NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

BRAIDWOOD 1 AND 2

50-456 and 50-457

SAIC

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NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

BRAIDWOOD 1 AND 2

50-456 and 50-457

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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.

BRAIDWOOD 1 AND 2
RECORD OF REVISIONS

REVISION	ISSUE	COMMENTS
0	1/89	Original report

BRAIDWOOD 1 AND 2 SYSTEM SOURCEBOOK

This sourcebook contains summary information on Braidwood 1 and 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 Braidwood 1 & 2 nuclear power plant is listed below:

- Docket number	50-456 (Unit 1), 50-457 (Unit 2)
- Operator	Commonwealth Edison Company
- Location	Braidwood, Illinois
- Commercial operation date	9/88 (Unit 1), early 1989 (Unit 2, expected)
- Reactor type	PWR
- NSSS vendor	Westinghouse
- Number of loops	4
- Power (MWt/MWe)	3411/1120
- Architect-engineer	Sargent & Lundy
- Containment type	Reinforced concrete cylinder with steel liner

2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

Each Braidwood unit has a Westinghouse PWR four-loop nuclear steam supply system (NSSS). Other four-loop Westinghouse plants in the United States include:

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

Braidwood differs from the majority of Westinghouse plants in that the auxiliary feedwater system consists of one motor driven and one diesel driven pump, whereas other plants contain some number of motor driven and turbine driven pumps. Braidwood is similar to other plants in the number and type of charging and high pressure injection pumps.

Braidwood is a twin of the Byron plant. However, there are minor differences between the two plants. These differences are noted in the appropriate sections of this report.

3. SYSTEM INFORMATION

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

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

Table 3-1. Summary of Braidwood Systems Covered in this Report

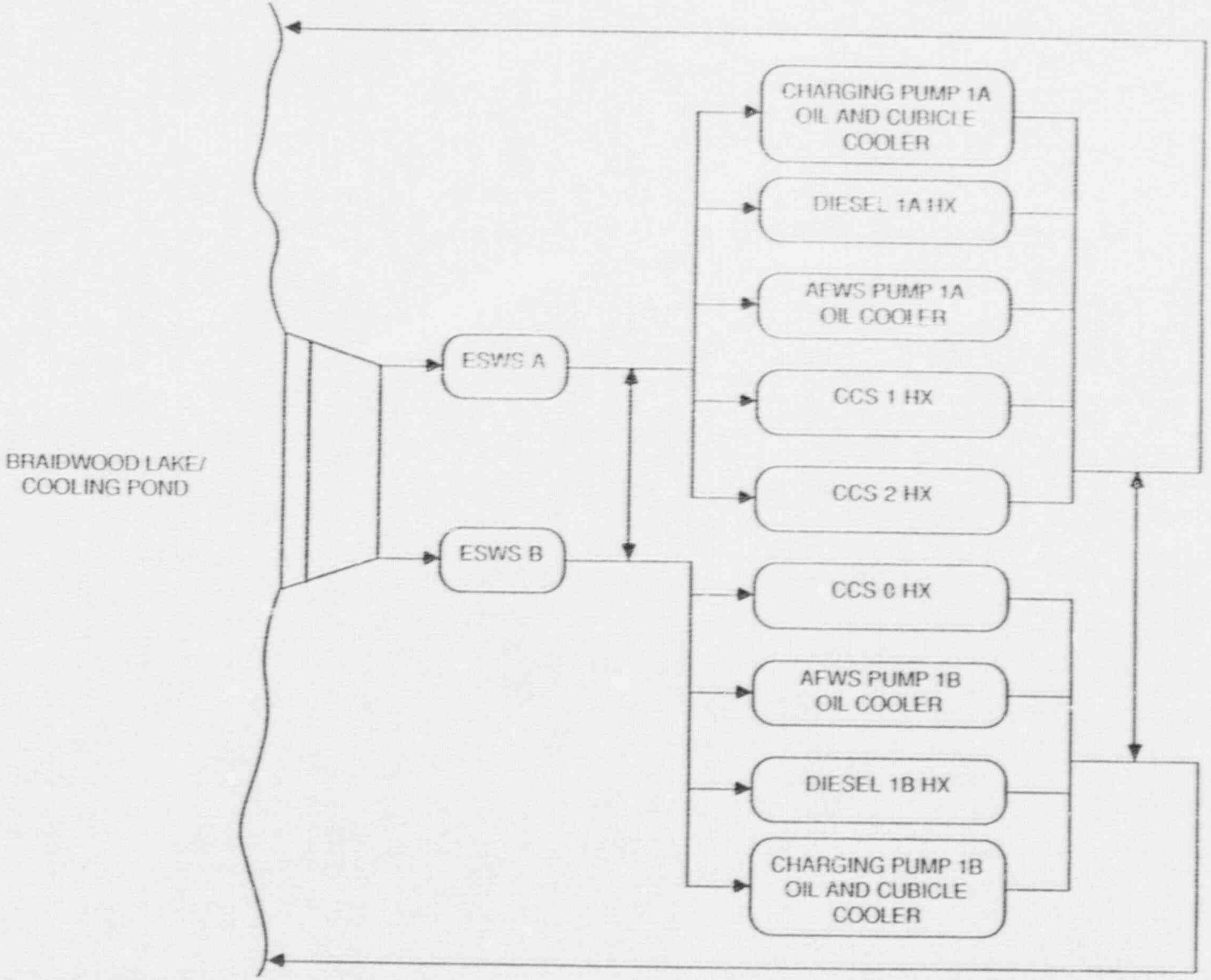
Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor Heat Removal Systems			
- Reactor Coolant System (RCS)	Same	3.1	5
- Auxiliary Feedwater (AFW) and Secondary Steam Relief (SSR) Systems	Same	3.2	10.4.9
- Emergency Core Cooling Systems (ECCS)	Same		
- High-Pressure Injection & Recirculation	Safety Injection System,	3.3	6.3
	Charging System	3.4	6.3
- Low-pressure Injection & Recirculation	Residual Heat Removal System	3.3	6.3
- Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System)	Residual Heat Removal (RHR) System	3.3	6.3
- Main Steam and Power Conversion Systems	Main Steam Supply System Condensate and Feedwater System, Circulating Water System	X	10.3, 10.4
- Other Heat Removal Systems	None identified	X	
Reactor Coolant Inventory Control Systems			
- Chemical and Volume Control System (CVCS) (Charging System)	Same	3.4	9.3.4, 6.3
- ECCS	See ECCS, above	-	-

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Containment Systems			
- Containment	Same	X	6.2.1
- Containment Heat Removal Systems - Containment Spray System	Same	3.5	6.5.2
- Containment Fan Cooler System	Reactor Containment Fan Cooler Subsystem	3.5	9.4.8.1, 6.2.2
- Containment Normal Ventilation Systems	Containment Ventilation System	X	9.4.8
- Combustible Gas Control Systems	Hydrogen Reconbiner System, Hydrogen Monitoring System, Hydrogen Mixing System, Post-LOCA Purge System	X	6.2.5
Reactor and Reactivity Control Systems			
- Reactor Core	Same	X	4.0
- Control Rod System	Control Rod Drive System	X	4.6
- Boration Systems	See CVCS, above	-	-
Instrumentation & Control (I&C) Systems			
- Reactor Protection System (RPS)	Reactor Trip System	3.6	7.2
- Engineered Safety Feature Actuation System (ESFAS)	Same	3.6	7.3
- Remote Shutdown System	Various Remote Shutdown Panels	X	7.4

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Instrumentation & Control (I&C) Systems (continued)			
- Other I&C Systems	Various systems	X	7.5, 7.6, 7.7
Support Systems			
- Class 1E Electric Power System	Same	3.7	8.1, 8.3
- Non-Class 1E Electric Power System	Same	3.7	8.2, 8.3
- Diesel Generator Auxiliary Systems	Same	3.7	9.5.4 thru 9.5.8
- Component Cooling Water (CCW) System	Component Cooling System	3.8	9.2.2
- Service Water System (SWS)	Essential Service Water System, Non-essential Service Water System	3.9	9.2.1
- Other Cooling Water Systems	Plant Chilled Water System	X	9.2.7
- Fire Protection Systems	Same	X	9.5.1
- Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems	Same	X	9.4
- Instrument and Service Air Systems	Compressed Air Systems	X	9.3.1
- Refueling and Spent Fuel Systems	Spent Fuel Pit Cooling and Cleanup System, Fuel Handling System	X	9.1.3, 9.1.4
- Radioactive Waste Systems	Radioactive Waste Management Systems	X	11
- Radiation Protection Systems	Same	X	12



AFWS = Auxiliary Feedwater System
CCS = Component Cooling System
ESWS = Essential Service Water System

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

3.1 REACTOR COOLANT SYSTEM (RCS)

3.1.1 System Function

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

3.1.2 System Definition

The RCS includes: (a) the reactor vessel, (b) reactor coolant loops, (c) reactor coolant pumps, (d) the primary side of the steam generators, (e) pressurizer, and (f) connected piping out to a suitable isolation valve boundary. An isometric drawing of a 4-loop Westinghouse RCS is shown in Figure 3.1-1. A simplified diagram of the RCS and important system interfaces is shown in Figure 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 reactor coolant pump in each of the four reactor coolant loops. RCS pressure is maintained within a prescribed band by the combined action of pressurizer heaters and pressurizer spray. RCS coolant inventory is measured by pressurizer water level which is maintained within a prescribed band by the chemical and volume control system (charging system).

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

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

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

3.1.4 System Success Criteria

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

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

3.1.5 Component Information

A. RCS
1. Volume: 12,257 ft^3, including pressurizer
2. Normal operating pressure: 2250 psia

B. Pressurizer
1. Volume: 1800 ft^3

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

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

E. Steam Generators
1. Type: Vertical shell and U-Tube
2. Model: Westinghouse 51 Series

F. Pressurizer Heaters
1. Capacity: 1800 kW

3.1.6 Support Systems and Interfaces

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

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

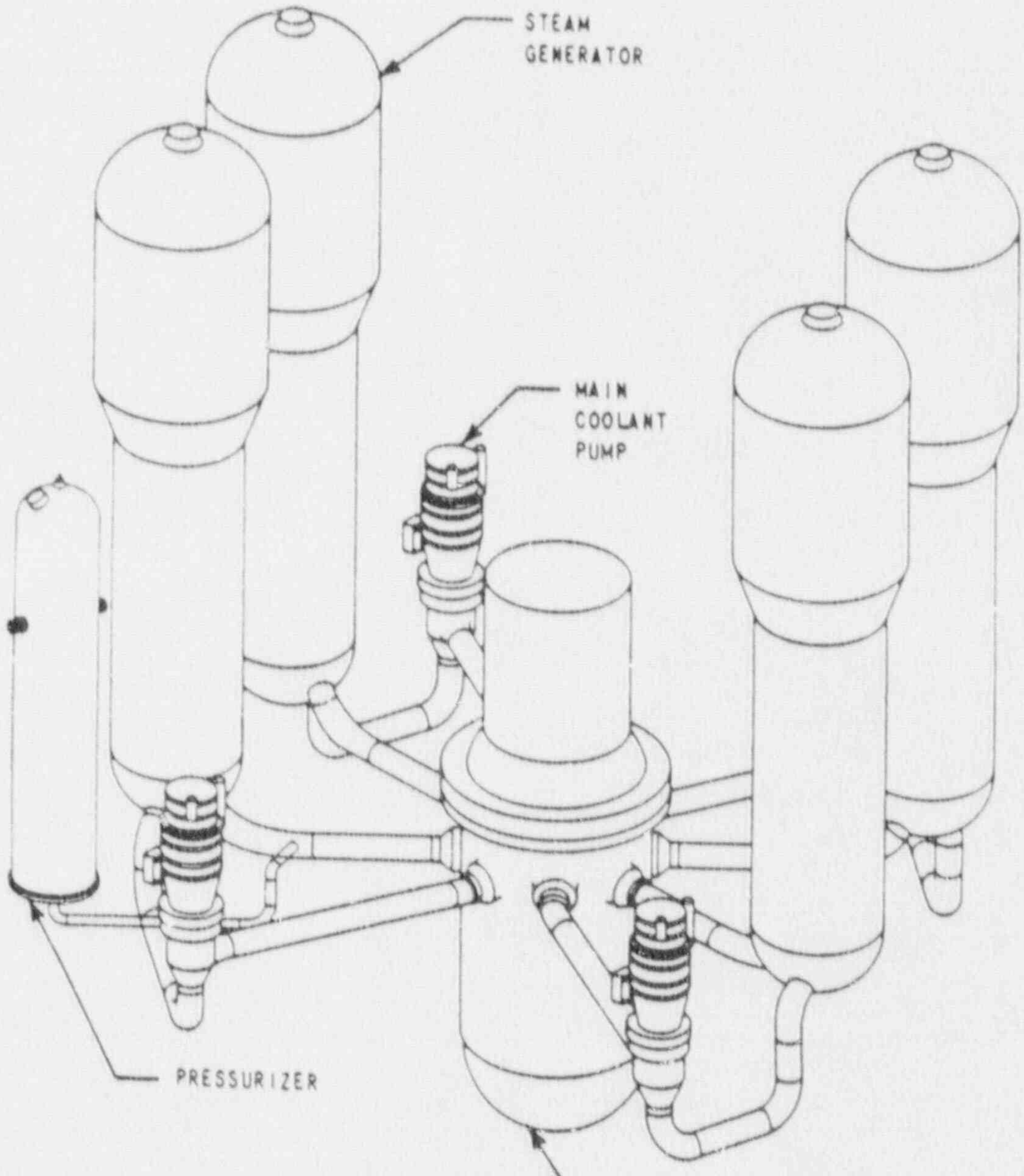


Figure 3.1-1. Isometric View of a 4-Loop Westinghouse RCS.

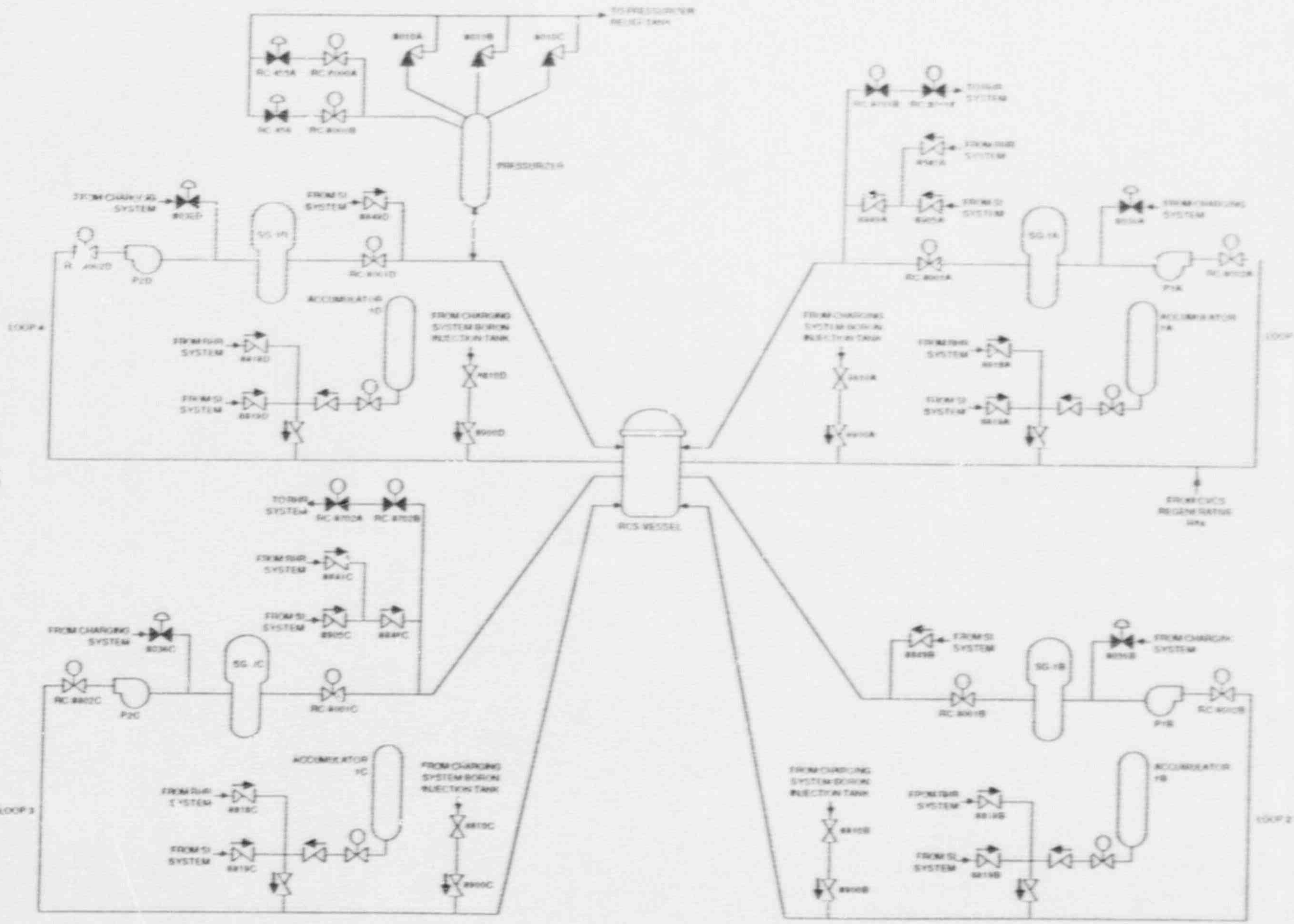


Figure 3.1-2. Braidwood Unit 1 Reactor Coolant System

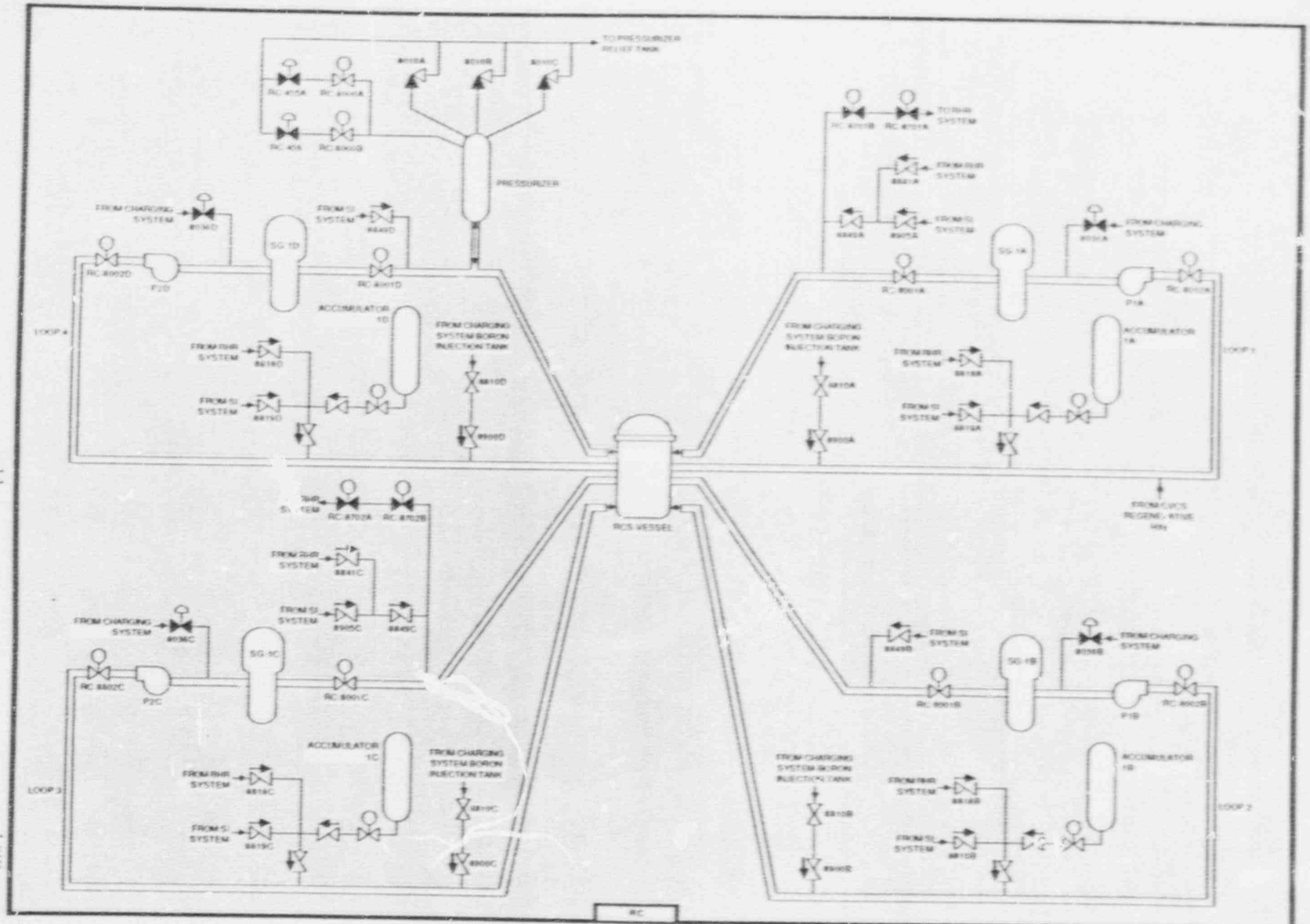


Figure 3.1-3. Braidwood Unit 1 Reactor Coolant System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP
RC-455A	NV	RC				
RC-456	NV	RC				
RC-8000A	MOV	RC	MCC-131X2	480	414PENRM	AC/A
RC-8000B	MOV	RC	MCC-132X2	480	426PENRM	AC/B
RC-8001A	MOV	RC				
RC-8001B	MOV	RC				
RC-8001C	MOV	RC				
RC-8001D	MOV	RC				
RC-8002A	MOV	RC				
RC-8002B	MOV	RC				
RC-8002C	MOV	RC				
RC-8002D	MOV	RC				
RC-8701A	MOV	RC	MCC-131X2	480	414PENRM	AC/A
RC-8701B	MOV	RC	MCC-132X2	480	426PENRM	AC/B
RC-8702A	MOV	RC	MCC-131X2	480	414PENRM	AC/A
RC-8702B	MOV	RC	MCC-132X2	480	426PENRM	AC/B
RCS-VESSEL	RV	RC				

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

3.2.1 System Function

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

3.2.2 System Definition

The AFW system consists of one motor-driven pump and one diesel-driven pump. The normal water sources for the pumps is the condensate storage tank. An alternate source of water is the Essential Service Water system. Either pump can supply all four steam generators. Interfacing with the AFW system is the startup feedwater system, which consists of one startup feedwater pump supplied from the main condenser hotwell via the main condensate and feed booster pumps.

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

Simplified drawings of the AFW and SSR systems are shown in Figures 3.2-1 and 3.2-2. The startup feedwater system is shown in Figure 3.2-3. A summary of data on selected AFW system components is presented in Table 3.2-1.

3.2.3 System Operation

During normal operation the AFW system is in standby, and is automatically actuated on either a low-low level in any steam generator, a safety injection signal, or a loss of power to the reactor coolant pumps. The system can also be manually started from the control room. Ordinarily, the AFW system is required to operate for about 5 hours to cool the unit down to 350°F, below which temperature the low pressure residual heat removal system operates.

Both AFW pumps are 1165 brake horsepower units. The diesel-driven AFW pump is capable of providing 840 gpm at 3350 feet head, which is nearly twice the capacity required for system success. This pump is capable of supplying its own cooling and lubrication independently of AC power, but when AC power is available backup pumps are provided for oil pressure, water jacket cooling, and room air cooling. The motor-driven AFW pump is capable of providing 890 gpm at 3350 feet of head. It requires essential service water for cooling (Ref. 1).

The primary suction source is the condensate storage tank. Redundant flow paths begin at the CST and meet at a header which supplies both pumps. No single valve can block the flow path. In the event of low suction pressure, there is automatic switchover to service water as the AFW pump water source.

Fl[illegible] n each AFW pump goes to all four steam generators through independen[illegible]. Flow is regulated by eight manually controlled air-operated valves which fail open on loss of air.

3.2.4 System Success Criteria

For the decay heat removal function to be successful both the AFW system and the SSR system must operate successfully. The AFW success criteria are the following (Ref. 1 and 2):

- Either AFW pump can provide adequate flow.
- Water must be provided from the Condensate Storage Tank or Essential Service Water System
- Delivery requirements are 160 gpm to each of three steam generators or 240 gpm to each of two steam generators. This delivery must commence prior to the steam generators boiling dry (within 20 to 30 minutes)

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

The startup feedwater system may be available as an alternate source of steam generator makeup if offsite power is available and the suction path from the main condenser hotwell via the condensate and feed booster pumps is functional.

3.2.5 Component Information

A. Motor-driven AFW pump 1A
   1. Rated flow: 890 gpm @ 3350 ft. head (1452 psid)
   2. Rated capacity: 175% (Ref. 1)
   3. Type: Centrifugal

B. Diesel-driven AFW pump
   1. Rated flow: 840 gpm @ 3350 ft. head (1452 psid)
   2. Rated capacity: 185% (Ref. 1)
   3. Type: Centrifugal

C. Startup Feedwater Pump
   1. Rated flow: unknown
   2. Type: Centrifugal

D. Condensate storage tank
   1. Capacity: Unknown
   2. Design Pressure: Atmospheric

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

3.2.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. The AFW pumps are automatically actuated based on the following signals:

         - low-low water level in any one steam generator
         - safety injection signal
         - loss of offsite power and station normal auxiliary power (blackout).

      b. The water source for the AFW pumps is automatically switched to the Essential Service Water system on low pump suction pressure.

c. The AFW pumps are automatically tripped on low suction pressure.

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

B. Motive power
1. The AFW motor-driven pump and motor-operated valves are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.7. Redundant loads are supplied from separate load groups.

2. The AFW diesel-driven pump is supplied with fuel from a day tank.

C. Other
1. Cooling for the motor-driven pump is provided by the essential service water system (see Section 3.9). Cooling for the diesel-driven pump is provided locally.
2. Pump cubicle coolers are cooled by essential service water (see Section 3.9).
3. Each AFW pump has an auxiliary lube oil pump that provides lubrication prior to starting the pump. For a normal pump startup, the pump will start when an oil pressure interlock is satisfied. Under emergency start condition prelubrication is not required for AFW pump start (Ref. 2).

3.2.7 Section 3.2 References

1. Youngblood, R. and Papazaglou, I.A., "Review of the Byron/Braidwood Units 1 and 2 Auxiliary Feedwater System Reliability Analysis, NUREG/CR-3096, BNL-NUREG-51633, Brookhaven National Laboratory, November 1983.

