NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

FERMI 2

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NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

FERMI 2

50-341

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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.

FERMI 2
RECORD OF REVISIONS

REVISION	ISSUE	COMMENTS
0	9/89	Original report

FERMI 2 SYSTEM SOURCEBOOK

This sourcebook contains summary information on Fermi 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 Fermi 2 nuclear plant is listed below:

- Docket number	50-341
- Operator	Detriot Edison Company
- Location	Michigan, 25 Miles South of Detroit
- Commercial operation date	expected 5/87
- Reactor type	BWR-4
- NSSS vendor	General Electric
- Power (MWt/MWe)	3293/1150
- Architect-engineer	Detriot Edison Company
- Containment type	Steel drywell and wetwell (Mark I)

2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

The Fermi 2 nuclear plant has a General Electric BWR/4 nuclear steam supply system. The unit has a Mark I BWR containment incorporating the drywell/pressure suppression concept with a secondary containment structure of reinforced concrete. Other BWR/4 plants in the United States are as follows:

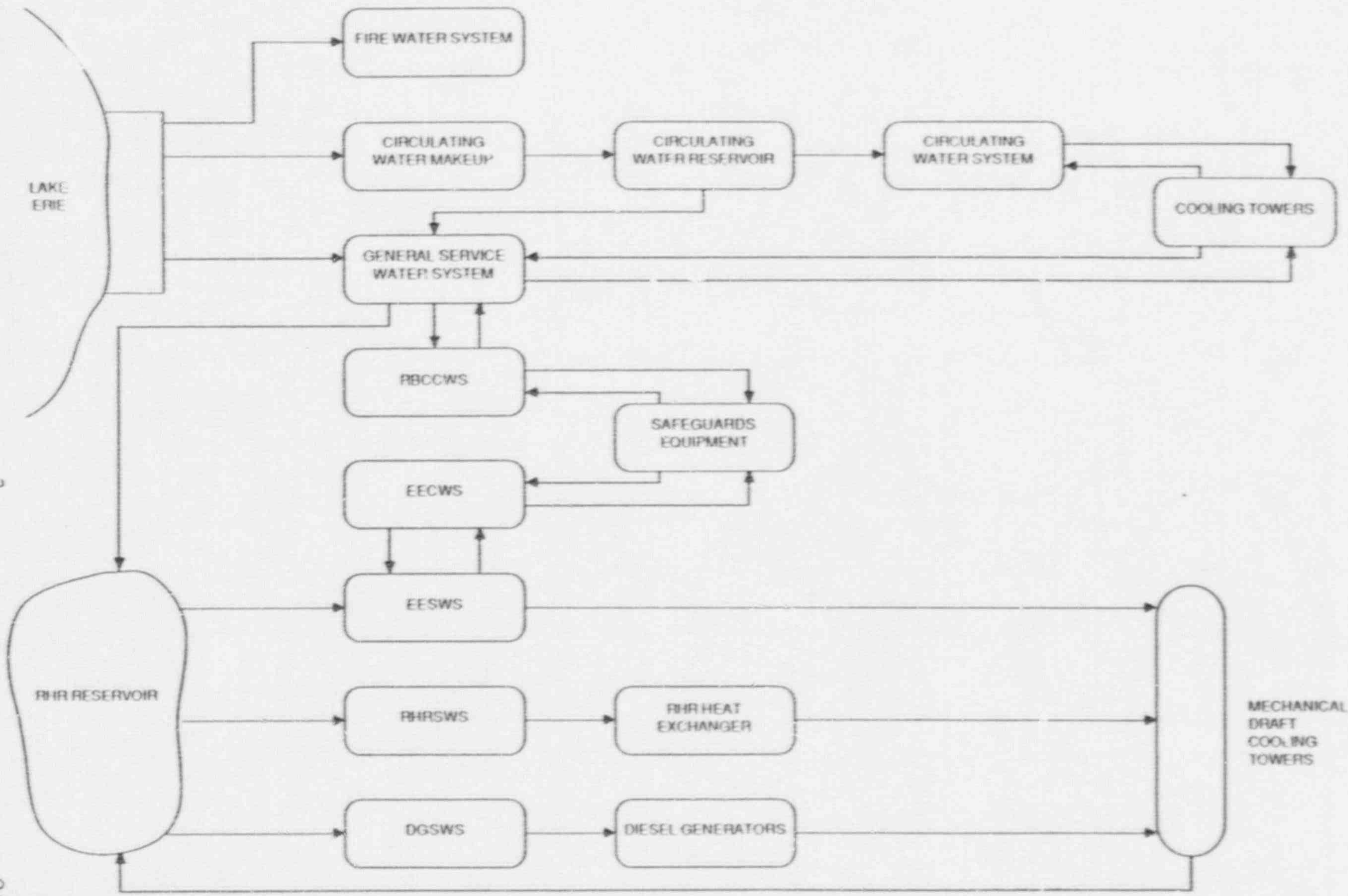
- Vermont Yankee
- Peach Bottom Units 2 and 3
- Hatch Units 1 and 2
- Cooper Nuclear Station
- Duane Arnold
- Fitzpatrick
- Brunswick Units 1 and 2
- Browns Ferry Units 1, 2 and 3
- Hope Creek Unit 1
- Limerick Units 1 and 2 (Mark II Containment)
- Shoreham (Mark II Containment)
- Susquehanna Units 1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

The Fermi 2 plant uses a high pressure coolant injection system, a single mode reactor core isolation cooling system, a low pressure core spray system and a multi-mode RHR system with no steam condensing capabilities (original steam capability at Fermi has been deleted).

3. SYSTEM INFORMATION

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



EECWS - Emergency Equipment Cooling Water System
EESWS - Emergency Equipment Service Water System
DGSWS - Diesel Generator Service Water System
RHRSWS - Residual Heat Removal Service Water System

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

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor Heat Removal Systems			
- Reactor Coolant System (RCS)	Same	3.1	5
- Reactor Core Isolation Cooling (RCIC) Systems	Same	3.2	5.5.6
- Emergency Core Cooling Systems (ECCS)			
- High-Pressure Injection & Recirculation	High-Pressure Coolant Injection (HPCI) System	3.3	6.3.2.2.1
- Low-pressure Injection & Recirculation	Core Spray (CS) System,	3.3	6.3.2.2.3
	Low-Pressure Coolant Injection (LPCI) System (an operating mode of the RHR system)	3.3	5.5.7.3.5, 6.3.2.2.4
- Automatic Depressurization System (ADS)	Same	3.3	6.3.2.2.2
- Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System)	Residual Heat Removal (RHR) System (a multi-mode system)	3.3	5.5.7
- Main Steam and Power Conversion Systems	Main Steam Supply System	X	10.3
	Condensate and Feedwater System,	X	10.4.7
	Circulating Water System	X	10.4.5
- Other Heat Removal Systems	None noted; Steam-condensing RHR/RCIC operation has been removed.	3.2	-

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor Coolant Inventory Control Systems			
- Reactor Water Cleanup (RWCU) System	Same	X	5.5.8
- ECCS	See above	-	-
- Control Rod Drive Hydraulic System (CRDHS)	Same	3.6	4.1.3
Containment Systems			
- Primary Containment	Same (drywell and pressure suppression chamber)	X	6.2.1.2.1
- Secondary Containment	Same	X	6.2.1.2.2
- Standby Gas Treatment System (SGTS)	Same	X	6.2.3
- Containment Heat Removal Systems			
- Suppression Pool Cooling System	Containment Cooling Subsystem (Part of RHR system)	3.3	5.5.7.3.3, 6.2.2
- Containment Spray System	Containment Cooling Subsystem (Part of RHR system)	3.3	5.5.7.3.3, 6.2.2
- Containment Fan Cooler System	Drywell Cooling System	X	9.4.5
- Containment Normal Ventilation Systems	Drywell Cooling System,	X	9.4.5
	Reactor Building Ventilation Systems	X	6.2.1.2.2.2
- Combustible Gas Control Systems	Primary Containment Combustible Gas Control Systems,	X	6.2.5
	Nitrogen Inerting System	X	9.3.6

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor and Reactivity Control Systems			
- Reactor Core	Same	X	4
- Control Rod System	Control Rod Drive Mechanisms	X	4.1.3
- Chemical Poison System	Standby Liquid Control System (SLCS)	X	7.4.1.2
Instrumentation & Control (I&C) Systems			
- Reactor Protection System (RPS)	Same	3.4	7.2
- Engineered Safety Feature Actuation System (ESFAS)	Engineered Safety Features System	X	7.3
- Remote Shutdown System	Local control panels	X	7
- Other I&C Systems	Various other systems	X	7.4 to 7.7
Support Systems			
- Class 1E Electric Power System	Same	3.5	8.3
- Non-Class 1E Electric Power System	Same	3.5	8
- Diesel Generator Auxiliary Systems	Same	3.5	8.3.1.1.8.3 to 8.3.1.1.8.7

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Support Systems (continued)			
- Component Cooling Water (CCW) System	Reactor Building Closed Cooling Water (RBCCW) System	X	9.2.2
	Emergency Equipment Cooling Water (EECW) System (back up to RBCCW)	3.7	9.2.2
Support Systems (continued)			
- Service Water System (SWS)	General Service Water System	X	9.2.1
- Residual Heat Removal Service Water (RHRSW) System	Same	3.8	9.2.5
- Other Cooling Water Systems	Turbine Building Closed Cooling Water (TBCCW) System	X	9.2.7
- Fire Protection Systems	Same	X	6.4.1.2.4, 9.5.1
- Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems	Same	X	9.4
- Instrument and Service Air Systems	Compressed Air System	X	9.3.1
- Refueling and Fuel Storage Systems	Fuel Storage and Handling System	X	9.1
- Radioactive Waste Systems	Same	X	11
- Radiation Protection Systems	Same	X	12

3.1 REACTOR COOLANT SYSTEM (RCS)

3.1.1 System Function

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

3.1.2 System Definition

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

3.1.3 System Operation

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

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

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

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

3.1.4 System Success Criteria

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

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

3.1.5 Component Information

A. RCS

1. Total volume: 22,034 ft^3
2. Water volume: 13,161 ft^3 (including recirculation loops)
3. Steam volume: 8,873 ft^3
4. Steam flow: 14.2 x 10^6 lb/hr.
5. Normal operating pressure: 1020 psia

B. Safety/Relief Valves (15)

1. Set pressure: 1110 to 1130 psig
2. Relief capacity: approximately 884,000 to 900,500 lb/hr each

C. Recirculation Pumps (2)

1. Rated flow: 45,200 gpm @ 710 ft. head (308 psid)
2. Type: Vertical centrifugal

D. Jet Pumps (20)

1. Total flow: 106.5 x 10^6 lb/hr @ 83.6 ft. head (36 psid)

3.1.6 Support Systems and Interfaces

A. Motive Power

1. The recirculation pumps are supplied with Nonclass 1E power.

B. MSIV Operating Power

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

C. Recirculation Pump Cooling

The reactor building closed cooling water (RBCCW) system or, upon loss of normal power, the Emergency Equipment Cooling Water System (EECW) provides cooling water to the recirculation pump coolers.

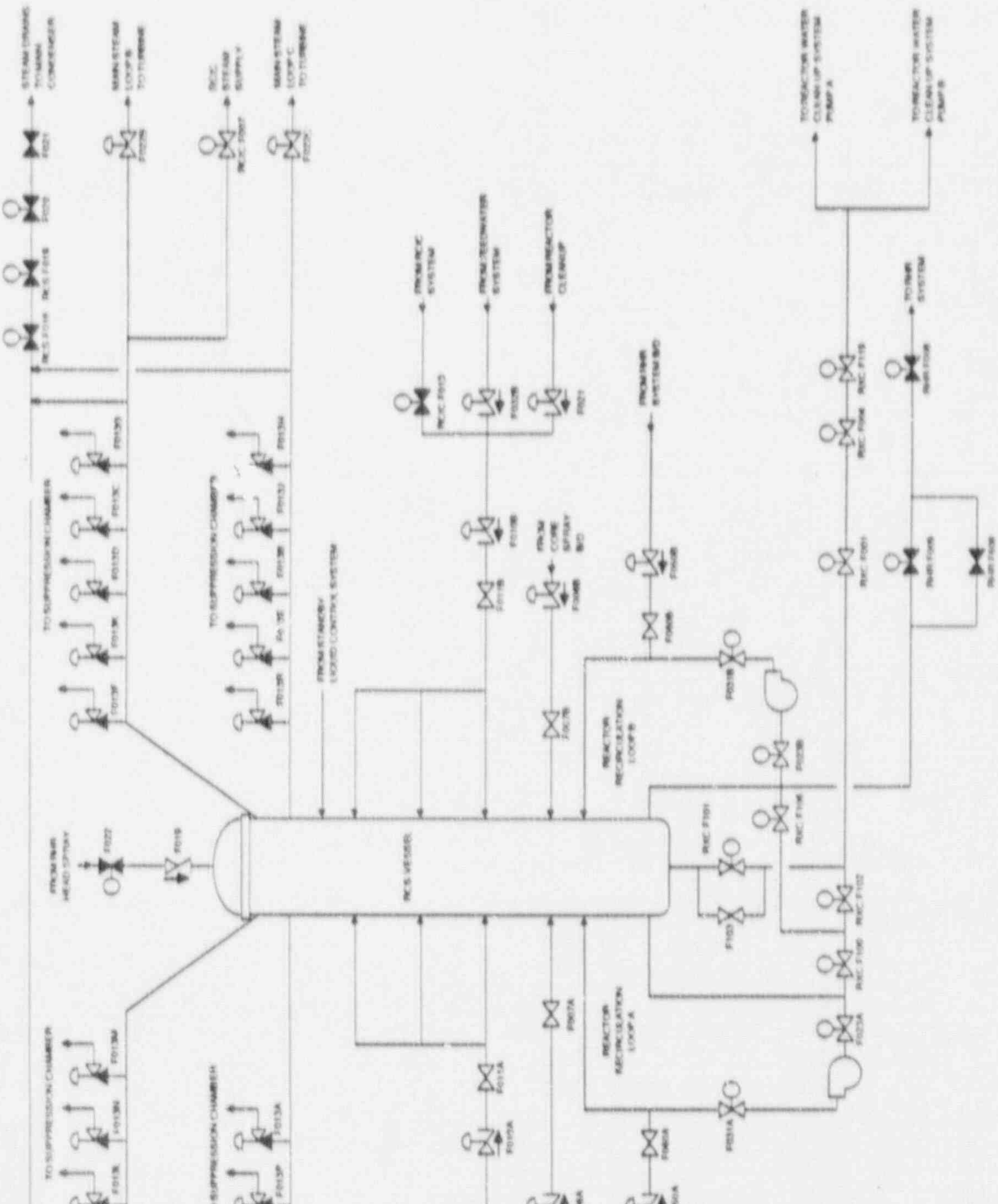


Figure 3.1-1. Enrico Fermi Unit 2 Nuclear Boiler System

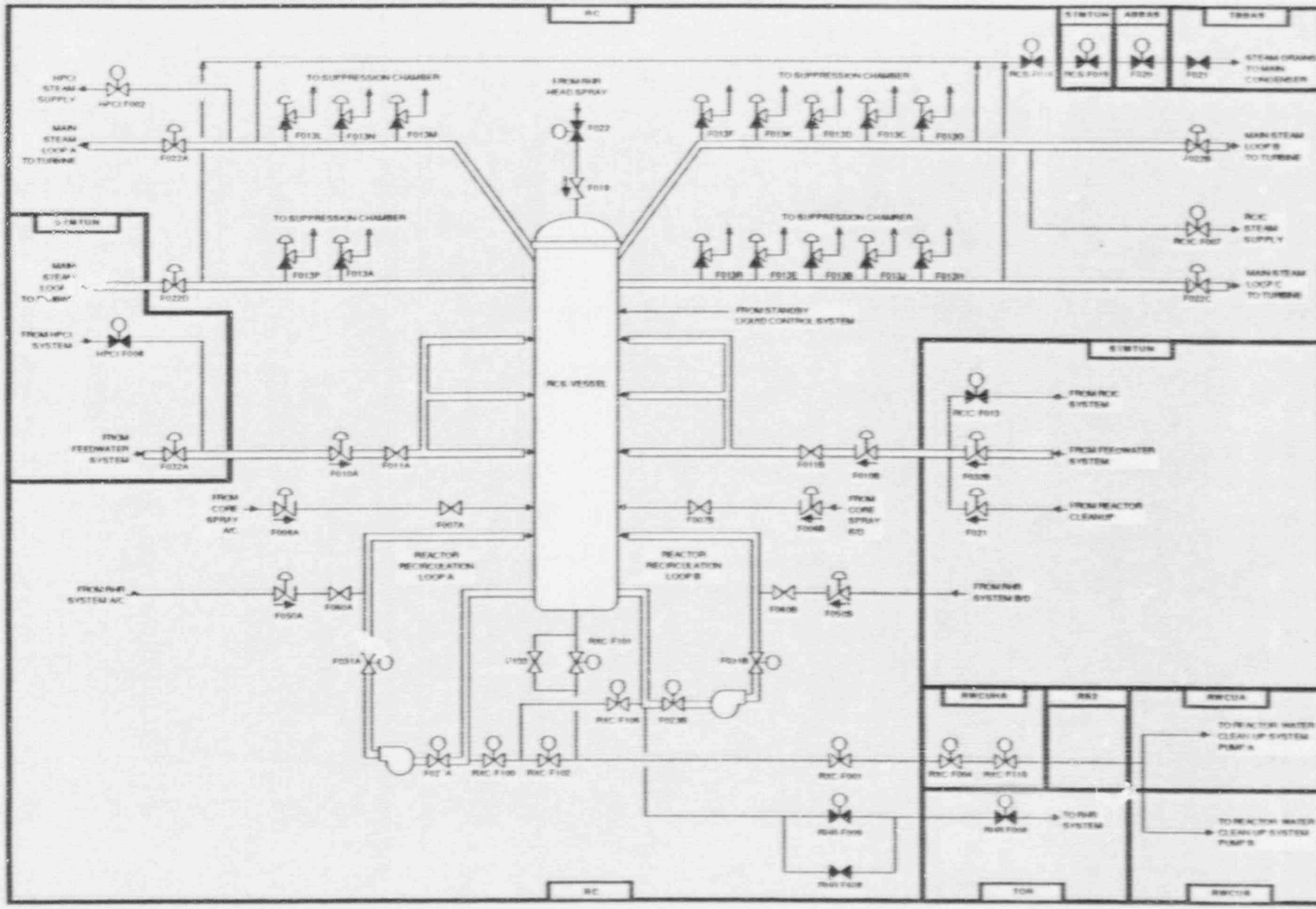


Figure 3.1-2. Enrico Fermi Unit 2 Nuclear Boiler System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
F013A	SRV	RC				
F013B	SRV	RC				
F013C	SRV	RC				
F013D	SRV	RC				
F013E	SRV	RC				
F013F	SRV	RC				
F013G	SRV	RC				
F013H	SRV	RC				
F013J	SRV	RC				
F013K	SRV	RC				
F013L	SRV	RC				
F013M	SRV	RC				
F013N	SRV	RC				
F013P	SRV	RC				
F013R	SRV	RC				
HPCI-F002	MOV	RC	MCC72C-3A	480	RB2	AC/B
HPCI-F003	MOV	STMTUN	MCC-2PB1	260	DC1	DC/2
RCIC-F007	MOV	RC	MCC72F-4A	480	RB2	AC/D
RCIC-F008	MOV	STMTUN	MCC-2PA1	260	DC1	DC/1
RCS-F016	MOV	RC	MCC72C-3A	480	RB2	AC/B
RCS-F019	MOV	STMTUN	BUS-2PA2	130	DC1	DC/1
RCS-VESSEL	RV	RC				
RHR-F008	MOV	TOR	MCC-2PA1	260	DC1	DC/1
RHR-F009	MOV	RC	MCC72C-3A	480	RB2	AC/B
RHR-MO608	MOV	RC	MCC72F-4A	480	RB2	AC/D
RXC-F001	MOV	RC	MCC72B-3A	480	RB1	AC/A
RXC-F004	MOV	RWCUHA	MCC-2PA1	260	DC1	DC/2

Table 3.1-1. Fermi 2 Reactor Coolant System Data Summary for Selected Components (continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RXC-F100	MOV	RC	MCC72E-3A	480	RB1	AC/C
RXC-F101	MOV	RC	MCC72B-4A	480	RB1	AC/A
RXC-F102	MOV	RC	MCC72E-3A	480	RB1	AC/C
RXC-F106	MOV	RC	MCC72E-3A	480	RB1	AC/C
RXC-F119	MOV	RWCUHA	MCC72C-4A	480	MCC72C-4A	AC/B
SUPP	TANK	TOR				

3.2 REACTOR CORE ISOLATION COOLING (RCIC) SYSTEM

3.2.1 System Function

The reactor core isolation cooling system provides adequate core cooling in the event that reactor isolation is accompanied by loss of feedwater flow. This system provides makeup at reactor operating pressure and does not require RCS depressurization.

The RCIC system is not considered to be part of the Emergency Core Cooling System (ECCS, see Section 3.3) and does not have a LOCA mitigating function.

3.2.2 System Definition

The reactor core isolation cooling system consists of a steam-driven turbine pump and associated valves and piping for delivering makeup water from the condensate storage tank or the suppression pool to the reactor pressure vessel. The RCIC system operates only in an injection mode. Piping and valves associated with steam-condensing RCIC operation (in conjunction with the RHR system) have been removed at Fermi 2.

Simplified drawings of the reactor core isolation cooling system are shown in Figures 3.2-1 and 3.2-2. Details of the condensate storage system are shown in Figures 3.2-3 and 3.2-4. A summary of data on selected RCIC system components is presented in Table 3.2-1.

3.2.3 System Operation

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

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

3.2.4 System Success Criteria

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

3.2.5 Component Information

A. Steam turbine-driven RCIC pump:
   1. Rated Flow: 600 gpm @ 2800 ft. head (1214 psid)
   2. Rated Capacity: 100%
   3. Type: centrifugal

B. Condensate Storage Tank (1)
   1. Capacity: 600,000 gal

3.2.6 Support System and Interfaces

A. Control Signals
   1. Automatic
      a. The RCIC pump is automatically actuated on a reactor vessel low water level signal.

b. The RCIC pump is automatically tripped on a reactor vessel high water level signal. It may be necessary to restart the pump manually.

c. The RCIC system will be automatically isolated if any of the following conditions exist:
   - High temperature (200°F) in RCIC steam line space
   - High flow (delta P) in RCIC steam line
   - Low RCIC steam line pressure (50 psig)
   - High exhaust pressure from RCIC turbine
   - Manual isolation

B. Motive Power

1. The RCIC turbine driven pump is supplied with steam from main steam loop B, upstream of the main steam isolation valves.
2. All RCIC valves and supporting equipment are Class 1E loads that are supplied from the DC and AC power systems as described in Section 3.5. The RCIC system is designed to be operable on DC power only.

C. Other

1. Lubrication and cooling for the turbine-driven pump are supplied locally. It should be noted that the pump lube oil cooler is cooled by water diverted from the RCIC pump discharge and returned to the barometric condenser. Design maximum lube oil cooling water temperature for continuous operation is 140°F.
2. The source of RCIC pump room cooling has not been identified. The RCIC pump is located in the northeast pump room in the reactor building where core spray pumps 1A and 1C also are located. Room cooling for the CS pumps is described in Section 3.3.
3. RCIC pump gland seal leakoff is collected, condensed and returned to the pump suction. A vacuum pump maintains condenser vacuum.

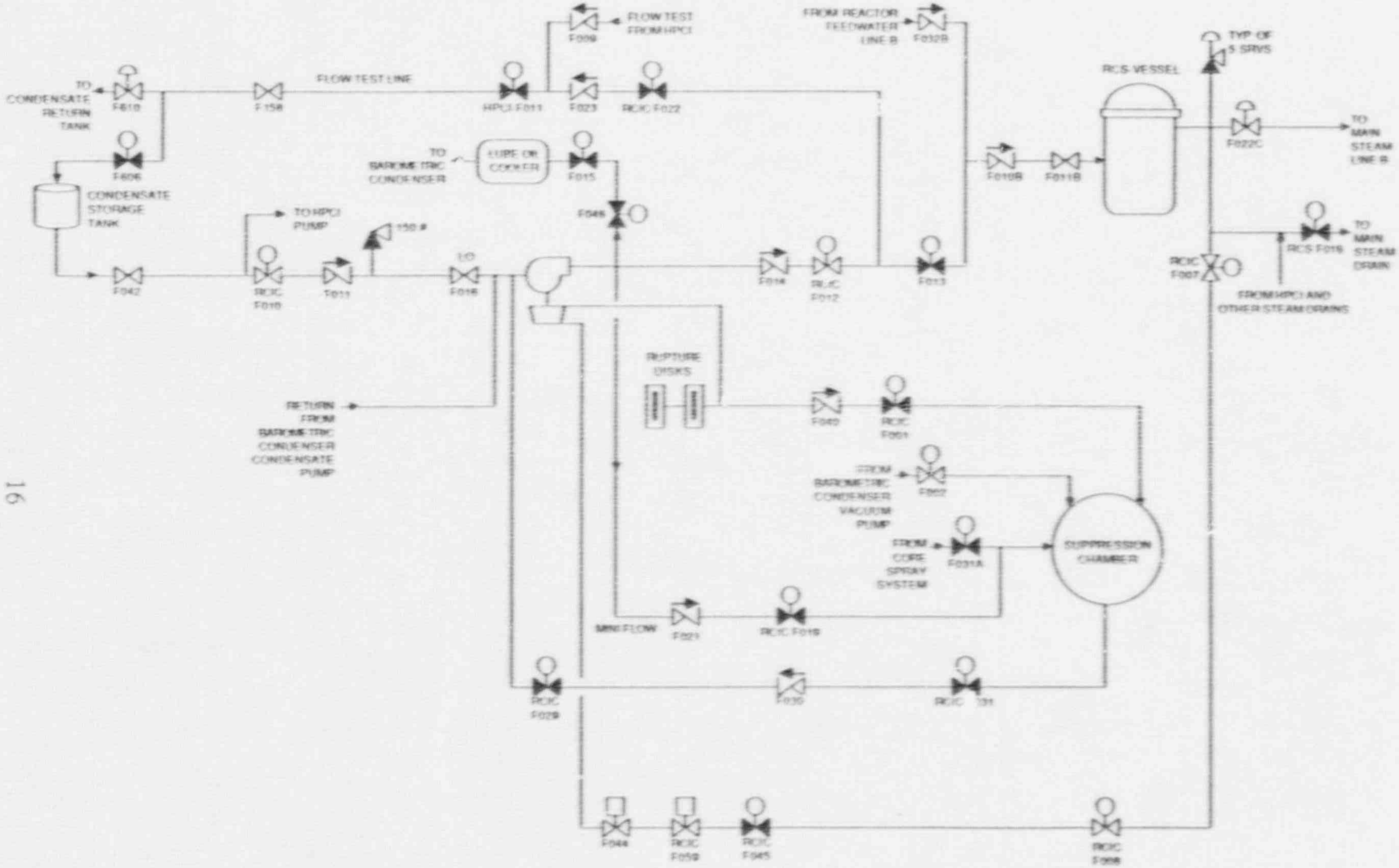


Figure 3.2-1. Enrico Fermi Unit 2 Reactor Core Isolation Cooling (RCIC) System

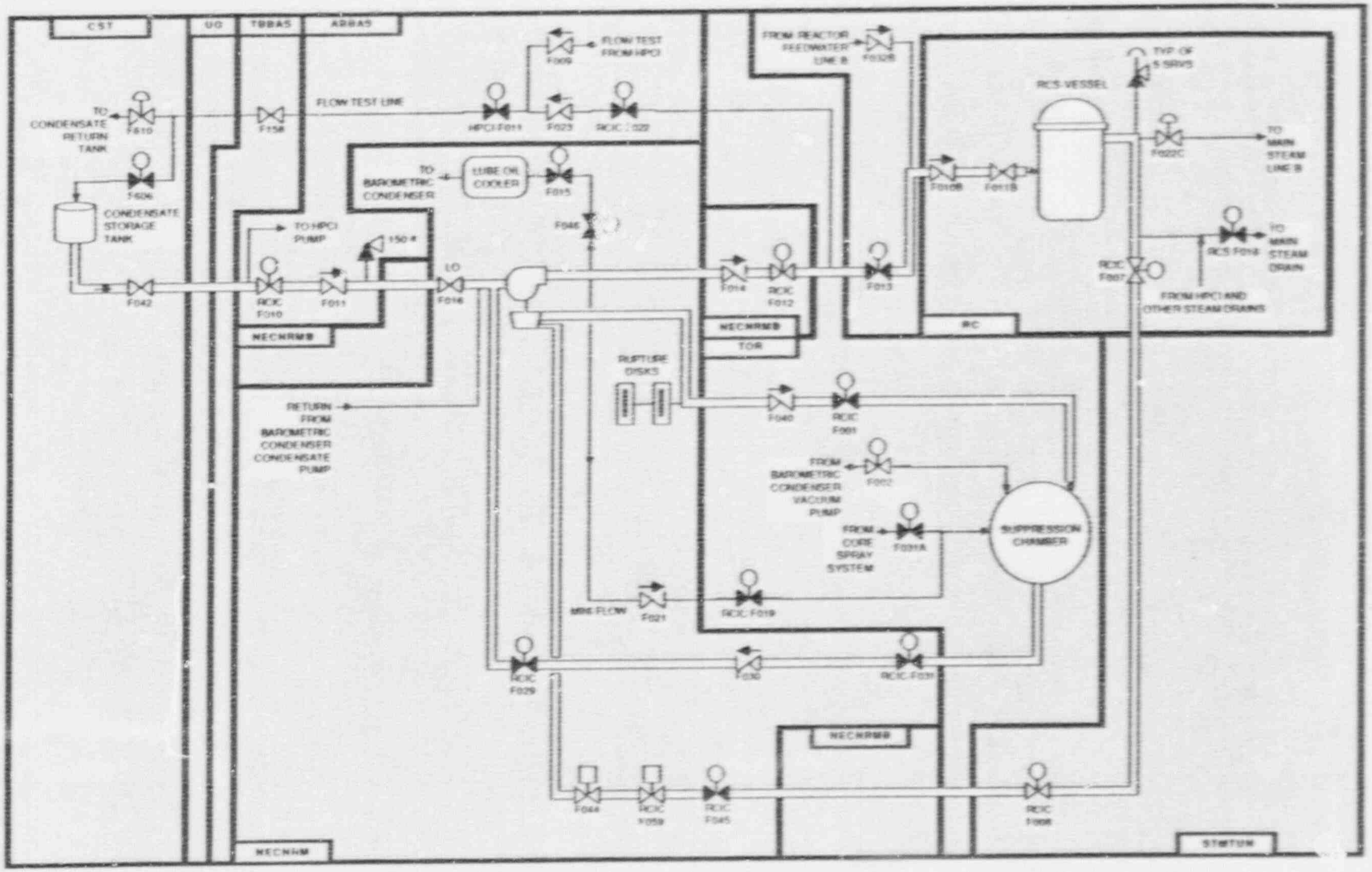


Figure 3.2-2. Enrico Fermi Unit 2 Reactor Core Isolation Cooling (RCIC) System Showing Component Locations

