NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

DRESDEN 2 & 3

50-237 and 50-249

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NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

DRESDEN 2 & 3

50-237 and 50-249

Editor: Peter Lobner
Author: James Mowrey

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SAIC

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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:

Mr. Mark Rubin
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Division of Engineering and Systems Technology
Mail stop 7E4
Washington, D.C. 20555

With copy to:

Mr. Peter Lobner
Manager, Systems Engineering Division
Science Applications International Corporation
10210 Campus Point Drive
San Diego, CA 92131
(619) 458-2673

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.

DRESDEN 2 & 3
RECORD OF REVISIONS

REVISION	ISSUE	COMMENTS
0	11/89	Original report

DRESDEN 2 AND 3 SYSTEM SOURCEBOOK

This sourcebook contains summary information on the Dresden 2 and 3 nuclear power plants. 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 Dresden nuclear plant is listed below:

- Docket number	50-237 (Unit 2) and 50-249 (Unit 3)
- Operator	Commonwealth Edison Company
- Location	Grundy County in Illinois
- Commercial operation date	6/70 (Unit 2), 11/71 (Unit 3)
- Reactor type	BWR/3
- NSSS vendor	General Electric
- Power (MWt/MWe)	2527/809
- Architect-engineer	Sargent and Lundy, Inc.
- Containment type	Steel drywell and wetwell (Mark I)

2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

The Dresden 2 and 3 nuclear plants have General Electric BWR/3 nuclear steam supply systems. Dresden 2 and 3 have an isolation condenser system similar to Millstone 1, and a High Pressure Coolant Injection (HPCI) system similar to Monticello and Pilgrim 1. Dresden 2 and 3 also has a single-mode Residual Heat Removal (RHR) system which performs only a shutdown cooling function. Each unit has a Mark I BWR containment incorporating the drywell/pressure suppression concept, and has a secondary containment structure of reinforced concrete. Other BWR/3 plants in the United States are as follows:

- Millstone 1
- Pilgrim 1
- Monticello
- Quad Cities 1 & 2

3. SYSTEM INFORMATION

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

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

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor Heat Removal Systems			
- Reactor Coolant System (RCS)	Same	3.1	4.2, 4.3, 4.5
- Isolation Condenser Systems	Same	3.2	4.6
- Emergency Core Cooling Systems (ECCS)	Same	-	6.2
- High-Pressure Injection & Recirculation	High-Pressure Coolant Injection (HPCI) System	3.4	6.2.5
- Low-Pressure Injection & Recirculation	Core Spray (CS) System,	3.4	6.2.3
	Low-Pressure Coolant Injection (LPCI) System	3.4	6.2.4
- Automatic Depressurization System (ADS)	Same	3.4	6.2.6
- Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System)	Shutdown Cooling System (single-mode)	3.10	10.4
- Main Steam and Power Conversion Systems	Main Steam Supply System,	X	4.4, 6.4
	Condensate and Feedwater System,	X	11.3
	Circulating Water System	X	11.3
- Other Heat Removal Systems	Standby Coolant Supply System,	X	6.3
	Reactor Vessel Head Cooing System	X	10.5

Table 3-1. Summary of Dresden 2 & 3 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	10.3
- ECCS	See above	-	-
- Control Rod Drive Hydraulic System (CRDHS)	Same	3.7	10.6
Containment Systems			
- Primary Containment	Containment Structure (drywell and pressure suppression chamber)	X	5.2
- Secondary Containment	Same	X	5.3
- Standby Gas Treatment System (SGTS)	Same	X	5.3.2.5
- Containment Heat Removal Systems			
- Suppression Pool Cooling System	Suppression Pool Cooling Mode (an operating mode of the LPCI system)	3.4	6.2.4
- Containment Spray System	Containment Spray Cooling Mode (an operating mode of the LPCI system)	3.4	6.2.4
- Containment Fan Cooler System	None	-	-
- Containment Normal Ventilation Systems	Same	X	5.2, 5.3
- Combustible Gas Control Systems	Containment Atmosphere Control Systems	X	6.8

Table 3-1. Summary of Dresden 2 & 3 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	3
- Control Rod System	Control Rod Drive System	X	3.5.3, 6.5, 6.6
- Chemical Poison System	Standby Liquid Control System (SLCS)	X	6.7, 7.3.4
Instrumentation & Control (I&C) Systems			
- Reactor Protection System (RPS)	Same	3.5	7.7.1
- Engineered Safety Feature Actuation System (ESFAS)	Engineered Safety Feature Systems	3.5	7.7.2
- Remote Shutdown System	Local control panels	3.5	Not described
- Other I&C Systems	Various other systems	X	7.2 to 7.6, 7.8 to 7.11
Support Systems			
- Class 1E Electric Power System	Same	3.6	8
- Non-Class 1E Electric Power System	Same	3.6	8
- Diesel Generator Auxiliary Systems	Same	3.6	8.2.3.1, 8.3.1
- Component Cooling Water (CCW) System	Reactor Building Closed Cooling Water (RBCCW) System	X	10.10

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Support Systems (continued)			
- Service Water System (SWS)	Service Water System	X	10.9
- Residual Heat Removal Service Water (RHRSW) System	Containment Cooling Service Water,	3.9	6.4
	Reactor Building Closed Cooling Water (RBCCW) System	X	10.10
- Other Cooling Water Systems	Diesel Generator Service Water (DGSW) System,	3.8	10.9
	Turbine Building Closed Cooling Water (TBCCW) System	X	Not described
- Fire Prote tion Systems	Fire Suppression Water System	3.3	10.7
- Other Water Systems	Condensate Transfer System	3.3	10.12
- Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems	Same	X	10.11
- Instrument and Service Air Systems	Station Instrument and Service Air System	X	10.8
- Refueling and Fuel Storage Systems	Fuel Storage and Handling Systems,	X	10.1
	Fuel Pool Cooling and Cleanup Systems	X	10.2
- Radioactive Waste Systems	Radioactive Waste Management Systems	X	9
- Radiation Protection Systems	Same	X	12

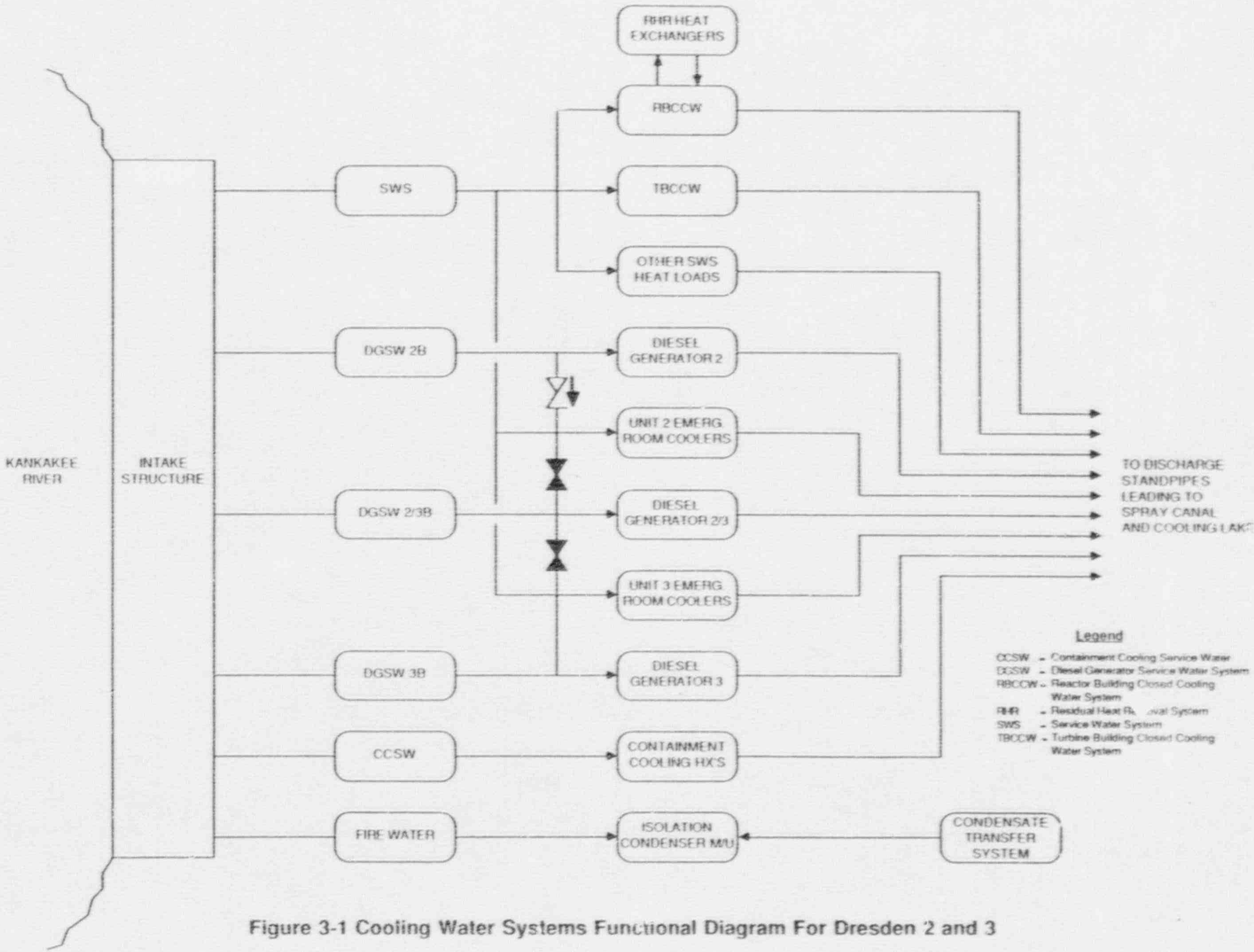


Figure 3-1 Cooling Water Systems Functional Diagram For Dresden 2 and 3

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) two recirculation pumps, (d) 13 safety/relief 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, mixes with the feedwater and is recycled again.

A portion 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 lines. 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 either dumped to the suppression chamber via safety/relief valves on the main steam lines or removed by boiling water in the isolation condenser.. 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 Emergency Core Cooling System (ECCS, see Section 3.4). Heat is transferred from the containment by the Low Pressure Coolant Injection (LPCI) System operating in the containment cooling mode. The Containment Cooling Service Water (CCSW) System completes the heat transfer path from the containment to the ultimate heat sink (see Section 3.9). Actuation systems provide for automatic closure of the MSIVs and isolation of other lines connected to the RCS.

RCS overpressure protection is provided by thirteen safety/relief valves which discharge to the suppression pool.

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 mitigatable LOCA is initiated, then LOCA mitigating systems are successful.

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

3.1.5 Component Information

A. RCS
1. Steam flow: 9.765×10^6 lb/hr
2. Normal operating pressure: 1005 psig

B. Safety/relief Valves (13)
1. Electromagnetic relief valves set pressure and discharge rate: 4 @ 1130 to 1135 psig, 540,000 lbm/hr (each)
2. Target-Rock safety/relief valve set pressure and discharge rate: 1115 psig; 622,000 lbm/hr
3. Safety valves set pressure and discharge rate: 1240 to 1260 psig; 644,501 to 654,774 lbm/hr (each)

C. Recirculation Pumps (2)
1. Rated flow: 45,200 gpm @ 570 ft. head
2. Type: Single stage vertical centrifugal, variable speed

D. Jet Pumps (20)

3.1.6 Support Systems and Interfaces

A. Motive Power

The recirculation pumps are supplied by non-Class 1E power through variable frequency motor generator sets.

B. MSIV Operating Power

The station instrument and service 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 the pneumatic supply 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 provides cooling water to the recirculation pump coolers.

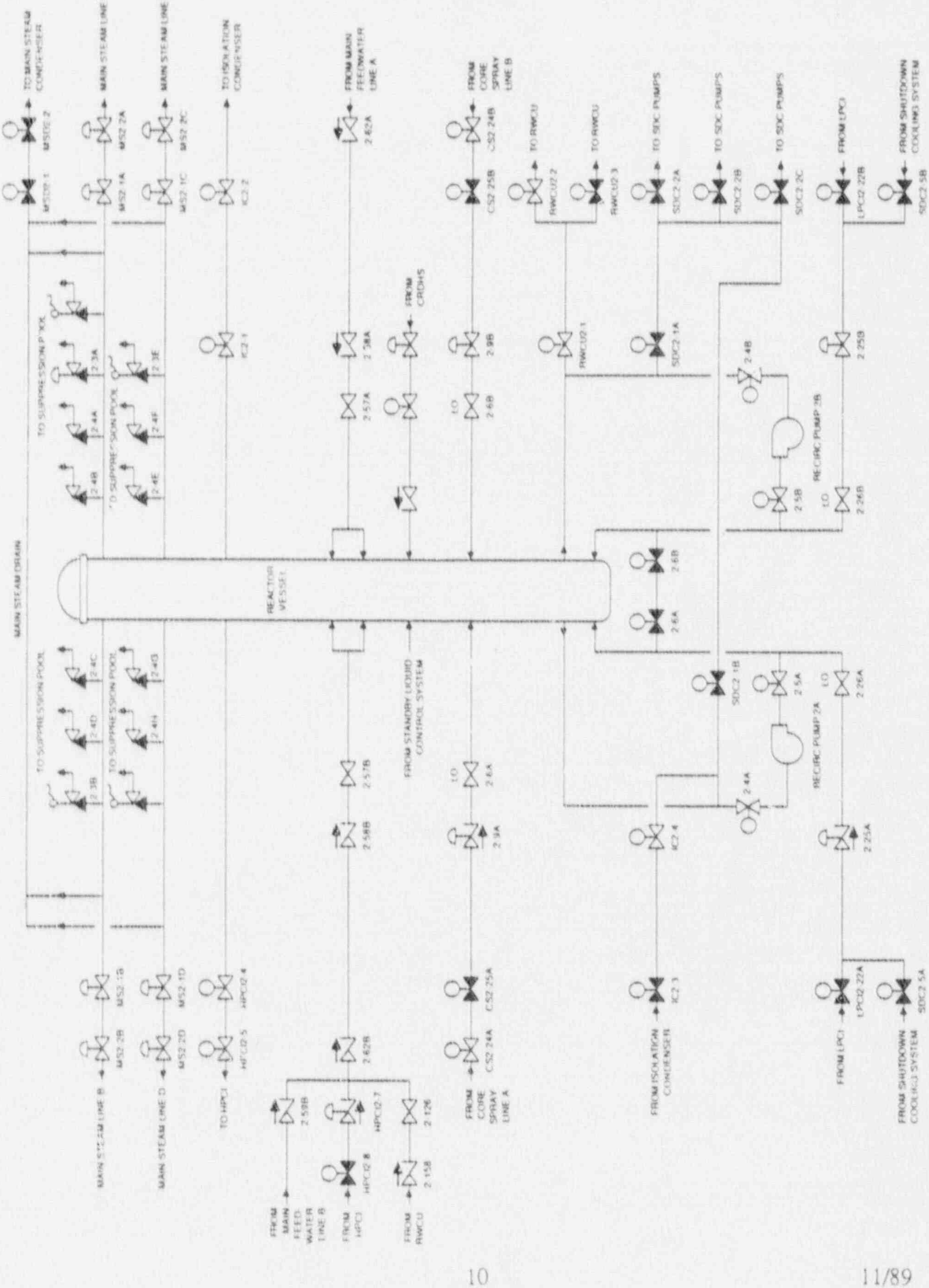


Figure 3.1-1. Dresden Unit 2 Reactor Coolant System

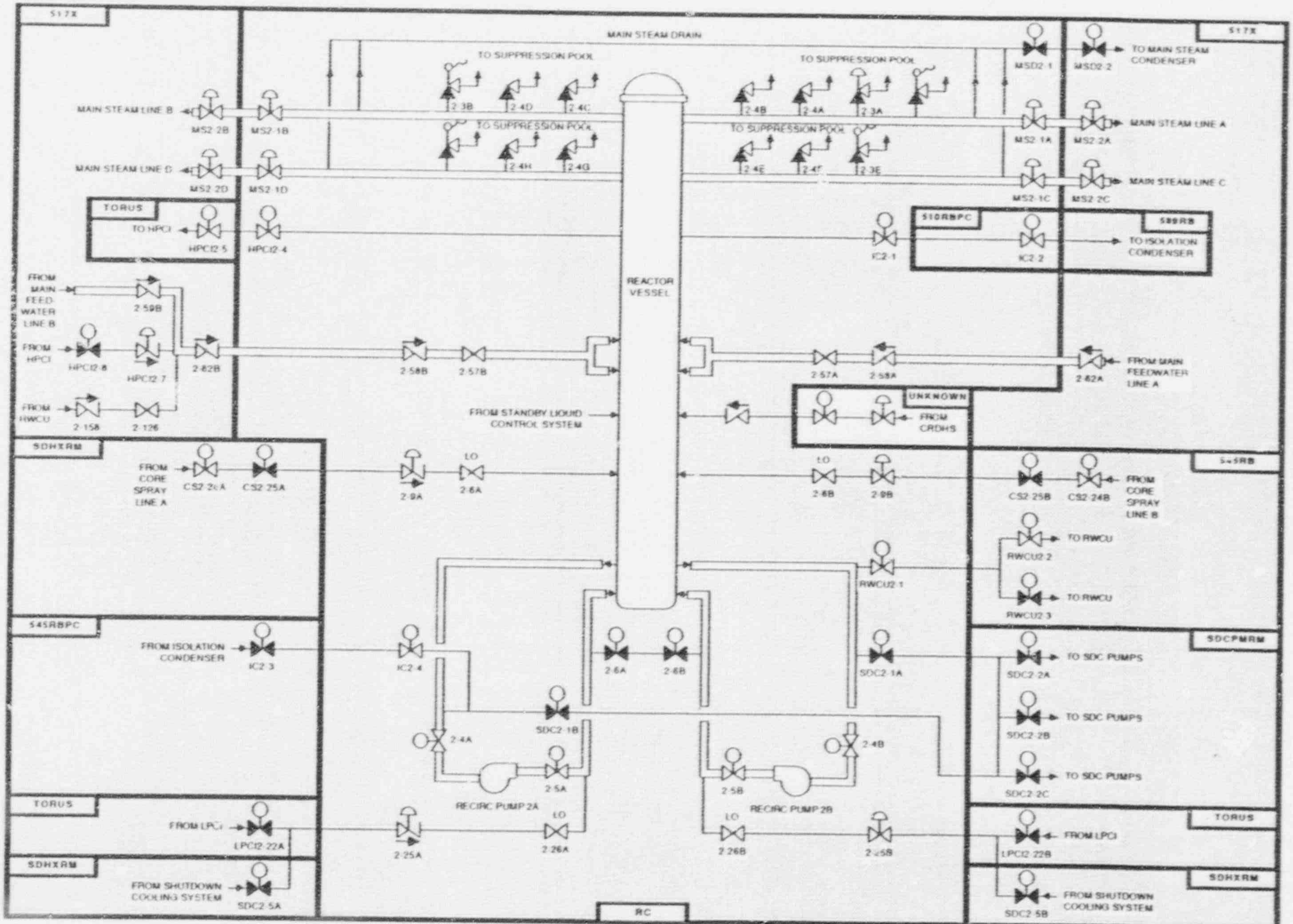


Figure 3.1-2. Dresden Unit 2 Reactor Coolant System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
MS2-1A	NV	RC				
MS2-1B	NV	RC				
MS2-1C	NV	RC				
MS2-1D	NV	RC				
MS2-2A	NV	517X				
MS2-2B	NV	517X				
MS2-2C	NV	517X				
MS2-2D	NV	517X				
MSD2-1	MOV	RC	MCC 28-1	480	517RB	AC/2-3
MSD2-2	MOV	517X	RB BUS 2A-2B	250	570RB	250/3
RWCU 2-1	MOV	RC	MCC 28-1	480	517RB	AC/2-3
RWCU2-2	MOV	545RB	UNKNOWN	250	UNKNOWN	DC
RWCU2-3	MOV	545RB	UNKNOWN	250	UNKNOWN	DC

3.2 ISOLATION CONDENSER (IC) SYSTEM

3.2.1 System Function

The isolation condenser system provides adequate core cooling in the event that the reactor becomes isolated from the main condenser. As such, the isolation condenser is a transient mitigating system.

3.2.2 System Definition

The isolation condenser removes residual and decay heat from the reactor vessel in the event that the main condenser is not available due to closure of the main steam isolation valves, or if a high-pressure condition exists. The system employs natural circulation as the driving head through the isolation condenser tubes and relies only on DC power for initiation.

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

3.2.3 System Operation

The isolation condenser system is normally in standby. The isolation condenser system is initiated by sustained (15 seconds) high reactor pressure (1070 psig). Normally, three of the four motor operated isolation valves are open, so that only one DC powered valve is required to open to begin operation. Steam passes through the tube side of the isolation condenser, condensing along the way. Water on the shell side is allowed to boil off as steam which is vented to atmosphere. Condensate returns by gravity to the reactor. The inventory of the shell side lasts approximately 20 minutes, and it takes approximately another 20 minutes before reactor vessel water level reaches the top of the core due to decay heat removal via the relief valves, by which time makeup can be provided by the fire protection system or the condensate transfer system (see Section 3.3).

Following a loss of all AC power, the isolation condenser will still operate. Makeup water to the shell side will be supplied by the fire protection system since the diesel-driven fire pumps automatically start when pressure falls in the fire main. The isolation valves between the fire main and the isolation condenser are also DC powered. Thus the isolation condenser system will function under blackout conditions.

3.2.4 System Success Criteria

For transient mitigation, the requirements for adequate coolant inventory and decay heat removal involve the following:

- Either the isolation condenser system, or
- Small LOCA mitigating systems (see Section 3.4)

For the isolation condenser to function properly, the one normally shut isolation valve must open and an adequate supply of makeup water to the shell side must be provided from either the fire protection system or the condensate transfer system. In addition, makeup to the RCS must be provided for long-term decay heat removal to account for leakage, relief valves lifting and coolant "shrink". This makeup to the RCS can be provided by either the HPCI system or the CRDHS.

3.2.5 Component Information

A. Isolation Condenser
1. Rated Capacity: 252.5 x 10^6 Btu/hr
2. Design Pressure: 1250 psig @ 575° F (tube side)
   25 psig @ 300° F (shell side)
3. Minimum Cooling Water Volume: 11,300 gal

3.2.6 Support Systems and Interfaces

A. Control Signals
1. Automatic
   The isolation condenser system is automatically initiated on sustained high reactor pressure. Initiation takes the form of opening the outboard isolation valve on the condensate return line.
2. Remote Manual
   The isolation condenser system can be actuated by remote manual means from the control room.

B. Motive Power
The isolation condenser motor-operated isolation valves are Class 1E AC and DC loads that can be supplied from the emergency diesel generators or station batteries. The only normally shut isolation valve is DC powered.

C. Makeup Water Sources
1. Fire Suppression Water System
   Makeup to the isolation condenser from the fire suppression water system is discussed in Section 3.3. Diesel driven fire water pumps enable makeup to be accomplished under blackout conditions.
2. Condensate Transfer System
   Makeup to the isolation condenser from the condensate transfer system is discussed in Section 3.3. The condensate transfer pumps require Class 1E AC power.
3. Clean Demineralized Water System
   Non-Class 1E clean demineralized water pumps in area 517TB can supply makeup to the isolation condenser. Details of the piping interface, with the isolation condenser have not been determined; however, there is a check valve and a motor-operated valve (4399-74) in this makeup path.

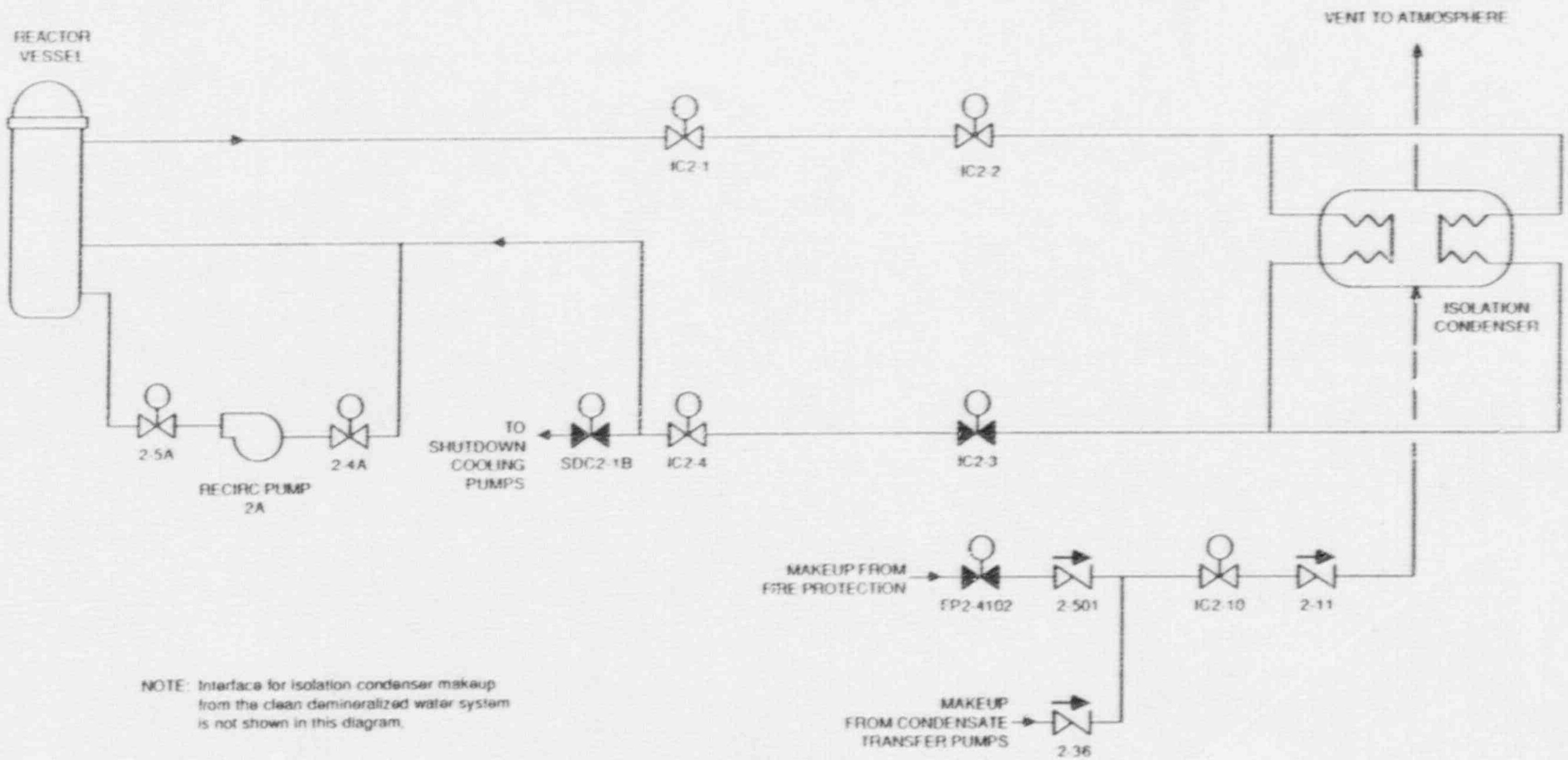


Figure 3.2-1. Dresden Unit 2 Isolation Condenser System

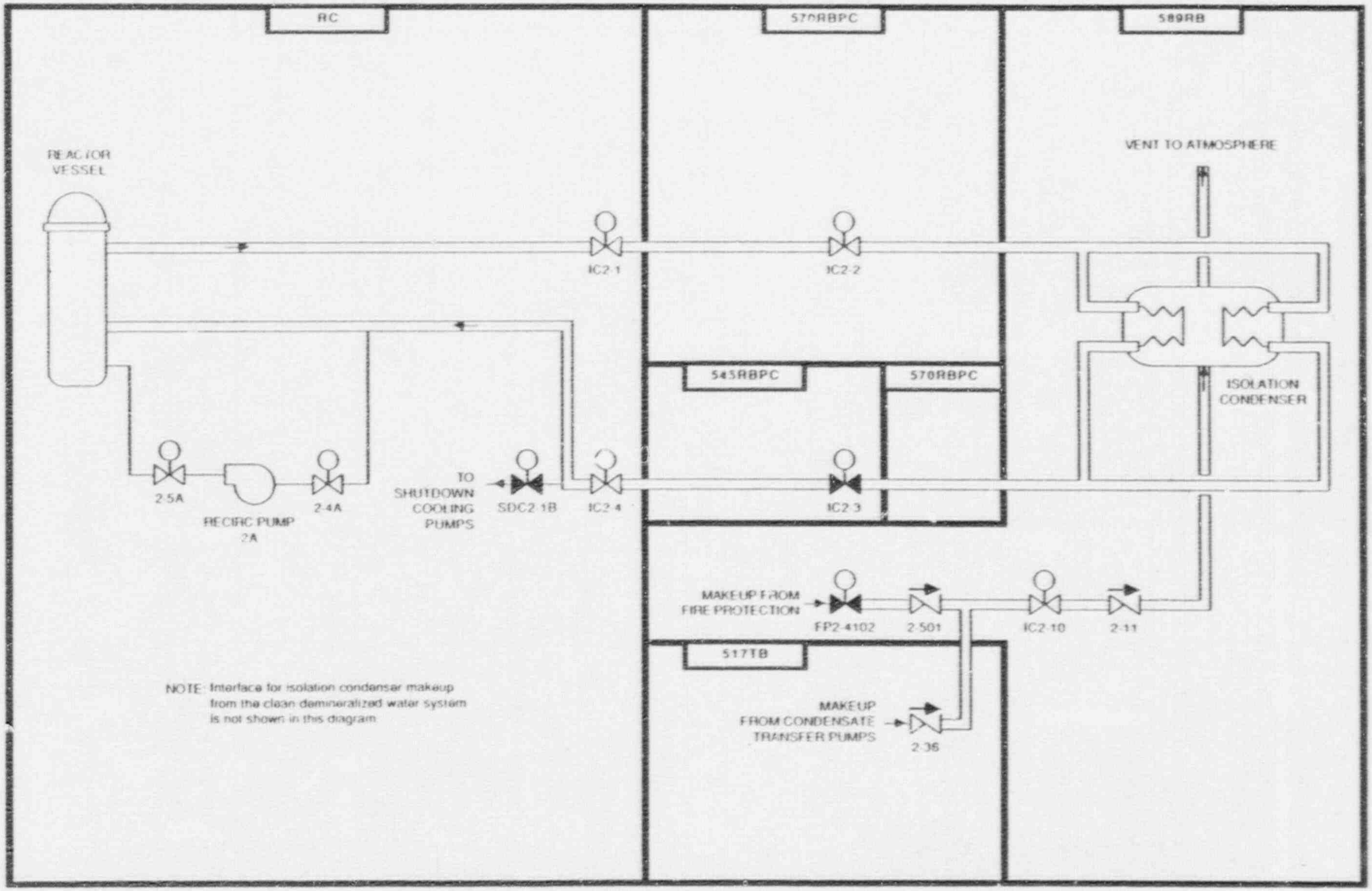


Figure 3.2-2. Dresden Unit 2 Isolation Condenser System Showing Component Locations

Table 3.2-1. Dresden 2 Isolation Condenser System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
IC2-1	MOV	RC	MCC 28-1	480	517RB	AC/2-3
IC2-2	MOV	570RBPC	RB BUS 2A-2B	250	570RB	250/3
IC2-3	MOV	545RBPC	RB BUS 2A-2B	250	570RB	250/3
IC2-4	MOV	RC	MCC 28-1	480	517RB	AC/2-3
ISO COND	HX	589RB				

3.3 FIRE PROTECTION SYSTEM AND CONDENSATE TRANSFER SYSTEM

3.3.1 System Function

The fire protection system provides water, halon, portable extinguishers and carbon dioxide to support fire suppression activities throughout the plants. The system also provides makeup to the isolation condenser to support its long-term operation.

The condensate transfer system provides makeup water to the main condenser and the isolation condenser from the condensate storage tanks.

3.3.2 System Definition

The portion of the fire protection system which can supply makeup to the isolation condenser is the fire suppression water system. The fire mains for the Unit 1 and Unit 2/3 systems are tied together into one station "ring header" which is fed by pumps in the Unit 2 and 3 cribhouse and the separate Unit 1 cribhouse. The fire suppression water system services individually valved lines feeding fixed pipe water suppression systems (wet pipe sprinklers, deluge systems and pre-action sprinklers), fire hoses throughout the units and hydrants located around the exterior of the station. The system normally receives its water from the Unit 2/3 service water pumps. Backup supplies are the Unit 1 screen wash pumps, the Unit 1 diesel-driven fire pump and the Unit 2/3 diesel-driven fire pump. The pumps are supplied by river water.

The condensate transfer system for Unit 2 consists of two condensate transfer pumps, a condensate transfer jockey pump, two condensate makeup pumps and piping and valves. The Unit 3 system should be the same. The Unit 2 condensate transfer system shares two 250,000 gallon condensate storage tanks with the Unit 3 system.

Simplified drawings of the portion of the fire suppression water system which supplies makeup to the isolation condenser are shown in Figures 3.3-1 and 3.3-2. Simplified drawings of the Unit 2 condensate transfer system makeup paths to the isolation condenser are shown in Figures 3.3-3 and 3.3-4. A summary of data on selected components associated with isolation condenser makeup from the fire suppression water and condensate transfer system is presented in Table 3.3-1.

3.3.3 System Operation

During normal operation, the Unit 2/3 service water pumps maintain the fire main pressure from 95 to 105 psig. The Unit 2/3 diesel-driven fire pump is activated at 80 psig. If line pressure continues to drop, the Unit 1 screen wash pumps are activated at 75 psig fire main pressure and supply 2,000 gpm each and the Unit 1 diesel-driven fire pump is activated at 70 psig. Both the diesel-driven pumps deliver 2000 gpm.

The condensate transfer system is not normally in operation. When placed in operation, the condensate makeup pumps are used to supply the main condenser and other makeup needs. The condensate transfer and transfer jockey pumps are used to supply makeup to the shell side of the isolation condenser or to transfer condensate to other locations.

3.3.4 System Success Criteria

In terms of the isolation condenser, the success criteria are that either the fire protection system or the condensate transfer system provide makeup water to the shell side of the isolation condenser prior to core damage occurring. The diesel-driven fire water pumps are sized to allow multiple, simultaneous demands on the system. Therefore, opening of fire hydrants is not expected to affect the capability to supply makeup to the isolation condenser.

3.3.5 Component Information

A. Service Water Pumps (5 pumps, 2 each per unit and 1 shared between units)
   1. Rated flow: 15,000 gpm @ 91 psig each

B. Unit 1 Screen Wash Pumps (2)
   1. Rated flow: 2000 gpm @ 75 psi each

C. Unit 2/3 Diesel-Driven Fire Pump
   1. Rated flow. 2,000 gpm @ 80 psig

D. Unit 1 Diesel-Driven Fire Pump
   1. Rated flow: 2,000 gpm @ 70 psig

E. Condensate Transfer Pumps (2)
   1. Rated flow 350 gpm @ unknown head

F. Condensate Transfer Jockey Pump
   1. Rated flow: 70 gpm @ unknown head

G. Unit 2/3 Condensate Storage Tanks (2)
   1. Minimum volume: 200,000 gallons each with 90,000 gallons in one tank reserved for HPCI operation

3.3.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. The Unit 2/3 diesel-driven fire pump is actuated automatically by a pressure switch set at a fire main pressure of 80 psig.
      b. The Unit 1 screen wash pumps are actuated automatically by a pressure switch set at a fire main pressure of 75 psig.
      c. The Unit 1 diesel-driven fire pump is actuated automatically by a pressure switch set at a fire main pressure of 70 psig.
      d. It is assumed that the condensate transfer system has no automatic start feature, but this should be verified.
   2. Remote Manual
      It is not known whether the fire pumps or the condensate transfer system pumps can be actuated by remote manual means from the control room.

B. Motive Power
   1. The service water pumps are non-Class 1E AC loads.
   2. The power supplies for the Unit 1 screen wash pumps are unknown.
   3. The diesel-driven emergency fire pumps have their own dedicated diesel engines.
   4. The power supplies for the condensate transfer and transfer jockey pumps are Class 1E AC buses.

C. Diesel Fire Pump Auxiliary Systems

Information regarding diesel pump auxiliaries, such as cooling, lubrication, and starting was unavailable. The Unit 2/3 emergency fire pump's diesel fuel day tank is in area PUMPHS in the crib house.