2. Byron/Braidwood Final Safety Analysis Report, Section 10.4.9.

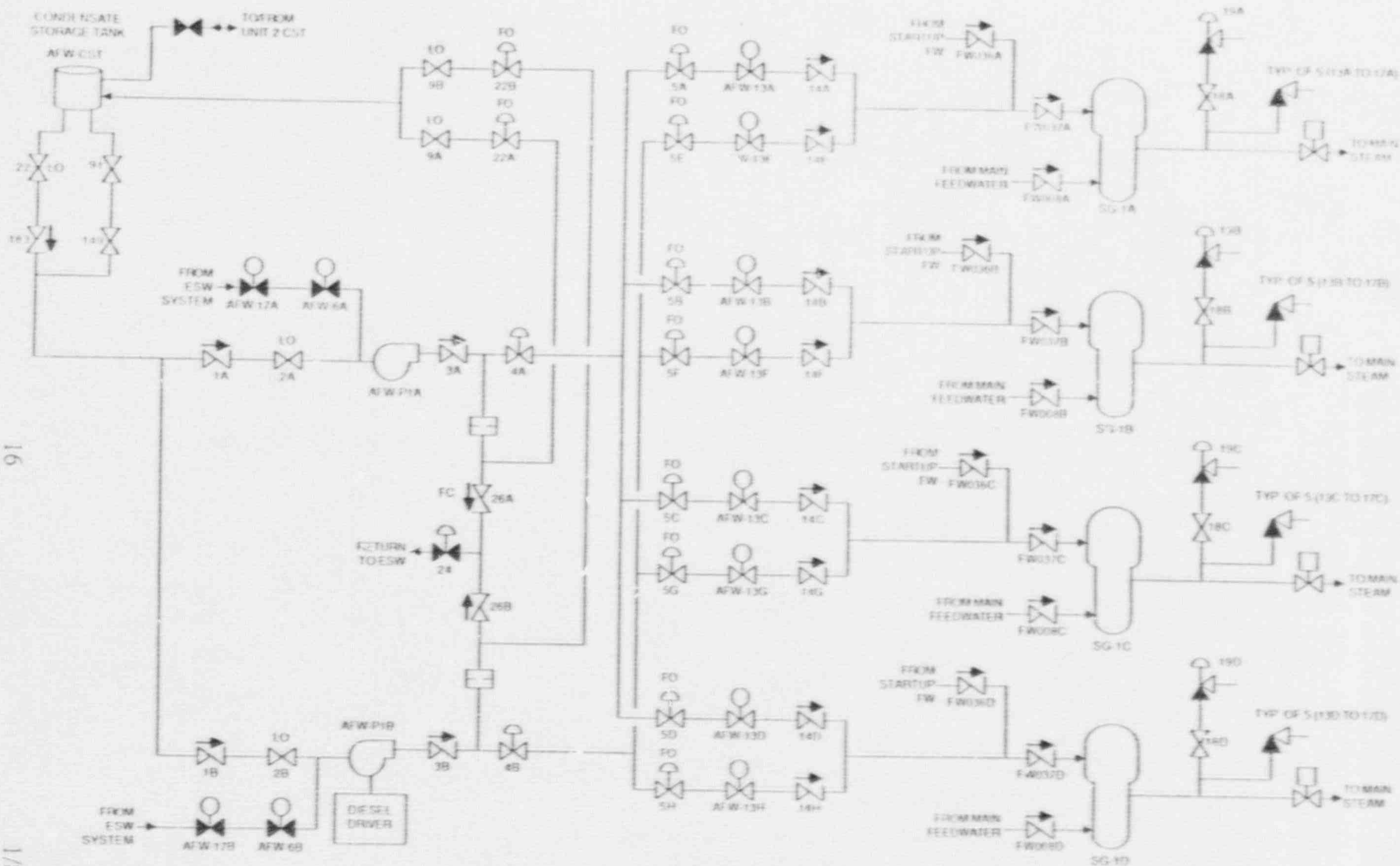


Figure 3.2-1. Braidwood Unit 1 Auxiliary Feedwater System

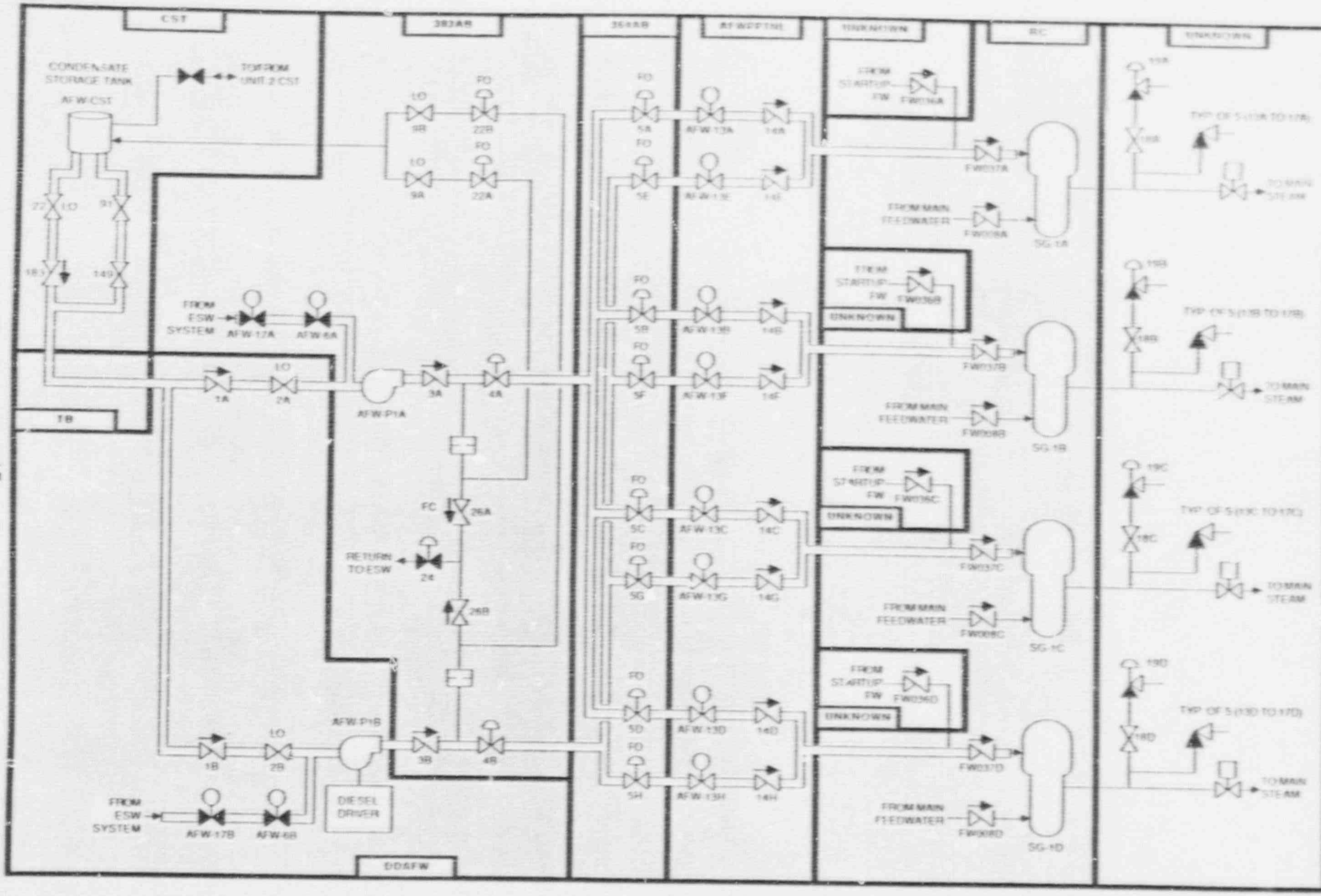


Figure 3.2-2. Braidwood Unit 1 Auxiliary Feedwater System Showing Component Locations

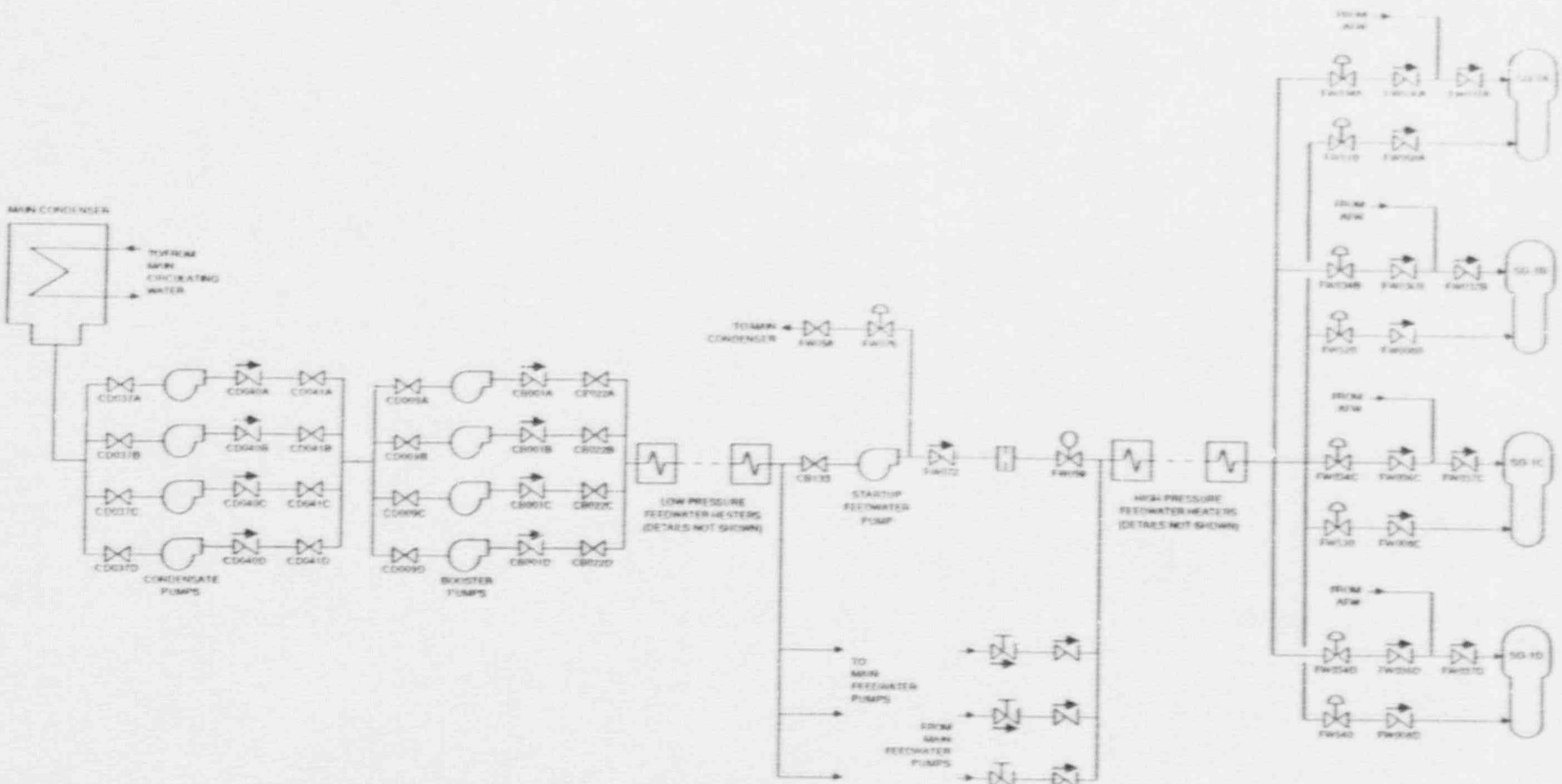


Figure 3.2-3. Braidwood Unit 1 Startup Feedwater System

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP
AFW-13A	MOV	AFWPPTNL	MCC-131X1	480	364PENRM	AC/A
AFW-13B	MOV	AFWPPTNL	MCC-131X1	480	364PENRM	AC/A
AFW-13C	MOV	AFWPPTNL	MCC-131X1	480	364PENRM	AC/A
AFW-13D	MOV	AFWPPTNL	MCC-131X1	480	364PENRM	AC/A
AFW-13E	MOV	AFWPPTNL	MCC-132X4	480	426PENRM	AC/B
AFW-13F	MOV	AFWPPTNL	MCC-132X4	480	426PENRM	AC/B
AFW-13G	MOV	AFWPPTNL	MCC-132X4	480	426PENRM	AC/B
AFW-13H	MOV	AFWPPTNL	MCC-132X4	480	426PENRM	AC/B
AFW-17A	MOV	383AB	MCC-131X3	480	383AB	AC/A
AFW-17B	MOV	DDAFW	MCC-132X3	480	383AB	AC/B
AFW-6A	MOV	383AB	MCC-131X3	480	383AB	AC/A
AFW-6B	MOV	DDAFW	MCC-132X3	480	383AB	AC/B
AFW-CST	TANK	CST				
AFW-P1A	MDP	383AB	BUS-141	4160	ESF11	AC/A
AFW-P1B	DDP	DDAFW				
SG-1A	SG	RC				
SG-1B	SG	RC				
SG-1C	SG	RC				
SG-1D	SG	RC				

3.3 EMERGENCY CORE COOLING SYSTEM (ECCS)

3.3.1 System Function

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

3.3.2 System Definition

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

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

The charging function of the CVCS is described in Section 3.4.

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

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

Simplified drawings of the safety injection system are shown in Figures 3.3-1 and 3.3-2. The residual heat removal system is shown in Figures 3.3-3 and 3.3-4. Interfaces between the accumulators, the ECCS injection and recirculation subsystems, and the RCS are shown in Section 3.1. A summary of data on selected ECCS components is presented in Table 3.3-1.

3.3.3 System Operation

During normal operation, the ECCS is in standby. Following a LOCA, the four cold leg injection accumulators (one for each loop) supply borated water to the RCS as soon as RCS pressure drops below accumulator pressure (approximately 585 psig). A safety injection signal (SIS) automatically starts the two charging pumps, the two safety injection pumps, and the two RHR pumps, and aligns the charging pumps for injection. The charging pumps inject through the boron injection tank (BIT) into the four RCS cold legs. The SI and RHR pumps can inject into either the cold legs or the hot legs. All pumps are aligned to take suction on the RWST.

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

When the RWST water level drops to a prescribed low level setpoint, the RHR pumps are realigned to draw a suction from the containment sump and deliver water to the RCS cold legs. If depressurization of the RCS proceeds slowly, high pressure recirculation can be accomplished by manually aligning the discharge of the RHR pumps to the suction of the charging and SI pumps. Approximately 18 hours after the accident, hot leg recirculation is initiated to ensure termination of boiling and preclude excessive boron concentration in the reactor vessel.

3.3.4 System Success Criteria

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

- 3 of 4 accumulators provide makeup as RCS pressure drops below tank pressure,
- One safety injection pump injects its flow to the RCS,
- One RHR pump delivers its flow to the RCS,
- One centrifugal charging pump injects from the RWST into the RCS, and
- Coolant recirculation occurs on a low level signal from the RWST or by remote manual means.

The recirculation success criteria are not clearly defined in the FSAR.

Success Criteria for a small LOCA is not clearly defined in the FSAR, however it is noted that (Ref. 2):

- The Safety injection pump shutoff head is less than RCS normal operating pressure, therefore, a small LOCA must be of sufficient size to cause some RCS depressurization, or the RCS must be depressurized by other means if the safety injection pumps are to provide makeup. Options for depressurizing the RCS may include:
  - Opening power-operated relief valves on the pressurizer (two PORVs are available, see Section 3.1)
  - RCS cooldown (i.e. using the auxiliary feedwater system, see Section 3.2)
- The combined capacity of the two centrifugal charging pumps is 300 gpm (i.e. 150 gpm each) @ 5,800 ft. head. One charging pump can maintain normal operating pressure (2,250 psia) following a 0.375" equivalent diameter rupture (127 gpm leak/charging rate).

3.3.5 Component Information

A. Safety injection (high pressure) pumps 1A and 1B
   1. Rated flow: 400 gpm @ 2540 ft head (1101 psid)
   2. Rated capacity: 100%
   3. Shutoff head: 3922 ft head (1700 psig)
   4. Type: horizontal centrifugal

B. Residual heat removal (low pressure) pumps 1A and 1B
   1. Rated flow: 3000 gpm @ 375 ft. head (163 psid)
   2. Rated capacity: 100%
   3. Shutoff head: 450 ft head (195 psid)
   4. Type: vertical centrifugal

C. Cold leg injection accumulators (4)
   1. Accumulator volume: 1350 ft^3
   2. Minimum water volume: 935 ft^3
   3. Normal operating pressure: 585 psig
   4. Nominal boric acid concentration: 2000 ppm

D. Refueling water storage tank
   1. Capacity: 458,000 gallons
   2. Design pressure: Atmospheric
   3. Minimum boron concentration. 1900 ppm
   4. Minimum water volume: 420,000 gallons

E. RHR heat exchangers 1A and 1B
   1. Design duty: 28.95 x 10^6 Btu/hr
   2. Type: Vertical, shell and U-tube

3.3.6 Support Systems and Interfaces

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

      a. Low pressurizer pressure
      b. High containment pressure
      c. Low steam line pressure
      d. Manual actuation

      The SIS automatically initiates the following actions:

      - starts the diesel generators
      - starts the charging, SI, and RHR pumps
      - aligns the charging pumps for injection

      Switchover to the recirculation mode occurs automatically on low level in the RWST.
   2. Remote manual
      An SIS signal can be initiated by remote manual means from the main control room. The transition from the injection to the recirculation phase of ECCS operation can be initiated by remote manual means. Manual action is required to realign the charging and safety injection pumps for recirculation.

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

C. Other

1. Each SI and charging pump is cooled by the Essential Service Water system (see Section 3.9).
2. The RHR pumps and heat exchangers are cooled by the Component Cooling Water system (see Section 3.8).
3. Lubrication and ventilation are provided locally for the SI, RHR, and charging pumps and motors.

3.3.7 Section 3.3 References

1. Byron/Braidwood Final Safety Analysis Report, Section 6.3.2.

2. Byron/Braidwood Final Safety Analysis Report, Section 6.3.3.

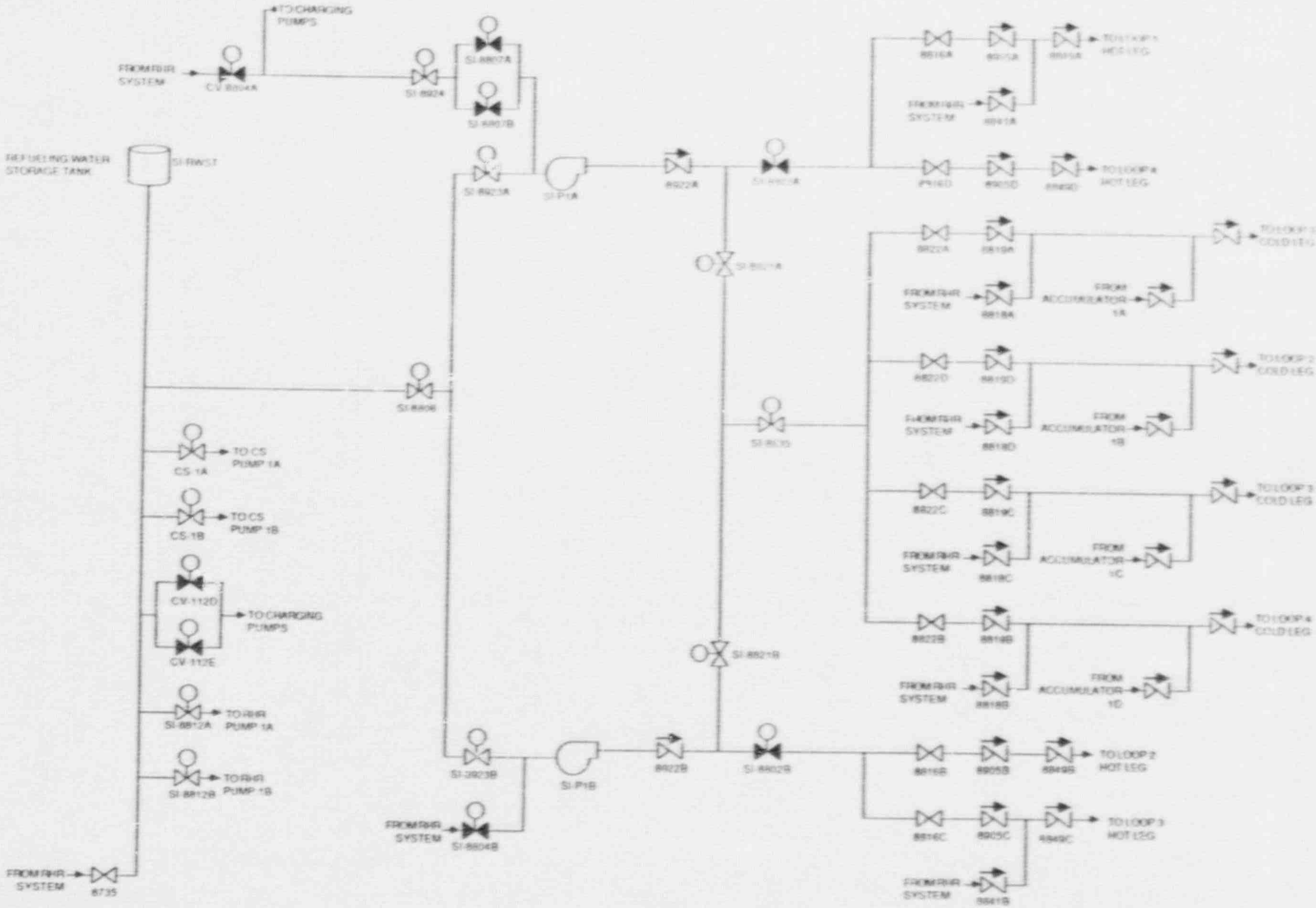


Figure 3.3-1. Braidwood Unit 1 Safety Injection System

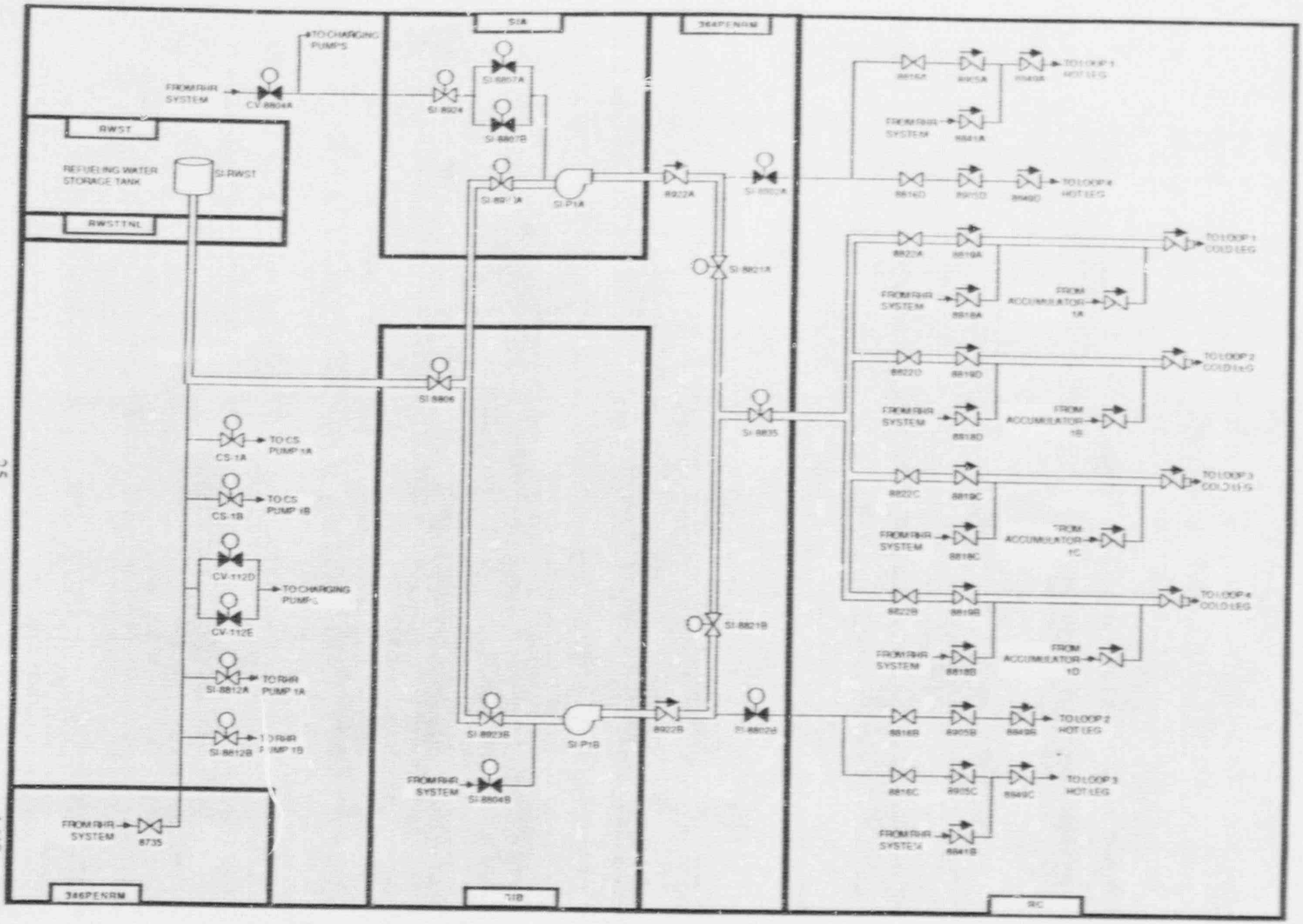


Figure 3.3-2. Braidwood Unit 1 Safety Injection System Showing Component Locations

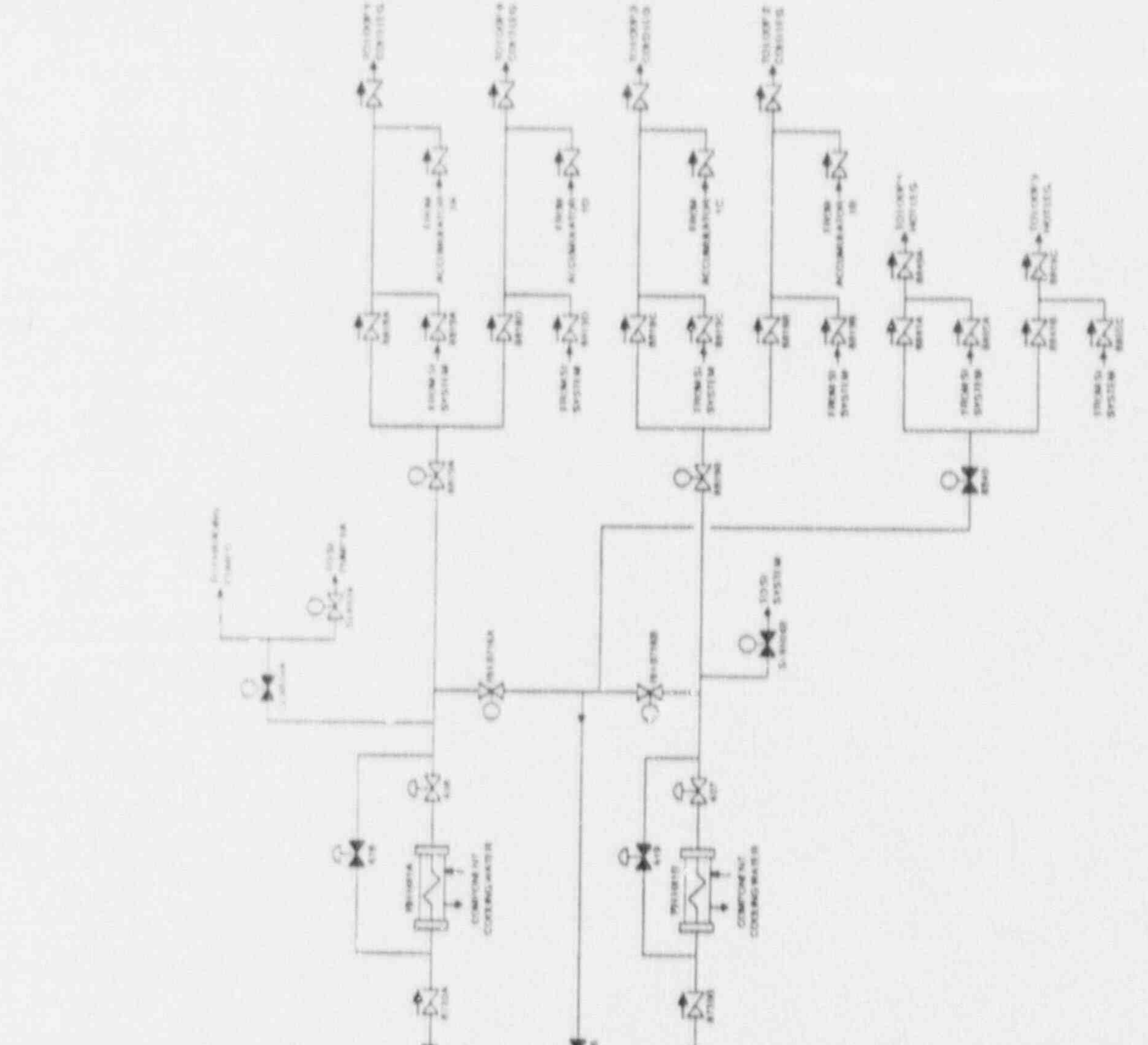


Figure 3.3-3. Braidwood Unit 1 Residual Heat Removal System

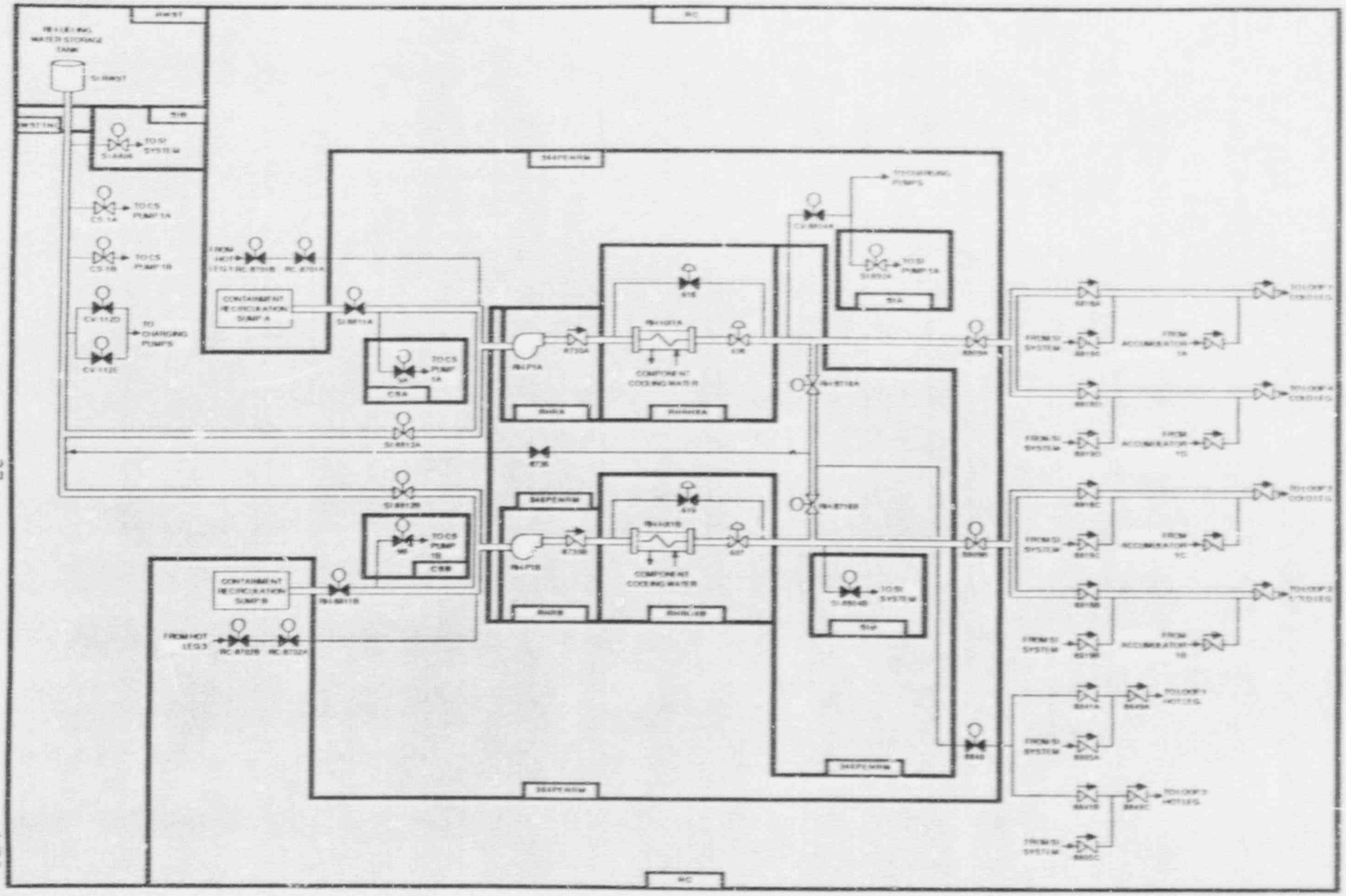


Figure 3.3-4. Braidwood Unit 1 Residual Heat Removal System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP
CV-8804A	MOV	364PENRM	MCC-131X1	480	364PENRM	AC/A
RH-8716A	MOV	364PENRM	MCC-131X1	480	364PENRM	AC/A
RH-8716A	MOV	364PENRM	MCC-131X1	480	364PENRM	AC/A
RH-8716B	MOV	364PENRM	MCC-132X4	480	426PENRM	AC/B
RH-8716B	MOV	364PENRM	MCC-132X4	480	426PENRM	AC/B
RH-HX1A	HX	RHRHXA				
RH-HX1B	HX	RHRHXB				
RH-P1A	MDP	RHRA	BUS-141	4160	ESF11	AC/A
RH-P1B	MDP	RHRB	BUS-142	4160	ESF12	AC/B
SI-8802A	MOV	364PENRM	MCC-131X1A	480	364PENRM	AC/A
SI-8802B	MOV	364PENRM	MCC-132X4A	480	426PENRM	AC/B
SI-8804B	MOV	SIB	MCC-132X4	480	426PENRM	AC/B
SI-8806	MOV	SIB				
SI-8807A	MOV	SIA	MCC-131X1	480	364PENRM	AC/A
SI-8807B	MOV	SIA	MCC-132X1	480	364AB	AC/B
SI-8811A	MOV	364PENRM	MCC-131X1	480	364PENRM	AC/A
SI-8811B	MOV	364PENRM	MCC-132X4A	480	426PENRM	AC/B
SI-8821A	MOV	364PENRM	MCC-131X1	480	364PENRM	AC/A
SI-8821A	MOV	364PENRM	MCC-131X1	480	364PENRM	AC/A
SI-8821B	MOV	364PENRM	MCC-132X4	480	426PENRM	AC/B
SI-8821B	MOV	364PENRM	MCC-132X4	480	426PENRM	AC/B
SI-8835	MOV	364PENRM	MCC-131X1A	480	364PENRM	AC/A
SI-8923A	MOV	SIA	MCC-131X1	480	364PENRM	AC/A
SI-8923B	MOV	SIB	MCC-132X4	480	426PENRM	AC/B
SI-8924	MOV	SIA	MCC-132X1	480	364AB	AC/B
SI-P1A	MDP	SIA	BUS-141	4160	ESF11	AC/A
SI-P1B	MDP	SIB	BUS-142	4160	ESF12	AC/B

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP
SI-RWST	TANK	RWST				
SUMP-A	SUMP	RC				
SUMP-B	SUMP	RC				

3.4 CHARGING SYSTEM (CVCS)

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 assumed to be required to maintain the plant in a long-term (8 hours) hot shutdown condition. The charging pumps also operate as part of the ECCS in the event of a LOCA.