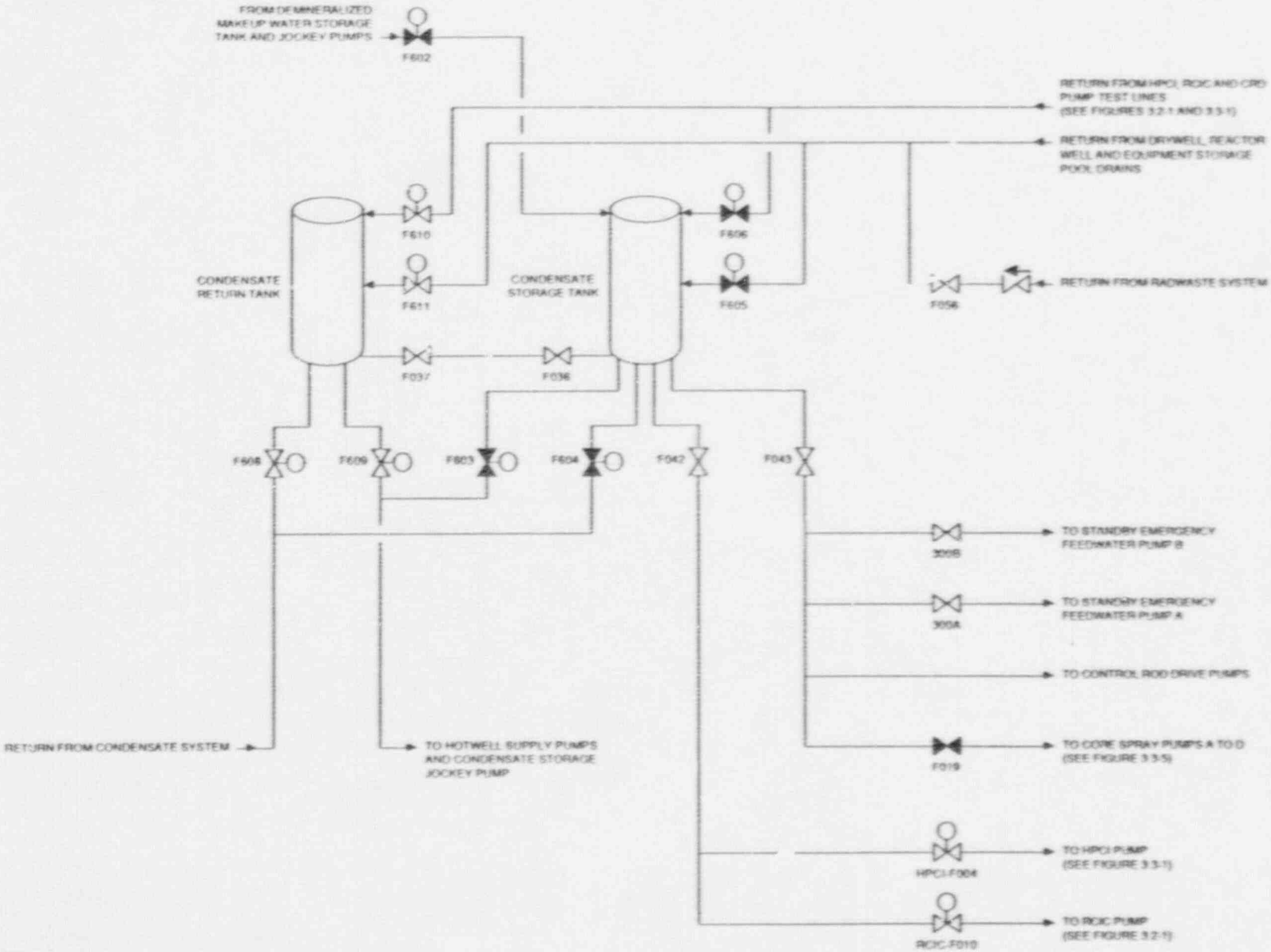


Figure 3.2-3. Enrico Fermi Unit 2 Condensate Storage System

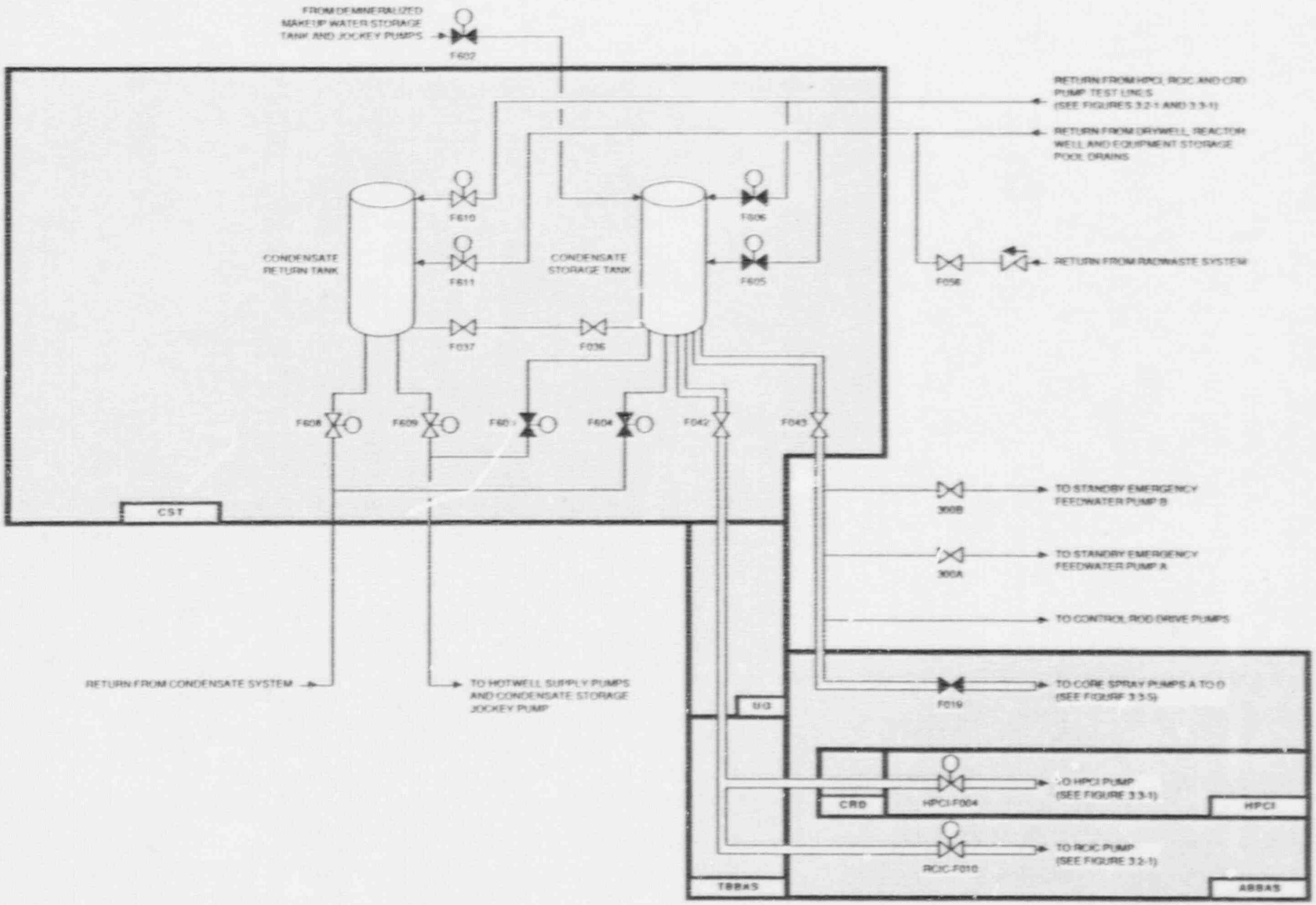


Figure 3.2-4. Enrico Fermi Unit 2 Condensate Storage System Showing Component Locations

Table 3.2-1. Fermi 2 Reactor Core Isolation Cooling System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CST	TANK	CST				
RCIC-F007	MOV	TOR	MCC-2PA1	280	DC1	DC/1
RCIC-F007	MOV	RC	MCC72F-4A	480	RB2	AC/D
RCIC-F008	MOV	STMTUN	MCC-2PA1	260	DC1	DC/1
RCIC-F010	MOV	ABBAS	MCC-2PA1	260	DC1	DC/1
RCIC-F012	MOV	NECNRMB	MCC-2PA1	260	DC1	DC/1
RCIC-F013	MOV	STMTUN	MCC-2PA1	260	DC1	DC/1
RCIC-F019	MOV	TOR	MCC-2PA1	260	DC1	DC/1
RCIC-F022	MOV	ABBAS	MCC-2PA1	260	DC1	DC/1
RCIC-F029	MOV	NECNRM	MCC-2PA1	260	DC1	DC/1
RCIC-F031	MOV	NECNRM	MCC-2PA1	260	DC1	DC/1
RCIC-F045	MOV	NECNRM	MCC-2PA1	260	DC1	DC/1
RCIC-F059	MOV	NECNRM	MCC-2PA1	260	DC1	DC/1
RCIC-TDP	TDP	NECNRM				

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 ECCS also performs suppression pool cooling and containment spray functions and has a capability for mitigating transients

3.3.2 System Definition

The emergency core cooling system consists of the following subsystems:

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

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

The automatic depressurization system (ADS) provides automatic RPV depressurization following a small break LOCA or transient so that the low pressure systems (LPCI and CS) can provide makeup to the RCS. The ADS utilize 5 of the 15 safety/relief valves that perform the RCS overpressure protection function and discharge the high pressure steam to the suppression pool.

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

The low-pressure coolant injection system is an operating mode of the Residual Heat Removal (RHR) system, and provides make-up water to the reactor vessel at low pressure. The LPCI system consists of two independent trains each with two motor-driven pumps which deliver water from the suppression pool to one of the RCS recirculation loops.

The condensate storage system, consisting of a Condensate Storage Tank and a return tank (CSTs), provides a water source for the ECCS and for the RCIC system. The HPCI system is shown in Figures 3.3-1 and 3.3-2. Simplified diagrams of the LPCI system are presented in Figures 3.3-3 and 3.3-4 and the core spray system is shown in Figures 3.3-5 and 3.3-6. Interfaces between these systems and the RCS are shown in Section 3.1. Details on the condensate storage system are included in Section 3.2. A summary of data on selected ECCS components is presented in Table 3.3-1.

3.3.3 System Operation

All ECCS systems normally are in standby. The manner in which the ECCS operates to protect the reactor core is a function of the rate at which coolant is being lost from the RCS. The HPCI system is normally aligned to take a suction on the Condensate Storage Tank (CST). The HPCI system is automatically started in response to decreasing RPV water level, and will serve as the primary source of makeup if RCS pressure remains high. Reactor core heat is dumped to the suppression pool via the safety/relief valves which cycle as needed to limit RCS pressure. The HPCI turbine also exhausts to the suppression pool. Operation of the HPCI system is not directly dependent on AC electric power. If the LOCA is of such a size that the coolant loss exceeds the HPCI system capacity or if reactor pressure is too low to operate the steam turbine-driven HPCI pump, then the CS and LPCI systems can provide higher capacity makeup to the reactor vessel.

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

A large LOCA results in rapid depressurization of the RCS. This class of LOCA is mitigated by the CS or LPCI systems without the need for the ADS.

3.3.4 System Success Criteria

LOCA mitigation requires that both the emergency coolant injection (ECI) and emergency coolant recirculation (ECR) functions be accomplished. The ECCS success criteria are not clearly defined in the Fermi 2 FSAR but can be inferred from pump capacities that are defined based on certain design basis accidents that are considered in the licensing process based on licensing considerations. The ECI system success criteria for a large LOCA are the following:

- 2 of 4 core spray pumps with a suction on the suppression pool, or
- 1 of the 4 low pressure coolant injection pumps with a suction on the suppression pool.

The ECI system success criteria for a small LOCA are the following:

- The high-pressure coolant injection (HPCI) pump with a suction on the suppression pool or the condensate storage tank, or
- The automatic depressurization system (ADS) and 1 of 4 LPCI pumps with a suction on the suppression pool, or
- The automatic depressurization system and 2 of 4 core spray pumps with a suction on the suppression pool.

The success criterion for the ADS is the use of any 1 of 2 ADS trains. Note that there may be integrated success criteria involving combinations of core spray and LPCI pumps. It is possible that the coolant inventory control function for some small LOCAs can be satisfied by low-capacity high-pressure injection systems such as the control rod drive hydraulic system (see Section 3.6).

The ECR success criteria for LOCAs are related to the ECI success criteria above. All injection systems essentially are operating in a recirculation mode when drawing water from the suppression pool.

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

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

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

3.3.5 Component Information

A. Steam turbine-driven HPCI pump
   1. Rated flow: 5000 gpm @ 2600 ft head (1127 psid)
   2. Type: centrifugal

B. Low-pressure Core Injection (RHR) Pumps (A, B, C and D)
   1. Rated flow: 10,000 gpm @ 46 ft. head (20 psid)
   2. Type: centrifugal

C. Core spray pumps (A, B, C and D)
   1. Rated flow: 3125 gpm @ [illegible]1 ft. head (122 psid)
   2. Type: centrifugal

D. Automatic depressurization valves (5)
   1. Rated capacity: 4 of 5 required
   2. Rated flow: approximately 900,500 lb/hr each

E. Pressure Suppression Chamber
   1. Design pressure: [illegible] psig
   2. Design temperature: [illegible]°F
   3. Minimum operating temperature: 95°F (assumed)
   4. Minimum water volume: [illegible]1,000 ft^3

F. Condensate Storage Tank
   1. Capacity: 600,000 gal

G. RHR Heat Exchangers (A and B)
   1. Rated Capacity: 41.6 x 10^6 Btu/hr each
   2. Type: Shell-and-tube

3.3.6 Support Systems and Interfaces

A. Control signals
   1. Automatic
      a. The HPCI pump, core spray pumps and the LPCI pumps and all their associated valves function on receipt of low water level in the reactor vessel or high pressure in the drywell.
      b. The HPCI pump is automatically tripped on a reactor vessel high water level signal. It may then be necessary to restart the pump manually.
      c. The HPCI pump suction is automatically switched to the suppression pool on high suppression pool water level.
      d. The ADS system is actuated upon coincident signals of the reactor vessel low water level, drywell high pressure and discharge pressure indication on any LPCI or CS pump but with a [illegible]-min delay.
      e. LPCI initiation automatically causes all RHR components to perform their function under the LPCI mode.

   2. Remote manual

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

B. Motive Power

1. The ECCS motor-driven pumps and motor-operated valves are Class 1E AC and DC loads that can be supplied from the emergency diesel generator or station battery, as described in Section 3.5.
2. The steam supply valves to the HPCI turbine are Class 1E loads. Valves that must open to start the pump are DC-powered. Normally open isolation valve HPCI-F002 is AC powered.
3. The HPCI turbine-driven pump is supplied with steam from main steam loop A, upstream of the main steam isolation valves.

C. Pump Cooling Water

1. Cooling for the HPCI turbine-driven pump is supplied locally. It should be noted that the pump lube oil cooler is cooled by water diverted from the HPCI pump discharge and returned to the pump suction. Design maximum cooling water temperature for the HPCI pump is not known. For the turbine-driven RCIC pump, the limit for continuous operation is 140°F (see Section 3.2).
2. The LPCI (RHR) pump seals are cooled by the emergency equipment cooling water (EECW) system (see Section 3.7).

D. Pump Room Cooling

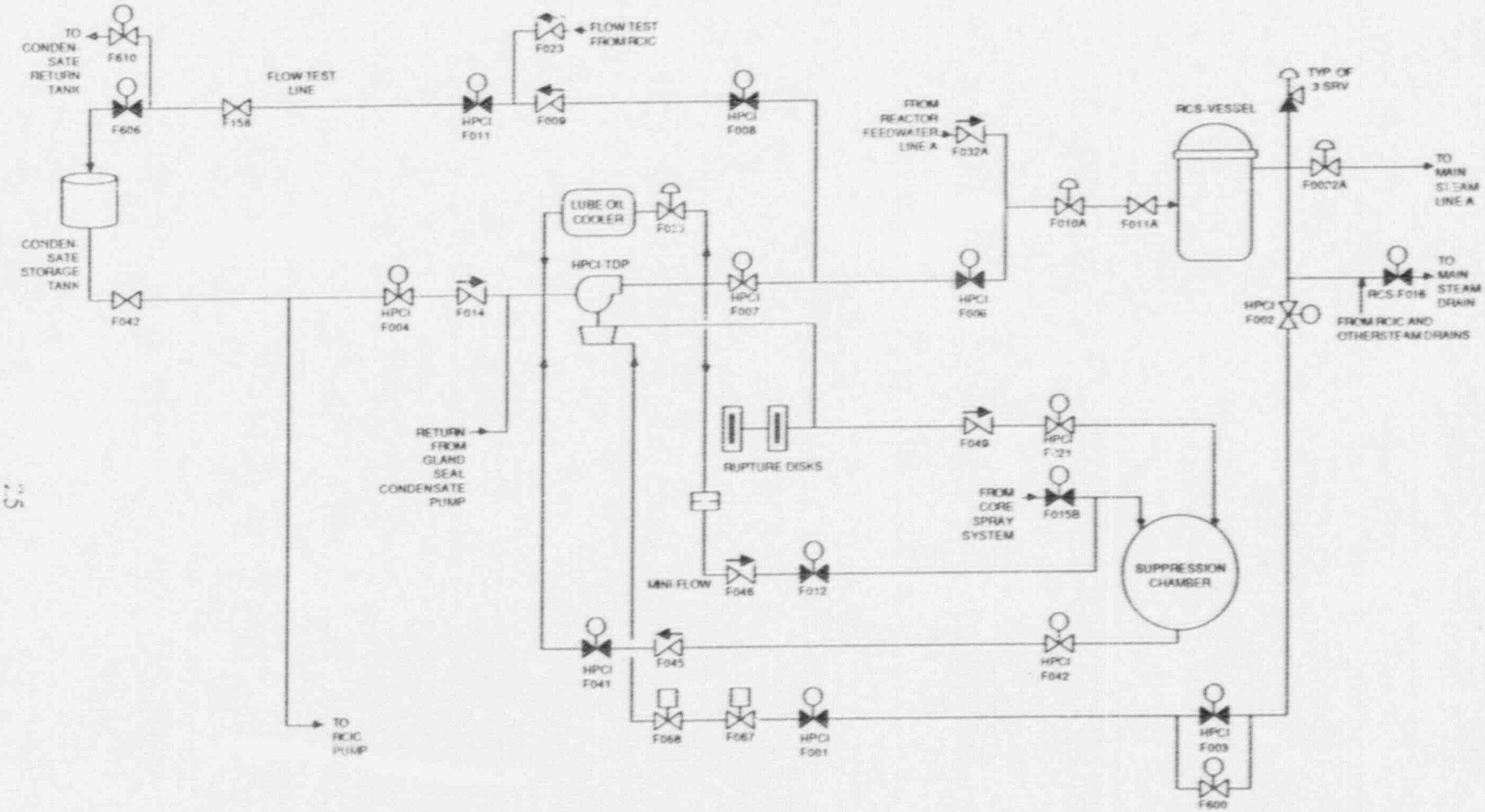
1. Pump room coolers served by the EECW system are provided for the following pump rooms in the reactor building:

   - North-west corner room : LPCI pumps A and C
   - South-west corner room : LPCI pumps B and D
   - North-east corner room : CS pumps A and C, RCIC pump
   - South-east corner room : CS pumps B and D

   One fan cooler unit is provided in each of the CS pump rooms and two fan cooler units are in each of the LPCI pump rooms. These fan cooler units are powered from 480 VAC Class 1E. The EECW supply to these room coolers is described in Section 3.7.
2. The source of HPCI pump room cooling has not been identified. The HPCI pump room is adjacent to the south-east room containing CS pumps B and D, and may share the CS room cooler.

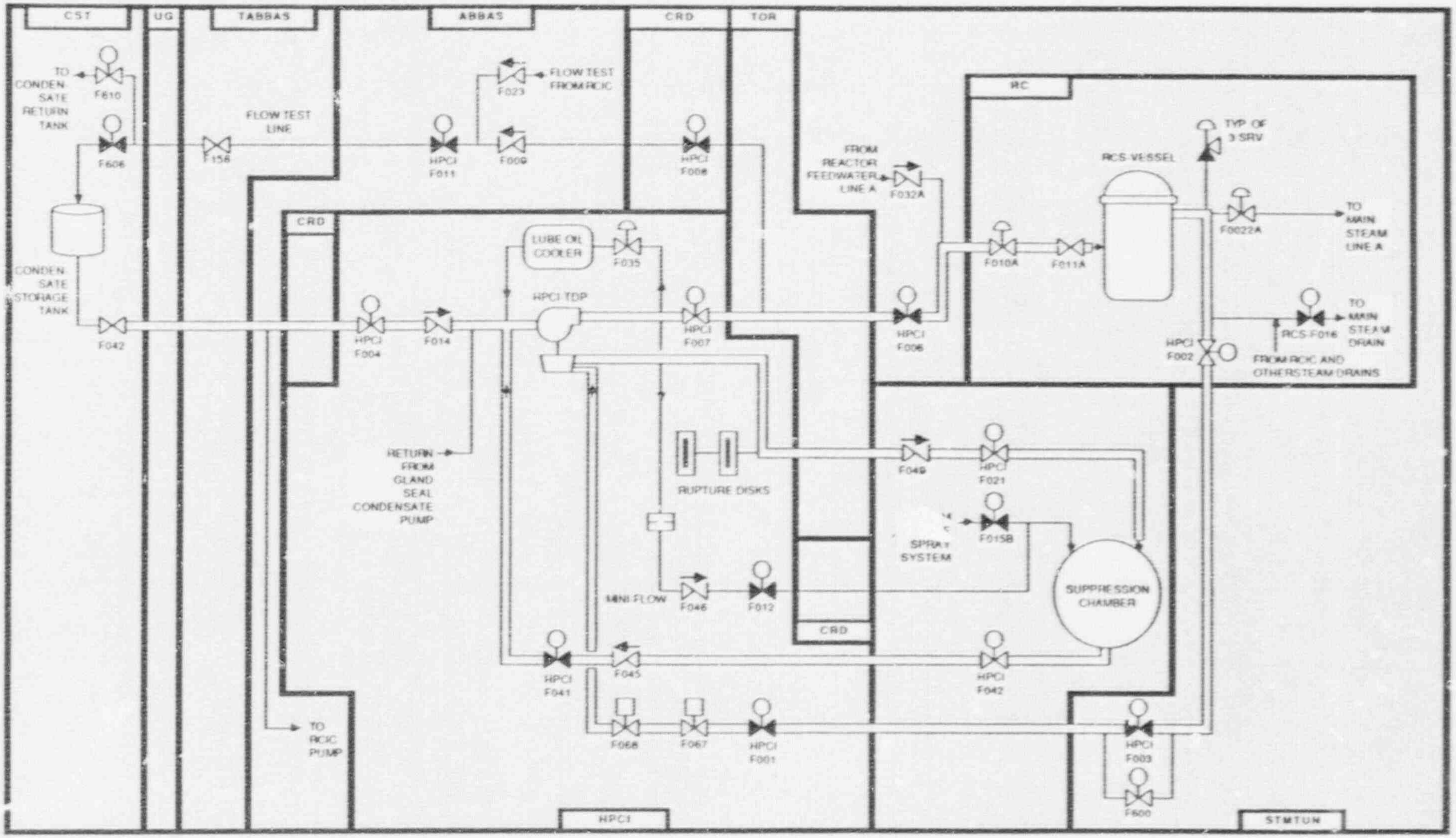
E. Other

1. The hydraulic steam turbine stop and governor valves (F067 and F068 respectively) are normally closed. These valves must be opened by a DC-powered auxiliary oil pump in order to start the HPCI pump. A shaft-driven oil pump provides hydraulic pressure to maintain these valves open once the HPCI pump is operating.
2. HPCI pump and valve leakoff is collected and condensed in a gland seal condenser. A condensate pump returns to the condensate to the HPCI pump suction. A vacuum pump maintains condenser vacuum. This vacuum pump exhaust to the standby gas treatment system.



NOTE: HPCI PUMP AND HPCI BOOSTER ARE SHOWN AS A SINGLE UNIT

Figure 3.3-1. Enrico Fermi Unit 2 High Pressure Coolant Injection (HPCI) System



NOTE: HPCI PUMP AND HPCI BOOSTER ARE SHOWN AS A SINGLE UNIT

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

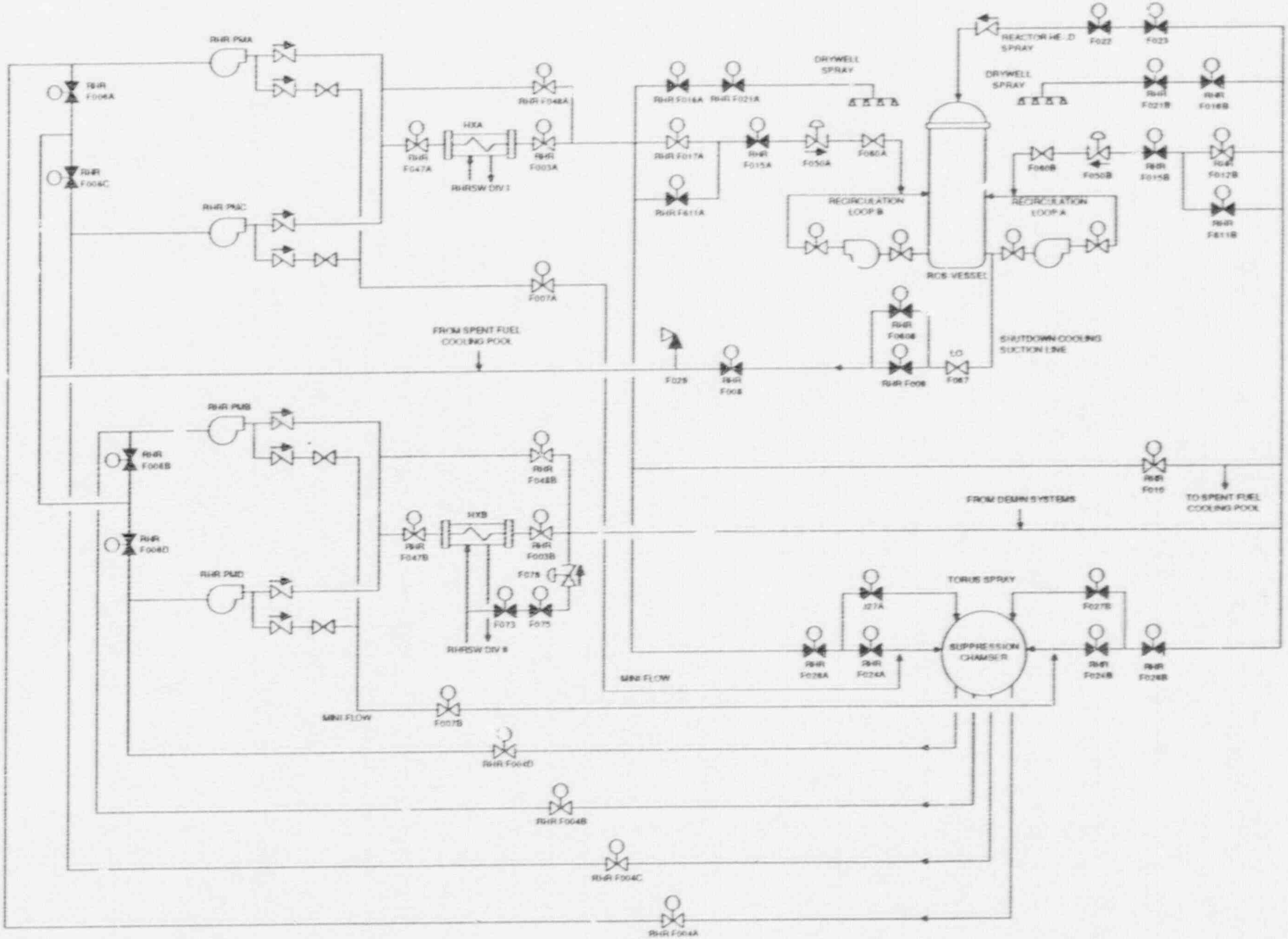


Figure 3.3-3. Enrico Fermi Unit 2 Low Pressure Coolant Injection (LPCI) System

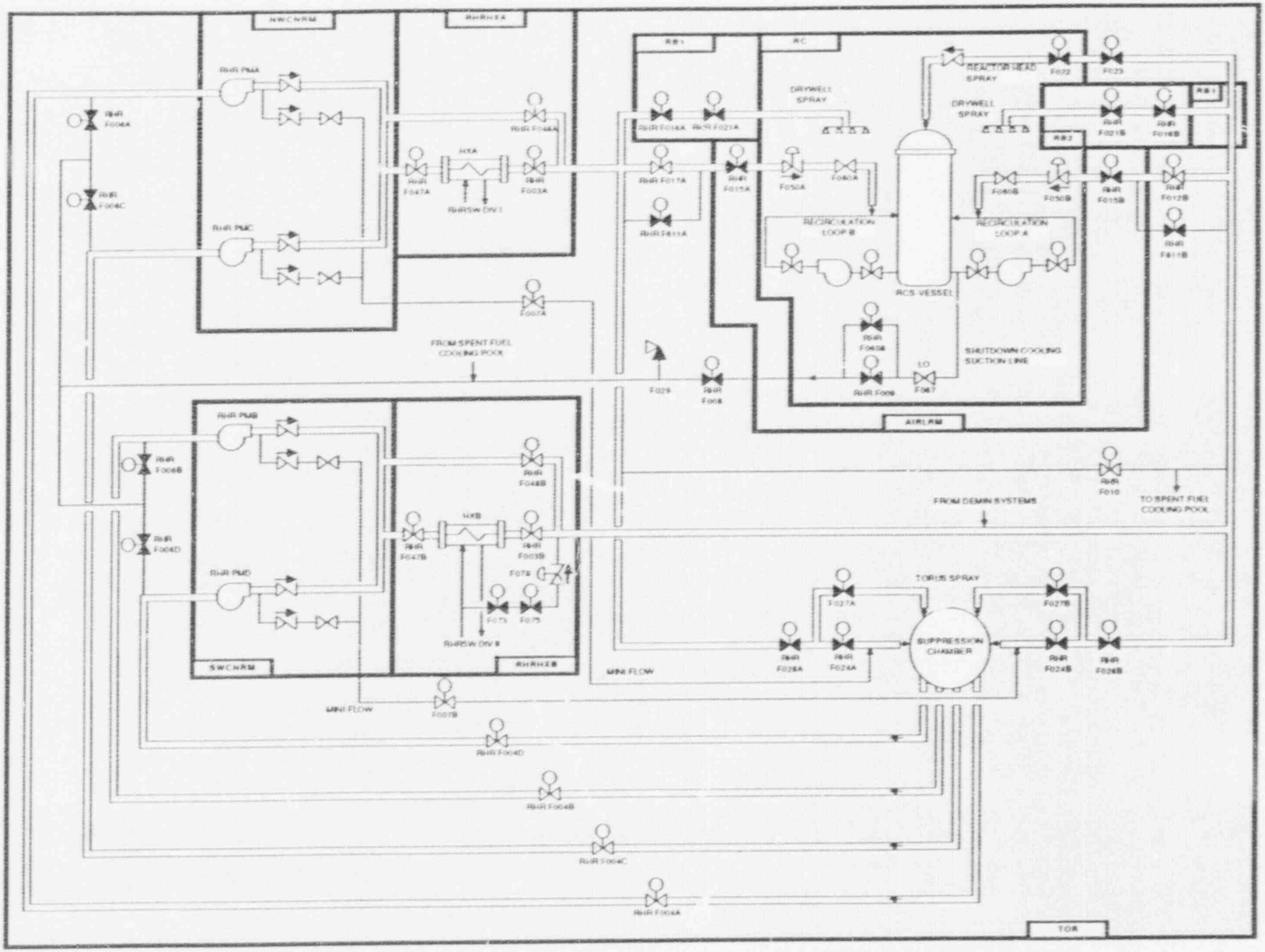


Figure 3.3-4. Enrico Fermi Unit 2 Low Pressure Coolant injection (LPCI) System Showing Component Locations