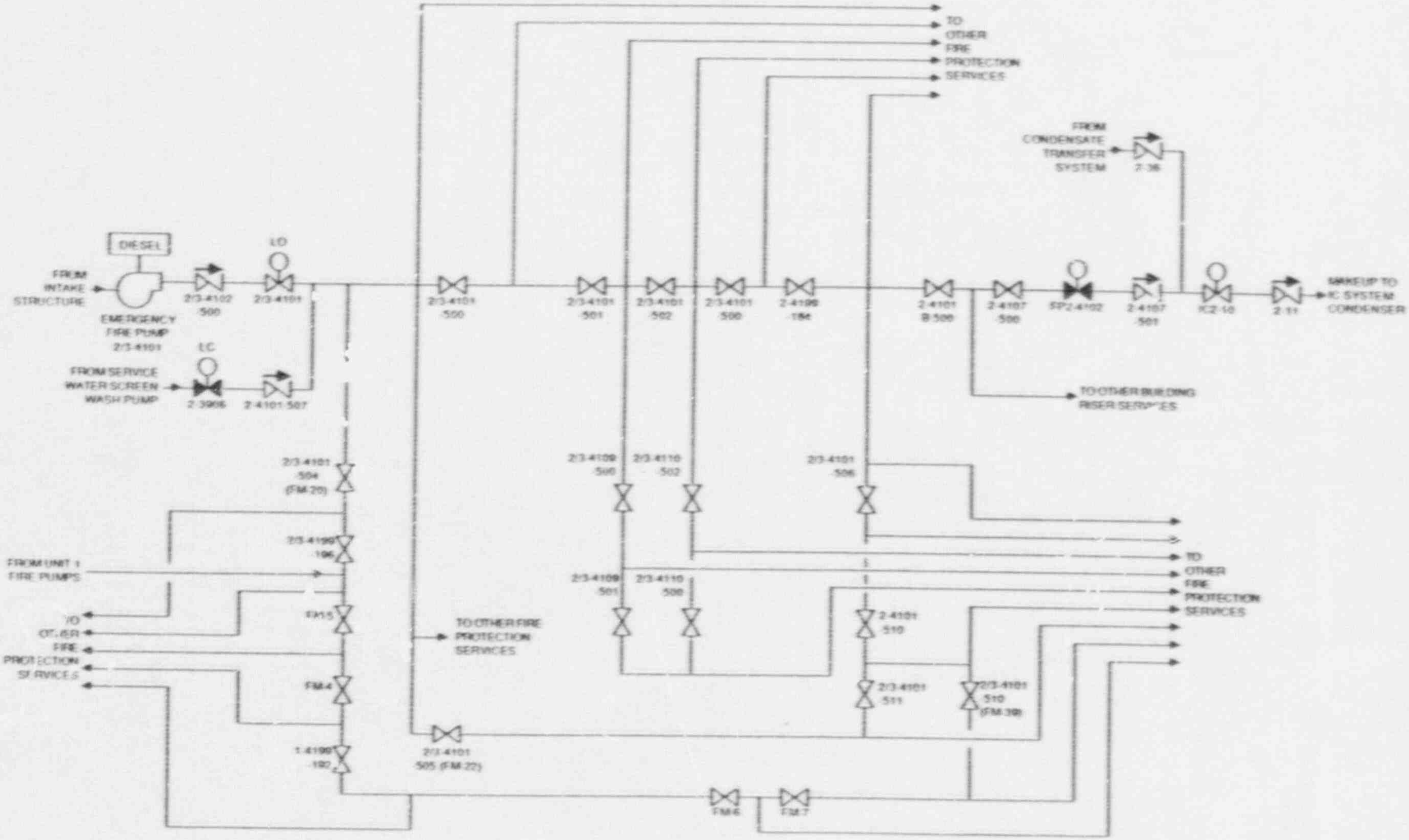


Figure 3.3-1. Dresden Unit 2 Fire Protection System Makeup to the Isolation Condenser

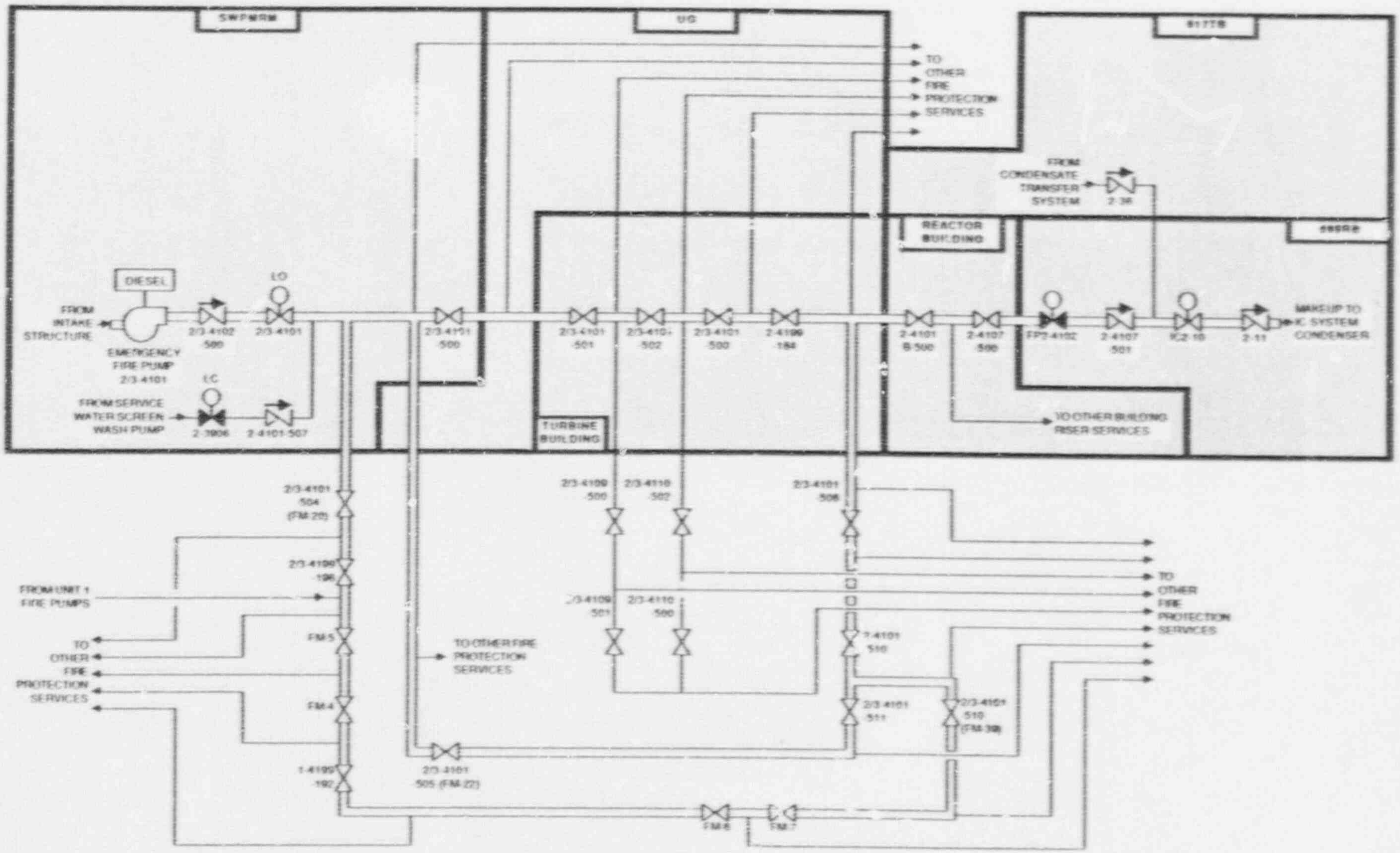


Figure 3.3-2. Dresden Unit 2 Fire Protection System Makeup to the Isolation Condenser Showing Component Locations

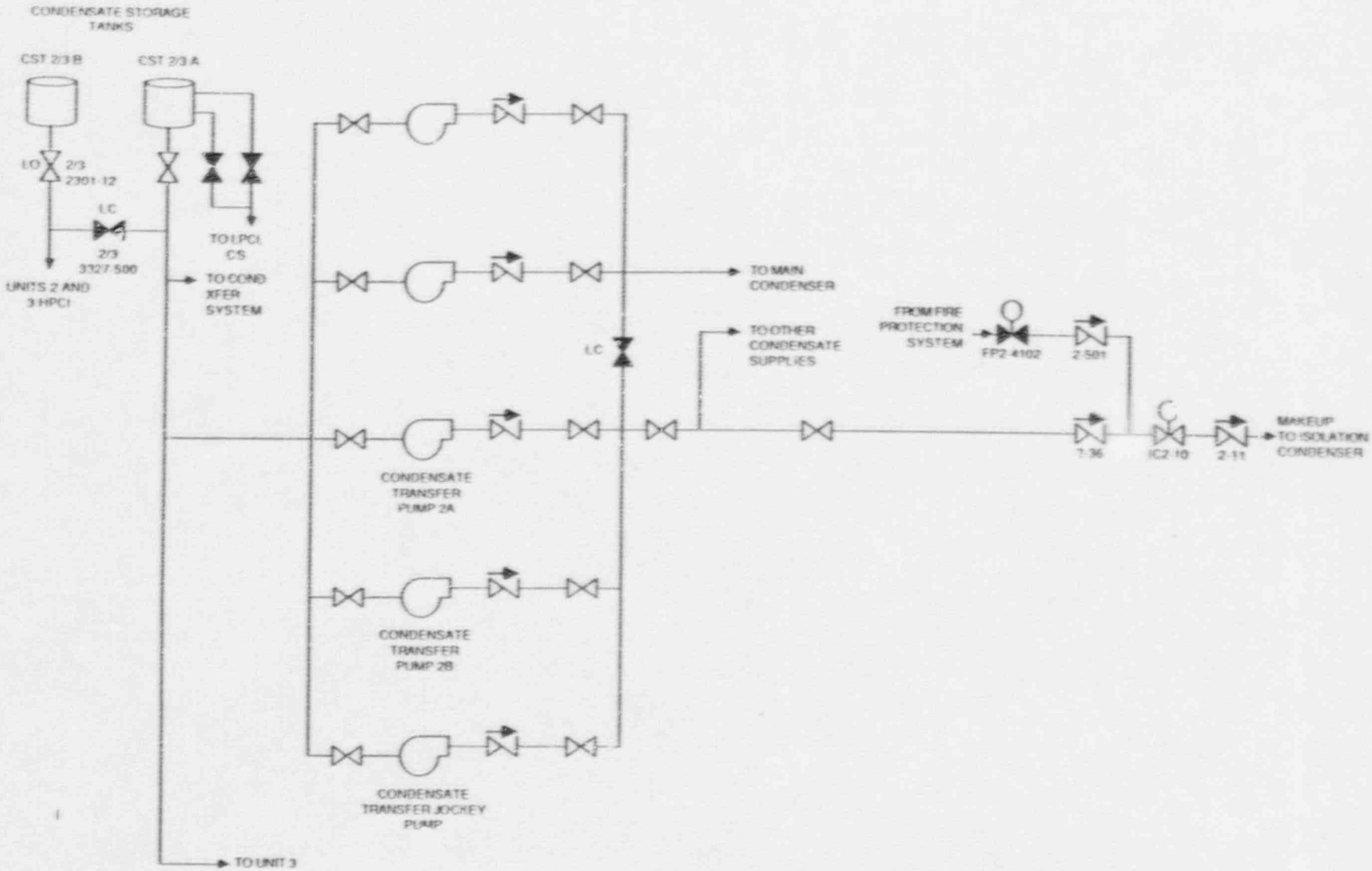


Figure 3.3-3. Dresden Unit 2 Condensate Transfer System Makeup to the Isolation Condenser

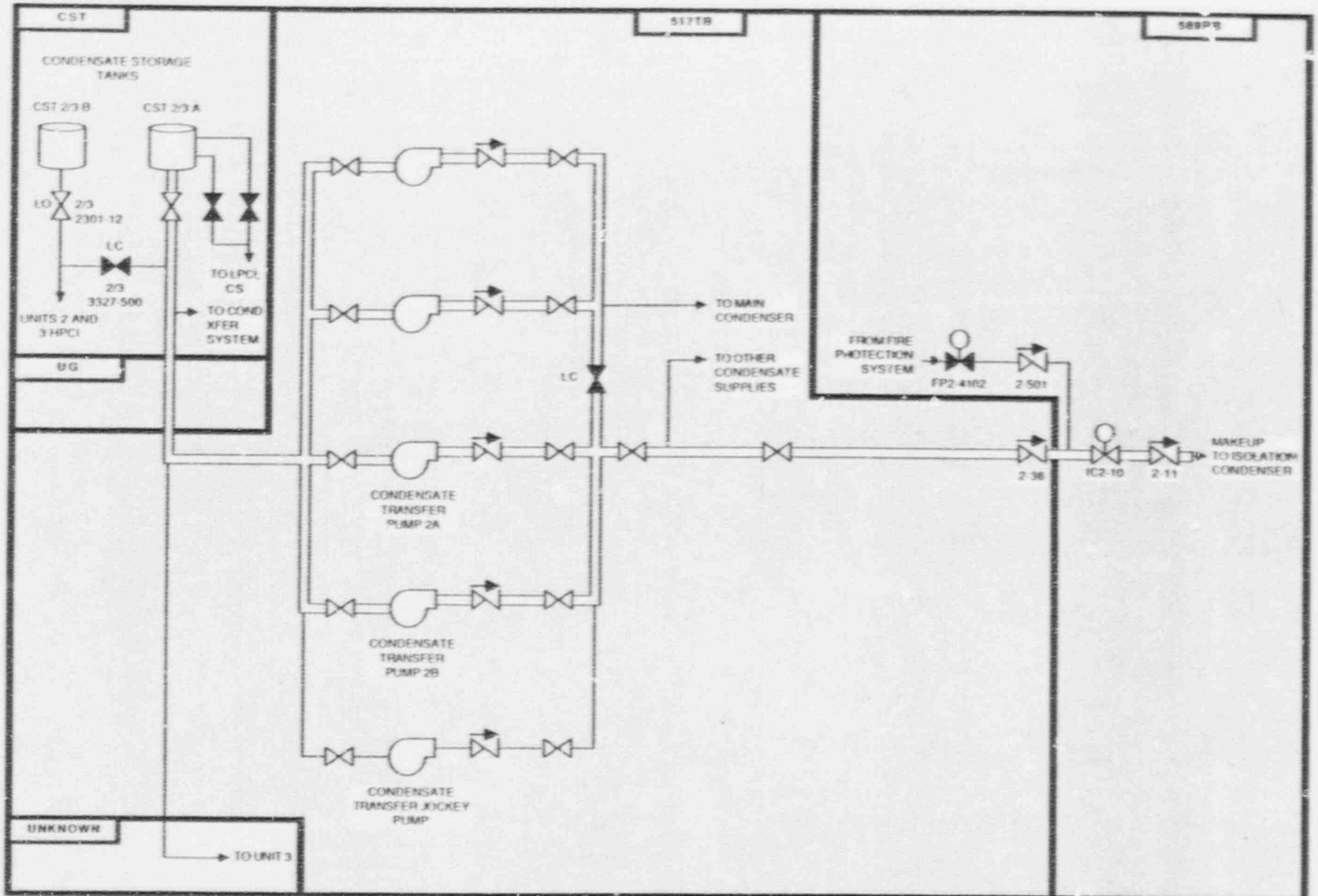


Figure 3.3-4. Dresden Unit 2 Condensate Transfer System Makeup to the Isolation Condenser Showing Component Locations

Table 3.3-1. Dresden 2 Isolation Condenser Makeup Systems Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CST2/3A	TANK	CST				
CTS PUMP 2A	MDP	517TB	MCC 28-2	480	538TB	AC/2-3
CTS PUMP 2B	MDP	517TB	MCC 29-2	480	517TB	AC/2
FIRE PUMP 2/3	DDP	SWPMRM				
FP2-4102	MOV	FP-UNK	589RB	250	UNKNOWN	DC
IC2-10	MOV	589RB	MCC 28-1	480	517RB	AC/2-3

3.4 EMERGENCY CORE COOLING SYSTEM (ECCS)

3.4.1 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 and containment cooling and containment spray functions and has a capability for mitigating transients.

3.4.2 System Definition

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

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

The HPCI system is provided to supply make-up water to the reactor pressure vessel (RPV) in the event of a small break LOCA which does not result in a rapid depressurization of the reactor vessel. The HPCI system consists of a turbine-driven pump and booster pump, system piping, valves and controls. The HPCI pump can draw suction from either the Unit 2/3 CSTs or the suppression pool. The HPCI pump is normally aligned to draw a suction on the Unit 2/3 B CST. Water is injected into the reactor via feedwater line B. The HPCI turbine is driven by steam from a separate HPCI steam line. The turbine exhausts to the suppression pool.

The automatic depressurization system (ADS) provides automatic RPV depressurization for small breaks and transients so that the low pressure systems (LPCI and CS) can provide makeup to the RCS. The ADS utilizes 5 relief valves that discharge the high pressure steam to the suppression pool. There are additionally 8 reactor pressure safety valves which do not have a ADS function.

The CS system supplies make-up water to the reactor vessel at low pressure. The system consists of two motor-driven pumps to supply water from the suppression pool to two spray spargers in the reactor vessel above the core.

The low pressure coolant injection system provides make-up water to the reactor vessel at low pressure. The LPCI system consists of two loops with two pumps in each loop which supplies water from the suppression pool into the reactor vessel. There are two heat exchangers in the system, one for pumps 2A and 2B and one for pumps 2C and 2D (3A, 3B, 3C and 3D for Dresden 3). The LPCI system can be realigned as needed to perform suppression pool cooling or containment spray as part of the basic emergency core cooling function.

Simplified drawings of the CS system are shown in Figures 3.4-1 and 3.4-2. The LPCI system is shown in Figures 3.4-3 and 3.4-4. The HPCI system is shown in Figures 3.4-5 and 3.4-6. Interfaces between these systems and the RCS are shown in Section 3.1. A summary of data on selected ECCS components is presented in Table 3.4-1.

3.4.3 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 Unit 2/3 B Condensate Storage Tank (CST). On low level in the CST or high level in the suppression pool, the HPCI suction will automatically switch to the suppression pool. The HPCI system is automatically started in response to low-low RPV water level or high drywell pressure, and will serve as the primary source of makeup if RCS pressure remains high. The system is automatically stopped on high reactor vessel water level. Reactor core heat is dumped to the suppression pool via the safety/relief valves, which cycle as needed to limit RCS pressure. Steam to drive the HPCI turbine is routed from a separate steam line. Exhaust steam is directed to the suppression pool. Operation of the system is completely independent of AC power, requiring only 250 VDC power from the batteries. If the break is of such a size that the coolant loss exceeds the HPCI system capacity, then the CS and LPCI systems can provide higher capacity makeup to the reactor vessel.

The Automatic Depressurization System will automatically reduce RCS pressure if a break has occurred and RPV water level is not maintained by the HPCI system. Rapid depressurization permits flow from the CS or LPCI systems to enter the vessel.

The CS system consists of two loops, each containing one 100% capacity pump. Each loop provides makeup to the reactor vessel through separate spray spargers. The source of water is the suppression pool. The CS pumps start on reactor low-low water level and reactor low pressure or high drywell pressure. The injection valves to the reactor open only after reactor pressure is below pump shutoff head.

The LPCI system consists of four pumps which take a suction on the suppression pool and inject back into the vessel through the reactor recirculation loops. Other operating modes of the LPCI system include: (a) suppression pool cooling, in which water is recirculated from the suppression pool through the two containment cooling heat exchangers and back to the suppression pool via the full flow test line; (b) containment spray, in which water is pumped to fog jet nozzles in the drywell and suppression pool; and (c) containment cooling using the two containment cooling heat exchangers and the normal injection path. Three out of four pumps are required during the injection phase, but after that phase is complete, one loop can be used for containment/drywell spray or suppression pool cooling.

3.4.4 System Success Criteria

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

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

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

- The high-pressure coolant injection (HPCI) pump with a suction on the suppression pool or a condensate storage tank, or
- The automatic depressurization system (ADS) and 3 of 4 LPCI pumps with a suction on the suppression pool, or
- The automatic depressurization system and 1 of 2 core spray pumps with a suction on the suppression pool.

The success criterion for the ADS has not been determined. 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 3.7).

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 isolation condenser (IC) system (not part of the ECCS, see Section 3.2) and the control rod hydraulic drive system for RCS makeup, or
- Small LOCA mitigating systems

For the suppression pool cooling function to be successful, LPCI loop A or B must be aligned for suppression pool heat removal and the associated Containment Cooling Service Water (CCSW) train must be operating to complete the heat transfer path from the containment cooling heat exchangers to the ultimate heat sink.

3.4.5 Component Information

A. Turbine-driven HPCI pump and booster pump
   1. Rated flow: 5600 gpm @ 1135 to 165 psia
   2. Rated capacity: 100%
   3. Main pump type: multi-stage, horizontal centrifugal
   4. Booster pump type: single stage, horizontal centrifugal

B. Motor-driven CS pumps 2A, 2B
   1. Rated flow: 4500 gpm each @ 90 psig (vessel to drywell)
   2. Rated capacity: 100%
   3. Type: single stage, vertical centrifugal

C. Motor-driven LPCI pumps 2A, 2B, 2C, 2D
   1. Rated flow: 5350 gpm each @ 0 psig (3 pumps running)
   2. Rated capacity: 33 1/3%
   3. Type: single stage, vertical centrifugal

D. Containment Cooling Heat Exchangers 2A and 2B
   1. Heat transfer capability: 102×10^6 Btu/hr each
   2. Design pressure: 375 psig
   3. Type: shell and tube

E. Automatic-depressurization valves (5)
   1. Rated flow:
      a. Target-Rock safety/relief valve (1): 622,000 lbm/hr @ 1115 psig
      b. Electromatic relief valves (4): 540,000 lbm/hr each @ 1130 to 1135 psig

F. Pressure Suppression Pool
   1. Design temperature: 281°F
   2. Maximum operating temperature: 95°F (assumed)
   3. Minimum water volume: 112,203 ft^3
   4. Design pressure: 62 psig

G. Unit 2/3 B Condensate Storage Tank
   1. Volume: 250,000 gal
   2. Minimum volume: 200,000 gal (90,000 gal reserved for HPCI)

3.4.6 Support Systems and Interfaces

A. Control signals
   1. Automatic
      a. The CS pumps function upon receipt of low-low water level in the reactor vessel and reactor low pressure or high pressure in the drywell. When the reactor vessel pressure is below the pump operating pressure (350 psig), the CS injection valves open. Low-low water level and high drywell pressure are each detected by four sensors which input to a one out of two twice logic matrix. Reactor low pressure is detected by two sensors arranged in a one-out-of-two logic sequence.
      b. The LPCI pumps automatically start on low-low reactor vessel level or high drywell pressure if reactor pressure is below 900 psig. The logic systems for drywell pressure and reactor vessel level are one-out-of-two twice types. The LPCI logic also detects where the LOCA break is located and directs the pumps' discharge to the opposite recirculation loop.
      c. The HPCI system is automatically initiated on low-low water level or high drywell pressure using a one-out-of-two twice logic for each signal.
      d. The HPCI system is automatically isolated upon turbine overspeed, HPCI pump low suction pressure, HPCI turbine exhaust high pressure, reactor vessel high level, high turbine exhaust pressure, low HPCI steam line pressure, high temperature from the HPCI steam leak detection system and high differential pressure across a steam line flow device. For low steam line pressure, turbine overspeed trip, low pump suction pressure, high turbine exhaust pressure and reactor vessel high water level; the isolation signal is not sealed in and will auto-reset once the initiating condition no longer exists, allowing auto-restart of the HPCI system. The other automatic isolation signals are sealed in signals and will not auto-reset, but may be manually reset, providing the condition causing the signal has cleared.
      e. HPCI pump suction is automatically switched from the CST to the suppression pool upon low CST level or high suppression pool water level.
      f. The ADS system is actuated upon coincident signals of the reactor vessel low-low water level, high drywell pressure and any LPCI or CS pump running. If all signals are present, the ADS valves will open after the ADS two minute timer runs out. The time delay gives the HPCI system a chance to operate before blowdown occurs.
   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 CS and LPCI motor-driven pumps and motor-operated valves are Class 1E AC loads that can be supplied from the emergency diesel generators, as described in Section 3.5.
   2. Most of the HPCI motor-operated valves are Class 1E 250 VDC loads. The HPCI pump is supplied with steam from a separate steam line.

C. Other
1. Lubrication for the ECCS pumps is assumed to be supplied locally.
2. ECCS pumps are cooled by water diverted from the respective pump discharge lines.
3. ECCS pump room ventilation systems are assumed to be supplied by local fan coolers.
4. The containment cooling heat exchangers are cooled by the Containment Cooling Service Water System (see Section 3.9).