3.4.2 System Definition

The CVCS provides a means for injection of control poison in the form of boric acid solution, chemical additions for corrosion control, and reactor coolant cleanup and degasification. This system also adds makeup water to the RCS, reprocesses water that is letdown from the RCS, provides seal water injection to the reactor coolant pump seals, and performs an emergency core cooling function.

The CVCS consists of several subsystems: the charging, letdown, and seal water 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 - the charging pumps, (two centrifugal, one positive displacement), boric acid transfer pumps, volume control tank, boric acid tanks, and 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. Note that the normal charging paths to the reactor coolant loops did not appear on the available drawings, so the arrangement for the Byron plant was assumed in these figures. 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, one charging pump is running with its suction aligned to the Volume Control Tank (VCT). The letdown flow from a RCS cold leg is cooled in the shell side of the regenerative heat exchanger, then directed to the VCT. The reactor makeup control system maintains the desired inventory in the VCT. The bulk of the charging flow is pumped back to the RCS through the tube side of the regenerative heat exchanger via two charging lines. Portions of the charging flow are directed to the reactor coolant pumps through a seal water injection filter, and to pressurizer spray.

The centrifugal charging pumps also provide high-head injection as part of the ECCS (see Section 3.3). During a LOCA the CVCS is isolated except for the centrifugal charging pumps and the piping in the safety injection path. The pumps take suction on the Refueling Water Storage Tank (RWST) and inject via the Boron Injection Tank into all four cold legs.

The reciprocating (positive displacement) charging pump is also used to perform hydrostatic tests which verify the integrity of the RCS. The pump can pressurize the RCS to the maximum design test pressure.

3.4.4 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.

For LOCA success criteria, see Section 3.3.4.

3.4.5 Component Information

A. Centrifugal charging pumps 1A and 1B
   1. Rated flow: 150 @ 5800 ft head (2514 psid)
   2. Rated capacity: 100%
   3. Type: centrifugal

B. Reciprocating charging pump 1
   1. Rated flow: 98 gpm
   2. Rated capacity: 100%
   3. Type: positive displacement

3.4.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. The centrifugal charging pumps are automatically actuated by a safety injection signal (SIS).
      b. The reciprocating charging pump is tripped and the normal charging line is isolated by an SIS.

   2. Remote Manual
      The charging pumps can be actuated by remote manual means from the control room.

B. Motive Power
   1. The centrifugal 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 3.7.

C. Other
   1. The centrifugal charging pumps are cooled by the Essential Service Water system (see Section 3.9).
   2. Pump lubrication and ventilation are provided locally.

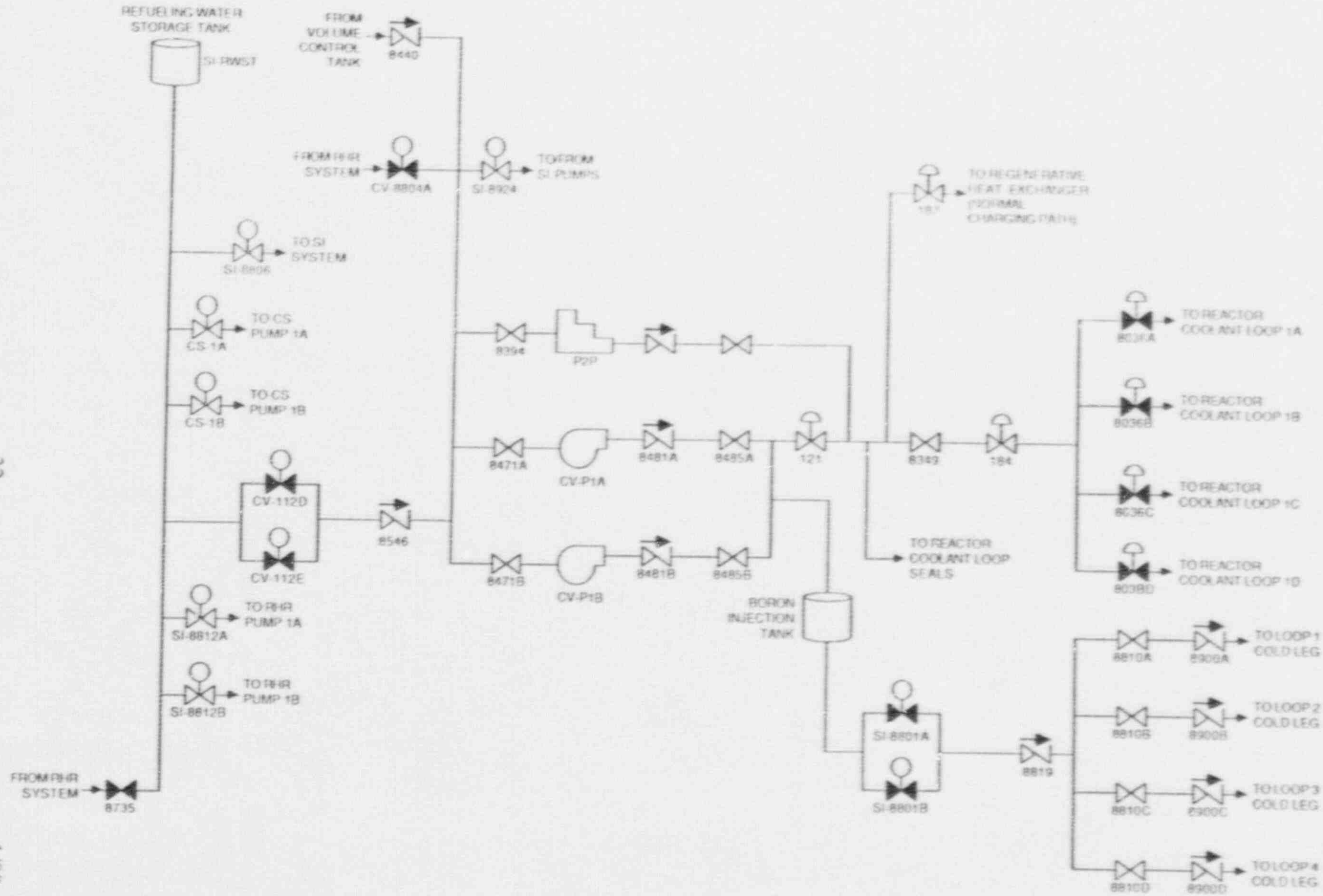


Figure 3.4-1. Braidwood Unit 1 Charging System

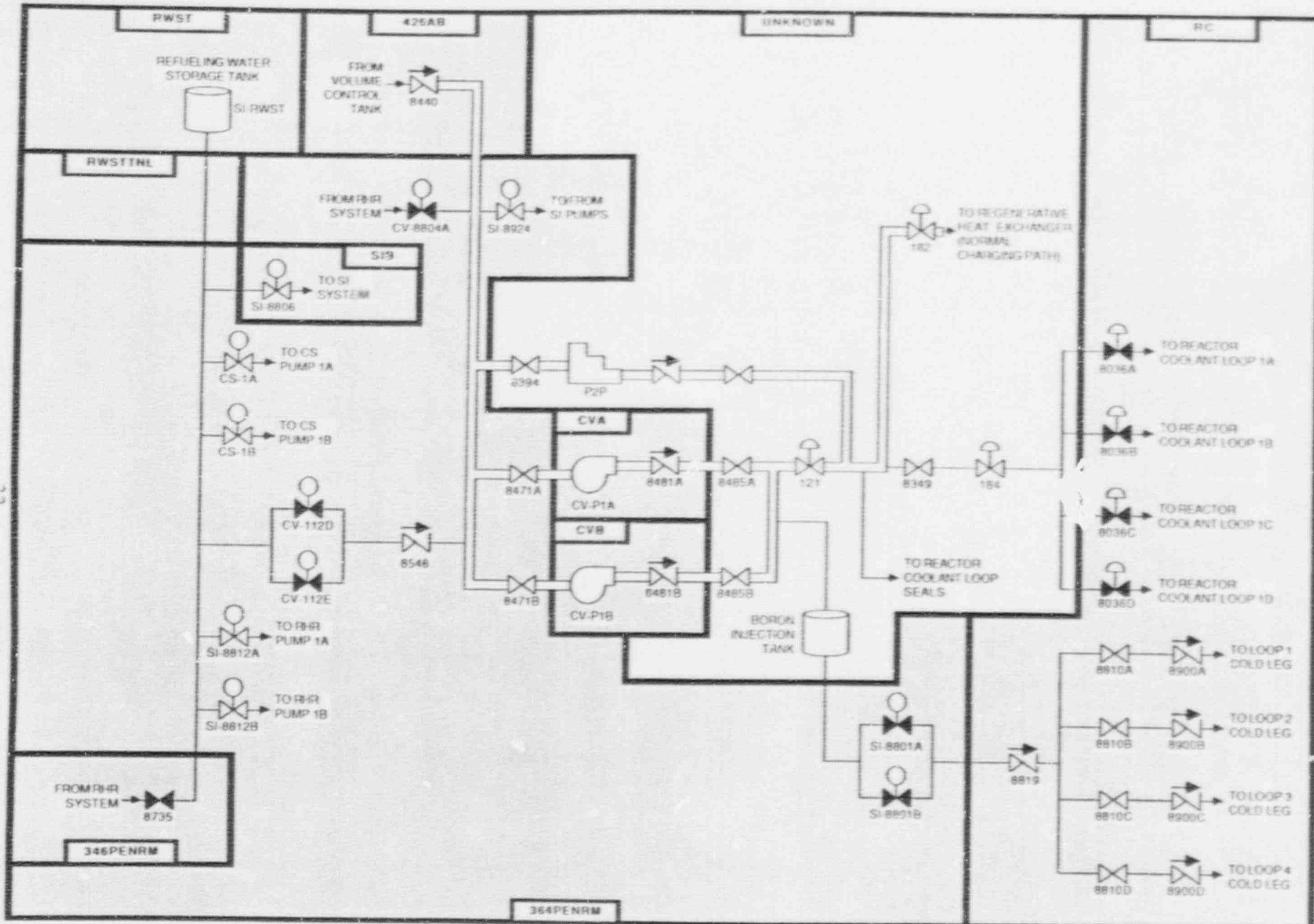


Figure 3.4-2. Braidwood Unit 1 Charging System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP
CV-112D	MOV	364PENRM	MCC-131X1	480	364PENRM	AC/A
CV-112E	MOV	364PENRM	MCC-132X4	480	426PENRM	AC/B
CV-P1A	MDP	CVA	BUS-141	4160	ESF11	AC/A
CV-P1B	MDP	CVB	BUS-142	4160	ESF12	AC/B
SI-8801A	MOV	364PENRM	MCC-131X1	480	364PENRM	AC/A
SI-8801B	MOV	364PENRM	MCC-132X5	480	426AB	AC/B
SI-RWST	TANK	RWST				

3.5 CONTAINMENT HEAT REMOVAL SYSTEM

3.5.1 System Function

Containment heat removal systems perform the functions of containment heat removal and pressure control following a loss of coolant accident. In conjunction with the ECCS, the containment heat removal systems completes the post-LOCA heat transfer path from the reactor core to the ultimate heat sink. The Containment Spray System, which is one of the containment heat removal systems, also serves to remove elemental iodine from the containment atmosphere.

3.5.2 System Definition

Containment heat removal systems include the following two systems:

- Reactor Containment Fan Cooler (RCFC) System
- Containment Spray (CS) System

The RCFC system provides the design heat removal capacity for the containment following a LOCA, assuming that core residual heat is released to the containment as steam. This is accomplished by the continuous recirculation of the air-steam mixture through cooling coils to transfer heat to essential service water. The RCFC system consists of two redundant trains, each powered from a separate bus. Each train consists of two 50% capacity fan cooler units.

The Containment Spray system is designed to remove fission products, primarily elemental iodine, from the containment atmosphere following a LOCA. The system also serves to reduce containment pressure and temperature during the injection phase of LOCA mitigation. The CS system consists of two independent trains, each containing a 100% capacity pump and three ring-type spray headers. During the injection phase of LOCA mitigation the CS pumps draw suction from the RWST. During recirculation the CS pumps draw from the containment sumps.

Simplified drawings of the Containment Spray system are shown in Figures 3.5-1 and 3.5-2. The interface between the containment fan cooler units and essential service water is shown on the ESW system drawings in Section 3.9. The interfaces are through motor operated valves CC-16A and CC-16B. A summary of data on selected containment spray system components is presented in Table 3.5-1.

3.5.3 System Operation

The Reactor Containment Fan Cooler system consists of two trains, each containing two 50% capacity fan cooler units. The RCFC is designed to commence operation approximately 45 seconds following the initiation of a safety injection signal. Heat is transferred through cooling coils to essential service water. During normal operation the RCFC fan motor operates in the high-speed mode. On initiation of post-LOCA mode of operation the motor will shift to low speed, resulting in lower air flow. The lower air flow compensates for the increase in containment air density resulting from the higher pressure following a LOCA (Ref. 1).

The Containment Spray system consists of two pumps, each supplying three spray headers located in the containment dome area. The spray system will be actuated by high-high-high containment pressure (approximately 23 psig). During the injection phase, water from the RWST is sprayed into the containment atmosphere by the CS pumps. Following the injection phase the spray pumps are realigned to draw suction from the containment sump during recirculation.

3.5.4 System Success Criteria

The CS success criteria are not clearly defined in the FSAR in terms of containment heat removal. However, the following is noted (Ref. 1):

- Operation of one of the two independent CS trains will provide 100% of system capacity.
- Operation of one CS train will lower containment pressure enough so that containment design leakage is not exceeded, and enough iodine will be removed to restrict the site boundary and offsite doses to below the limits of 10 CFR 100.

The RCFC success criteria are as follows (Ref. 2):

- One of two redundant trains is in operation approximately 45 seconds after a safety injection signal is initiated.

Partial CS and RCFS success criteria may exist, but are not defined in the FSAR.

3.5.5 Component Information

A. Reactor Containment Fan Cooler Units 1A, 1B, 1C, and 1D
1. Fan type: vane-axial
2. Rated capacity: 50%
3. Accident mode heat removal: 132×10^6 Btu/hr

B. Containment Spray Pump 1A
1. Rated flow: 3415 gpm @ 450 ft head (195 psid)
2. Rated capacity: 100%
3. Type: vertical centrifugal

C. Containment Spray Pump 1B
1. Rated flow: 3925 gpm @ 450 ft. head (195 psid)
2. Rated capacity: 100%
3. Type: vertical centrifugal

3.5.6 Support Systems and Interfaces

A. Control Signals
1. Automatic
   The fan cooler units are automatically actuated by a safety injection signal. The containment spray system is automatically actuated on high-high-high containment pressure.
2. Remote manual
   The RCFC and CS systems can be actuated by remote manual means from the control room.

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

C. Cooling Water
   1. The RCFC units are cooled by the Essential Service Water system (see Section 3.9).

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

3.5.7 Section 3.5 References

1. Byron/Braidwood Final Safety Analysis Report, 6.2.2.
2. Byron/Braidwood Final Safety Analysis Report, Section 6.2.2.

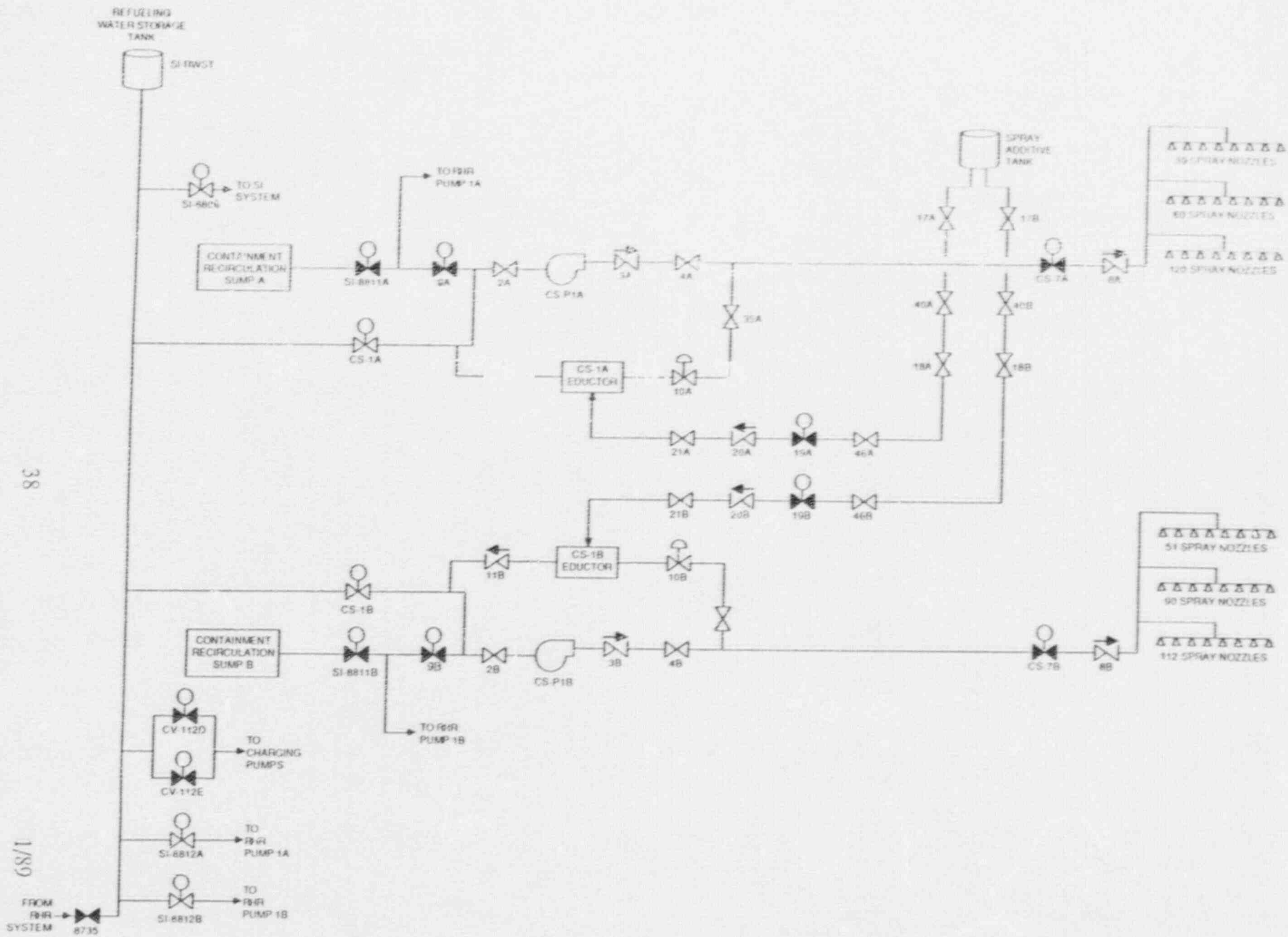


Figure 3.5-1. Braidwood Unit 1 Containment Spray System

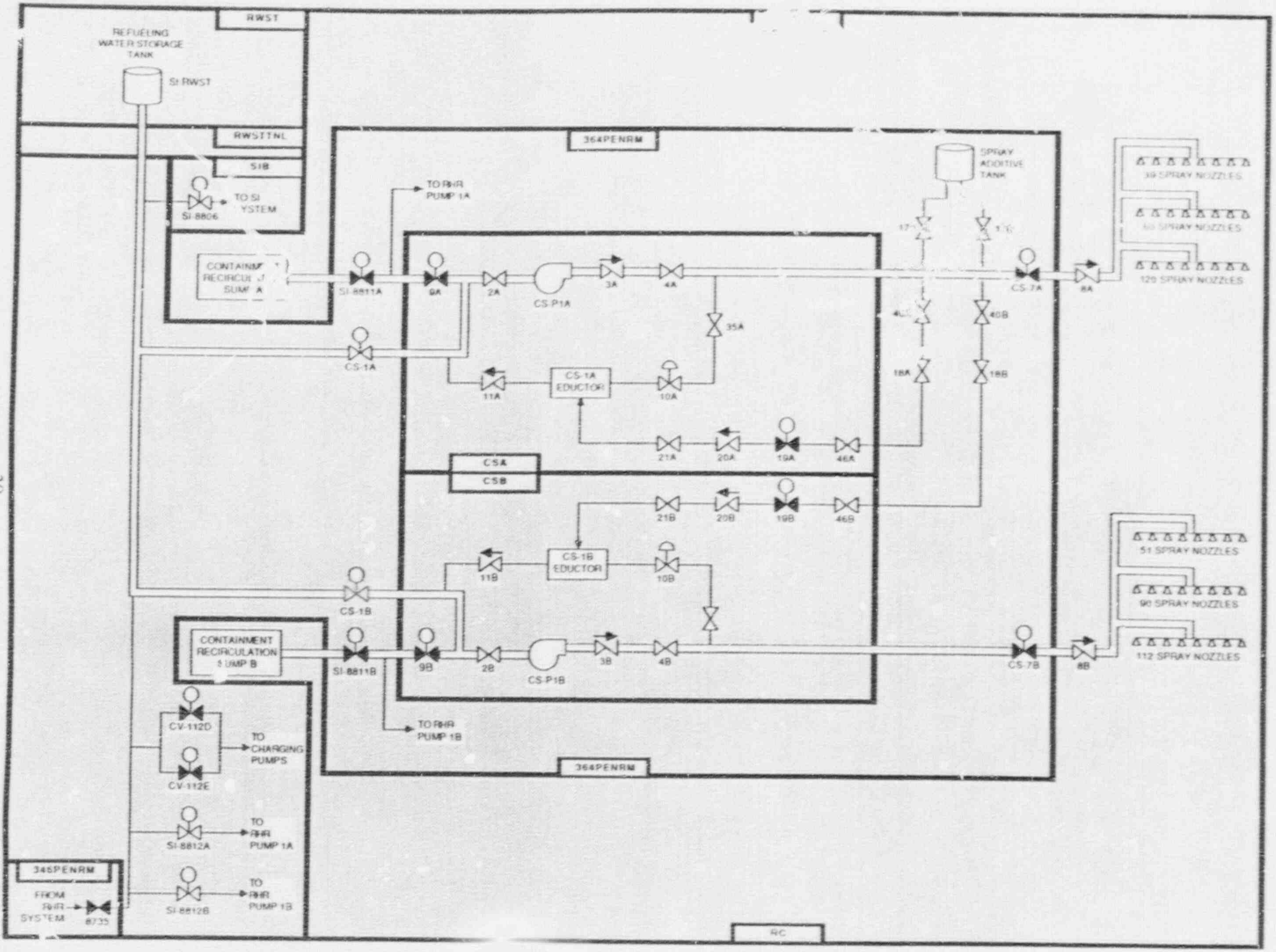


Figure 3.5-2. Braidwood Unit 1 Containment Spray System Showing Component Locations

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Table 3.5-1. Braidwood Unit 1 Containment Heat Removal System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP
CC-16A	MOV	364PENRM	MCC-131X5	480	426AB	AC/A
CC-16B	MOV	364PENRM	MCC-132X4	480	426PENRM	AC/B
CC-27A	MOV	364PENRM	MCC-131X5	480	426AB	AC/A
CC-27B	MOV	364PENRM	MCC-132X4	480	426PENRM	AC/B
CC-FANA	ACU	RC				
CC-FANB	ACU	RC				
CC-FANC	ACU	RC				
CC-FAND	ACU	RC				
CS-1A	MOV	364PENRM	MCC-131X1	480	364PENRM	AC/A
CS-1B	MOV	364PENRM	MCC-132X4A	480	426PENRM	AC/B
CS-7A	MOV	364PENRM	MCC-131X5	480	426AB	AC/A
CS-7B	MOV	364PENRM	MCC-132X4	480	426PENRM	AC/B
CS-9A	MOV	CSA	MCC-131X1	480	364PENRM	AC/A
CS-9B	MOV	CSB	MCC-132X1	480	364AB	AC/A
CS-P1A	MDP	CSA	BUS-141	4160	ESF11	AC/A
CS-P1B	MDP	CSB	BUS-142	4160	ESF12	AC/B

3.6 INSTRUMENTATION AND CONTROL (I & C) SYSTEMS

3.6.1 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 ESFAS 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 ESFAS will automatically actuate selected safety systems based on the specific limits or combinations of limits that are exceeded. A remote shutdown capability is provide to ensure that the reactor can be placed in a safe condition in the event that the main control room has to be evacuated.

3.6.2 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 ESFAS includes independent sensor and transmitter units, logic units and relays that interface with the control circuits for the many different sets of components that can be actuated by the ESFAS. Operator instrumentation display systems consist of display panels in the control room that are powered by the 120 VAC electric power system (see Section 3.7). The remote shutdown capability is provided by the remote shutdown panel in conjunction with normal automatic systems and local controls outside the control room.

3.6.3 System Operation

A. RPS

The Westinghouse RPS (or Reactor Trip System, RTS) has two to four redundant input instrument channels for each sensed parameter and two output actuation trains (A and B). The A and B logic trains independently generate a reactor trip command when prescribed parameters are outside the safe operating range. Either 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 ESFAS 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 buses. An individual component usually receives an actuation signal from only one ESFAS train. The ESFAS generates the following signals: (a) reactor trip, provided one has not already been generated by the RPS, (b) safety injection signal (SIS), (3) containment isolation, (4) main steam line isolation, (5) main feedwater line isolation, (6) emergency diesel start, (7) control room isolation and (8) containment spray actuation. The control room operators can manually trip the various ESFAS logic subsystems. Details regarding ESFAS actuation logic are included in the system description for the actuated system.

C. Remote Shutdown

For equipment having controls outside the control room (which duplicate the functions inside the control room), the controls are provided with a selector switch which transfers control of the switchgear from the control room to a local station. Placing the local selector switch in the local operating position gives an annunciating alarm in the control room and turns off the indicating lights on the control room panel.