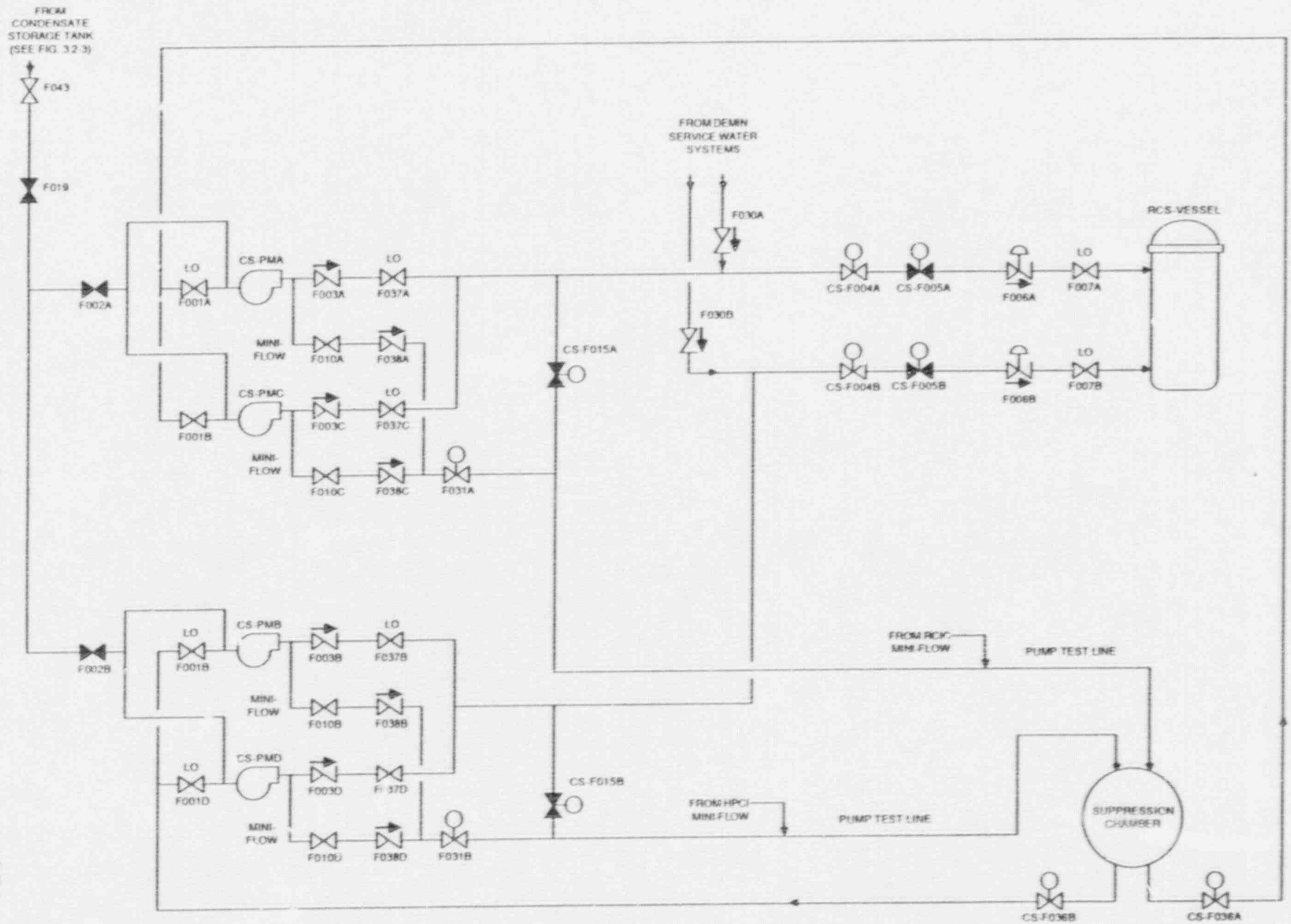


Figure 3.3-5. Enrico Fermi 2 Core Spray (CS) System

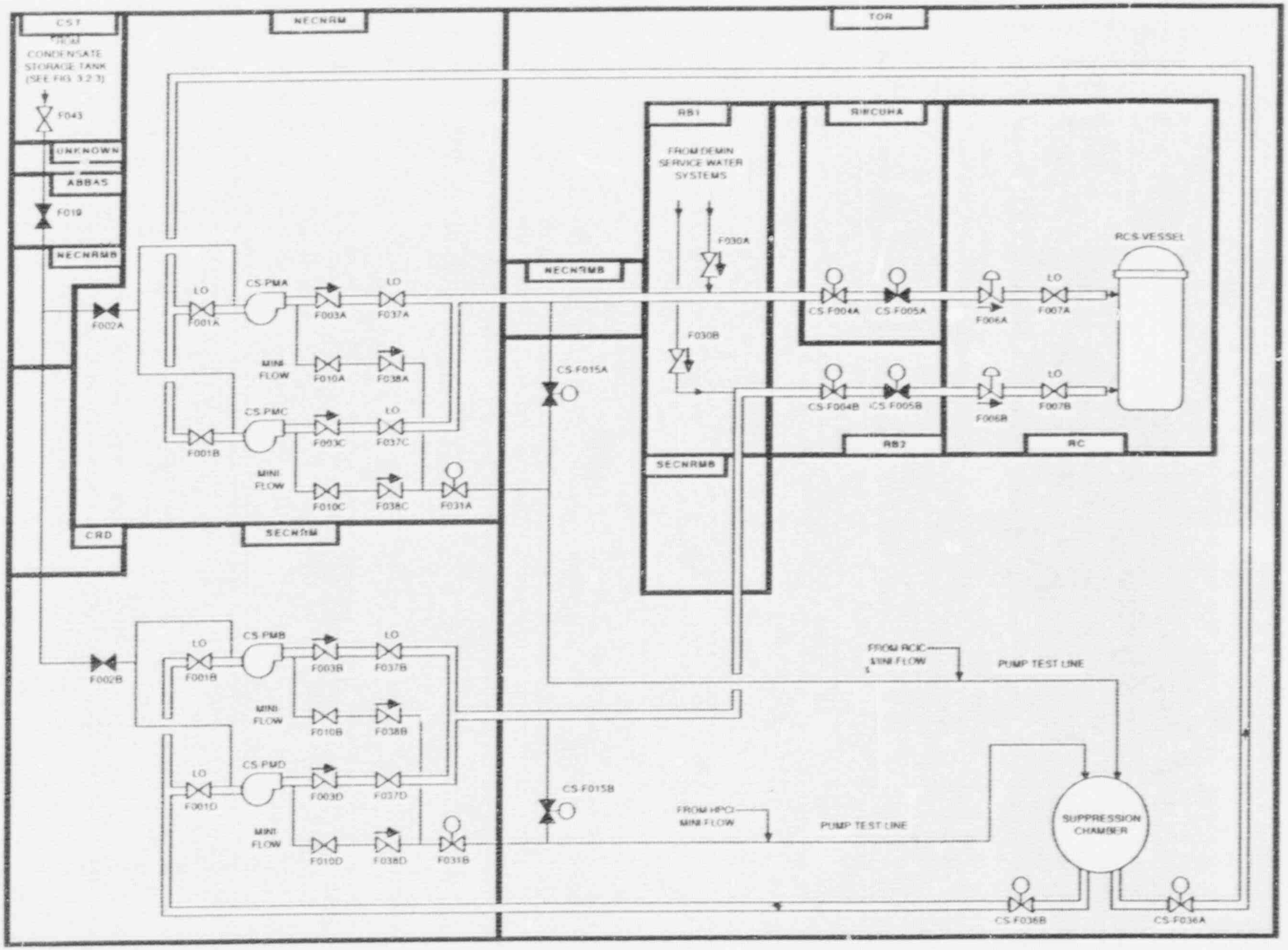


Figure 3.3-6. Enrico Fermi 2 Core Spray (CS) System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CS-F004A	MOV	RWCUHA	MCC72C-3A	480	RB2	AC/B
CS-F004B	MOV	RB2	MCC72F-4A	480	RB2	AC/D
CS-F005A	MOV	RWCUHA	MCC72C-3A	480	RB2	AC/B
CS-F005B	MOV	RB2	MCC72F-4A	480	RB2	AC/D
CS-F015A	MOV	TOR	MCC72B-3A	480	RB1	AC/A
CS-F015B	MOV	SECNRMB	MCC72E-5A	480	RB1	AC/C
CS-F036A	MOV	TOR	MCC72B-3A	480	RB1	AC/A
CS-F036B	MOV	TOR	MCC72E-5A	480	RB1	AC/C
CS-PMA	MDP	NECNRM	BUS-64B	4160	SWGRMAB	AC/A
CS-PMB	MDP	SECNRM	BUS-65E	4160	SWGRMCD	AC/C
CS-PMC	MDP	NECNRM	BUS-64C	4160	SWGRMAB	AC/B
CS-PMD	MDP	SECNRM	BUS-65F	4160	SWGRMCD	AC/D
HPCI-F001	MOV	HPCI	MCC-2PB1	260	DC1	DC/2
HPCI-F002	MOV	RC	MCC72C-3A	480	RB2	AC/B
HPCI-F003	MOV	STMTUN	MCC-2PB1	260	DC1	DC/2
HPCI-F004	MOV	HPCI	MCC-2PB1	260	DC1	DC/2
HPCI-F006	MOV	STMTUN	MCC-2PB1	260	DC1	DC/2
HPCI-F007	MOV	HPCI	MCC-2PB1	260	DC1	DC/2
HPCI-F008	MOV	CRD	MCC-2PB1	260	DC1	DC/2
HPCI-F011	MOV	ABBAS	MCC-2PB1	260	DC1	DC/2
HPCI-F021	MOV	TOR	MCC-2PB1	260	DC1	DC/2
HPCI-F041	MOV	HPCI	MCC-2PB1	260	DC1	DC/2
HPCI-F042	MOV	TOR	MCC-2PB1	260	DC1	DC/2
HPCI-TDP	TDP	HPCI				
RHR-F003A	MOV	RHRHXA				
RHR-F003B	MOV	RHRHXB	MCC72F-4A	480	RB2	AC/D
RHR-F004A	MOV	TOR	MCC72B-3A	480	RB2	AC/A

Table 3.3-1. Fermi 2 Emergency Core Cooling System Data Summary for Selected Components (continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RHR-F004B	MOV	TOR	MCC72E-5A	480	RB1	AC/C
RHR-F004C	MOV	TOR	MCC72C-3A	480	RB2	AC/B
RHR-F004D	MOV	TOR	MCC72F-4A	480	RB2	AC/D
RHR-F006A	MOV	TOR	MCC72B-3A	480	RB1	AC/A
RHR-F006B	MOV	TOR	MCC72E-5A	480	RB1	AC/C
RHR-F006C	MOV	TOR	MCC72C-3A	480	RB2	AC/B
RHR-F006D	MOV	TOR	MCC72F-4A	480	RB2	AC/D
RHR-F010	MOV	TOR	MCC72C-F	480	RB2	AC/B
RHR-F010	MOV	TOR	MCC72C-F	480	RB2	AC/B
RHR-F015A	MOV	AIRLRM	MCC72C-F	480	RB2	AC/B
RHR-F015B	MOV	AIRLRM	MCC72C-F	480	RB2	AC/B
RHR-F016A	MOV	RB1	MCC72C-3A	480	RB2	AC/B
RHR-F016B	MOV	RB2	MCC72F-4A	480	RB2	AC/D
RHR-F017A	MOV	TOR	MCC72C-F	480	RB2	AC/B
RHR-F017B	MOV	TOR	MCC72C-F	480	RB2	AC/B
RHR-F021A	MOV	RB1	MCC72C-3A	480	RB2	AC/B
RHR-F021B	MOV	RB2	MCC72F-4A	480	RB2	AC/D
RHR-F024A	MOV	TOR	MCC72B-3A	480	RB1	AC/A
RHR-F024B	MOV	TOR	MCC72E-5A	480	RB1	AC/C
RHR-F028A	MOV	TOR	MCC72B-3A	480	RB1	AC/A
RHR-F028B	MOV	TOR	MCC72E-5A	480	RB1	AC/C
RHR-F047A	MOV	RHRHXA	MCC72C-3A	480	RB2	AC/B
RHR-F047B	MOV	RHRHXB	MCC72F-4A	480	RB2	AC/D
RHR-F048A	MOV	RHRHXA	MCC72C-3A	480	RB2	AC/B
RHR-F048B	MOV	RHRHXB	MCC72F-4A	480	RB2	AC/D
RHR-F611A	MOV	TOR	MCC72B-3A	480	RB2	AC/A
RHR-F611B	MOV	TOR	MCC72E-5A	480	RB1	AC/C

Table 3.3-1. Fermi 2 Emergency Core Cooling System Data Summary for Selected Components (continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RHR-PMA	MDP	NWCNRM	BUS-64B	4160	SWGRMAB	AC/A
RHR-PMB	MDP	SWCNRM	BUS-65E	4160	SWGRMCD	AC/C
RHR-PMC	MDP	NWCNRM	BUS-64C	4160	SWGRMAB	AC/B
RHR-PMD	MDP	SWCNRM	BUS-65F	4160	SWGRMCD	AC/D
SUPP	TANK	TOR				

3.4 INSTRUMENTATION AND CONTROL (I&C) SYSTEMS

3.4.1 System Function

The instrumentation and control systems consist of the Reactor Protection System (RPS), Alternate Rod Insertion (ARI) System, other actuation and control systems, and systems for the display of plant information to the operators. The RPS monitors the reactor plant, and alerts the operator to take corrective action before specified limits are exceeded. The RPS will initiate an automatic reactor trip (scram) to rapidly shutdown the reactor when plant conditions exceed one or more specified limits. The ARI system will insert the control rods bypassing the RPS during an ATWS. The other actuation systems will automatically actuate various safety systems based on the specific limits or combinations of limits that are exceeded. A remote shutdown panel is provided to ensure that the reactor can be placed in a safe shutdown condition in the event that the main control room must be evacuated in an emergency.

3.4.2 System Definition

The RPS includes sensor and transmitter units, logic units, and output trip relays that interface with the control circuits for components in the scram portion of the Control Rod Drive Hydraulic System (see Section 3.6). The ARI components are redundant to the RPS. Other actuation and control systems include independent sensor and transmitter units and relay units that interface with the control circuits of many different components in safety systems. Operator instrumentation display systems consist of display panels that are powered from various DC buses (see Section 3.5).

3.4.3 System Operation

A. RPS

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

- Neutron monitoring system
- Reactor pressure
- Low water level in reactor vessel
- Turbine stop valve closure
- Turbine control valve fast closure
- Main steam line isolation signal
- Scram discharge header high water level
- Primary containment high pressure
- Main steam line radiation
- Main condenser low vacuum
- Scram valve pilot air header low pressure
- Manual

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

B. ARI

Upon receipt of a high reactor dome pressure or low water level-2, the ARI logic will actuate the ARI valves. Energizing these valves will depressurize the scram air header independent of the RPS logic and scram valves. Additionally this system will trip the recirculation pump motor generator field breaker. The insert signal is generated in two separate divisions (two-out-of-two logic in each division) energizing eight Class 1E DC valves to initiate the rod insertion

C. Other Actuation and Control Systems
Actuation and control systems cause the various safety systems to be started, stopped or realigned as needed to respond to abnormal plant conditions. Details regarding actuation logic are included in the system description of the actuated system.

D. Remote Shutdown
A remote shutdown panel is located on the 613'6" elevation of the Auxiliary Building. Remote controls are provided for the following equipment:

- RCIC system
  - Steam supply valve F045
  - Turbine trip and throttle valve F059
- RHR system
  - RHR pump 2A
  - RHR shutdown cooling suction valves F008 and F009
  - RHR valves F004A, F008A, F015A, F017A, F024A, F028A and F048A
- RHR service water system
  - RHR service water pumps A and C
  - Cooling tower fans A and C
  - RHRSW valve F068A
- Control rod drive pumps A and B
- Primary safety/relief valves F013A and F013B
- Recirculation loop isolation valve F023A

3.4.4 System Success Criteria

A. RPS
The RPS uses hindrance logic (normal = 1, trip = 0) in both the input and output logic. Therefore, a channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e. the channel has a fail-safe failure mode). A reactor scram will occur upon loss of control power to the RPS. A reactor scram is implemented by the scram pilot valves in the control rod drive hydraulic system (see Section 3.6). Details of the RPS for Fermi 2 have not been determined.

B. ARI
The ARI success criterion is that either of two divisions must generate a signal to initiate rod insertion. Note that the RPS and ARI are redundant.

C. Other Actuation Systems
A single component usually receives a signal from only one actuation system output train. Trains A and B must be available in order to automatically actuate their respective components. Actuation systems other than the RPS typically use hindrance input logic (normal = 1, trip = 0) and transmission output logic (normal = 0, trip = 1). In this case, an input channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e. the channel has a fail-safe failure mode). Control power is needed for the actuation system output channels to send an actuation signal. Note that there may be some actuation subsystems that utilize hindrance output logic. For these subsystems,

loss of control power will cause system or component actuation, as is the case with the RPS. Details of the other actuation systems for Fermi 2 have not been determined.

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

3.4.5 Support Systems and Interfaces

A. Control Power
   1. RPS
      The RPS is powered via motor-generator sets from the 260 VDC Class 1E electric power system.
   2. Operator instrumentation
      Specific power supplies for operator instrumentation systems were not identified. General instrumentation power sources are described in Section 3.5.

3.5 ELECTRIC POWER SYSTEM

3.5.1 System Function

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

3.5.2 System Definition

The onsite Class 1E AC electric power system consists of four diesel generators, eight 4160 VAC ESS buses, eight 480 VAC AC buses. The Class 1E plant DC power system consists of two 260/130 VDC batteries, two 130 VDC buses and two 260 VDC buses.

The Class 1E AC power distribution system is shown in Figures 3.5-1 and 3.5-2. The Class 1E DC power system is shown in Figures 3.5-3 to 3.5-6. A summary of data on selected electric power system components is presented in Table 3.5-1. A partial listing of electrical sources and loads is presented in Table 3.5-2.

3.5.3 System Operation

During normal operation, station auxiliary power is taken from the main generators through the unit station service transformer. During startup and shutdown, auxiliary power is supplied from the 345 kV system through the main transformers. Auxiliary power also is available from the 120 kV system. Upon loss of off-site power, or in response to an accident signal, the diesel generators are automatically started. If the 4160 VAC buses are deenergized, the diesel generators are automatically aligned to reenergize the Class 1E electric power system. The AC power system includes features which permit establishing cross-ties between the 4160 VAC buses and for providing a backup source of power to each 480 VAC buses.

The 260/130 VDC power system consists of two independent Class 1E batteries and buses, each serving two independent divisions (I and II). This system is shown in Figure 3.5-2. The system is designed to supply all required loads for 4 hours without recharging.

Each 260V battery is divided into two 130V batteries connected in series. Each 130V battery section has a battery charger connected in parallel to the respective battery. For each 260V battery, a 130V spare charger is provided to replace each of the normally connected chargers. The two 130V batteries and chargers in each division are the source of DC control power for that respective division. 260V DC is provided to appropriate DC motor-operated valves and other equipment in the HPCI and RCIC systems.

There also are 48 VDC and 24 VDC electric power systems to support various communications, instrumentation and annunciator loads.

Selected loads and components supplied by the Class 1E electric power system are listed in Table 3.5-2.

3.5.4 System Success Criteria

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

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

3.5.5 Component Information

A. Standby diesel generators (11, 12, 13, and 14)
   1. Power rating: 2850 kW continuous
   2. Rated voltage: 4160 VAC
   3. Manufacturer: Fairbanks Morse

B. Station batteries (2PA and 2PB)
   1. Type: unknown
   2. Cells: 120

3.5.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The standby diesel generators are automatically started on the following signals:
      - Degraded voltage on the 4160 VAC Class 1E system
      - Accident signal (drywell high pressure or RPV low water level)
   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
   The following auxiliaries are provided for the emergency diesel generator:
   1. Cooling
      The diesel generator service water system, which is part of the RHR service water system (see Section 3.8), provides for diesel cooling.
   2. Fueling
      A long-term diesel fuel supply is provided adjacent to each diesel in the RHR complex. This fuel supply is designed to support the operation of each diesel generator for seven days.
   3. Lubrication
      Each diesel generator has a self-contained lubrication system.
   4. Starting
      Two independent starting air systems are provided for each diesel generator.
   5. Control power
      The 260/130 VDC system provides control power for the diesels.
   6. Diesel room ventilation
      Diesel room fans are Class 1E loads that are powered from the 480 VAC diesel buses boards.

C. Switchgear and Battery Room Ventilation Systems
Details on the switchgear and battery room ventilation systems have not been determined.

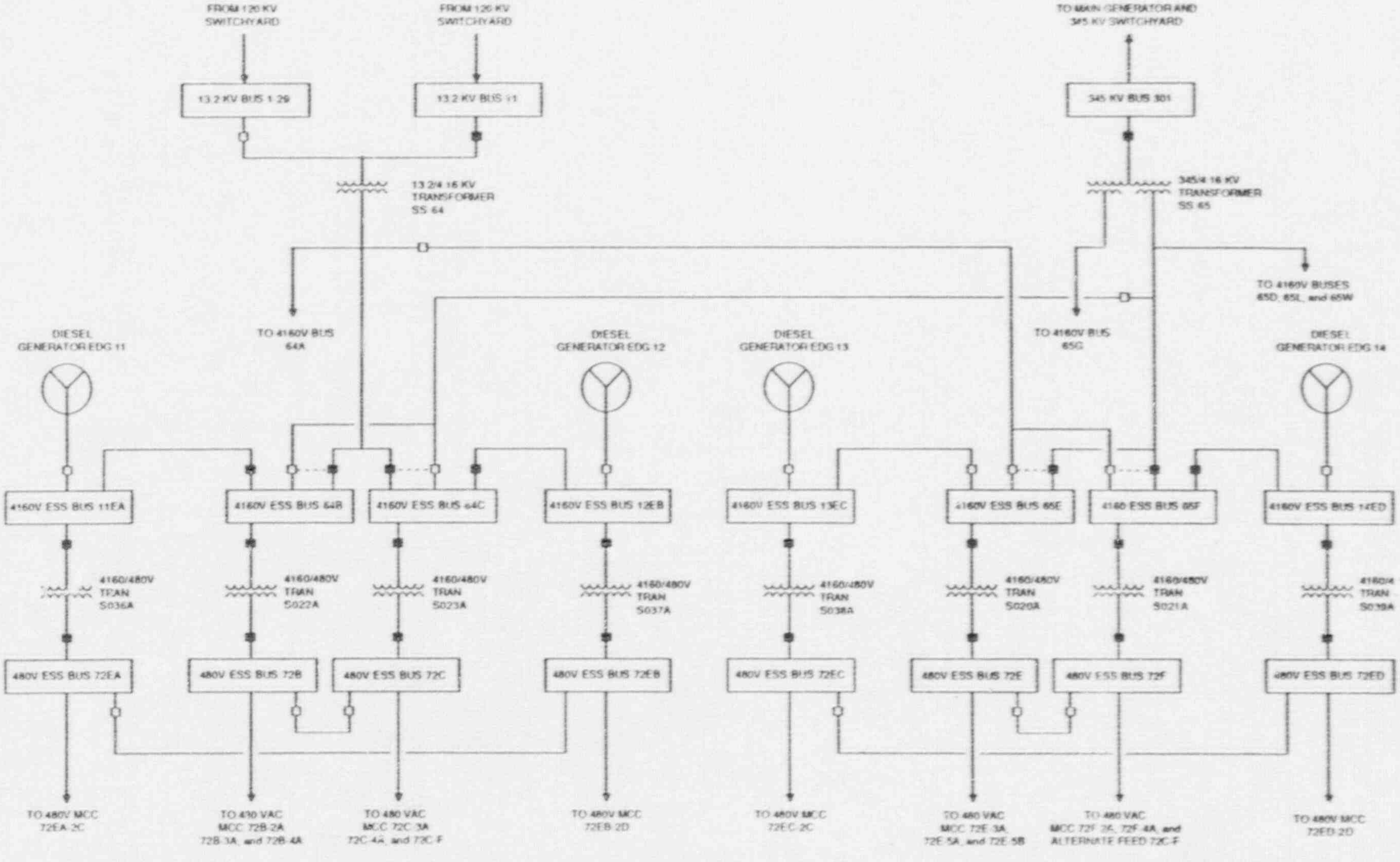


Figure 3.5-1. Enrico Fermi Unit 2 4160 and 480 VAC Electric Distribution System

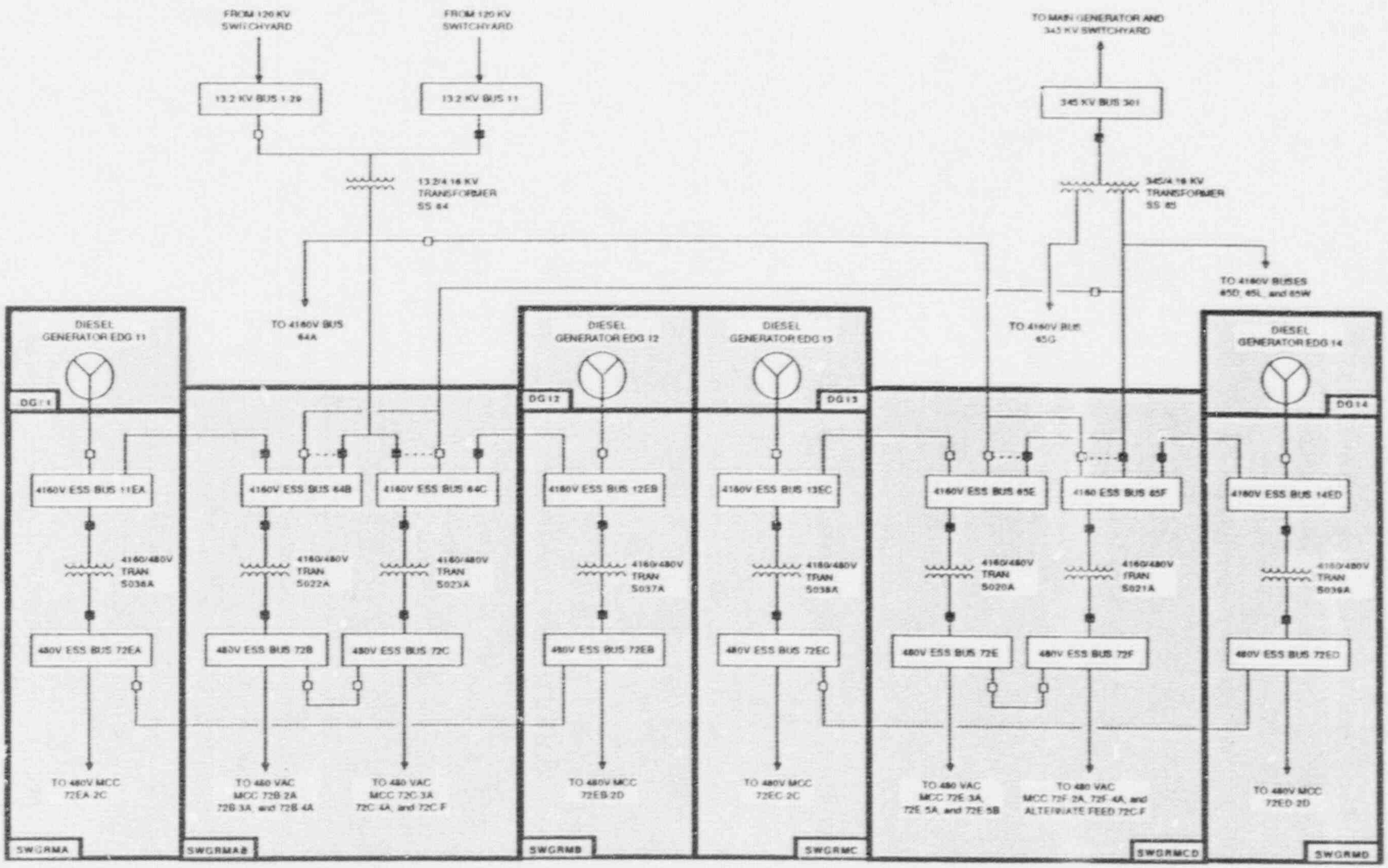


Figure 3.5-2. Enrico Fermi Unit 2 4160 and 480 VAC Electric Distribution System Showing Component Locations

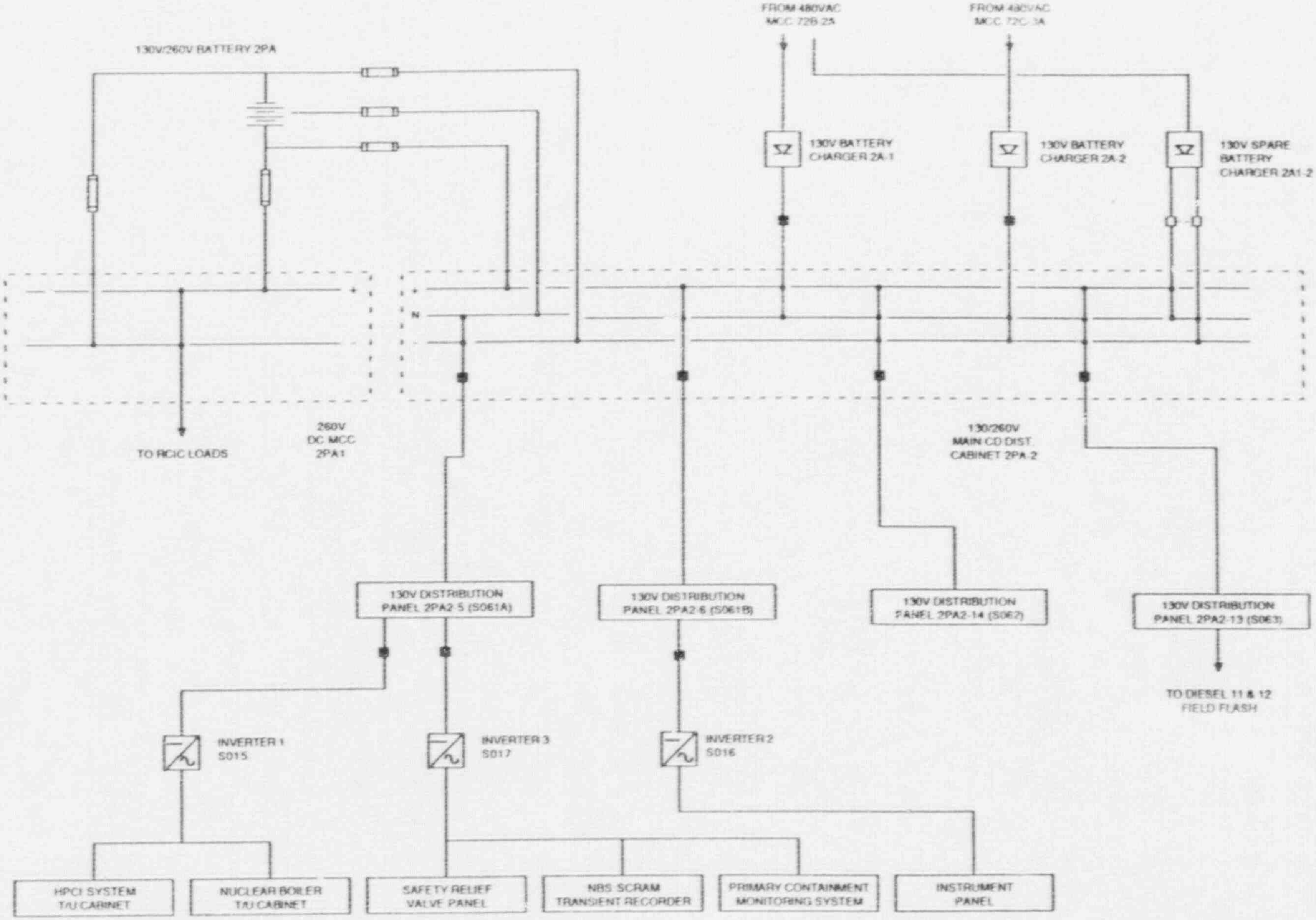


Figure 3.5-3. Enrico Fermi Unit 2 130V and 260V DC and 120 VAC Electric Power Distribution System, Division I