3.4.7 Section 3.4 References

1. Dresden 2 and 3 Updated Final Safety Analysis Report, Section 6.2.

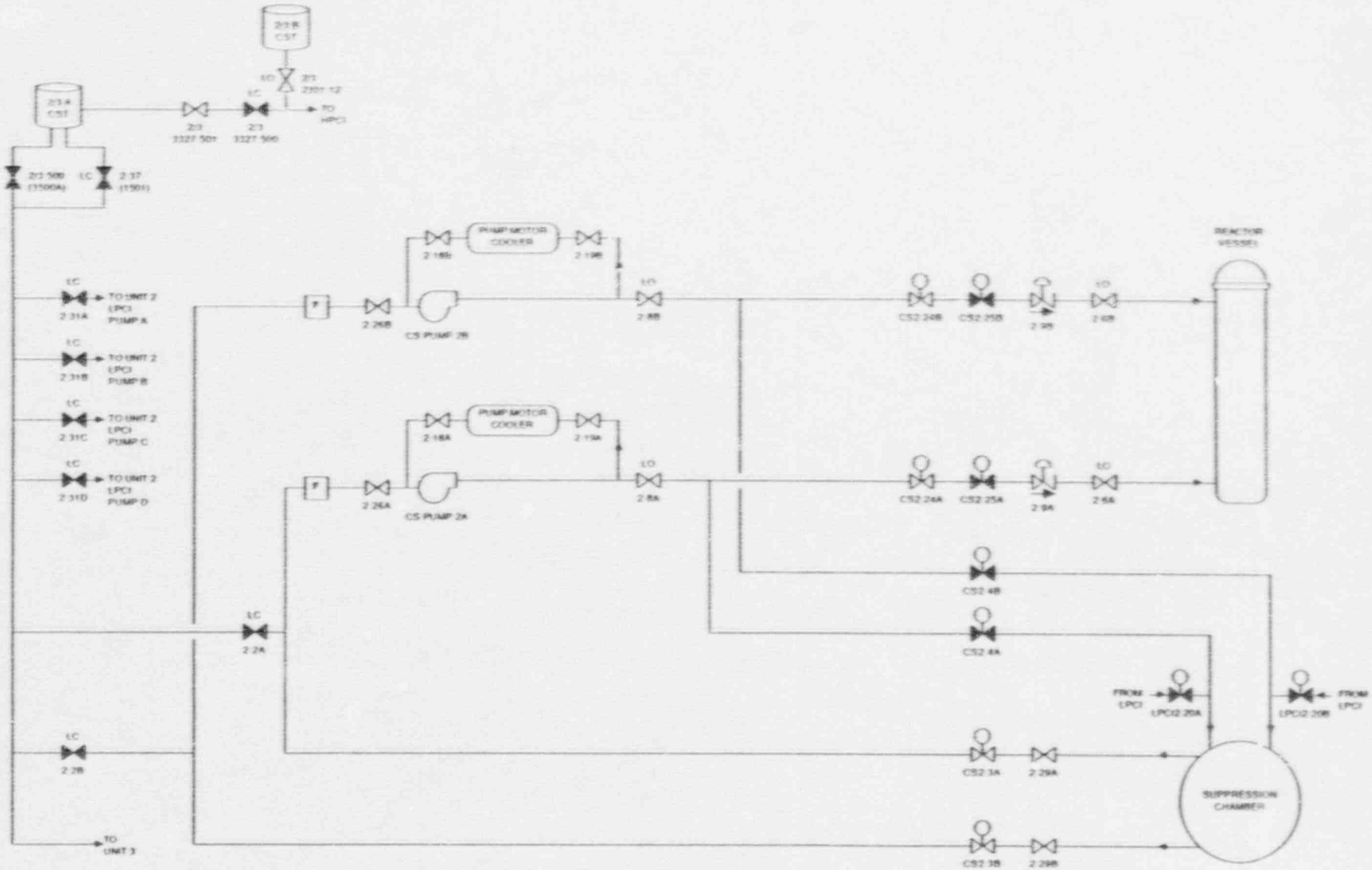


Figure 3.4-1. Dresden Unit 2 Core Spray System

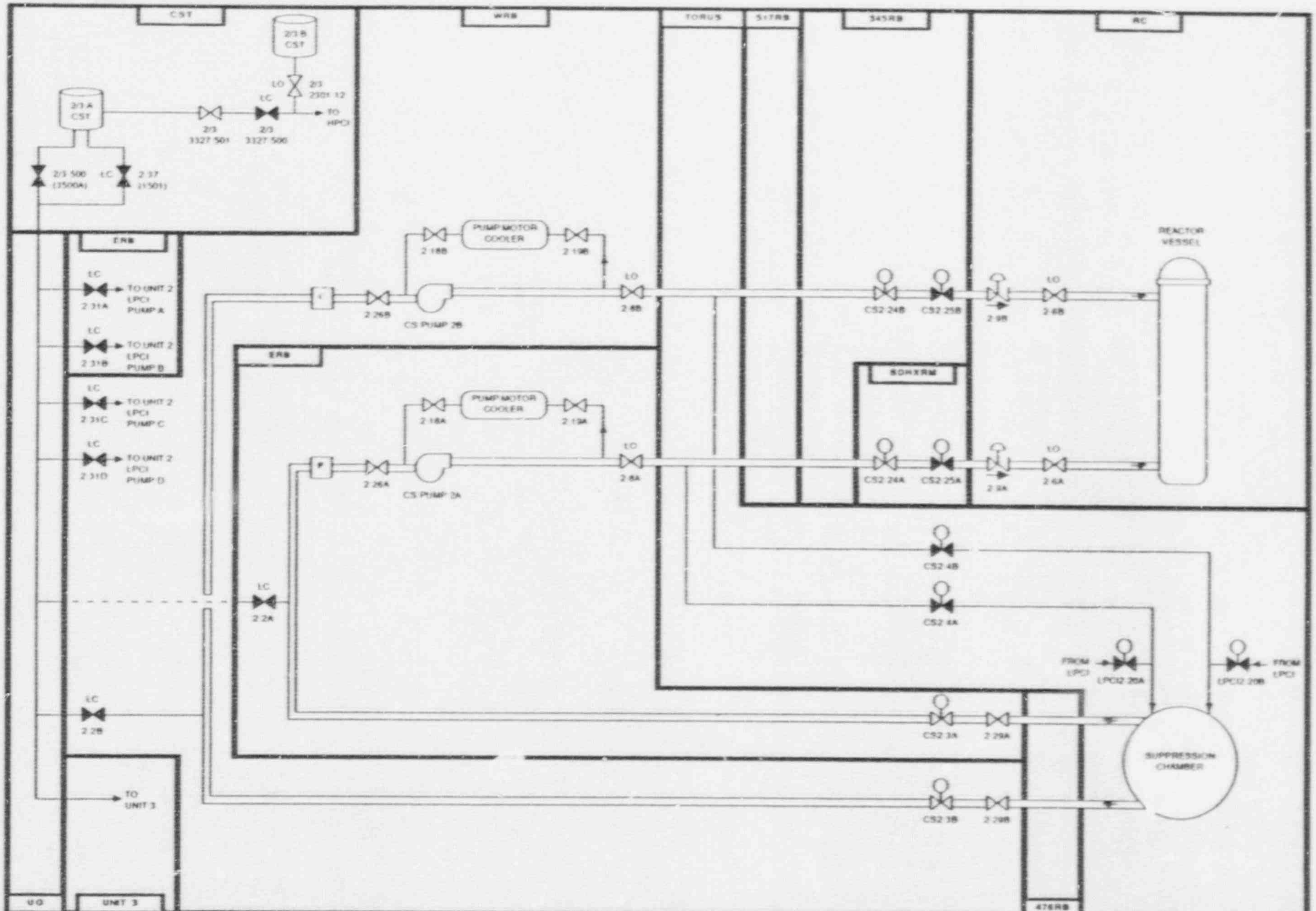


Figure 3.4-2. Dresden Unit 2 Core Spray System Showing Component Locations

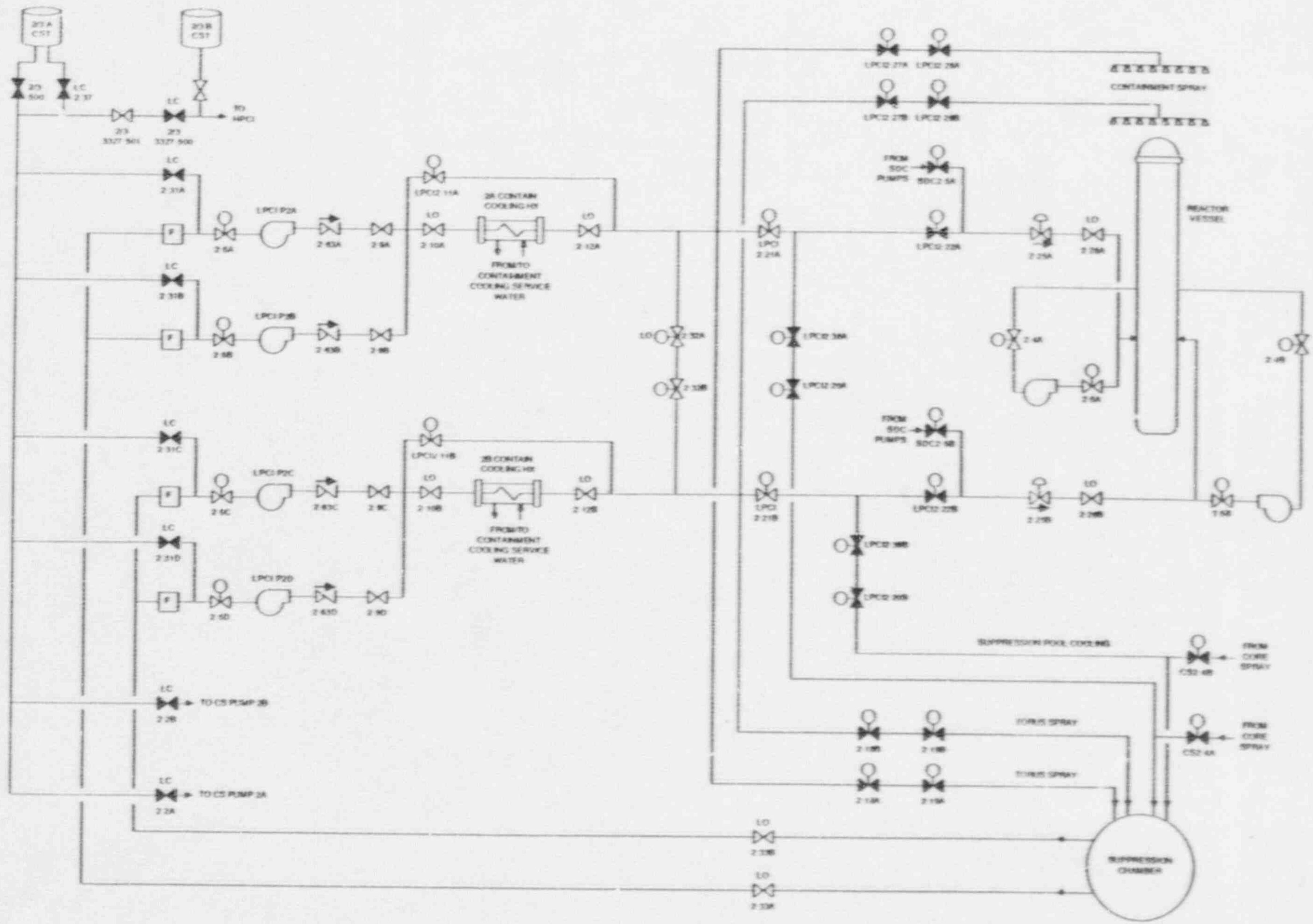


Figure 3.4-3. Dresden Unit 2 Low Pressure Coolant Injection System

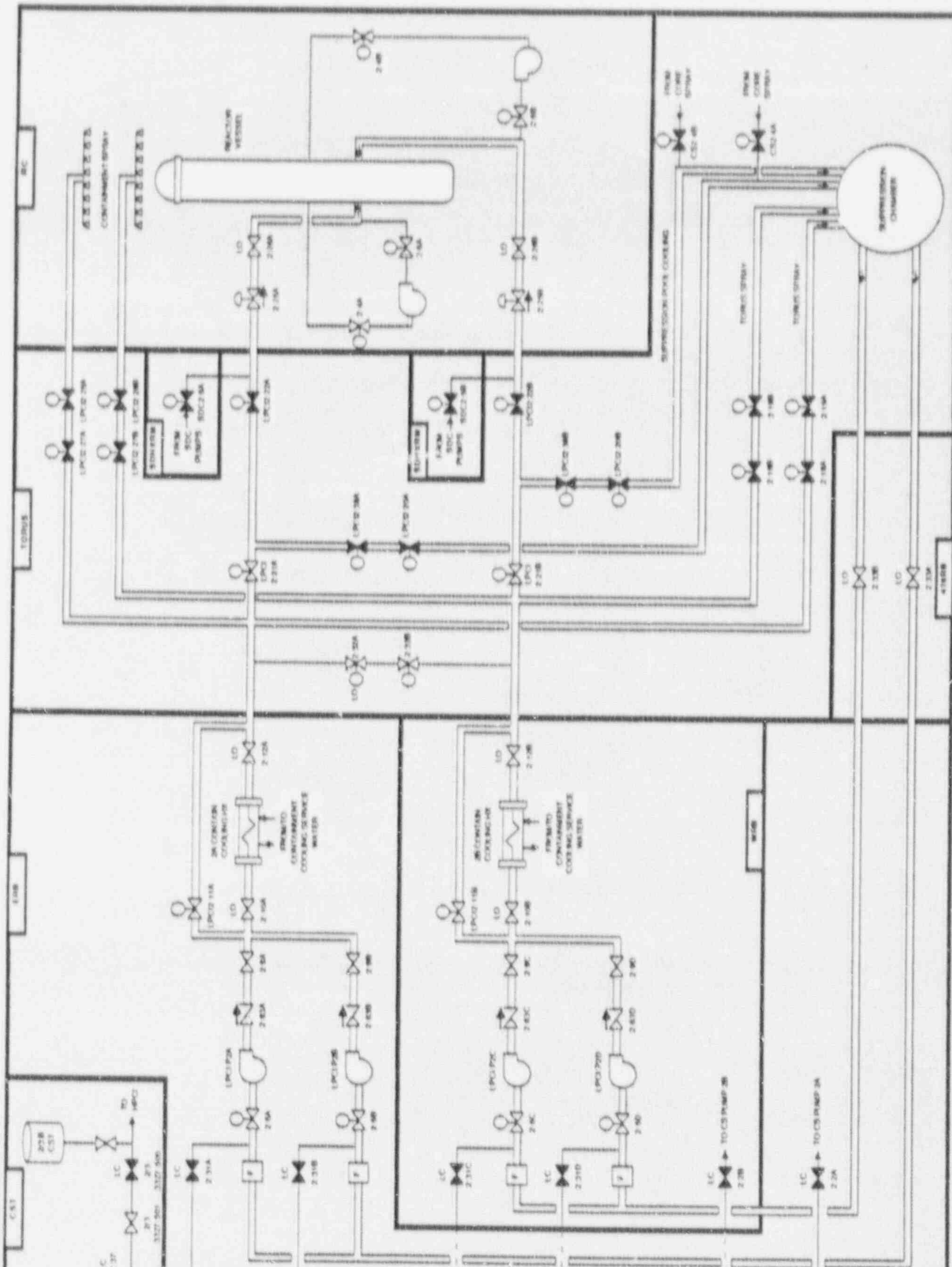
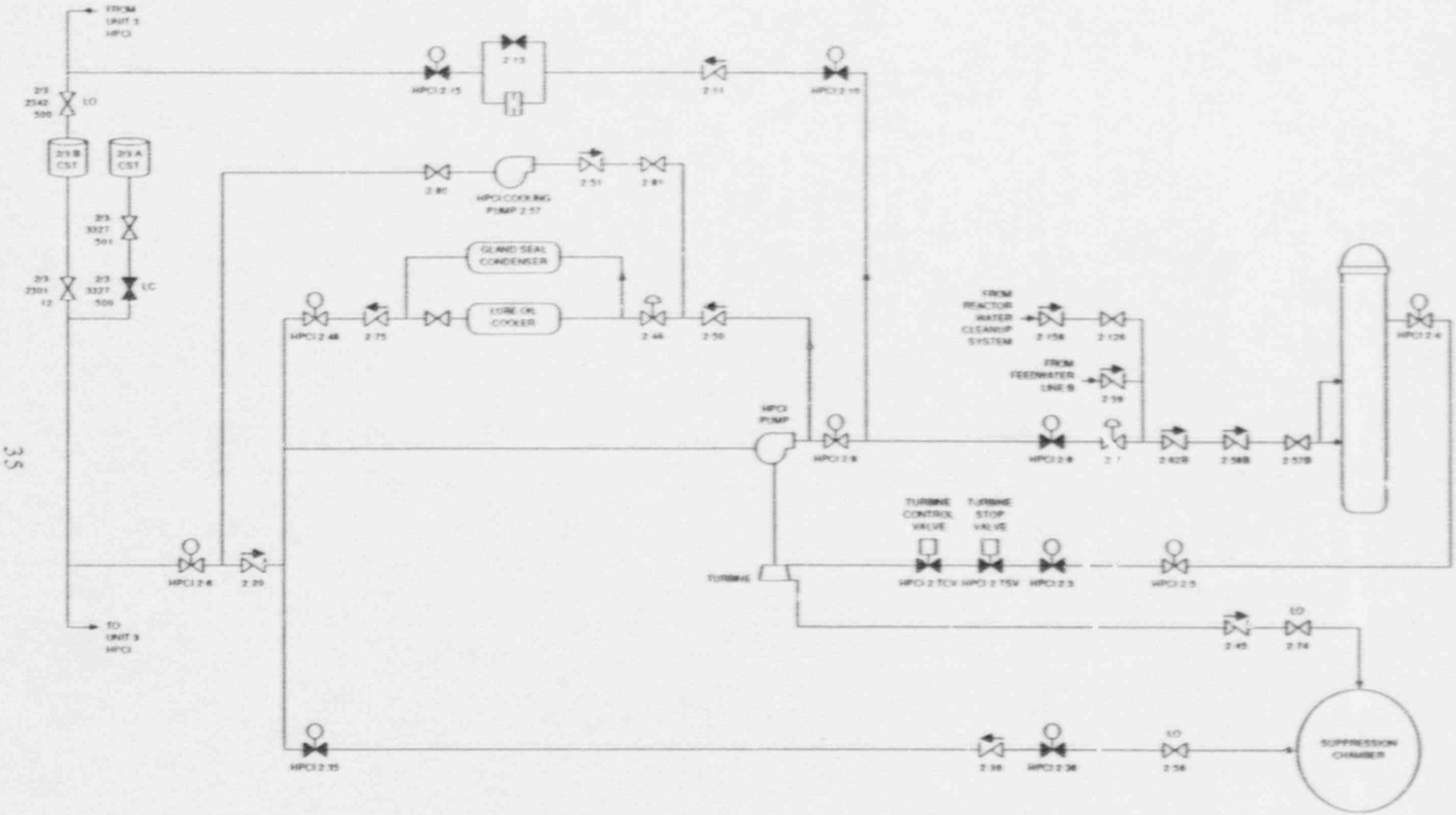


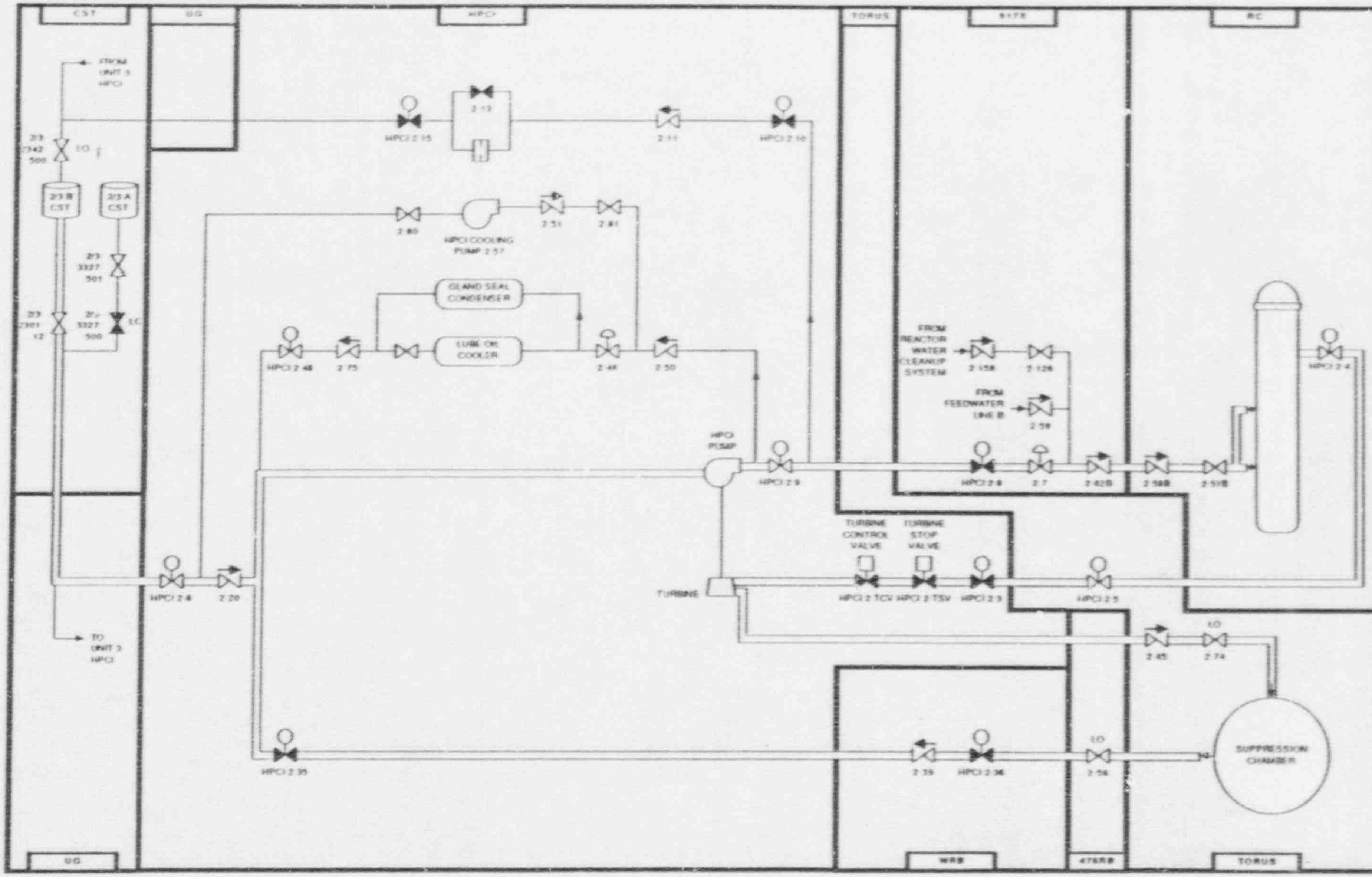
Figure 3.4-4. Dresden Unit 2 Low Pressure Coolant Injection System Showing Component Locations



NOTE

THE HPCI PUMP AND THE GEAR DRIVEN BOOSTER PUMP ARE SHOWN AS A SINGLE UNIT

Figure 3.4-5. Dresden Unit 2 High Pressure Coolant Injection



NOTE

THE HPCI PUMP AND THE GEAR-DRIVEN BOOSTER PUMP ARE SHOWN AS A SINGLE UNIT

Figure 3.4-6. Dresden Unit 2 High Pressure Coolant Injection Showing Component Locations

Table 3.4-1. Dresden 2 Emergency Core Cooling System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CCHX 2A	HX	ERB				
CCHX 2B	HX	WRB				
CS PUMP 2A	MDP	ERB	BUS 23-1	4160	545RB	AC/2-3
CS PUMP 2B	MDP	WRB	BUS 24-1	4169	545RB	AC/2
CS2-24A	MOV	SDHXRM	MCC 28-1	480	517RB	AC/2-3
CS2-24B	MOV	545RB	MCC 29-1	480	517RB	AC/2
CS2-25A	MOV	SDHXRM	MCC 28-1	480	517RB	AC/2-3
CS2-25B	MOV	545RB	MCC 29-1	480	517RB	AC/2
CS2-2B	MOV	WRB	MCC 29-4	480	517RB	AC/2
CS2-3A	MOV	ERB	MCC 28-1	480	517RB	AC/2-3
CS2-4A	MOV	TORUS	MCC 28-1	480	517RB	AC/2-3
CS2-4B	MOV	TORUS	MCC 29-1	480	517RB	AC/2
CST2/3B	TANK	CST				
HPCI LO PUMP	MDP	HPCI	RB BUS 2A-2B	250	570RB	250/3
HPCI PUMP	TDP	HPCI				
HPCI2-10	MOV	HPCI	RB BUS 2A-2B	250	570RB	250/3
HPCI2-21	MOV	HPCI	RB BUS 2A-2B	250	570RB	250/3
HPCI2-3	MOV	HPCI	RB BUS 2A-2B	250	570RB	250/3
HPCI2-35	MOV	HPCI	RB BUS 2A-2B	250	570RB	250/3
HPCI2-36	MOV	WRB	RB BUS 2A-2B	250	570RB	250/3
HPCI2-4	MOV	RC	MCC 29-1	480	517RB	AC/2
HPCI2-48	MOV	HPCI	RB BUS 2A-2B	250	570RB	250/3
HPCI2-5	MOV	TORUS	RB BUS 2A-2B	250	570RB	250/3
HPCI2-6	MOV	HPCI	RB BUS 2A-2B	250	570RB	250/3
HPCI2-8	MOV	517X	RB BUS 2A-2B	250	570RB	250/3
HPCI2-9	MOV	HPCI	RB BUS 2A-2B	250	570RB	250/3
HPCI2-TCV	HV	HPCI				

Table 3.4-1. Dresden 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.
HPCI2-TSV	HV	HPCI				
LPCI PUMP 2A	MDP	ERB	BUS 23-1	4160	545RB	AC/2-3
LPCI PUMP 2B	MDP	ERB	BUS 23-1	4160	545RB	AC/2-3
LPCI PUMP 2C	MDP	WRB	BUS 24-1	4160	545RB	AC/2
LPCI PUMP 2D	MDP	WRB	BUS 24-1	4160	545RB	AC/2
LPCI2-11A	MOV	ERB	MCC 28-1	480	517RB	AC/2-3
LPCI2-11B	MOV	WRB	MCC 29-4	480	517RB	AC/2
LPCI2-20A	MOV	TORUS	MCC 28-1	480	517RB	AC/2-3
LPCI2-20B	MOV	TORUS	MCC 29-4	480	517RB	AC/2
LPCI2-22A	MOV	TORUS	MCC 28-7	480	517RB	AC/2-3
LPCI2-22B	MOV	TORUS	MCC 29-7	480	517RB	AC/2
LPCI2-27A	MOV	TORUS	MCC 28-1	480	517RB	AC/2-3
LPCI2-27B	MOV	TORUS	MCC 29-1	480	517RB	AC/2
LPCI2-28A	MOV	TORUS	MCC 28-1	480	517RB	AC/2-3
LPCI2-28B	MOV	TORUS	MCC 29-1	480	517RB	AC/2
LPCI2-38A	MOV	TORUS	MCC 28-1	480	517RB	AC/2-3
LPCI2-38B	MOV	TORUS	MCC 29-4	480	517RB	AC/2
LPCI2-5A	MOV	ERB	MCC 28-1	480	517RB	AC/2-3
LPCI2-5B	MOV	ERB	MCC 28-1	480	517RB	AC/2-3
LPCI2-5C	MOV	WRB	MCC 29-4	480	517RB	AC/2
LPCI2-5D	MOV	WRB	MCC 29-4	480	517RB	AC/2
SUPP POOL	TANK	TORUS				

3.5 INSTRUMENTATION AND CONTROL (I&C) SYSTEMS

3.5.1 System Function

The instrumentation and control systems consist of the Reactor Protection System (RPS), actuation logic and controls for various Engineered Safeguards (ES) systems, systems for the display of plant information to the operators, the primary containment isolation system and other miscellaneous systems. The RPS will initiate an automatic reactor trip (scram) to rapidly shut down the reactor when plant conditions exceed one or more specified limits. The ES actuation systems will automatically actuate selected safety systems based on the specific limits or combinations of limits that are exceeded. A remote shutdown capability is provided to ensure that the reactor can be placed in a safe shutdown condition in the event that the main control room must be evacuated.

3.5.2 System Definition

The RPS includes sensor and transmitter units, logic units, and output trip relays that interface with the control circuits for components in the Control Rod Drive Hydraulic System (see Section 3.7). The ES actuation systems include independent sensor and transmitter units, logic units, and relays that interface with the control circuits for the many different components that can be actuated. The primary containment isolation system has a similar logic system to the RPS.

A summary of data on selected I&C system components is presented in Table 3.5-1.

3.5.3 System Operation

A. RPS

The RPS has four input independent subchannels and two output actuation trains. The subchannels are grouped into independent logic channels of two subchannels each. Each subchannel receives an input from at least one independent sensor monitoring each of the plant variables. Each variable that is monitored is sensed by four independent sensing switches which are energized when the variable is normal. A scram is initiated when the sensed variable in at least one subchannel in both independent logic channels is abnormal. The RPS monitors and automatically initiates a scram based on the following variables:

- High neutron flux (APRM or IRM neutron monitoring systems)
- Reactor vessel high pressure
- Reactor vessel low water level
- Turbine stop valve closure
- Generator load rejection
- Loss of turbine control oil pressure
- Main steam line isolation valve partial closure
- Scram discharge volume high water level
- Primary containment high pressure
- Main steam line high radiation
- Main condenser low vacuum
- Mode switch in SHUTDOWN
- Loss of AC power to the RPS

In addition, a scram can be manually initiated. There are two scram push buttons, one for logic channel A and one for logic channel B. Depressing the A scram push button deenergizes a relay which opens corresponding contacts in the power supply to the pilot scram valve solenoids supplied by the A logic channel. A single channel trip is the result. A single channel trip brought about from one or both subchannels works exactly the same way. Both pilot scram valve solenoids must be deenergized to cause a scram. To effect a manual scram, the buttons for both logic channel A and logic channel B must be depressed. It is also possible for the control room operator to scram the reactor by interrupting power to the reactor protection system.

To restore the reactor protection system to normal operation following any single channel trip or scram, the contacts in the scram relay circuits must be reset. Reset is possible only if the conditions that caused the trip or scram have been cleared.

B. ES Actuation Systems
ES actuation systems have up to four input instrument channels for each sensed parameter, and two output trains. In general, each train controls equipment powered from different Class 1E electrical buses. The ES systems that can be automatically actuated include the following (not a complete listing):

- Emergency Core Cooling System
  - HPCI
  - CS
  - LPCI
  - ADS
- Standby power systems
- Isolation Condenser System
- Various room cooling systems

Details regarding ES actuation logic are included in the system description for the actuated system.

C. Remote Shutdown
Procedures exist for achieving and maintaining a hot shutdown condition following evacuation of the main control room. Instructions are provided for local operation of the isolation condenser, diesel generator start and loading, and operation of the control rod drive and condensate transfer pumps. A commitment was made by the licensee to provide the capability to achieve cold shutdown from outside the main control room, however, no details on this capability are available (Ref. 1, Section 4.25.1).

3.5.4 System Success Criteria

A. RPS
The RPS uses hindrance logic (normal = 1, trip = 0) in both the input and output logic. Therefore, a channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e. the channel has a fail-safe failure mode). A reactor scram will occur upon loss of control power to the RPS. A reactor scram is implemented by the scram pilot valves in the control rod drive hydraulic system (see Section 3.7). Both trip systems must be de-energized to initiate a scram. Details of the RPS for Dresden 2 and 3 have not been determined.

B. Other Actuation Systems
A single component usually receives a signal from only one actuation system output train. Trains A and B must be available in order to automatically actuate their respective components. Actuation systems other than the RPS typically 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 Dresden 2 and 3 have not been determined.

C. Manually-Initiated Protective Actions
When reasonable time is available, certain protective actions may be performed manually by plant personnel. The control room operators are capable of operating individual components using normal control circuitry, or operating groups of components by manually tripping the RPS or 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. a motor control center). To make these judgments, data on key plant parameters must be available to the operators.

3.5.5 Support Systems and Interfaces

A. Control Power
1. RPS
The RPS appears to be powered from two different sources: RPS motor-generator sets (Ref. 2, Section 7.7), and static uninterruptible power supplies (Ref. 2, Section 7.2.2.4). Backup scram valves are powered from a DC system, probably the 125 VDC system.
2. Operator Instrumentation
The power supplies for operator instrumentation displays could not be determined.

3.5.6 Section 3.5 References

1. NUREG-0823, "Integrated Plant Safety Assessment, Systematic Evaluation Program - Dresden Nuclear Power Station, Unit 2," USNRC, February 1983.
2. Dresden 2 and 3 Updated Final Safety Analysis Report.

3.6 ELECTRIC POWER SYSTEM

3.6.1 System Function

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

3.6.2 System Definition

The onsite Class 1E electric power system consists of one independent 4160 and 480 VAC train for each unit and one independent 4160 and 480 VAC train shared between Unit 2 and 3. In the VAA, the Dresden 2 train is denoted AC/2, and the Dresden 3 train is denoted AC/3. The shared train is denoted as AC/2-3. Each AC power division has a standby diesel generator which serves as the AC power source when the normal source of offsite power is unavailable.

The Class 1E DC system for the two units consists of two 125 VDC divisions and two 250 VDC divisions. The 125 VDC divisions are each supplied by a battery charger and a battery. A third battery and battery charger can supply either division. The division normally supplied from the Unit 2 battery and battery charger is denoted 125/2. However, not all Unit 2 125 VDC buses are in this division. Some of the 125 VDC buses in one unit are supplied from the battery charger and battery in the other unit. The same holds true for the division normally supplied form the Unit 3 battery and battery charger, denoted division 125/3. A similar situation exists in the 250 VAC divisions, 250/2 and 250/3.

Details on the 120/240 VAC essential services power system are not known. It appears that this system is either powered from motor generator sets powered from the 250 VDC system or from static uninterruptable power supplies.

The general configuration of the on-site electric power system for Dresden 2 and 3 is shown in Figure 3.6-1. Simplified one-line diagrams of the electric power system for Dresden 2 are shown in Figures 3.6-2 to 3.6-7. A summary of data on selected electric power system components is presented in Table 3.6-1. A partial listing of electrical sources and loads is presented in Table 3.6-2.

3.6.3 System Operation

Each Class 1E 4160 VAC bus is provided with a normal non-Class 1E power supply and one standby diesel generator. Each unit's diesel generator can carry the ECCS power requirements or supply the power for safe shutdown of the plant. Another diesel generator and associated Class 1E 4160 VAC bus is shared between the units. The standby diesel generators are started upon loss of offsite power at the 4.16 kV bus, or an accident signal, or manual actuation. For Dresden 2, diesel generators 2 and 2/3 are connected to the 4160 VAC Class 1E buses 24-1 and 23-1, respectively. Each diesel is connected to only one bus. In turn, each 4160 VAC safeguard bus supplies power to a 480 VAC load center bus through a transformer. Details of the 4160 and 480 VAC systems are shown in Figures 3.6-1 and 3.6-2.

The Class 1E 125 VDC system for both Dresden 2 and 3 consists of two independent divisions, 2 and 3. Each 125 VDC division supplies buses in both units. Each division receives power from one battery and one battery charger. A third battery and battery charger can provide power to either division. Each battery is sized to provide 62.3 amperes for eight hours. The Dresden 2 and 3 Class 1E 125 VDC systems are shown in Figures 3.6-3 and 3.6-4.

The Class 1E 250 VDC system for both units consists of two independent divisions, 2 and 3. Each 250 VDC supplies buses in both units. Each division is supplied from one battery and one battery charger. A third battery and battery charger can supply either division. Each battery has a nominal manufacturer's eight hour rating of 913 ampere hours, and the batteries can supply their required loads without recharging for eight hours. Unit 2 Reactor Building Buses 2A and 2B, in division 3, supply power to Unit 2 HPCI system valves and most IC system valves. Details of the 250 VDC divisions are shown in Figures 3.6-5 and 3.6-6.

Redundant safeguards equipment such as motor driven pumps and motor operated valves are supplied by different buses or MCCs. For the purpose of discussion, this equipment has been grouped into "load groups" for the Dresden 2 VAA. Load group designations are based on the division designations discussed above. Load group "AC/2" contains components powered either directly or indirectly from 4160 V bus 24-1. Load group "AC/2-3" contains components powered either directly or indirectly from 4160 V bus 23-1. Components receiving 125 VDC power are assigned to load groups "125/2" or "125/3" depending on the battery source. Components receiving 250 VDC power are assigned to load groups "250/2" or "250/3" depending on their battery sources. Selected loads and components supplied by the Class 1E electric power system are listed in Table 3.6-2.

3.6.4 System Success Criteria

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

- Each Class 1E 125 VDC load group is supplied initially from its respective battery (also needed for diesel starting). Similarly, each Class 1E 250 VDC load group is supplied initially from its respective battery.
- Each Class 1E AC load group is isolated from the non-Class 1E system and is supplied from its respective emergency power source (i.e. diesel generator)
- Power distribution paths to essential loads are intact
- Power to the battery chargers is restored before the batteries are exhausted

3.6.5 Component Information

A. Standby diesel generators 2, 3 and 2/3
   1. Continuous power rating: 2600 kW @ 0.8 power factor
   2. Rated voltage: 4160 VAC
   3. Manufacturer: General Motors

B. 125 VDC Station batteries 2, 3 and 2/3
   1. Rated voltage: 125 VDC
   2. Capacity: 498 amp-hours each

C. 250 VDC Station batteries 2, 3 and 2/3
   1. Rated voltage: 250 VDC
   2. Capacity: 913 amp-hours each

3.6.6 Support Systems and Interfaces

A. Control Signals

1. Automatic
   The standby diesel generators are automatically started upon loss of voltage on their associated 4160 VAC bus or on an accident signal.
2. Remote manual
   The diesel generators can be started, and many distribution circuit breakers can be operated, from the main control room.
3. Local manual
   The diesel generators can be started locally.

B. Diesel Generator Auxiliary Systems

1. Cooling
   The diesel generator cooling water system (see Section 3.8) provides for diesel cooling.
2. Fueling
   An independent day tank with enough fuel for over 4 hours (750 gallons) is provided for each diesel. Long-term fuel tanks with 15,000 gallons each are located underground near the diesel generator rooms.
3. Lubrication
   Each diesel generator is assumed to have a self-contained lubrication system, but this should be verified.
4. Starting
   An independent, self-contained compressed air starting system is provided for each diesel generator. Field excitation is provided by the 125 VDC station batteries.
5. Control power
   Each diesel generator is dependent on 125 VDC power from a station battery for initial excitation, starting logic and starting air system control.
6. Diesel room cooling
   Diesel room cooling during diesel operation is provided by three emergency room air coolers for the reactor building and the HPCI building. The emergency air cooler fans and diesel generator cooling water pumps are powered by the diesel generators.

C. Switchgear Room Ventilation

Ventilation capabilities for the essential switchgear rooms and battery rooms has not been determined.

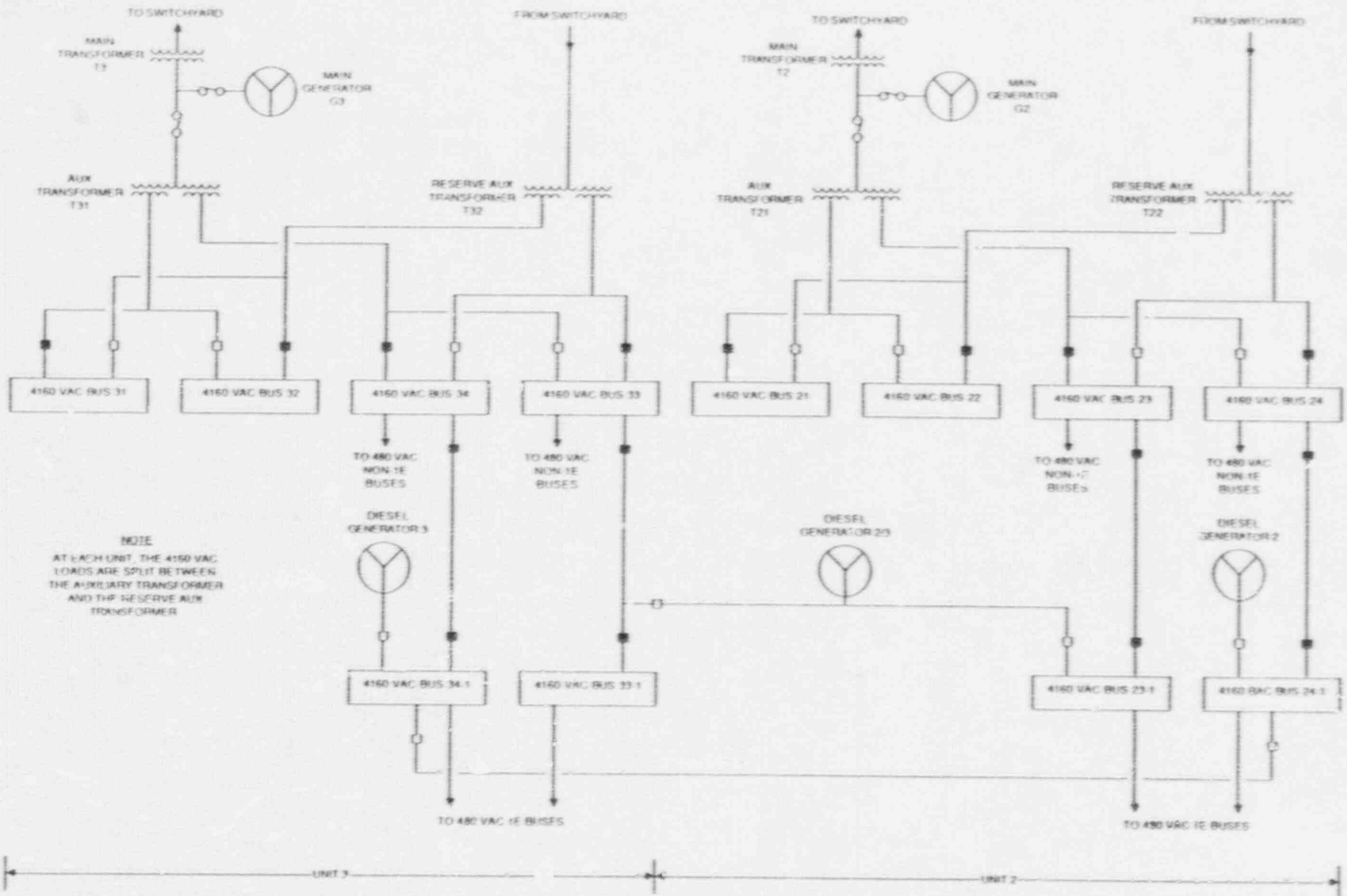


Figure 3.6-1. Dresden Units 2 and 3 4160 VAC Auxiliary Electric Power System

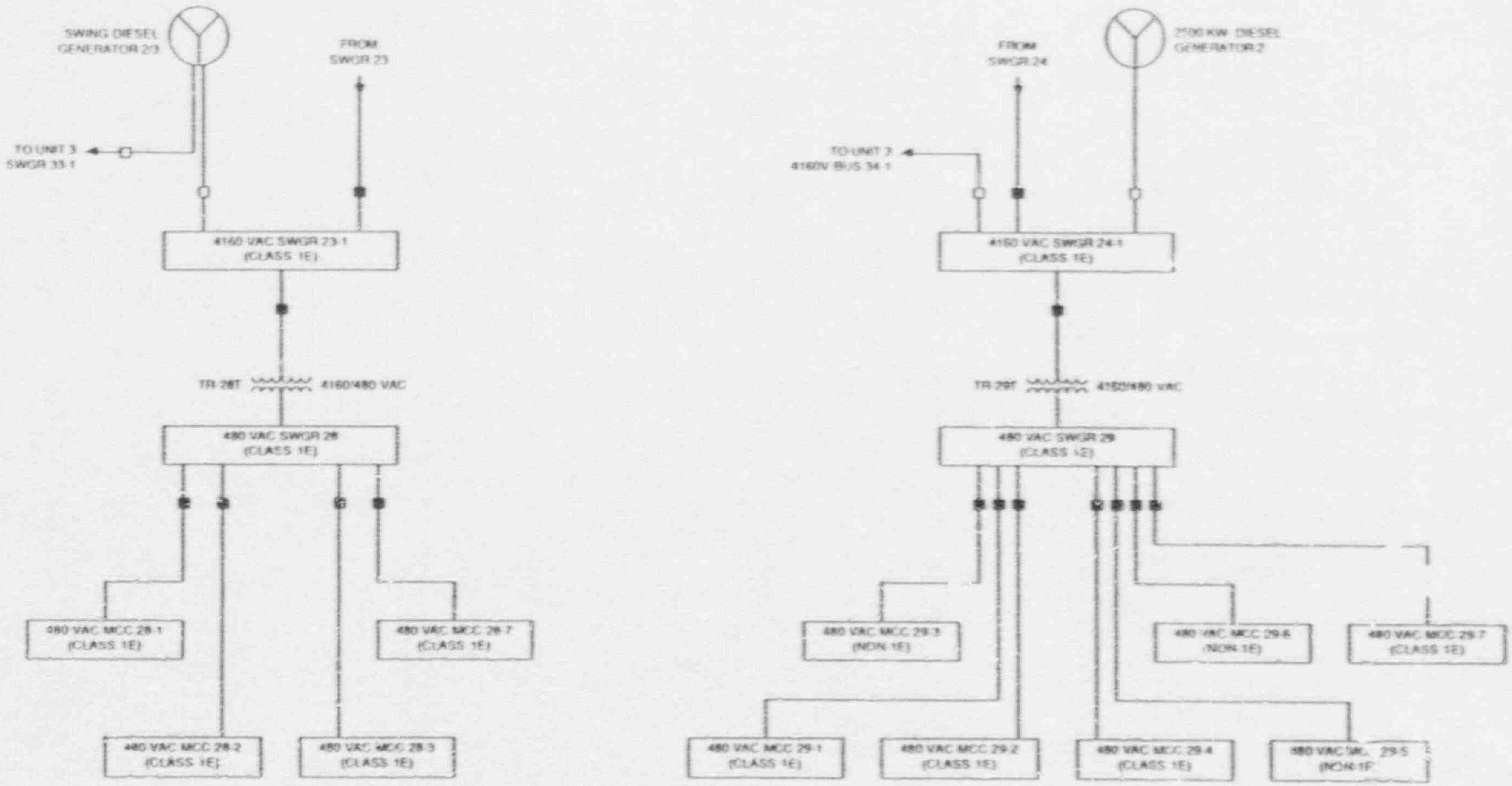
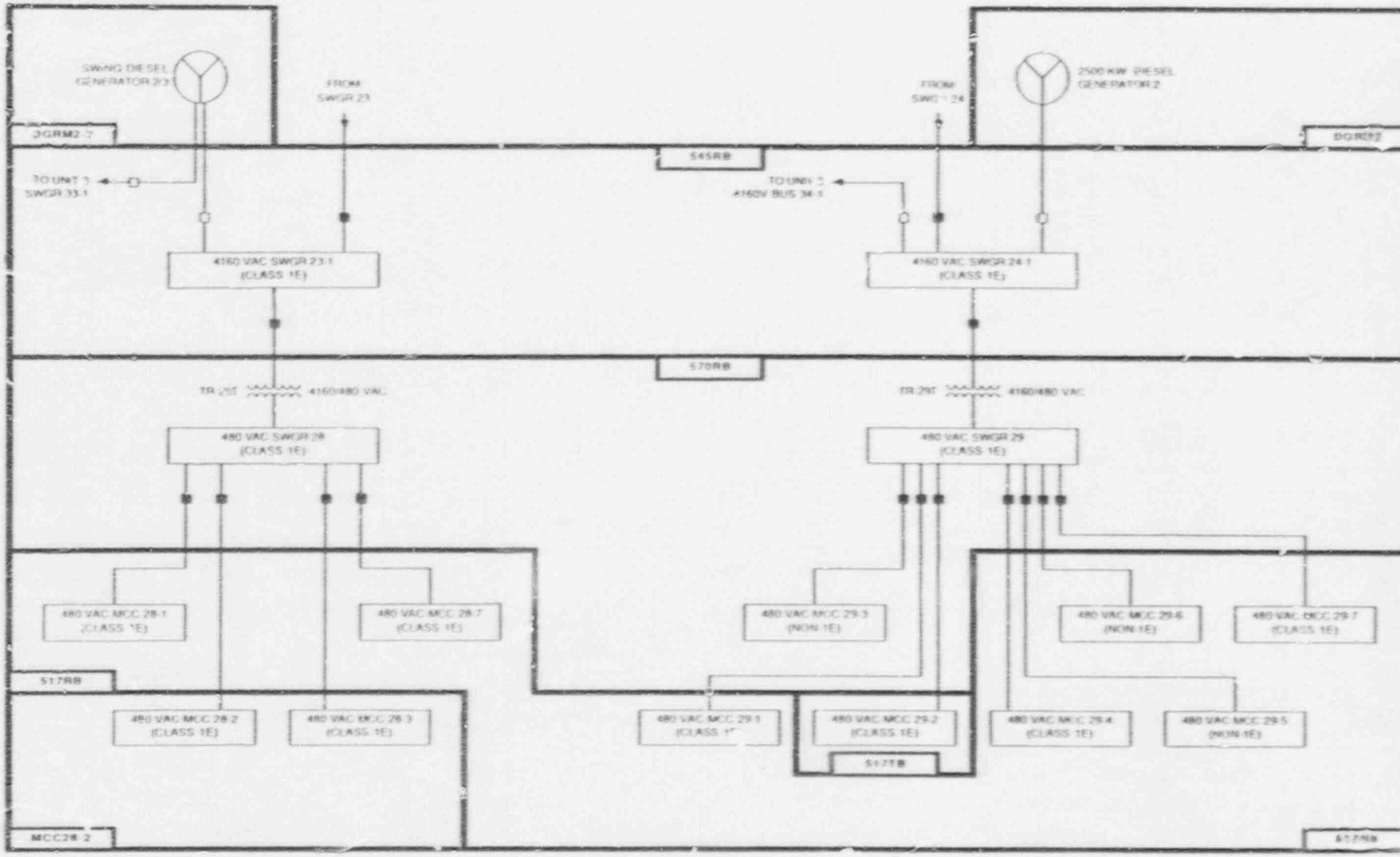