The remote shutdown panels are located at plant elevation 383 feet in the radwaste control area.

The main control room panels and the remote shutdown panels are located in separate physical locations, on separate elevations, with separate ventilation systems and multiple communication systems, and with lighted access routes between the two locations. Therefore, it is expected that no single credible event which will cause evacuation of the main control room will also cause remote shutdown panels to be inoperable. Equipment having controls available outside the control room are listed in Table 3.6-1 (Ref. 1).

3.6.4 System Success Criteria

A. RPS

In the analog portion, two to four redundant sensors and channels are used. The coincidence required to cause a trip varies from parameter to parameter. The channel's analog input is converted into a digital signal for the logic portion. The RPS uses hindrance logic (normal = 1, trip = 0) in both the input and output logic. Therefore, a channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e. the channel has a fail-safe failure mode). A reactor scram will occur upon loss of control power to the RPS. A reactor scram usually is implemented by the scram circuit breakers which must open in response to a scram signal. 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 Braidwood have not been determined.

B. ESFAS

A single component usually receives a signal from only one ESFAS output train although both AFW pumps receive signals from both trains. ESFAS Trains A and B must be available in order to automatically actuate their respective components. ESFAS 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 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 Braidwood have not been determined.

3.6.5 Support Systems and Interfaces

A. Control Power

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

3.6.6 Section 3.6 References

1. Byron/Braidwood Final Safety Analysis Report, Section 7.4.1.

Table 3.6-1. Braidwood Equipment Controls Available Outside the Control Room

The following equipment can be controlled from local stations outside the main control room:

- Auxiliary Feedwater Pumps
- Centrifugal Charging Pumps
- Boric Acid Transfer Pumps
- Essential Serv. Water Pump
- Component Cooling Water Pump
- Reactor Containment Fan Coolers
- Control Room Ventilation Unit including Control Room Air
- Inlet Dampers
- Primary Water Makeup Pumps
- Charging Flow Control Valve
- Letdown Orifice Isolation Valves
- Aux. Feedwater Control Valves
- Power-Operated Atmospheric Steam Relief
- Pressurizer Heater Control
- Emergency Boration Isolation Valve

3.7 ELECTRIC POWER SYSTEM

3.7.1 System Function

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

3.7.2 System Definition

The onsite Class 1E electric power system consists of two 4160 switchgear buses, designated 141 and 142. There are two standby diesel generators connected to the buses. Diesel generator 1A is connected to bus 141, and diesel generator 1B is connected to bus 142. There are also four 480 VAC switchgear buses, designated 131X, 131Z, 132X, and 132Z. Buses 131X and 131Z are connected to 4160 bus 141 through transformers, and buses 132X and 132Z are connected to 4160 bus 142 through transformers. Buses 131Z and 132Z serve loads associated with the essential cooling towers. Various motor control centers (MCCs) receive their power from the 480 VAC buses.

Emergency power for vital instruments, control, and emergency lighting is supplied by two 125 VDC station batteries. The batteries energize two DC buses, designated 111 and 112. Four 120 VAC instrument buses are connected to the DC buses through inverters, and to 480 VAC MCCs through transformers.

Simplified one-line diagrams of the electric power system are shown in Figures 3.7-1 through 3.7-4. A diagram of the diesel generator fuel oil system is shown in Figure 3.7-5. A summary of data on selected electric power system components is presented in Table 3.7-1. A partial listing of electrical sources and loads is presented in Table 3.7-2.

3.7.3 System Operation

During normal operation, the Class 1E electric power system is supplied from the 345 kV switchyard, directly to the two 4160 buses through two system auxiliary transformers. An alternate source of power is also from the 345 kV switchyard but through Unit 2's 4160 switchgear. 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 the instrument inverters for up to 30 minutes, and other loads such as diesel generator control power for up to 4 hours.

The 120 VAC vital buses normally receive power from the DC buses through an inverter. An alternate source is from the 480 VAC system through transformers.

Redundant safeguards equipment such as motor driven pumps and motor operated valves are supplied by different VAC buses. For the purpose of discussion, this equipment has been grouped into "load groups". Load group "AC/A" contains components receiving electric power either directly or indirectly from 4160 bus 141. Load group "AC/B" contains components powered either directly or indirectly from 4160 bus 142. Components receiving DC power are assigned to load groups "DC/A" and "DC/B", based on the battery power source.

3.7.4 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
- 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

3.7.5 Component Information

A. Standby diesel generators (2)
   1. Maximum continuous rating: 5500 kW
   2. 2 hour rating: 6050 kW
   3. Rated voltage: 4160 VAC
   4. Manufacturer: unknown

B. Batteries (2)
   1. Rated voltage: 125 VDC

3.7.6 Support Systems and Interfaces

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

   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 is transferred from a jacket water system to the Essential Service Water system. Each diesel receives redundant cooling water supplies from the ESW "A" and "B" headers (see Section 3.9).
   2. Diesel Starting System
      Each diesel has an air starting system.
   3. Diesel Fuel Oil Transfer and Storage System
      A 500 gallon "day tank" supplies the relatively short-term (approximately 72 minutes) fuel needs of each diesel. Each day tank is replenished from two 25,000 gallon storage tanks during engine operation.
   4. Diesel Lubrication System
      Each diesel generator has its own lubrication system.
   5. Combustion Air Intake and Exhaust System
      This system supplies fresh air to the diesel intake, and directs the diesel exhaust outside of the diesel building.

6. Diesel Room Ventilation System
   This system maintains 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.

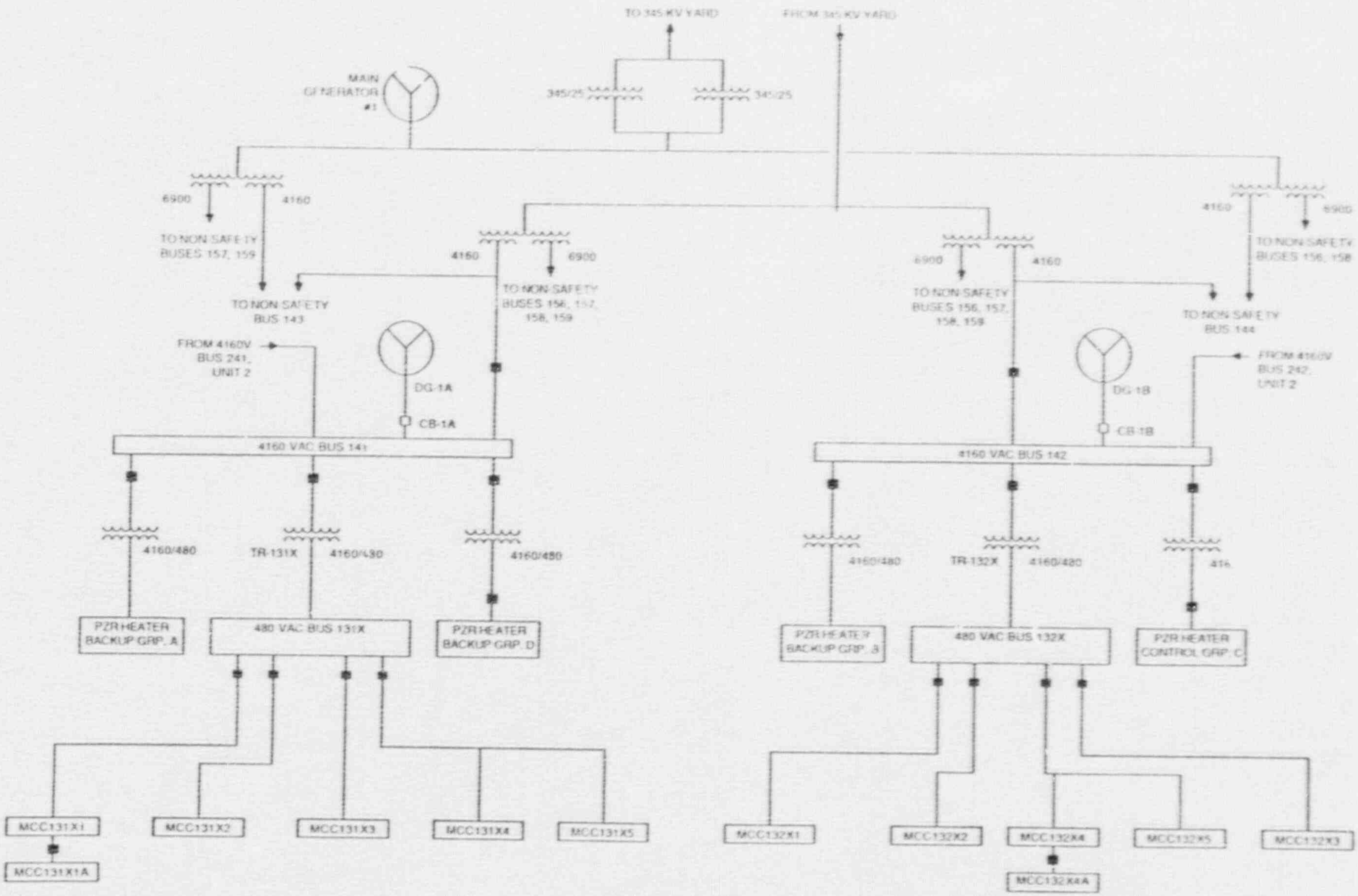
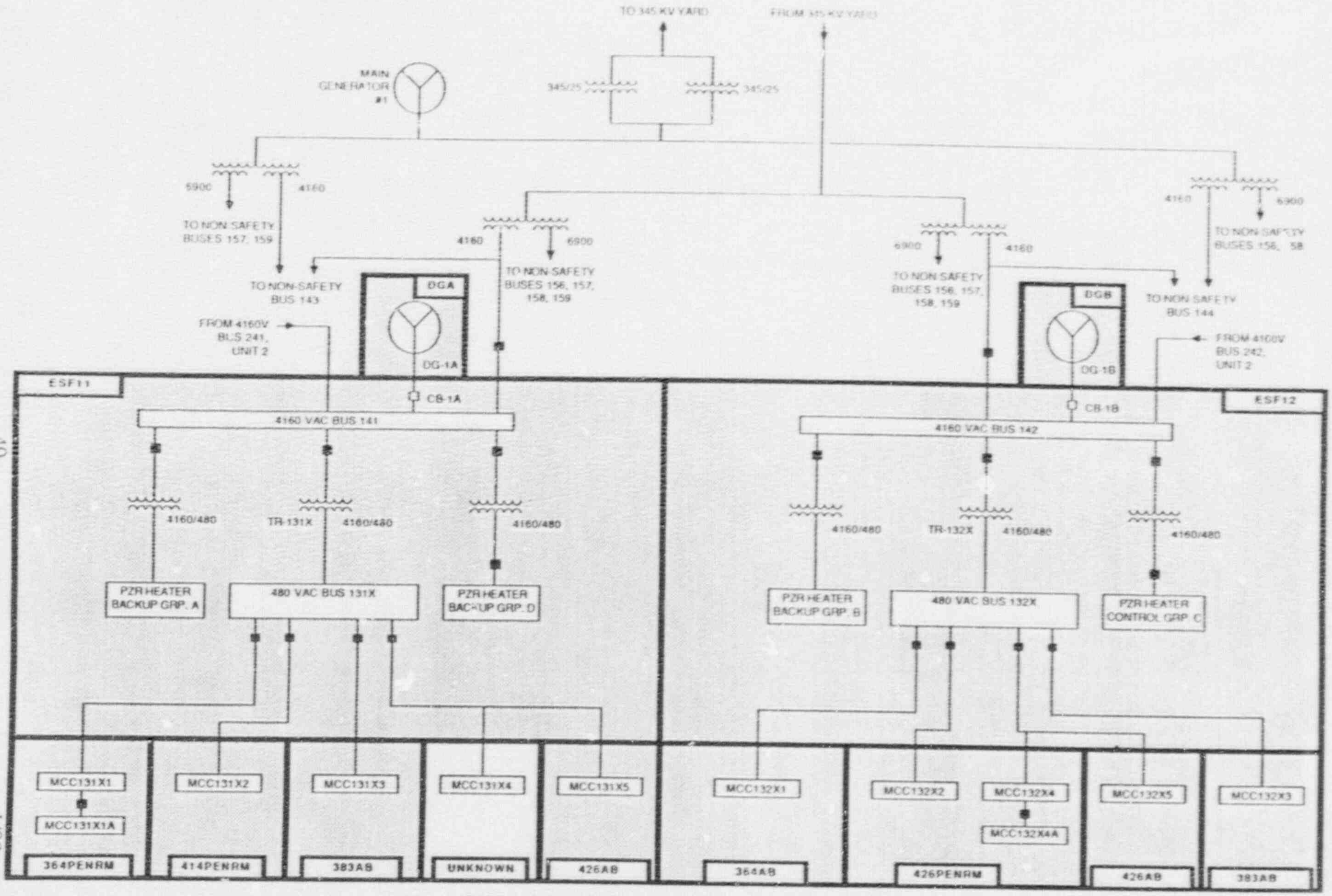


Figure 3.7-1. Braidwood Unit 1 4160 and 480 VAC Electric Power Distribution System



NOTE: Lines May Not Represent Actual Cable Routing Between Rooms

Figure 3.7-2. Braidwood Unit 1 4160 and 480 VAC Electric Power Distribution System Showing Component Locations

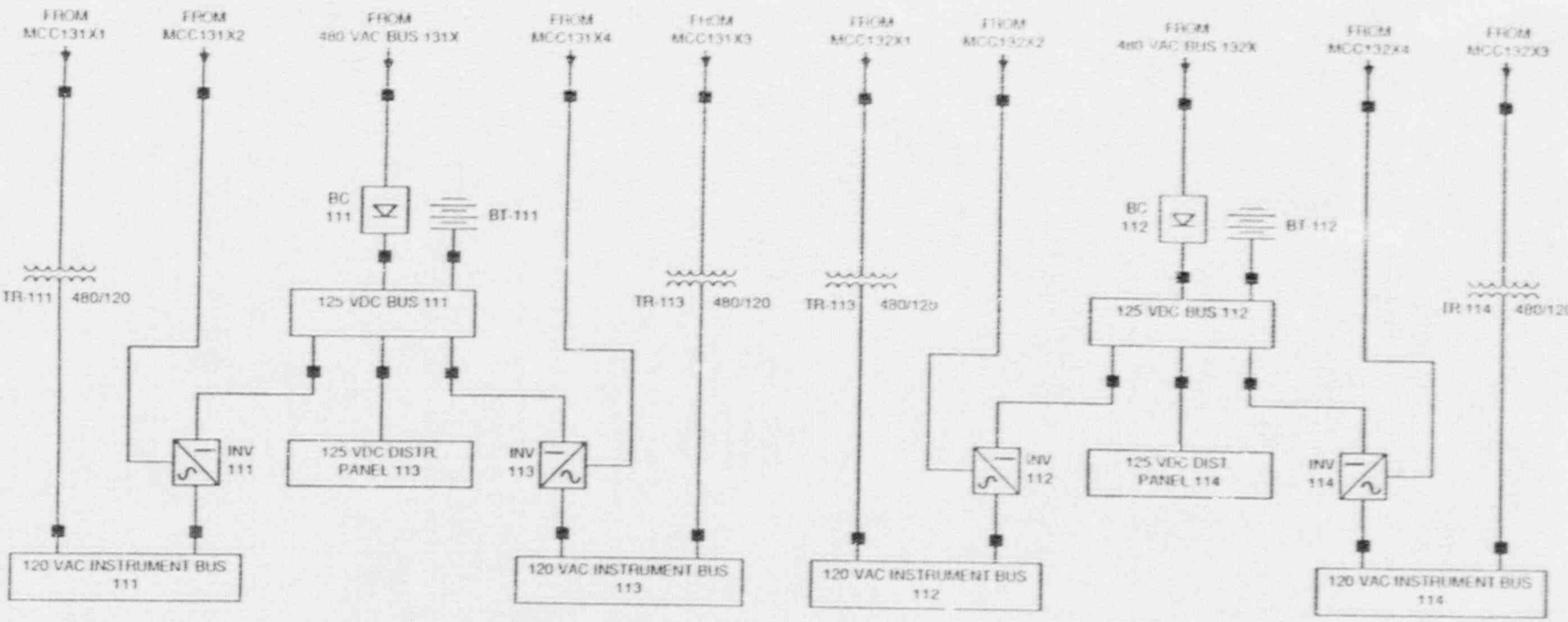


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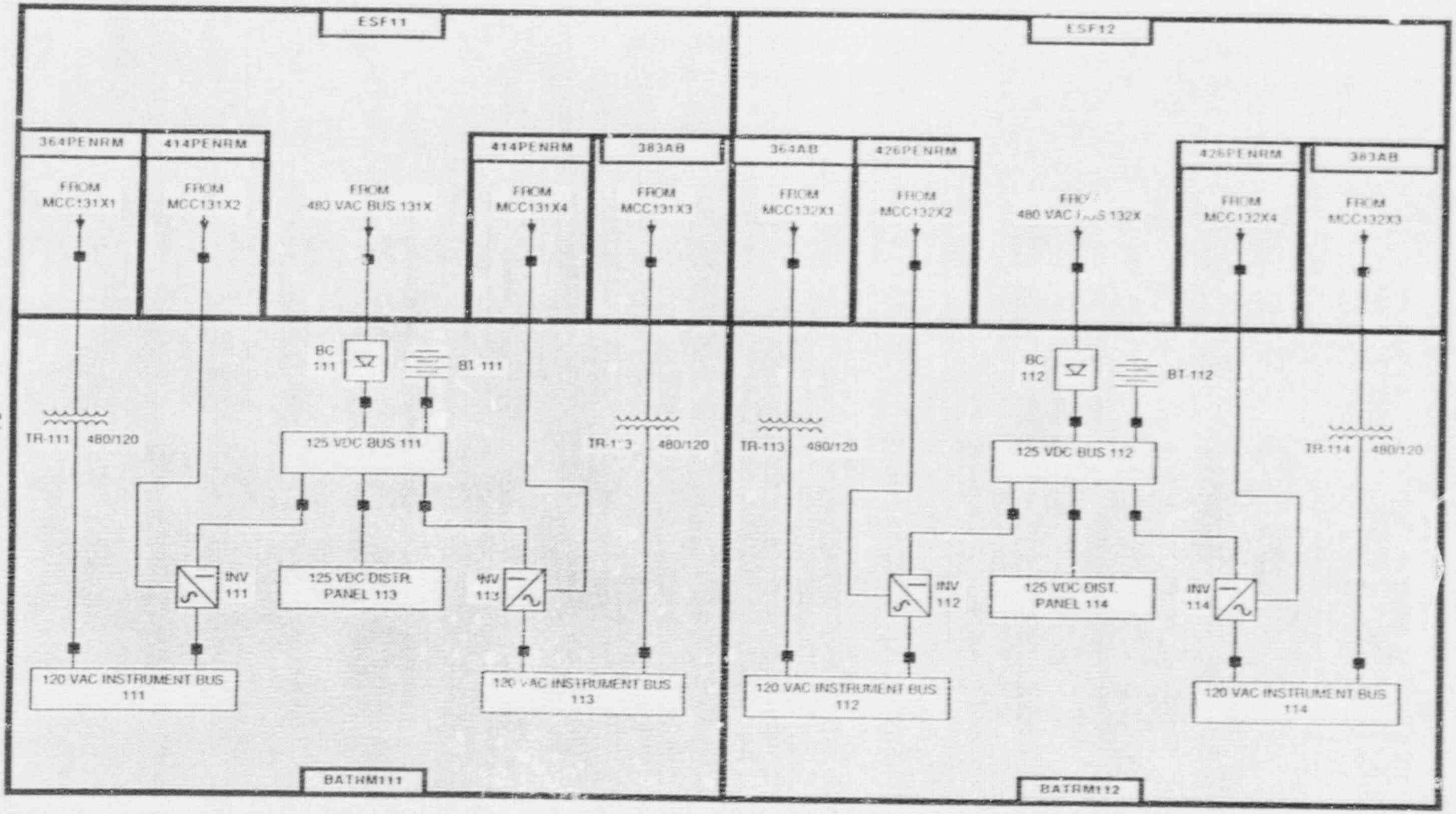
Figure 3.7-3. Braidwood Unit 1 125 VDC and 120 VAC Electric Power Distribution System



NOTE: Lines May Not Represent Actual Cable Routing Between Rooms

Figure 3.7-4. Braidwood Unit 1 125 VDC and 120 VAC Electric Power Distribution System Showing Component Locations

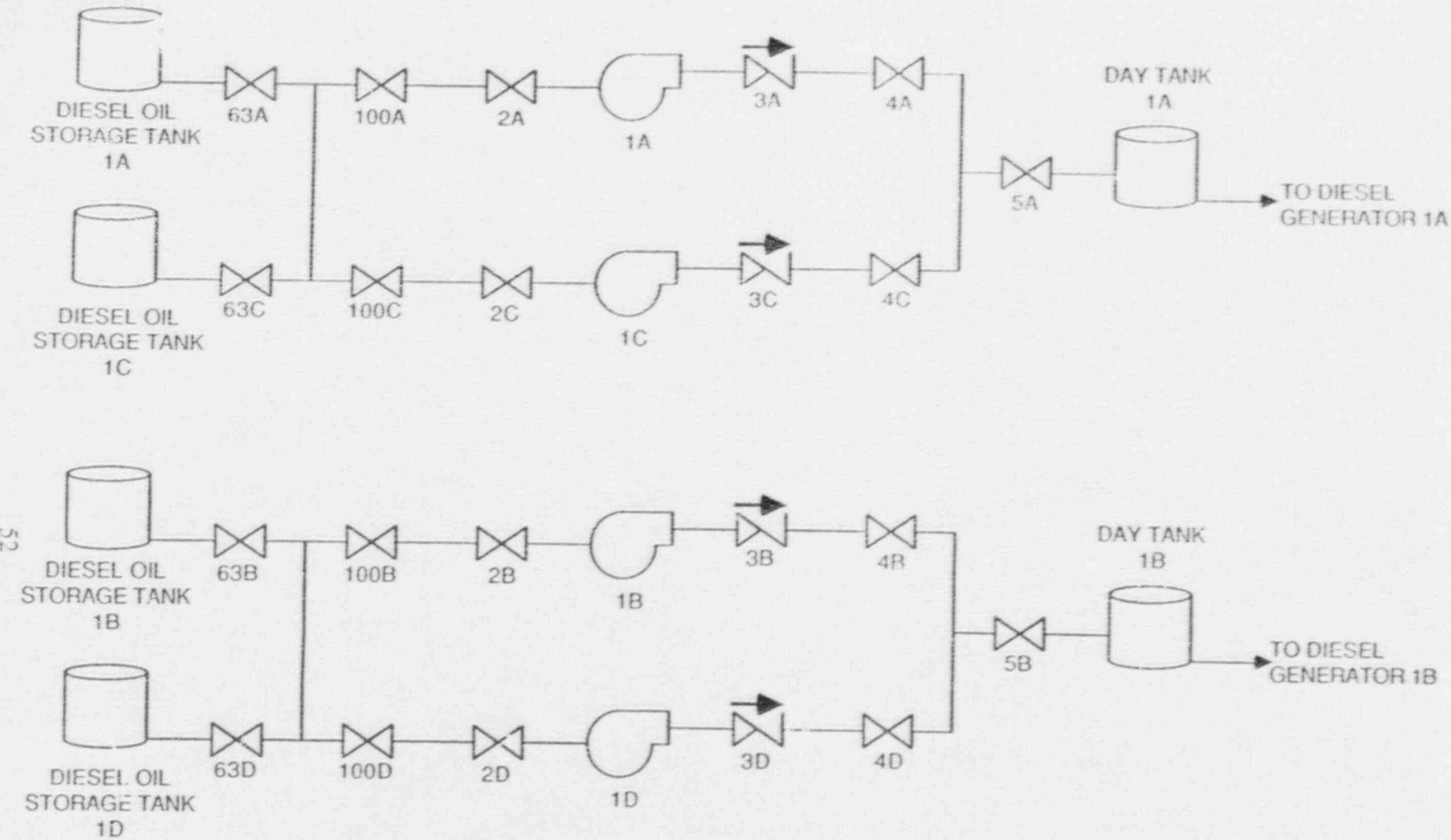


Figure 3.7-5. Braidwood Unit 1 Diesel Fuel Oil System

Table 3.7-1. Braidwood Unit 1 Electric Power System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP
ACBUS-111	BUS	BATRM111	TR-111	120	BATRM111	AC/A
ACBUS-111	BUS	BATRM111	INV-111	120	BATRM111	AC/A
ACBUS-112	BUS	BATRM112	TR-112	120	BATRM112	AC/B
ACBUS-112	BUS	BATRM112	INV-112	120	BATRM112	AC/B
ACBUS-113	BUS	BATRM111	TR-113	120	BATRM111	AC/A
ACBUS-113	BUS	BATRM111	INV-113	120	BATRM111	AC/A
ACBUS-114	BUS	BATRM112	TR-114	120	BATRM112	AC/B
ACBUS-114	BUS	BATRM112	INV-114	120	BATRM112	AC/B
BC-111	BC	BATRM111	BUS-131X	125	ESF11	DC/A
BC-112	BC	BATRM112	BUS-132X	125	ESF12	DC/B
BT-111	BATT	BATRM111		125		DC/A
BT-112	BATT	BATRM112		125		DC/B
BUS-131X	BUS	ESF11	TR-131X	480	ESF11	AC/A
BUS-132X	BUS	ESF12	TR-132X	480	ESF12	AC/B
BUS-141	BUS	ESF11	DG-1A	4160	DGA	AC/A
BUS-142	BUS	ESF12	DG-1B	4160	DGB	AC/B
CB-1A	CB	ESF11	DG-1A	4160	DGA	AC/A
CB-1B	CB	ESF12	DG-1B	4160	DGB	AC/B
DCBUS-111	BUS	BATRM111	BT-111	125	BATRM111	DC/A
DCBUS-111	BUS	BATRM111	BC-111	125	BATRM111	DC/A
DCBUS-112	BUS	BATRM112	BT-112	125	BATRM112	DC/B
DCBUS-112	BUS	BATRM112	BC-112	125	BATRM112	DC/B
DG-1A	DG	DGA		4160		AC/A
DG-1B	DG	DGB		4160		AC/B
INV-111	INV	BATRM111	MCC-131X2	120	414PENRM	DC/A
INV-111	INV	BATRM111	DCBUS-111	120	BATRM111	DC/A
INV-112	INV	BATRM112	MCC-132X2	120	426PENRM	DC/B

Table 3.7-1. Braidwood Unit 1 Electric Power System Data Summary for Selected Components (Continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP
INV-112	INV	BATRM112	DCBUS-112	120	BATRM112	DC/B
INV-113	INV	BATRM111	MCC-131X4	120	414PENRM	DC/A
INV-113	INV	BATRM111	DCBUS-111	120	BATRM111	DC/A
INV-114	INV	BATRM112	MCC-132X4	120	426PENRM	DC/B
INV-114	INV	BATRM112	DCBUS-112	120	BATRM112	DC/B
MCC-131X1	MCC	364PENRM	BUS-131X	480	ESF11	AC/A
MCC-131X1A	MCC	364PENRM	MCC-131X1	480	364PENRM	AC/A
MCC-131X2	MCC	414PENRM	BUS-131X	480	ESF11	AC/A
MCC-131X3	MCC	383AB	BUS-131X	480	ESF11	AC/A
MCC-131X4	MCC	414PENRM	BUS-131X	480	ESF11	AC/A
MCC-131X5	MCC	426AB	BUS-131X	480	ESF11	AC/A
MCC-132X1	MCC	364AB	BUS-132X	480	ESF12	AC/B
MCC-132X2	MCC	426PENRM	BUS-132X	480	ESF12	AC/B
MCC-132X3	MCC	383AB	BUS-132X	480	ESF12	AC/B
MCC-132X4	MCC	426PENRM	BUS-132X	480	ESF12	AC/B
MCC-132X4A	MCC	426PENRM	MCC-132X4	480	426PENRM	AC/B
MCC-132X5	MCC	426AB	BUS-132X	480	ESF12	AC/B
TR-111	XFMR	BATRM111	MCC-131X1	120	364PENRM	AC/A
TR-112	XFMR	BATRM112	MCC-132X1	120	364AB	AC/B
TR-113	XFMR	BATRM111	MCC-131X3	120	383AB	AC/A
TR-114	XFMR	BATRM112	MCC-132X3	120	383AB	AC/B
TR-131X	XFMR	ESF11	BUS-141	480	ESF11	AC/A
TR-132X	XFMR	ESF12	BUS-142	480	ESF12	AC/B

