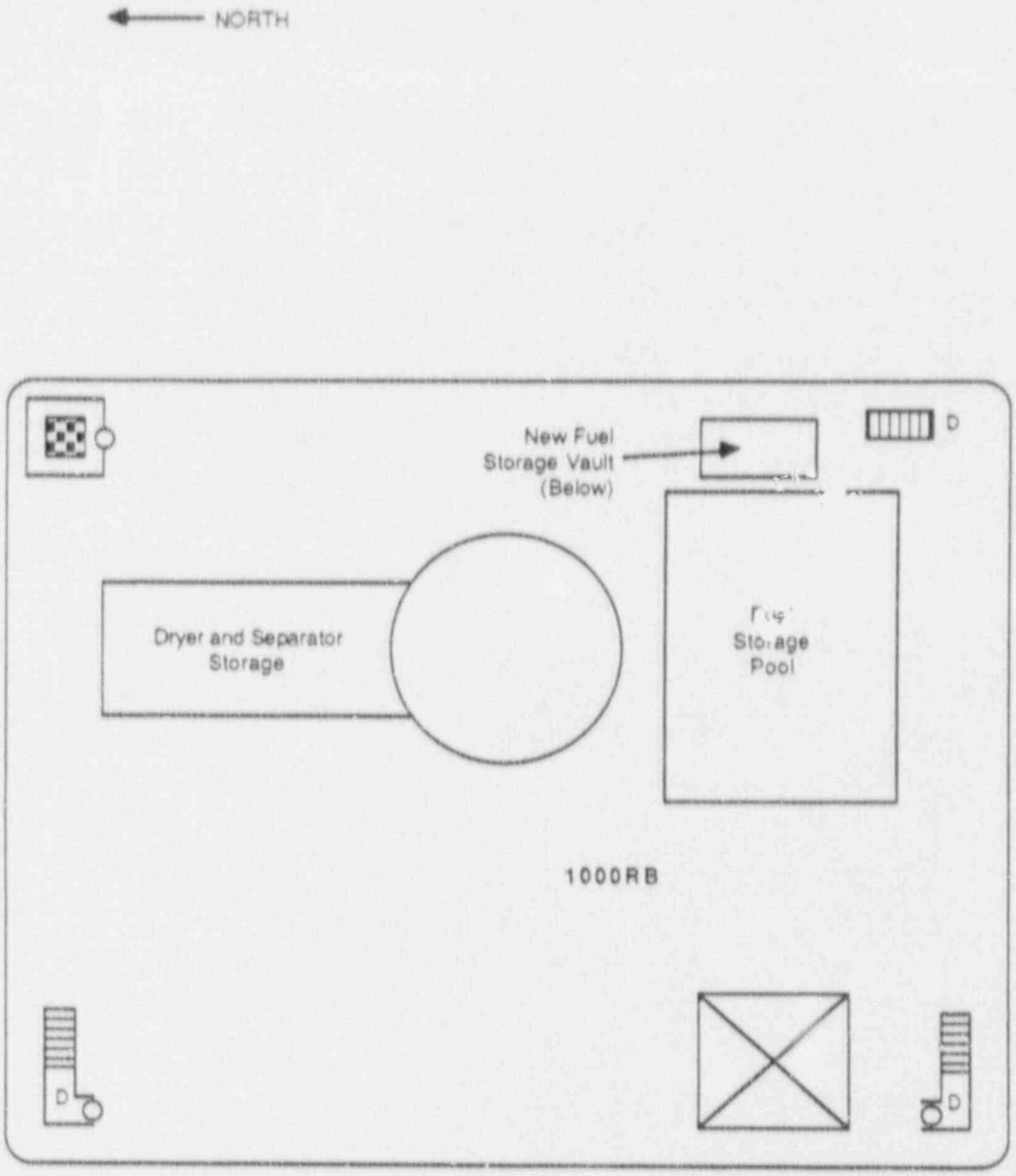

Figure 4-10. Cooper Nuclear Station Reactor Building, Elevation 1001'-0"