Figure 3.6-2. Dresden Unit 2 4160/480V Electric Power System



NOTE
LINES MAY NOT SHOW TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.6-3. Dresden Unit 2 4160/480V Electric Power System Showing Component Locations

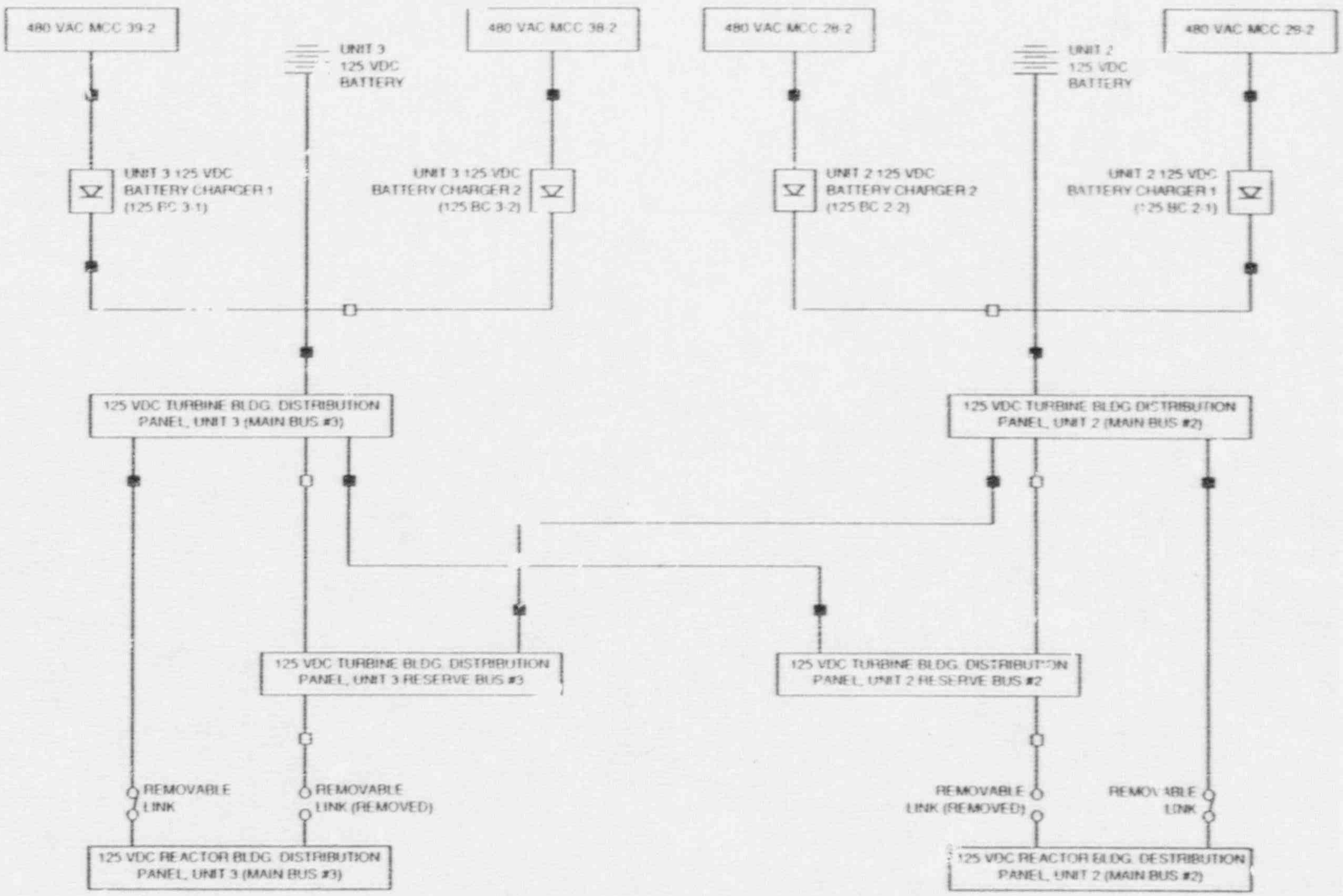
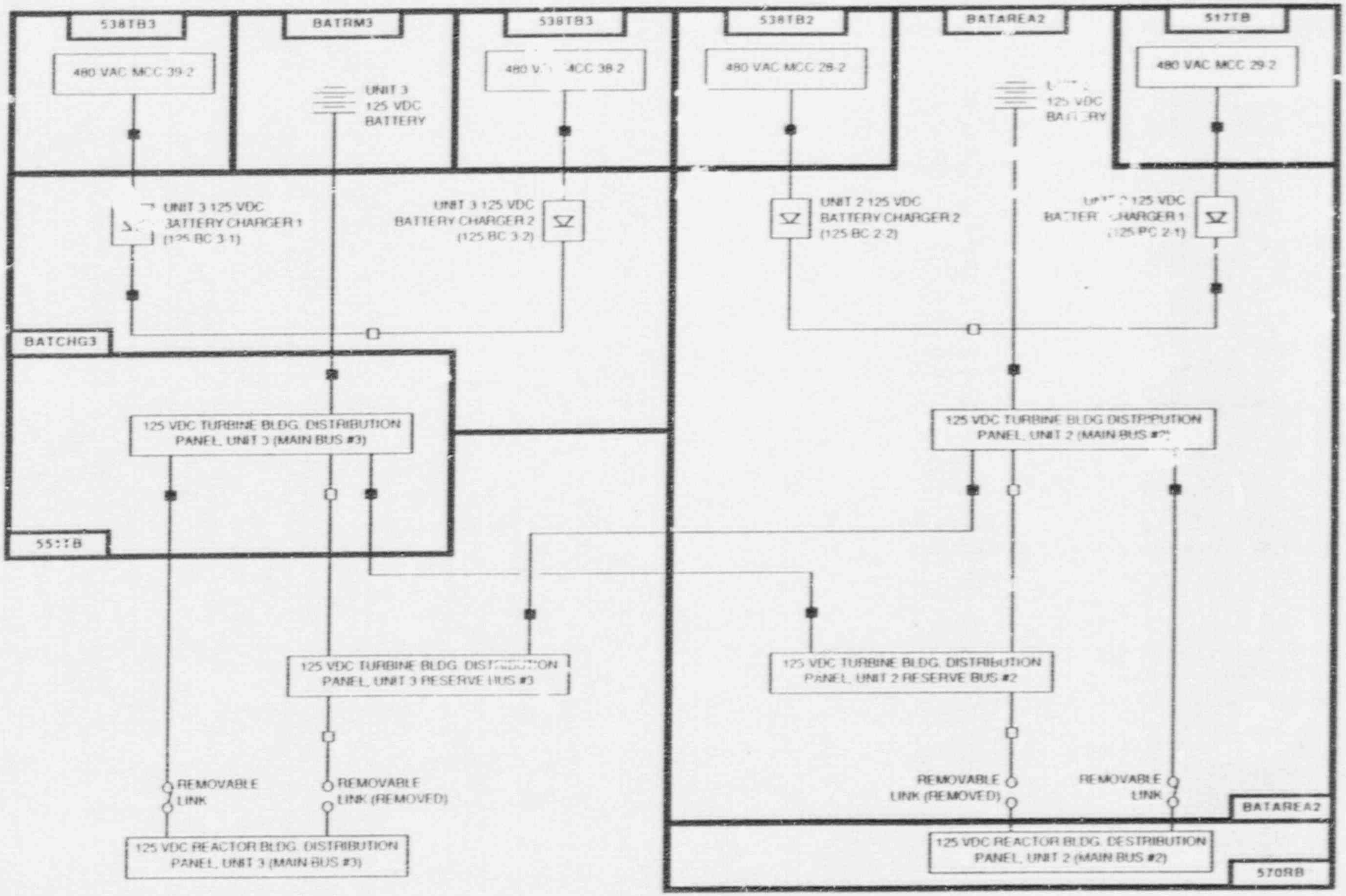


Figure 3.6-4. Dresden Units 2 and 3 Electric Plant 125 VDC System Showing Component Locations



NOTE
LINES MAY NOT SHOW TRUE CABLE ROUTING BETWEEN ROOMS.

Figure 3.6-5. Dresden Units 2 and 3 Electric Plant 125 VDC System Showing Component Locations

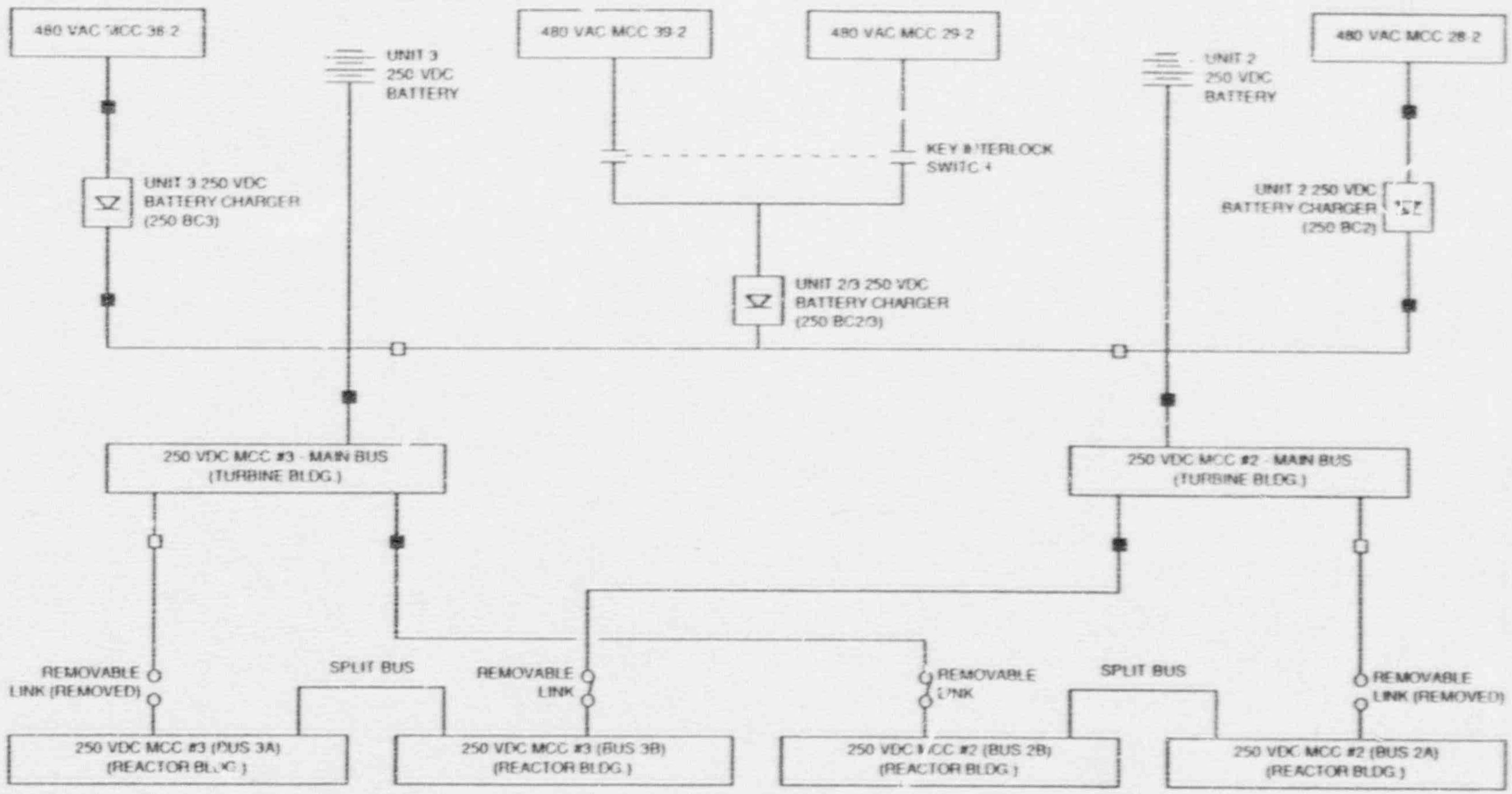


Figure 3.6-6. Dresden Units 2 and 3 Electric Plant 250 VDC System

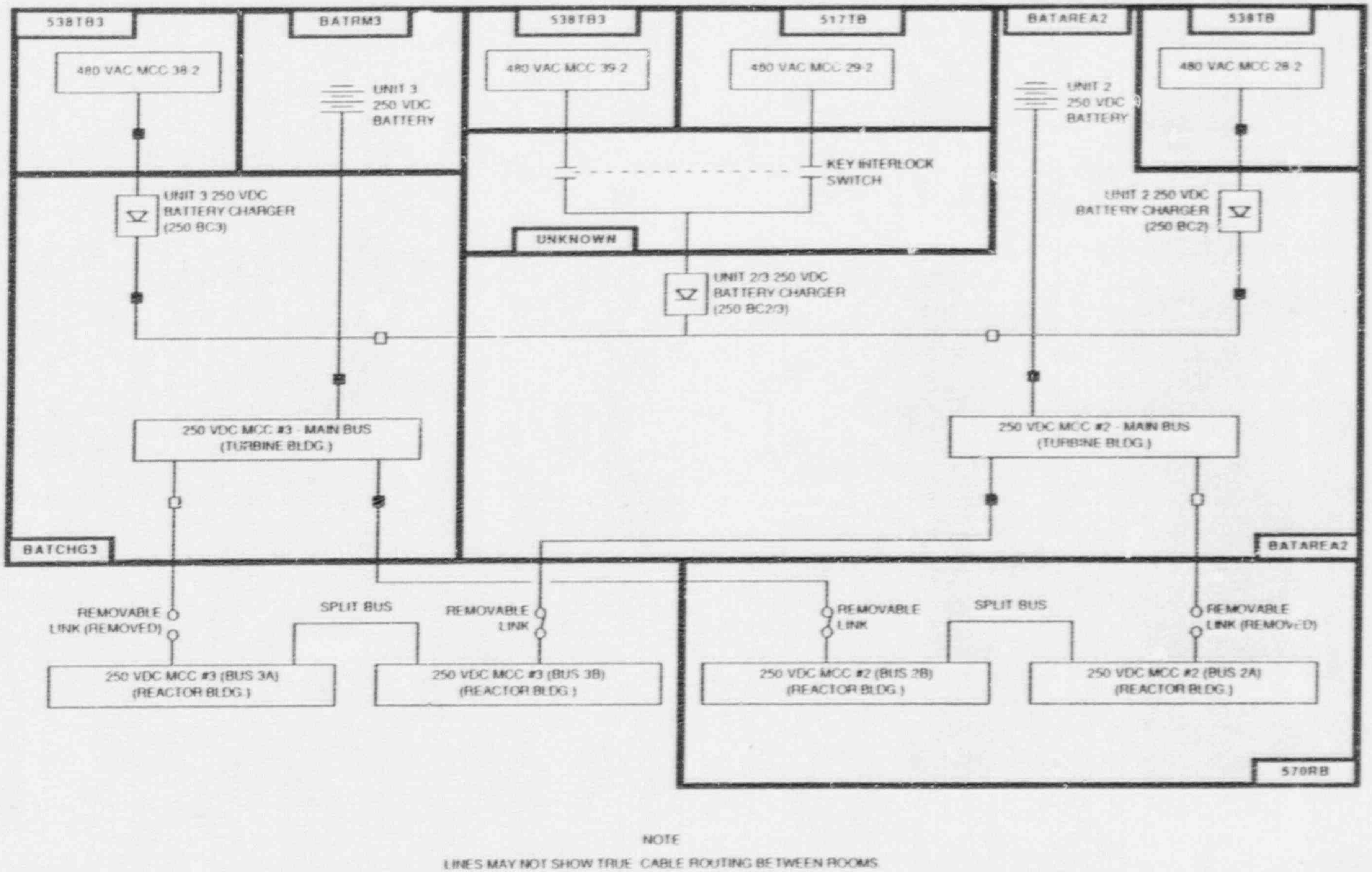


Figure 3.6-7. Dresden Units 2 and 3 Electric Plant 250 VDC System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
125 BAT 2	BAT	BATAREA2		125		125/2
125 BAT 3	BAT	BATRM3		125		125/3
125BC2-1	BC	BATAREA2	MCC 29-2	480	517TB	AC/2
125BC2-2	BC	BATAREA2	MCC 28-2	480	538TB2	AC/2-3
125BC3-1	BC	BATCHG3	MCC 39-2	480	538TB3	AC/3
125BC3-2	BC	BATCHG3	MCC 38-2	480	538TB3	AC/2-3
125RB BUS 2	BUS	570RB	125TB BUS 2	125	BATAREA2	125/2
125RB BUS 3	BUS	UNKNOWN	125TB BUS 3	125	551TB	125/3
125TB BUS 2	BUS	BATAREA2	125 BAT 2	125	BATAREA2	125/2
125TB BUS 2	BUS	BATAREA2	125BC2-1	125	BATAREA2	125/2
125TB BUS 2	BUS	BATAREA2	125BC2-2	125	BATAREA2	125/2
125TB BUS 3	BUS	551TB	125 BAT 3	125	BATRM3	125/3
125TB BUS 3	BUS	551TB	125BC3-1	125	BATCHG3	125/3
125TB BUS 3	BUS	551TB	125BC3-2	125	BATCHG3	125/3
250 BAT 2	BATT	BATAREA2		250	BATAREA2	AC/2-3
250 BAT 3	BATT	BATRM3		250		250/3
250 BC2/3	BC	BATAREA2	MCC 29-2	480	MCC29-2	AC/2
250 BC2/3	BC	BATAREA2	MCC 39-2	480	538TB3	AC/3
250 BC3	BC	BATCHG3	MCC 38-2	480	MCC29-2	AC/3
250BC2	BC	BATAREA2	MCC 28-2	480	538TB	AC/2
250TB BUS 2	BUS	BATAREA2	250BC2	250	BATAREA2	250/2
250TB BUS 3	BUS	BATCHG3	250 BAT 3	250	BATRM3	250/3
250TB BUS 3	BUS	BATCHG3	250BC3	250	538TB3	250/3
250TB BUS2	BUS	BATAREA2	250 BAT 2	250	BATAREA2	250/2
BUS 23-1	BUS	545RB	DG#2/3	4160	DGRM2-3	AC/2-3
BUS 24-1	BUS	545RB	DG #2	4160	DGRM2	AC/2
BUS 28	BUS	570RB	TRAN TR-28T	4160/480	570RB	AC/2-3

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
BUS 29	BUS	570RB	TRAN TR-29T	4160/480	570RB	AC/2
BUS 33-1	BUS	UNIT 3	DG#2/3	4160	DGRM2-3	AC/2-3
BUS 34-1	BUS	UNIT 3	DG#3	4160	DGRM3	AC/3
BUS 38	BUS	545RB3	UNKNOWN	480	UNKNOWN	AC/3
DG #2	DG	DGRM2		4160		AC/2
DG #2/3	DG	DC[illegible]3		4160		AC/2-3
DG #3	DG	DGRM3		4160		AC/3
DG 2 FO PMP	MDP	DGRM2	MCC 29-2	480	517TB	AC/2
DG2/3 FO PMP	MDP	DGRM2-3	MCC 28-1	480	517RB	AC/2-3
MCC 28-1	MCC	517RB	BUS 28	480	570RB	AC/2-3
MCC 28-2	MCC	MCC28-2	BUS 28	480	570RB	AC/2-3
MCC 28-3	MCC	570RB	BUS 28	480	570RB	AC/2-3
MCC 28-7	MCC	517RB	BUS 28	480	570RB	AC/2-3
MCC 29-1	MCC	617RB	BUS 29	480	570RB	AC/2
MCC 29-4	MCC	517RB	BUS 29	480	570RB	AC/2
MCC 29-5	MCC	517RB	BUS 29	480	570RB	AC/2
MCC 29-6	MCC	517RB	BUS 29	480	570RB	AC/2
MCC 29-7	MCC	517RB	BUS 29	480	570RB	AC/2
MCC 38-2	MCC	538TB3	BUS 38	480	545RB3	AC/3
MCC 39-2	BUS	538TB3	UNKNOWN	480	UNKNOWN	250/3
RB BUS 2A-2B	BUS	570RB	250TB BUS 3	250	BATCHG3	250/3
RB BUS 2A-2B	BUS	BATAREA2	250TB BUS 2	250	BATAREA2	250/2
RB BUS 3A-3B	BUS	UNKNOWN	250TB BUS 2	250	BATAREA2	250/2
RB BUS 3A-3B	BUS	UNKNOWN	250TB BUS 3	250	BATCHG3	250/3
TRAN-28T	TRAN	570RB	BUS 23-1	4160	545RB	AC/2-3
TRAN-29T	TRAN	570RB	BUS 24-1	4160	545RB	AC/2

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
125 BAT 2	125	125/2	BATAREA2	EP	125TB BUS 2	BUS	BATAREA2
125 BAT 3	125	125/3	BATRM3	EP	125TB BUS 3	BUS	551TB
125BC2-1	125	125/2	BATAREA2	EP	125TB BUS 2	BUS	BATAREA2
125BC2-2	125	125/2	BATAREA2	EP	125TB BUS 2	BUS	BATAREA2
125BC3-1	125	125/3	BATCHG3	EP	125TB BUS 3	BUS	551TB
125BC3-2	125	125/3	BATCHG3	EP	125TB BUS 3	BUS	551TB
125TB BUS 2	125	125/2	BATAREA2	EP	125RB BUS 2	BUS	570RB
125TB BUS 3	125	125/3	551TB	EP	125RB BUS 3	BUS	UNKNOWN
250 BAT 2	250	250/2	BATAREA2	EP	250TB BUS2	BUS	BATAREA2
250 BAT 3	250	250/3	BATRM3	EP	250TB BUS 3	BUS	BATCHG3
250BC2	250	250/2	BATAREA2	EP	250TB BUS 2	BUS	BATAREA2
250BC3	250	250/3	538TB3	EP	250TB BUS 3	BUS	BATCHG3
250TB BUS 2	250	250/2	BATAREA2	EP	RB BUS 2A-2B	BUS	BATAREA2
250TB BUS 2	250	250/2	BATAREA2	EP	RB BUS 3A-3B	BUS	UNKNOWN
250TB BUS 3	250	250/3	BATCHG3	EP	RB BUS 2A-2B	BUS	570RB
250TB BUS 3	250	250/3	BATCHG3	EP	RB BUS 3A-3B	BUS	UNKNOWN
589RB	250	DC	UNKNOWN	IC-MU	FP2-4102	MOV	FP-UNK
BUS 23-1	4160	AC/2-3	545RB	ECCS	CS PUMP 2A	MDP	ERB
BUS 23-1	4160	AC/2-3	545RB	ECCS	LPCI PUMP 2A	MDP	ERB
BUS 23-1	4160	AC/2-3	545RB	ECCS	LPCI PUMP 2B	MDP	ERB
BUS 23-1	4160	AC/2-3	545RB	EP	TRAN-28T	TRAN	570RB
BUS 23-1	4160	AC/1	545RB	RHR	PUMP 2A	MDP	SDCPMRM
BUS 23-1	4160	AC/1	545RB	RHR	PUMP 2B	MDP	SDCPMRM
BUS 24-1	4169	AC/2	545RB	ECCS	CS PUMP 2B	MDP	WRB
BUS 24-1	4160	AC/2	545RB	ECCS	LPCI PUMP 2C	MDP	WRB
BUS 24-1	4160	AC/2	545RB	ECCS	LPCI PUMP 2D	MDP	WRB
BUS 24-1	4160	AC/2	545RB	EP	TRAN-29T	TRAN	570RB
BUS 24-1	4160	AC/2	545RB	RHR	PUMP 2C	MDP	SDCPMRM
BUS 28	480	AC/2-3	570RB	EP	MCC 28-1	MCC	517RB
BUS 28	480	AC/2-3	570RB	EP	MCC 28-2	MCC	MCC28-2
BUS 28	480	AC/2-3	570RB	EP	MCC 28-3	MCC	570RB

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
BUS 28	480	AC/2-3	570RB	EP	MCC 28-7	MCC	517RB
BUS 29	480	AC/2	570RB	EP	MCC 29-1	MCC	617RB
BUS 29	480	AC/2	570RB	EP	MCC 29-2	MCC	MCC29-2
BUS 29	480	AC/2	570RB	EP	MCC 29-2	MCC	517TB
BUS 29	480	AC/2	570RB	EP	MCC 29-4	MCC	517RB
BUS 29	480	AC/2	570RB	EP	MCC 29-5	MCC	517RB
BUS 29	480	AC/2	570RB	EP	MCC 29-6	MCC	517RB
BUS 29	480	AC/2	570RB	EP	MCC 29-7	MCC	517RB
BUS 38	480	AC/3	545RB3	EP	MCC 38-2	MCC	538TB3
DG #2	4160	AC/2	DGRM2	EP	BUS 24-1	BUS	545RB
DG#2/3	4160	AC/2-3	DGRM2-3	EP	BUS 23-1	BUS	545RB
DG#2/3	4160	AC/2-3	DGRM2-3	EP	BUS 33-1	BUS	UNIT 3
DG#3	4160	AC/3	DGRM3	EP	BUS 34-1	BUS	UNIT 3
MCC 28-1	480	AC/2-3	517RB	CCSW	CCSW2-3A	MOV	ERB
MCC 28-1	480	AC/2-3	517RB	ECCS	CS2-24A	MOV	SDHXRM
MCC 28-1	480	AC/2-3	517RB	ECCS	CS2-25A	MOV	SDHXRM
MCC 28-1	480	AC/2-3	517RB	ECCS	CS2-3A	MOV	ERB
MCC 28-1	480	AC/2-3	517RB	ECCS	CS2-4A	MOV	TORUS
MCC 28-1	480	AC/2-3	517RB	ECCS	LPCI2-11A	MOV	ERB
MCC 28-1	480	AC/2-3	517RB	ECCS	LPCI2-20A	MOV	TORUS
MCC 28-1	480	AC/2-3	517RB	ECCS	LPCI2-27A	MOV	TORUS
MCC 28-1	480	AC/2-3	517RB	ECCS	LPCI2-28A	MOV	TORUS
MCC 28-1	480	AC/2-3	517RB	ECCS	LPCI2-38A	MOV	TORUS
MCC 28-1	480	AC/2-3	517RB	ECCS	LPCI2-5A	MOV	ERB
MCC 28-1	480	AC/2-3	517RB	ECCS	LPCI2-5B	MOV	ERB
MCC 28-1	480	AC/2-3	517RB	EP	DG2/3 FO PMP	MDP	DGRM2-3
MCC 28-1	480	AC/2-3	517RB	IC	IC2-1	MOV	RC
MCC 28-1	480	AC/2-3	517RB	IC	IC2-4	MOV	RC
MCC 28-1	480	AC/2-3	517RB	IC-MU	IC2-10	MOV	589RB
MCC 28-1	480	AC/2-3	517RB	RCS	MSD2-1	MOV	RC
MCC 28-1	480	AC/2-3	517RB	RCS	RWCU 2-1	MOV	RC

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC 28-1	480	AC/2-3	517RB	RHR	SDC2-1A	MOV	RC
MCC 28-1	480	AC/2-3	517RB	RHR	SDC2-1B	MOV	RC
MCC 28-2	480	AC/2-3	538TB2	EP	125BC2-2	BC	BATAREA2
MCC 28-2	480	AC/2	538TB	EP	250BC2	BC	BATAREA2
MCC 28-2	480	AC/2-3	538TB	IC-MU	CTS PUMP 2A	MDP	517TB
MCC 28-3	480	AC/2-3	538TB	DGCW	DGCW P-2/3B	MDP	PUMPHS
MCC 28-7	480	AC/2-3	517RB	ECCS	LPCI2-21A	MOV	TORUS
MCC 28-7	480	AC/2-3	517RB	ECCS	LPCI2-22A	MOV	TORUS
MCC 29-1	480	AC/2	517RB	ECCS	CS2-24B	MOV	545RB
MCC 29-1	480	AC/2	517RB	ECCS	CS2-25B	MOV	545RB
MCC 29-1	480	AC/2	517RB	ECCS	CS2-4B	MOV	TORUS
MCC 29-1	480	AC/2	517RB	ECCS	HPCI2-4	MOV	RC
MCC 29-1	480	AC/2	517RB	ECCS	LPCI2-27B	MOV	TORUS
MCC 29-1	480	AC/2	517RB	ECCS	LPCI2-28B	MOV	TORUS
MCC 29-2	480	AC/2	517TB	DGCW	DGCW P-2B	MDP	PUMPHS
MCC 29-2	480	AC/2	517TB	EP	125BC2-1	BC	BATAREA2
MCC 29-2	480	AC/2	MCC29-2	EP	250 BC2/3	BC	BATAREA2
MCC 29-2	480	AC/2	517TB	EP	DG 2 FO PMP	MDP	DGRM2
MCC 29-2	480	AC/2	517TB	IC-MU	CTS PUMP 2B	MDP	517TB
MCC 29-4	480	AC/2	517RB	CCSW	CCSW2-3B	MOV	WRB
MCC 29-4	480	AC/2	517RB	ECCS	CS2-2B	MOV	WRB
MCC 29-4	480	AC/2	517RB	ECCS	LPCI2-11B	MOV	WRB
MCC 29-4	480	AC/2	517RB	ECCS	LPCI2-20B	MOV	TORUS
MCC 29-4	480	AC/2	517RB	ECCS	LPCI2-38B	MOV	TORUS
MCC 29-4	480	AC/2	517RB	ECCS	LPCI2-5C	MOV	WRB
MCC 29-4	480	AC/2	517RB	ECCS	LPCI2-5D	MOV	WRB
MCC 29-7	480	AC/2	517RB	ECCS	LPCI2-21B	MOV	TORUS
MCC 29-7	480	AC/2	517RB	ECCS	LPCI2-22B	MOV	TORUS
MCC 38-2	480	AC/2-3	538TB3	EP	125BC3-2	BC	BATCHG3
MCC 38-2	480	AC/3	MCC29-2	EP	250 BC3	BC	BATCHG3
MCC 39-2	480	AC/3	538TB3	EP	125BC3-1	BC	BATCHG3

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
MCC 39-2	480	AC/3	538TB3	EP	250 BC2/3	BC	BATAREA2
RB BUS 2A-2B	250	250/3	570RB	ECCS	HPCI LO PUMP	MDP	HPCI
RB BUS 2A-2B	250	250/3	570RB	ECCS	HPCI2-10	MOV	HPCI
RB BUS 2A-2B	250	250/3	570RB	ECCS	HPCI2-21	MOV	HPCI
RB BUS 2A-2B	250	250/3	570RB	ECCS	HPCI2-3	MOV	HPCI
RB BUS 2A-2B	250	250/3	570RB	ECCS	HPCI2-35	MOV	HPCI
RB BUS 2A-2B	250	250/3	570RB	ECCS	HPCI2-36	MOV	WRB
RB BUS 2A-2B	250	250/3	570RB	ECCS	HPCI2-48	MOV	HPCI
RB BUS 2A-2B	250	250/3	570RB	ECCS	HPCI2-5	MOV	TORUS
RB BUS 2A-2B	250	250/3	570RB	ECCS	HPCI2-6	MOV	HPCI
RB BUS 2A-2B	250	250/3	570RB	ECCS	HPCI2-8	MOV	517X
RB BUS 2A-2B	250	250/3	570RB	ECCS	HPCI2-9	MOV	HPCI
RB BUS 2A-2B	250	250/3	570RB	IC	IC2-2	MOV	570RBPC
RB BUS 2A-2B	250	250/3	570RB	IC	IC2-3	MOV	545RBPC
RB BUS 2A-2B	250	250/3	570RB	RCS	MSD2-2	MOV	517X
RB BUS 2A-2B	250	250/3	570RB	RHR	SDC2-2A	MOV	SDCPMRM
RB BUS 2A-2B	250	250/3	570RB	RHR	SDC2-2B	MOV	SDCPMRM
RB BUS 2A-2B	250	250/3	570RB	RHR	SDC2-2C	MOV	SDCPMRM
TRAN TR-28T	4160/480	AC/2-3	570RB	EP	BUS 28	BUS	570RB
TRAN TR-29T	4160/480	AC/2	570RB	EP	BUS 29	BUS	570RB
UNKNOWN	UNK		CCPM2APWR	CCSW	CCSW P-2A	MDP	495TB
UNKNOWN	UNK		CCPM2BPWR	CCSW	CCSW P-2B	MDP	495PMBY
UNKNOWN	UNK		CCPM2CPWR	CCSW	CCSW P-2C	MDP	495PMBY
UNKNOWN	UNK		CCPM2DPWR	CCSW	CCSW P-2D	MDP	495TB
UNKNOWN	UNK	UNK	CRDPUNK1	CRDHS	CRD P-2A	MDP	495TB
UNKNOWN	UNK	UNK	CRDPUNK2	CRDHS	CRD P-2B	MDP	495TB
UNKNOWN	480	AC/3	UNKNOWN	EP	BUS 38	BUS	545RB3
UNKNOWN	250	DC	UNKNOWN	RCS	RWCU2-2	MOV	545RB
UNKNOWN	250	DC	UNKNOWN	RCS	RWCU2-3	MOV	545RB
UNKNOWN	250			RHR	SDC2-5A	MOV	SDHXRM
UNKNOWN	250			RHR	SDC2-5B	MOV	SDHXRM

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

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
UNKNOWN	480	250/3	UNKNOWN	EP	MCC 39-2	BUS	538TB3

3.7 CONTROL ROD DRIVE HYDRAULIC SYSTEM (CRDHS)

3.7.1 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.

3.7.2 System Definition

The CRDHS consists of two high-head, low-flow CRD supply pumps, piping, filters, control valves, one control rod drive hydraulic equipment module for each control rod drive mechanism, and instrumentation. Water is supplied from the rejected condensate system or the condensate storage tanks. The CRDHS also includes scram valves, scram accumulators, and a scram discharge volume.

Simplified drawings of the CRDHS are shown in Figures 3.7-1 and 3.7-2. Details of the scram portion of a typical BWR CRDHS is shown in Figure 3.7-3.

3.7.3 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.

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

The control rod drive accumulators are necessary to scram the control rods within the required time. It should be noted that each drive has an internal ball check valve which allows reactor pressure to be admitted under the drive piston. If reactor pressure exceeds the supply pressure at the drive, the ball check valve ensures rod insertion in the event that the scram accumulator is not charged or the inlet scram valve fails to open. This also furnishes the force to complete the scram stroke at higher reactor pressures.

Although not intended as a makeup system, the CRDHS can provide a source of cooling water to the RCS during vessel isolation. In Dresden 2 and 3, the HPCI system normally supplies RCS makeup at high reactor pressures. During long-term isolation condenser operation, makeup to the RCS must be provided. Either the HPCI system or CRDHS can supply the required high pressure makeup. The maximum RCS makeup rate of the CRDHS is expected to be about 200 gpm with both pumps operating (Ref. 1).

3.7.4 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 respond and insert into the reactor core (specific number needed is not known).

Adequate makeup to the RCS for isolation condenser operation can be provided by either CRD pump taking suction on the Condensate Storage Tanks.