Table 3.7-2. Partial Listing of Electrical Sources and Loads at Braidwood Unit 1

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
BC-111	125	DC/A	BATRM111	EP	DCBUS-111	BUS	BATRM111
BC-112	125	DC/B	BATRM112	EP	DCBUS-112	BUS	BATRM112
BT-111	125	DC/A	BATRM111	EP	DCBUS-111	BUS	BATRM111
BT-112	125	DC/B	BATRM112	EP	DCBUS-112	BUS	BATRM112
BUS-131X	125	DC/A	ESF11	EP	BC-111	BC	BATRM111
BUS-131X	4[illegible]	AC/A	ESF11	EP	MCC-131X1	MCC	364PENRM
BUS-131X	480	AC/A	ESF11	EP	MCC-131X2	MCC	414PENRM
BUS-131X	480	AC/A	ESF11	EP	MCC-131X3	MCC	383AB
BUS-131X	480	AC/A	ESF11	EP	MCC-131X4	MCC	414PENRM
BUS-131X	480	AC/A	ESF11	EP	MCC-131X5	MCC	426AB
BUS-132X	125	DC/B	ESF12	EP	BC-112	BC	BATRM112
BUS-132X	480	AC/B	ESF12	EP	MCC-132X1	MCC	364AB
BUS-132X	480	AC/B	ESF12	EP	MCC-132X2	MCC	426PENRM
BUS-132X	480	AC/B	ESF12	EP	MCC-132X3	MCC	383AB
BUS-132X	480	AC/B	ESF12	EP	MCC-132X4	MCC	426PENRM
BUS-132X	480	AC/B	ESF12	EP	MCC-132X5	MCC	426AB
BUS-141	4160	AC/A	ESF11	AFW	AFW-P1A	MDP	383AB
BUS-141	4160		ESF11	CCW	CCW-P0	MDP	364AB
BUS-141	4160	AC/A	ESF11	CVCS	CV-P1A	MDP	CVA
BUS-141	4160	AC/A	ESF11	ECCS	RH-P1A	MDP	RHRA
BUS-141	4160	AC/A	ESF11	ECCS	SI-P1A	MDP	SIA
BUS-141	480	AC/A	ESF11	EP	TR-131X	XFMR	ESF11
BUS-141	4160	AC/A	ESF11	ESW	ESW-P1A	MDP	ESWPMPA
BUS-141	4160	AC/A	ESF11	PAHRS	CS-P1A	MDP	CSA
BUS-142	4160		ESF12	CCW	CCW-P0	MDP	364AB
BUS-142	4160	AC/B	ESF12	CCW	CCW-P1B	MDP	364AB
BUS-142	4160	AC/B	ESF12	CVCS	CV-P1B	MDP	CVB
BUS-142	4160	AC/B	ESF12	ECCS	RH-P1B	MDP	RHRB
BUS-142	4160	AC/B	ESF12	ECCS	SI-P1B	MDP	SIB
BUS-142	480	AC/B	ESF12	EP	TR-132X	XFMR	ESF12
BUS-142	4160	AC/B	ESF12	ESW	ESW-P1B	MDP	ESWPMPB

Table 3.7-2. Partial Listing of Electrical Sources and Loads at Braidwood Unit 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
BUS-142	4160	AC/B	ESF12	PAHRS	CS-P1B	MDP	CSB
BUS141	4160	AC/A	ESF11	CCW	CCW-P1A	MDP	364AB
DCBUS-111	120	DC/A	BATRM111	EP	INV-111	INV	BATRM111
DCBUS-111	120	DC/A	BATRM111	EP	INV-113	INV	BATRM111
DCBUS-112	120	DC/B	BATRM112	EP	INV-112	INV	BATRM112
DCBUS-112	120	DC/B	BATRM112	EP	INV-114	INV	BATRM112
DG-1A	4160	AC/A	DGA	EP	BUS-141	BUS	ESF11
DG-1A	4160	AC/A	DGA	EP	CB-1A	CB	ESF11
DG-1B	4160	AC/B	DGB	EP	BUS-142	BUS	ESF12
DG-1B	4160	AC/B	DGB	EP	CB-1B	CB	ESF12
INV-111	120	AC/A	BATRM111	EP	ACBUS-111	BUS	BATRM111
INV-112	120	AC/B	BATRM112	EP	ACBUS-112	BUS	BATRM112
INV-113	120	AC/A	BATRM111	EP	ACBUS-113	BUS	BATRM111
INV-114	120	AC/B	BATRM112	EP	ACBUS-114	BUS	BATRM112
MCC-131X1	480	AC/A	364PENRM	AFW	AFW-13A	MOV	AFWPPTNL
MCC-131X1	480	AC/A	364PENRM	AFW	AFW-13B	MOV	AFWPPTNL
MCC-131X1	480	AC/A	364PENRM	AFW	AFW-13C	MOV	AFWPPTNL
MCC-131X1	480	AC/A	364PENRM	AFW	AFW-13D	MOV	AFWPPTNL
MCC-131X1	480	AC/A	364PENRM	CCW	CCW-9412A	MOV	364AB
MCC-131X1	480	AC/A	364PENRM	CVCS	CV-112D	MOV	364PENRM
MCC-131X1	480	AC/A	364PENRM	CVCS	SI-8801A	MOV	364PENRM
MCC-131X1	480	AC/A	364PENRM	ECCS	CV-8804A	MOV	364PENRM
MCC-131X1	480	AC/A	364PENRM	ECCS	RH-8716A	MOV	364PENRM
MCC-131X1	480	AC/A	364PENRM	ECCS	RH-8716A	MOV	364PENRM
MCC-131X1	480	AC/A	364PENRM	ECCS	SI-8807A	MOV	SIA
MCC-131X1	480	AC/A	364PENRM	ECCS	SI-8811A	MOV	364PENRM
MCC-131X1	480	AC/A	364PENRM	ECCS	SI-8821A	MOV	364PENRM
MCC-131X1	480	AC/A	364PENRM	ECCS	SI-8821A	MOV	364PENRM
MCC-131X1	480	AC/A	364PENRM	ECCS	SI-8923A	MOV	SIA
MCC-131X1	480	AC/A	364PENRM	EP	MCC-131X1A	MCC	364PENRM
MCC-131X1	120	AC/A	364PENRM	EP	TR-111	XFMR	BATRM111

Table 3.7-2. Partial Listing of Electrical Sources and Loads at Braidwood Unit 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC-131X1	480	AC/A	364PENRM	ESW	ESW-1-33	MOV	ESWPMPA
MCC-131X1	480	AC/A	364PENRM	ESW	ESW-1-33	MOV	ESWPMPA
MCC-131X1	480	AC/A	364PENRM	ESW	ESW-1-4	MOV	ESWPMPA
MCC-131X1	480	AC/A	364PENRM	ESW	ESW-1-4	MOV	ESWPMPA
MCC-131X1	480	AC/A	364PENRM	ESW	ESW-1-7	MOV	346AB
MCC-131X1	480	AC/A	364PENRM	PAHRS	CS-1A	MOV	364PENRM
MCC-131X1	480	AC/A	364PENRM	PAHRS	CS-9A	MOV	CSA
MCC-131X1A	480	AC/A	364PENRM	ECCS	SI-8802A	MOV	364PENRM
MCC-131X1A	480	AC/A	364PENRM	ECCS	SI-8835	MOV	364PENRM
MCC-131X2	120	DC/A	414PENRM	EP	INV-111	INV	BATRM111
MCC-131X2	480	AC/A	414PENRM	RCS	RC-8000A	MOV	RC
MCC-131X2	480	AC/A	414PENRM	RCS	RC-8701A	MOV	RC
MCC-131X2	480	AC/A	414PENRM	RCS	RC-8702A	MOV	RC
MCC-131X3	480	AC/A	383AB	AFW	AFW-17A	MOV	383AB
MCC-131X3	480	AC/A	383AB	AFW	AFW-6A	MOV	383AB
MCC-131X3	480	AC/A	383AB	CCW	CCW-1-9473A	MOV	364AB
MCC-131X3	480	AC/A	383AB	CCW	CCW-1-9473A	MOV	364AB
MCC-131X3	120	AC/A	383AB	EP	TR-113	XFMR	BATRM111
MCC-131X3	480	AC/A	383AB	ESW	ESW-1-1A	MOV	SX1A
MCC-131X4	120	DC/A	414PENRM	EP	INV-113	INV	BATRM111
MCC-131X5	480	AC/A	426AB	PAHRS	CC-16A	MOV	364PENRM
MCC-131X5	480	AC/A	426AB	PAHRS	CC-27A	MOV	364PENRM
MCC-131X5	480	AC/A	426AB	PAHRS	CS-7A	MOV	364PENRM
MCC-132X1	480	AC/B	364AB	CCW	CCW-1-9473B	MOV	364AB
MCC-132X1	480	AC/B	364AB	CCW	CCW-1-9473B	MOV	364AB
MCC-132X1	480	AC/B	364AB	CCW	CCW-9412B	MOV	364AB
MCC-132X1	480	AC/B	364AB	ECCS	SI-8807B	MOV	SIA
MCC-132X1	480	AC/B	364AB	ECCS	SI-8924	MOV	SIA
MCC-132X1	120	AC/B	364AB	EP	TR-112	XFMR	BATRM112
MCC-132X1	480	AC/B	364AB	ESW	ESW-0-7	MOV	346AB
MCC-132X1	480	AC/B	364AB	ESW	ESW-1-1B	MOV	SX1B

Table 3.7-2. Partial Listing of Electrical Sources and Loads at Braidwood Unit 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC-132X1	480	AC/B	364AB	ESW	ESW-1-34	MOV	ESWPMPB
MCC-132X1	480	AC/B	364AB	ESW	ESW-1-34	MOV	ESWPMPB
MCC-132X1	480	AC/B	364AB	ESW	ESW-1-5	MOV	ESWPMPB
MCC-132X1	480	AC/B	364AB	ESW	ESW-1-5	MOV	ESWPMPB
MCC-132X1	480	AC/A	364AB	PAHRS	CS-9B	MOV	CSB
MCC-132X2	120	DC/B	426PENRM	EP	INV-112	INV	BATRM112
MCC-132X2	480	AC/B	426PENRM	RCS	RC-8000B	MOV	RC
MCC-132X2	480	AC/B	426PENRM	RCS	RC-8701B	MOV	RC
MCC-132X2	480	AC/B	426PENRM	RCS	RC-8702B	MOV	RC
MCC-132X3	480	AC/B	383AB	AFW	AFW-17B	MOV	DDAFW
MCC-132X3	480	AC/B	383AB	AFW	AFW-6B	MOV	DDAFW
MCC-132X3	120	AC/B	383AB	EP	TR-114	XFMR	BATRM112
MCC-132X4	480	AC/B	426PENRM	AFW	AFW-13E	MOV	AFWPPTNL
MCC-132X4	480	AC/B	426PENRM	AFW	AFW-13F	MOV	AFWPPTNL
MCC-132X4	480	AC/B	426PENRM	AFW	AFW-13G	MOV	AFWPPTNL
MCC-132X4	480	AC/B	426PENRM	AFW	AFW-13H	MOV	AFWPPTNL
MCC-132X4	480	AC/B	426PENRM	CVCS	CV-112E	MOV	364PENRM
MCC-132X4	480	AC/B	426PENRM	ECCS	RH-8716B	MOV	364PENRM
MCC-132X4	480	AC/B	426PENRM	ECCS	RH-8716B	MOV	364PENRM
MCC-132X4	480	AC/B	426PENRM	ECCS	SI-8804B	MOV	SIB
MCC-132X4	480	AC/B	426PENRM	ECCS	SI-8821B	MOV	364PENRM
MCC-132X4	480	AC/B	426PENRM	ECCS	SI-8821B	MOV	364PENRM
MCC-132X4	480	AC/B	426PENRM	ECCS	SI-8923B	MOV	SIB
MCC-132X4	120	DC/B	426PENRM	EP	INV-114	INV	BATRM112
MCC-132X4	480	AC/B	426PENRM	EP	MCC-132X4A	MCC	426PENRM
MCC-132X4	480	AC/B	426PENRM	PAHRS	CC-16B	MOV	364PENRM
MCC-132X4	480	AC/B	426PENRM	PAHRS	CC-27B	MOV	364PENRM
MCC-132X4	480	AC/B	426PENRM	PAHRS	CS-7B	MOV	364PENRM
MCC-132X4A	480	AC/B	426PENRM	ECCS	SI-8802B	MOV	364PENRM
MCC-132X4A	480	AC/B	426PENRM	ECCS	SI-8811B	MOV	364PENRM
MCC-132X4A	480	AC/B	426PENRM	PAHRS	CS-1B	MOV	364PENRM

Table 3.7-2. Partial Listing of Electrical Sources and Loads at Braidwood Unit 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC-132X5	480	AC/B	426AB	CVCS	SI-8801B	MOV	364PENRM
MCC-231X3	480	AC/A	383AB	CCW	CCW-2-9473A	MOV	364AB
MCC-232X1	480	AC/B	364AB	CCW	CCW-2-9473B	MOV	364AB
TR-111	120	AC/A	BATRM111	EP	ACBUS-111	BUS	BATRM111
TR-112	120	AC/B	BATRM112	EP	ACBUS-112	BUS	BATRM112
TR-113	120	AC/A	BATRM111	EP	ACBUS-113	BUS	BATRM111
TR-114	120	AC/B	BATRM112	EP	ACBUS-114	BUS	BATRM112
TR-131X	480	AC/A	ESF11	EP	BUS-131X	BUS	ESF11
TR-132X	480	AC/B	ESF12	EP	BUS-132X	BUS	ESF12

3.8 COMPONENT COOLING SYSTEM

3.8.1 System Function

The Component Cooling system provides cooling water to various plant components in both units during normal operation, and plant shutdown. After an accident, the Component Cooling system acts as an intermediate system between the components being cooled and the Essential Service Water system. Separation is required to minimize the possible release of radioactive material. The Component Cooling System serves to remove residual and sensible heat from the RCS during plant shutdown by cooling the RHR heat exchangers.

3.8.2 System Definition

The Component Cooling system is a closed loop system consisting of five motor driven pumps, three heat exchangers, two surge tanks, and associated piping and valves. The system is designed to serve both units. The major heat loads in the plant can be divided into a Unit 1 loop and a Unit 2 loop, with each loop containing two pumps and one heat exchanger. An exception is the RHR heat exchangers and pumps, which are cooled by a common header which may be aligned with the Component Cooling pumps for Unit 1 or Unit 2, or isolated and supplied by the fifth pump and third heat exchanger, which are common to both units. These components are designated pump 0 and heat exchanger 0.

The heat exchangers transfer heat to the Essential Service Water system. The surge tanks accommodate expansion, contraction, and in-leakage of water.

Simplified drawings of the Component Cooling system are shown in Figures 3.8-1 and 3.8-2. These drawings show some components from Unit 2. Unit 1 component IDs begin with "1", Unit 2 component IDs begin with "2". A summary of the data on selected Component Cooling system components is presented in Table 3.8-1.

3.8.3 System Operation

Three component cooling pumps, two component cooling heat exchangers, and the two surge tanks are sufficient for normal operation of the two units. The remaining two pumps and one heat exchanger serve as backups. 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 makeup water is added into the surge tanks as needed to maintain coolant inventory. A backup source of makeup water is the primary water storage tank.

Heat loads supported by the Component Cooling system include the following:

- RHR heat exchangers and pumps
- Spent fuel pit heat exchangers
- Letdown heat exchanger
- Excess letdown heat exchanger
- Positive displacement charging pump

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

3.8.4 System Success Criteria

Following a LOCA, the following success criteria apply to the Component Cooling System (Ref. 1):

- Following a LOCA, Unit 1 equipment is normally isolated from Unit 2 equipment. Component Cooling System equipment in the unit experiencing the LOCA is then divided into two redundant trains each consisting of one

Component Cooling pump, one heat exchanger and half of the baffled surge tank. One Component Cooling train is adequate for establishing a safe shutdown condition.

- Essential Service water must be supplied to the Component Cooling heat exchanger used for post-LOCA recovery.

3.8.5 Component Information

A. Component Cooling Pumps 1A, 1B, 2A, 2B, and 0
   1. Rated flow: 4800 gpm @ 250 ft head (108 psid)
   2. Rated capacity: 33% (to supply both units)
   3. Type: horizontal centrifugal

B. Component Cooling Heat Exchangers 1A, 1B, and 0
   1. Design duty: 40.87×10^6 Btu/hr
   2. Type: shell and straight tube

3.8.6 Support Systems and Interfaces

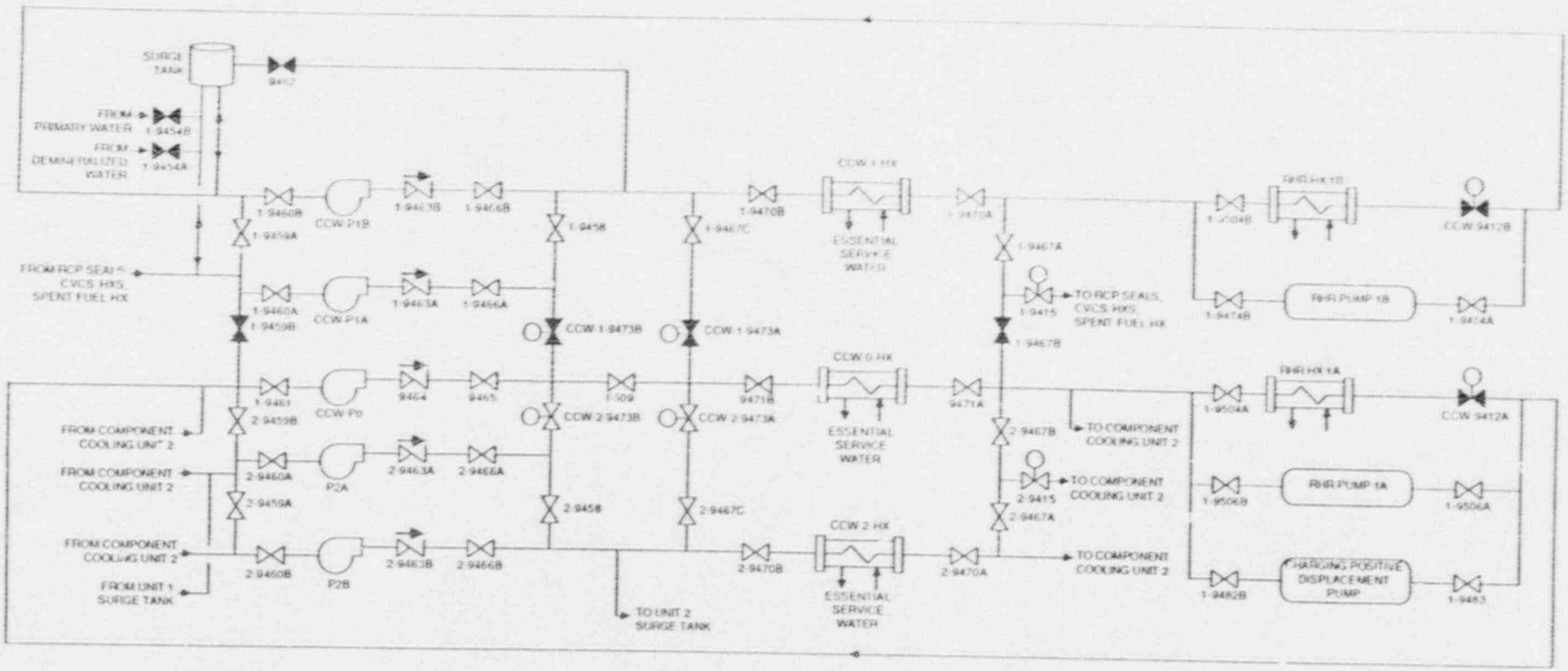
A. Control Signals
   1. Automatic
      The Component Cooling pumps are not automatically actuated.
   2. Remote Manual
      The Component Cooling pumps can be actuated by remote manual means from the control room and from the remote shutdown control panel.

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

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

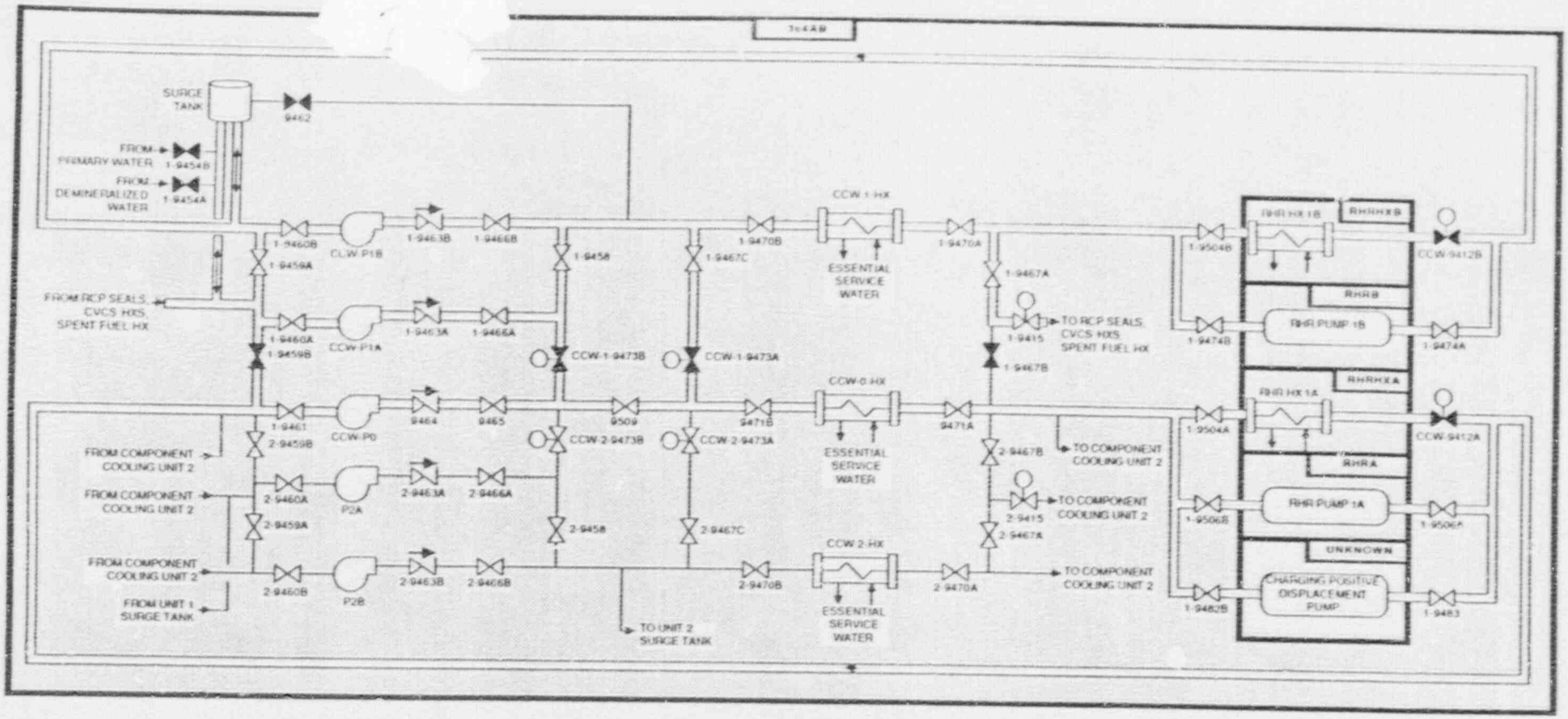
3.8.7 Section 3.8 References

1. Byron/Braidwood Final Safety Analysis Report, Section 9.2.2.



NOTE: Details For Unit 2 Are Not Included

Figure 3.8-1. Braidwood Unit 1 & 2 Component Cooling System



NOTE: Details For Unit 2 Are Not Included

Figure 3.8-2. Braidwooc Unit 1 & 2 Component Cooling System Showir.. Cc..mponent Locations

Table 3.8-1. Braidwood Unit 1 Component Cooling System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP
CCW-0-HX	HX	364AB				
CCW-1-9473A	MOV	364AB	MCC-131X3	480	383AB	AC/A
CCW-1-9473A	MOV	364AB	MCC-131X3	480	383AB	AC/A
CCW-1-9473B	MOV	364AB	MCC-132X1	480	364AB	AC/B
CCW-1-9473B	MOV	364AB	MCC-132X1	480	364AB	AC/B
CCW-1-HX	HX	364AB				
CCW-2-9473A	MOV	364AB	MCC-231X3	480	383AB	AC/A
CCW-2-9473B	MOV	364AB	MCC-232X1	480	364AB	AC/B
CCW-9412A	MOV	364AB	MCC-131X1	480	364PENRM	AC/A
CCW-9412B	MOV	364AB	MCC-132X1	480	364AB	AC/B
CCW-P0	MDP	364AB	BUS-141	4160	ESF11	
CCW-P0	MDP	364AB	BUS-142	4160	ESF12	
CCW-P1A	MDP	364AB	BUS141	4160	ESF11	AC/A
CCW-P1B	MDP	364AB	BUS-142	4160	ESF12	AC/B

3.9 ESSENTIAL SERVICE WATER (ESW) SYSTEM

3.9.1 System Function

The Essential Service Water System supplies cooling water from the ultimate heat sink to various heat loads in both the primary and secondary portions of the plant. The system is designed to provide a continuous flow of cooling water to those loads which are safety-related or essential to the safe shutdown of the reactor.

3.9.2 System Definition

The Essential Service Water System contains two headers, each supplied by a single motor-driven pump. The system is designed to serve both units. The source of water for the system is the lake screen house essential cooling pond. Strainers are provided to remove impurities from the raw water before it enters the ESW pumps. Heat is rejected to the essential cooling pond.

Simplified drawings of the ESW system are shown in Figures 3.9-1 and 3.9-2. These drawings show some components from Unit 2. Unit 1 component IDs begin with "1", Unit 2 component IDs begin with "2". A summary of data on selected ESW components is presented in Table 3.9-1.

3.9.3 System Operation

During normal operation, one of the ESW pumps is in continuous operation providing cooling water to essential loads. Essential loads are those required for safe shutdown, and are therefore redundant and served by the corresponding channels of the ESW system. Heat loads supported by the ESW system include the following:

- Diesel generator coolers
- Containment fan coolers
- Component Cooling System heat exchangers
- AFW, ESW, SI, and centrifugal charging pump lube oil coolers
- AFW, ESW, SI, RHR, CS, and centrifugal and positive displacement charging pump cubicle coolers.

The ESW also provides an assured supply of water to the Auxiliary Feedwater System. ESW header 1A supplies the motor-driven AFW pump 1A and ESW header 1B supplies the diesel-driven AFW pump 1B.

3.9.4 System success Criteria

Following a LOCA the following success criteria apply to the ESW system (Ref 1):

- One out of two ESW pumps operates supplying cooling water to essential loads.

3.9.5 Component Information

A. Service Water Pumps 1A and 1B
   1. Rated flow: 24,000 gpm @ 180 ft head (78 psid)
   2. Rated capacity: 100%
   3. Type: horizontal centrifugal

B. Ultimate Heat Sink - Essential cooling pond

3.9.6 Support Systems and Interfaces

A. Control Signals

1. Automatic
   The ESW pumps are not automatically actuated.
2. Remote Manual
   The ESW pumps can be actuated by remote manual means from the control room and from the remote shutdown control panel.