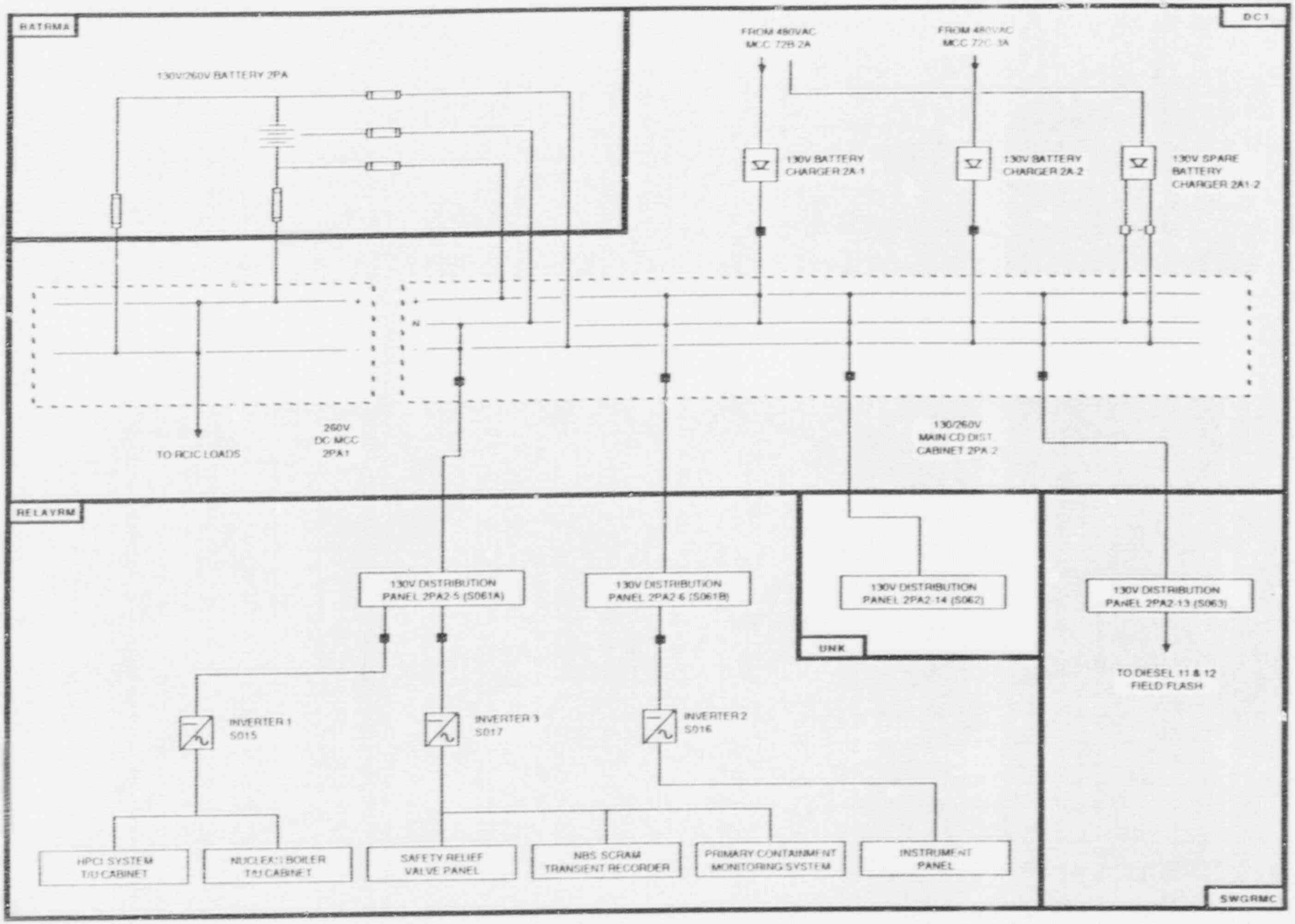


Figure 3.5-4. Enrico Fermi Unit 2 130V and 260V DC and 120 VAC Electric Power Distribution System, Division I Showing Component Locations

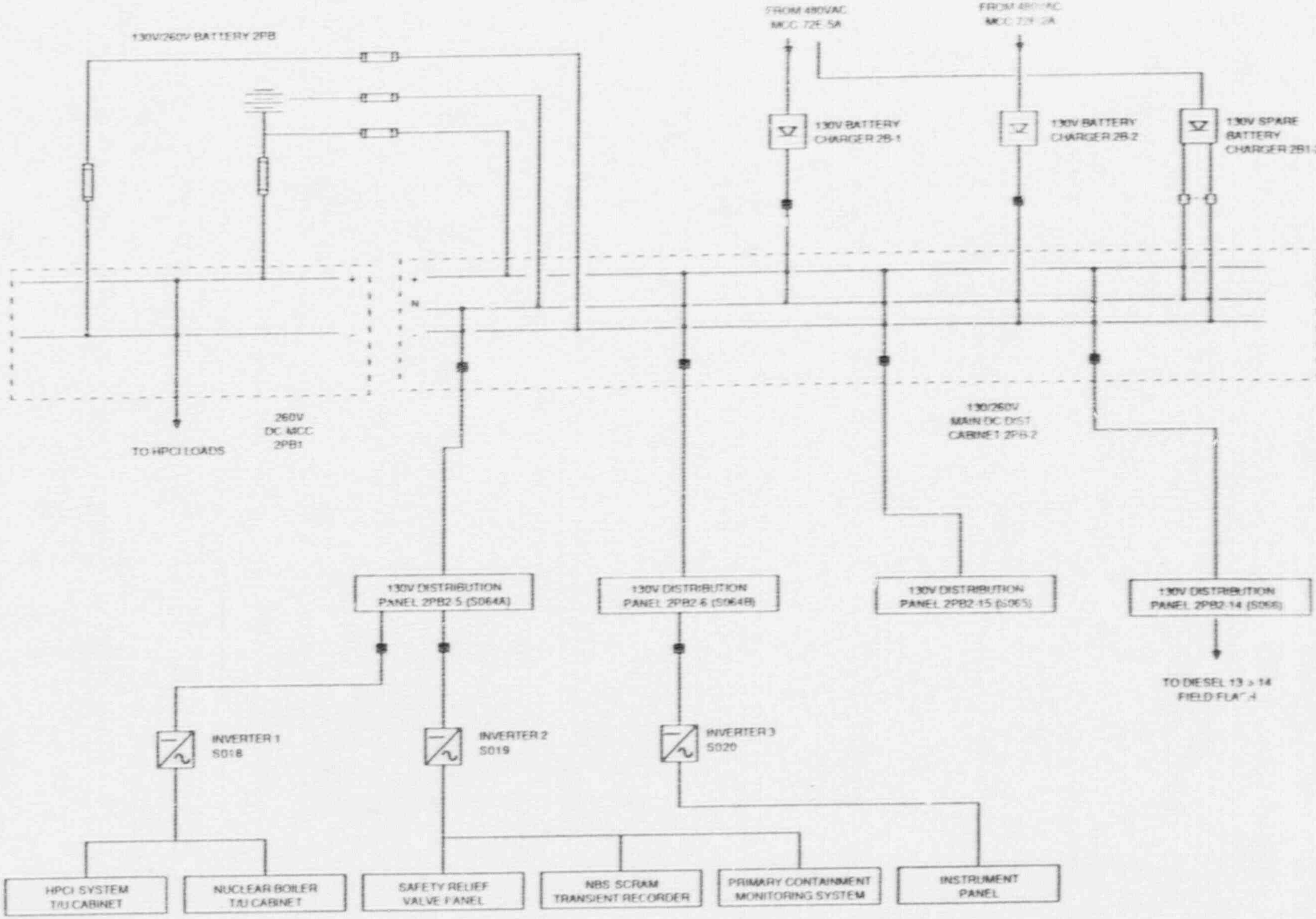


Figure 3.5-5. Enrico Fermi Unit 2 130V and 260V DC and 120 VAC Electric Power Distribution System, Division II

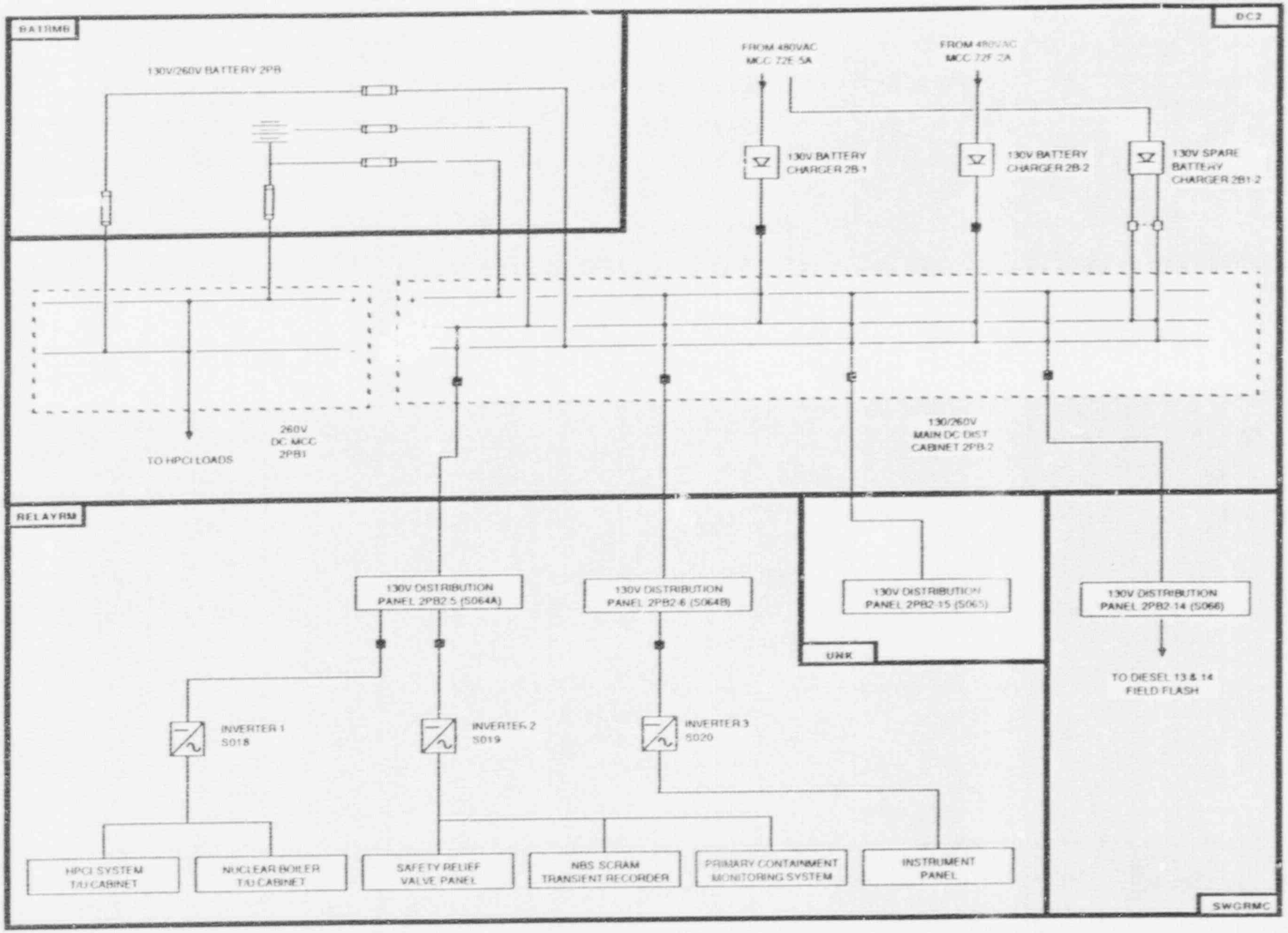


Figure 3.5-6. Enrico Fermi Unit 2 130V and 260V DC and 120 VAC Electric Power Distribution System, Division II Showing Component Locations

Table 3.5-1. Fermi 2 Electric Power System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
	PNL	RELAYRM	BUS-P2B2	120	DC2	DC/2
BAT-2PA	BATT	BATRMA		130		DC/1
BAT-2PB	BATT	BATRMB		130		DC/2
BATT-2PA	BATT	BATRMA		260		DC/1
BATT-2PB	BATT	BATRMB		260		DC/2
BC-2A-1	BC	DC1	MCC72B-2A	130	SWGRMAB	AC/A
BC-2A-2	BC	DC1	MCC72C-3A	130	RB2	AC/B
BC-2B-1	BC	DC2	MCC72E-5A	130	RB1	AC/C
BC-2B-2	BC	DC2	MCC72F-2A	130	SWGRMCD	AC/D
BUS-11EA	BUS	SWGRMA	DG-11	4160	DG11	AC/A
BUS-12EB	BUS	SWGRMB	DG-12	4160	DG12	AC/B
BUS-13EC	BUS	SWGRMC	DG-13	4160	DG13	AC/C
BUS-14ED	BUS	SWGRMD	DG-14	4160	DG14	AC/D
BUS-64B	BUS	SWGRMAB	BUS-11EA	4160	SWGRMA	AC/A
BUS-64C	BUS	SWGRMAB	BUS-12EB	4160	SWGRMB	AC/B
BUS-65F	BUS	SWGRMCD	BUS-14ED	4160	SWGRMD	AC/D
BUS-72B	BUS	SWGRMAB	S022A	480	SWGRMAB	AC/A
BUS-72C	BUS	SWGRMAB	S023A	480	SWGRMAB	AC/B
BUS-72E	BUS	SWGRMCD	S020B	480	SWGRMCD	AC/C
BUS-72EA	BUS	SWGRMA	S036A	480	SWGRMA	AC/A
BUS-72EB	BUS	SWGRMB	S037A	480	SWGRMB	AC/B
BUS-72EC	BUS	SWGRMC	S038A	480	SWGRMC	AC/C
BUS-72ED	BUS	SWGRMD	S039A	480	SWGRMD	AC/D
BUS-72F	BUS	SWGRMCD	S021A	480	SWGRMCD	AC/D
CB-11EA	CB	SWGRMA	DG-11	4160	DG11	AC/A
CB-12EB	CB	SWGRMB	DG-12	4160	DG12	AC/B
CB-13EC	CB	SWGRMC	DG-13	4160	DG13	AC/C

Table 3.5-1. Fermi 2 Electric Power System Data Summary for Selected Components (continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CB-14ED	CB	SWGRMD	DG-14	4160	DG14	AC/D
DG-11	DG	DG11		4160		AC/A
DG-12	DG	DG12		4160		AC/B
DG-13	DG	DG13		4160		AC/C
DG-14	DG	DG14		4160		AC/D
MCC-2PA1	MCC	DC1	BAT-2PA	260	BATRMA	DC/1
MCC-2PB1	MCC	DC2	BAT-2PB	260	BATRMB	DC/2
MCC72B-2A	MCC	SWGRMAB	BUS-72B	480	SWGRMAB	AC/A
MCC72B-3A	MCC	RB1	BUS-72B	480	SWGRMAB	AC/A
MCC72C-F	MCC	RB2	BUS-72C	480	SWGRMAB	AC/B
MCC72C-F	MCC	RB2	BUS-72F	480	SWGRMCD	AC/D
MCC72E-5A	MCC	RB1	BUS-72E	480	SWGRMCD	AC/C
MCC72EA	MCC	SWGRMA	BUS-72EA	480	SWGRMA	AC/A
MCC72EB	MCC	SWGRMB	BUS-72EB	480	SWGRMB	AC/B
MCC72EC	MCC	SWGRMC	BUS-72EC	480	SWGRMC	AC/C
MCC72ED	MCC	SWGRMD	BUS-72ED	480	SWGRMD	AC/D
MCC72F-2A	MCC	SWGRMCD	BUS-72F	480	SWGRMCD	AC/D
MCC72F-4A	MCC	RB2	BUS-72F	480	SWGRMCD	AC/D
S020B	XFMR	SWGRMCD	BUS-65E	4160	SWGRMCD	AC/C
S021A	XFMR	SWGRMCD	BUS-65F	4160	SWGRMCD	AC/D
S022A	XFMR	SWGRMAB	BUS-64B	4160	SWGRMAB	AC/A
S023A	XFMR	SWGRMAB	BUS-64C	4160	SWGRMAB	AC/B
S036A	XFMR	SWGRMA	BUS-11EA	480	SWGRMA	AC/A
S037A	XFMR	SWGRMB	BUS-12EB	480	SWGRMB	AC/B
S038A	XFMR	SWGRMC	BUS-13EC	480	SWGRMC	AC/C
S039A	XFMP	SWGRMD	BUS-14ED	480	SWGRMD	AC/D
S063	PNL	SWGRMA	BUS-2PA2	130	DC1	DC/1

Table 3.5-1. Fermi 2 Electric Power System Data Summary for Selected Components (continued)

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
S066	PNL	SWGRMC	BUS-2PB2	130	DC2	DC/2
BUS-65E	BUS	SWGRMCD	BUS-13EC	4160	SWGRMC	AC/C
MCC72C-3A	MCC	RB2	BUS-72C	480	SWGRMAB	AC/B

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Fermi Unit 2

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
BAT-2PA	130	DC/1	BATRMA	EP	BUS-2PA2	BUS	DC1
BAT-2PA	130	DC/1	BATRMA	EP	BUS-2PA2	BUS	DC1
BAT-2PA	260	DC/1	BATRMA	EP	MCC-2PA1	MCC	DC1
BAT-2PB	130	DC/2	BATRMB	EP	BUS-2PB2	BUS	DC2
BAT-2PB	130	DC/2	BATRMB	EP	BUS-2PB2	BUS	DC2
BAT-2PB	260	DC/2	BATRMB	EP	MCC-2PB1	MCC	DC2
BC-2A-1	130	DC1	DC1	EP	BUS-2PA2	BUS	DC1
BC-2A-1	130	DC/1	DC1	EP	BUS-2PA2	BUS	DC1
BC-2A-2	130	DC/1	DC1	EP	BUS-2PA2	BUS	DC1
BC-2A-2	130	DC/1	DC1	EP	BUS-2PA2	BUS	DC1
BC-2B-1	130	DC/2	DC2	EP	BUS-2PB2	BUS	DC2
BC-2B-1	130	DC2	DC2	EP	BUS-2PB2	BUS	DC2
BC-2B-2	130	DC/2	DC2	EP	BUS-2PB2	BUS	DC2
BC-2B-2	130	DC/2	DC2	EP	BUS-2PB2	BUS	DC2
BUS-11EA	4160	AC/A	SWGRMA	EP	BUS-64B	BUS	SWGRMAB
BUS-11EA	480	AC/A	SWGRMA	EP	S036A	XFMR	SWGRMA
BUS-11EA	4160	AC/A	SWGRMA	RHRSW	RHRSW-A	MDP	SWPM1
BUS-12EB	4160	AC/B	SWGRMB	EP	BUS-64C	BUS	SWGRMAB
BUS-12EB	480	AC/B	SWGRMB	EP	S037A	XFMR	SWGRMB
BUS-12EB	4160	AC/B	SWGRMB	RHRSW	RHRSW-C	MDP	SWPM1
BUS-13EC	480	AC/C	SWGRMC	EP	S038A	XFMR	SWGRMC
BUS-13EC	4160	AC/C	SWGRMC	EP	BUS-65E	BUS	SWGRMCD
BUS-13EC	4160	AC/C	SWGRMC	RHRSW	RHRSW-B	MDP	SWPM2
BUS-14ED	4160	AC/D	SWGRMD	EP	BUS-65F	BUS	SWGRMCD
BUS-14ED	480	AC/D	SWGRMD	EP	S039A	XFMR	SWGRMD
BUS-14ED	4160	AC/D	SWGRMD	RHRSW	RHRSW-D	MDP	SWPM2
BUS-2PA2	120	DC/1	DC1	EP		PNL	RELAYRM
BUS-2PA2	130	DC/1	DC1	EP	S063	PNL	SWGRMA
BUS-2PA2	130	DC/1	DC1	RCS	RCS-F019	MOV	STMTUN
BUS-2PB2	130	DC/2	DC2	EP	S066	PNL	SWGRMC
BUS-64B	4160	AC/A	SWGRMAB	ECCS	CS-PMA	MDP	NECNRM

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Fermi Unit 2 (continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
BUS-64B	4160	AC/A	SWGRMAB	ECCS	RHR-PMA	MDP	NWCNRM
BUS-64B	4160	AC/A	SWGRMAB	EP	S022A	XFMR	SWGRMAB
BUS-64C	4160	AC/B	SWGRMAB	ECCS	CS-PMC	MDP	NECNRM
BUS-64C	4160	AC/B	SWGRMAB	ECCS	RHR-PMC	MDP	NWCNRM
BUS-64C	4160	AC/B	SWGRMAB	EP	S023A	XFMR	SWGRMAB
BUS-65E	4160	AC/C	SWGRMCD	ECCS	CS-PMB	MDP	SECNRM
BUS-65E	4160	AC/C	SWGRMCD	ECCS	RHR-PMB	MDP	SWCNRM
BUS-65E	4160	AC/C	SWGRMCD	EP	S020B	XFMR	SWGRMCD
BUS-65F	4160	AC/D	SWGRMCD	ECCS	CS-PMD	MDP	SECNRM
BUS-65F	4160	AC/D	SWGRMCD	ECCS	RHR-PMD	MDP	SWCNRM
BUS-65F	4160	AC/D	SWGRMCD	EP	S021A	XFMR	SWGRMCD
BUS-72B	480	AC/A	SWGRMAB	EP	MCC72B-2A	MCC	SWGRMAB
BUS-72B	480	AC/A	SWGRMAB	EP	MCC72B-3A	MCC	RB1
BUS-72C	480	AC/B	SWGRMAB	EECW	EECW-PMPB	MDP	RB1
BUS-72C	480	AC/B	SWGRMAB	EP	MCC72C-F	MCC	RB2
BUS-72C	480	AC/B	SWGRMAB	EP	MCC72C-3A	MCC	RB2
BUS-72E	480	AC/C	SWGRMCD	EP	MCC72E-5A	MCC	RB1
BUS-72EA	480	AC/A	SWGRMA	EP	MCC72EA	MCC	SWGRMA
BUS-72EB	480	AC/B	SWGRMB	EP	MCC72EB	MCC	SWGRMB
BUS-72EB	480	AC/B	SWGRMB	RHRSW	EESW-2A	MDP	SWPM1
BUS-72EC	480	AC/C	SWGRMC	EP	MCC72EC	MCC	SWGRMC
BUS-72ED	480	AC/D	SWGRMD	EP	MCC72ED	MCC	SWGRMD
BUS-72ED	480	AC/D	SWGRMD	RHRSW	EESW-2B	MDP	SWPM2
BUS-72F	480	AC/D	SWGRMCD	EECW	EECW-PMPA	MDP	RB2
BUS-72F	480	AC/D	SWGRMCD	EP	MCC72C-F	MCC	RB2
BUS-72F	480	AC/D	SWGRMCD	EP	MCC72F-2A	MCC	SWGRMCD
BUS-72F	480	AC/D	SWGRMCD	EP	MCC72F-4A	MCC	RB2
BUS-P2B2	120	DC/2	DC2	EP		PNL	RELAYRM
DG-11	4160	AC/A	DG11	EP	BUS-11EA	BUS	SWGRMA
DG-11	4160	AC/A	DG11	EP	CB-11EA	CB	SWGRMA
DG-12	4160	AC/B	DG12	EP	BUS-12EB	BUS	SWGRMB

Table 5.5-2. Partial Listing of Electrical Sources and Loads at Fermi Unit 2 (continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
DG-12	4160	AC/B	DG12	EP	CB-12EB	CB	SWGRMB
DG-13	4160	AC/C	DG13	EP	BUS-13EC	BUS	SWGRMC
DG-13	4160	AC/C	DG13	EP	CB-13EC	CB	SWGRMC
DG-14	4160	AC/D	DG14	EP	BUS-14ED	BUS	SWGRMD
DG-14	4160	AC/D	DG14	EP	CB-14ED	CB	SWGRMD
MCC-2PA1	260	DC/1	DC1	RCIC	RCIC-F001	MOV	TOR
MCC-2PA1	260	DC/1	DC1	RCIC	RCIC-F006	MOV	STMTUN
MCC-2PA1	260	DC/1	DC1	RCIC	RCIC-F010	MOV	ABBAS
MCC-2PA1	260	DC/1	DC1	RCIC	RCIC-F012	MOV	NECNR&B
MCC-2PA1	260	DC/1	DC1	RCIC	RCIC-F013	MOV	STMTUN
MCC-2PA1	260	DC/1	DC1	RCIC	RCIC-F019	MOV	TOR
MCC-2PA1	260	DC/1	DC1	RCIC	RCIC-F022	MOV	ABBAS
MCC-2PA1	260	DC/1	DC1	RCIC	RCIC-F029	MOV	NECNRM
MCC-2PA1	260	DC/1	DC1	RCIC	RCIC-F031	MOV	NECNRM
MCC-2PA1	260	DC/1	DC1	RCIC	RCIC-F045	MOV	NECNRM
MCC-2PA1	260	DC/1	DC1	RCIC	RCIC-F059	MOV	NECNRM
MCC-2PA1	260	DC/1	DC1	RCS	RCIC-F008	MOV	STMTUN
MCC-2PA1	260	DC/1	DC1	RCS	RHR-F008	MOV	TOR
MCC-2PA1	260	DC/2	DC1	RCS	RXC-F004	MOV	RWCUHA
MCC-2PB1	260	DC/2	DC1	ECCS	HPCI-F001	MOV	HPCI
MCC-2PB1	260	DC/2	DC1	ECCS	HPCI-F003	MOV	STMTUN
MCC-2PB1	260	DC/2	DC1	ECCS	HPCI-F004	MOV	HPCI
MCC-2PB1	260	DC/2	DC1	ECCS	HPCI-F006	MOV	STMTUN
MCC-2PB1	260	DC/2	DC1	ECCS	HPCI-F007	MOV	HPCI
MCC-2PB1	260	DC/2	DC1	ECCS	HPCI-F008	MOV	CRD
MCC-2PB1	260	DC/2	DC1	ECCS	HPCI-F011	MOV	ABBAS
MCC-2PB1	260	DC/2	DC1	ECCS	HPCI-F021	MOV	TOR
MCC-2PB1	260	DC/2	DC1	ECCS	HPCI-F041	MOV	HPCI
MCC-2PB1	260	DC/2	DC1	ECCS	HPCI-F042	MOV	TOR
MCC-2PB1	260	DC/2	DC1	RCS	HPCI-F003	MOV	STMTUN
MCC72B-2A	130	AC/A	SWGRMAB	EP	BC-2A-1	BC	DC1

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Fermi Unit 2 (continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC72B-3A	480	AC/A	RB1	ECCS	CS-F015A	MOV	TOR
MCC72B-3A	480	AC/A	RB1	ECCS	CS-F036A	MOV	TOR
MCC72B-3A	480	AC/A	RB2	ECCS	RHR-F004A	MOV	TOR
MCC72B-3A	480	AC/A	RB1	ECCS	RHR-F006A	MOV	TOR
MCC72B-3A	480	AC/A	RB1	ECCS	RHR-F024A	MOV	TOR
MCC72B-3A	480	AC/A	RB1	ECCS	RHR-F028A	MOV	TOR
MCC72B-3A	480	AC/A	RB2	ECCS	RHR-F611A	MOV	TOR
MCC72B-3A	480	AC/A	RB1	RCS	RXC-F001	MOV	RC
MCC72B-4A	480	AC/A	RB1	RCS	RXC-F101	MOV	RC
MCC72C-3A	480	AC/B	RB2	ECCS	CS-F004A	MOV	RWCUHA
MCC72C-3A	480	AC/B	RB2	ECCS	CS-F005A	MOV	RWCUHA
MCC72C-3A	480	AC/B	RB2	ECCS	HPCI-F002	MOV	RC
MCC72C-3A	480	AC/B	RB2	ECCS	RHR-F004C	MOV	TOR
MCC72C-3A	480	AC/B	RB2	ECCS	RHR-F006C	MOV	TOR
MCC72C-3A	480	AC/B	RB2	ECCS	RHR-F016A	MOV	RB1
MCC72C-3A	480	AC/B	RB2	ECCS	RHR-F021A	MOV	RB1
MCC72C-3A	480	AC/B	RB2	ECCS	RHR-F047A	MOV	RHRHXA
MCC72C-3A	480	AC/B	RB2	ECCS	RHR-F048A	MOV	RHRHXA
MCC72C-3A	130	AC/B	RB2	EP	BC-2A-2	BC	DC1
MCC72C-3A	480	AC/B	RB2	RCS	HPCI-F002	MOV	RC
MCC72C-3A	480	AC/B	RB2	RCS	RCS-F016	MOV	RC
MCC72C-3A	480	AC/B	RB2	RCS	RHR-F009	MOV	RC
MCC72C-4A	480	AC/B	MCC72C-4A	RCS	RXC-F119	MOV	RWCUHA
MCC72C-F	480	AC/B	RB2	ECCS	RHR-F010	MOV	TOR
MCC72C-F	480	AC/B	RB2	ECCS	RHR-F010	MOV	TOR
MCC72C-F	480	AC/B	RB2	ECCS	RHR-F015A	MOV	AIRLRM
MCC72C-F	480	AC/B	RB2	ECCS	RHR-F015B	MOV	AIRLRM
MCC72C-F	480	AC/B	RB2	ECCS	RHR-F017A	MOV	TOR
MCC72C-F	480	AC/B	RB2	ECCS	RHR-F017B	MOV	TOR
MCC72E-3A	480	AC/C	RB1	RCS	RXC-F100	MOV	RC
MCC72E-3A	480	AC/C	RB1	RCS	RXC-F102	MOV	RC

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Fermi Unit 2 (continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC72E-3A	480	AC/C	RB1	RCS	RXC-F106	MOV	RC
MCC72E-5A	480	AC/C	RB1	ECCS	CS-F015B	MOV	SECNRMB
MCC72E-5A	480	AC/C	RB1	ECCS	CS-F03[illegible]B	MOV	TOR
MCC72E-5A	480	AC/C	RB1	ECCS	RHR-F004B	MOV	TOR
MCC72E-5A	480	AC/C	RB1	ECCS	RHR-F006B	MOV	TOR
MCC72E-5A	480	AC/C	RB1	ECCS	RHR-F024B	MOV	TOR
MCC72E-5A	480	AC/C	RB1	ECCS	RHR-F028B	MOV	TOR
MCC72E-5A	480	AC/C	RB1	ECCS	RHR-F611B	MOV	TOR
MCC72E-5A	130	AC/C	RB1	EP	BC-2B-1	BC	DC2
MCC72EA	480	AC/A	SWGRMA	RHRSW	DG-F603A	MOV	SWPM1
MCC72EA	480	AC/A	SWGRMA	RHRSW	DG-F604A	MOV	SWPM1
MCC72EA	480	AC/A	SWGRMA	RHRSW	DG-PMPA	MDP	SWPM1
MCC72EB	480	AC/B	SWGRMB	RHRSW	DG-F605A	MOV	SWPM1
MCC72EB	480	AC/B	SWGRMB	RHRSW	DG-PMPC	MDP	SWPM1
MCC72EC	480	AC/C	SWGRMC	RHRSW	DG-F603B	MOV	SWPM2
MCC72EC	480	AC/C	SWGRMC	RHRSW	DG-F604B	MOV	SWPM2
MCC72EC	480	AC/C	SWGRMC	RHRSW	DG-PMPB	MDP	SWPM2
MCC72ED	480	AC/D	SWGRMD	RHRSW	DG-F605B	MOV	SWPM2
MCC72ED	480	AC/D	SWGRMD	RHRSW	DG-PMPD	MDP	SWPM2
MCC72F-2A	130	AC/D	SWGRMCD	EP	BC-2B-2	BC	DC2
MCC72F-4A	480	AC/D	RB2	ECCS	CS-F004B	MOV	RB2
MCC72F-4A	480	AC/D	RB2	ECCS	CS-F005B	MOV	RB2
MCC72F-4A	480	AC/D	RB2	ECCS	RHR-F003B	MOV	RHRHXB
MCC72F-4A	480	AC/D	RB2	ECCS	RHR-F004D	MOV	TOR
MCC72F-4A	480	AC/D	RB2	ECCS	RHR-F006D	MOV	TOR
MCC72F-4A	480	AC/D	RB2	ECCS	RHR-F016B	MOV	RB2
MCC72F-4A	480	AC/D	RB2	ECCS	RHR-F021B	MOV	RB2
MCC72F-4A	480	AC/D	RB2	ECCS	RHR-F047B	MOV	RHRHXB
MCC72F-4A	480	AC/D	RB2	ECCS	RHR-F048B	MOV	RHRHXB
MCC72F-4A	480	AC/D	RB2	RCIC	RCIC-F007	MOV	RC
MCC72F-4A	480	AC/D	RB2	RCS	RCIC-F007	MOV	RC

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Fermi Unit 2 (continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC 72F-4A	480	AC/D	RB2	RCS	RHR-MO608	MOV	RC
S020B	480	AC/C	SWGRMCD	EP	BUS-72E	BUS	SWGRMCD
S021A	480	AC/D	SWGRMCD	EP	BUS-72F	BUS	SWGRMCD
S022A	480	AC/A	SWGRMAB	EP	BUS-72B	BUS	SWGRMAB
S023A	480	AC/B	SWGRMAB	EP	BUS-72C	BUS	SWGRMAB
S036A	480	AC/A	SWGRMA	EP	BUS-72EA	BUS	SWGRMA
S037A	480	AC/B	SWGRMB	EP	BUS-72EB	BUS	SWGRMB
S038A	480	AC/C	SWGRMC	EP	BUS-72EC	BUS	SWGRMC
S039A	480	AC/D	SWGRMD	EP	BUS-72ED	BUS	SWGRMD

3.6 CONTROL ROD DRIVE HYDRAULIC SYSTEM (CRDHS)

3.6.1 System Function

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

3.6.2 System Definition

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

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

3.6.3 System Operation

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

A reactor scram is implemented by pneumatic scram valves in the CRDHS. An inlet scram valve opens to align the insert side of each control rod drive mechanism (CRDM) to its scram accumulator. An outlet scram valve opens to vent the opposite side of each CRDM to the dump tank (or discharge volume). This coordinated action results in rapid insertion of control rods into the reactor. At Fermi 2, the Alternate Rod Insertion (ARI) System also can initiate a reactor scram.