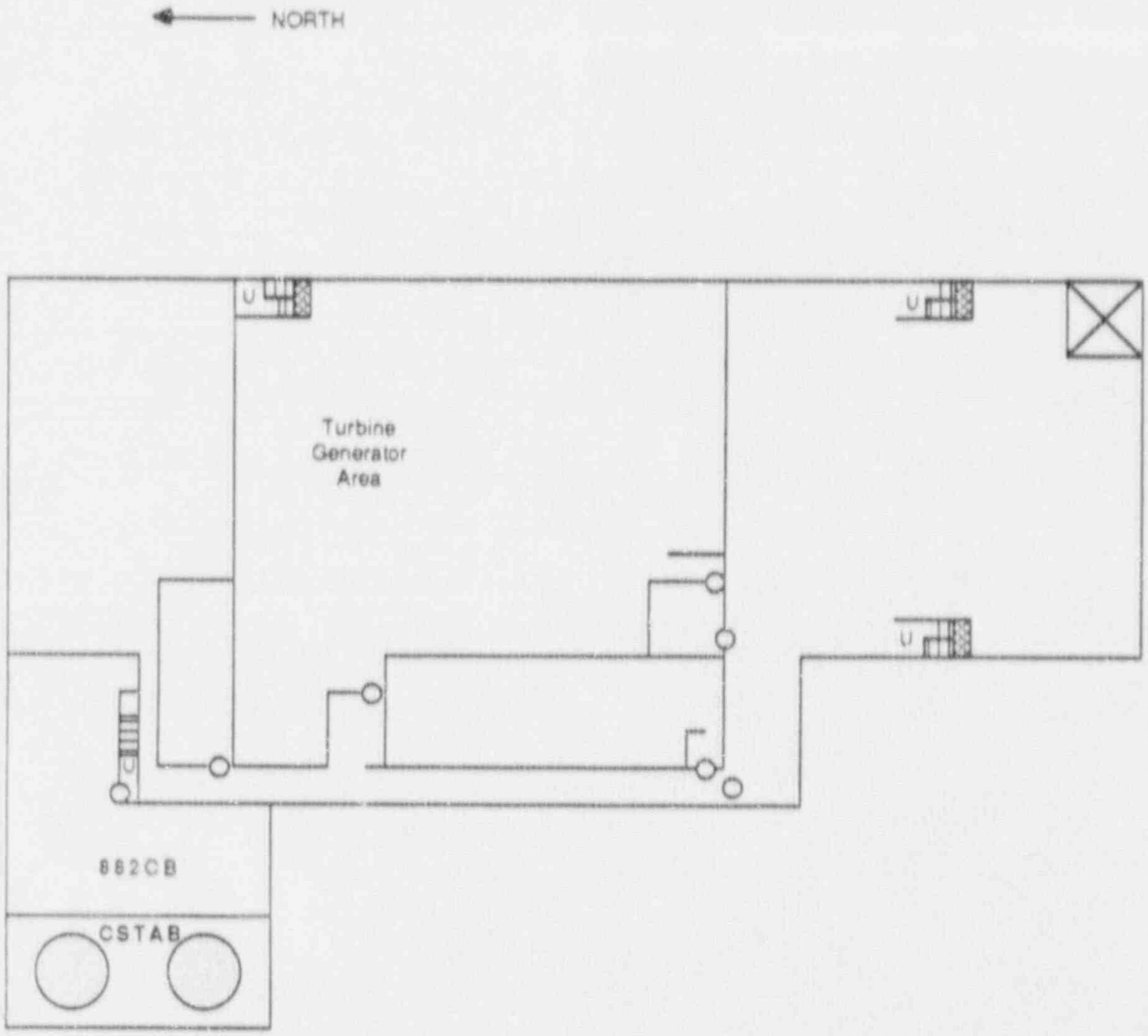

Figure 4-11. Cooper Nuclear Station Turbine Building, Elevation 882"-6"

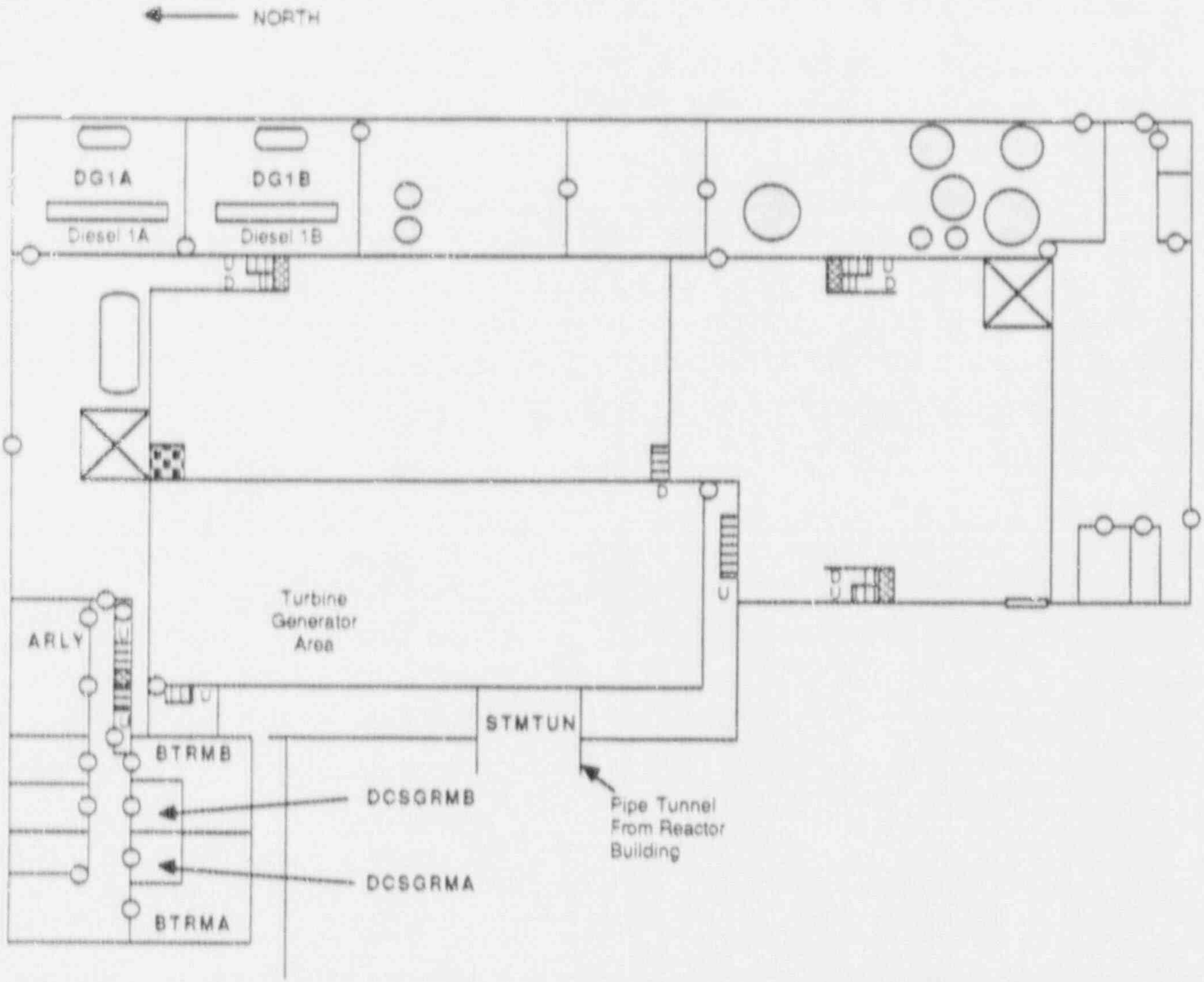

Figure 4-12. Cooper Nuclear Station Turbine Building, Elevation 903"-6"