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

C. Other

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

3.9.7 Section 3.9 References

1. Byron/Braidwood Final Safety Analysis Report, Section 9.2.1.

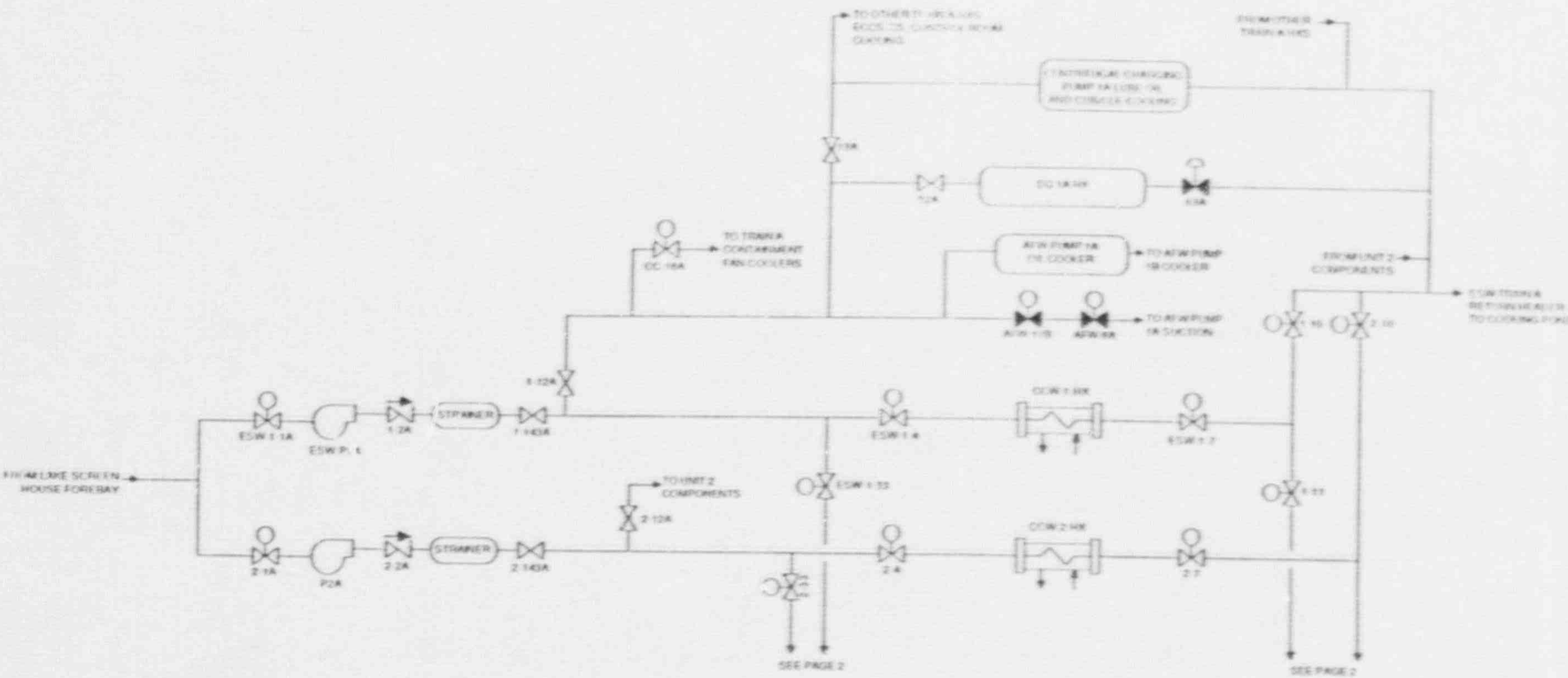


Figure 3.9-1. Braidwood Units 1 & 2 Essential Service Water System (Page 1 of 2)

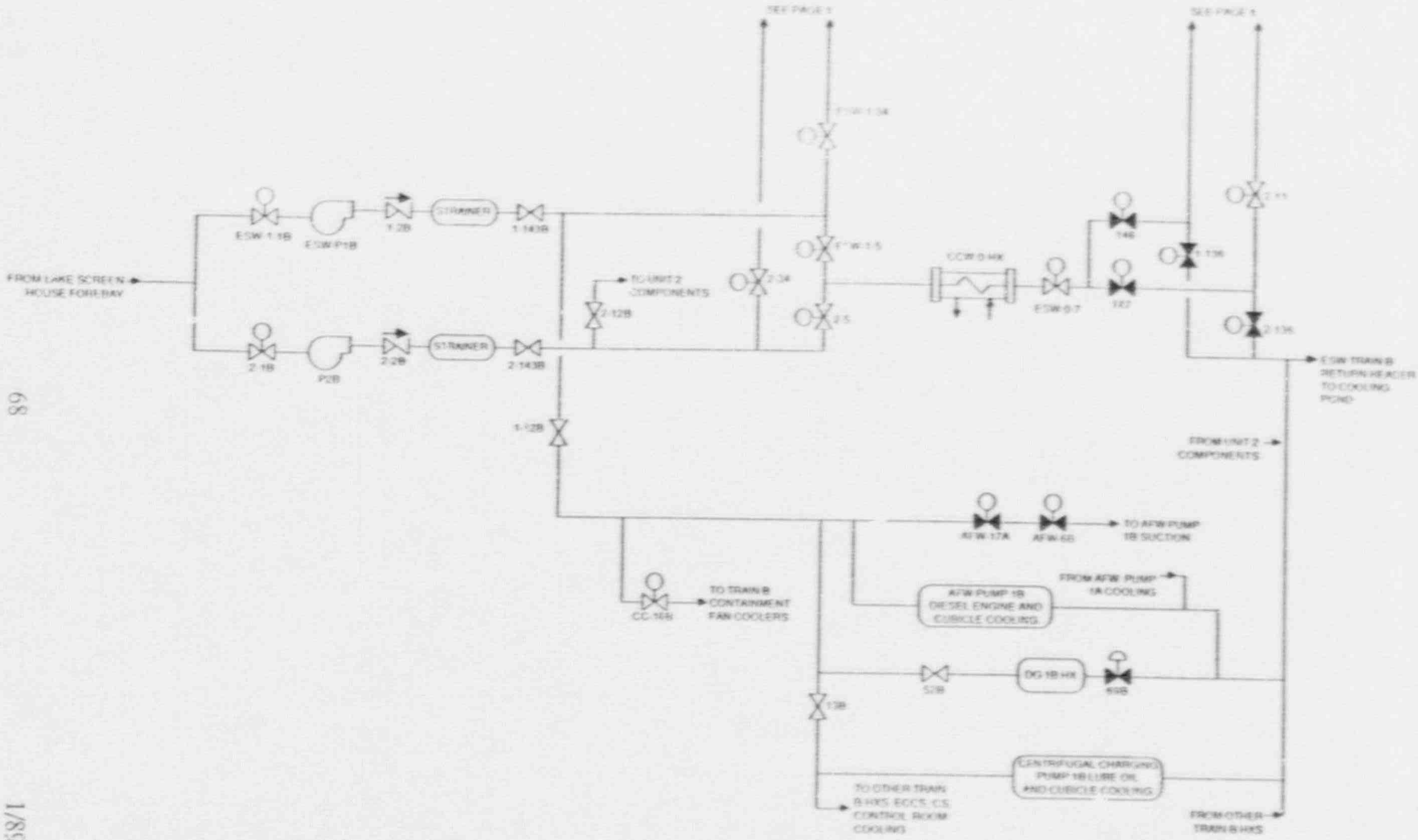


Figure 3.9-1. Braidwood Units 1 & 2 Essential Servire Water System (Page 2 of 2)

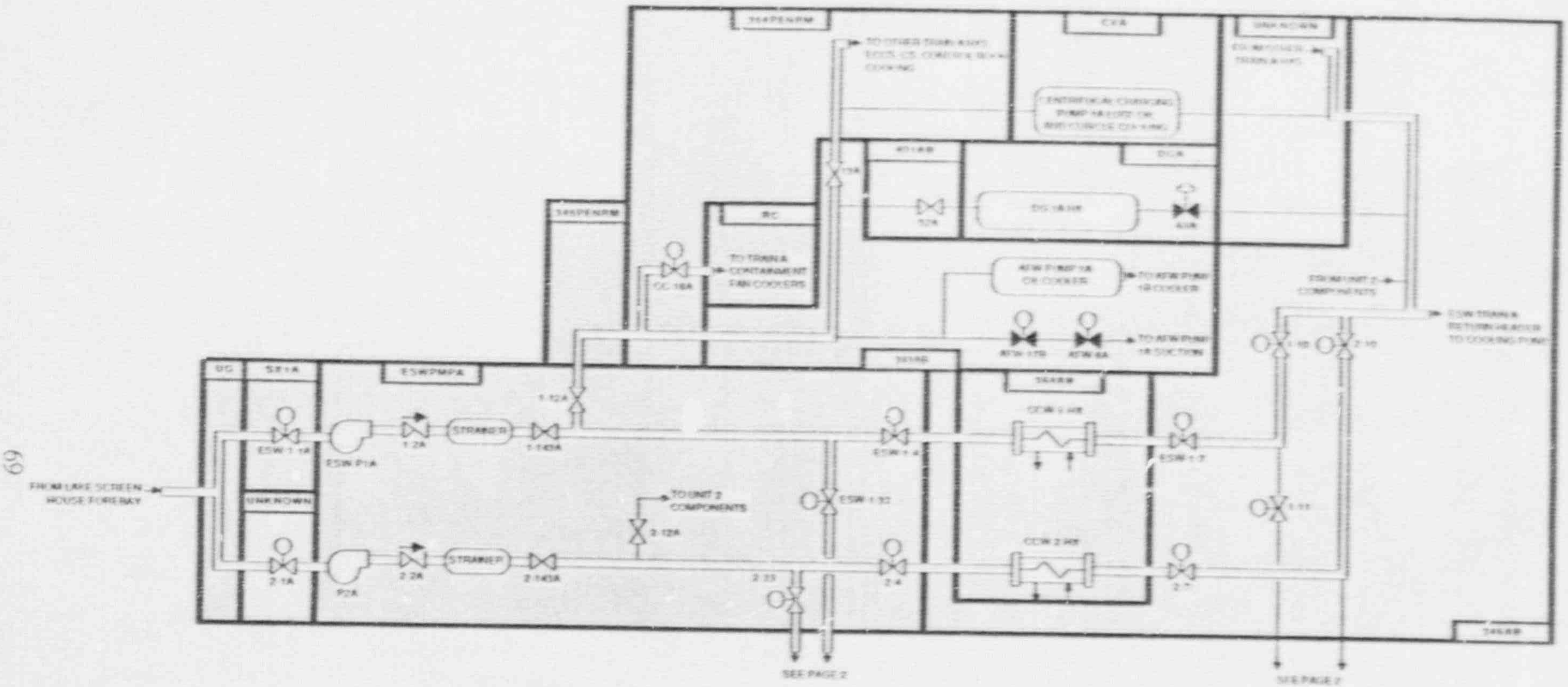


Figure 3.9-2. Braidwood Units 1 & 2 Essential Service Water System Showing Component Locations (Page 1 of 2)

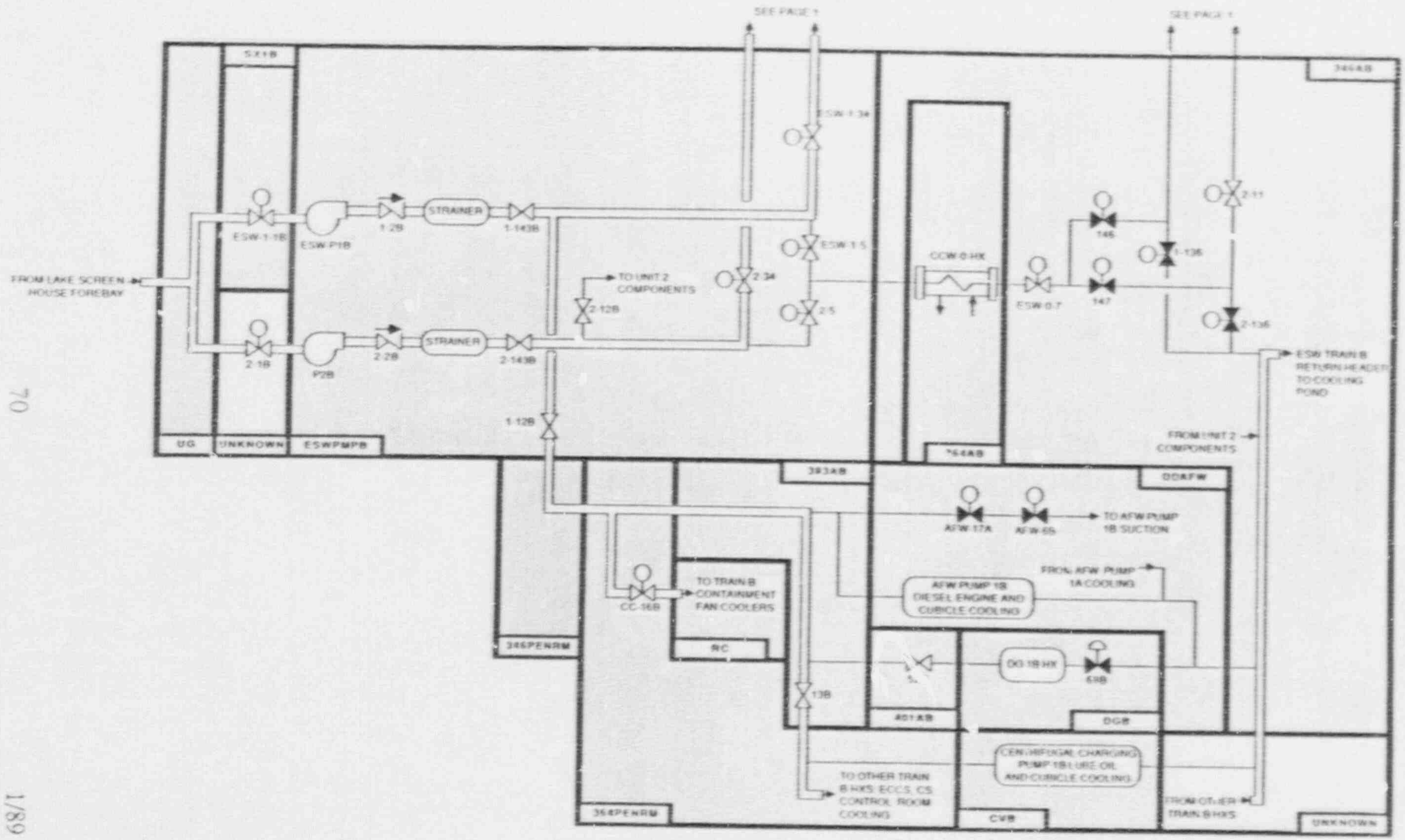


Figure 3.9-2. Braidwood Units 1 & 2 Essential Service Water System Showing Component Locations (Page 2 of 2)

Table 3.9-1. Braidwood Unit 1 Essential Service Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP
ESW-0-7	MOV	346AB	MCC-132X1	480	364AB	AC/B
ESW-1-1A	MOV	SX1A	MCC-131X3	480	383AB	AC/A
ESW-1-1B	MOV	SX1B	MCC-132X1	480	364AB	AC/B
ESW-1-33	MOV	ESWPMPA	MCC-131X1	480	364PENRM	AC/A
ESW-1-33	MOV	ESWPMPA	MCC-131X1	480	364PENRM	AC/A
ESW-1-34	MOV	ESWPMPB	MCC-132X1	480	364AB	AC/B
ESW-1-34	MOV	ESWPMPB	MCC-132X1	480	364AB	AC/B
ESW-1-4	MOV	ESWPMPA	MCC-131X1	480	364PENRM	AC/A
ESW-1-4	MOV	ESWPMPA	MCC-131X1	480	364PENRM	AC/A
ESW-1-5	MOV	ESWPMPB	MCC-132X1	480	364AB	AC/B
ESW-1-5	MOV	ESWPMPB	MCC-132X1	480	364AB	AC/B
ESW-1-7	MOV	346AB	MCC-131X1	480	364PENRM	AC/A
ESW-P1A	MDP	ESWPMPA	BUS-141	4160	ESF11	AC/A
ESW-P1B	MDP	ESWPMPB	BUS-142	4160	ESF12	AC/B

4. PLANT INFORMATION

4.1 SITE AND BUILDING SUMMARY

The Braidwood Station, Units 1 and 2, is located in northern Illinois, 2 miles south of the town of Braidwood and 50 miles southwest of Chicago. The site is in the southwest corner of Will County in a predominately agricultural area. The site occupies approximately 4320 acres of land. Figure 4-1 is a general view of the plant and vicinity (from Ref. 1).

The major structures at this unit include the two containment buildings, a shared turbine building, a shared auxiliary building, and a shared fuel building. A site plot plan is shown in Figure 4-2. Plant section drawings are shown in Figures 4-3 and 4-4.

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

The turbine building, located west of the containments, houses the turbine generator and the associated power generating auxiliaries.

The auxiliary building is located to the west of and between the containments and contains much of the plant's safety related equipment, specifically the auxiliary feedwater pumps, high pressure injection pumps, RHR pumps and heat exchangers, containment spray pumps, charging pumps, component cooling water pumps and heat exchangers, and motor control centers supplying power to safety system components.

The fuel building is between the two containments and houses the spent fuel pool.

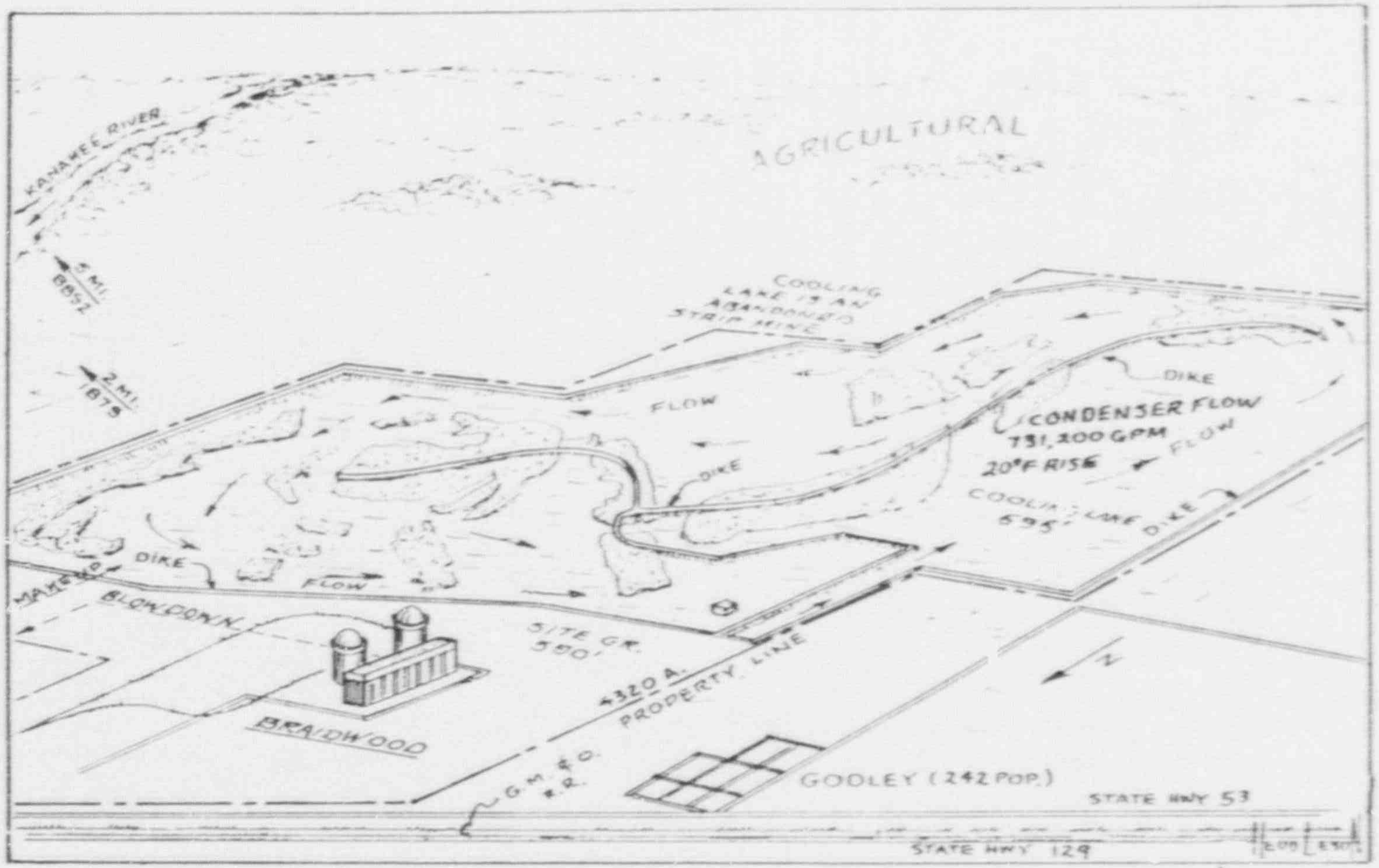
4.2 FACILITY LAYOUT DRAWINGS

Figures 4-5 through 4-11 are simplified building layout drawings for Braidwood. Details of the turbine building and many of the outlying buildings are not shown on these drawings. Major rooms, stairways, elevators, and doorways are shown in the simplified layout drawings, however, many interior walls have been omitted for clarity. Labels printed in uppercase correspond to the location codes listed in Table 4-1 and used in the component data listings and system drawings in Section 3. Some additional labels are included for information and are printed in lowercase type.

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

4.3 SECTION 4 REFERENCES

1. Heddleson, F.A., "Design Data and Safety Features of Commercial Nuclear Power Plants.", ORNL-NSIC-55, Volume IV, Oak Ridge National Laboratory, Nuclear Safety Information Center, March 1975.



NUCLEAR SAFETY INFORMATION CENTER

Figure 4-1. General View of Braidwood Station and Vicinity

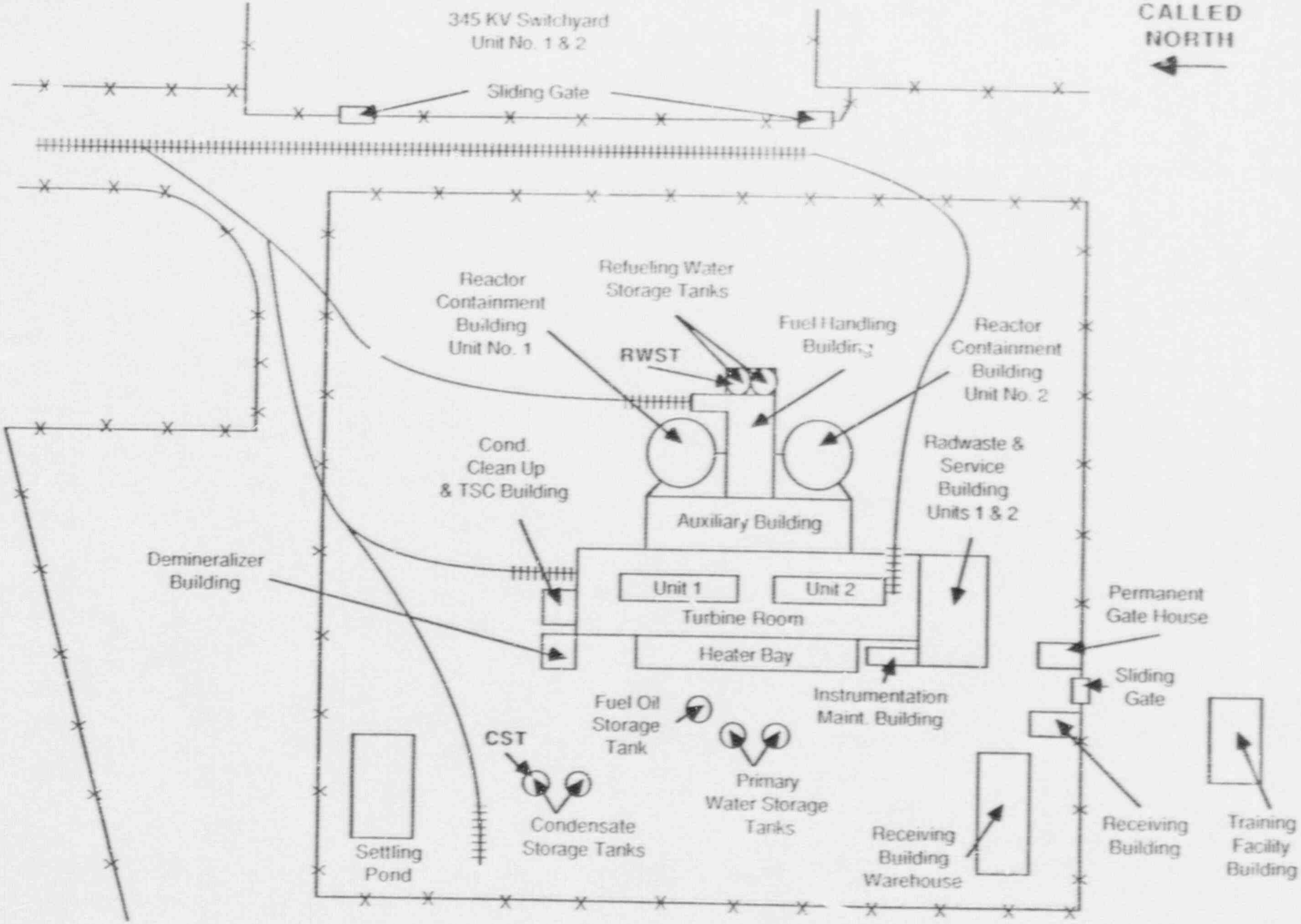


Figure 4-2. Braidwood 1 & 2 Plot Plan

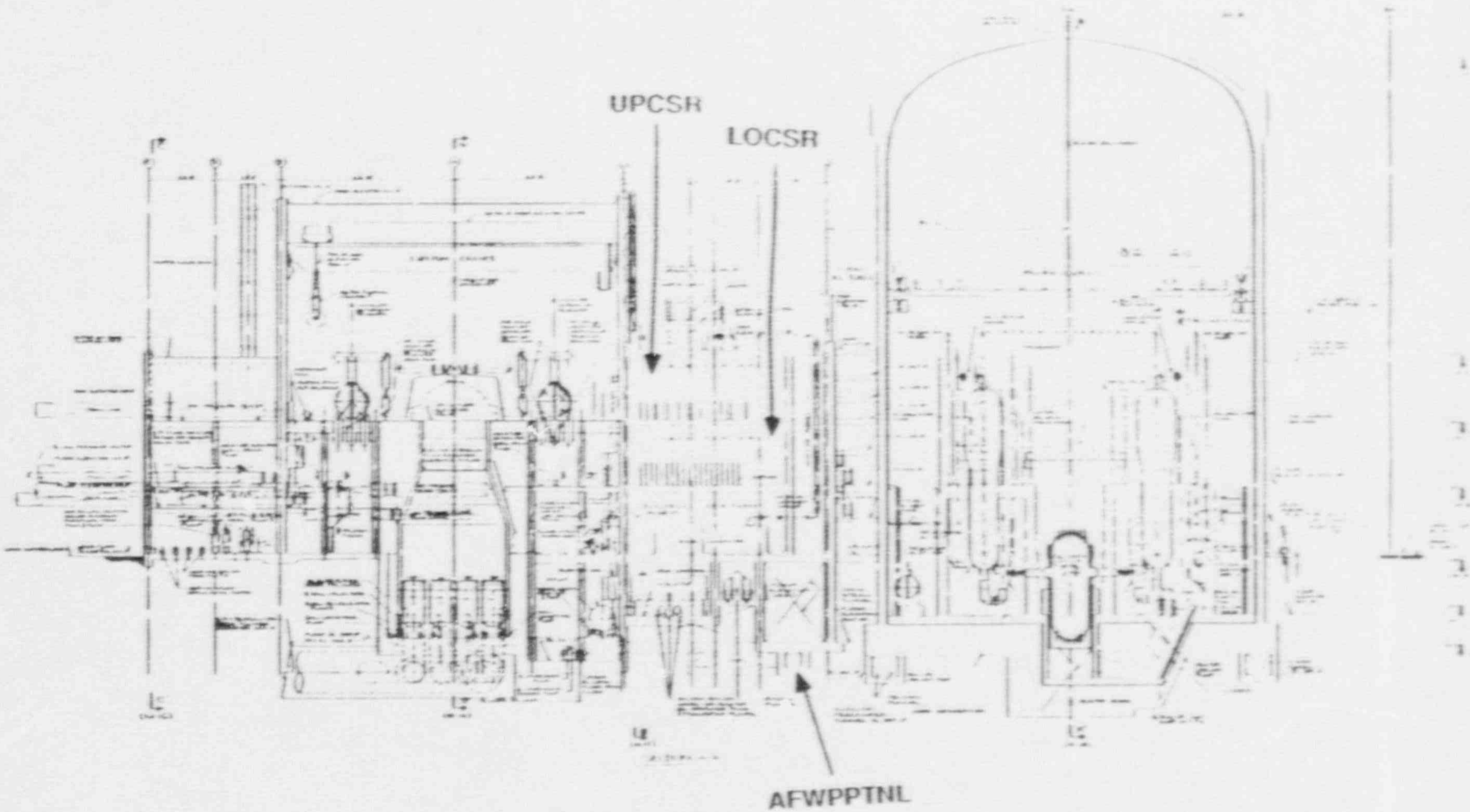


Figure 4-3. Braidwood Unit 1 Reactor, Auxiliary, and Turbine Building Elevation Drawing

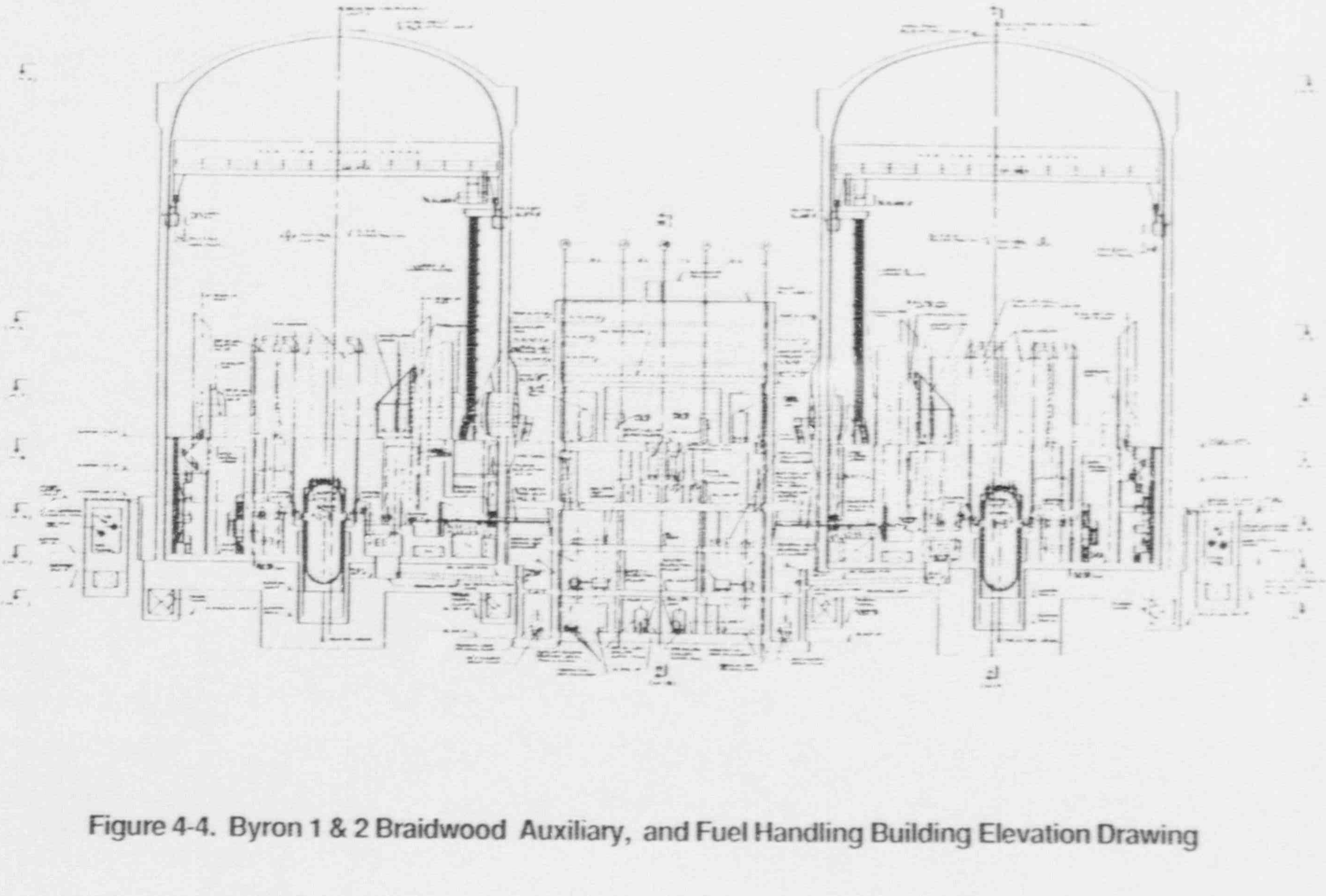


Figure 4-4. Byron 1 & 2 Braidwood Auxiliary, and Fuel Handling Building Elevation Drawing