3.7.5 Component Information

A. Control rod drive pumps (2)
   1. Rated capacity: 100% (for control rod drive function)
   2. Type: centrifugal
   3. Flow rate: unknown

B. Unit 2/3 Condensate Storage Tanks (2)
   1. Minimum capacity: 200,000 gal each

C. Scram Accumulators
   1. Normal pressure: 1400 psig

D. Scram Discharge Volume
   1. Normal pressure: Atmospheric

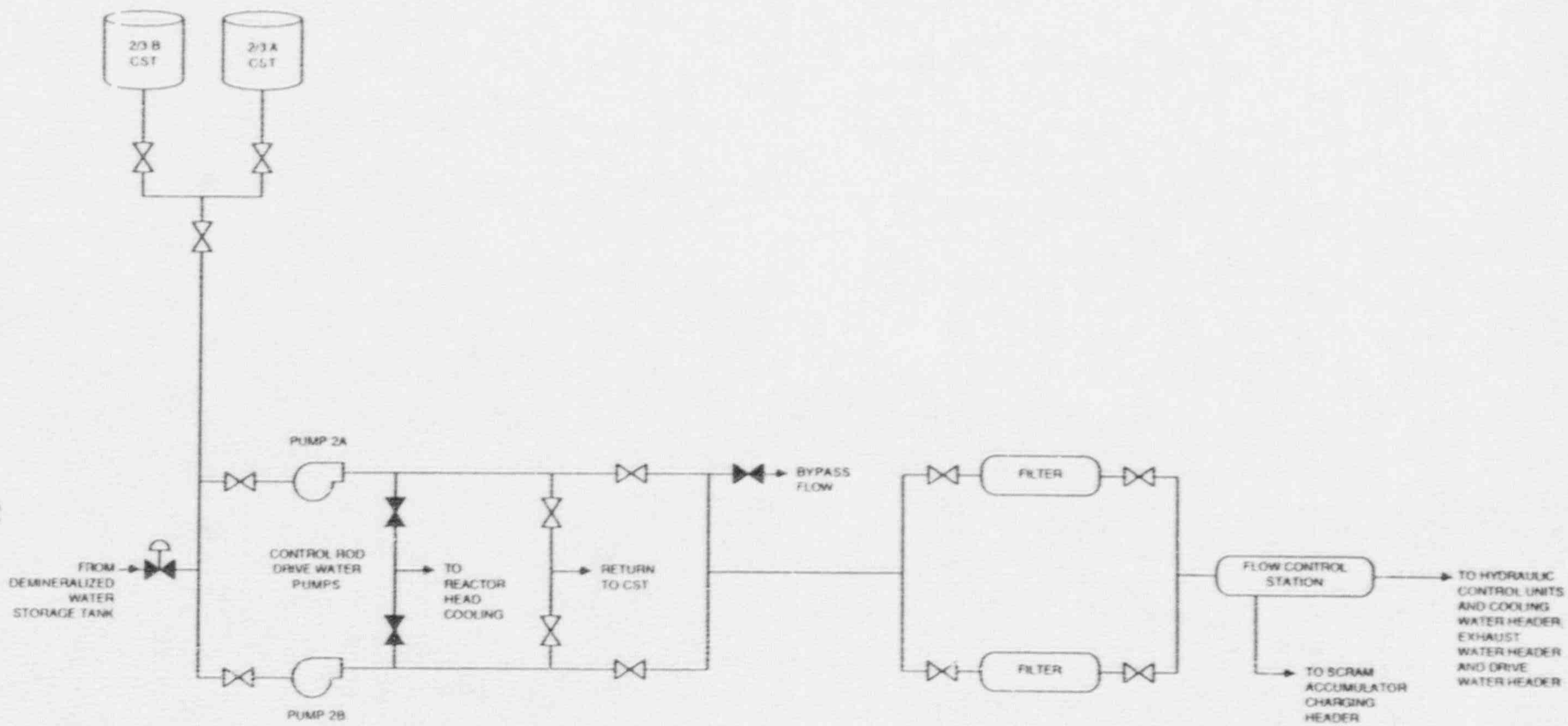
3.7.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The RPS transmits scram commands to solenoid pilot valves which control the pneumatic scram valves.
   2. Remote Manual
      a. A reactor scram can be initiated manually from the control room
      b. The CRDHS can be operated manually from the control room to insert and withdraw rods, or to inject water into the RCS.

B. Motive Power
   The power sources for the control rod drive water pumps are unknown. The control rod drive water pumps are assumed to be Class 1E AC loads that can be supplied from the emergency diesel generator as described in Section 3.6. This should be verified.

3.7.7 Section 3.7 References

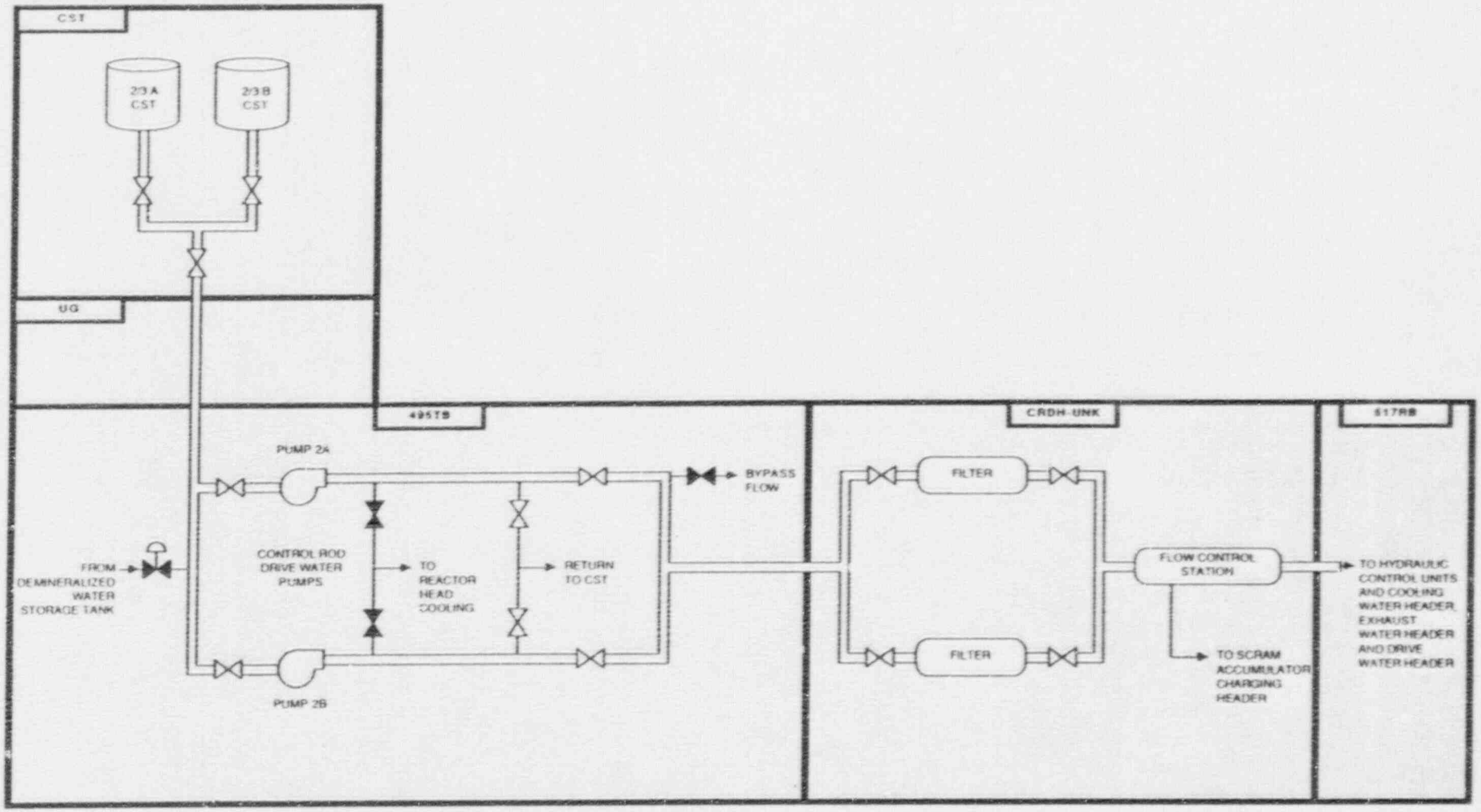
1. Harrington, R.M., and Ott, L.J., "The Effect of Small-Capacity, High-Pressure Injection Systems on TQUV Sequences at Browns Ferry Unit One," NUREG/CR-3179, Oak Ridge National Laboratory, September 1983.



NOTE

INTERCONNECTIONS TO OTHER SYSTEMS FROM THE CONDENSATE STORAGE TANK ARE NOT SHOWN ON THIS DRAWING

Figure 3.7-1. Dresden Unit 2 Control Rod Drive Hydraulic System



NOTE

INTERCONNECTIONS TO OTHER SYSTEMS FROM THE CONDENSATE STORAGE TANK ARE NOT SHOWN ON THIS DRAWING

Figure 3.7-2. Dresden Unit 2 Control Rod Drive Hydraulic System Showing Component Locations

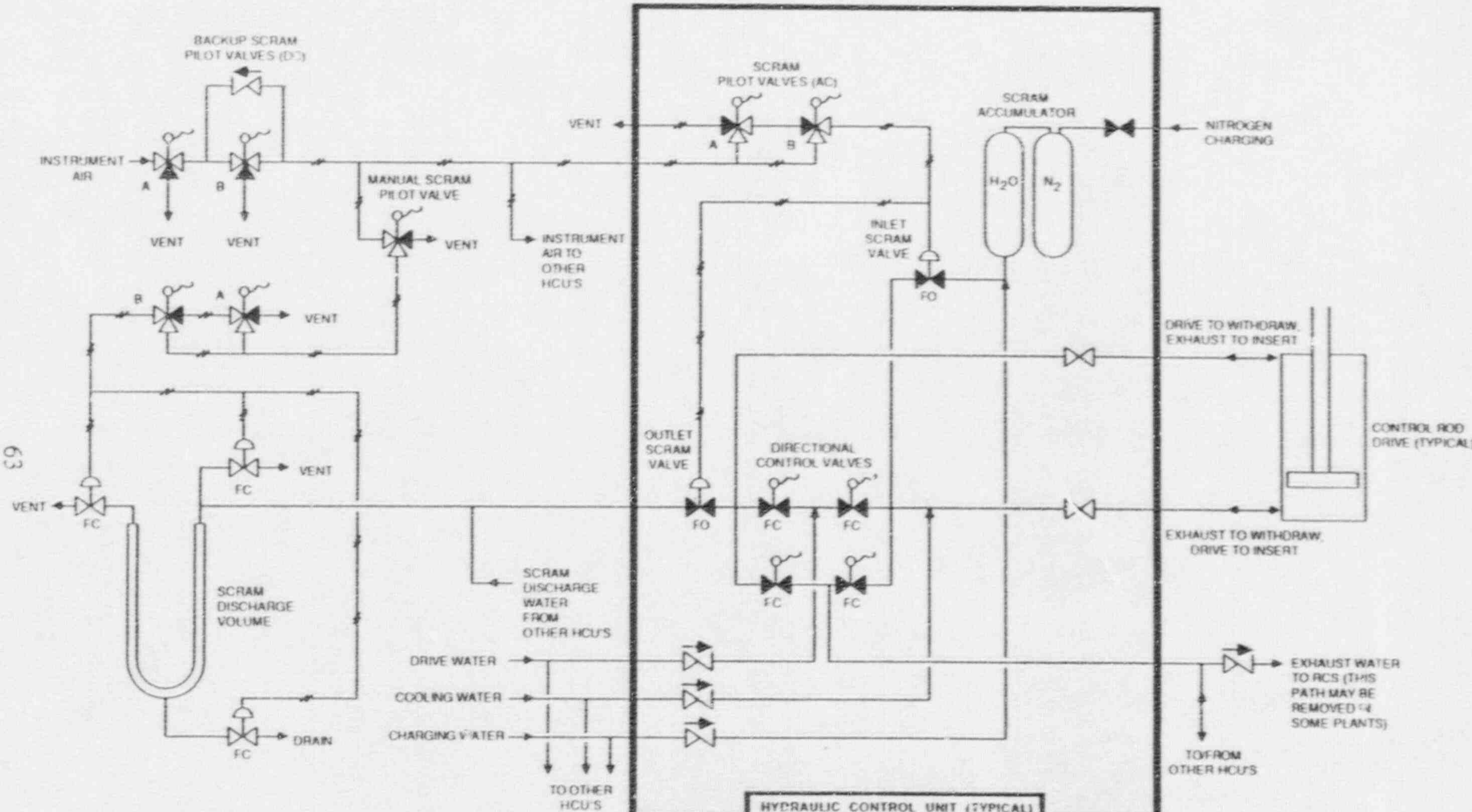


Figure 3.7-3. Simplified Diagram Of Portions Of The Control Rod Drive Hydraulic System That Are Related To The Scram Function

3.8 DIESEL GENERATOR COOLING WATER (DGCW) SYSTEM

3.8.1 System Function

The Diesel Generator Cooling Water (DGCW) System for Dresden 2 and 3 is designed to operate under all conditions that the diesel generators operate under. The diesel generator cooling water pumps provide cooling water to the diesel generators and to emergency room air coolers for the reactor buildings and the HPCI building.

3.8.2 System Definition

The DGCW system is subdivided into three open loops, one for each standby diesel generator at Dresden 2 and 3. The loops are supplied with cooling water from the intake flume also used by the Service Water System. Each loop is normally operated independently, each consisting of a DGCW pump, diesel generator cooler, other loads, and interconnecting headers. Manual valves and piping are provided to cross-connect the loops for backup of diesel generator and emergency room air cooling.

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

3.8.3 System Operation

Diesel generator cooling water for Dresden 2 and 3 is supplied by three pumps installed in the Unit 2 and 3 crib house that take a suction from the intake flume. Under normal operating conditions, the system is in standby. When the diesel generators are started, the system is put into operation. Each loop normally supplies its associated diesel generator cooler with cooling water. Each loop has one pump in it, supplied with power from its associated diesel generator. DGCW pumps 2B and 3B also normally supply the Unit 2 reactor building and HPCI building emergency air coolers, and the Unit 3 reactor building and HPCI building emergency air coolers, respectively. These parallel heat loads can be cross-connected between the diesel generator cooling water loops by means of manual, normally closed cross-connect valves.

Without cooling water flow from the DGCW system to the diesel generator coolers, the standby diesel generators will not operate. At a full load, a diesel generator with a speed of 900 RPM can only run for 3 minutes without cooling water. Even at a no load condition, the diesel would only run for 10 minutes. These figures assume an initial cooling water temperature of 100° F (Ref. 1).

3.8.4 System Success Criteria

A single DGCW pump can supply adequate cooling water to a single diesel generator and the emergency air coolers for a single unit. There does not appear to be a check valve in the cross-tie line between DGCW pumps 2/3B and 3B, therefore, the following DGCW pumps are capable of being aligned to supply the following heat loads:

DGCW Pump	Heat Load
DGCW 2B	DG's 2B, 2/3, and 3 and Unit 2 & 3 emergency air coolers
DGCW 2/3B	DG's 2/3, and 3 and Unit 2 & 3 emergency air coolers
DGCW 3B	Same as DGCW 2/3B

3.8.5 Component Information

A. Diesel Generator Cooling Water System Pumps 2B, 2/3B and 3B
   1. Rated flow: unknown
   2. Type: centrifugal

3.8.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The actuation method of the DGCW pumps is not known, but the pumps are believed to be actuated by starting their associated diesel generators.
   2. Remote manual
      It is believed that the DGCW pumps can be started from the control room or locally.

B. Motive Power
   The DGCW pumps are Class 1E AC loads that can be supplied from the associated standby diesel generators as described in Section 3.6.

3.8.7 Section 3.8 References

1. Dresden 2 and 3 Updated Final Safety Analysis Report, Section 10.9.

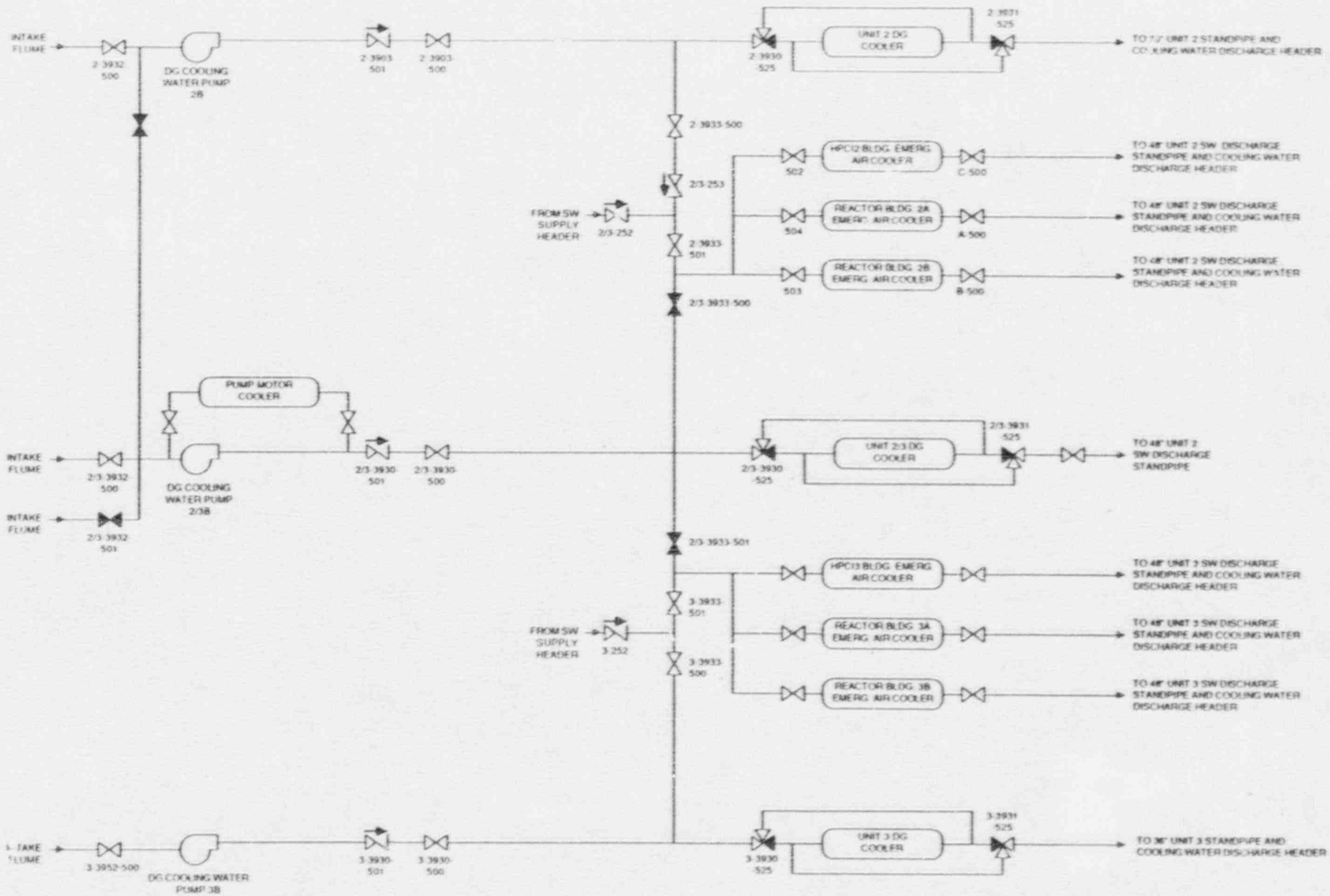


Figure 3.8-1. Dresden Units 2 and 3 Diesel Generator Cooling Water System

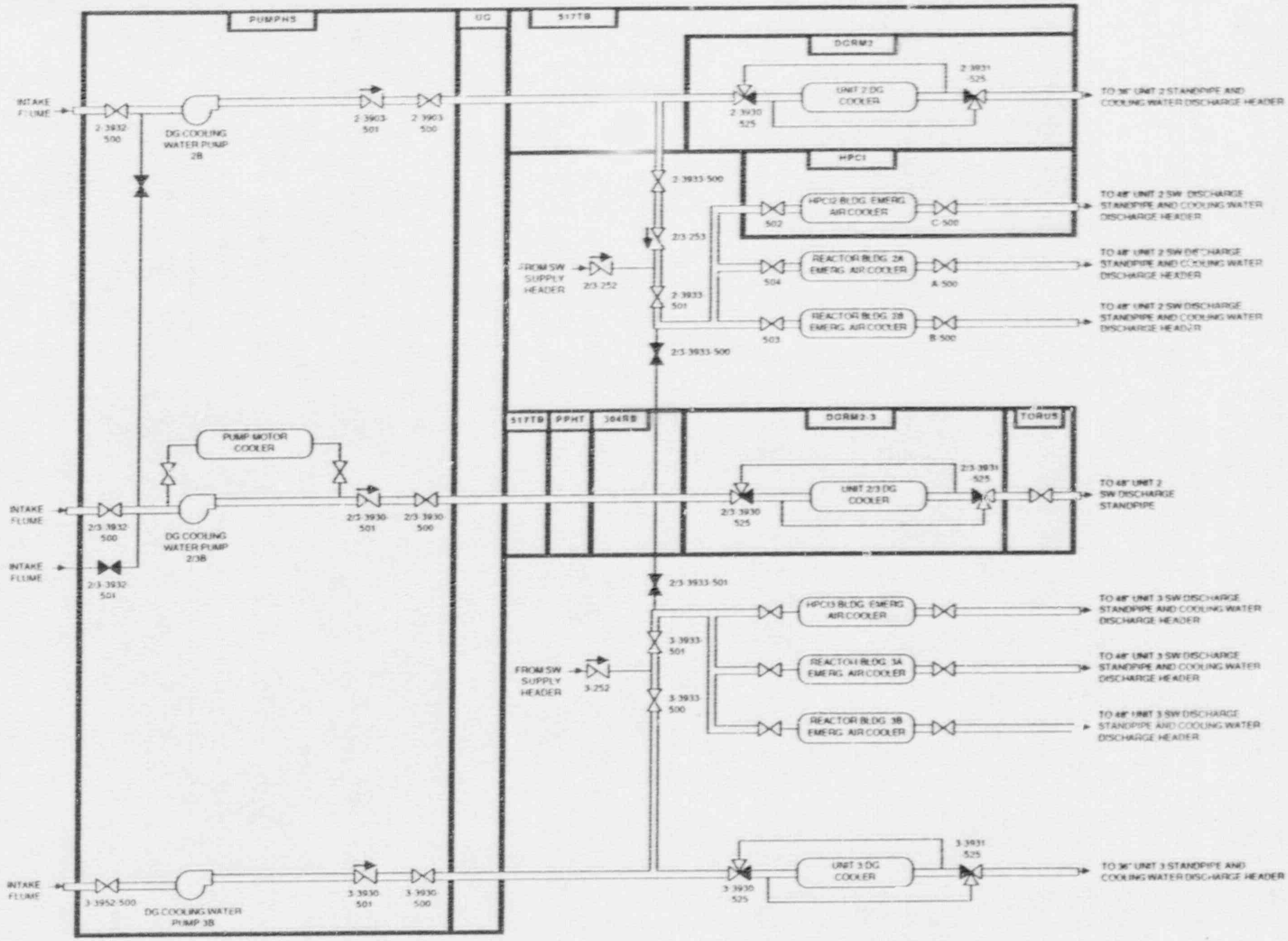


Figure 3.8-2. Dresden Units 2 and 3 Diesel Generator Cooling Water System Showing Component Locations

Table 3.8-1. Dresden 2 Diesel Generator Cooling Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
DG HX2	HX	DGRM2				
DG HX2/3	HX	DGRM2-3				
DGCW P-2/3B	MDP	PUMPHS	MCC 28-3	480	538TB	AC/2-3
DGCW P-2B	MDP	PUMPHS	MCC 29-2	480	517TB	AC/2

3.9 CONTAINMENT COOLING SERVICE WATER (CCSW) SYSTEM

3.9.1 System Function

The Containment Cooling Service Water (CCSW) System provides cooling water from the ultimate heat sink to the containment cooling heat exchangers for containment and suppression pool cooling.

3.9.2 System Definition

The Containment Cooling Service Water System for Dresden 2 consists of two loops with two motor-driven pumps per loop. Each CCSW loop cools a separate containment cooling heat exchanger, and either containment cooling heat exchanger can provide adequate post-LOCA cooling for the containment or suppression pool. The sources of cooling water are two pipes supplying Kankakee River water from the Unit 2/3 crib house.

Simplified system drawings are shown in Figures 3.9-1 and 3.9-2. A summary of data on selected CCSW components is presented in Table 3.9-1.

3.9.3 System Operation

During normal operation, the system is in standby. Following actuation of the LPCI system, the Containment Cooling Service Water System can be used to provide some cooling for the containment. Since LPCI flow is passing through the heat exchangers already, starting the CCSW pumps when sufficient power is available will remove heat from the coolant. During this LPCI operational mode, the LPCI pumps take a suction on the suppression pool and discharge to the reactor. The coolant returns to the suppression pool via the break in the RCS.

The Containment Cooling Service Water System can also remove heat from the containment when one LPCI loop is aligned for containment spray. In this LPCI mode, water is directed to the drywell spray spargers, collects in the suppression pool and is returned to the LPCI pump suctions. The CCSW system supplies the containment cooling heat exchanger in the LPCI loop aligned for drywell spray. Similarly, the CCSW system can remove suppression pool heat when a LPCI loop is aligned for suppression pool cooling or spray. In these modes, the LPCI loop returns water to the suppression pool via the suppression pool spray spargers or the full flow test line.

During operation, the CCSW pumps provide enough head so that in case of a leak in the containment cooling heat exchanger, leakage would be into the primary coolant side, preventing contamination of river water. The system heat exchangers were designed to remove enough heat to maintain suppression pool temperature no greater than 170 degrees F assuming HPCI operation following a LOCA.

3.9.4 System Success Criteria

The CCSW system should be capable of supply the required decay heat removal capacity in the following configurations:

- Two CCSW pumps in one loop supplying the containment cooling heat exchanger in one operating LPCI loop
- One CCSW pump in each loop, supplying the containment cooling heat exchangers in two operating LPCI loops

3.9.5 Component Information

A. Containment Cooling Service Water Pumps 2A, 2B, 2C, 2D
   1. Rated flow: 3500 gpm each @ 435 ft. head
   2. Type: Horizontal centrifugal

B. Ultimate Heat Sink - Kankakee and Illinois Rivers and cooling lake

C. Containment Cooling Heat Exchangers 2A, 2B
   1. Primary flow - shell side: 10700 gpm
   2. Secondary flow - tube side: 7000 gpm
   3. Capacity: 102×10^6 Btu/hr each
   4. Design press· re: 375 psig

3.9.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      None have been identified.
   2. Remote Manual
      The CCSW pumps and motor operated valves can be actuated from the control room.

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

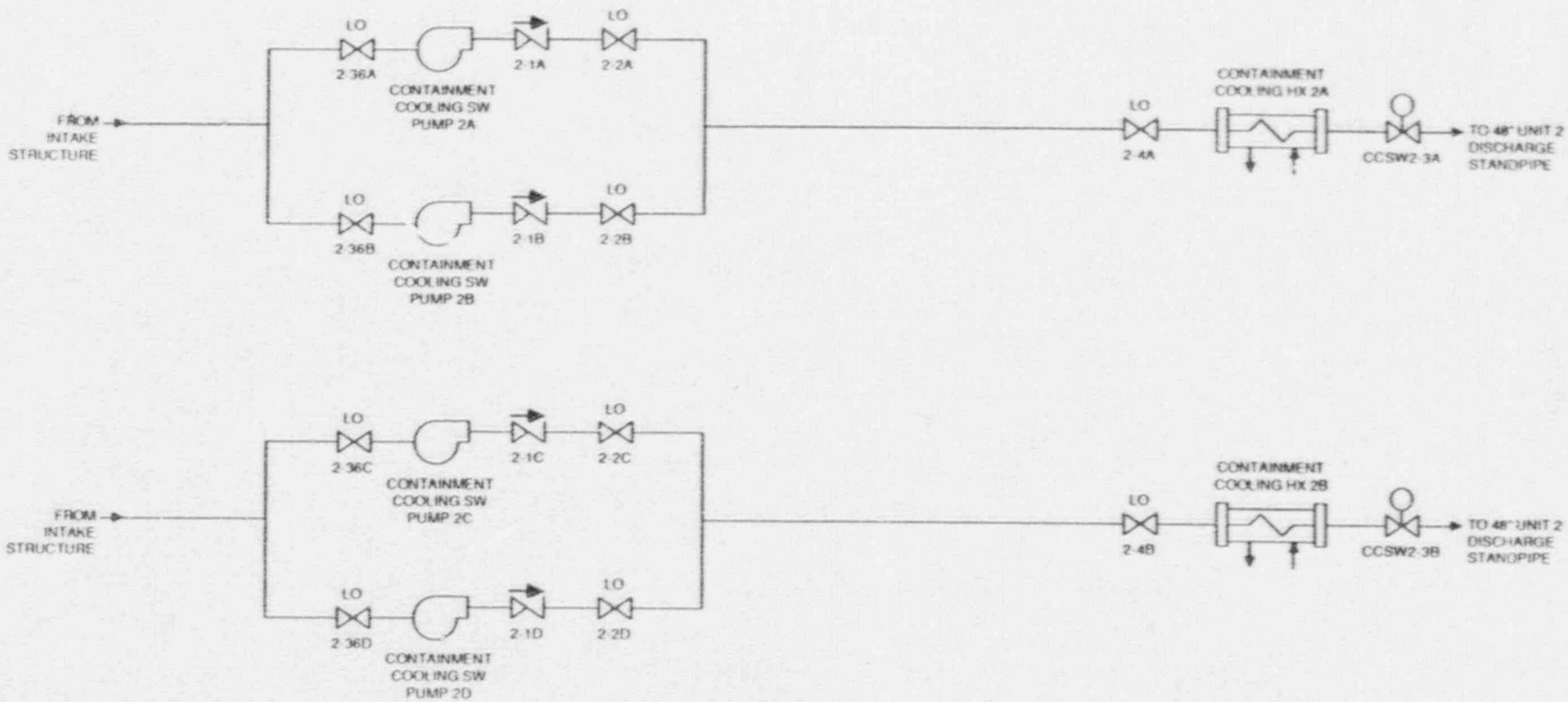


Figure 3.9-1. Dresden Unit 2 Containment Cooling Service Water System

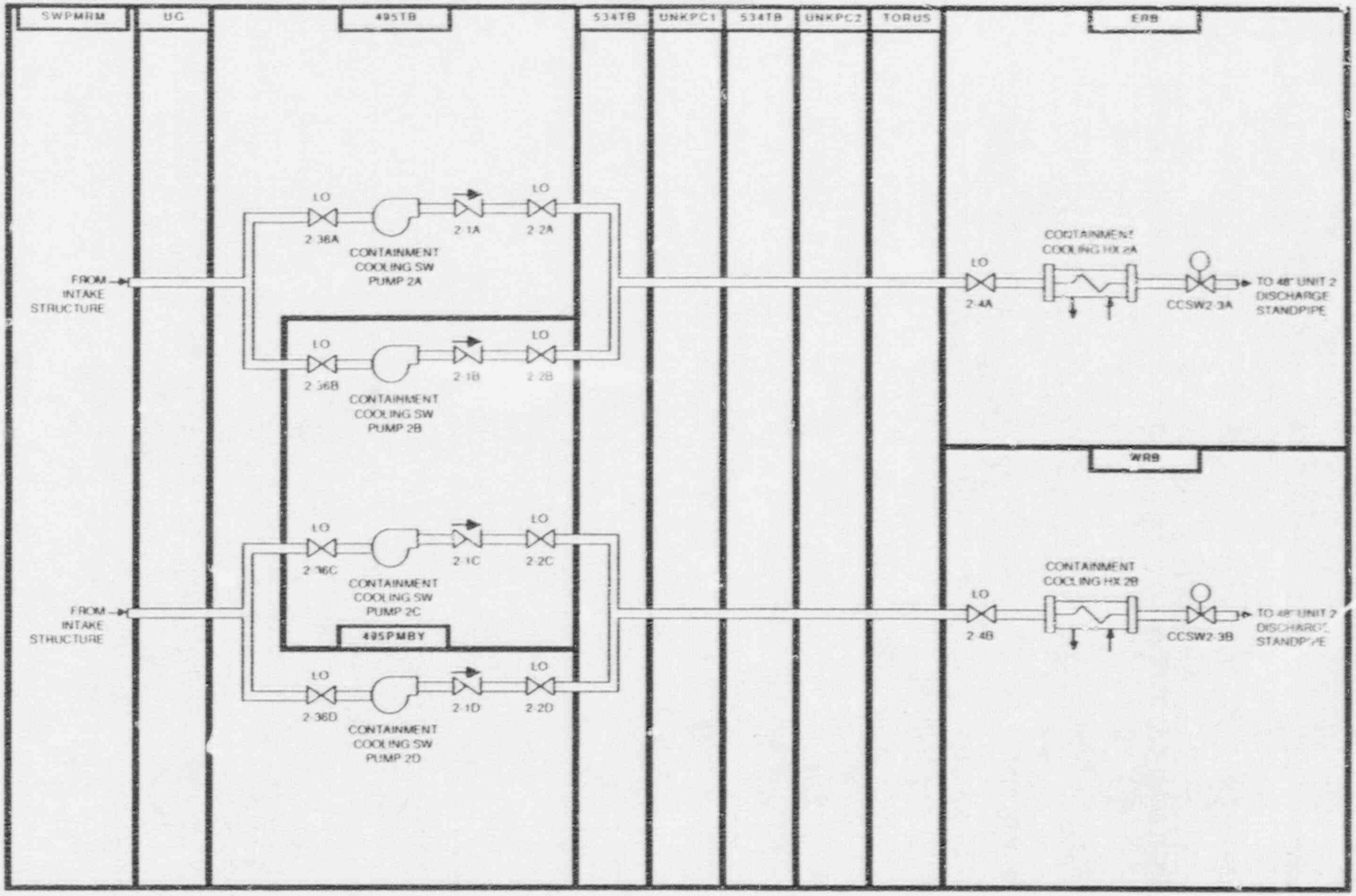


Figure 3.9-2. Dresden Unit 2 Containment Cooling Service Water System Showing Component Locations

Table 3.9-1. Dresden 2 Containment Cooling Service Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CCSW P-2A	MDP	495TB	UNKNOWN	UNK	CCPM2APWR	
CCSW P-2B	MDP	495PMBY	UNKNOWN	UNK	CCPM2BPWR	
CCSW P-2C	MDP	495PMBY	UNKNOWN	UNK	CCPM2CPWR	
CCSW P-2D	MDP	495TB	UNKNOWN	UNK	CCPM2DPWR	
CCSW2-3A	MOV	ERB	MCC 28-1	480	517RB	AC/2-3
CCSW2-3B	MOV	WRB	MCC 29-4	480	517RB	AC/2

3.10 SHUTDOWN COOLING SYSTEM

3.10.1 System Function

The shutdown cooling system (SCS) provides for shutdown cooling of the reactor after the RCS has been depressurized to less than 350°F. The SCS transfers decay heat to the reactor building closed cooling water (RBCCW) system. The SCS is not part of the Emergency Core Cooling System.

3.10.2 System Definition

The SCS consists of three parallel SCS pumps and associated SCS heat exchangers. The pumps take a suction on, and return coolant to RCS recirculation loops A and B. The suction and discharge sides of the pumps are cross-tied, therefore, the three SCS trains are not independent. Simplified drawings of the shutdown cooling system are shown in Figures 3.10-1 and 3.10-2. A summary of data on selected SCS components is presented in Table 3.10-1.

3.10.3 System Operation

During normal operation, the SCS is shutdown and isolated from the RCS. Following reactor shutdown, RCS cooling is provided by steaming on the turbine bypass system and providing makeup to the RCS with the main condensate and feedwater system. The SCS is manually actuated during RCS cooldown and depressurization when RCS temperature is less than 350°F. The SCS is designed with sufficient capacity to remove decay heat being generated by the core 24 hours after shutdown and hold RCS temperature at 125°F (Ref. 1).

3.10.4 System Success Criteria

All three SCS loops are required in order to cool the RCS to less than 125°F in 24 hours. The RCS can be cooled to less than 125°F with two SCS trains, but more than 24 hours are required. RCS temperature can be maintained at less than 125°F following a loss of one SCS train 24 hours after shutdown (Ref. 1).

3.10.5 Component Information

A. SCS pumps (3)
   1. Type: Horizontal centrifugal
   2. Capacity: 6,750 gpm (approx.) at unknown head

B. SCS heat exchangers (3)
   1. Type: Horizontal U-tube
   2. Heat removal capacity: 27 x 10^6 Btu/hr

3.10.6 Support Systems and Interfaces

A. Control Signals
   1. The SCS is controlled from the reactor control room.
   2. An interlock prevents opening both isolation valves between the RCS and SCS when RCS pressure is greater than 120 psig. A single isolation valve can be exercised at higher RCS pressure.
   3. The SCS isolation valves are automatically closed by a low-low RCS water level signal from the Reactor Protection System, or a high SCS area temperature from temperature detectors intended to sense the effects of an SCS pipe break.

4. The SCS pump permissive instrumentation prevents pump operation unless suction pressure is above 4 psig and reactor water temperature is below 350°F.

B. Motive Power
The SCS pumps can be powered from the diesel generators as described in Section 3.6.

C. Others
1. The reactor building closed cooling water (RBCCW) system provides cooling water to the SCS heat exchangers and to the SCS pump bearings.
2. Spool pieces can be connected to SCS trains A and B to align these trains to supply cooling to the spent fuel pool.