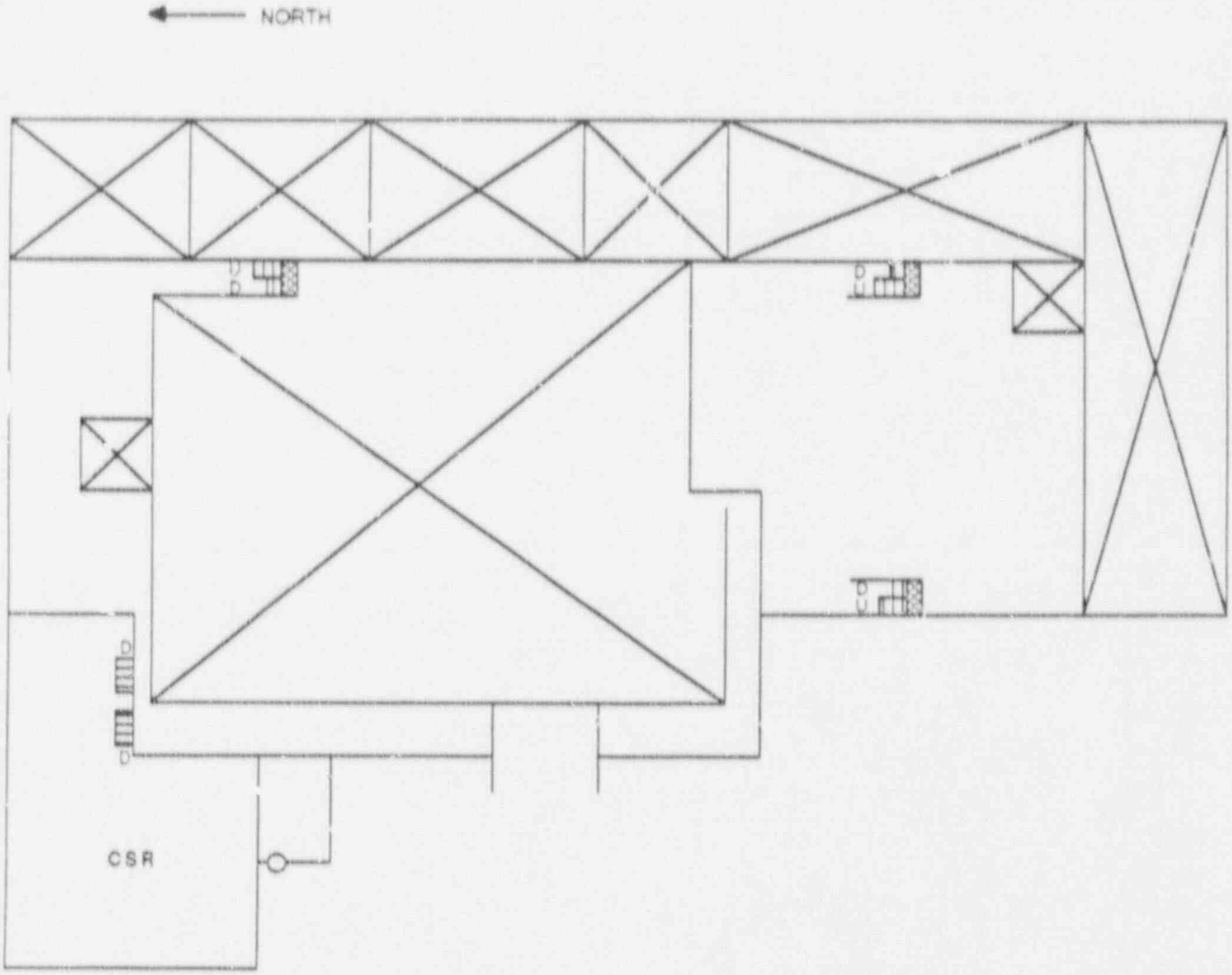

Figure 4-13. Cooper Nuclear Station Turbine Building, Elevation 918"-0"

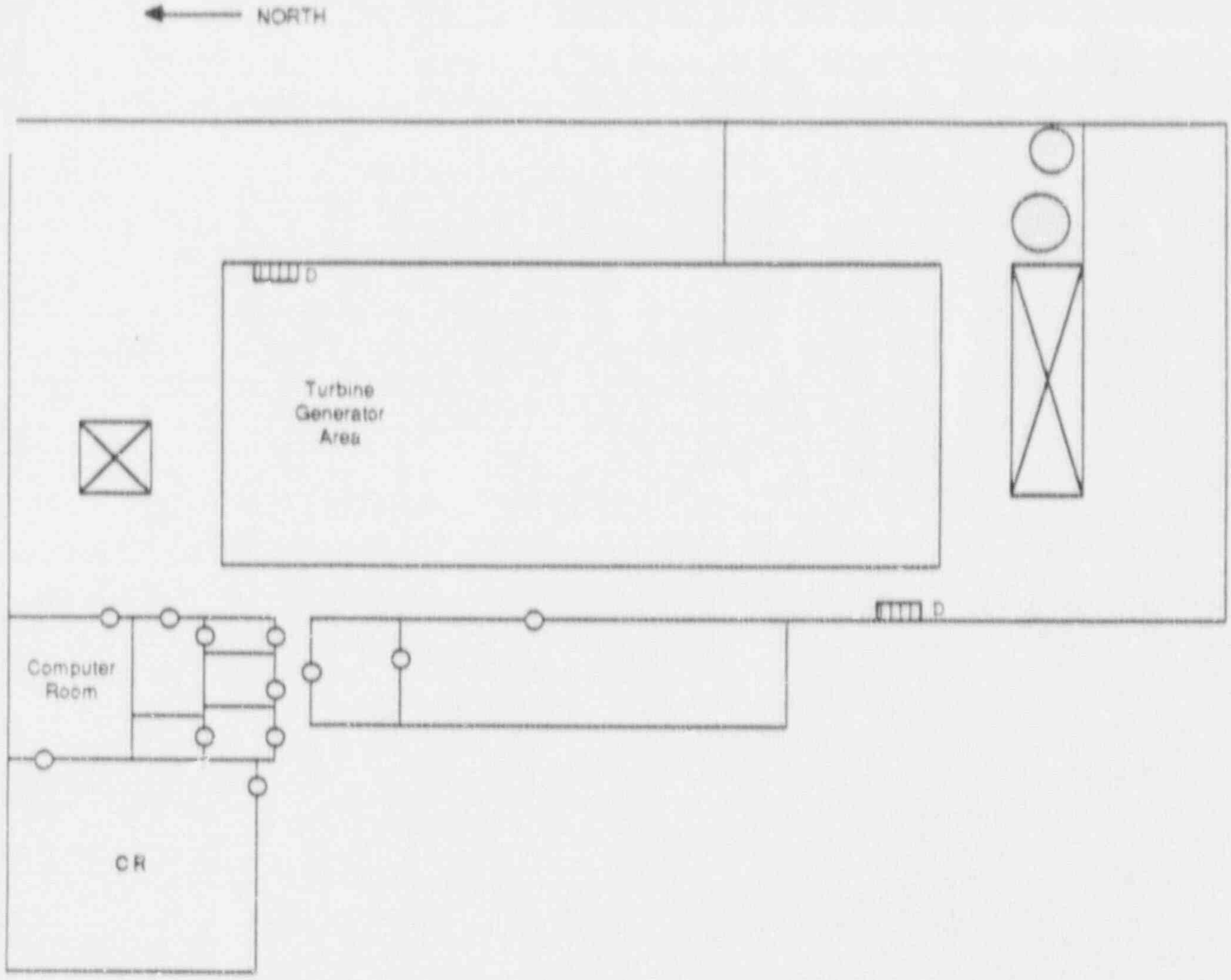

Figure 4-14. Cooper Nuclear Station Turbine Building, Elevation 932"-6"