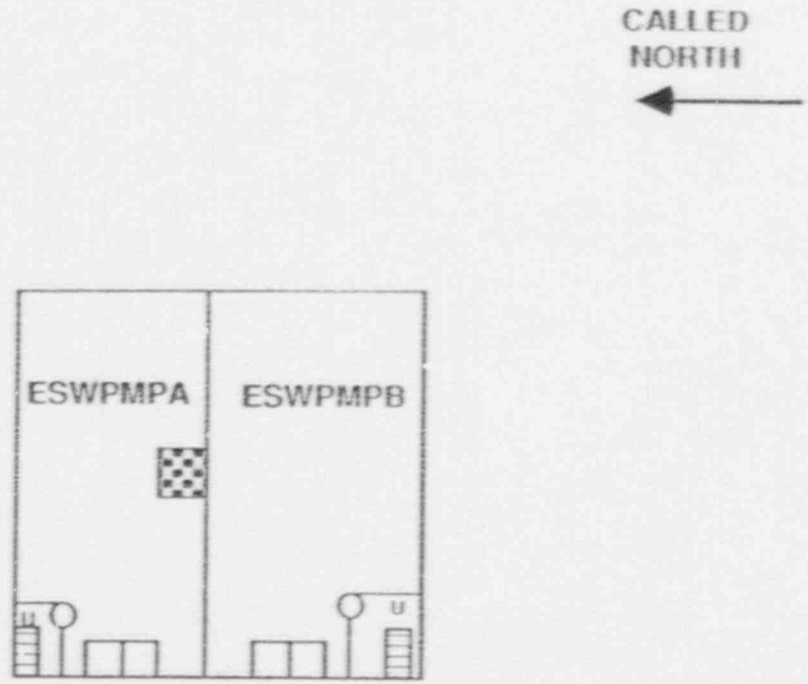


Figure 4-5. Braidwood 1 & 2 Station Arrangement, Elevation 330' of the Auxiliary Building

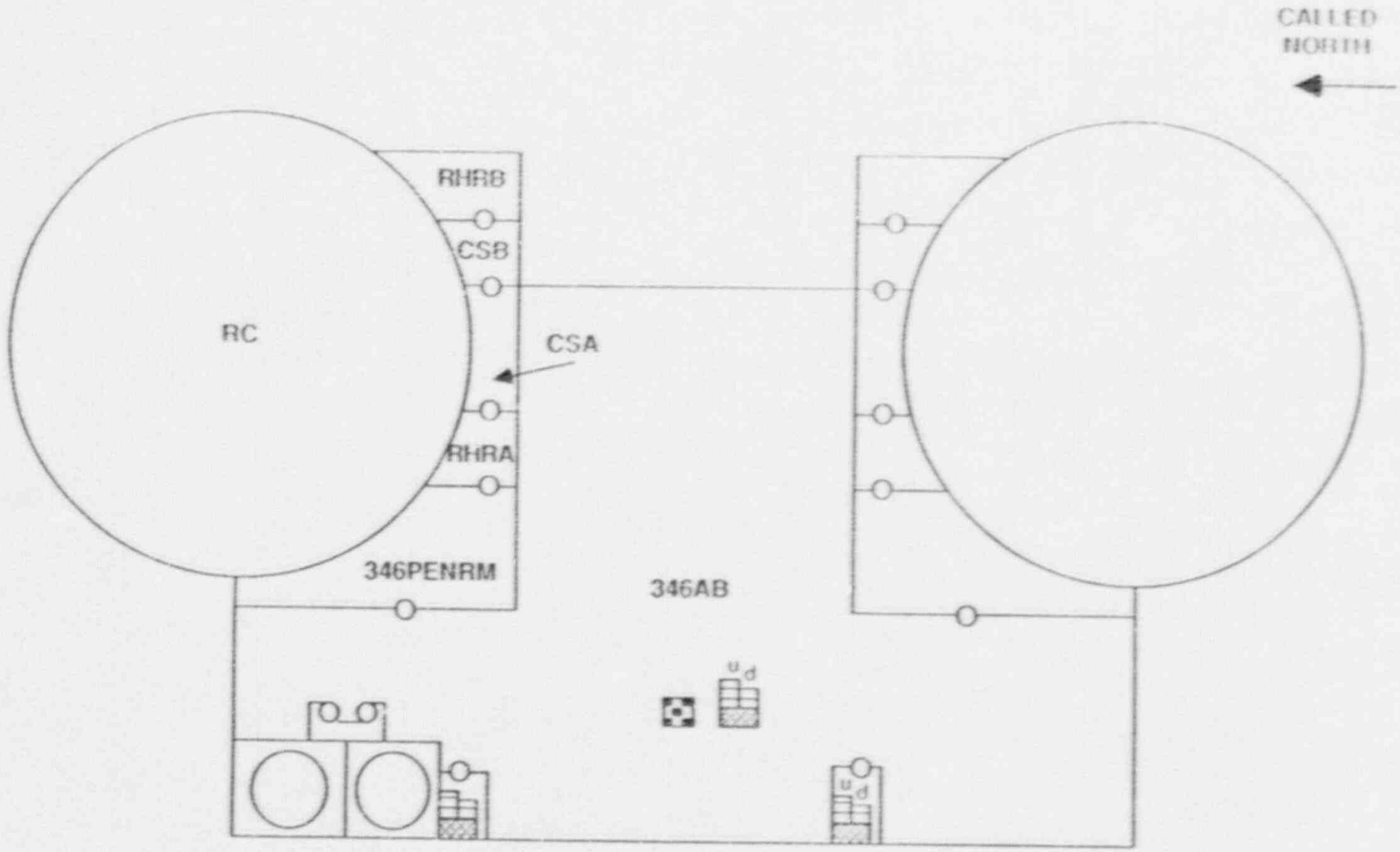


Figure 4-6. Braidwood 1 & 2 Station Arrangement, Elevation 346'

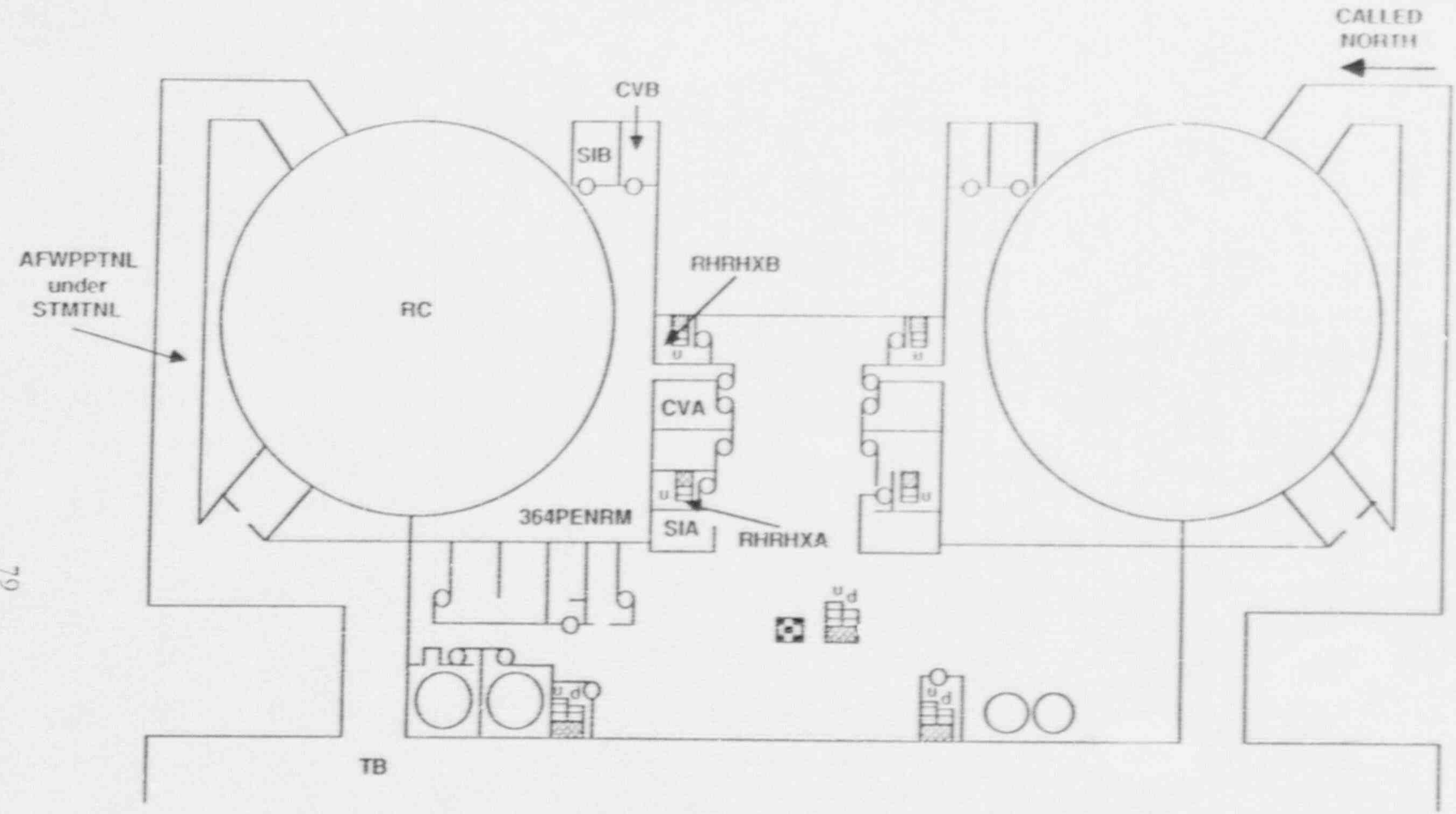


Figure 4-7. Braidwood 1 & 2 Station Arrangement, Elevation 364'

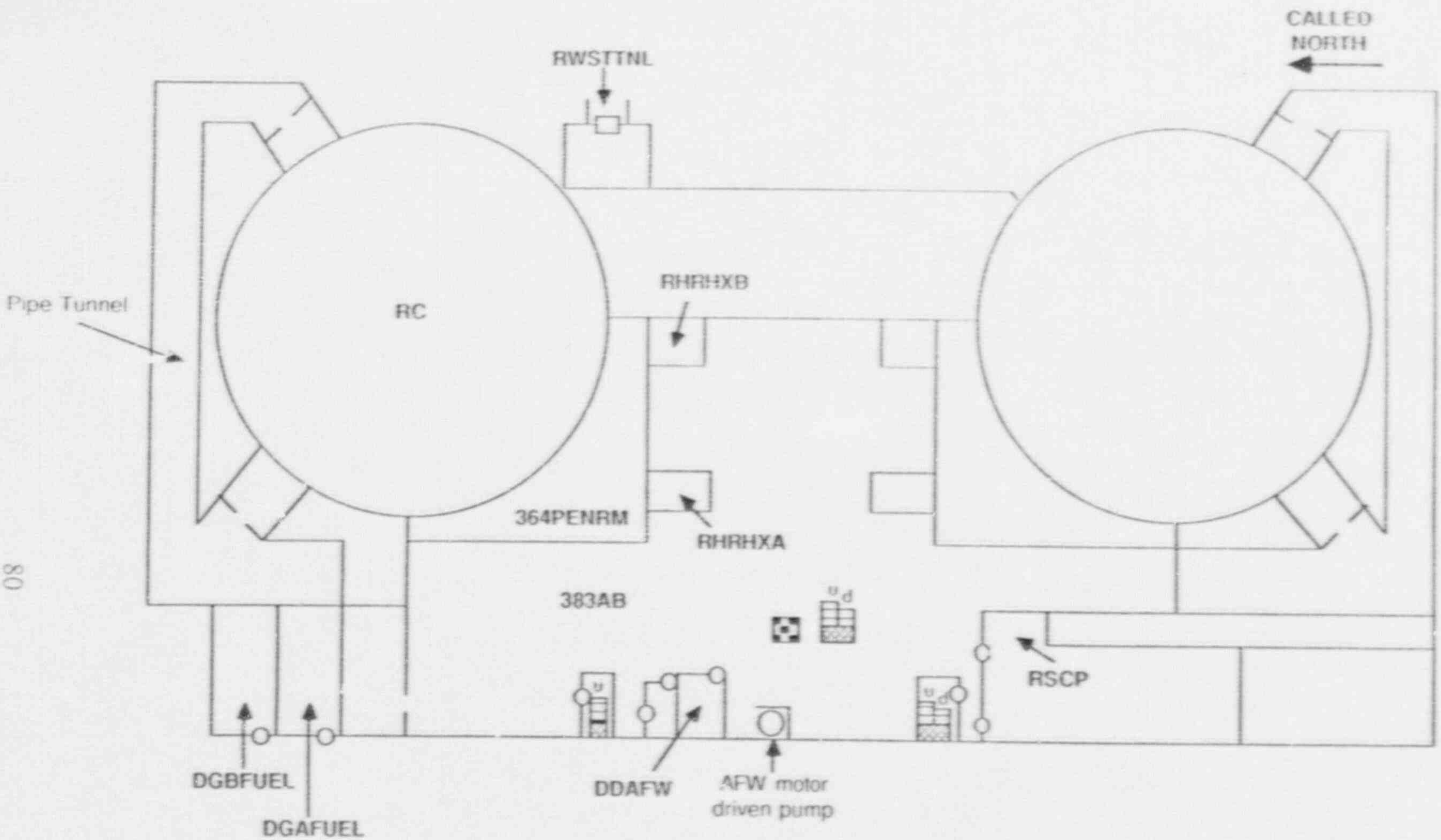


Figure 4-8. Braidwood 1 & 2 Station Arrangement, Elevation 383'

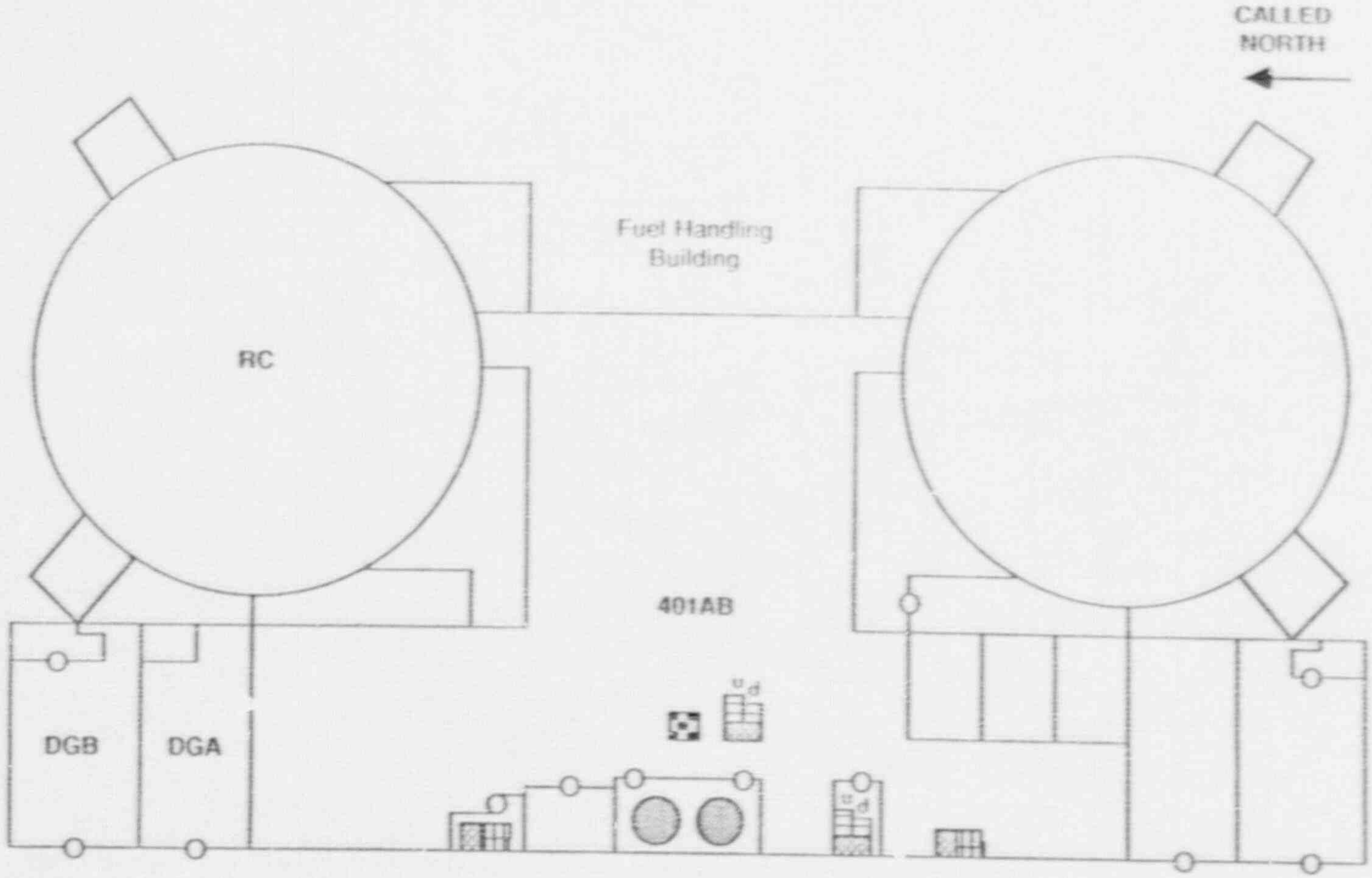


Figure 4-9. Braidwood 1 & 2 Station Arrangement, Elevation 401'

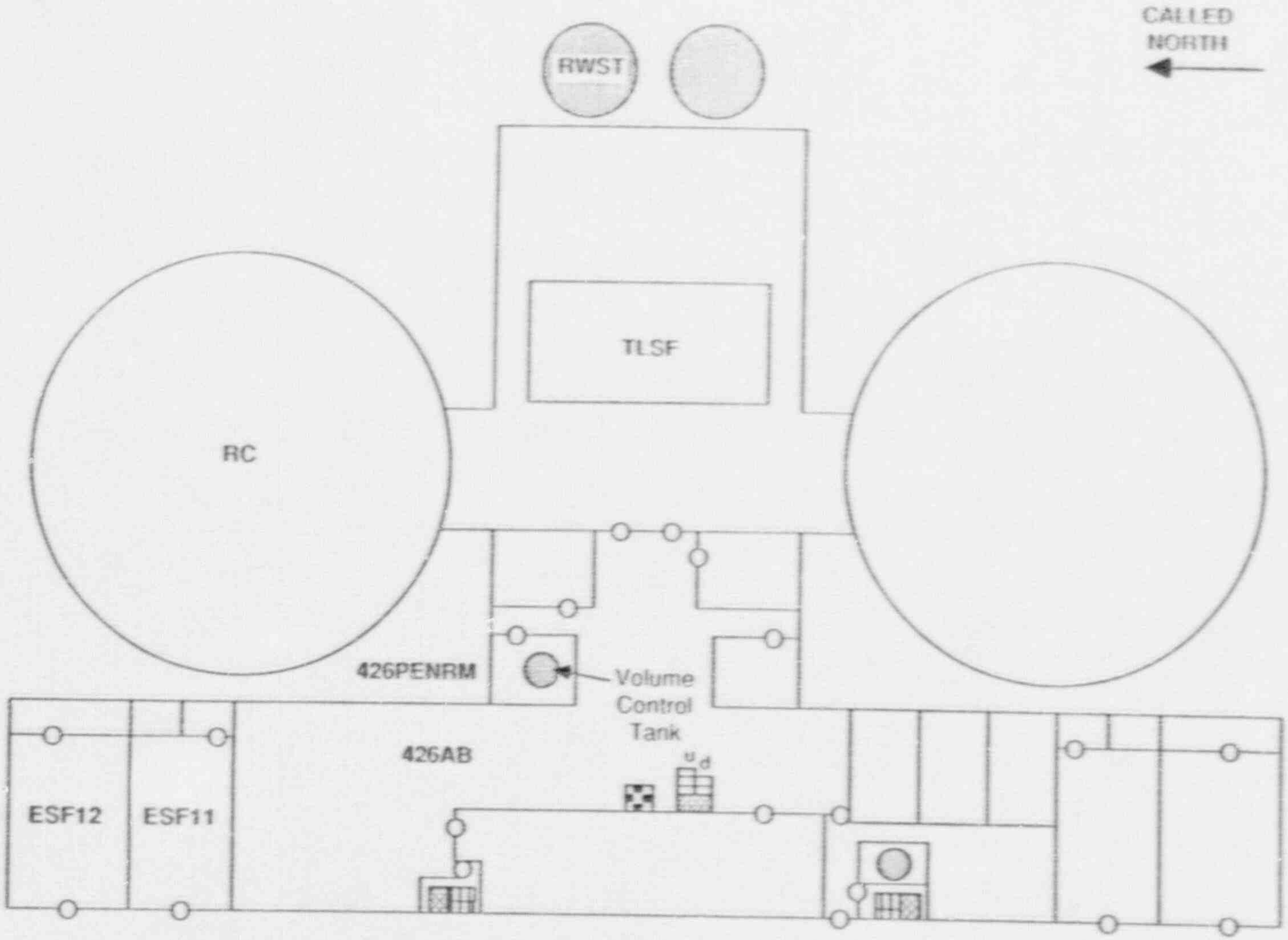


Figure 4-10. Braidwood 1 & 2 Station Arrangement, Elevation 426'

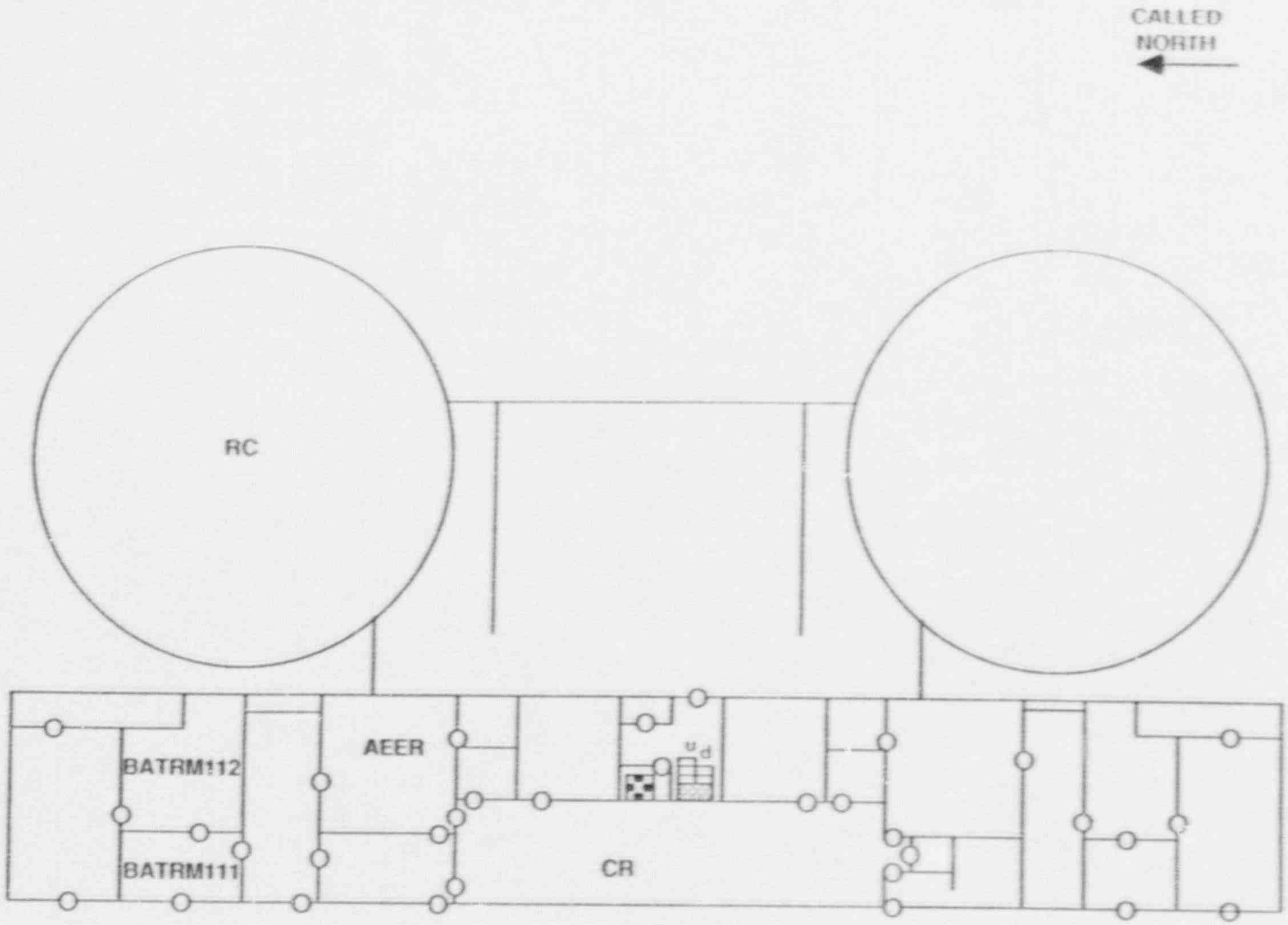


Figure 4-11. Braidwood 1 & 2 Station Arrangement, Elevation 451'

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

	Codes	Descriptions
1.	346AB	346' elevation of the Auxiliary Building
2.	346PENRM	Penetration Area, located on the 346' elevation of the Auxiliary Building
3.	364AB	346' elevation of the Auxiliary Building
4.	364PENRM	Penetration Area, located on the 364' elevation of the Auxiliary Building
5.	383AB	383' elevation of the Auxiliary Building
6.	401AB	401' elevation of the Auxiliary Building
7.	414PENRM	Penetration Area, located on the 414' of the Auxiliary Building
8.	426AB	426' elevation of the Auxiliary Building
9.	426PENRM	Penetration Area, located on the 426' of the Auxiliary Building
10.	AEER	Auxiliary Electric Equipment Room, located on the 451' elevation of the Auxiliary Building
11.	AFWPPTNL	Auxiliary Feedwater Pipe Tunnel under Main Steam Tunnel
12.	BATRM111	111 Battery Room, located on the 451' elevation of the Auxiliary Building
13.	BATRM112	112 Battery Room, located on the 451' elevation of the Auxiliary Building
14.	CR	Control Room, located on the 451' elevation of the Auxiliary Building
15.	CSA	Core Spray Pump A Room, located on the 346' elevation of the Auxiliary Building
16.	CSB	Core Spray Pump B Room, located on the 346' elevation of the Auxiliary Building
17.	CST	Condensate Storage Tank
18.	CVA	Centrifugal Charging Pump A Room, located on the 364' elevation of the Auxiliary Building
19.	CVB	Centrifugal Charging Pump B Room, located on the 364' elevation of the Auxiliary Building

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

Codes	Descriptions
20. DDAFW	Diesel Driven Auxiliary Feedwater Pump Room, located on the 38' elevation of the Auxiliary Building
21. DGA	Diesel Generator 1A Room, located on the 401' elevation of the Auxiliary Building
22. DGAFUEL	Diesel Generator 1A Fuel Storage Room, located on the 383' elevation of the Auxiliary Building
23. DGB	Diesel Generator 1B Room, located on the 401' elevation of the Auxiliary Building
24. DGBFUEL	Diesel Generator 1B Fuel Storage Room, located on the 383' elevation of the Auxiliary Building
25. ESF11	Division 11 ESF Switchgear Room, located on the 426' elevation of the Auxiliary Building
26. ESF12	Division 12 ESF Switchgear Room, located on the 426' elevation of the Auxiliary Building
27. ESWPMPA	Emergency Service Water A Pump Room, located on the 330' elevation of the Auxiliary Building
28. ESWPMPB	Emergency Service Water B Pump Room, located on the 330' elevation of the Auxiliary Building
29. LOCSR	Residual Heat Removal System "A" Pump Room, located in the Auxiliary Building on the 93' elevation - east side of the Reactor Containment Building
30. RC	Reactor Containment Building
31. RHRA	RHR Pump A Room, located on the 346' elevation of the Auxiliary Building
32. RHRB	RHR Pump B Room, located on the 346' elevation of the Auxiliary Building
33. RHRHXA	RHR Heat Exchanger A Room, located on the 364' elevation of the Auxiliary Building
34. RHRHXB	RHR Heat Exchanger B Room, located aon the 364' elevation of the Auxiliary Building
35. RWST	Refueling Water Storage Tank