3.10.7 Section 3.10 References

1. Dresden 2 & 3 FSAR, Section 10.4.

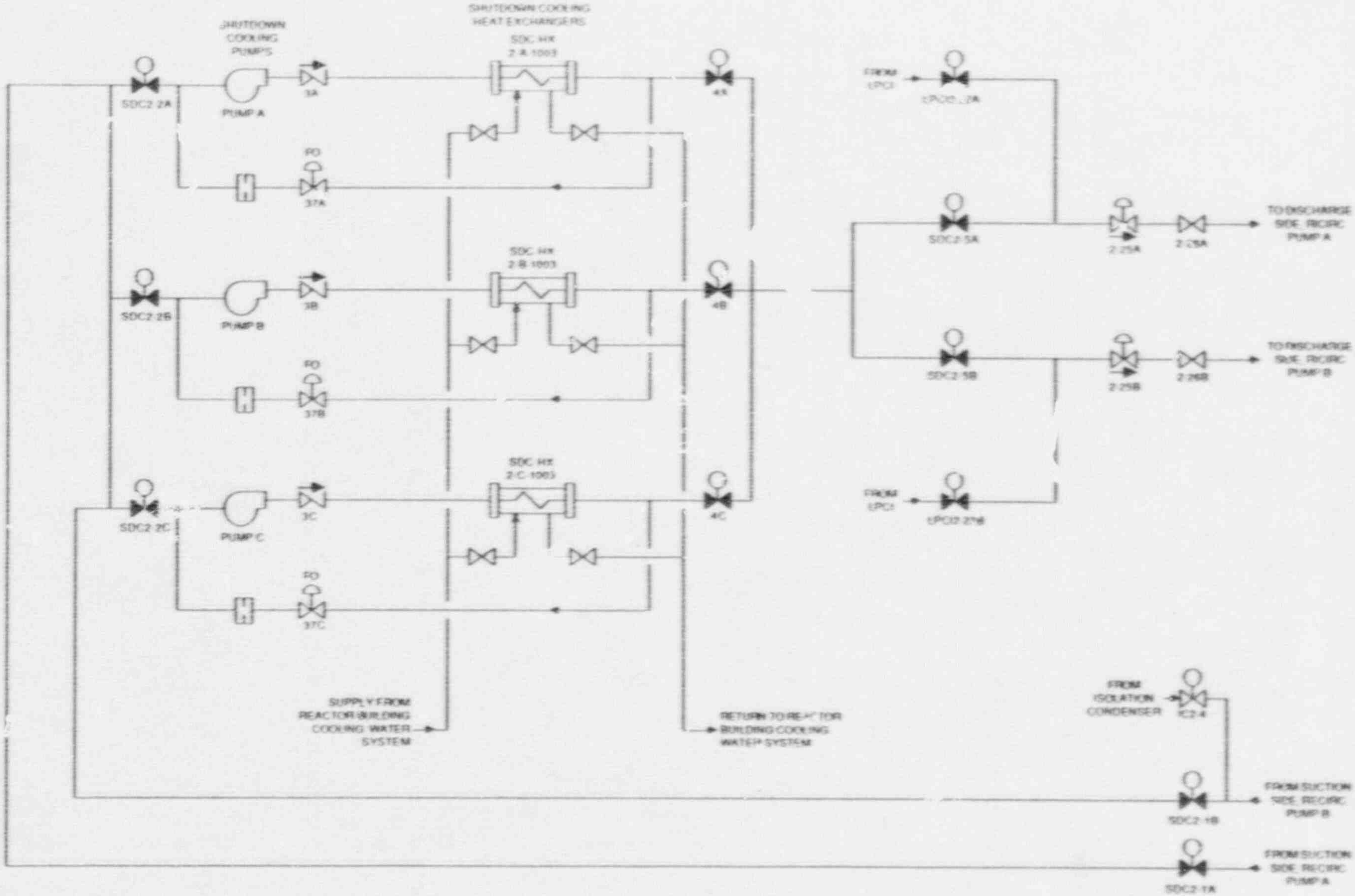


Figure 3.10-1. Dresden Unit 2 Shutdown Cooling System

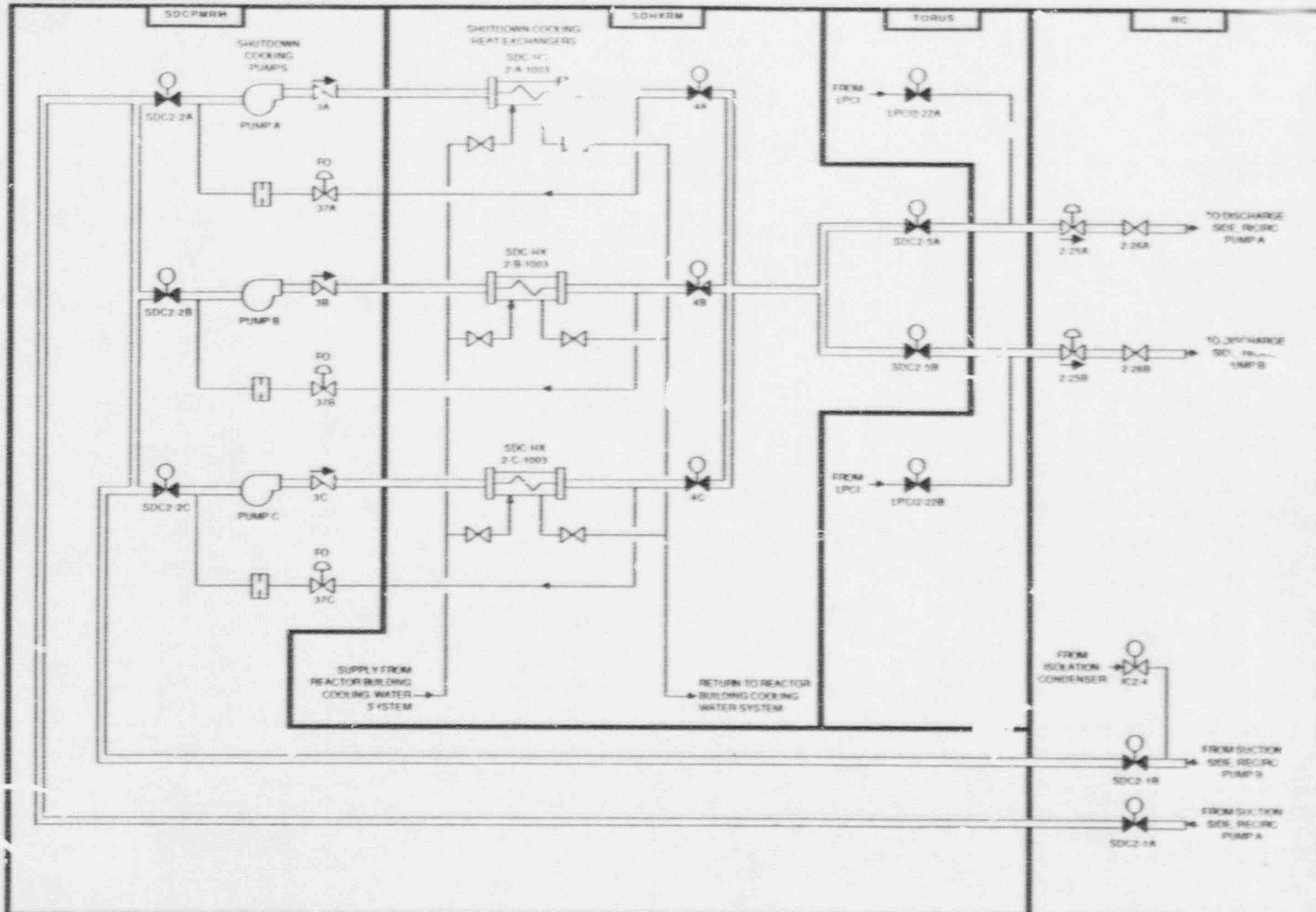


Figure 3.10-2. Dresden Unit 2 Shutdown Cooling System Showing Component Locations

Table 3.10-1. Dresden 2 Shutdown Cooling System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
PUMP 2A	MDP	SDCPMRM	BUS 23-1	4160	545RB	AC/1
PUMP 2B	MDP	SDCPMRM	BUS 23-1	4160	545RB	AC/1
PUMP 2C	MDP	SDCPMRM	BUS 24-1	4160	545RB	AC/2
SDC2-1A	MOV	RC	MCC 28-1	480	517RB	AC/2-3
SDC2-1B	MOV	RC	MCC 28-1	480	517RB	AC/2-3
SDC2-2A	MOV	SDCPMRM	RB BUS 2A-2B	250	570RB	250/3
SDC2-2B	MOV	SDCPMRM	RB BUS 2A-2B	250	570RB	250/3
SDC2-2C	MOV	SDCPMRM	RB BUS 2A-2B	250	570RB	250/3
SDC2-5A	MOV	SDHXRM	UNKNOWN	250		
SDC2-5B	MOV	SDHXRM	UNKNOWN	250		
SDCHXA	HX	SDHXRM				
SDCHXB	HX	SDHXRM				
SDCHXC	HX	SDHXRM				

4. PLANT INFORMATION

4.1 SITE AND BUILDING SUMMARY

The Dresden site is located in the northeastern portion of Illinois in Goose Lake Township, Grundy County, at the point where the Kankakee and Des Plaines Rivers meet to form the Illinois River. The site is bounded on two sides by the Kankakee and Illinois Rivers. The site contains one BWR/1 plant, Unit 1, and two BWR/3 plants, Units 2 and 3. Unit 1 is located in the northeastern portion of the site and is no longer in commercial operation. Unit 2 is located adjacent to and immediately to the west of Unit 1. Unit 3 is located adjacent to Unit 2, immediately to the west. The site comprises approximately 953 acres and is owned by Commonwealth Edison Company. A cooling lake for the plant covers another 1275 acres. The city of Joliet, Illinois is 14 miles northeast of the Dresden site. A general view of the site is shown in Figure 4-1 (from Ref. 1) and a more detailed site plan is shown in Figure 4-2.

The two reactor buildings for Units 2 and 3 are adjacent to each other, as shown in Figure 4-3. A turbine building, containing the Unit 2 and 3 main turbines, control rooms and balance-of-plant systems, is adjacent to the north sides of the Unit 2 and 3 reactor buildings.

At each unit, the containment is surrounded by the reactor building, as shown in Figure 4-5. The IC, core spray, LPCI, reactor water cleanup systems, and the CRD hydraulic control equipment modules are located on various elevations of the reactor buildings. The HPCI systems are located in a separate HPCI building adjacent to the south of the Unit 3 reactor building. The bottoms of the spent fuel storage pools are on the 574 foot elevation of the reactor buildings. Equipment hatches and personnel air locks into the reactor buildings and the drywells are located on the 517'-6" elevation of the reactor buildings.

The turbine building, located adjacent to and north of the two reactor buildings, contains the control rooms, auxiliary electrical rooms, battery rooms, main turbines and balance-of-plant systems. The control rooms for Units 2 and 3 are in a common area on the 538 foot elevation of the turbine building.

Diesel generators 2 and 3 are located in the turbine building. Diesel generator 2/3 is located in the HPCI building. The long-term fuel storage tanks for the diesels are located underground outside the buildings.

The Unit 2/3 crib house is located on the intake canal north of the other Unit 2/3 buildings. The crib house contains the circulating and service water pumps for both Units 2 and 3 and the diesel-driven fire pump for Units 2 and 3. The intake canal draws water from the Kankakee River which is located to the east of the site. The discharge canal exits underground on the north side of the site and discharges to the cooling lake or Illinois River.

The switchyards for both Units 2 and 3 are located to the north and west of the units. The radwaste building for both units is located adjacent to and north of the turbine building.

Two condensate storage tanks (CST) are provided for the two units. They are located together south of Unit 2.

Personnel and vehicle access to the protected area is through an access control point adjacent to the gate house south of Unit 1. The Elgin, Joliet and Eastern Railroad owns and operates a rail line serving the site via a spur line. Rail access is provided at a point on the west side of the site.

4.2 FACILITY LAYOUT DRAWINGS

Simplified layout drawings of the Dresden 2 and 3 reactor buildings are shown in Figures 4-6 to 4-10. The Unit 2 turbine building is shown in Figures 4-11 to 4-15. Comparable layout drawings for the Unit 3 turbine building are shown in Figures 4-16 to 4-19. Partial plans showing the battery rooms in the turbine building are in Figure 4-20.

The intake cribhouse is shown in Figure 4-21. 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 II, Oak Ridge National Laboratory, January 1972.

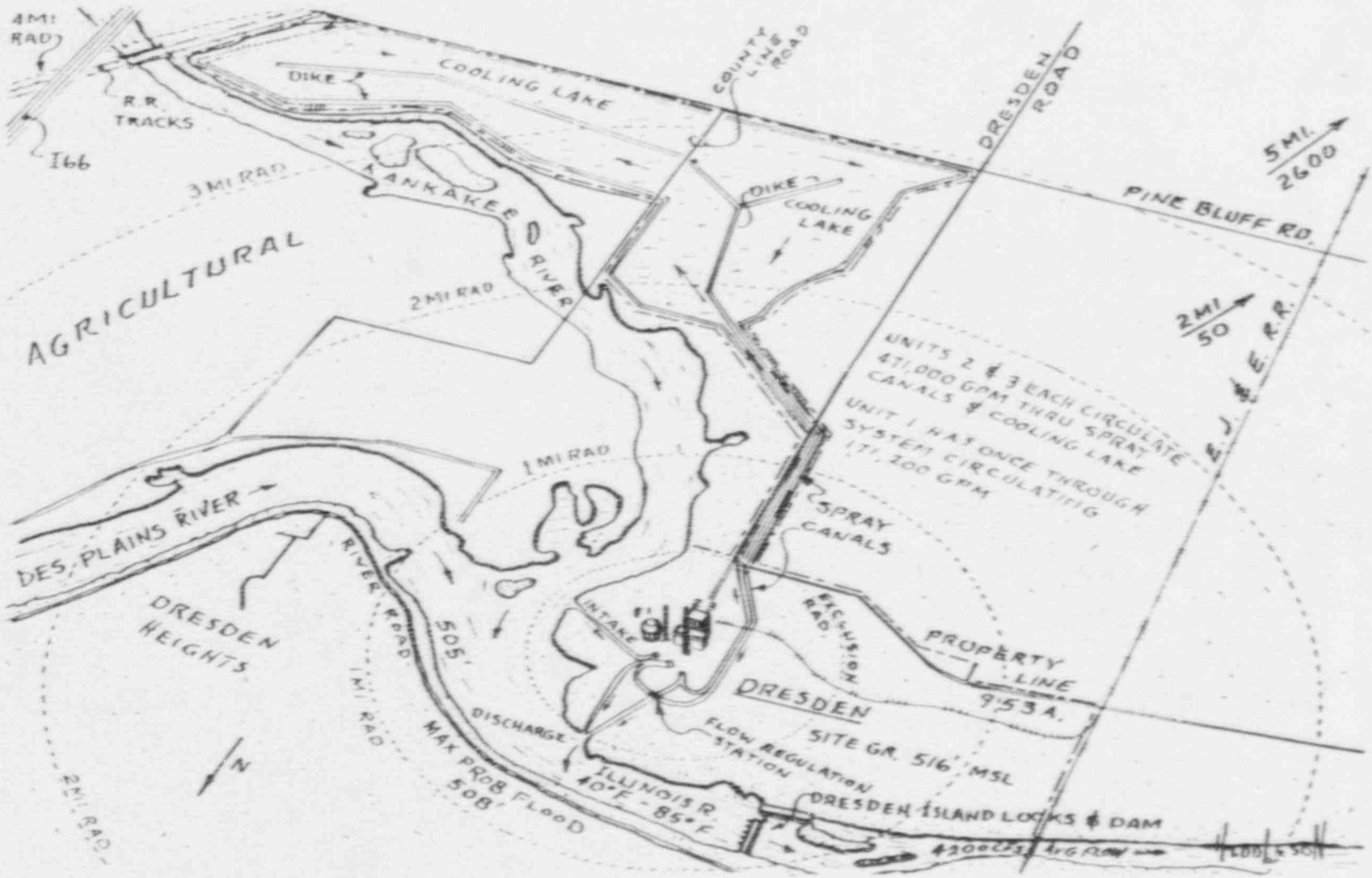


Figure 4-1. General View of the Dresden Site and Vicinity

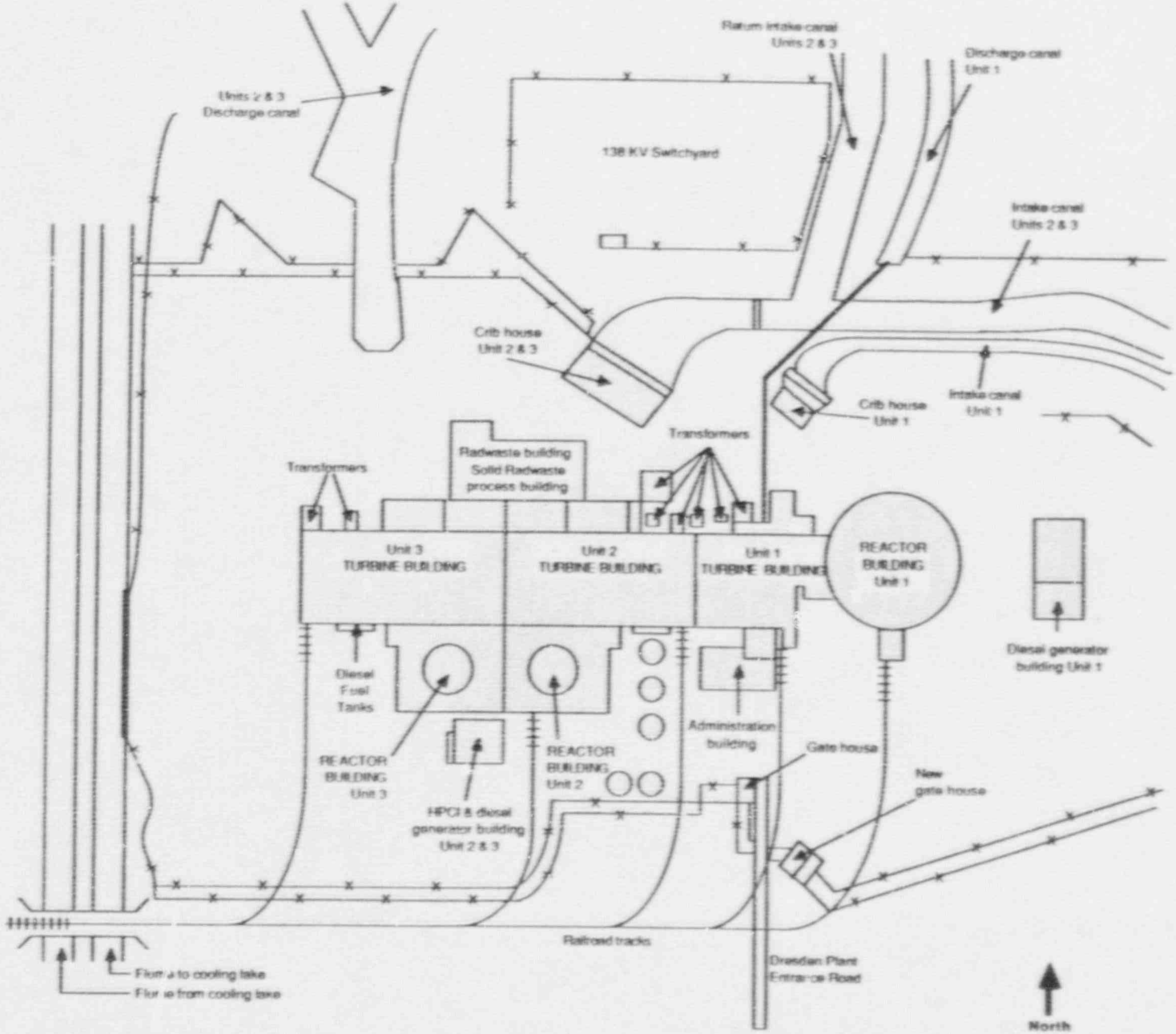


Figure 4-2. Dresden Plant Site Plan

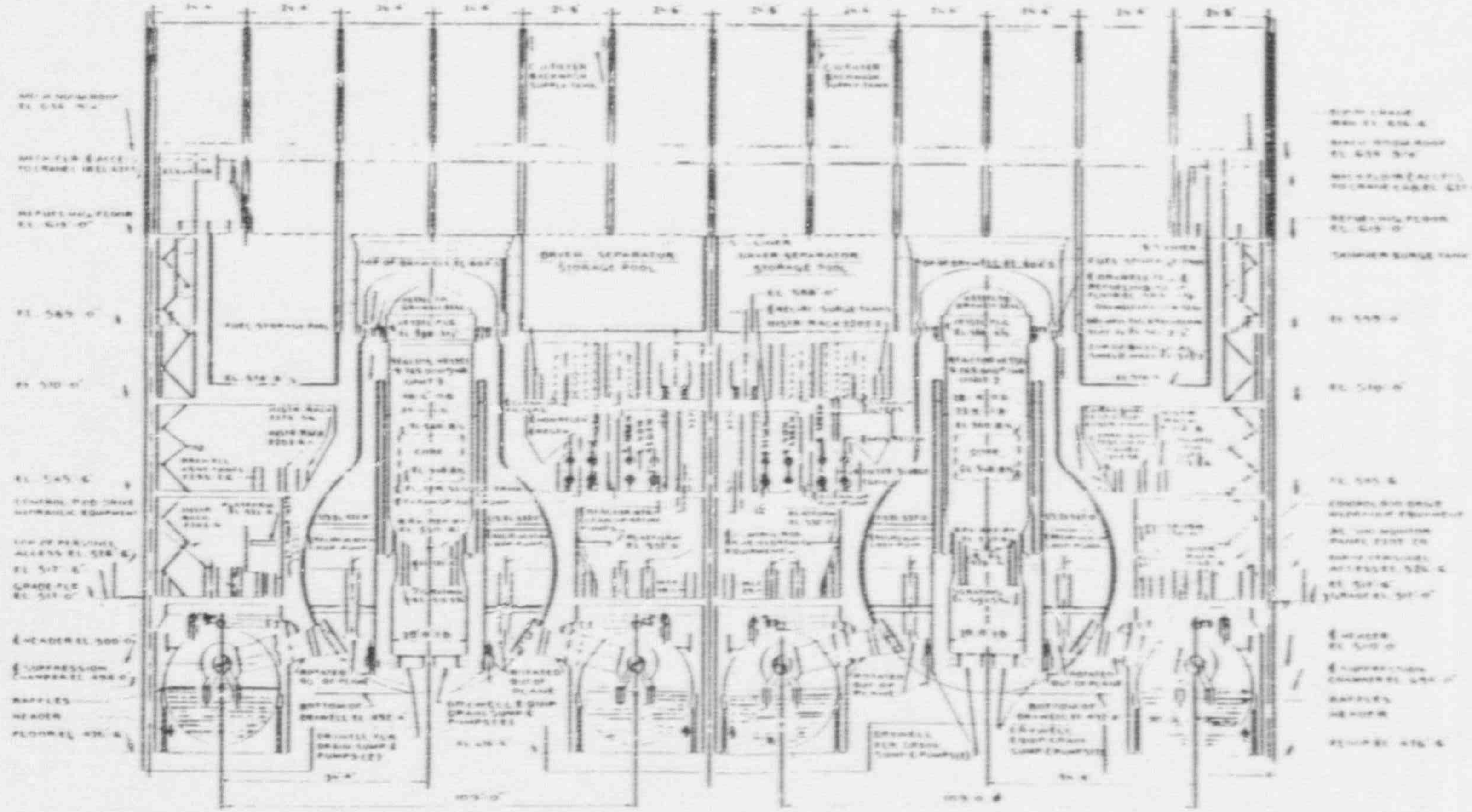


Figure 4-3. Dresden Units 2 and 3 Reactor Buildings Section, Looking North

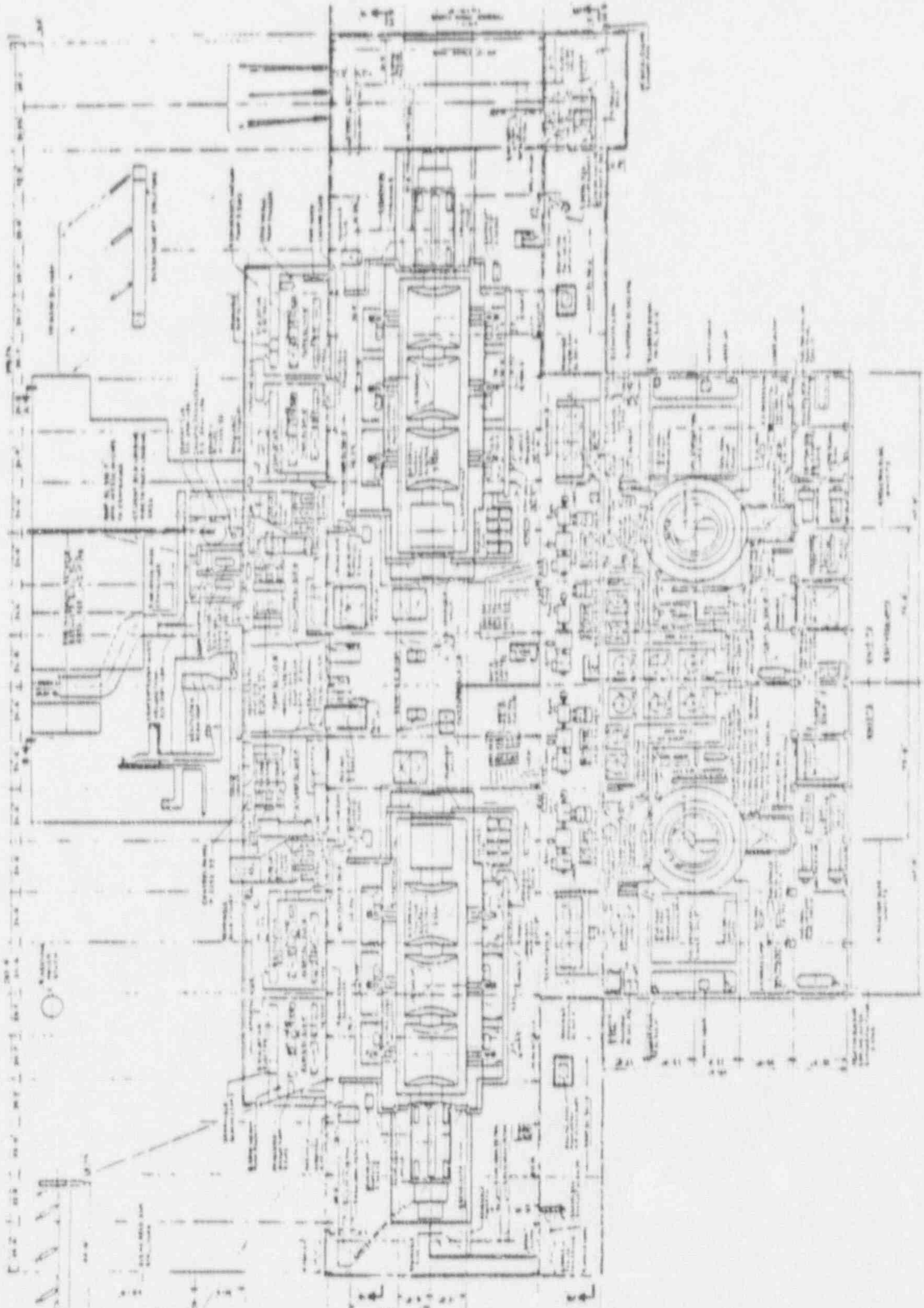


Figure 4-4. General Arrangement, Reactor, Turbine and Radwaste Buildings, Dresden Units 2 and 3 at 570' and 561'-6" Elevations

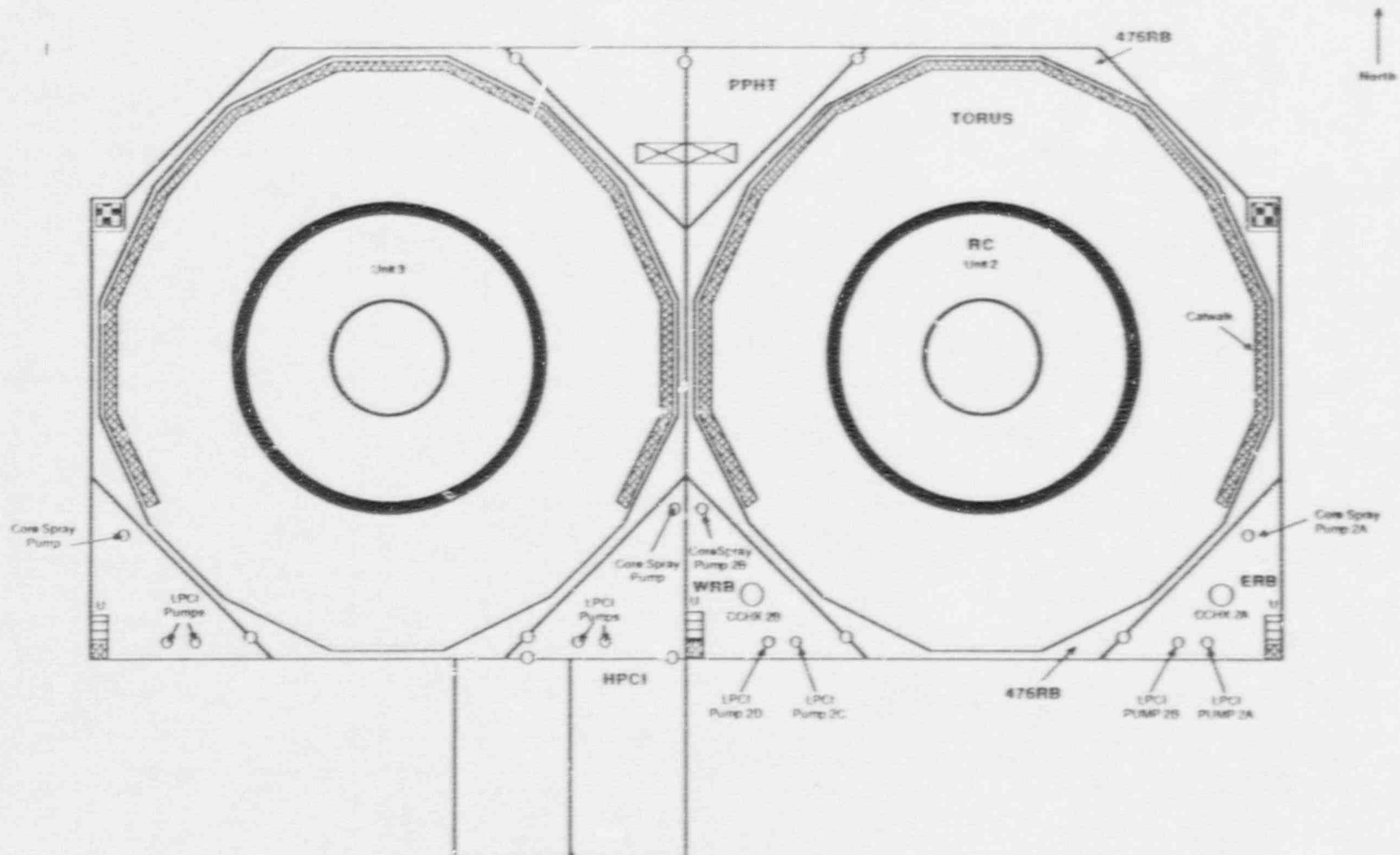


Figure 4-5. Dresden Units 2 and 3 Reactor Buildings, Elevation 476'-6"

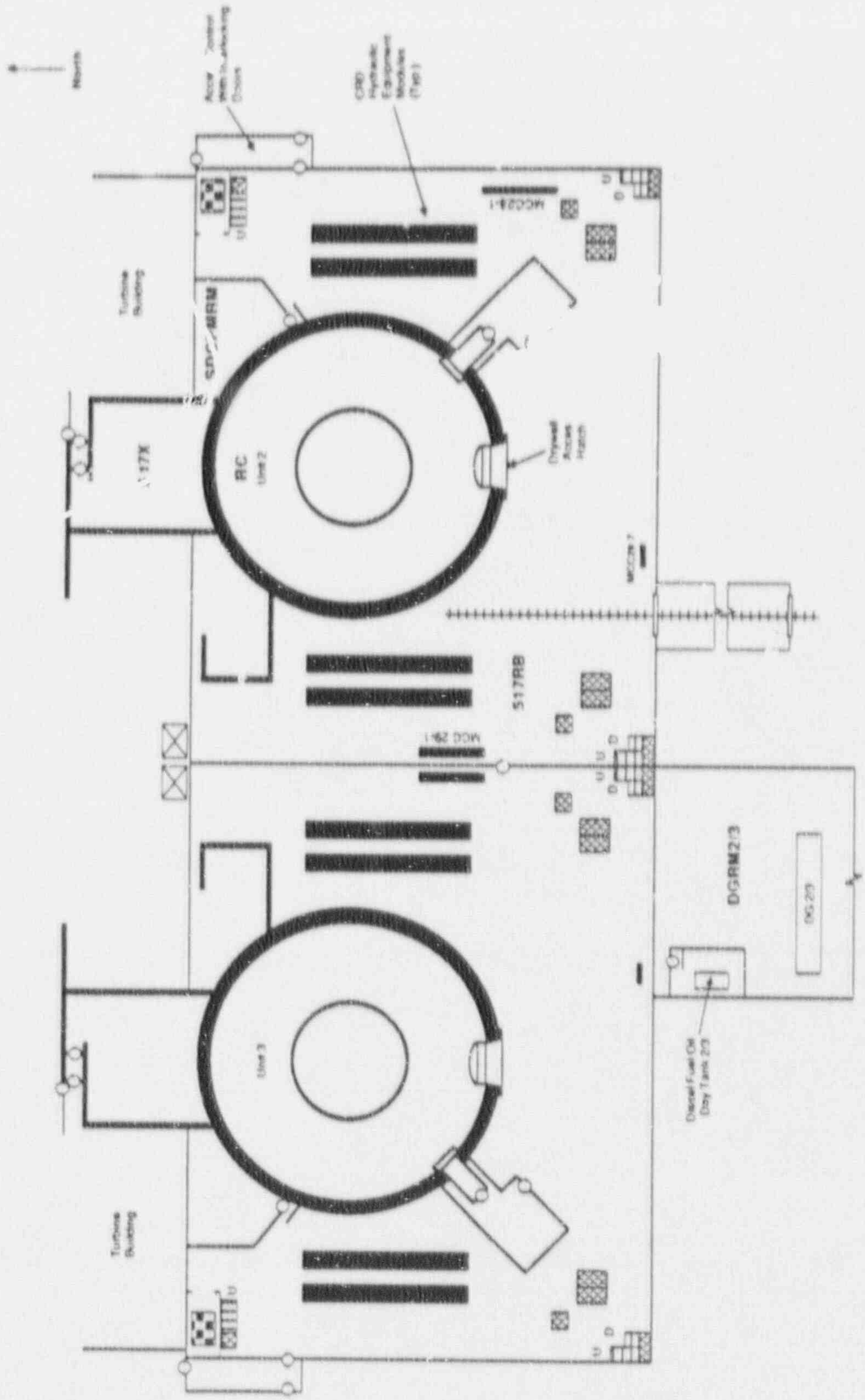


Figure 4-6. Dresden Units 2 and 3 Reactor Buildings, Elevation 517'-6"