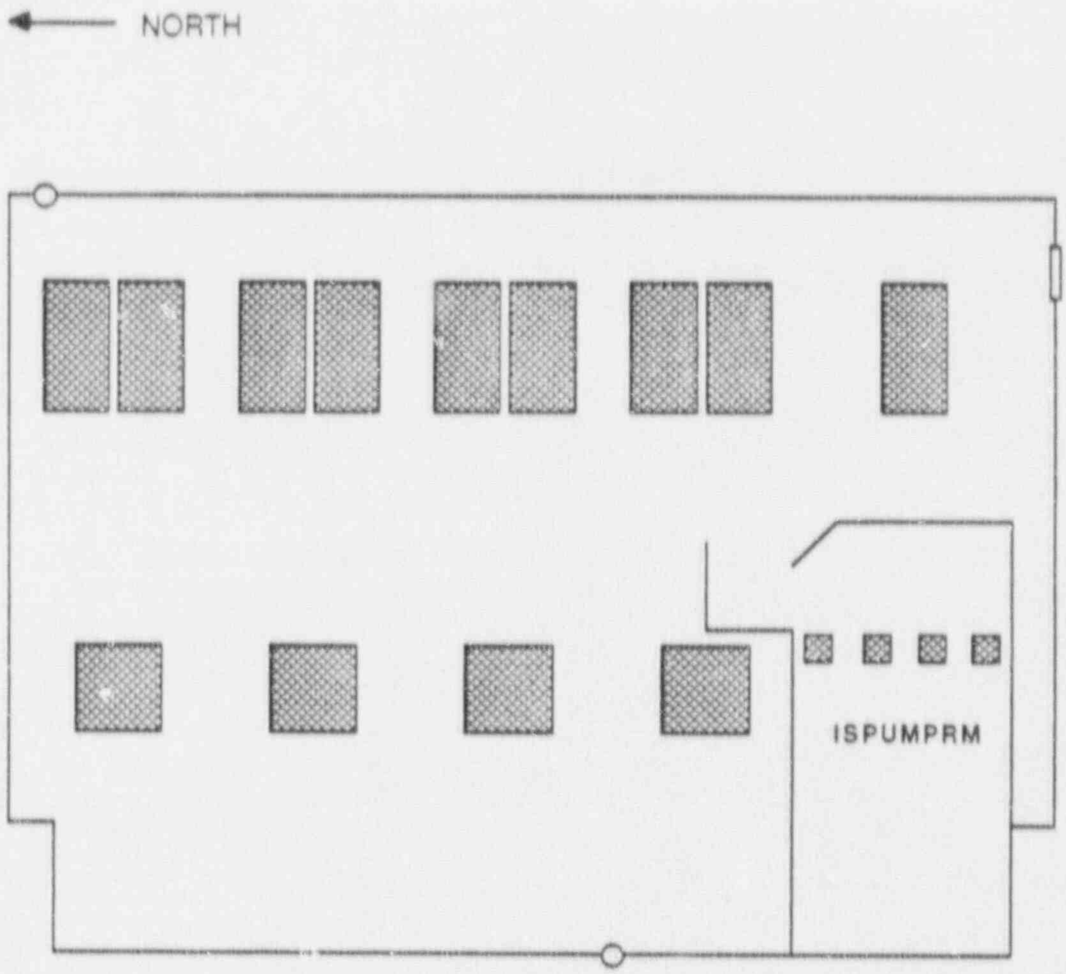

Figure 4-15. Cooper Nuclear Station Intake Structure

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

	Codes	Descriptions
1.	859NECRNRM	859' elevation - northeast corner room
2.	859NWCRNRM	859' elevation - northwest corner room
3.	859SWCRNRM	859' elevation - southwest corner room
4.	881NECRNRM	881' elevation - northwest corner room
5.	881SWCRNRM	881' elevation - southwest corner room
6.	882CB	882' elevation - Control Building
7.	903ACCSHLDRM	Personnel Access Shield Room, located on the 903' elevation of the Reactor Building
8.	903AHXRM	903' elevation of the Reactor Building - RHR A Heat Exchanger Room
9.	903BHXRM	903' elevation of the Reactor Building - RHR B Heat Exchanger Room
10.	90RB	903' elevation of the Reactor Building - MCCR, MCCRB, MCCY, MCCQ, RHR Start rack, RCIC Start rack
11.	931AHXRM	931' elevation of the Reactor Building - RHR A Heat Exchanger Room
12.	931BHXRM	931' elevation of the Reactor Building - RHR B Heat Exchanger Room
13.	931RB	931' elevation of the Reactor Building
14.	958RB	958' elevation of the Reactor Building - MCCRA
15.	1000RB	1000' elevation of the Reactor Building - Spent Fuel Pool Operating Floor
16.	ARLY	Auxiliary Relay Room, located on the 903' elevation of the Turbine Building
17.	B1F	1F Switchgear Room, located on the 931' elevation of the Reactor Building
18.	B1G	1G Switchgear Room, located on the 931' elevation of the Reactor Building
19.	BTRMA	Battery Room A - Mezzanine Level of Turbine Building

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

Codes		Descriptions
20.	BTRMB	Battery Room B - Mezzanine Level of Turbine Building
21.	CR	Control Room, located on the 932' elevation of the Turbine Building
22.	CSR	Cable Spreading Room, located on the 918' elevation of the Turbine Building
23.	CSTAB	Condensate Storage Tanks A and B
24.	CX	Reactor Containment
25.	DCSGRMA	DC Switchgear Room A - Mezzanine Level of Turbine Building
26.	DCSGRMB	DC Switchgear Room B - Mezzanine Level of Turbine Building
27.	DG1A	Diesel Generator Room 1A - Mezzanine Level of Turbine Building
28.	DG1B	Diesel Generator Room 1B - Mezzanine Level of Turbine Building
29.	HPCIRM	High Pressure Coolant Injection System Pump Room, located on the 859' elevation - adjacent southwest corner room
30.	ISPMPRM	Intake Structure Pump Room
31.	RWCUHXRM	Reactor Water Cleanup Heat Exchanger Room, located on the 931' elevation of the Reactor Building
32.	RWCUPMPA	Reactor Water Cleanup Pump A Room, located on the 931' elevation of the Reactor Building
33.	RWCUPMPB	Reactor Water Cleanup Pump B Room, located on the 931' elevation of the Reactor Building
34.	SECRNRM	Located on the 859' elevation - southeast corner room
35.	STMTUN	Steam Tunnel
36.	TORR	Torus Area