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

3.6.4 System Success Criteria

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

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

3.6.5 Component Information

A. Control rod drive pumps (2)
   1. Rated capacity: 100% (for control rod drive function)
   2. Flow rate: 120 gpm @ 3460 ft. head (1500 psid)
   3. Type: centrifugal

B. Condensate Storage Tank
   1. Capacity: 600,000 gal.

3.6.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. The RPS transmits scram commands to solenoid pilot valves which control the pneumatic scram valves. The RPS also controls the backup scram valves.
      b. The ARI System actuates independent ARI valves which cause a scram.

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

B. Motive Power
   The power sources for the control rod drive pumps were not identified.

3.6.7 Section 3.6 References

1. NEDO-24708A, "Additional Information Required for NRC Staff Generic Report on Boiling Water Reactors," General Electric Company, December 1980.
2. NUREG-0626, "Generic Evaluation of Feedwater Transients and Small Break Loss-of-Coolant-Accidents in GE-designed Operating Plants and Near-term Operating License Applications," USNRC, January 1980.
3. Harrington, R.M., and Ott, L.J., "The Effect of Small-Capacity, High-Pressure Injection Systems on TQUV Sequences at Browns Ferry Unit One," NUREG/CR-3179, Oak Ridge National Laboratory, September 1983.

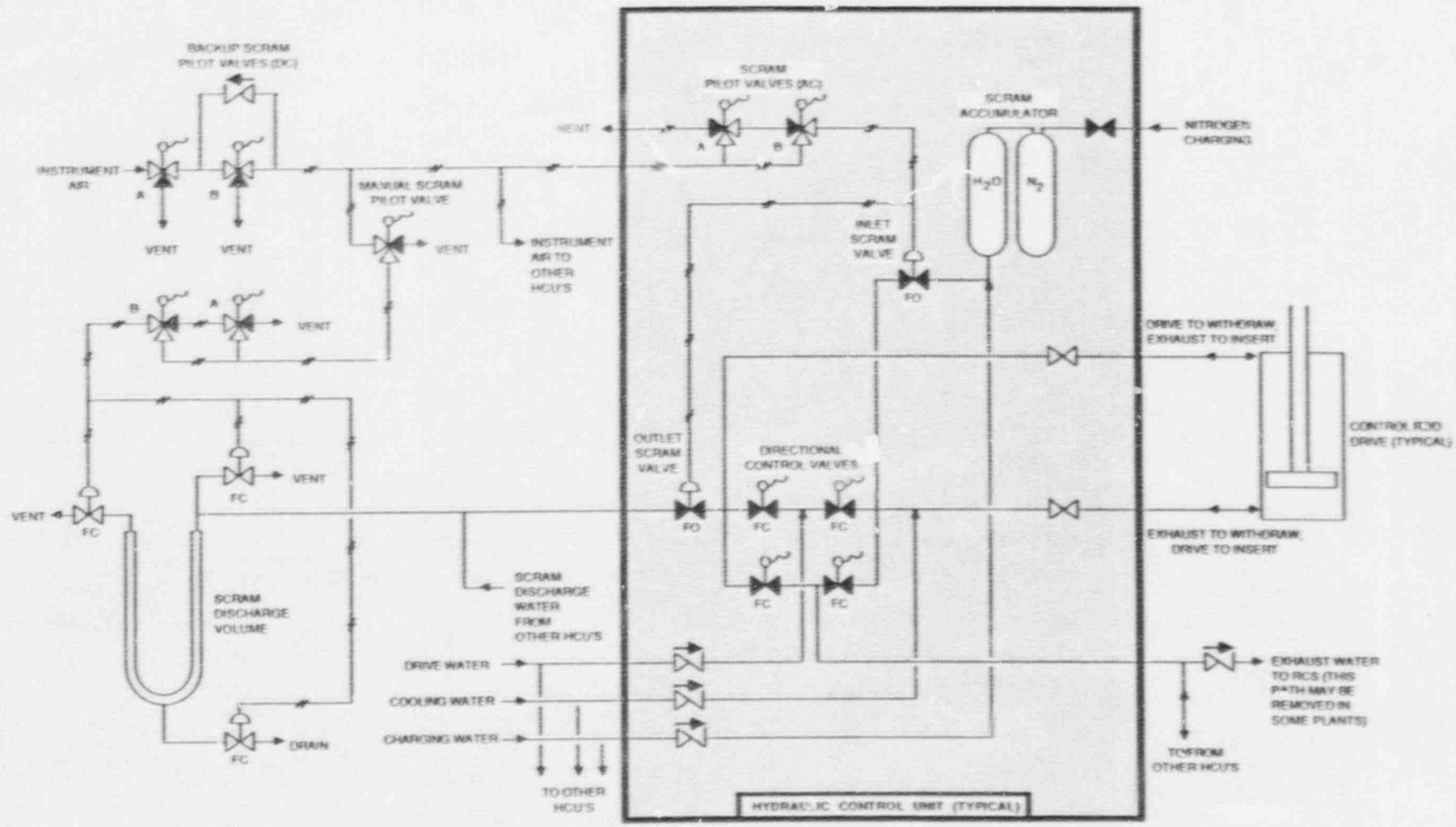


Figure 3.6-1. Simplified Diagram Of Portions Of The Control Rod Drive Hydraulic System That Are Related To The Scram Function

3.7 EMERGENCY EQUIPMENT COOLING WATER (EECW) SYSTEM

3.7.1 System Function

The EECW is a closed loop cooling water system that provides cooling water to various component heat loads in the plant including the RHR and CSS pump room cooler, RHR pump seal coolers and various other heat loads. The EECW system serves as a backup (upon loss of power) to the Reactor Building Closed Cooling Water (RBCCW) system.

3.7.2 System Definition

The EECW system consists of two loops each powered by a separate division which upon loss of power are isolated from the RBCCW system. Each loop consists of a pump and a heat exchanger which is cooled by the Residual Heat Removal Service Water (RHRSW) System (Section 3.8). Simplified drawings of each loop are shown in Figures 3.7-1 and 3.7-2.

3.7.3 System Operation

During normal operation each EECW division is isolated from the RBCCW system and are in a standby mode. Upon loss of off-site power, both divisions of the EECW are automatically actuated. The EECW pumps start and valves isolate the nonessential portions of the RBCCW system.

The EECW make-up tanks are supplied automatically from the demineralized makeup water system.

3.7.4 System Success Criteria

The EECW success criteria are defined on a per division basis. If cooling to equipment in a particular division is required, the EECW pump in that division must operate, there must be an intact closed loop flow path from the pump to the heat loads and back through the EECW heat exchanger, and cooling for the heat exchanger must be provided by the corresponding RHRSW division (see Section 3.8).

3.7.5 Component Information

A. EECW pumps (A and B)
   1. Rated flow: 1450 gpm @ 158 ft. head (68 psid)
   2. Type: horizontal centrifugal

B. EECW heat exchanger (HX-1 and HX-2)
   1. Heat transfer duty: 10.84×10^6 Btu/hr
   2. Type: Two-pass, U-tube

3.7.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The EECW pumps automatically start on:
      - Loss of off-site power
      - Loss of pressure on the RBCCW

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

B. Motive Power
The EECW pumps and valves are Class 1E AC loads powered from the diesel generators.

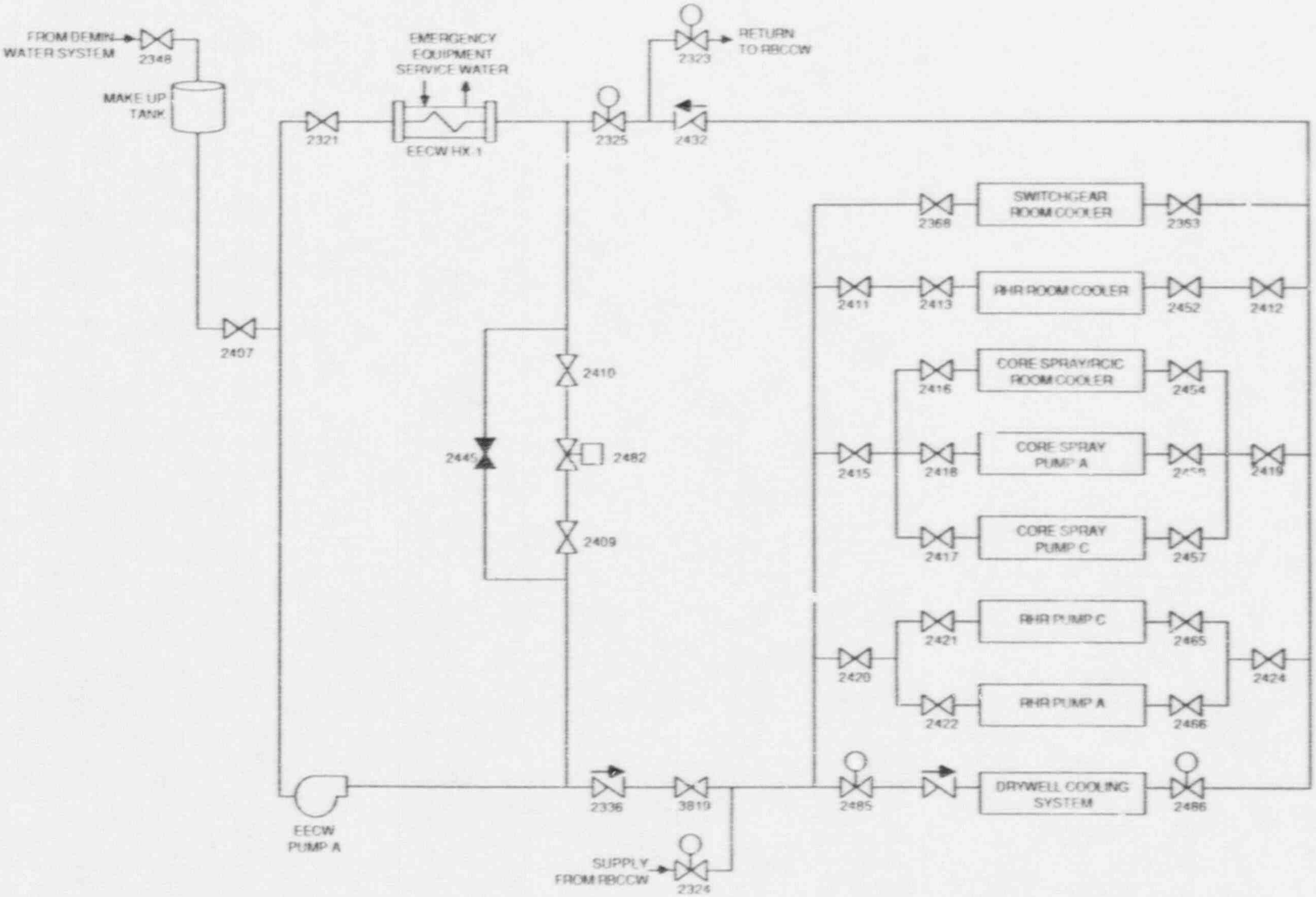


Figure 3.7-1. Enrico Fermi Unit 2 Emergency Equipment Cooling Water (EECW) System, Division I

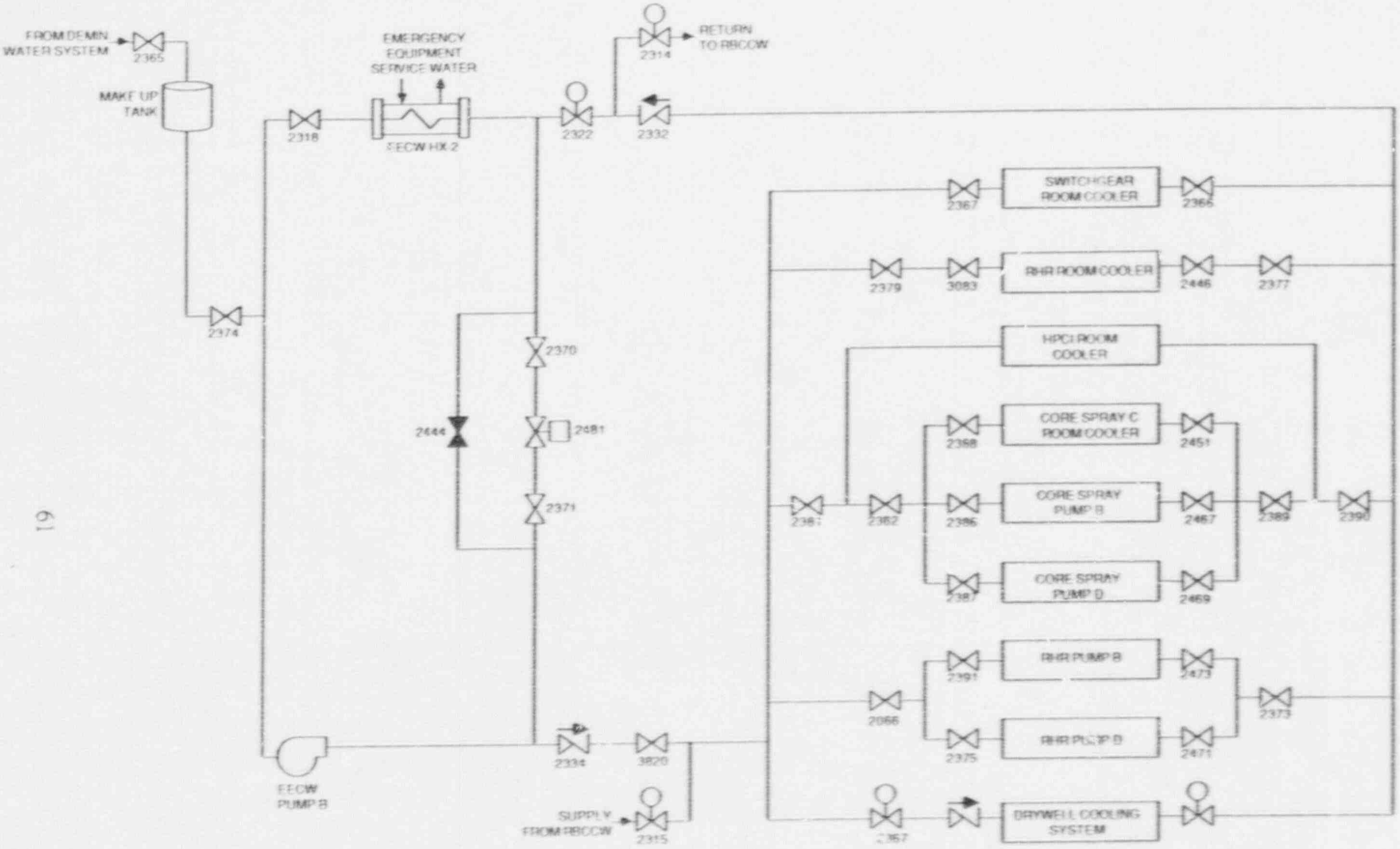


Figure 3.7-2. Enrico Fermi Unit 2 Emergency Equipment Cooling Water (EECW) System, Division II

Table 3.7-1. Fermi 2 Emergency Equipment Cooling Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
EECW-HX-1	HX	RB2				
EECW-HX-2	HX	RB2				
EECW-PMPA	MDP	RB2	BUS-72F	480	SWGRMCD	AC/D
EECW-PMPB	MDP	RB2	BUS-72C	480	SWGRMAB	AC/B

3.8 SERVICE WATER SYSTEMS

3.8.1 System Function

The service water systems encompasse three systems that provide cooling water to the RHR system, the EECW system, and the emergency diesel generators. The system has dedicated loops for each function to provide cooling water from the ultimate heat sink (RHR reservoir) to each heat source and return to the reservoir via mechanical draft cooling towers.

3.8.2 System Definition

The service water system consists of ten motor driven service pumps (five for each division) that take a suction from the RHR reservoir and supply water to the RHR heat exchangers, each diesel generator cooling system, and the EECW heat exchangers. The water returns to the reservoir through four mechanical draft cooling towers (two for each division). Simplified diagrams of the diesel and emergency equipment service water (EESW) subsystems are shown in Figures 3.8-1 and 3.8-2. Similar diagrams for the RHR service water subsystem are shown in Figures 3.8-3 and 3.8-4.

3.8.3 System Operation

The RHR complex contains the ultimate heat sink as well as the pumps for the RHRSW, the EESW, and diesel generator service water systems and the mechanical draft cooling towers.

Diesel generator cooling is supplied to each diesel generator by its own dedicated pump. Supply lines for each diesel are independent. The service water pumps for the diesels start and stop automatically in conjunction with its own diesel. Water is returned to the reservoir and cooled by the mechanical draft cooling fans.

The RHRSW pumps supply water from the reservoir to the shell side of the RHR heat exchanger.

Dedicated EESW pumps are started automatically upon loss of off-site power and provide cooling water to the EECW heat exchangers for ventilation cooling.

3.8.4 System Success Criteria

The service water system success criteria are defined for each heat load served. The diesel generators and EECW heat exchangers are served by dedicated EESW system pumps. For these components to receive adequate cooling their corresponding system pump must operate with an intact flow path. Each RHR heat exchanger is served by two RHRSW pumps. Both pumps are required for adequate cooling.

3.8.5 Component Information

A. RHR Service Water Pumps (A, B, C and D)
   1. Rated flow: 4500 gpm @ 185 ft. head (80 psid)
   2. Rated capacity: 50%
   3. Type: vertical turbine

B. Emergency Equipment Service Water Pumps (A and B)
   1. Rated flow: 1500 gpm @ 145 ft. head (63 psid)
   2. Rated capacity: 100%
   3. Type: vertical turbine

C. Diesel Generator Service Water Pumps (A, B, C and D)
  1. Rated flow: 800 gpm @ 115 ft. head (50 psid)
  2. Rated capacity: 100%
  3. Type: vertical turbine

D. Ultimate Heat Sink (two reservoirs)
  1. Capacity: 3.45×10^6 gallons
  2. 30 day cooling capacity

E. Mechanical Draft Cooling Towers (2 towers)
  1. Type: Induced draft
  2. Cells: 2 per tower
  3. Capacity: 100%
  4. Design Heat Load: 160×10^6 Btu/hr

3.8.6 Support Systems and Interfaces

A. Control Signals
  1. Automatic
     The diesel generator service water pumps and the EESW pumps are automatically started when its associated diesel is started.
  2. Remote manual
     The RHRSW pumps are placed in service by remote manual means from the control rooms. Any of the other pumps can be operated from the control room.

B. Motive Power
   All the service water pumps and valve are Class 1E AC loads powered from the associated diesel generator.

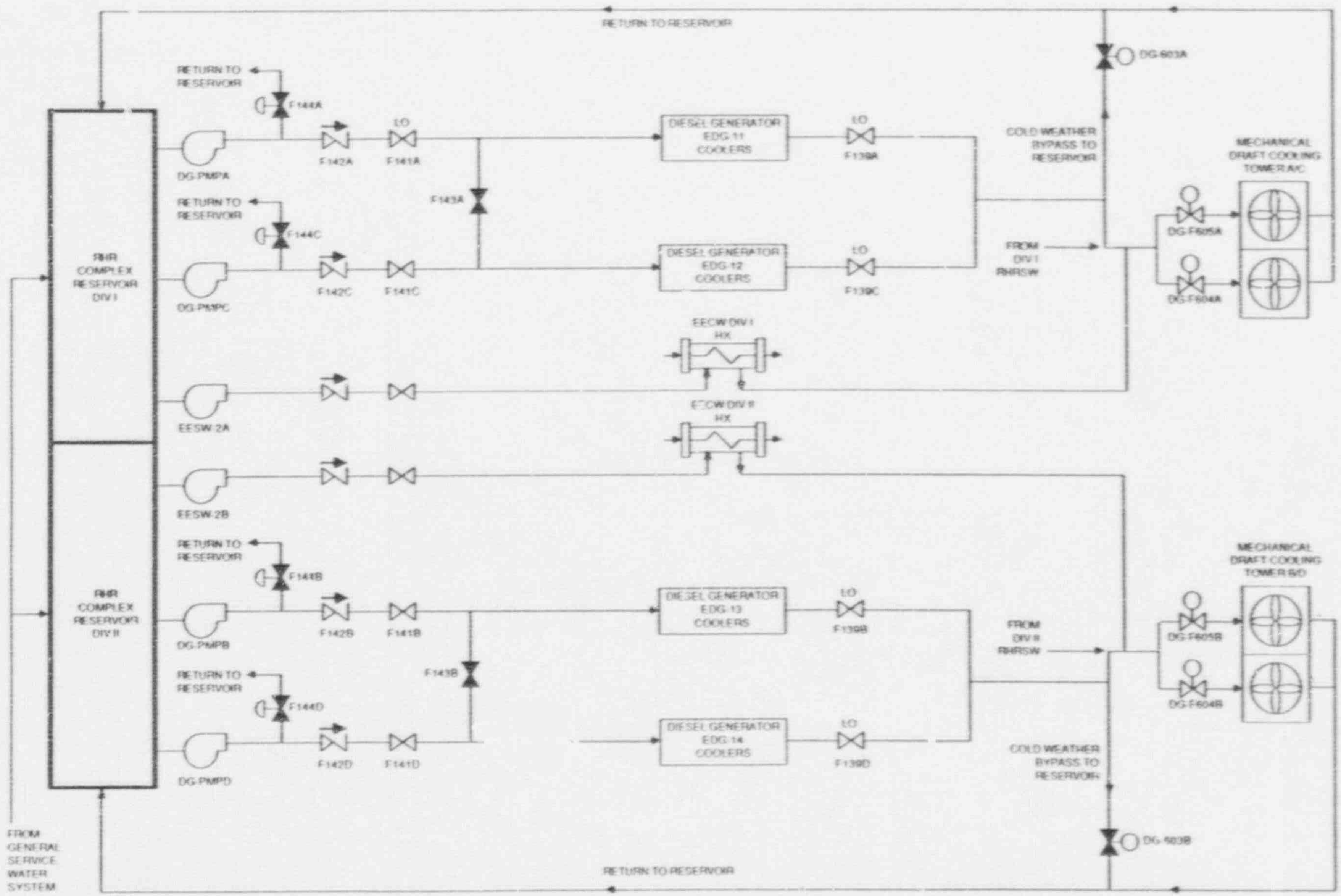


Figure 3.8-1. Enrico Fermi Unit 2 Diesel and Emergency Equipment Service Water (EESW) Systems.

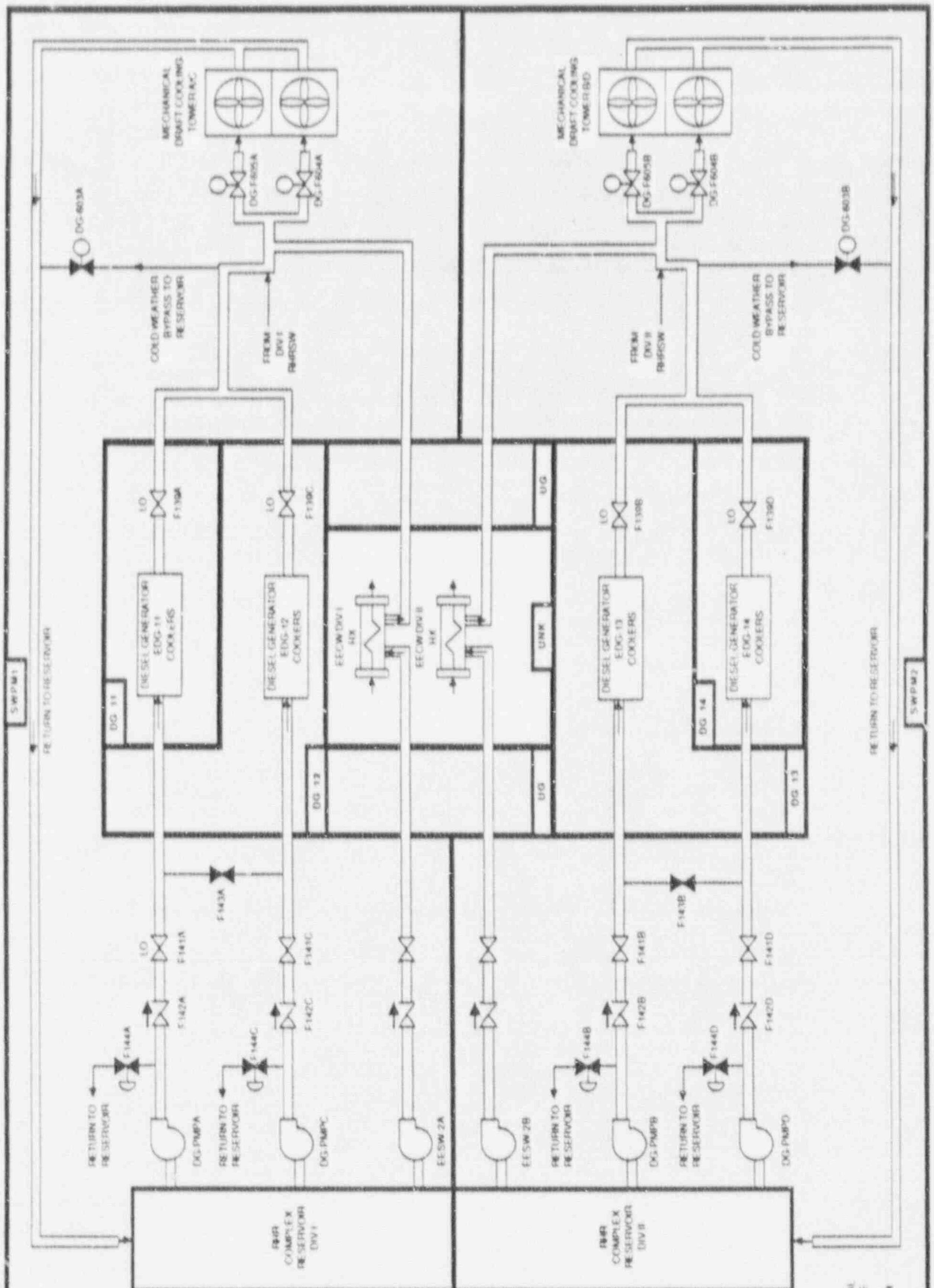


Figure 3.8-2. Enrico Fermi Unit 2 Diesel and Emergency Equipment Service Water (EESW) Systems Showing Component Locations.

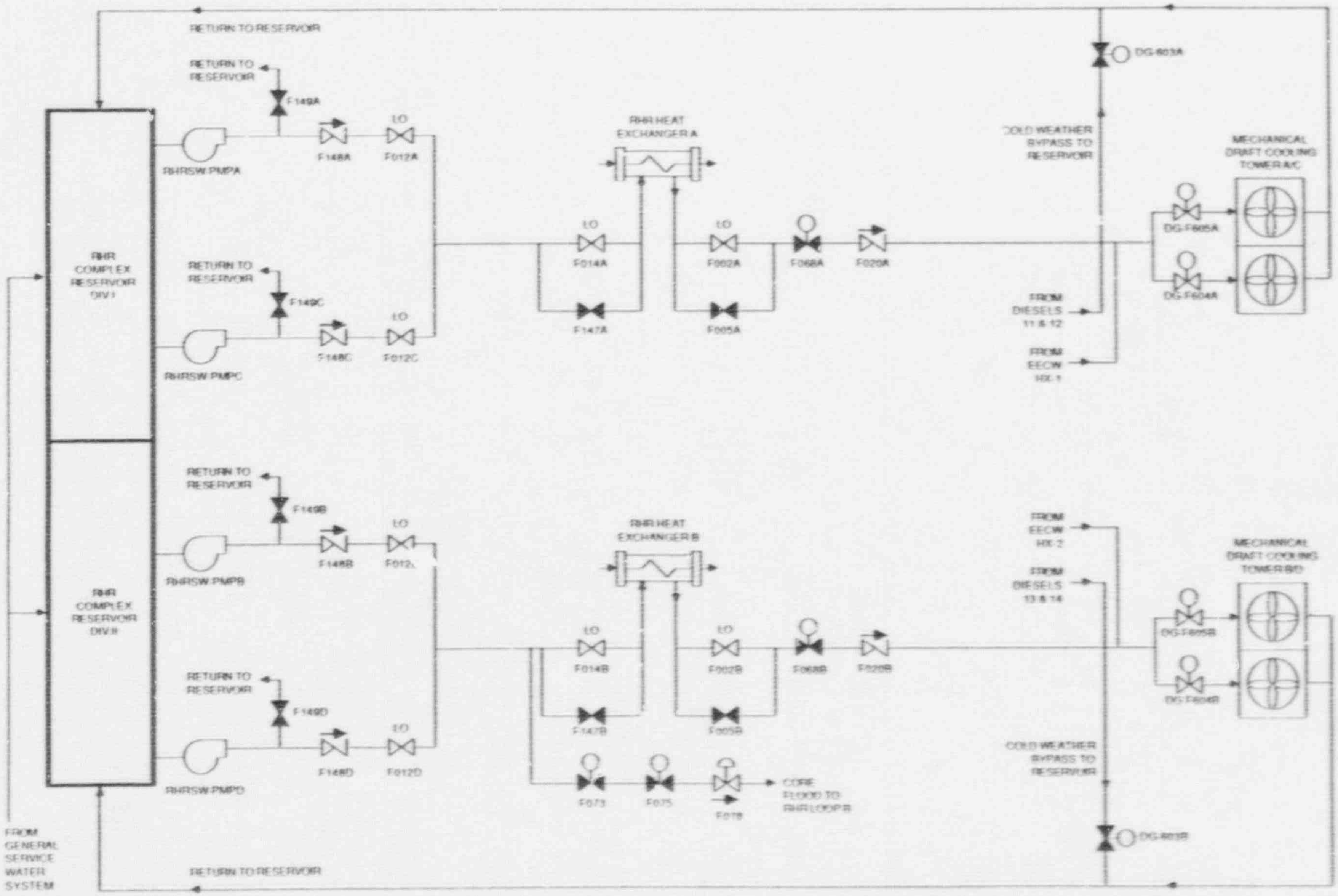


Figure 3.8-3. Enrico Fermi Unit 2 RHR Service Water (RHRSW) System.