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

Codes		Descriptions
36.	RWSTTNL	Tunnel from RWST, located on the 364' elevation of the Auxiliary Building
37.	RSCP	Remote Shutdown Control Panel, located on the 383' elevation of the Auxiliary Building
38.	SIA	Safety Injection Pump A Room, located on the 364' elevation of the Auxiliary Building
39.	SIB	Safety Injection Pump B Room, located on the 364' elevation of the Auxiliary Building
40.	STMTNL	Main Steam Tunnel, locatec on the 364 elevation - outboard side of Containment
41.	SX1A	Pit containing ESW Valve 1S001A, located on the 330' elevation of the Auxiliary Building
42.	SX1B	Pit containing ESW Valve 1S001B, located on the 330' elevation of the Auxiliary Building
43.	SXCTA	Emergency Service Water A Cooling Tower
44.	SXCTASG	Switchgear Room for the ESW A Cooling Tower
45.	TB	Turbine Building
46.	TLSF	Spent fuel pool operating floor, located on the 426' elevation of the Fuel Building
47.	UPCSR	Upper Cable Spreading Room, located on the 467' of the Auxiliary Building

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
346AB	ESW	ESW-1-7	MOV
346AB	ESW	ESW-0-7	MOV
364AB	CCW	CCW-1-9473A	MOV
364AB	CCW	CCW-1-9473A	MOV
364AB	CCW	CCW-1-9473B	MOV
364AB	CCW	CCW-1-9473B	MOV
364AB	CCW	CCW-2-9473A	MOV
364AB	CCW	CCW-2-9473B	MOV
364AB	CCW	CCW-P0	MDP
364AB	CCW	CCW-P1A	MDP
364AB	CCW	CCW-P1B	MDP
364AB	CCW	CCW-9412A	MOV
364AB	CCW	CCW-9412B	MOV
364AB	CCW	CCW-0-HX	HX
364AB	CCW	CCW-1-HX	HX
364AB	CCW	CCW-P0	MDP
364AB	EP	MCC-132X1	MCC
364PENRM	CVCS	CV-112D	MOV
364PENRM	CVCS	CV-112E	MOV
364PENRM	CVCS	SI-8801A	MOV
364PENRM	CVCS	SI-8801B	MOV
364PENRM	ECCS	RH-8716A	MOV
364PENRM	ECCS	RH-8716A	MOV
364PENRM	ECCS	CV-8804A	MOV
364PENRM	ECCS	SI-8811A	MOV
364PENRM	ECCS	RH-8716B	MOV
364PENRM	ECCS	RH-8716B	MOV
364PENRM	ECCS	SI-8811B	MOV
364PENRM	ECCS	SI-8821A	MOV
364PENRM	ECCS	SI-8821A	MOV
364PENRM	ECCS	SI-8821B	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
364PENRM	ECCS	SI-8821B	MOV
364PENRM	ECCS	SI-8835	MOV
364PENRM	ECCS	SI-8802A	MOV
364PENRM	ECCS	SI-8802B	MOV
364PENRM	EP	MCC-131X1	MCC
364PENRM	EP	MCC-131X1A	MCC
364PENRM	PAHRS	CC-16A	MOV
364PENRM	PAHRS	CC-27A	MOV
364PENRM	PAHRS	CC-16B	MOV
364PENRM	PAHRS	CC-27B	MOV
364PENRM	PAHRS	CS-1A	MOV
364PENRM	PAHRS	CS-7A	MOV
364PENRM	PAHRS	CS-1B	MOV
364PENRM	PAHRS	CS-7B	MOV
383AB	AFW	AFW-P1A	MDP
383AB	AFW	AFW-17A	MOV
383AB	AFW	AFW-6A	MOV
383AB	EP	MCC-131X3	MCC
383AB	EP	MCC-132X3	MCC
414PENRM	EP	MCC-131X2	MCC
414PENRM	EP	MCC-131X4	MCC
426AB	EP	MCC-131X5	MCC
426AB	EP	MCC-132X5	MCC
426PENRM	EP	MCC-132X2	MCC
426PENRM	EP	MCC-132X4	MCC
426PENRM	EP	MCC-132X4A	MCC
AFWPPTNL	AFW	AFW-13E	MOV
AFWPPTNL	AFW	AFW-13F	MOV
AFWPPTNL	AFW	AFW-13G	MOV
AFWPPTNL	AFW	AFW-13H	MOV
AFWPPTNL	AFW	AFW-13A	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
AFWPPTNL	AFW	AFW-13B	MOV
AFWPPTNL	AFW	AFW-13C	MOV
AFWPPTNL	AFW	AFW-13D	MOV
BATRM111	EP	DCBUS-111	BUS
BATRM111	EP	BC-111	BC
BATRM111	EP	BT-111	BATT
BATRM111	EP	DCBUS-111	BUS
BATRM111	EP	TR-111	XFMR
BATRM111	EP	TR-113	XFMR
BATRM111	EP	INV-111	INV
BATRM111	EP	INV-111	INV
BATRM111	EP	INV-113	INV
BATRM111	EP	INV-113	INV
BATRM111	EP	ACBUS-111	BUS
BATRM111	EP	ACBUS-111	BUS
BATRM111	EP	ACBUS-113	BUS
BATRM111	EP	ACBUS-113	BUS
BATRM112	EP	DCBUS-112	BUS
BATRM112	EP	BC-112	BC
BATRM112	EP	BT-112	BATT
BATRM112	EP	DCBUS-112	BUS
BATRM112	EP	TR-112	XFMR
BATRM112	EP	TR-114	XFMR
BATRM112	EP	INV-112	INV
BATRM112	EP	INV-112	INV
BATRM112	EP	INV-114	INV
BATRM112	EP	INV-114	INV
BATRM112	EP	ACBUS-112	BUS
BATRM112	EP	ACBUS-112	BUS
BATRM112	EP	ACBUS-114	BUS
BATRM112	EP	ACBUS-114	BUS

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
CSA	PAHRS	CS-P1A	MDP
CSA	PAHRS	CS-9A	MOV
CSB	PAHRS	CS-P1B	MDP
CSB	PAHRS	CS-9B	MOV
CST	AFW	AFW-CST	TANK
CVA	CVCS	CV-P1A	MDP
CVB	CVCS	CV-P1B	MDP
DDAFW	AFW	AFW-P1B	DDP
DDAFW	AFW	AFW-17B	MOV
DDAFW	AFW	AFW-6B	MOV
DGA	EP	DG-1A	DG
DGB	EP	DG-1B	DG
ESF11	EP	BUS-141	BUS
ESF11	EP	BUS-131X	BUS
ESF11	EP	TR-131X	XFMR
ESF11	EP	CB-1A	CB
ESF12	EP	BUS-142	BUS
ESF12	EP	BUS-132X	BUS
ESF12	EP	TR-132X	XFMR
ESF12	EP	CB-1B	CB
ESWPMPA	ESW	ESW-1-33	MOV
ESWPMPA	ESW	ESW-1-33	MOV
ESWPMPA	ESW	ESW-1-4	MOV
ESWPMPA	ESW	ESW-1-4	MOV
ESWPMPA	ESW	ESW-P1A	MDP
ESWPMPB	ESW	ESW-1-34	MOV
ESWPMPB	ESW	ESW-1-34	MOV
ESWPMPB	ESW	ESW-1-5	MOV
ESWPMPB	ESW	ESW-1-5	MOV
ESWPMPB	ESW	ESW-P1B	MDP
RC	AFW	SG-1A	SG

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RC	AFW	SG-1B	SG
RC	AFW	SG-1C	SG
RC	AFW	SG-1D	SG
RC	ECCS	SUMP-A	SUMP
RC	ECCS	SUMP-B	SUMP
RC	PAHRS	CC-FANA	ACU
RC	PAHRS	CC-FANC	ACU
RC	PAHRS	CC-FANB	ACU
RC	PAHRS	CC-FAND	ACU
RC	RCS	RCS-VESSEL	RV
RC	RCS	RC-455A	NV
RC	RCS	RC-456	NV
RC	RCS	RC-8000A	MOV
RC	RCS	RC-8000B	MOV
RC	RCS	RC-8701A	MOV
RC	RCS	RC-8701B	MOV
RC	RCS	RC-8702A	MOV
RC	RCS	RC-8702B	MOV
RC	RCS	RC-8001A	MOV
RC	RCS	RC-8002A	MOV
RC	RCS	RC-8001B	MOV
RC	RCS	RC-8002B	MOV
RC	RCS	RC-8001C	MOV
RC	RCS	RC-8002C	MOV
RC	RCS	RC-8001D	MOV
RC	RCS	RC-8002D	MOV
RHRA	ECCS	RH-P1A	MDP
RHRB	ECCS	RH-P1B	MDP
RHRHXA	ECCS	RH-HX1A	HX
RHRHXB	ECCS	RH-HX1B	HX
RWST	CVCS	SI-RWST	TANK

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RWST	ECCS	SI-RWST	TANK
SIA	ECCS	SI-8923A	MOV
SIA	ECCS	SI-P1A	MDP
SIA	ECCS	SI-8807A	MOV
SIA	ECCS	SI-8807B	MOV
SIA	ECCS	SI-8924	MOV
SIB	ECCS	SI-8804B	MOV
SIB	ECCS	SI-8806	MOV
SIB	ECCS	SI-8923B	MOV
SIB	ECCS	SI-P1B	MDP
SX1A	ESW	ESW-1-1A	MOV
SX1B	ESW	ESW-1-1B	MOV

5. BIBLIOGRAPHY FOR BRAIDWOOD 1 AND 2

1. NUREG-75/023, "Safety Evaluation Report on Byron Station, Units 1 and 2, and The Braidwood Station, Units 1 and 2," USNRC, April 1975.

2. NUREG-1002, "Safety Evaluation Report Related to the Operation of Braidwood Station, Units 1 and 2," USNRC, November 1983.

3. NUREG-1026, "Draft Environmental Statement Related to the Operation of Braidwood Station, Units 1 and 2," USNRC, December 1983.

4. NUREG-1276, "Technical Specifications for Braidwood Station, Units 1 and 2," USNRC.

5. Youngblood, R. and Papazoglou, I.A., "Review of the Byron/Braidwood Units 1 and 2 Auxiliary Feedwater System Reliability Analysis," NUREG/CR-3096, Brookhaven National Laboratory, November 198[illegible].

APPENDIX A
DEFINITION OF SYMBOLS USED IN THE SYSTEM AND LAYOUT DRAWINGS

A1. SYSTEM DRAWINGS

A1.1 Fluid System Drawings

The simplified system drawings are accurate representations of the major flow paths in a system and the important interfaces with other fluid systems. As a general rule, small fluid lines that are not essential to the basic operation of the system are not shown in these drawings. Lines of this type include instrumentation lines, vent lines, drain lines, and other lines that are less than 1/3 the diameter of the connecting major flow path. There usually are two versions of each fluid system drawing; a simplified system drawing, and a comparable drawing showing component locations. The drawing conventions used in the fluid system drawings are the following:

- Flow generally is left to right.
  - Water sources are located on the left and water "users" (i.e., heat loads) or discharge paths are located on the right.
  - One exception is the return flow path in closed loop systems which is right to left.
  - Another exception is the Reactor Coolant System (RCS) drawing which is "vessel-centered", with the primary loops on both sides of the vessel.
  - Horizontal lines always dominate and break vertical lines.

- Component symbols used in the fluid system drawings are defined in Figure A-1.
  - Most valve and pump symbols are designed to allow the reader to distinguish among similar components based on their support system requirements (i.e., electric power for a motor or solenoid, steam to drive a turbine, pneumatic or hydraulic source for valve operation, etc.)
  - Valve symbols allow the reader to distinguish among valves that allow flow in either direction, check (non-return) valves, and valves that perform an overpressure protection function. No attempt has been made to define the specific type of valve (i.e.. as a globe, gate, butterfly, or other specific type of valve).
  - Pump symbols distinguish between centrifugal and positive displacement pumps and between types of pump drives (i.e., motor, turbine, or engine).

- Locations are identified in terms of plant location codes defined in Section 4 of this Sourcebook.
  - Location is indicated by shaded "zones" that are not intended to represent the actual room geometry.
  - Locations of discrete components represent the actual physical location of the component.
  - Piping locations between discrete components represent the plant areas through which the piping passes (i.e. including pipe tunnels and underground pipe runs).
  - Component locations that are not known are indicated by placing the components in an unshaded (white) zone.
  - The primary flow path in the system is highlighted (i.e. bold white line) in the location version of the fluid system drawings.

A1.2 Electrical System Drawings

The electric power system drawings focus on the Class 1E portions of the plant's electric power system. Separate drawings are provided for the AC and DC portions of the Class 1E system. There often are two versions of each electrical system drawing; a simplified system drawing, and a comparable drawing showing component locations. The drawing conventions used in the electrical system drawings are the following:

- Flow generally is top to bottom
  - In the AC power drawings, the interface with the switchyard and/or offsite grid is shown at the top of the drawing.
  - In the DC power drawings, the batteries and the interface with the AC power system are shown at the top of the drawing.
  - Vertical lines dominate and break horizontal lines.

- Component symbols used in the electrical system drawings are defined in Figure A-2.

- Locations are identified in terms of plant location codes defined in Section 4 of this Sourcebook.
  - Locations are indicated by shaded "zones" that are not intended to represent the actual room geometry.
  - Locations of discrete components represent the actual physical location of the component.
  - The electrical connections (i.e., cable runs) between discrete components, as shown on the electrical system drawings, DO NOT represent the actual cable routing in the plant.
  - Component locations that are not known are indicated by placing the discrete components in an unshaded (white) zone.

A2. SITE AND LAYOUT DRAWINGS

A2.1 Site Drawings

A general view of each reactor site and vicinity is presented along with a simplified site plan showing the arrangement of the major buildings, tanks, and other features of the site. The general view of the reactor site is obtained from ORNL-NSIC-55 (Ref. 1). The site drawings are approximately to scale, but should not be used to estimate distances on the site. As-built scale drawings should be consulted for this purpose.

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

A2.2 Layout Drawings

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

Symbols used in the simplified layout drawings are defined in Figure A-3. Major rooms, stairways, elevators, and doorways are shown in the simplified layout drawings however, many interior walls have been omitted for clarity. The building layout drawings, are approximately to scale, should not be used to estimate room size or distances. As-built scale drawings for should be consulted his purpose.

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

A3. APPENDIX A REFERENCES

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

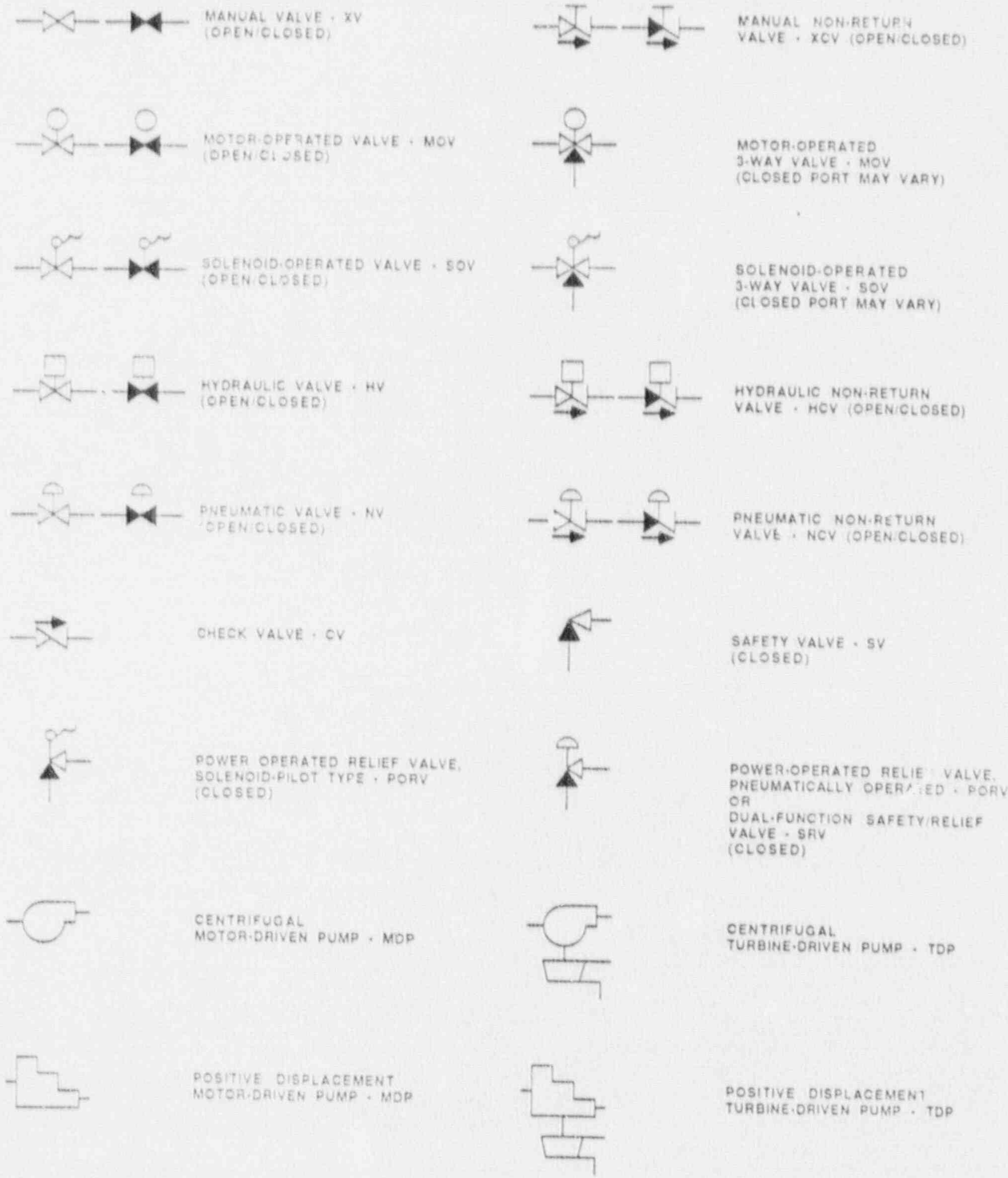


Figure A-1. Key To Symbols In Fluid System Drawings

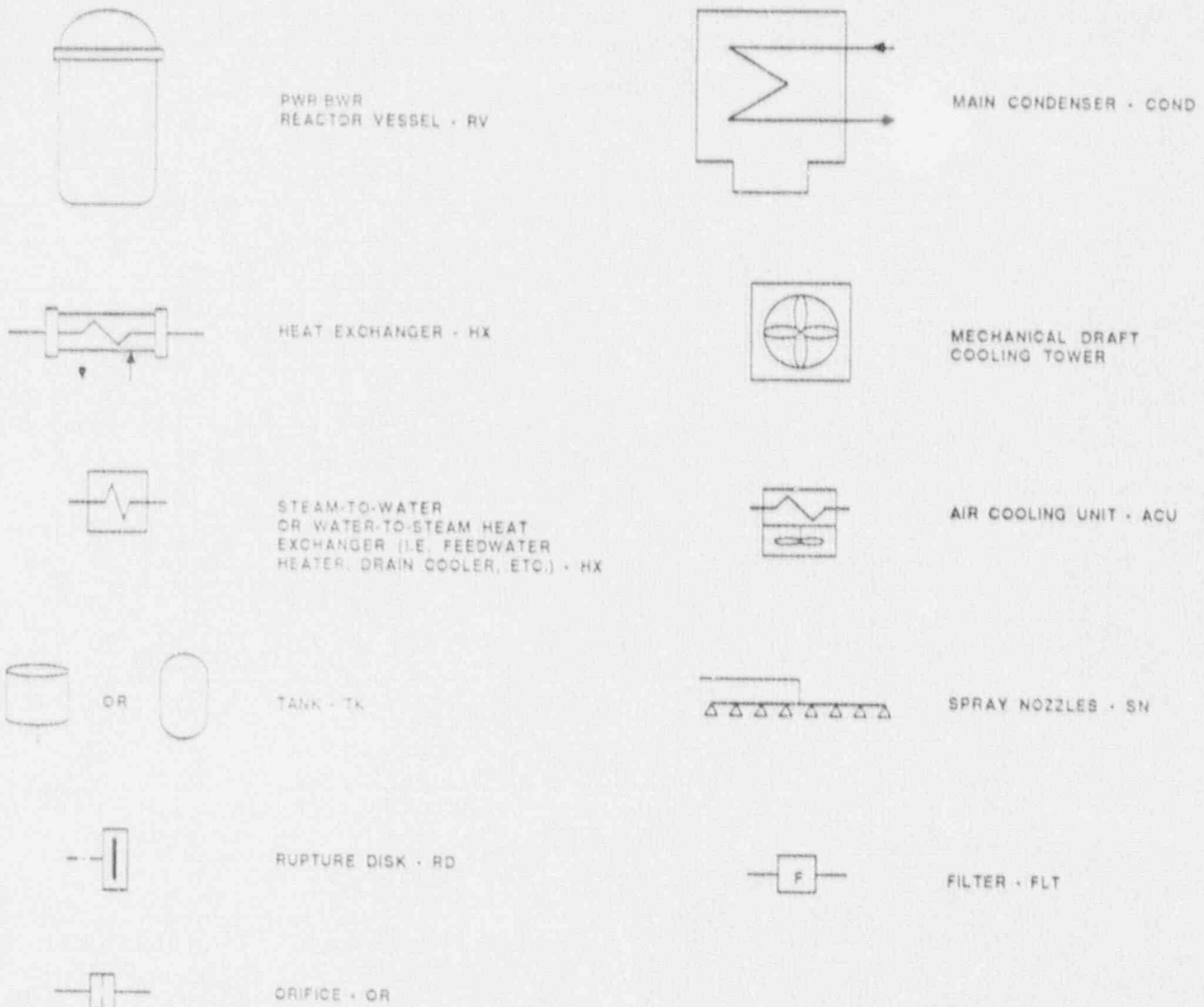


Figure A-1. Key To Symbols In Fluid System Drawings
(Continued)

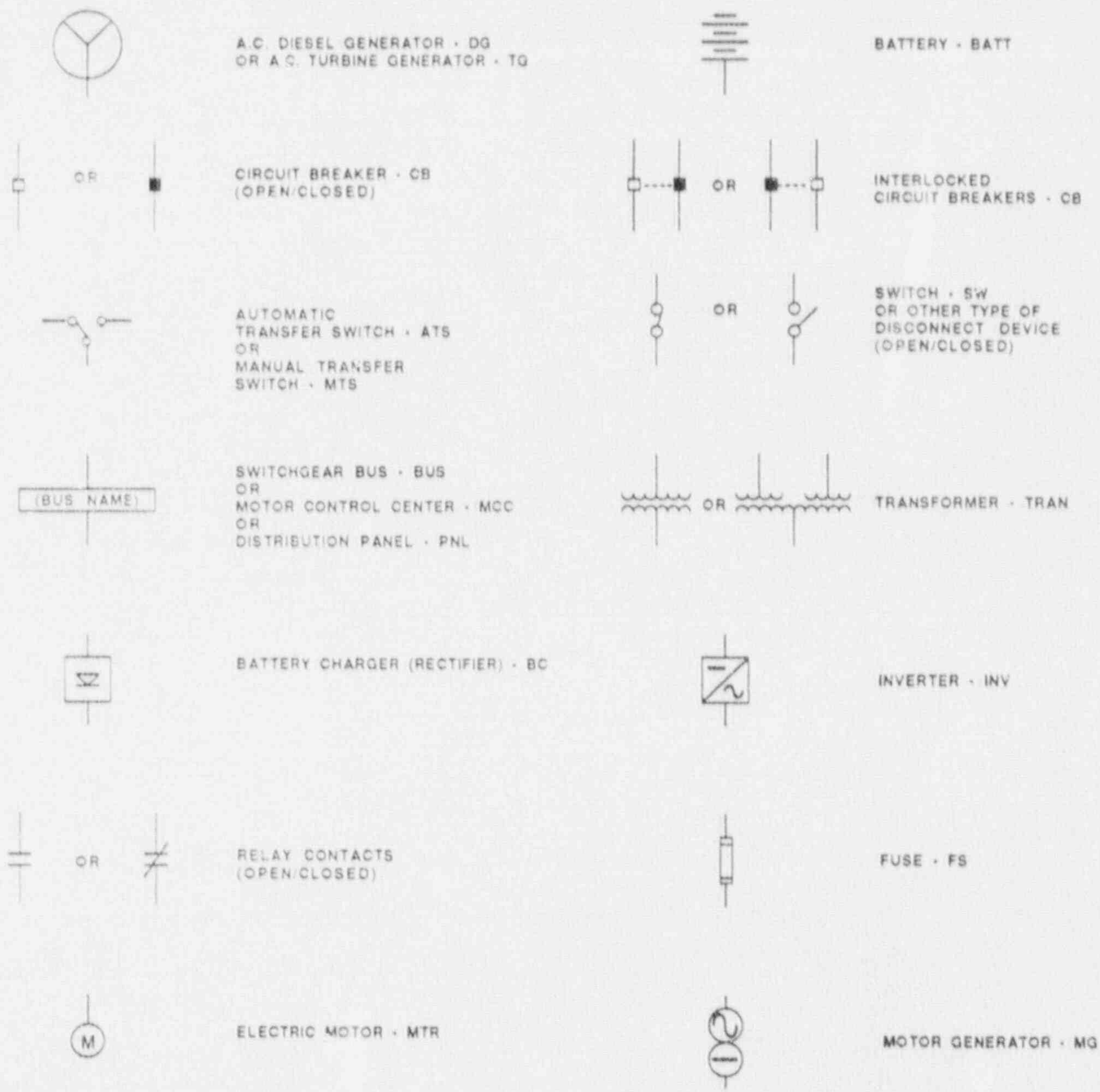


Figure A-2. Key To Symbols In Electrical System Drawings

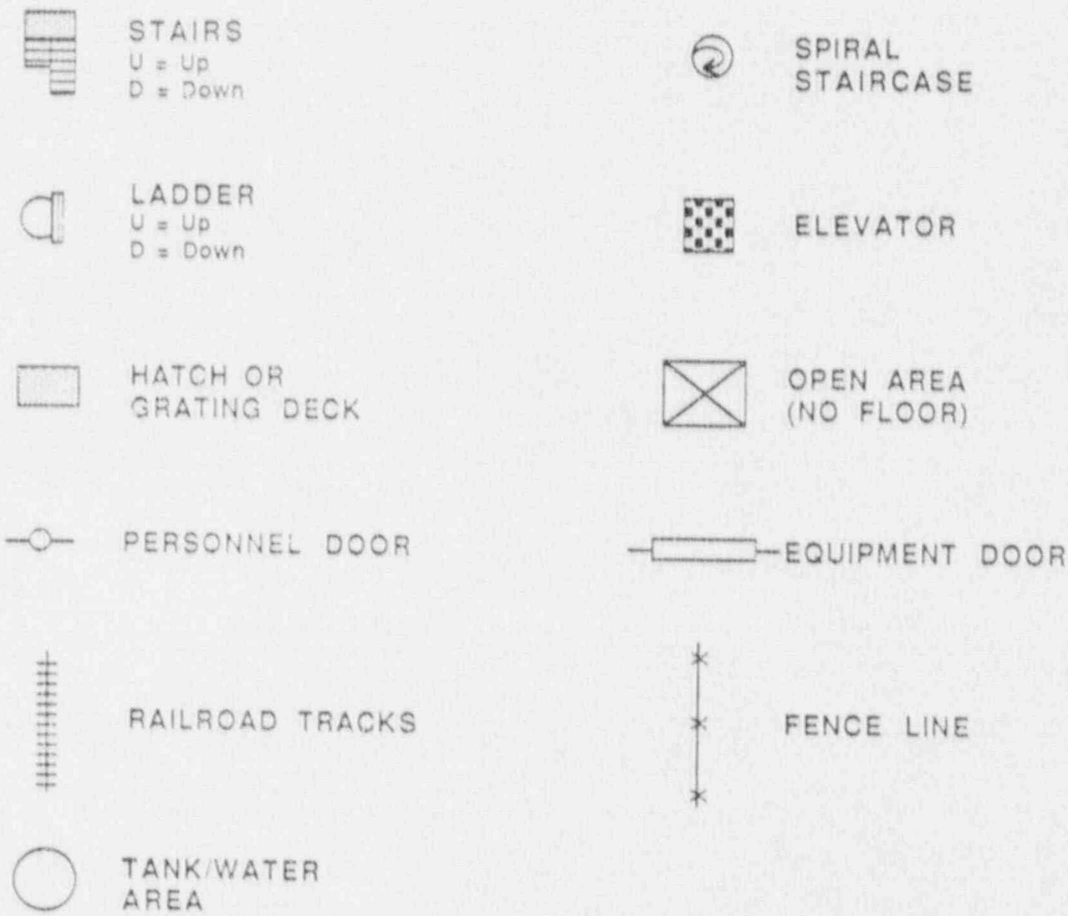


Figure A-3. Key To Symbols In Facility Layout Drawings

APPENDIX B
DEFINITION OF TERMS USED IN THE DATA TABLES

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

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

Code	Definition
RCS	Reactor Coolant System
AFW	Auxiliary Feedwater System
ECCS	Emergency Core Cooling System
CVCS	Charging System
PAHRS	Containment Heat Removal Systems (including containment spray system and fan coolers)
I&C	Instrumentation and Control Systems
EP	Electric Power System
CCW	Component Cooling Water System
ESW	Essential 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 strai	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