TABLE 4-2. PARTIAL LISTING OF COMPONTENTS BY LOCATION AT COOPER

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
859NECRNRM	ECCS	CS-M07A	MOV
859NECRNRM	ECCS	CS-PM1A	MDP
859NECRNRM	ECCS	CS-V26A	MOV
859NECRNRM	EP	RCIC-RK	MCC
859NECRNRM	RCIC	RCIC-MO131	MOV
859NECRNRM	RCIC	RCIC-MO1[illegible]	MOV
859NECRNRM	RCIC	RCIC-MO20	MOV
859NECRNRM	RCIC	RCIC-MO41	MOV
859NECRNRM	RCIC	SUPP	PP
859NECRNRM	RCIC	RCIC-TURB	TDP
859NECRNRM	RCIC	RCIC-V27	MOV
859NECRNRM	RCIC	RCIC-V30	MOV
859NECRNRM	RCIC	RCIC-V33	MOV
859NWCRNRM	ECCS	LPSI-PMA	MDP
859NWCRNRM	ECCS	LPSI-PMC	MDP
859NWCRNRM	ECCS	LPSI-V13A	MOV
859NWCRNRM	ECCS	LPSI-V13C	MOV
859SWCRNRM	ECCS	LPSI-PMB	MDP
859SWCRNRM	ECCS	LPSI-PMD	MDP
859SWCRNRM	ECCS	LPSI-V13B	MOV
859SWCRNRM	ECCS	LPSI-V13D	MOV
881NWCRNRM	ECCS	LPSI-V34A	MOV
881NWCRNRM	ECCS	LPSI-V39A	MOV
881SWCRNRM	ECCS	LPSI-V34B	MOV
881SWCRNRM	ECCS	LPSI-V39B	MOV
882CB	EP	MCC-L	MCC
903ACCSHLDRM	ECCS	HPCI-MO16	MOV
903ACCSHLDRM	ECCS	HPCI-MO16	MOV
903ACCSHLDRM	ECCS	LPSI-MO27A	MOV
903ACCSHLDRM	ECCS	LPSI-V25A	MOV
903ACCSHLDRM	ECCS	LPSI-MO27B	MOV

TABLE 4-2. PARTIAL LISTING OF COMPONTENTS BY LOCATION AT COOPER (CONTINUED)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
903ACCSHLDRM	ECCS	LPSI-V25A	MOV
903ACCSHLDRM	RCS	RHR-M17	MOV
903AHXRM	ECCS	LPSI-V12A	MOV
903AHXRM	ECCS	LPSI-V26A	MOV
903AHXRM	ECCS	LPSI-V66A	MOV
903BHXRM	ECCS	LPSI-V12B	MOV
903BHXRM	ECCS	LPSI-V26B	MOV
903BHXRM	ECCS	LPSI-V66B	MOV
903RB	ECCS	LPSI-V31B	MOV
903RB	EP	MCC-Q	MCC
903RB	EP	MCC-K	MCC
903RB	EP	MCC-R	MCC
903RB	EP	RHRA-RK	MCC
903RB	EP	RCIC-RK	MCC
903RB	EP	MCC-S	MCC
903RB	EP	MCC-RB	MCC
903RB	EP	MCC-Y	MCC
903RB	EP	RHRB-RK	MCC
931AHXRM	ECCS	LPSI-V65A	MOV
931BHXRM	ECCS	LPSI-V65B	MOV
931RB	ECCS	CS-MO11A	MOV
931RB	ECCS	CS-M011B	MOV
931RB	ECCS	CS-MO12A	MOV
931RB	ECCS	CS-M012B	MOV
931RB	ECCS	LPSI-V31A	MOV
958RB	EP	MCC-M	MCC
958RB	EP	STRT-RK	MCC
ARLY	EP	MCC-LX	MCC
ARLY	EP	MCC-TX	MCC
B1F	EP	CB-1F	CB
B1F	EP	BUS-1F	BUS

TABLE 4-2. PARTIAL LISTING OF COMPONTENTS BY LOCATION AT COOPER (CONTINUED)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
B1F	EP	IDBUS-1F	BUS
B1F	EP	TR-1F	XFMR
B1G	EP	CB-1G	CB
B1G	EP	BUS-1G	BUS
B1G	EP	IDBUS-1G	BUS
B1G	EP	TR-1G	XFMR
BTRMA	EP	BAT-1A	BATT
BTRMB	EP	BAT-1B	BATT
CSR	EP	INSPNL-1A	PNL
CSR	EP	INSPNL-1B	PNL
CSTAB	ECCS	CST-1A	TANK
CSTAB	ECCS	CST-1B	TANK
CSTAB	RCIC	CST-1A	TANK
CSTAB	RCIC	CST-1B	TANK
CX	ECCS	RCS-VESSEL	RV
CX	ECCS	RCS-VESSEL	RV
CX	ECCS	HPCI-MO15	MOV
CX	ECCS	RCS-VESSEL	RV
CX	ECCS	HPCI-MO15	MOV
CX	ECCS	RCS-VESSEL	RV
CX	ECCS	RCS-VESSEL	RV
CX	RCIC	RCIC-MO115	MOV
CX	RCIC	RCS-VESSEL	RV
CX	RCS	RHR-M18	MOV
CX	RCS	RCS-V74	MOV
CX	RCS	RV-71A	SRV
CX	RCS	RCS-VESSEL	RV
CX	RCS	RCIC-MO15	MOV
CX	RCS	RV-71A	SRV
CX	RCS	RWCU-V15	MOV
CX	RCS	RV-70A	SV