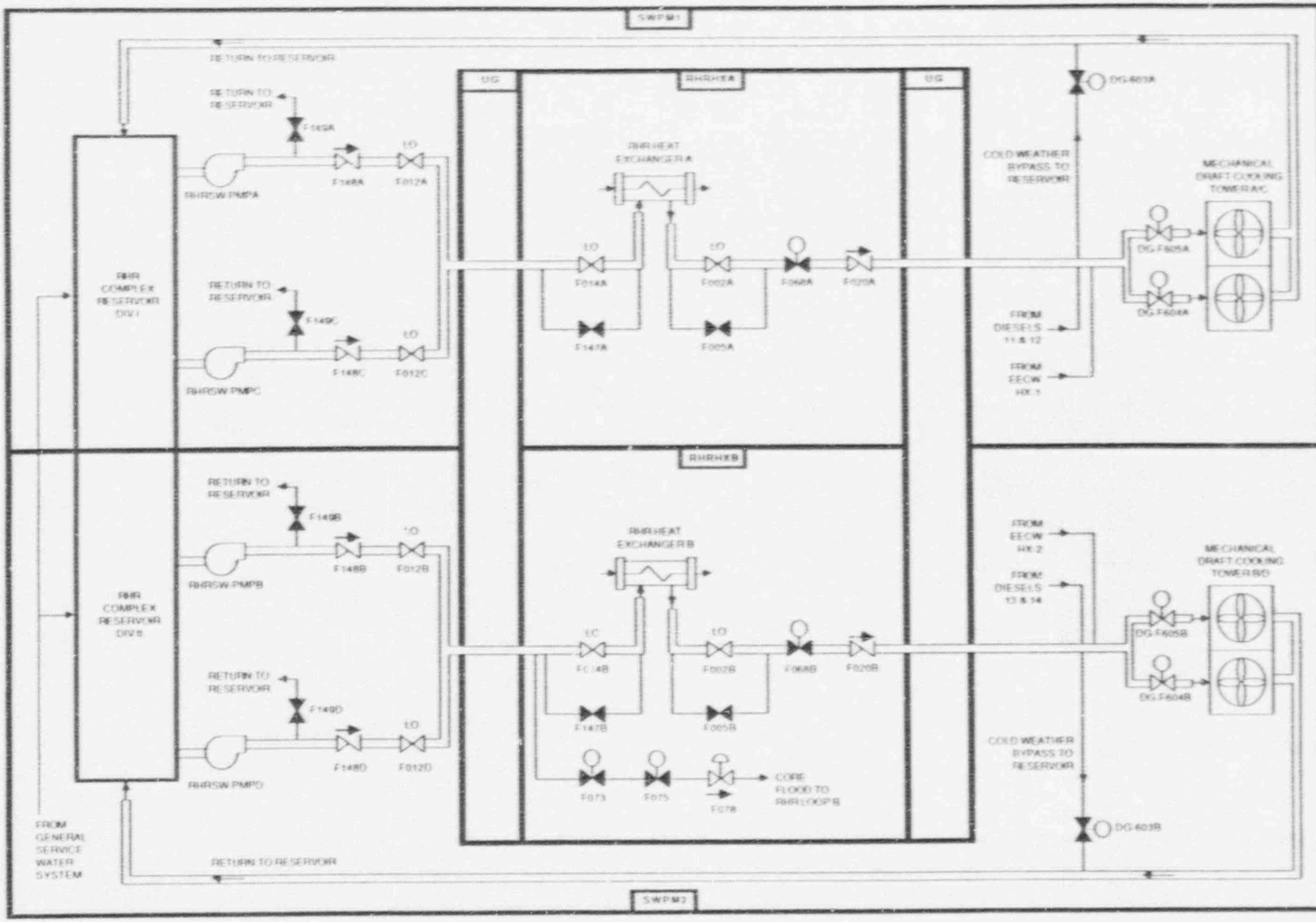


Figure 3.8-4. Enrico Fermi Unit 2 RHR Service Water (RHRSW) System Showing Component Locations.

Table 3.8-1. Fermi 2 RHR and Emergency Equipment Service Water Systems Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
DG-F603A	MOV	SWPM1	MCC72EA	480	SWGRMA	AC/A
DG-F603B	MOV	SWPM2	MCC72EC	480	SWGRMC	AC/C
DG-F604A	MOV	SWPM1	MCC72EA	480	SWGRMA	AC/A
DG-F604B	MOV	SWPM2	MCC72EC	480	SWGRMC	AC/C
DG-F605A	MOV	SWPM1	MCC72EB	480	SWGRMB	AC/B
DG-F605B	MOV	SWPM2	MCC72ED	480	SWGRMD	AC/D
DG-PMPA	MDP	SWPM1	MCC72EA	480	SWGRMA	AC/A
DG-PMPB	MDP	SWPM2	MCC72EC	480	SWGRMC	AC/C
DG-PMPC	MDP	SWPM1	MCC72EB	480	SWGRMB	AC/B
DG-PMPD	MDP	SWPM2	MCC72ED	480	SWGRMD	AC/D
EESW-2A	MDP	SWPM1	BUS-72EB	480	SWGRMB	AC/B
EESW-2B	MDP	SWPM2	BUS-72ED	480	SWGRMD	AC/D
RHRSW-A	MDP	SWPM1	BUS-11EA	4160	SWGRMA	AC/A
RHRSW-B	MDP	SWPM2	BUS-13EC	4160	SWGRMC	AC/C
RHRSW-C	MDP	SWPM1	BUS-12EB	4160	SWGRMB	AC/B
RHRSW-D	MDP	SWPM2	BUS-14ED	4160	SWGRMD	AC/D

4. PLANT INFORMATION

4.1 SITE AND BUILDING SUMMARY

The Fermi 2 site is located in Michigan about 25 miles south of Detroit on the western shore of Lake Erie in Monroe County. A general view of the site is shown in Figure 4-1 and more details of the major site buildings can be seen in Figure 4-2.

The largest building on the site is the Turbine Building which houses the power conversion equipment, the off-gas system and plant auxiliaries. The Auxiliary Building, located to the west of the Turbine Building houses the main control room, computer facility and electrical equipment.

The Reactor Building is located to the west side of the Auxiliary Building and houses the drywell, suppression pool, the NSSS, some auxiliary systems and the fuel storage area.

The radioactive waste building is located on the north side of the Turbine Building and the Office and Service Building is on the east side.

The RHR Complex is on the west side of the site and houses the emergency diesel generators, the RHR cooling towers, the RHR service water reservoir, and the RHRSW, EESW, and EDG service water pumps.

Two natural draft hyperbolic circulating water cooling towers are located on the north portion of the site.

4.2 FACILITY LAYOUT DRAWINGS

Figures 4-3 through 4-15 are section views and simplified building layout drawings for the Fermi 2 containment, auxiliary building, and intake structure. The turbine and service building, maintenance shop, and technical support building are not shown on these drawings. Major rooms, stairways, elevators, and doorways are shown in the simplified layout drawings, however, many interior walls have been omitted for clarity. Labels printed in uppercase correspond to the location codes listed in Table 4-1 and used in the component data listings and system drawings in Section 3. Some additional labels are included for information and are printed in lowercase type.

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

4.3 SECTION 4 REFERENCES

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

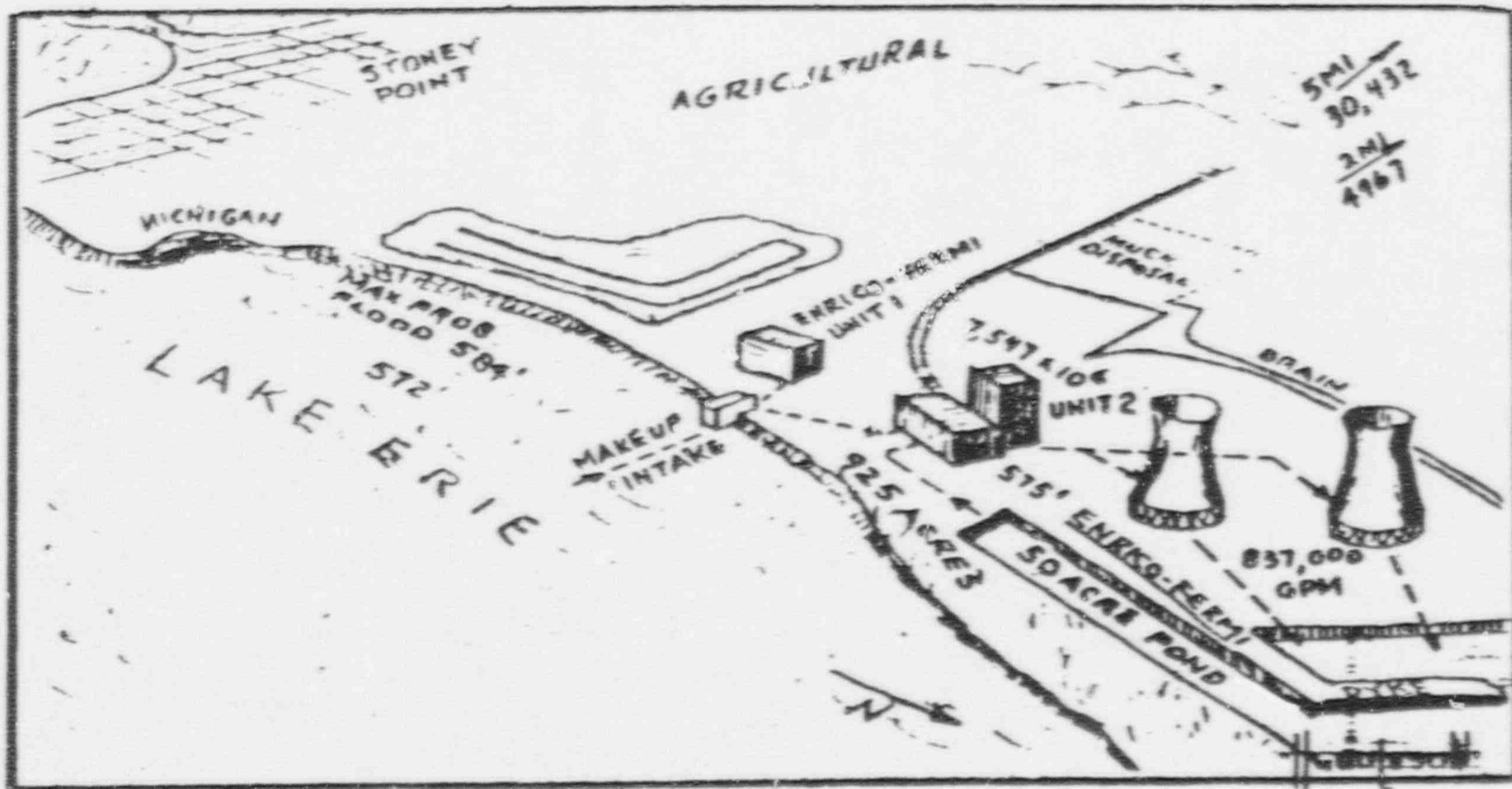


Figure 4-1. General View of the Enrico Fermi Unit 2 Site and Vicinity

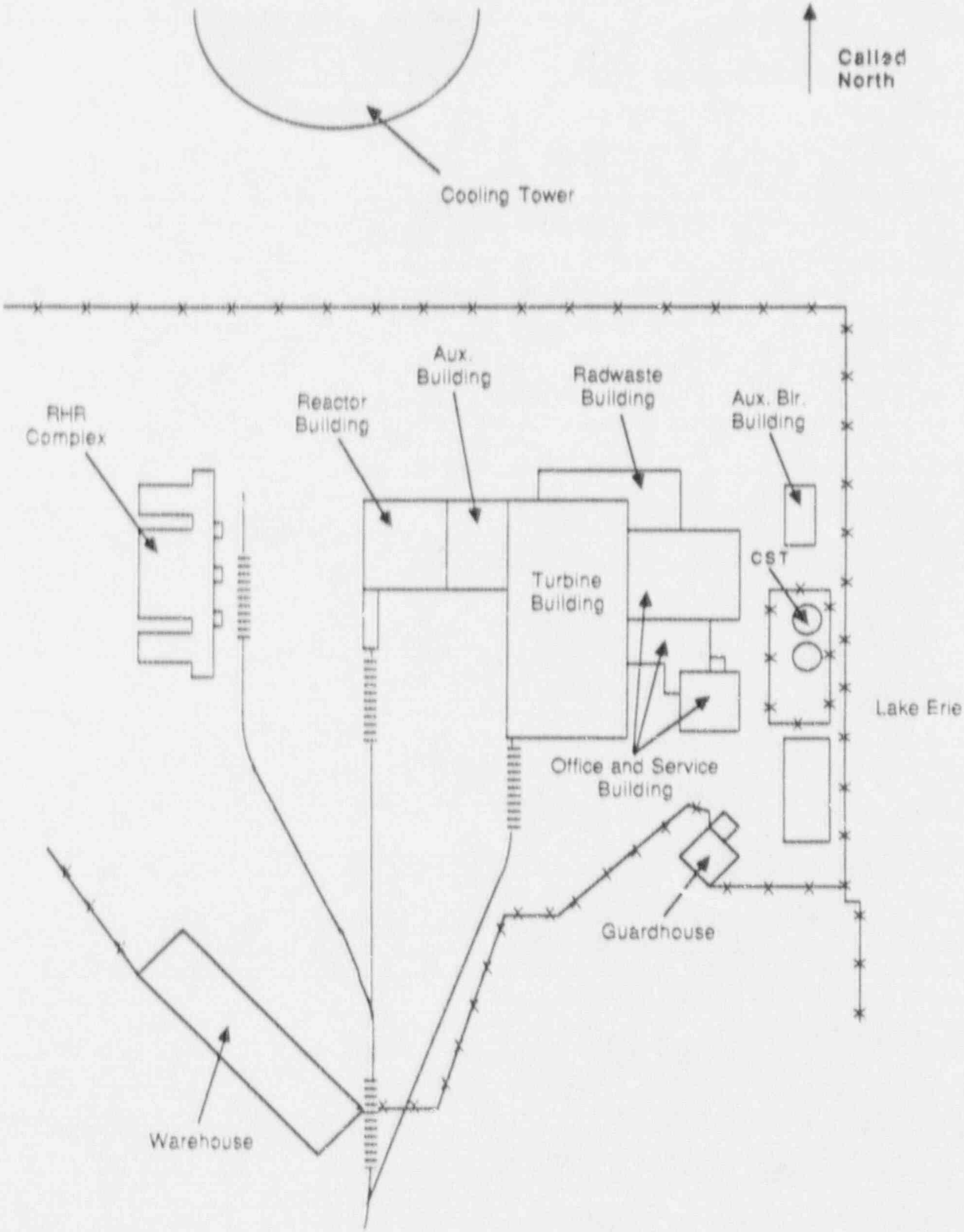


Figure 4-2. General Arrangement of Major Buildings at the Fermi 2 Site

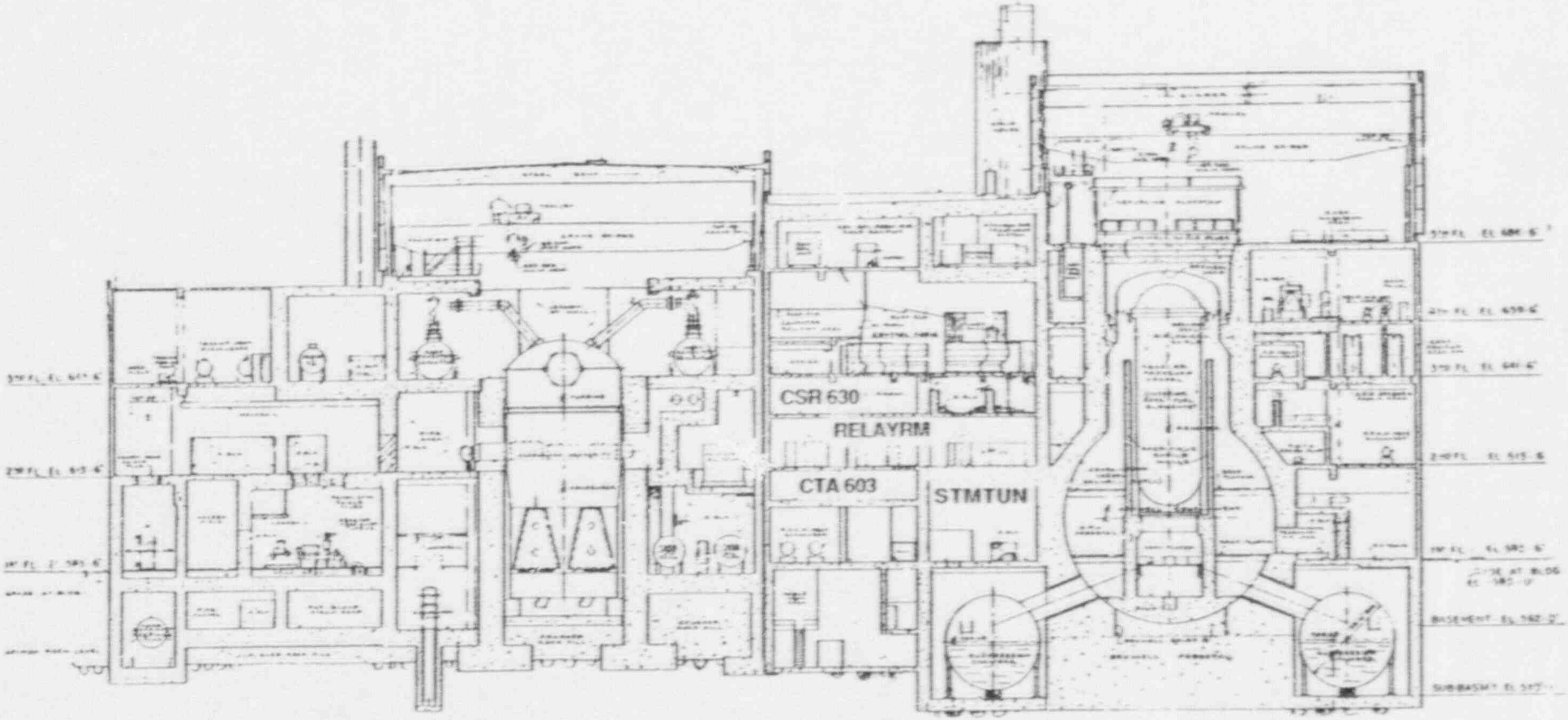


Figure 4-3. Enrico Fermi Unit 2 - Reactor and Turbine Buildings Elevation Drawing (Section Looking South)

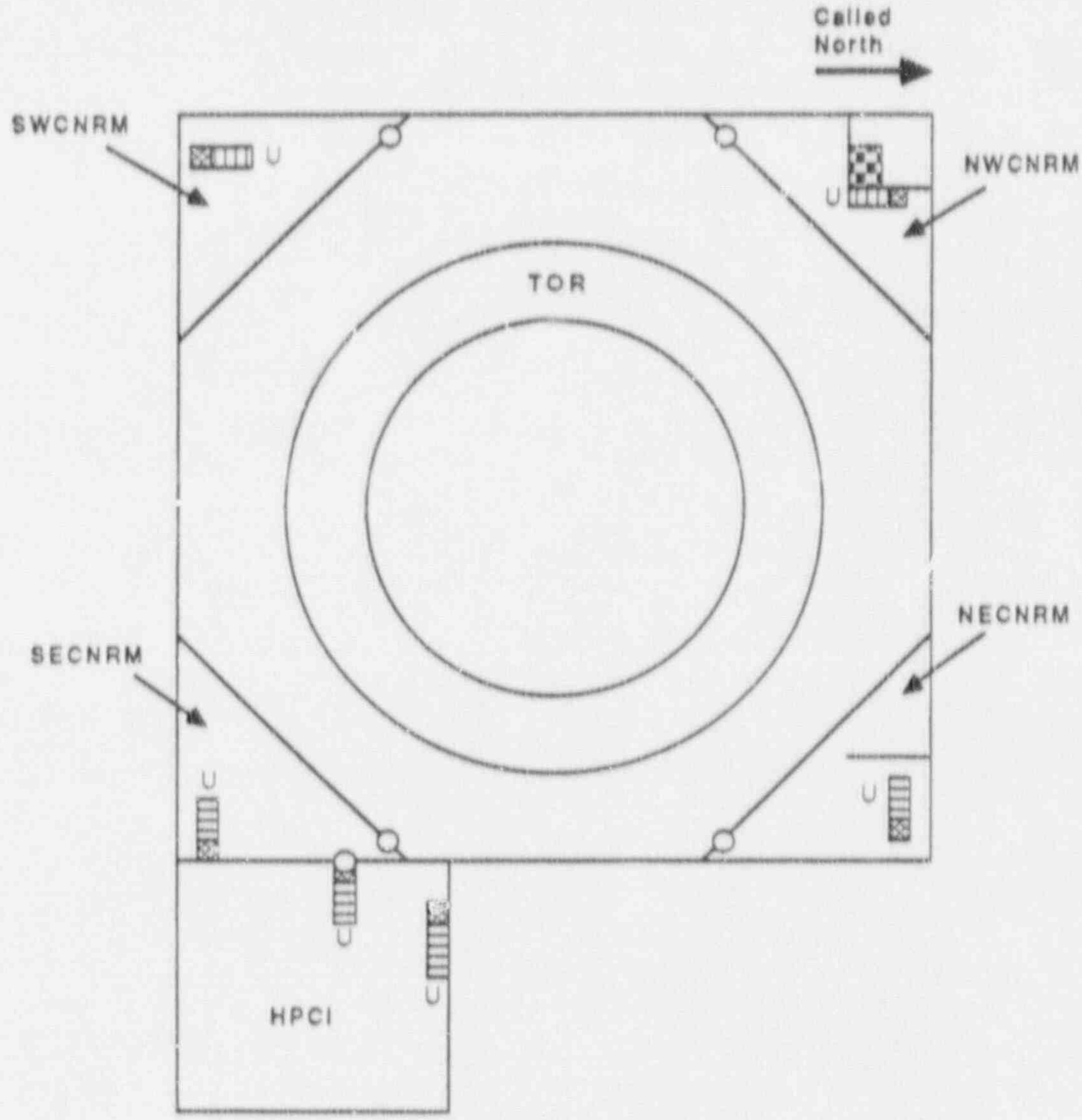


Figure 4-4. Enrico Fermi Unit 2 - Reactor Building and Auxiliary Building - 540 ft. Elevation

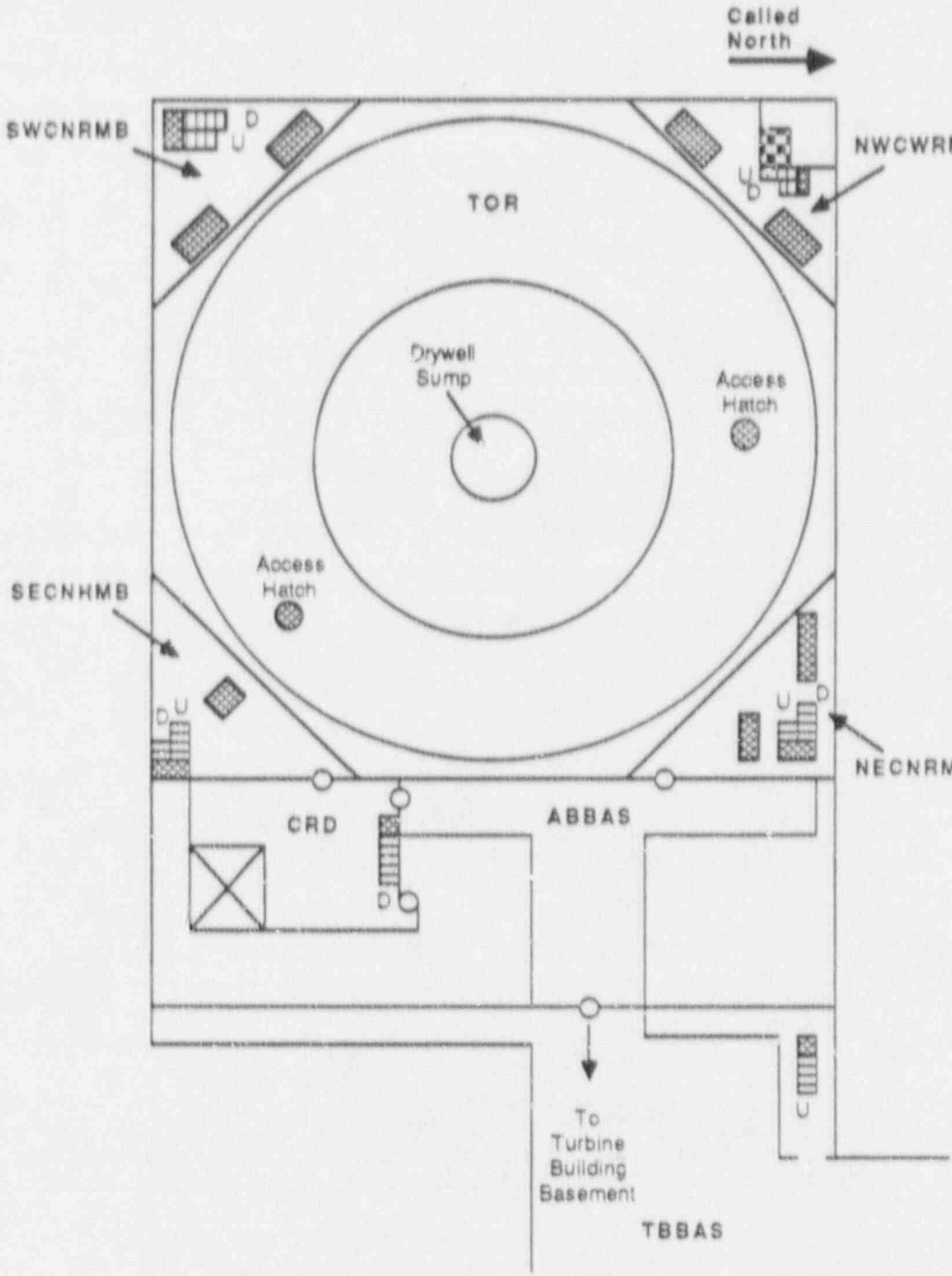


Figure 4-5. Enrico Fermi Unit 2 - Reactor Building and Auxiliary Building - 562 ft. Elevation

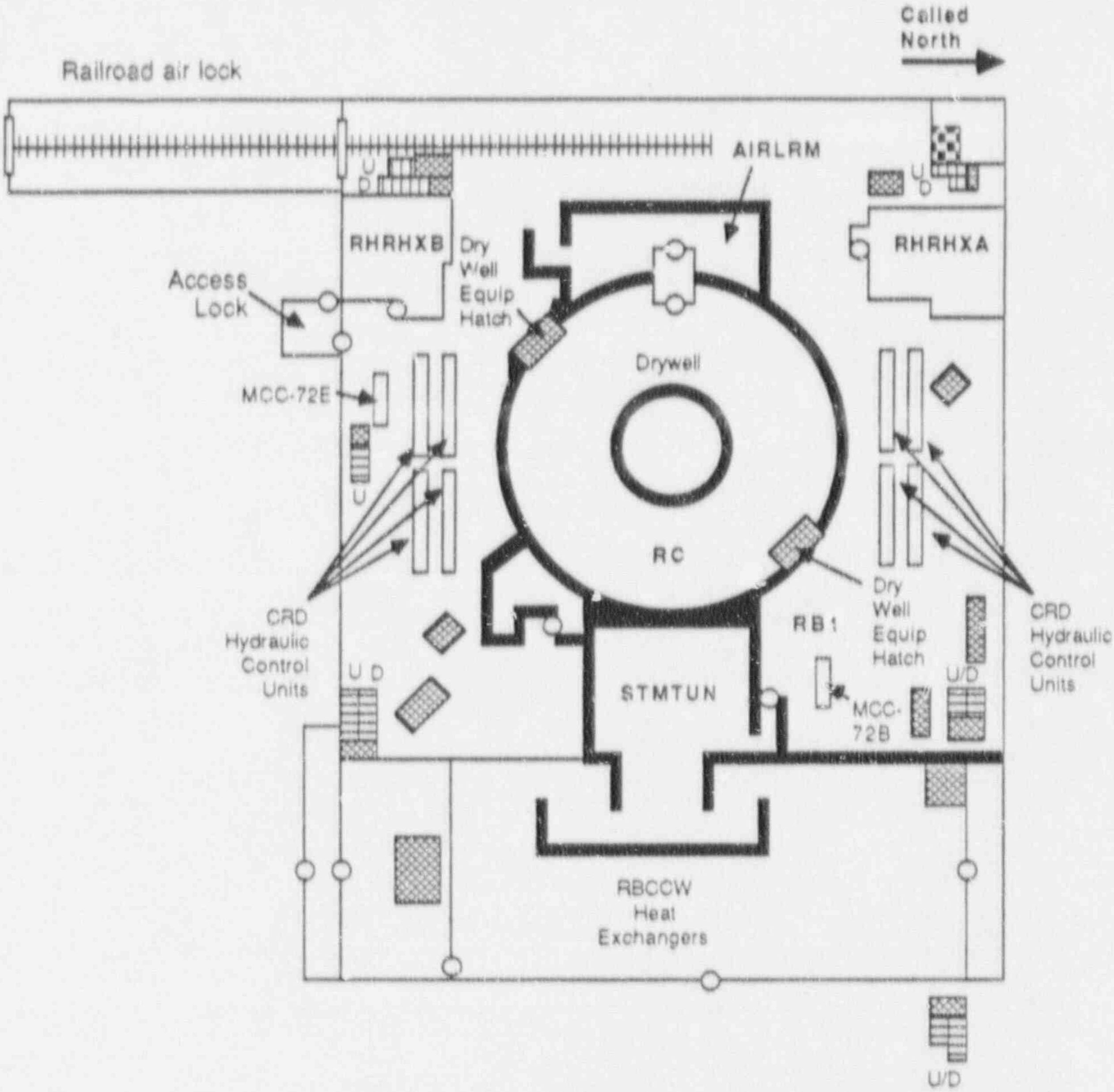


Figure 4-6. Enrico Fermi Unit 2 - Reactor Building and Auxiliary Building - 583 ft. Elevation