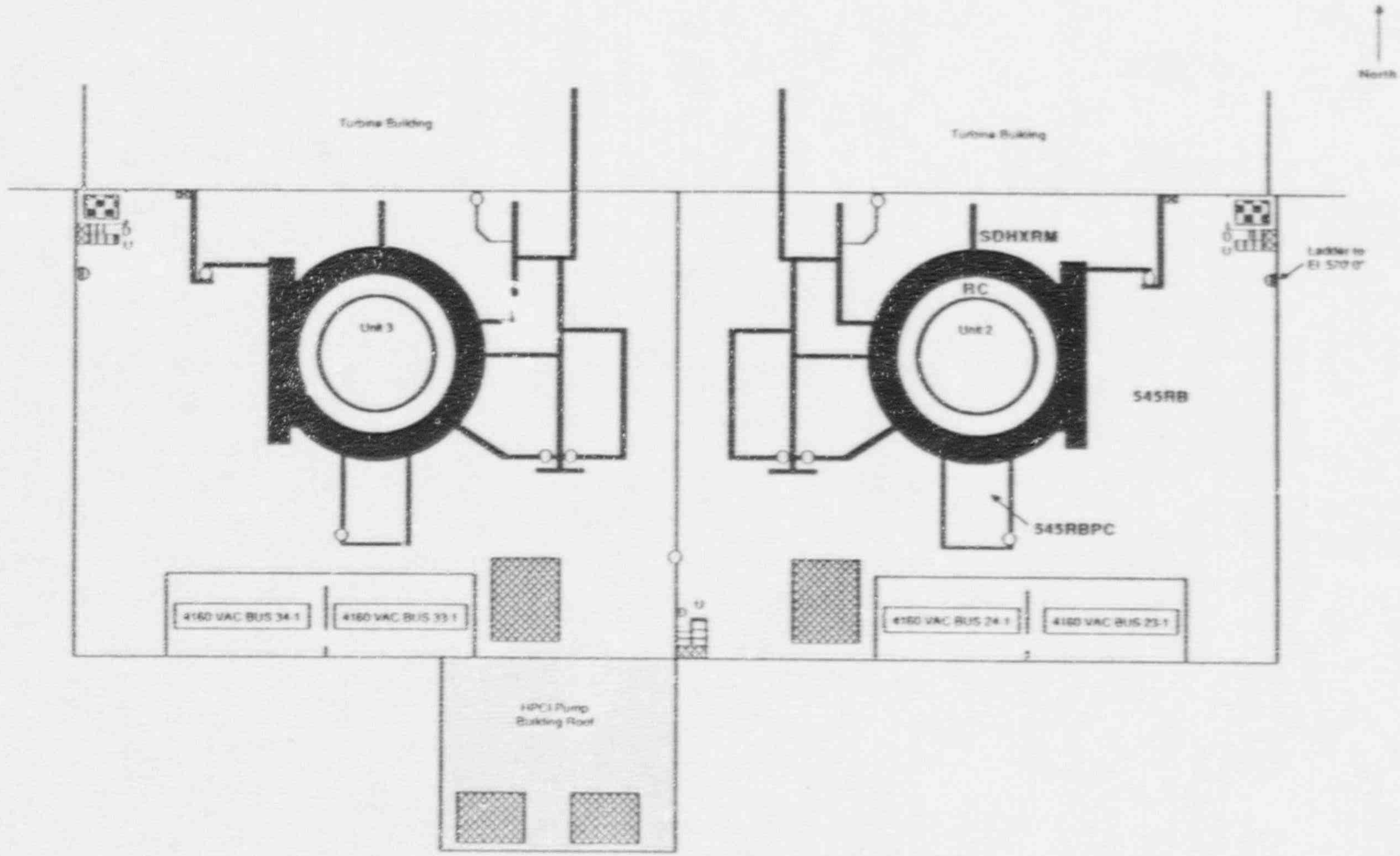


Figure 4-7. Dresden Units 2 and 3 Reactor Buildings, Elevation 545'-6"

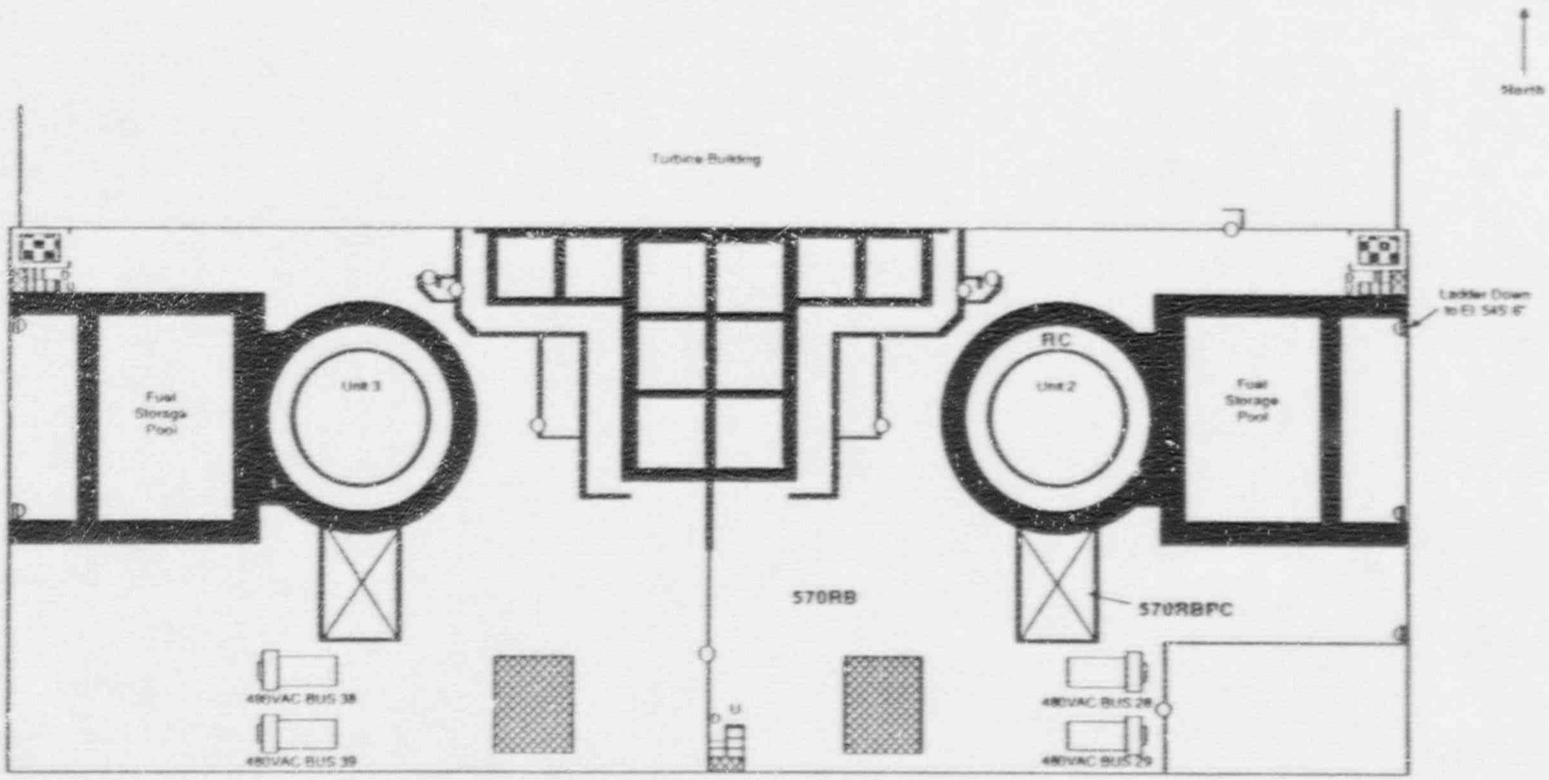


Figure 4-8 Dresden Units 2 and 3 Reactor Buildings, Elevation 570'-0"

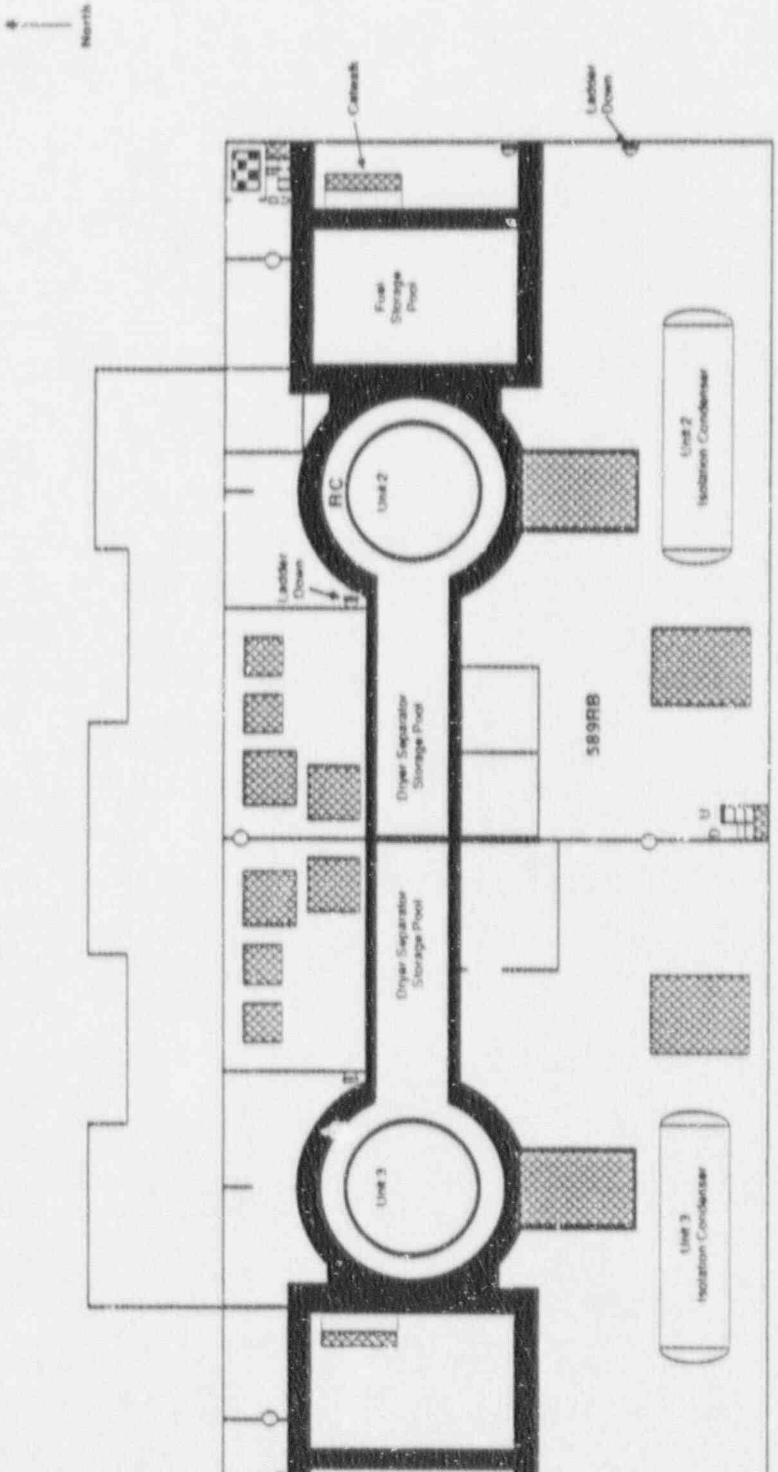


Figure 4-9. Dresden Units 2 and 3 Reactor Buildings, Elevation 589'-0"

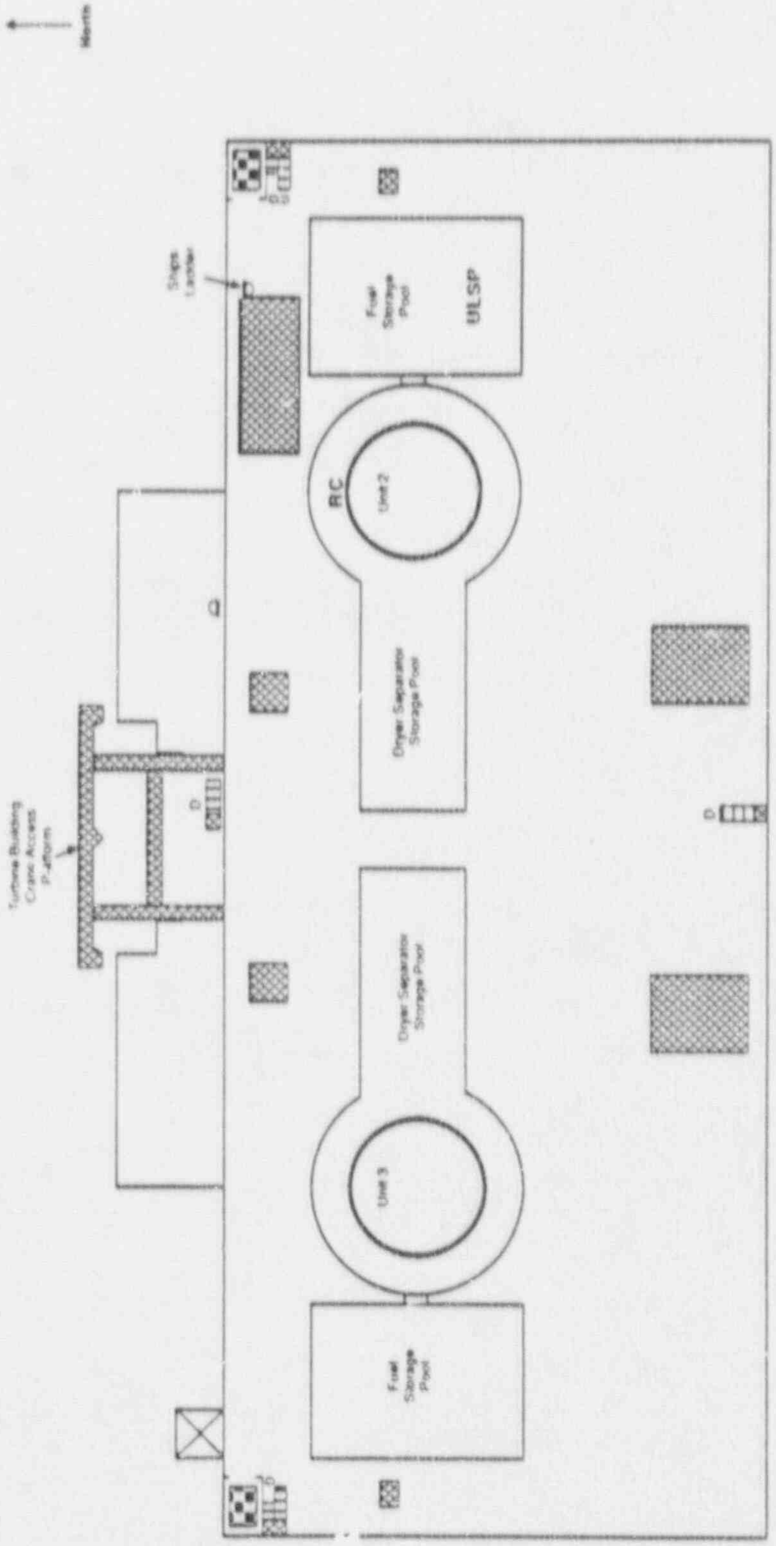


Figure 4-10. Dresden Units 2 and 3 Reactor Buildings, Elevation 613'-0"

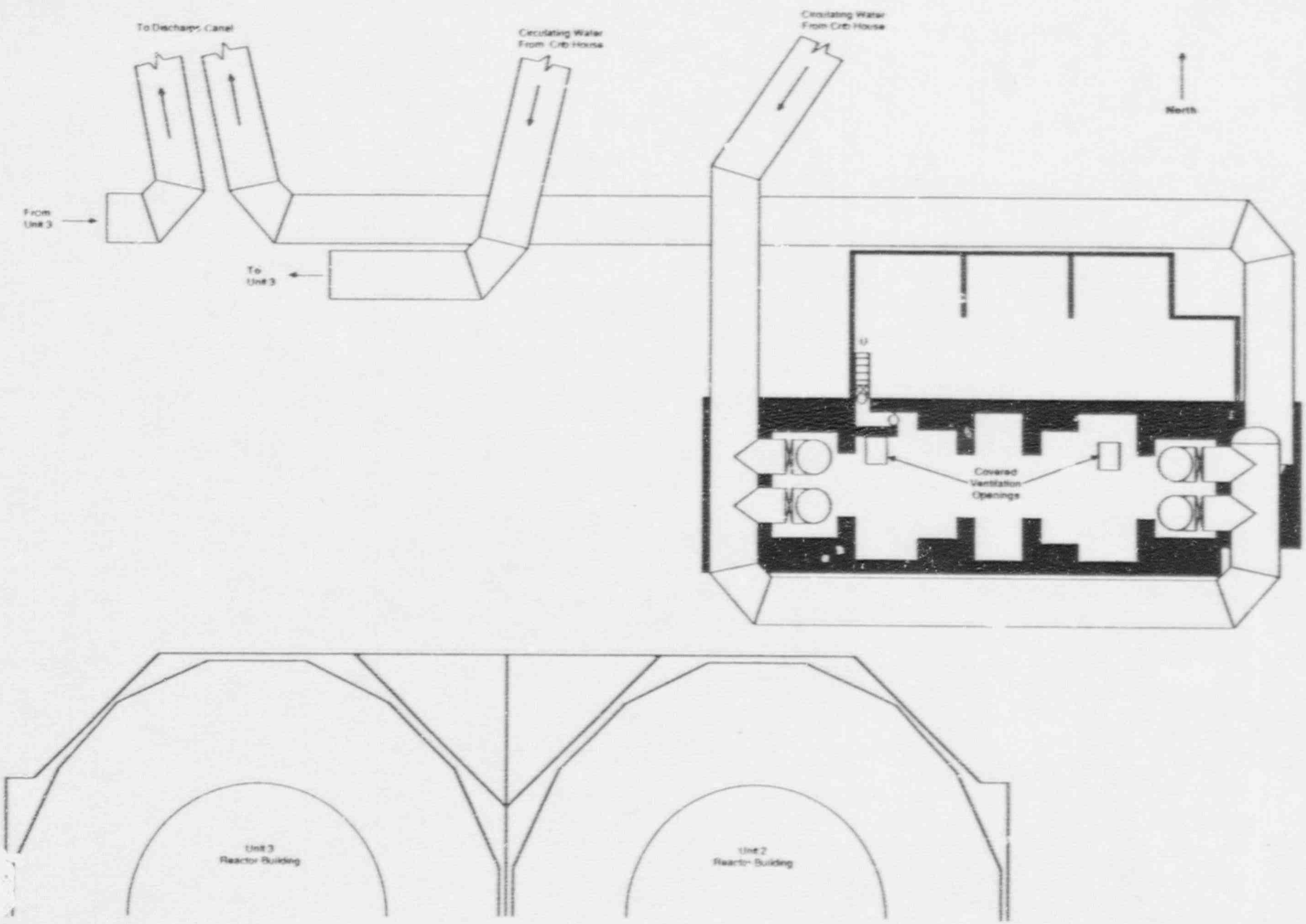


Figure 4-11. Dresden Unit 2 Turbine Building, Elevation 481'-0"

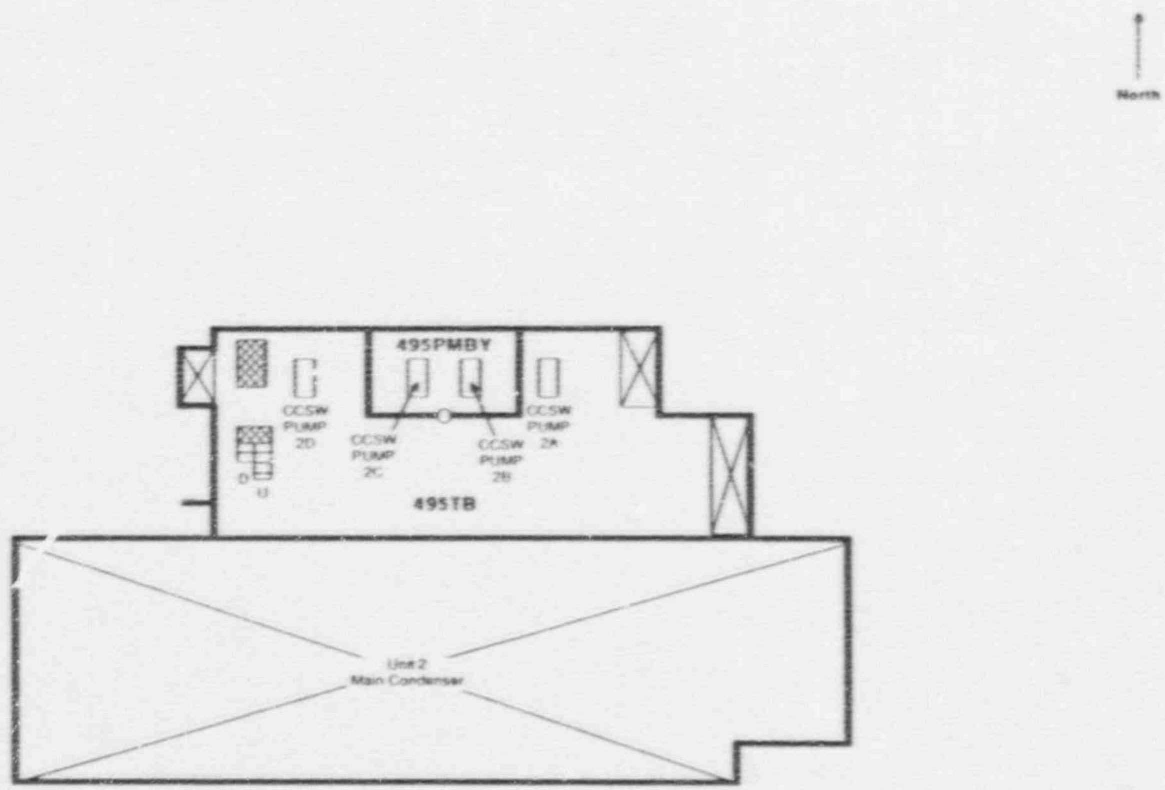


Figure 4-12. Dresden Unit 2 Turbine Building, Partial Plan at 495'-0"Elevation

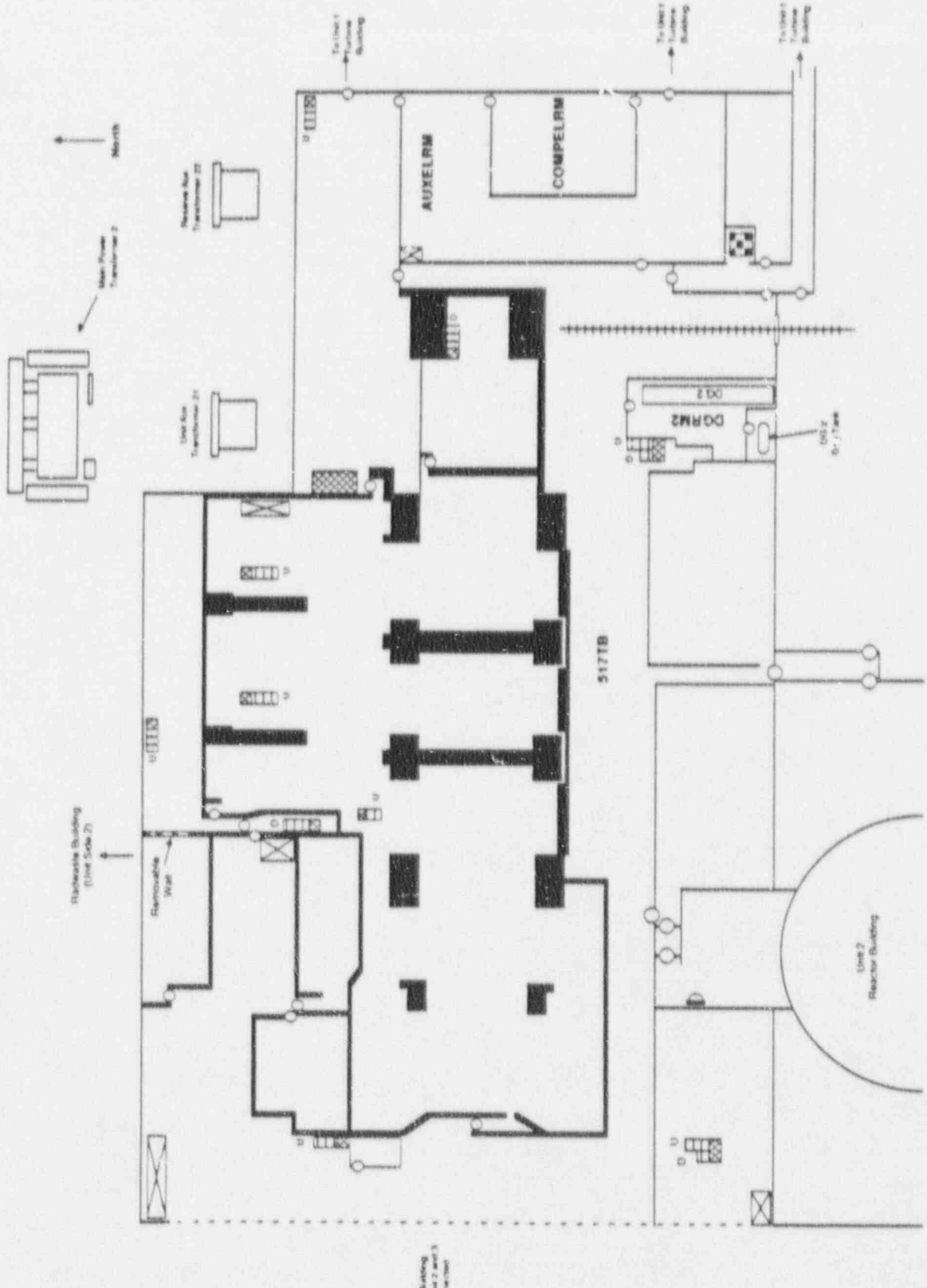


Figure 4-13. Dresden Unit 2 Turbine Building Elevation 517'-6"

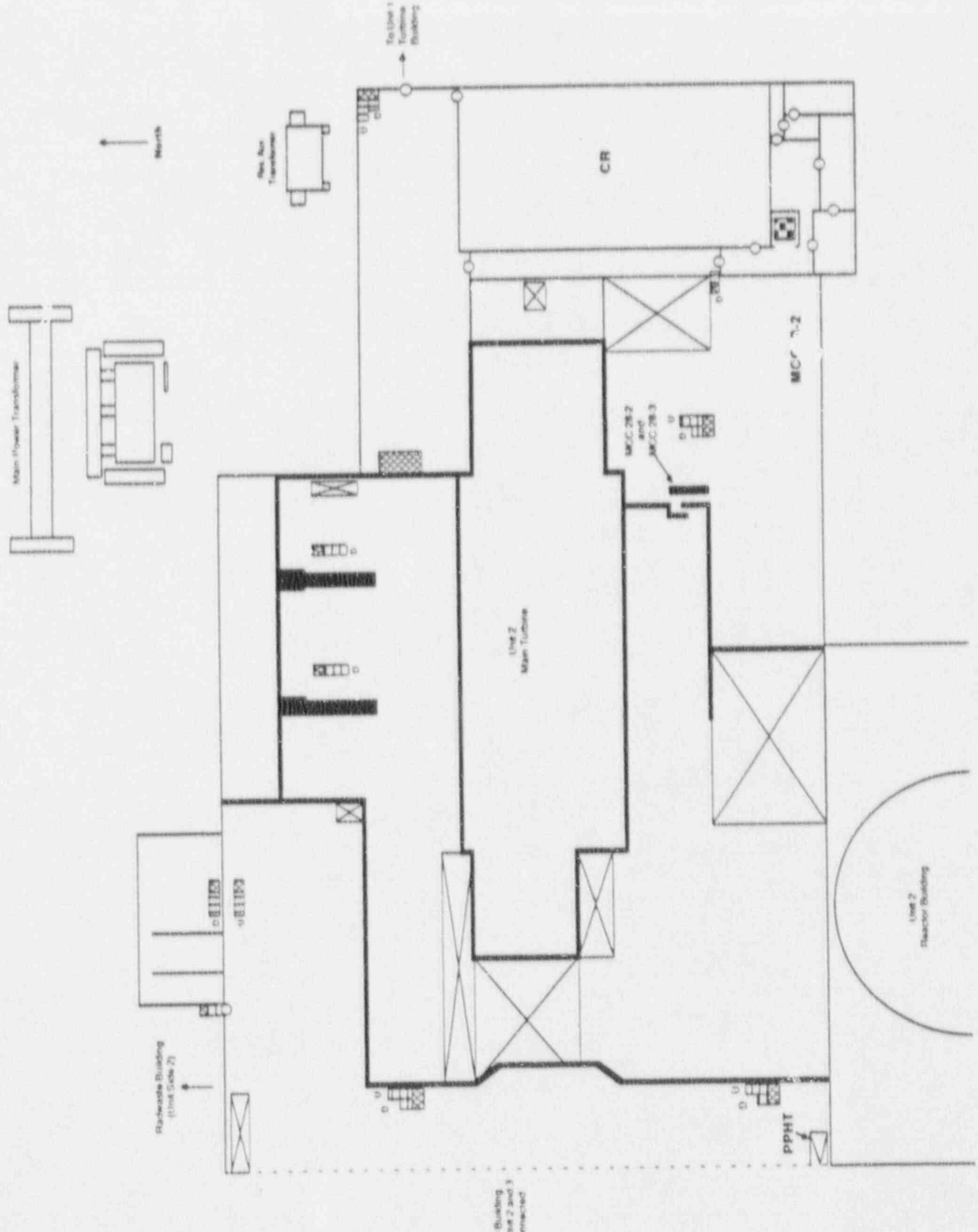


Figure 4-14. Dresden Unit 2 Turbine Building Elevation 538'-0"

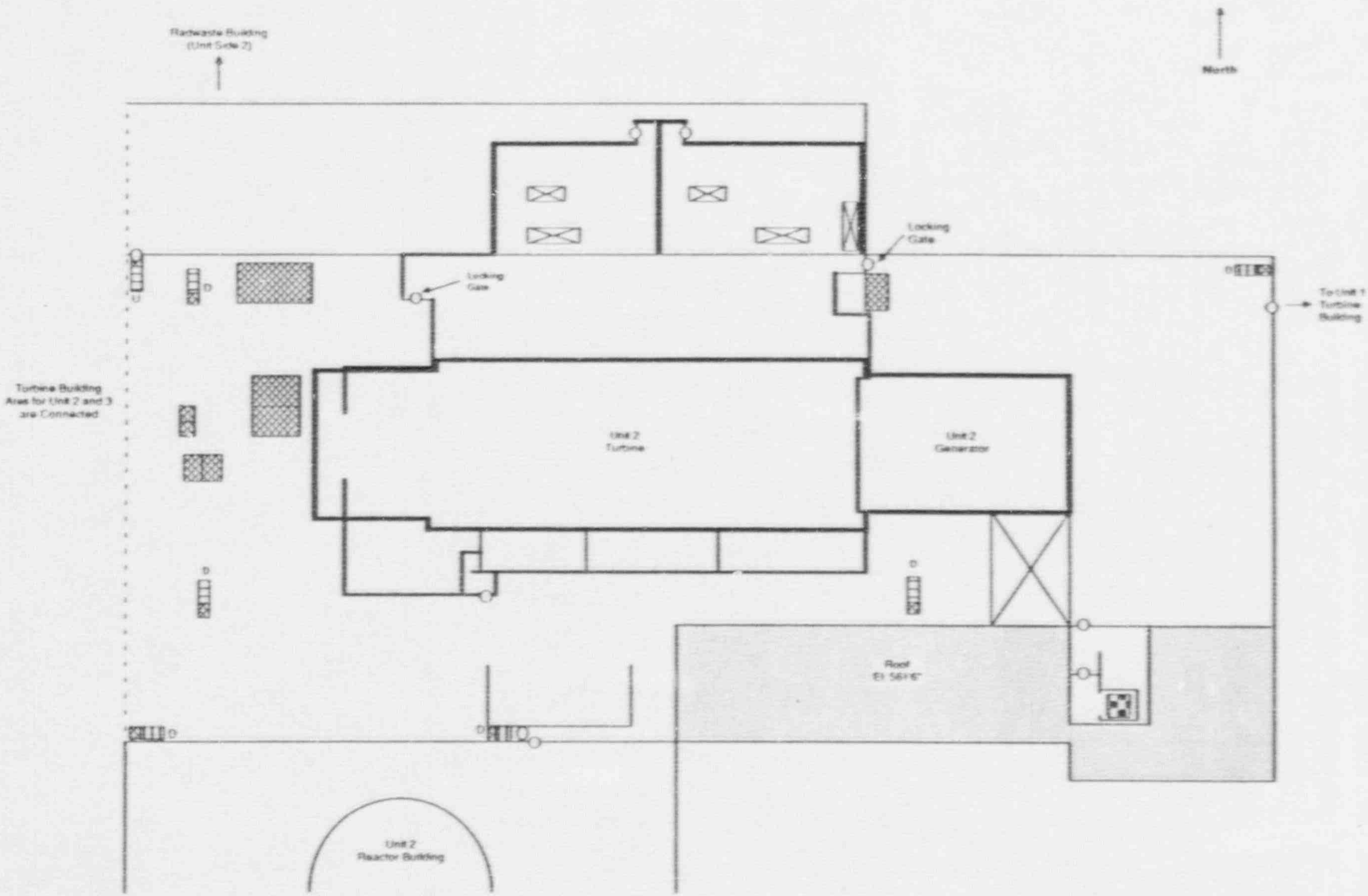


Figure 4-15. Dresden Unit 2 Turbine Building Elevation 561'-6"

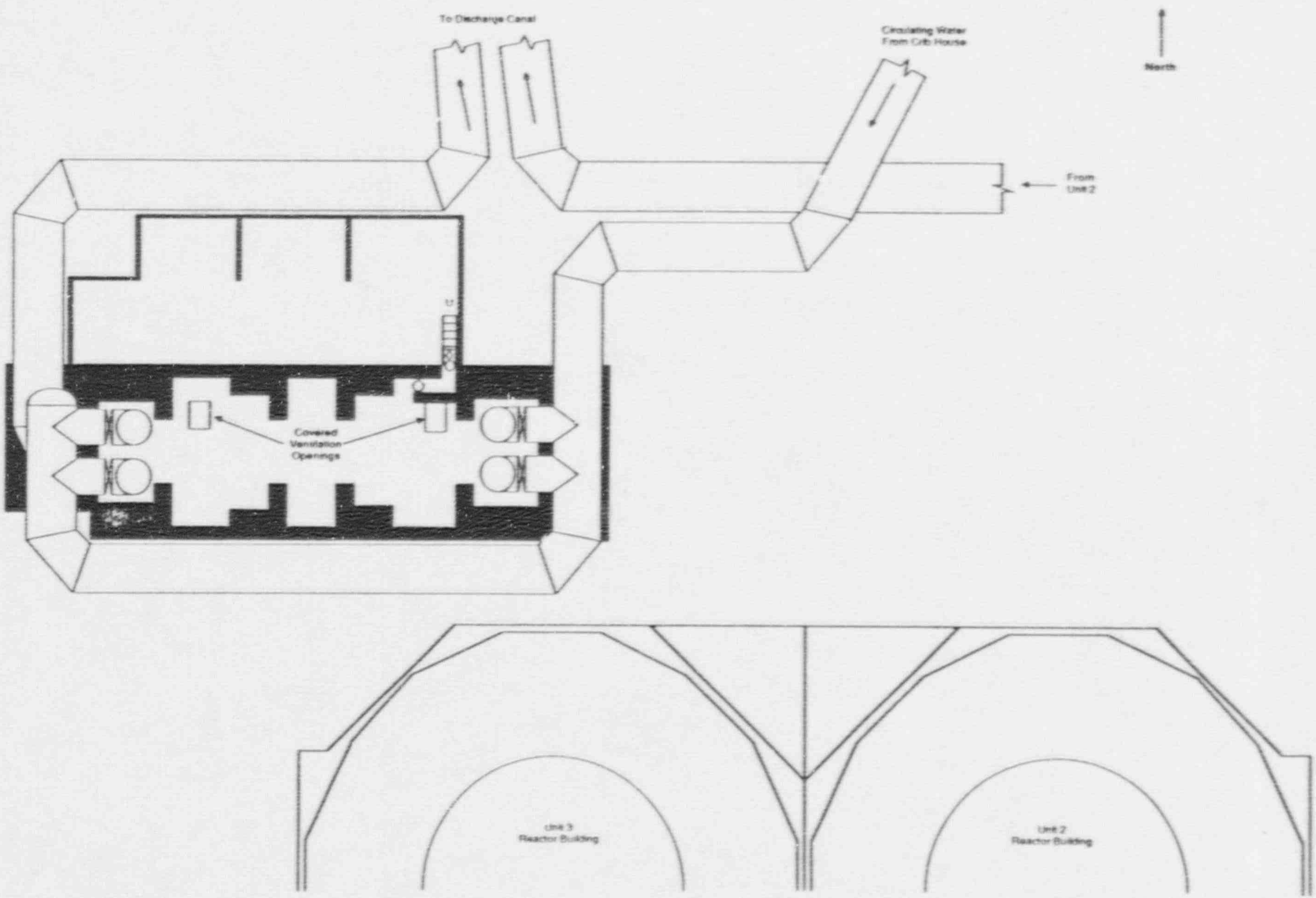


Figure 4-16. Dresden Unit 3 Turbine Building, Elevation 481'-0"