TABLE 4-2. PARTIAL LISTING OF COMPONTENTS BY LOCATION AT COOPER (CONTINUED)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
CX	RCS	RV-70B	SV
CX	RCS	RV-70C	SV
CX	RCS	RV-70B	SV
CX	RCS	RV-70A	SV
CX	RCS	RV-70C	SV
CX	RCS	RV-71B	SRV
CX	RCS	RV-71C	SRV
CX	RCS	RV-71D	SRV
CX	RCS	RV-71E	SRV
CX	RCS	RV-71F	SRV
CX	RCS	RV-7'G	SRV
CX	RCS	RV-71H	SRV
CX	RCS	RV-71B	SRV
CX	RCS	RV-71C	SRV
CX	RCS	RV-71D	SRV
CX	RCS	RV-71E	SRV
CX	RCS	RV-71F	SRV
CX	RCS	RV-71G	SRV
CX	RCS	RV-71H	SRV
DCSGRMA	EP	BC-1A	BC
DCSGRMA	EP	BUS-1A	BUS
DCSGRMA	EP	BUS-1A	BUS
DCSGRMA	EP	ITR480/120	XFMR
DCSGRMA	EP	DC-PNL-A	PNL
DCSGRMB	EP	BC-1B	BC
DCSGRMB	EP	BUS-1B	BUS
DCSGRMB	EP	BUS-1B	BUS
DCSGRMB	EP	ITR480/120	XFMR
DCSGRMB	EP	DC-PNL-B	PNL
DG1A	EP	DG-1A	DG
DG1B	EP	DG-1B	DG

TABLE 4-2. PARTIAL LISTING OF COMPONTENTS BY LOCATION AT COOPER (CONTINUED)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
HPCIRM	ECCS	HPCI-MO14	MOV
HPCIRM	ECCS	HPCI-MO17	MOV
HPCIRM	ECCS	HPCI-MO20	MOV
HPCIRM	ECCS	HPCI-MO58	MOV
HPCIRM	ECCS	HPCI-TURB	TDP
HPCIRM	ECCS	HPCI-V21	MOV
HPCIRM	ECCS	HPCI-V24	MOV
HPCIRM	ECCS	HPCI-V25	MOV
HPCIRM	EP	HPCI-RK	MCC
HPCIRM	EP	HPCI-RK	MCC
ISPUMPRM	SW	SW-PMA	MDP
ISPUMPRM	SW	SW-PMB	MDP
ISPUMPRM	SW	SW-PMC	MDP
ISPUMPRM	SW	SW-PMD	MDP
RWCUHXRM	RCS	RWCU-V18	MOV
SECRNRM	ECCS	CS-M07B	MOV
SECRNRM	ECCS	CS-PM1B	MDP
SECRNRM	ECCS	CS-V26B	MOV
STMTUN	ECCS	HPCI-MO19	MOV
STMTUN	RCIC	RCIC-MO16	MOV
STMTUN	RCIC	RCIC-MO21	MOV
STMTUN	RCS	RCIC-MO16	MOV

5. BIBLIOGRAPHY FOR COOPER NUCLEAR STATION

1. Hatch, S.W., et al., "Shutdown Decay Heat Removal Analysis of a General Electric BWR4/Mark I; Case Study," NUREG/CR-4767, Sandia National Laboratories, July 1987.

2. Brice, J.R., "Aquatic Impacts from Operation of Three Mid-Western Nuclear Power Stations: Cooper Nuclear Station Environmental Appraisal Report," NUREG/CR-2337, Volume 2, Environmental Sciences & Engineering, Inc., October 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)