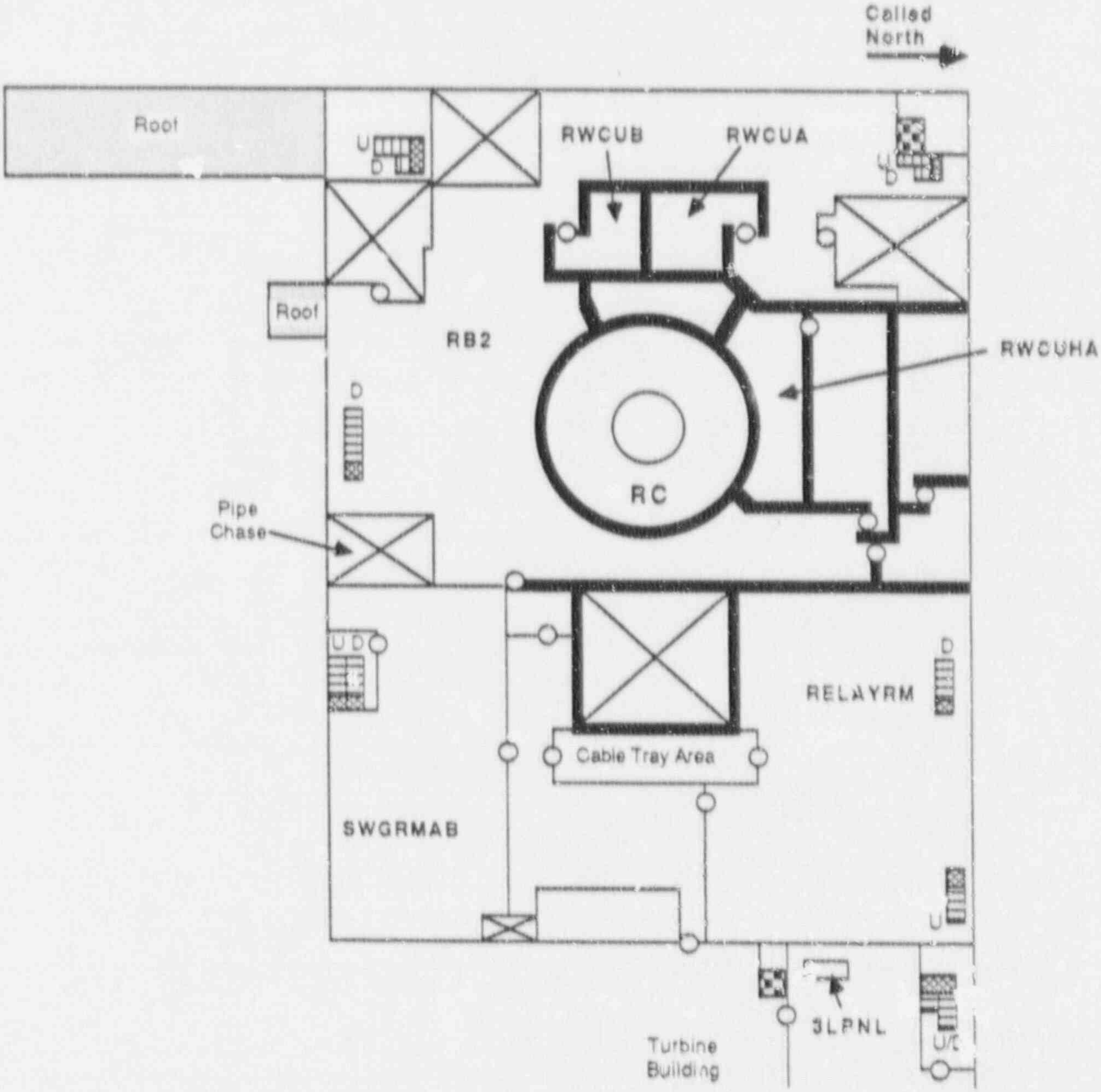


Figure 4-7. Enrico Fermi Unit 2 - Reactor Building and Auxiliary Building - 613 ft. Elevation

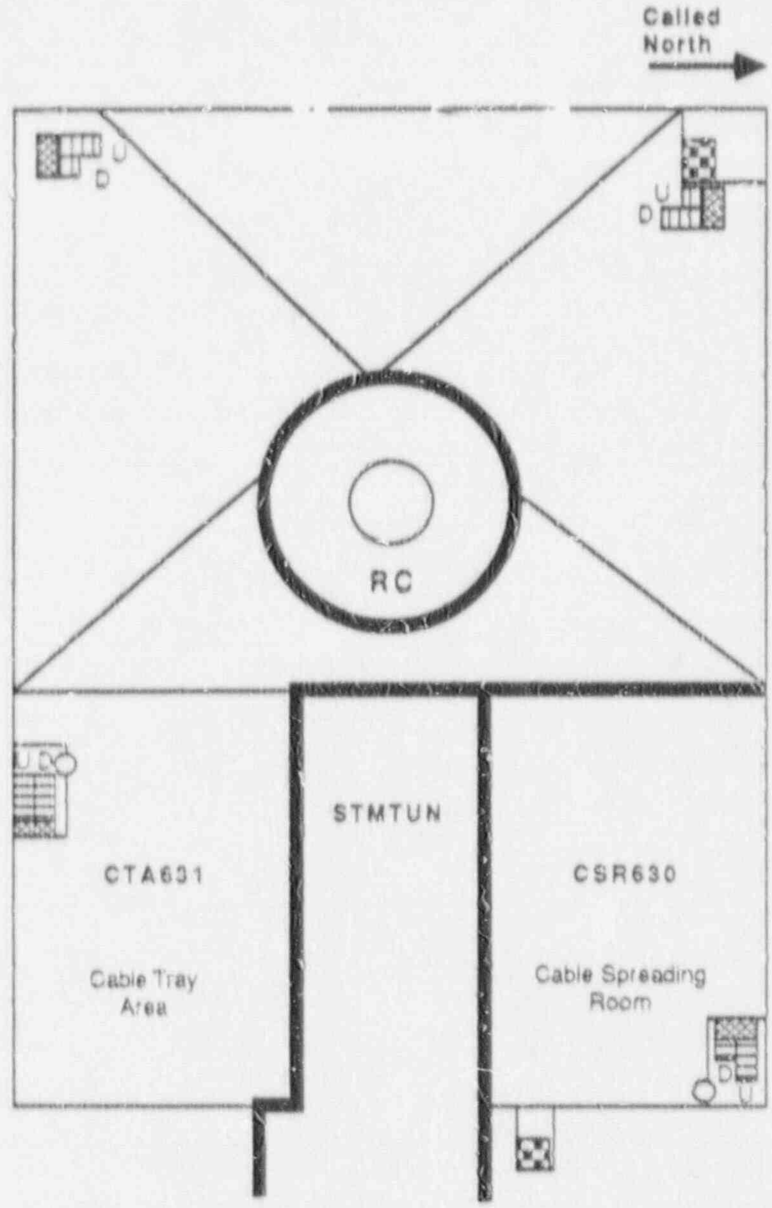


Figure 4-8. Enrico Fermi Unit 2 - Reactor Building and Auxiliary Building Mezzanine Between 2nd and 3rd Floor -631 ft. Elevation

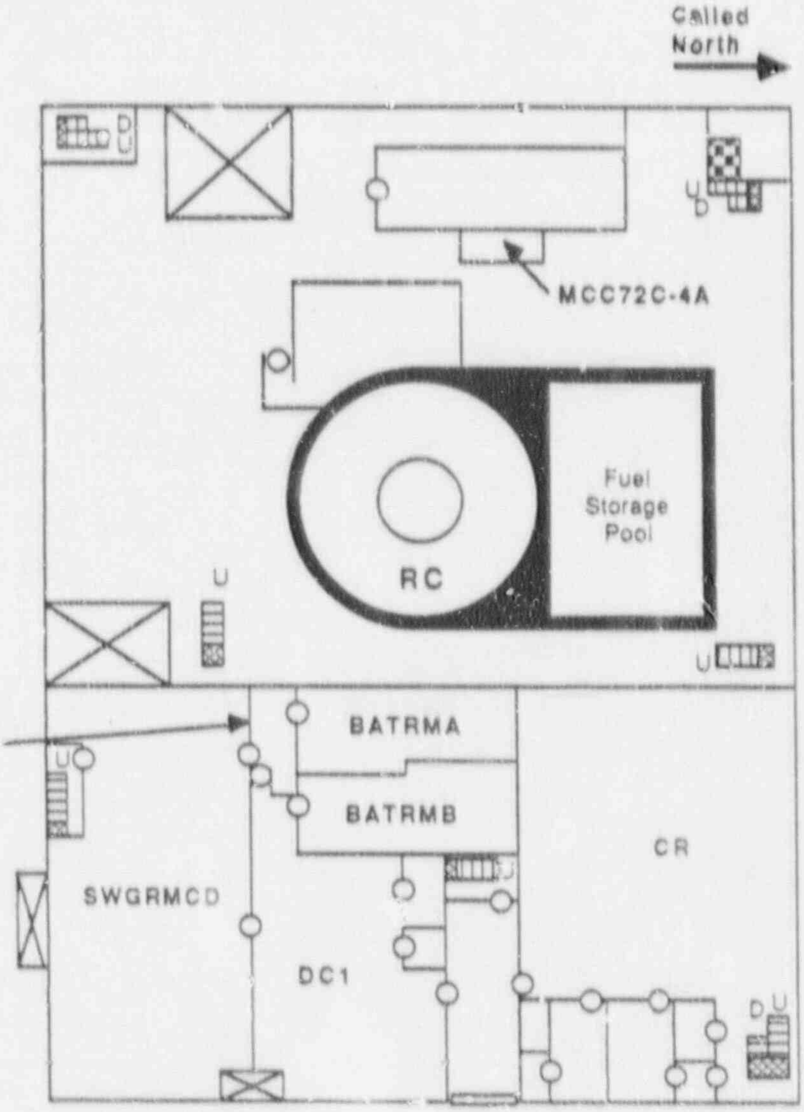


Figure 4-9. Enrico Fermi Unit 2 - Reactor Building - 641 ft. Elevation and Auxiliary Building - 643 ft. Elevation

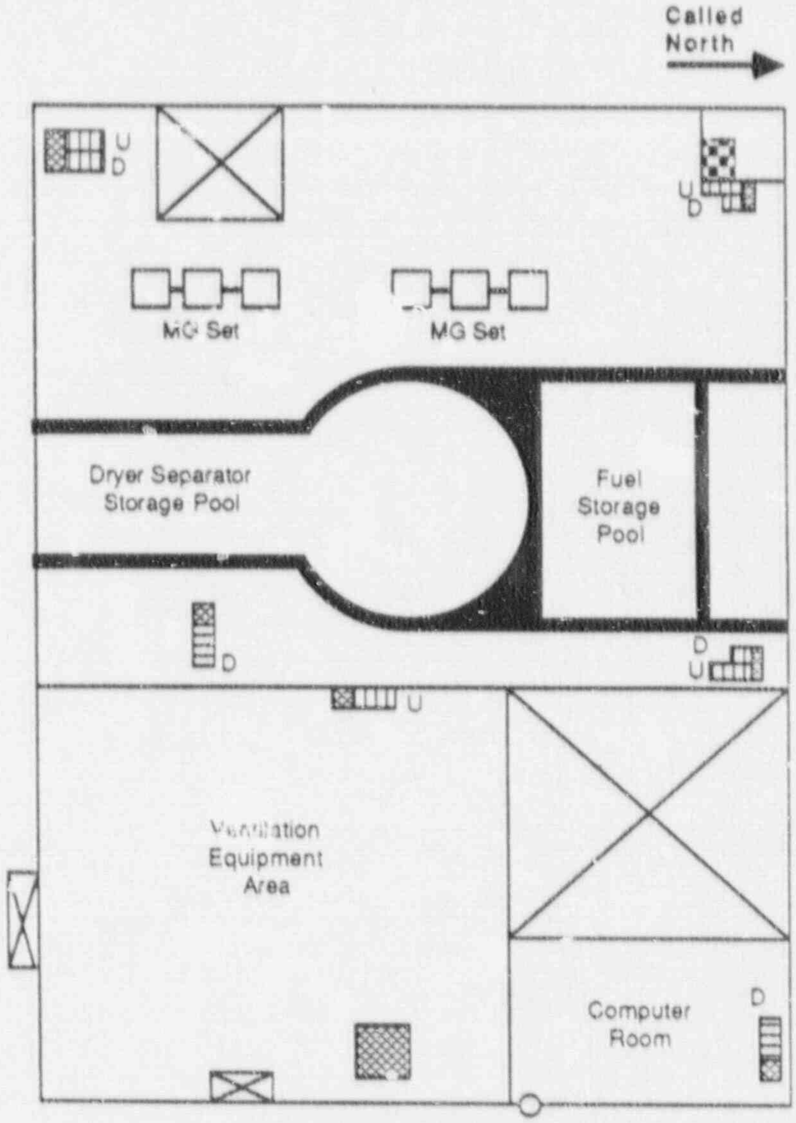


Figure 4-10. Enrico Fermi Unit 2 - Reactor Building and Auxiliary Building - 659 ft. Elevation

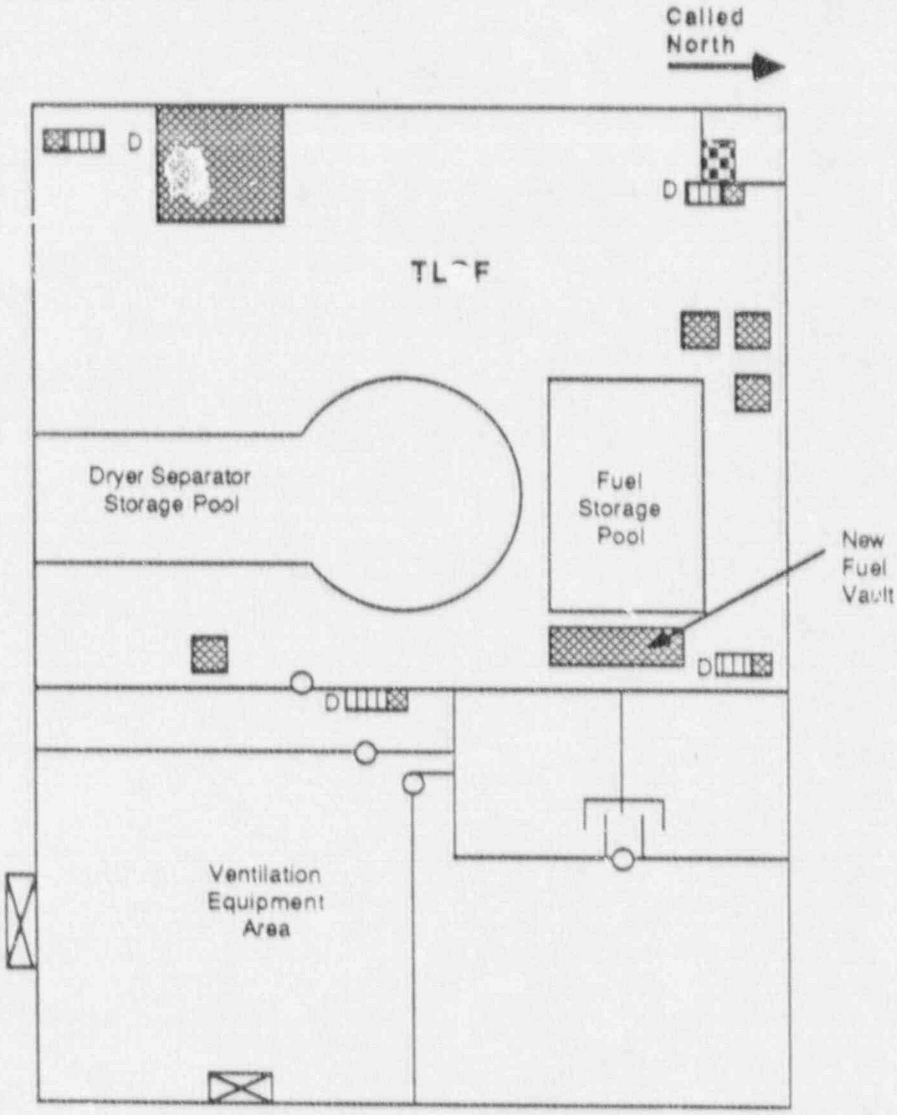
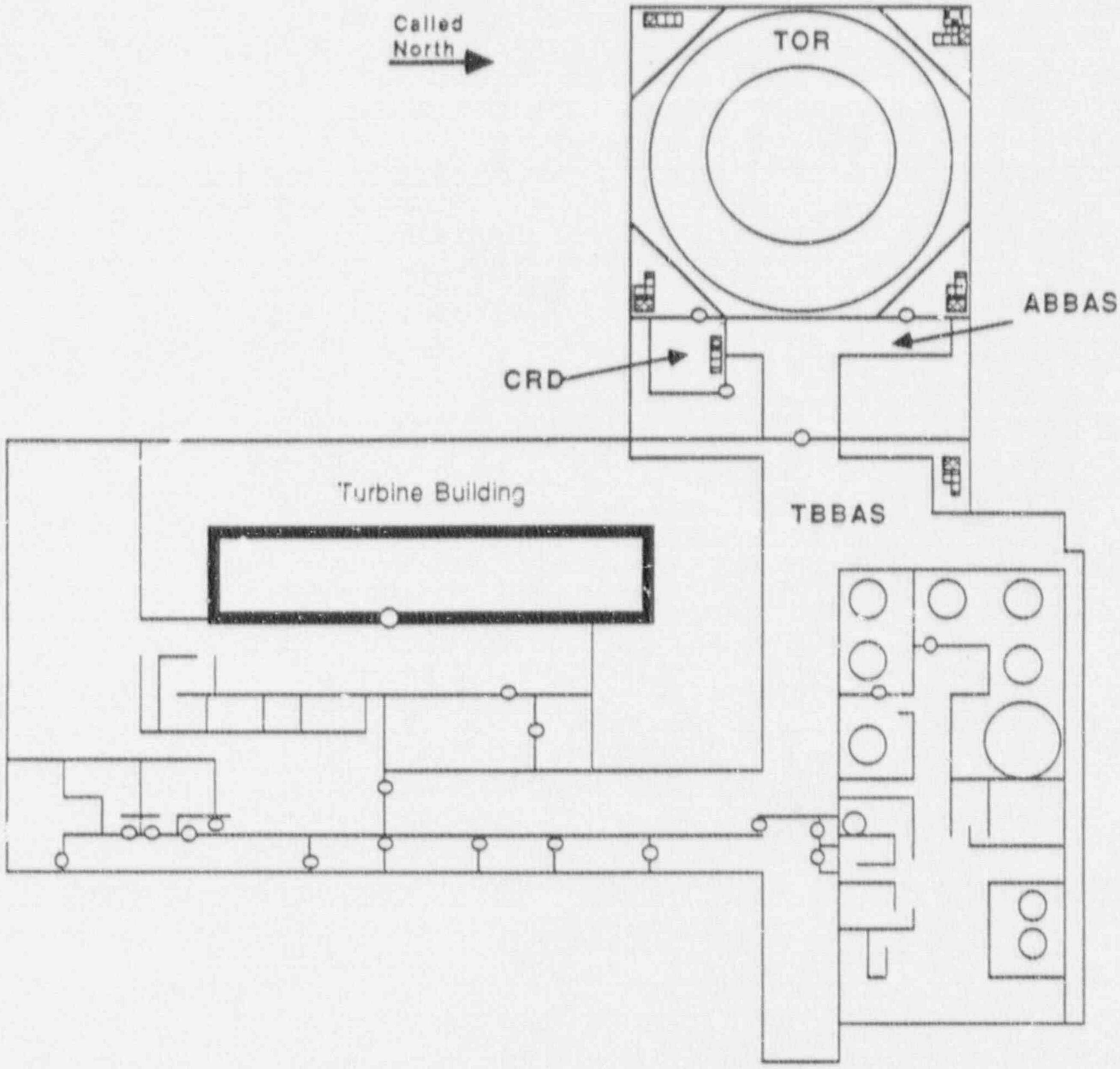


Figure 4-11. Enrico Fermi Unit 2 - Reactor Building - 684 ft. Elevation and Auxiliary Building - 677 ft. Elevation



Note: This Drawing is Drawn to a Different Scale than
the Reactor Building Floor Plans in Figures 4-4 to 4-11

Figure 4-12. Enrico Fermi Unit 2 Reactor Building - 562 ft. Elevation and Turbine Building - 564 ft. Elevation

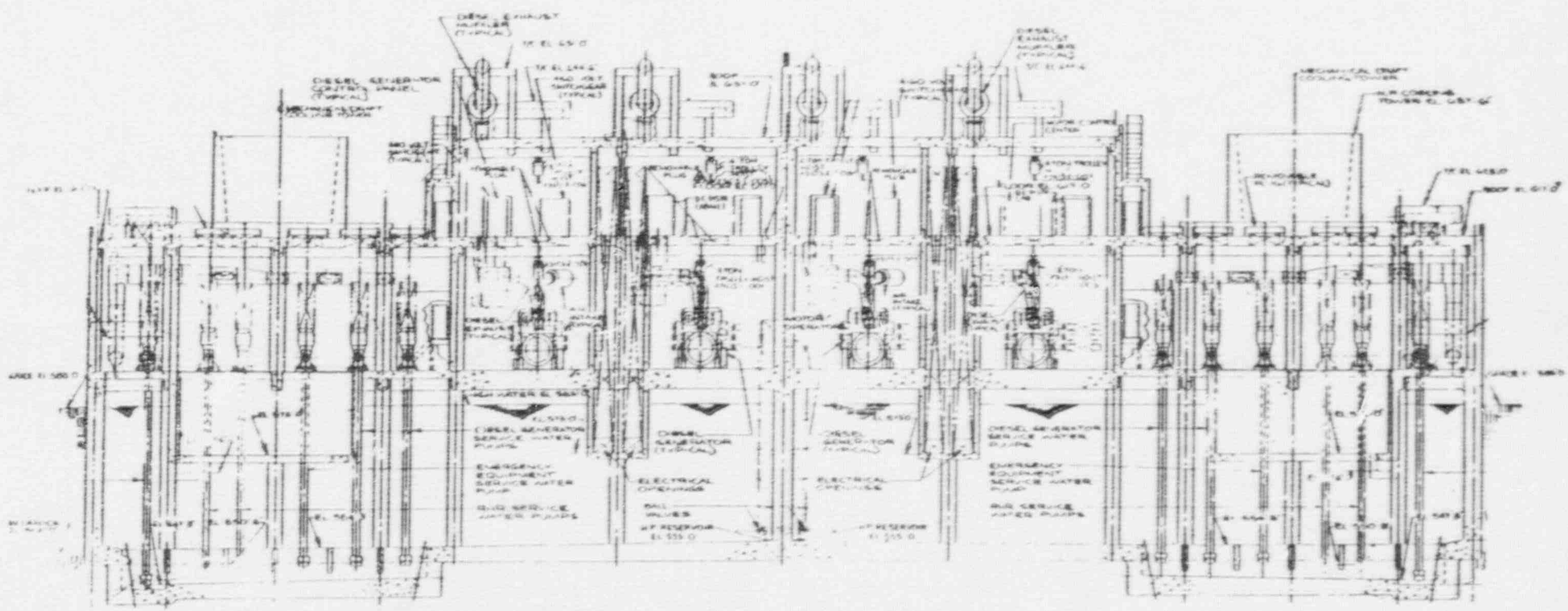


Figure 4-13. Enrico Fermi Unit 2 - RHR Complex Elevation Drawing (Section Through The Diesel Generator Rooms)

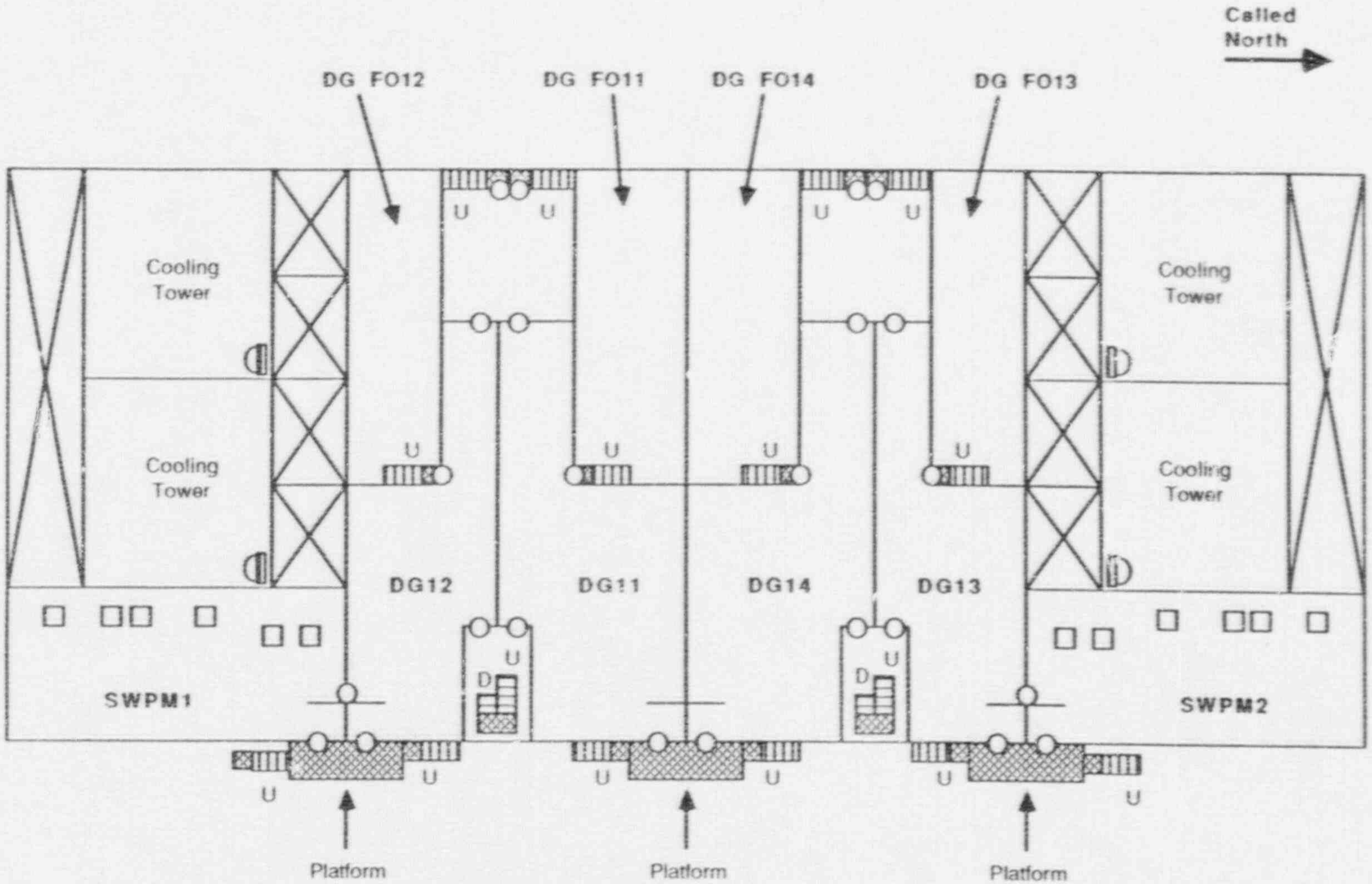


Figure 4-14. Enrico Fermi Unit 2 - RHR Complex Arrangement Grade Elevation

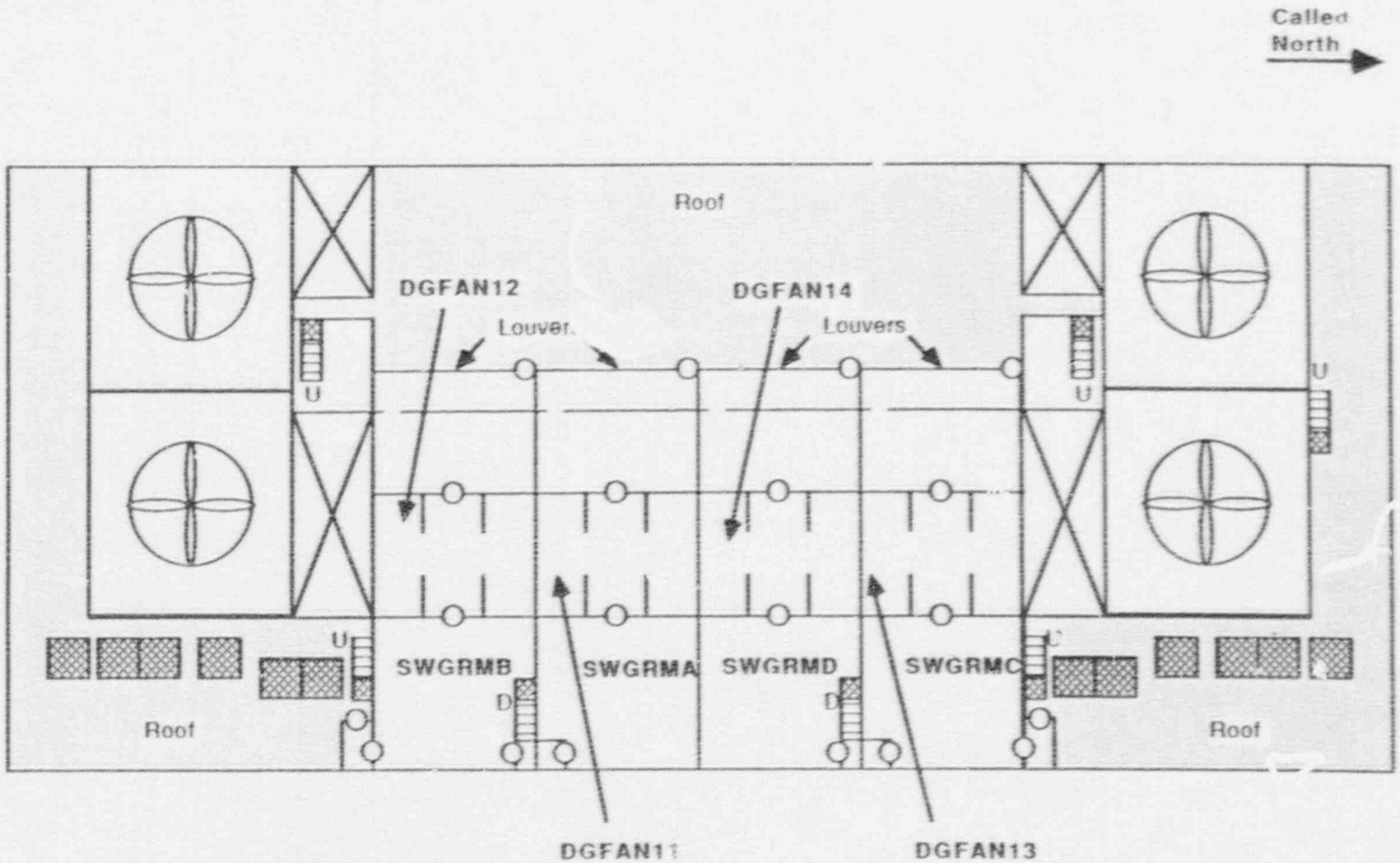


Figure 4-15. Enrico Fermi Unit 2 - RHR Complex Arrangement - Upper Elevation

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

	Codes	Descriptions
1.	3LPNL	3L Remote Shutdown Panel - located at 613'-6" elevation of the Auxiliary Building just east of the Relay Room
2.	ABBAS	Auxiliary Building Basement, located at the 562' elevation
3.	AIRLRM	Air Lock Room, located adjacent to Reactor Containment - west side
4.	BATRMA	Battery Room A, located at the 643'-6" elevation of the Auxiliary Building
5.	BATRMB	Battery Room B, located at the 643'-6" elevation of the Auxiliary Building
6.	CR	Control Room, located at the 643'-6" elevation of the Auxiliary Building
7.	CRD	Control Rod Drive Pump Room, located at the 562' elevation of the Auxiliary Building
8.	CSR630	Cable Spreading Room, located at the 630' elevation above the Relay Room of the Auxiliary Building
9.	CST	Condensate Storage Tank, located outside in yard area.
10.	CTA603	Cable Tray Area, located at the 603'-6" elevation of the Auxiliary Building
11.	CTA631	Cable Tray Area, located at the 631' elevation of the Auxiliary Building
12.	DC1	DC Equipment Room 1, located at the 643'-6" elevation of the Auxiliary Building
13.	DC2	DC Equipment Room 2, located at the 643'-6" elevation of the Auxiliary Building
14.	DG11	Diesel Generator Room 11, located at the 590'-8" elevation of the RHR Complex
15.	DG12	Diesel Generator Room 12, located at the 590'-8" elevation of the RHR Complex