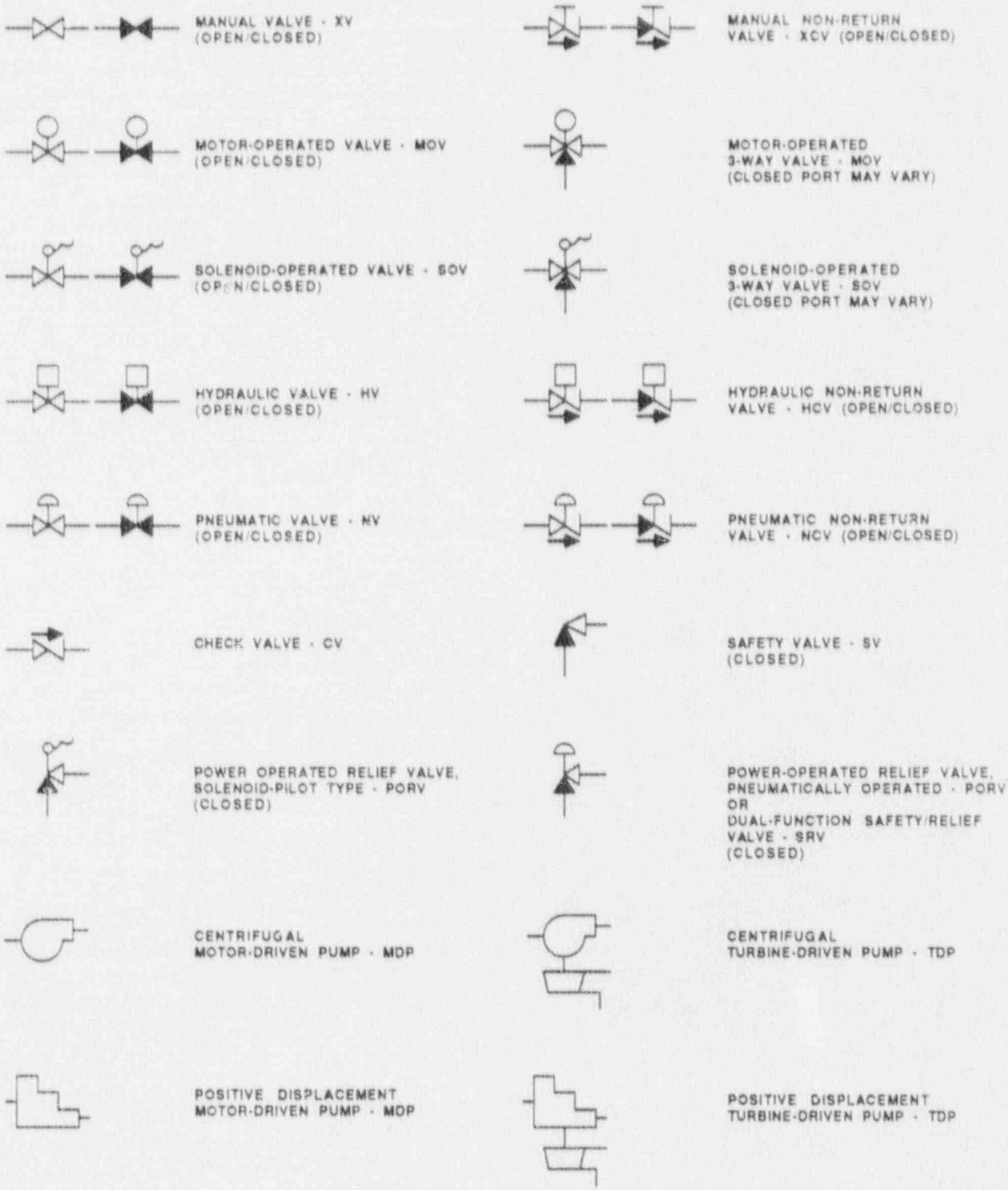

Figure A-1. Key To Symbols In Fluid System Drawings

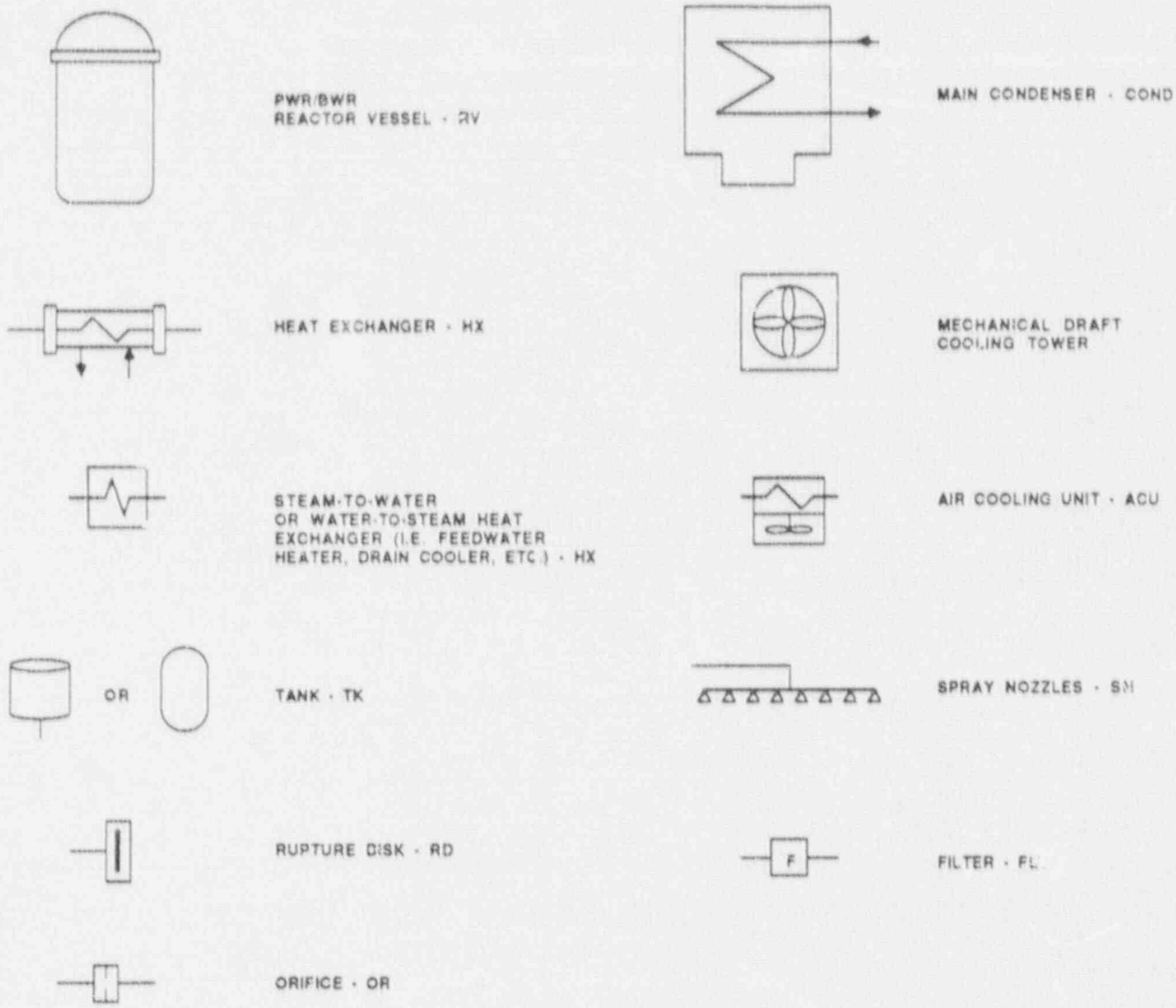

Figure A-1. Key To Symbols In Fluid System Drawings
(Continued)

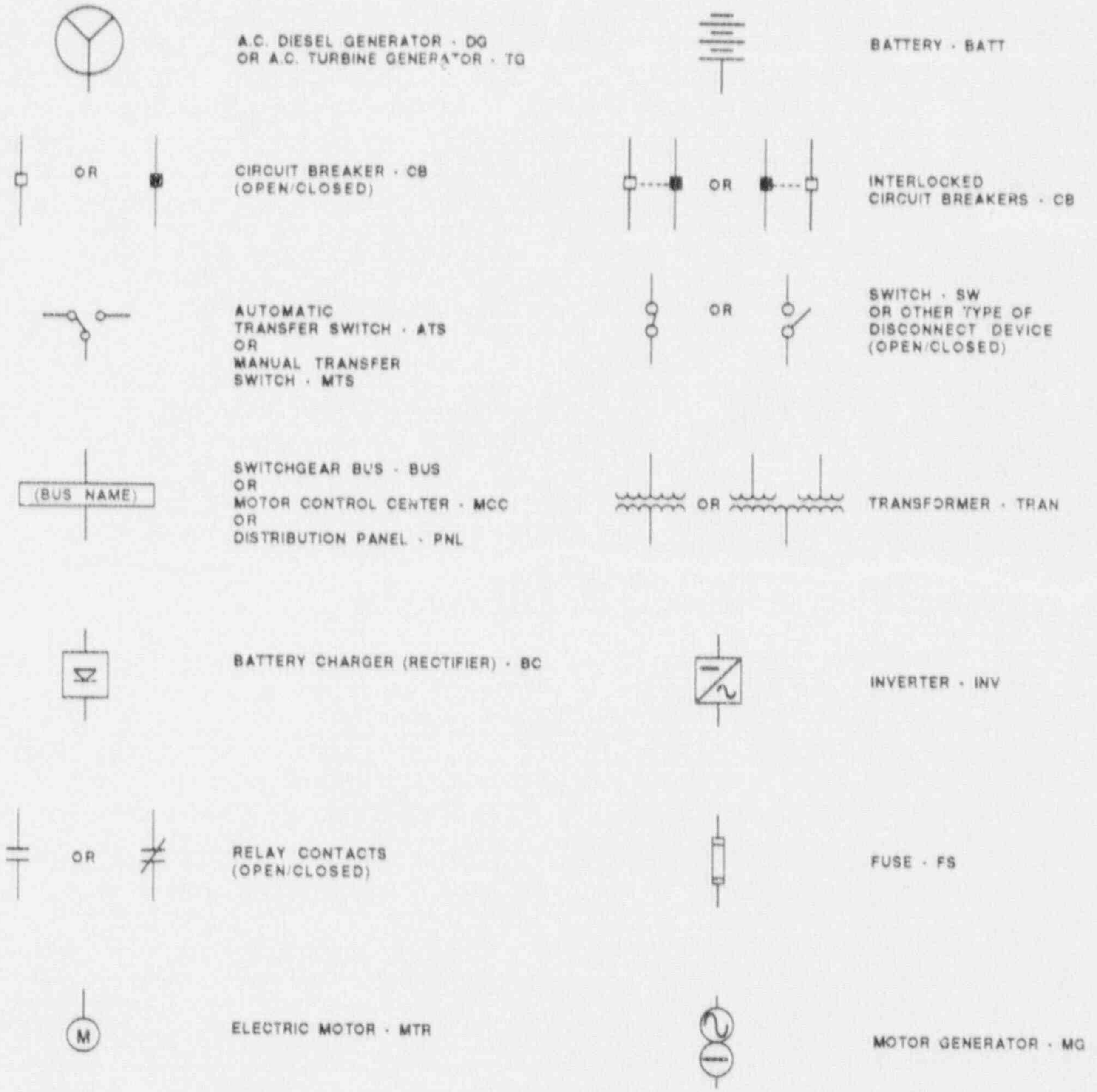

Figure A-2. Key To Symbols In Electrical System Drawings

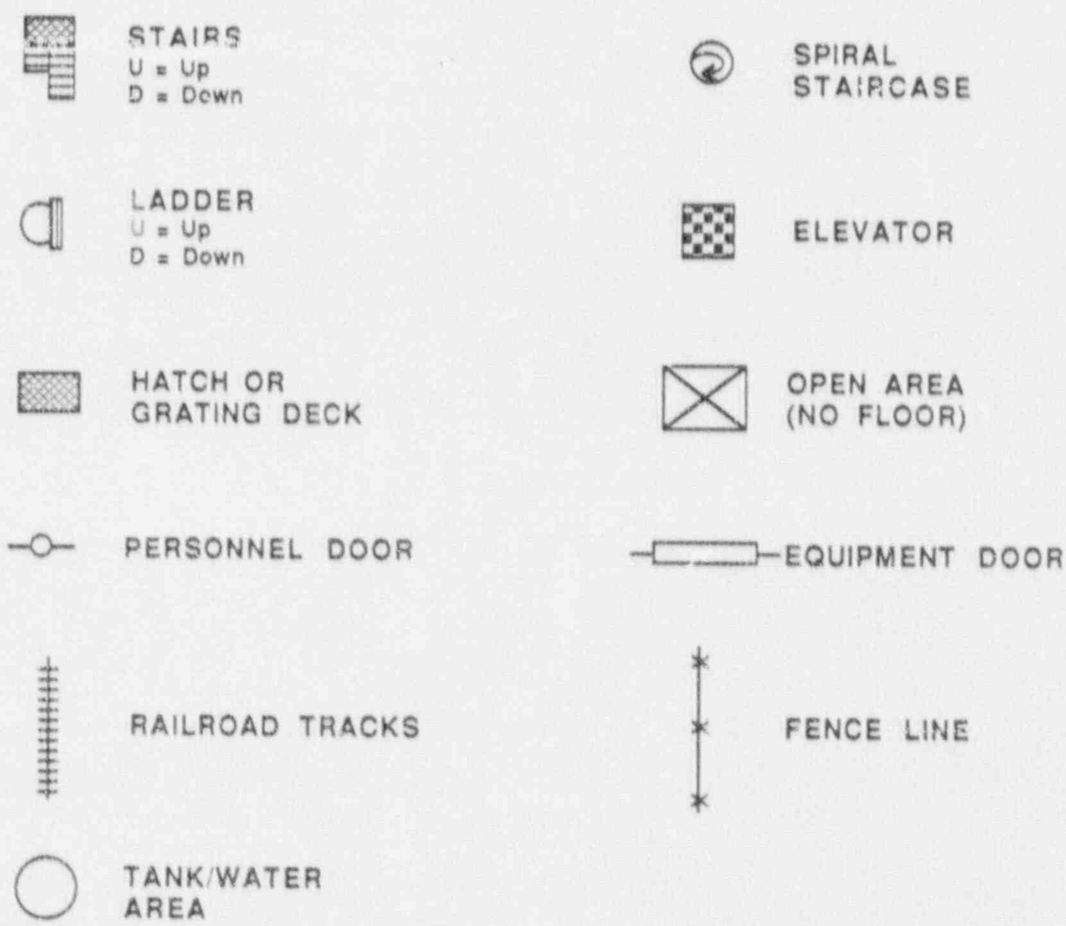

Figure A-3. Key To Symbols In Facility Layout Drawings

APPENDIX B
DEFINITION OF TERMS USED IN THE DATA TABLES

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

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

Code	Definition
RCS	Reactor Coolant System
RCIC	Reactor Core Isolation System
ECCS	Emergency Core Cooling System (including HPCI, ADS, CSS and LPCI
I&C	Instrumentation and Control Systems
EP	Electric Power System
SW	Service Water System

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

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

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

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

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

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

TABLE B-1. COMPONENT TYPE CODES

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

TABLE B-1. COMPONENT TYPE CODES (Continued)

COMPONENT	COMP TYPE
ELECTRIC POWER DISTRIBUTION EQUIPMENT:	
Bus or switchgear	BUS
Motor control center	MCC
Distribution panel or cabinet	PNL or CAB
Transformer	TRAN or XFMR
Battery charger (rectifier)	BC or RECT
Inverter	INV
Uninterruptible power supply (a unit that may include battery, battery charger, and inverter)	UPS
Motor generator	MG
Circuit breaker	CB
Switch	SW
Automatic transfer switch	ATS
Manual transfer switch	MTS