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

Codes	Descriptions
16. DG13	Diesel Generator Room 13, located at the 590'-8" elevation of the RHR Complex
17. DG14	Diesel Generator Room 14, located at the 590'-8" elevation of the RHR Complex -
18. DGFO11	Diesel Generator Fuel Oil Storage Tank 11, located at the 590' elevation of the RHR Complex
19. DGFO12	Diesel Generator Fuel Oil Storage Tank 12, located at the 590' elevation of the RHR Complex
20. DGFO13	Diesel Generator Fuel Oil Storage Tank 13, located at the 590' elevation of the RHR Complex
21. DGFO14	Diesel Generator Fuel Oil Storage Tank 14, located at the 590' elevation of the RHR Complex
22. DGFAN11	Diesel Generator Fan No. 11, located at the 624' elevation of the RHR Complex
23. DGFAN12	Diesel Generator Fan No. 12, located at the 624' elevation of the RHR Complex
24. DGFAN13	Diesel Generator Fan No. 13, located at the 624' elevation of the RHR Complex
25. DGFAN14	Diesel Generator Fan No. 14, located at the 624' elevation of the RHR Complex
26. MCC72C-4A	Motor Control Center 72C-4A, located on third floor of Reactor Building
27. HPCI	High Pressure Coolant Injection Pump Room, located at 540' elevation of the Reactor Building
28. NECNRM	Northeast Corner Room, located at the 540' elevation of the Reactor Building
29. NECNRMB	Northeast Corner Room - Basement, located at 562' elevation of the Reactor Building
30. NWCNRM	Northwest Corner Room, located at the 540' elevation of the Reactor Building
31. RB1	Reactor Building - 1st Floor, located at the 540' elevation of the Reactor Building

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

Codes	Descriptions
32. RB2	Reactor Building - 2nd Floor, located at the 540' elevation of the Reactor Building
32. RC	Reactor Containment
32. RELAYRM	Relay Room, located at the 613'-6" elevation of the Auxiliary Building
35. RHRHXA	RHR Heat Exchanger Room A, located on 2nd floor of the Reactor Building
36. RHRHXB	RHR Heat Exchanger Room B, located on 2nd floor of the Reactor Building
37. RWCUA	Reactor Water Cleanup Room A , located on the 2nd floor of the Reactor Building
38. RWCUB	Reactor Water Cleanup Room B , located on the 2nd floor of the Reactor Building
39. RWCUBA	Reactor Water Cleanup Holding Are, located on the 2nd floor of the Reactor Building
40. SECNRM	Southeast Corner Room, located on the 540' elevation of the Reactor Building
41. SECNRMB	Southeast Corner Room - Basement, located the 562' elevation of the Reactor Building
42. STMTUN	Steam Tunnel, located at the 583'6" elevation of the Reactor Building - east side of the reactor containment
43. SWCNRM	Southwest Corner Room, located at the 540' elevation of the Reactor Building
44. SWGRMA	Switchgear Room A, located at the 624' elevation of the RHR Complex
45. SWGRMAB	Switchgear Room AB, located at the 613'-6" elevation of the Auxiliary Building
46. SWGRMB	Switchgear Room B, located at the 624' elevation of the RHR Complex
47. SWGRMC	Switchgear Room C, located at the 624' elevation of the RHR Complex

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

Codes	Descriptions
48. SWGRMCD	Switchgear Room CD, located at the 643'-6" elevation of the Auxiliary Building
49. SWGRMD	Switchgear Room D, located at elevation 624' elevation of the RHR Complex
50. SWPM1	Service Water Pump Room No. 1, located at the 590' elevation of the RHR Complex
51. SWPM2	Service Water Pump Room No. 2, located at the 590' elevation of the RHR Complex
52. TBBAS	Turbine Building - basement
53. TLSF	Spent fuel operating floor, located at the 684'-6" elevation of the Reactor Building
54. TOR	Torus (Suppression Pool), located at the 540' elevation of the Reactor Building

Table 4-2 Partial Listing of Components by Location at Fermi Unit 2

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
ABBAS	ECCS	HPCI-F011	MOV
ABBAS	RCIC	RCIC-F010	MOV
ABBAS	RCIC	RCIC-F022	MOV
AIRLRM	ECCS	RHR-F015A	MOV
AIRLRM	ECCS	RHR-F015B	MOV
BATRMA	EP	BAT-2PA	BATT
BATRMA	EP	BATT-2PA	BATT
BATRMB	EP	BAT-2PB	BATT
BATRMB	EP	BATT-2PB	BATT
CRD	ECCS	HPCI-F008	MOV
CST	ECCS	CST	TANK
CST	RCIC	CST	TANK
DC1	EP	BC-2A-1	BC
DC1	EP	BC-2A-2	BC
DC1	EP	BUS-2PA2	BUS
DC1	EP	BUS-2PA2	BUS
DC1	EP	BUS-2PA2	BUS
DC1	EP	BUS-2PA2	BUS
DC1	EP	BUS-2PA2	BUS
DC1	EP	BUS-2PA2	BUS
DC1	EP	MCC-2PA1	MCC
DC2	EP	BC-2B-1	BC
DC2	EP	BC-2B-2	BC
DC2	EP	BUS-2PB2	BUS
DC2	EP	BUS-2PB2	BUS
DC2	EP	BUS-2PB2	BUS
DC2	EP	BUS-2PB2	BUS
DC2	EP	BUS-2PB2	BUS
DC2	EP	BUS-2PB2	BUS
DC2	EP	MCC-2PB1	MCC
DG11	EP	DG-11	DG

Table 4-2 Partial Listing of Components by Location at Fermi Unit 2 (continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
DG12	EP	DG-12	DG
DG13	EP	DG-13	DG
DG14	EP	DG-14	DG
HPCI	ECCS	HPCI-F004	MOV
HPCI	ECCS	HPCI-F001	MOV
HPCI	ECCS	HPCI-F007	MOV
HPCI	ECCS	HPCI-F041	MOV
HPCI	ECCS	HPCI-TDP	TDP
NECNRM	ECCS	CS-PMA	MDP
NECNRM	ECCS	CS-PMC	MDP
NECNRM	RCIC	RCIC-F029	MOV
NECNRM	RCIC	RCIC-F031	MOV
NECNRM	RCIC	RCIC-F045	MOV
NECNRM	RCIC	RCIC-F059	MOV
NECNRM	RCIC	RCIC-TDP	TDP
NECNRMB	RCIC	RCIC-F012	MOV
NWCNRM	ECCS	RHR-PMA	MDP
NWCNRM	ECCS	RHR-PMC	MDP
RB1	ECCS	RHR-F016A	MOV
RB1	ECCS	RHR-F021A	MOV
RB1	EP	MCC72E-5A	MCC
RB1	EP	MCC72B-3A	MCC
RB2	ECCS	CS-F004B	MOV
RB2	ECCS	CS-F005B	MOV
RB2	ECCS	RHR-F016B	MOV
RB2	ECCS	RHR-F021B	MOV
RB2	EECW	EECW-PMPB	MDP
RB2	EECW	EECW-PMPA	MDP
RB2	EECW	EECW-HX-1	HX
RB2	EECW	EECW-HX-2	HX
RB2	EP	MCC72F-4A	MCC

Table 4-2 Partial Listing of Components by Location at Fermi Unit 2 (continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RB2	EP	MCC72C-F	MCC
RB2	EP	MCC72C-F	MCC
RB2	EP	MCC72C-3A	MCC
RC	ECCS	F013E	SRV
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	HPCI-F002	MOV
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	RCS-VESSEL	RV
RC	ECCS	F013H	SRV
RC	ECCS	F013J	SRV
RC	ECCS	F013K	SRV
RC	ECCS	F013[illegible]	SRV
RC	RCIC	RCIC-F007	MOV
RC	RCIC	RCS-VESSEL	RV
RC	RCS	RCS-F016	MOV
RC	RCS	F013E	SRV
RC	RCS	HPCI-F002	MOV
RC	RCS	RCIC-F007	MOV
RC	RCS	RCS-VESSEL	RV
RC	RCS	RHR-F008	MOV
RC	RCS	RHR-MO608	MOV
RC	RCS	F013E	SRV
RC	RCS	RXC-F001	MOV
RC	RCS	RXC-F100	MOV
RC	RCS	RXC-F101	MOV
RC	RCS	RXC-F102	MOV
RC	RCS	RXC-F106	MOV
RC	RCS	F013E	SRV
RC	RCS	F013H	SRV
RC	RCS	F013J	SRV
RC	RCS	F013K	SRV

Table 4-2 Partial Listing of Components by Location at Fermi Unit 2 (continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RC	RCS	F013P	SRV
RC	RCS	F013J	SRV
RC	RCS	F013H	SRV
RC	RCS	F013K	SRV
RC	RCS	F013P	SRV
RC	RCS	F013A	SRV
RC	RCS	F013B	SRV
RC	RCS	F013C	SRV
RC	RCS	F013D	SRV
RC	RCS	F013F	SRV
RC	RCS	F013G	SRV
RC	RCS	F013L	SRV
RC	RCS	F013M	SRV
RC	RCS	F013N	SRV
RC	RCS	F013R	SRV
RC	RCS	F013H	SRV
RC	RCS	F013J	SRV
RC	RCS	F013K	SRV
RC	RCS	F013P	SRV
RC	RCS	F013A	SRV
RC	RCS	F013B	SRV
RC	RCS	F013C	SRV
RC	RCS	F013D	SRV
RC	RCS	F013F	SRV
RC	RCS	F013N	SRV
RC	RCS	F013R	SRV
RC	RCS	F013G	SRV
RC	RCS	F013L	SRV
RC	RCS	F013M	SRV
RELAYRM	EP		PNL
RHRHXA	ECCS	RHR-F003A	MOV

Table 4-2 Partial Listing of Components by Location at Fermi Unit 2 (continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RHRHXA	ECCS	RHR-F047A	MOV
RHRHXA	ECCS	RHR-F048A	MOV
RHRHXB	ECCS	RHR-F003B	MOV
RHRHXB	ECCS	RHR-F047B	MOV
RHRHXB	ECCS	RHR-F048B	MOV
RWCUHA	ECCS	CS-F004A	MOV
RWCUHA	ECCS	CS-F005A	MOV
RWCUHA	RCS	RXC-F004	MOV
RWCUHA	RCS	RXC-F119	MOV
SECNRM	ECCS	CS-PMB	MDP
SECNRM	ECCS	CS-PMD	MDP
SECNRMB	ECCS	CS-F015B	MOV
STMTUN	ECCS	HPCI-F003	MOV
STMTUN	ECCS	HPCI-F006	MOV
STMTUN	RCIC	RCIC-F008	MOV
STMTUN	RCIC	RCIC-F013	MOV
STMTUN	RCS	RCS-F019	MOV
STMTUN	RCS	HPCI-F003	MOV
STMTUN	RCS	RCIC-F008	MOV
SWCNRM	ECCS	RHR-PMB	MDP
SWCNRM	ECCS	RHR-PMD	MDP
SWGRMA	EP	CB-11EA	CB
SWGRMA	EP	BUS-11EA	BUS
SWGRMA	EP	S063	PNL
SWGRMA	EP	MCC72EA	MCC
SWGRMA	EP	S036A	XFMR
SWGRMA	EP	BUS-72EA	BUS
SWGRMAB	EP	MCC72B-2A	MCC
SWGRMAB	EP	BUS-64B	BUS
SWGRMAB	EP	BUS-64C	BUS
SWGRMAB	EP	BUS-72B	BUS

Table 4-2 Partial Listing of Components by Location at Fermi Unit 2 (continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
SWGRMAB	EP	BUS-72C	BUS
SWGRMAB	EP	S022A	XFMR
SWGRMAB	EP	S023A	XFMR
SWGRMB	EP	CB-12EB	CB
SWGRMB	EP	BUS-12EB	BUS
SWGRMB	EP	MCC72EB	MCC
SWGRMB	EP	S037A	XFMR
SWGRMB	EP	BUS-72EB	BUS
SWGRMC	EP	CB-13EC	CB
SWGRMC	EP	BUS-13EC	BUS
SWGRMC	EP	S066	PNL
SWGRMC	EP	MCC72EC	MCC
SWGRMC	EP	S038A	XFMR
SWGRMC	EP	BUS-72EC	BUS
SWGRMCD	EP	MCC72F-2A	MCC
SWGRMCD	EP	BUS-65F	BUS
SWGRMCD	EP	BUS-72E	BUS
SWGRMCD	EP	BUS-72F	BUS
SWGRMCD	EP	S020B	XFMR
SWGRMCD	EP	S021A	XFMR
SWGRMCD	EP	BUS-65E	BUS
SWGRMD	EP	CB-14ED	CB
SWGRMD	EP	BUS-14ED	BUS
SWGRMD	EP	MCC72ED	MCC
SWGRMD	EP	S039A	XFMR
SWGRMD	EP	BUS-72ED	BUS
SWPM1	RHRSW	DG-F603A	MOV
SWPM1	RHRSW	DG-F604A	MOV
SWPM1	RHRSW	DG-F605A	MOV
SWPM1	RHRSW	DG-PMPA	MDP
SWPM1	RHRSW	DG-PMPC	MDP

Table 4-2 Partial Listing of Components by Location at Fermi Unit 2 (continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
SWPM1	RHRSW	RHRSW-A	MDP
SWPM1	RHRSW	RHRSW-C	MDP
SWPM1	RHRSW	EESW-2A	MDP
SWPM2	RHRSW	DG-F603B	MOV
SWPM2	RHRSW	DG-F604B	MOV
SWPM2	RHRSW	DG-F605B	MOV
SWPM2	RHRSW	DG-PMPB	MDP
SWPM2	RHRSW	DG-PMPD	MDP
SWPM2	RHRSW	EESW-2B	MDP
SWPM2	RHRSW	RHRSW-B	MDP
SWPM2	RHRSW	RHRSW-D	MDP
TOR	ECCS	CS-F015A	MOV
TOR	ECCS	CS-F036A	MOV
TOR	ECCS	CS-F036B	MOV
TOR	ECCS	SUPP	TANK
TOR	ECCS	HPCI-F021	MOV
TOR	ECCS	HPCI-F042	MOV
TOR	ECCS	SUPP	TANK
TOR	ECCS	RHR-F004A	MOV
TOR	ECCS	RHR-F004B	MOV
TOR	ECCS	RHR-F004C	MOV
TOR	ECCS	RHR-F004D	MOV
TOR	ECCS	RHR-F006A	MOV
TOR	ECCS	RHR-F006B	MOV
TOR	ECCS	RHR-F006C	MOV
TOR	ECCS	RHR-F006D	MOV
TOR	ECCS	RHR-F010	MOV
TOR	ECCS	RHR-F010	MOV
TOR	ECCS	RHR-F017A	MOV
TOR	ECCS	RHR-F017B	MOV
TOR	ECCS	RHR-F024A	MOV

Table 4-2 Partial Listing of Components by Location at Fermi Unit 2 (continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
TOR	ECCS	RHR-F024B	MOV
TOR	ECCS	RHR-F028A	MOV
TOR	ECCS	RHR-F028B	MOV
TOR	ECCS	RHR-F611A	MOV
TOR	ECCS	RHR-F611B	MOV
TOR	ECCS	SUPP	TANK
TOR	RCIC	RCIC-F001	MOV
TOR	RCIC	RCIC-F019	MOV
TOR	RCS	SUPP	TANK
TOR	RCS	RHR-F008	MOV

5. BIBLIOGRAPHY FOR FERMI 2

1. NUREG-0769, "Environmental Statement Related to the Operation of Enrico Fermi Atomic Power Plant, Unit No. 2", USNRC.

2. NUREG-0798, "Safety Evaluation Report Related to the Operation of Enrico Fermi Atomic Power Plant, Unit No. 2", USNRC.

3. NUREF-1141, "Technical Specifications for Fermi-2 Facility", USNRC.

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

A1. SYSTEM DRAWINGS

A1.1 Fluid System Drawings

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

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

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

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

A1.2 Electrical System Drawings

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

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

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

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

A2. SITE AND LAYOUT DRAWINGS

A2.1 Site Drawings

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

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

A2.2 Layout Drawings

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

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

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

A3. APPENDIX A REFERENCES

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

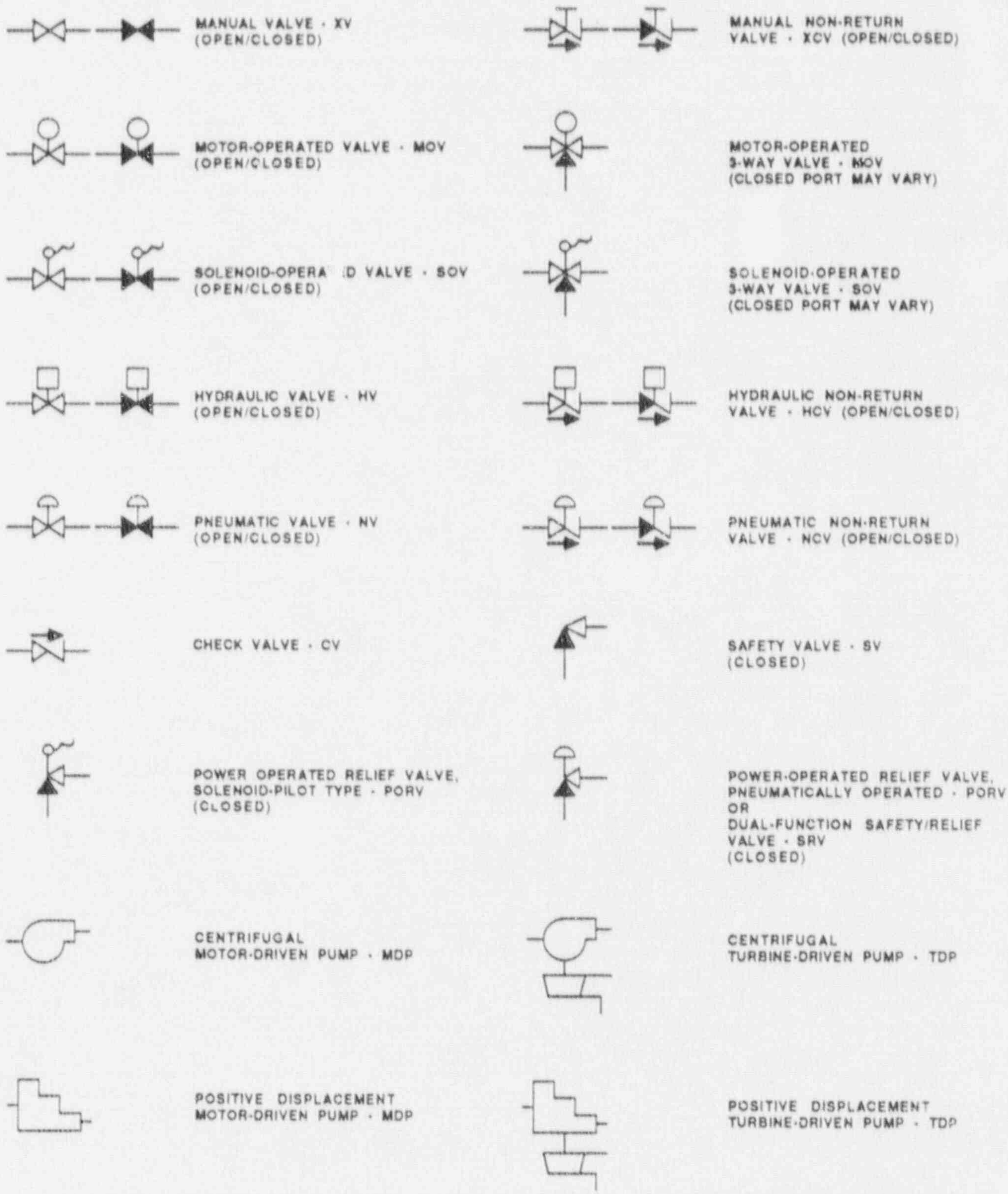


Figure A-1. Key To Symbols In Fluid System Drawings

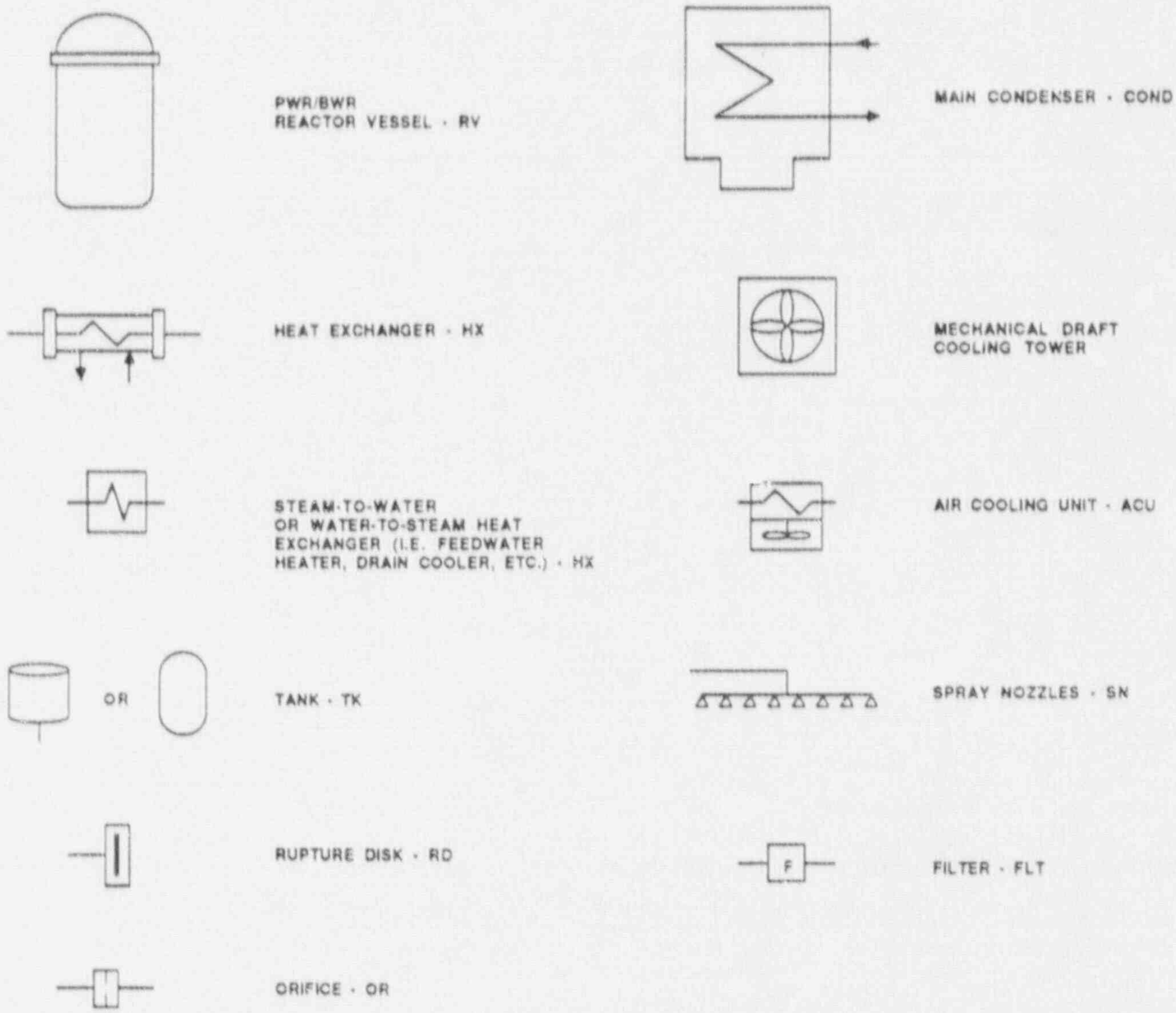


Figure A-1. Key To Symbols In Fluid System Drawings
(Continued)

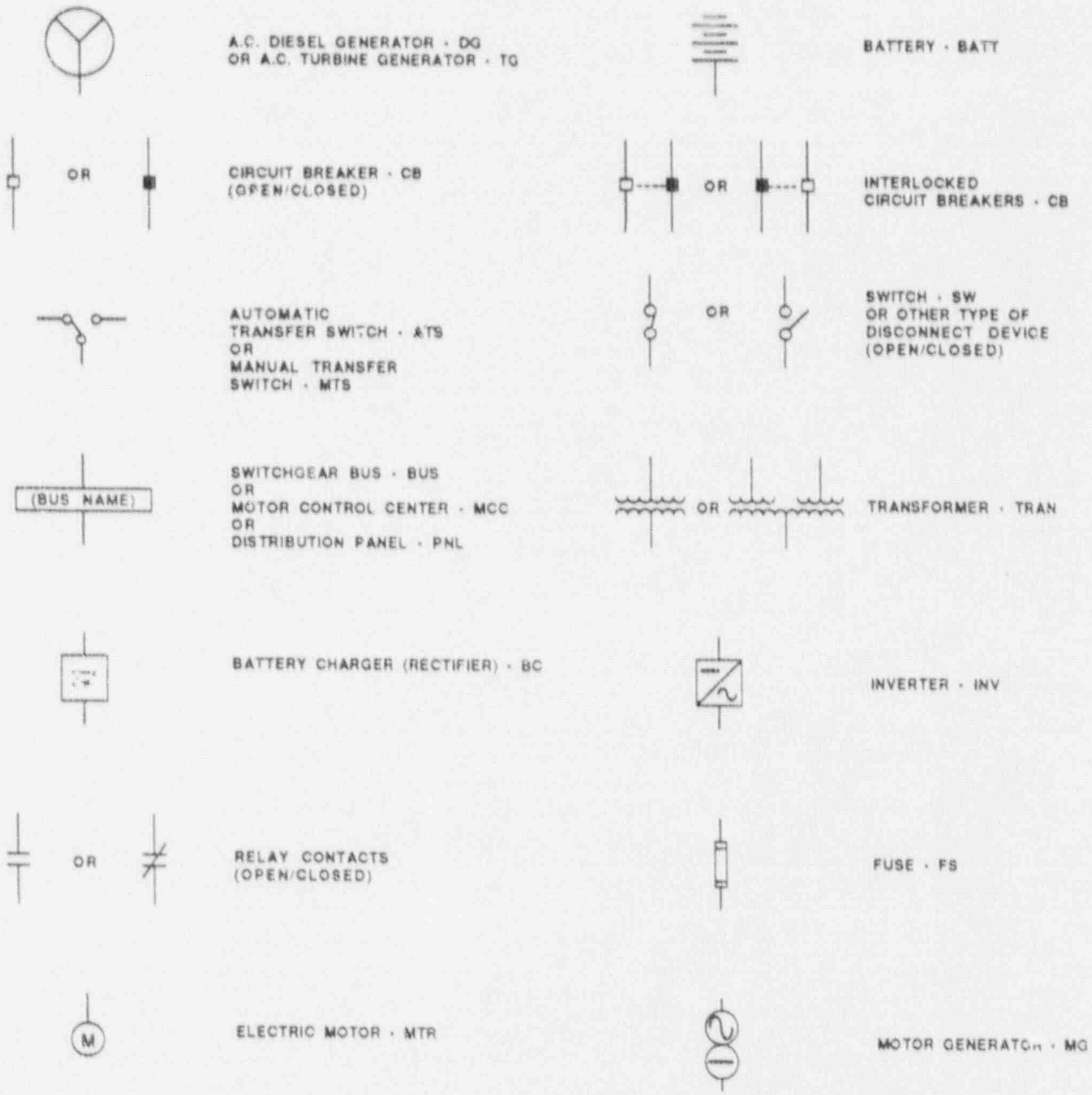


Figure A-2. Key To Symbols In Electrical System Drawings

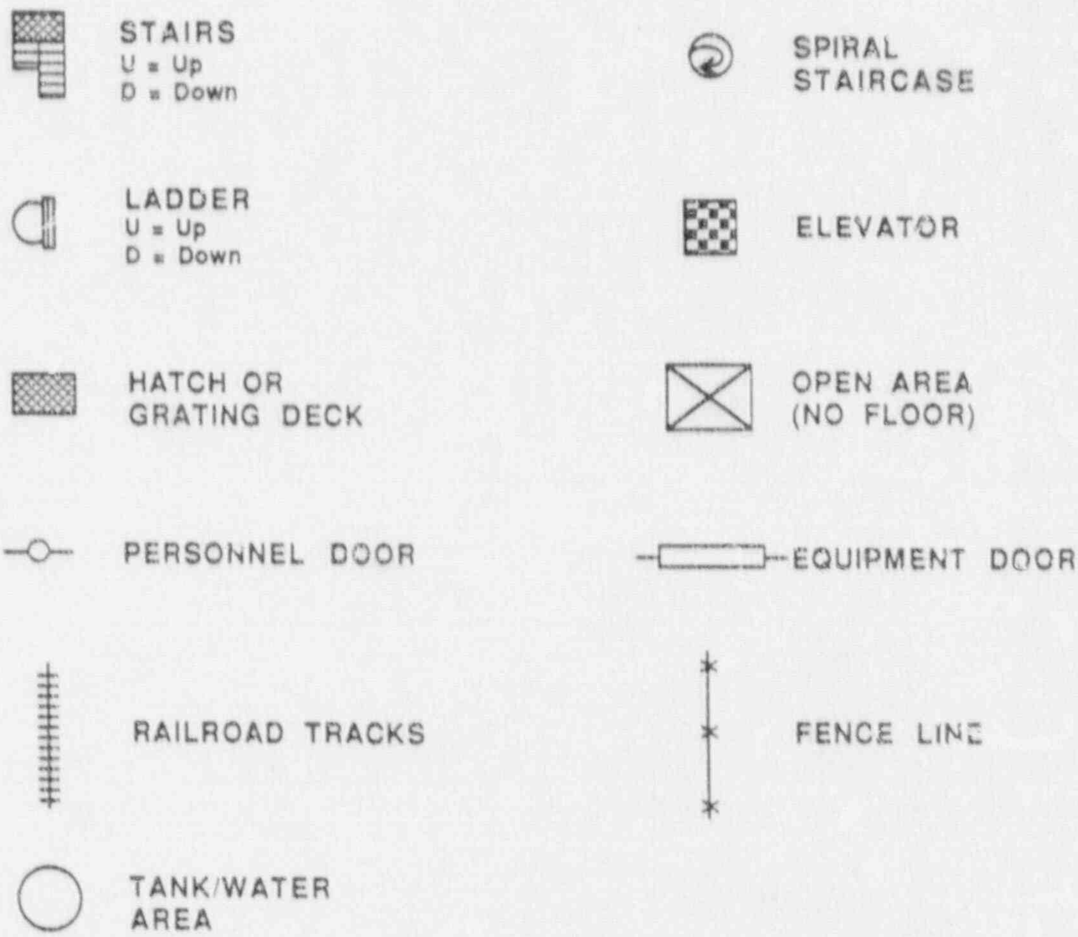


Figure A-3. Key To Symbols In Facility Layout Drawings

APPENDIX B
DEFINITION OF TERMS USED IN THE DATA TABLES

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

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

Code	Definition
RCS	Reactor Coolant System
RCIC	Reactor Core Isolation Cooling System
ECCS	Emergency Core Cooling Systems (including HPCI, LPCI, LPCS and ADS)
EP	Electric Power System
EECW	Emergency Equipment Cooling Water System
RHRSW	RHR and Emergency Equipment Service Water Systems

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

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

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

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

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

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

TABLE B-1. COMPONENT TYPE CODES

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

TABLE B-1. COMPONENT TYPE CODES (Continued)

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