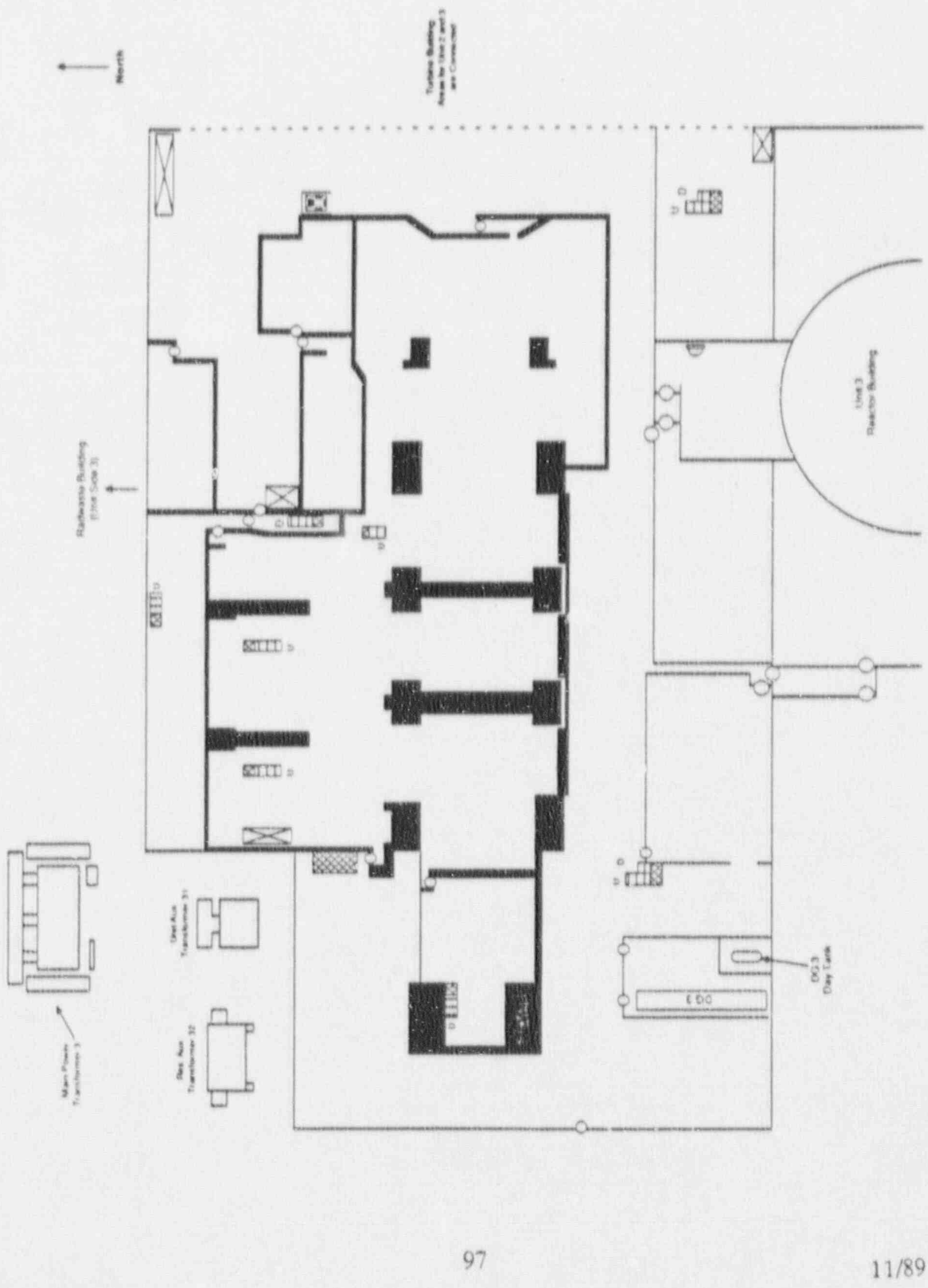


Figure 4-17. Dresden Unit 3 Turbine Building Elevation 517'-6"

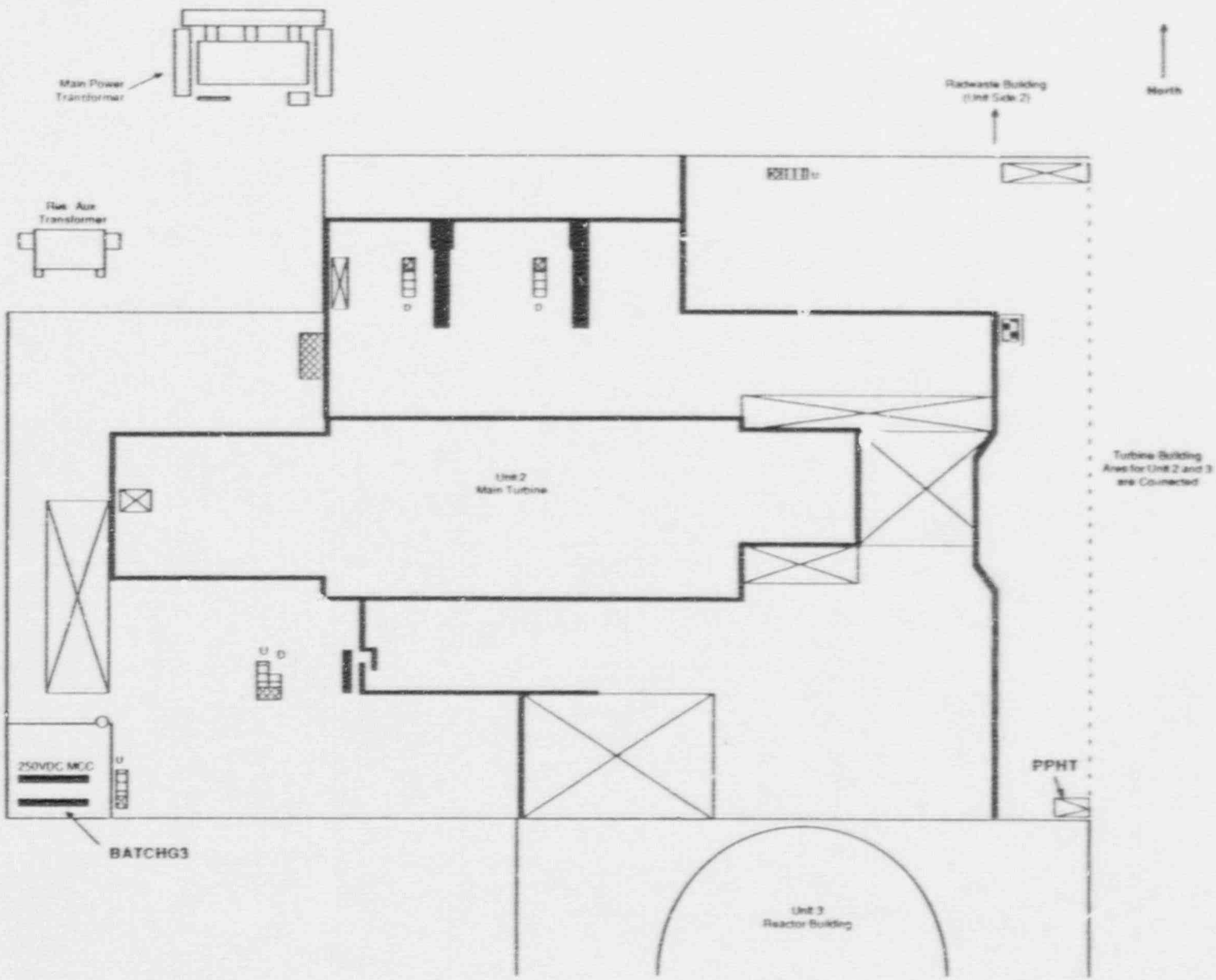


Figure 4-18. Dresden Unit 3 Turbine Building Elevation 538'-0"

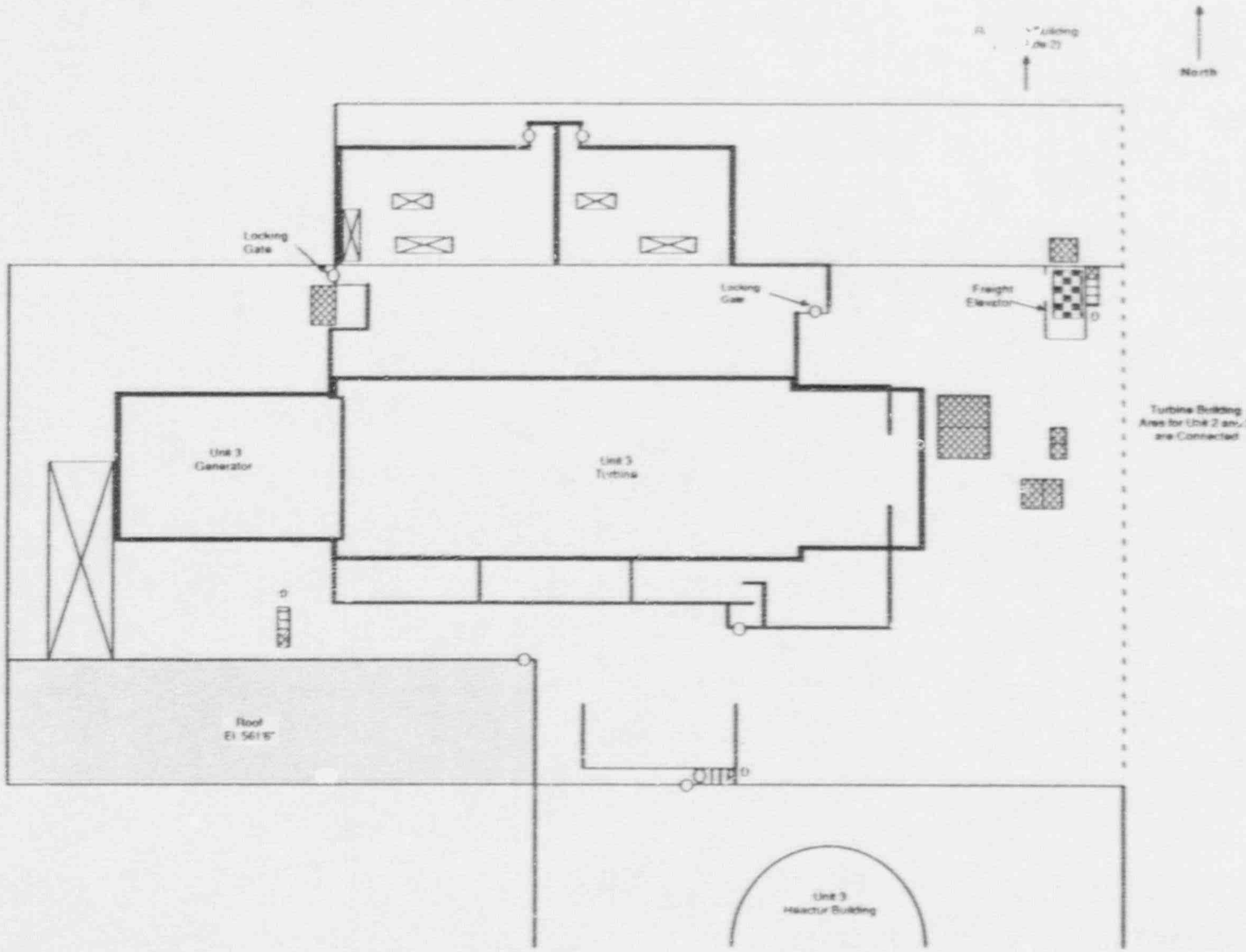
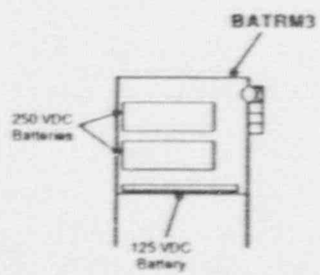
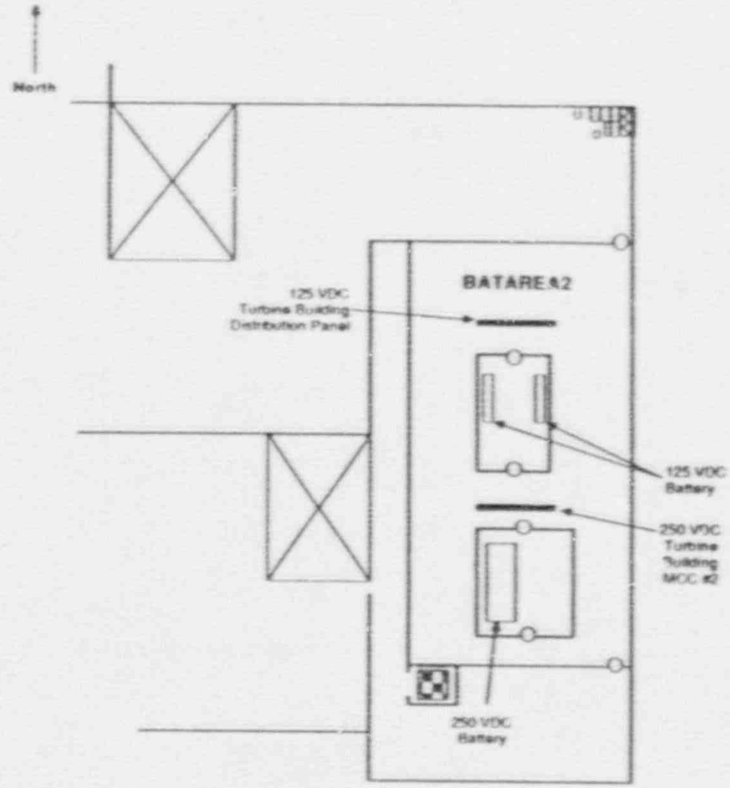


Figure 4-19. Dresden Unit 3 Turbine Building Elevation 561'-6"



Partial Plan Unit 3, Elevation 551'0"



Partial Plan Unit 2, Elevation 549'0"

Figure 4-20. Dre' .n Units 2 and 3 Turbine Building, Partial Plans

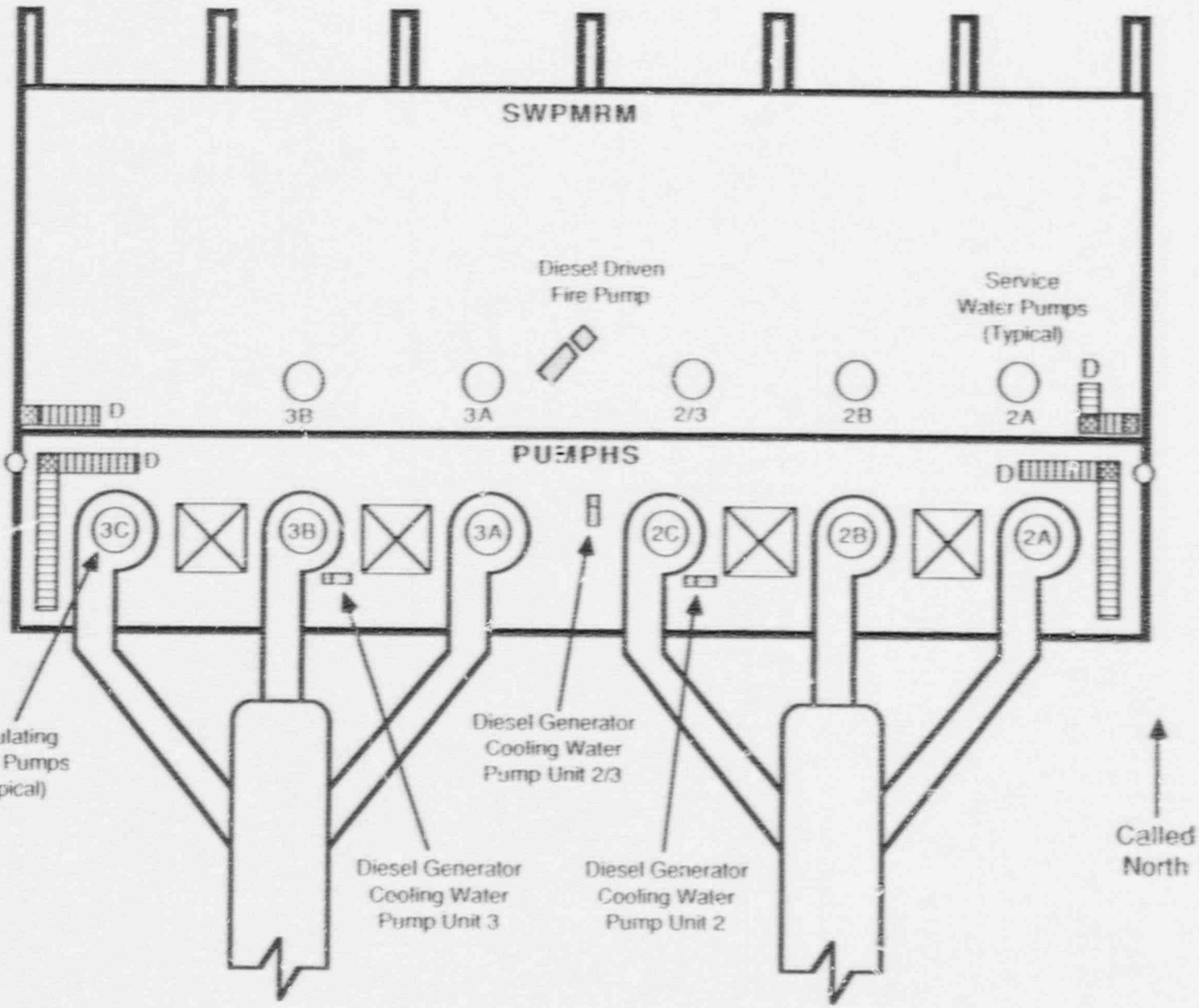


Figure 4-21. Dresden Unit 2 and 3 Crib House, Elevation 517'-6"

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

Abbreviation	Descriptions
1. 476RB	476'-6" elevation of the Unit 2 Reactor Building, excluding areas contained in WRB, ERB, PPHT and TORUS
2. 495PMBY	Room containing CCSW pumps 2B and 2C on the 495' elevation of the Turbine Building
3. 5TB	495' elevation of the Turbine Building, excluding area 495PMBY
4. 504RB	504' elevation of the Unit 2 Reactor Building.
5. 517RB	517'-6" elevation of the Unit 2 Reactor Building, excluding portions in areas 517X, PPHT and RC
6. 517TB	517'-6" elevation of the Unit 2 area of the Turbine Building, excluding portions in areas AUXELRM, DGRM2 and COMPELRM
7. 517X	Area containing main steam lines and isolation valves located on the 517'-6" elevation of the Unit 2 Reactor Building
8. 583TB3	Unit 3 area of the 538' elevation of the Turbine Building
9. 545RB	545'-6" elevation of the Unit 2 Reactor Building excluding areas RC, SDHXRM and 545RBPC
10. 545RBPC	Pipe chase located at the 545'-6" elevation of the Unit 2 Reactor Building
11. 570RB	570' elevation of the Unit 2 Reactor Building, excluding areas 570RBPC, RC and the spent fuel pool
12. 570RBPC	Pipe chase located at the 570' elevation of the Unit 2 Reactor Building
13. 589RB	Area located on the 589' elevation of the Unit 2 Reactor Building containing the isolation condenser
14. AUXELRM	Auxiliary Electrical Equipment Room located on the 517'-6" elevation of the Turbine Building
15. BATAREA2	Area containing Unit 2 batteries, Unit 2 and Unit 2/3 battery chargers, and 125 and 250 VDC buses, located on the 549' elevation of the Turbine Building
16. BATCHG3	Area containing the Unit 3 battery chargers located on the 538' elevation of the Turbine Building

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

Abbreviation	Descriptions
17. BATRM3	Area containing the Unit 3 batteries located on the 551' elevation of the Turbine Building
18. COMPELRM	Computer Electrical Room located on the 517'-6" elevation of the Turbine Building
19. CR	Units 2 and 3 Control Room located on the 534' elevation of the Turbine Building
20. CST	Condensate Storage Tanks 2/3A and 2/3B
21. DGRM2	Diesel Generator 2 Room located on the 517'-6" elevation of the Turbine Building
22. DGRM2-3	Diesel Generator 2/3 Room located on the 517'-6" elevation of the HPCI Building
23. ERB	Room containing CS pump 2A located on the 476'-6" elevation of the Unit 2 Reactor Building
24. HPCI	Unit 2 HPCI room located on the 476'-6" elevation of the HPCI Building
25. PPCH	Pipe chase between the Torus and Unit 2 HPCI room on the 476'-6" elevation of the Unit 2 Reactor Building
26. PPHT	Pipe chase between 476'-6" and 517'-6" elevations of the Unit 2 Reactor Building
27. PUMPHS	Area of the Unit 2/3 Crib House at the 517'-6" elevation containing the DGCW pumps
28. RC	Unit 2 Reactor Containment
29. SDCPMRM	Area containing the shutdown cooling pumps located on the 517'-6" elevation of the Unit 2 Reactor Building
30. SDHXRM	Area containing the shutdown cooling heat exchangers located on the 545'-6" elevation of the Unit 2 Reactor Building
31. SWPMRM	Area containing the diesel-driven emergency fire pump and service water pumps on the 509'-6" elevation of the Unit 2/3 Crib House
32. TORUS	Area containing the Unit 2 suppression pool

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

Abbreviation	Descriptions
33. ULSF	Spent fuel pool operating floor
34. WRB	Room containing CS pump 2B located on the 476'-6" elevation of the Unit 2 Reactor Building

Tabel 4-2. Partial Listing of Components by Location at Dresden 2

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
495PMBY	CCSW	CCSW P-2B	MDP
495PMBY	CCSW	CCSW P-2C	MDP
495TB	CCSW	CCSW P-2A	MDP
495TB	CCSW	CCSW P-2D	MDP
495TB	CRDHS	CRD P-2A	MDP
495TB	CRDHS	CRD P-2B	MDP
517RB	EP	MCC 29-4	MCC
517RB	EP	MCC 29-5	MCC
517RB	EP	MCC 29-6	MCC
517RB	EP	MCC 29-7	MCC
517RB	EP	MCC 28-1	MCC
517RB	EP	MCC 28-7	MCC
517TB	EP	MCC 29-2	MCC
517TB	IC-MU	CTS PUMP 2A	MDP
517TB	IC-MU	CTS PUMP 2B	MDP
517X	ECCS	HPCI2-8	MOV
517X	RCS	MS2-2A	NV
517X	RCS	MSD2-2	MOV
517X	RCS	MS2-2B	NV
517X	RCS	MS2-2C	NV
517X	RCS	MS2-2D	NV
538TB3	EP	MCC 39-2	BUS
538TB3	EP	MCC 38-2	MCC
545RB	ECCS	CS2-24B	MOV
545RB	ECCS	CS2-25B	MOV
545RB	EP	BUS 23-1	BUS
545RB	EP	BUS 24-1	BUS
545RB	RCS	RWCU2-2	MOV
545RB	RCS	RWCU2-3	MOV
545RB3	EP	BUS 38	BUS

Tabel 4-2. Partial Listing of Components by Location at Dresden 2 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
545RBPC	IC	IC2-3	MOV
551TB	EP	125TB BUS 3	BUS
551TB	EP	125TB BUS 3	BUS
551TB	EP	125TB BUS 3	BUS
570RB	EP	RB BUS 2A-2B	BUS
570RB	EP	125RB BUS 2	BUS
570RB	EP	MCC 28-3	MCC
570RB	EP	BUS 28	BUS
570RB	EP	BUS 29	BUS
570RB	EP	TRAN-28T	TRAN
570RB	EP	TRAN-29T	TRAN
570RBPC	IC	IC2-2	MOV
589RB	IC	ISO COND	HX
589RB	IC-MU	IC2-10	MOV
617RB	EP	MCC 29-1	MCC
BATAREA2	EP	250 BC2/3	BC
BATAREA2	EP	250 BAT 2	BATT
BATAREA2	EP	125TB BUS 2	BUS
BATAREA2	EP	RB BUS 2A-2B	BUS
BATAREA2	EP	250 BC2/3	BC
BATAREA2	EP	125TB BUS 2	BUS
BATAREA2	EP	250BC2	BC
BATAREA2	EP	250TB BUS 2	BUS
BATAREA2	EP	250TB BUS2	BUS
BATAREA2	EP	125TB BUS 2	BUS
BATAREA2	EP	125BC2-1	BC
BATAREA2	EP	125BC2-2	BC
BATAREA2	EP	125 BAT 2	BAT
BATCHG3	EP	250 BC3	BC
BATCHG3	EP	250TB BUS 3	BUS

Tabel 4-2. Partial Listing of Components by Location at Dresden 2 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
BATCHG3	EP	250TB BUS 3	BUS
BATCHG3	EP	125BC3-1	BC
BATCHG3	EP	125BC3-2	BC
BATRM3	EP	250 BAT 3	BATT
BATRM3	EP	125 BAT 3	BAT
CST	CRDHS	CST2/3A	TANK
CST	CRDHS	CST2/3B	TANK
CST	ECCS	CST2/3B	TANK
CST	IC-MU	CST2/3A	TANK
DGRM2	DGCW	DG HX2	HX
DGRM2	EP	DG #2	DG
DGRM2	EP	DG 2 FO PMP	MDP
DGRM2-3	DGCW	DG HX2/3	HX
DGRM2-3	EP	DG #2/3	DG
DGRM2-3	EP	DG2/3 FO PMP	MDP
DGRM3	EP	DG #3	DG
ERB	CCSW	CCSW2-3A	MOV
ERB	ECCS	CS2-3A	MOV
ERB	ECCS	CS PUMP 2A	MDP
ERB	ECCS	CCHX 2A	HX
ERB	ECCS	LPCI2-11A	MOV
ERB	ECCS	LPCI2-5A	MOV
ERB	ECCS	LPCI2-5B	MOV
ERB	ECCS	LPCI PUMP 2A	MDP
ERB	ECCS	LPCI PUMP 2B	MDP
FP-UNK	IC-MU	FP2-4102	MOV
HPCI	ECCS	HPCI2-TCV	HV
HPCI	ECCS	HPCI2-TSV	HV
HPCI	ECCS	HPCI2-3	MOV
HPCI	ECCS	HPCI2-35	MOV

Tabel 4-2. Partial Listing of Components by Location at Dresden 2 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
HPCI	ECCS	HPCI2-6	MOV
HPCI	ECCS	HPCI2-9	MOV
HPCI	ECCS	HPCI PUMP	TDP
HPCI	ECCS	HPCI2-48	MOV
HPCI	ECCS	HPCI LO PUMP	MDP
HPCI	ECCS	HPCI2-21	MOV
HPCI	ECCS	HPCI2-10	MOV
MCC28-2	EP	MCC 28-2	MCC
MCC29-2	EP	MCC 29-2	MCC
PUMPHS	DGCW	DG[illegible]	MDP
PUMPHS	DGCW	DGC[illegible]	MDP
RC	ECCS	HPCI2-4	MOV
RC	IC	IC2-1	MOV
RC	IC	IC2-4	MOV
RC	RCS	RWCU 2-1	MOV
RC	RCS	MS2-1A	NV
RC	RCS	MSD2-1	MOV
RC	RCS	MS2-1B	NV
RC	RCS	MS2-1C	NV
RC	RCS	MS2-1D	NV
RC	RHR	SDC2-1A	MOV
RC	RHR	SDC2-1B	MOV
SDCPMRM	RHR	SDC2-2A	MOV
SDCPMRM	RHR	SDC2-2B	MOV
SDCPMRM	RHR	SDC2-2C	MOV
SDCPMRM	RHR	PUMP 2A	MDP
SDCPMRM	RHR	PUMP 2B	MDP
SDCPMRM	RHR	PUMP 2C	MDP
SDHXRM	ECCS	CS2-24A	MOV
SDHXRM	ECCS	CS2-25A	MOV

Tabel 4-2. Partial Listing of Components by Location at Dresden 2 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
SDHXRM	RHR	SDCHXA	HX
SDHXRM	RHR	SDCHXB	HX
SDHXRM	RHR	SDCHXC	HX
SDHXRM	RHR	SDC2-5A	MOV
SDHXRM	RHR	SDC2-5B	MOV
SWPMRM	IC-MU	FIRE PUMP 2/3	DDP
TORUS	ECCS	CS2-4A	MOV
TORUS	ECCS	CS2-4B	MOV
TORUS	ECCS	HPCI2-5	MOV
TORUS	ECCS	LPCI2-21A	MOV
TORUS	ECCS	LPCI2-22A	MOV
TORUS	ECCS	LPCI2-22B	MOV
TORUS	ECCS	SUPP POOL	TANK
TORUS	ECCS	LPCI2-38A	MOV
TORUS	ECCS	LPCI2-20A	MOV
TORUS	ECCS	LPCI2-27A	MOV
TORUS	ECCS	LPCI2-28A	MOV
TORUS	ECCS	LPCI2-21B	MOV
TORUS	ECCS	LPCI2-38B	MOV
TORUS	ECCS	LPCI2-20B	MOV
TORUS	ECCS	LPCI2-27B	MOV
TORUS	ECCS	LPCI2-28B	MOV
UNIT 3	EP	BUS 33-1	BUS
UNIT 3	EP	BUS 34-1	BUS
UNKNOWN	EP	RB BUS 3A-3B	BUS
UNKNOWN	EP	RB BUS 3A-3B	BUS
UNKNOWN	EP	125RB BUS 3	BUS
WRB	CCSW	CCSW2-3B	MOV
WRB	ECCS	CS2-2B	MOV
WRB	ECCS	CS PUMP 2B	MDP

Tabel 4-2. Partial Listing of Components by Location at Dresden 2 (Continued)

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
WRB	ECCS	HPCI2-36	MOV
WRB	ECCS	CCHX 2B	HX
WRB	ECCS	LPCI2-11B	MOV
WRB	ECCS	LPCI2-5C	MOV
WRB	ECCS	LPCI2-5D	MOV
WRB	ECCS	LPCI PUMP 2C	MDP
WRB	ECCS	LPCI PUMP 2D	MDP

5. BIBLIOGRAPHY FOR DRESDEN 2 AND 3

1. NUREG-0823, "Integrated Safety Assessment Systematic Evaluation Program, Dresden Nuclear Power Station Unit 2, Docket No. 50 237, Commonwealth Edison Company," USNRC, February 1983.

2. NUREG/CR-0891, "Seismic Review of Dresden Nuclear Power Station - Unit 2 for the Systematic Evaluation Program," Lawrence Livermore National Laboratory, April 1980.

3. Cagle, C.D., "Dresden 2 Incident of June 5, 1970," Nuclear Safety, Vol. 12, No. 5, September-October 1971.

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)

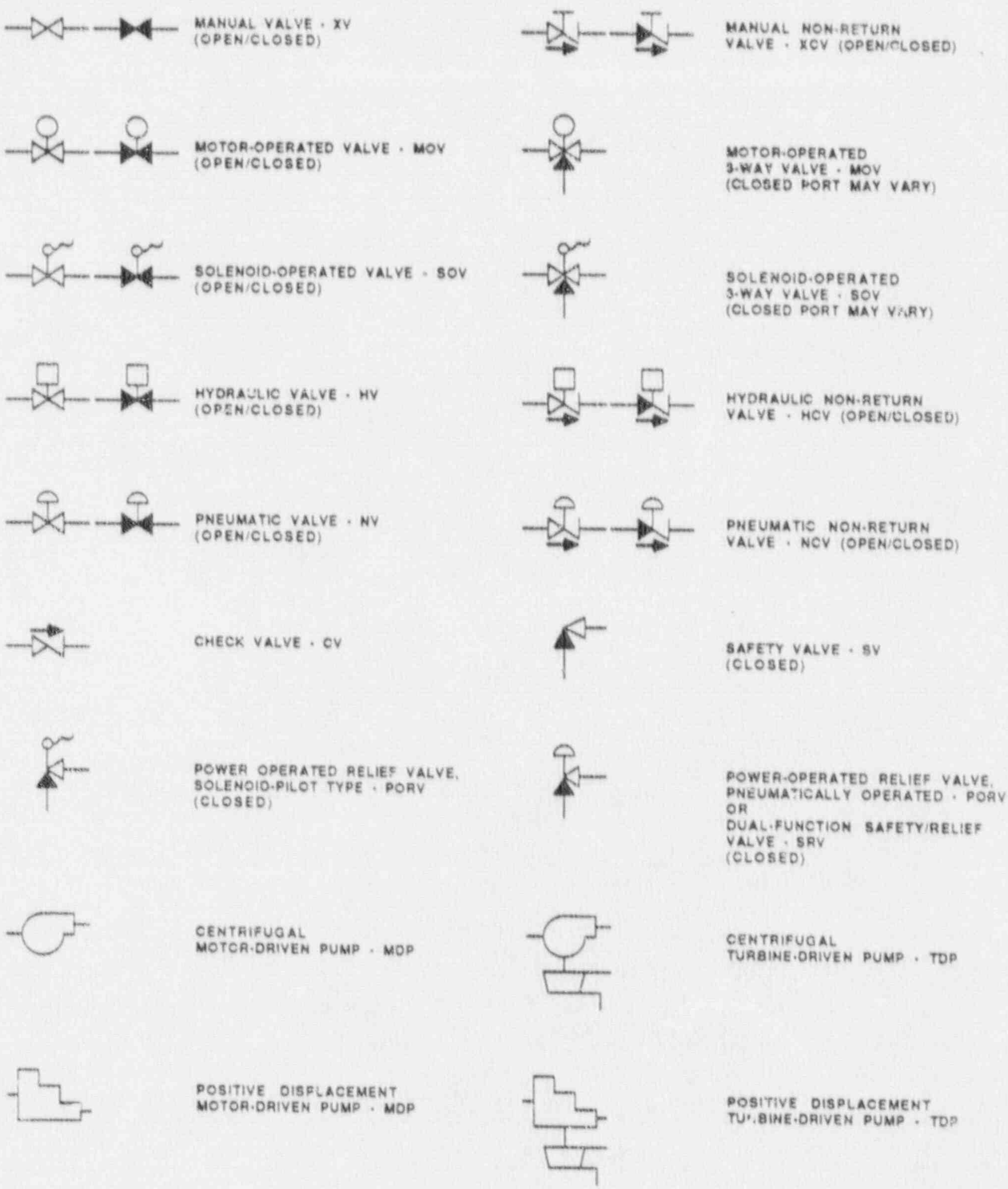


Figure A-1. Key To Symbols In Fluid System Drawings

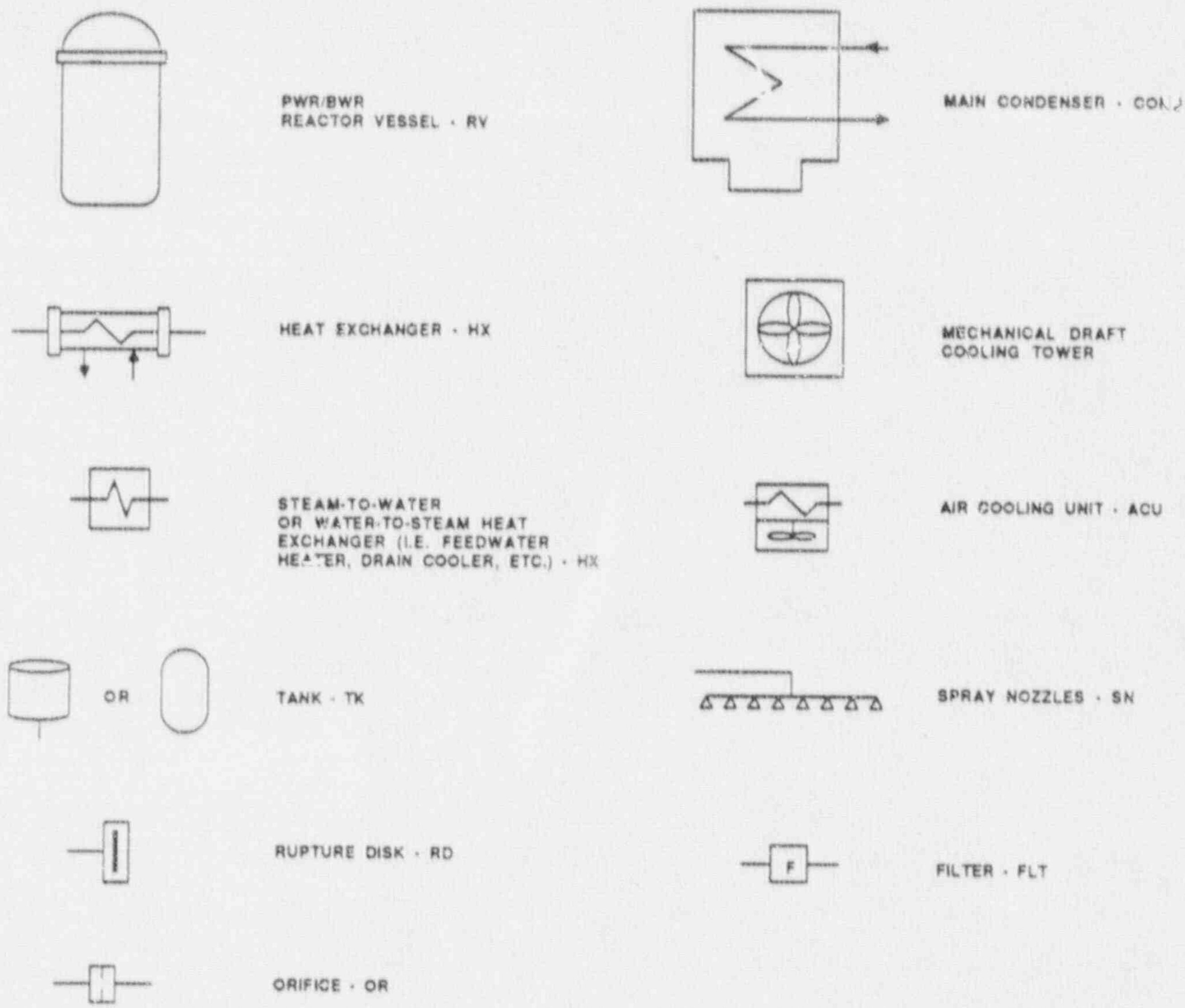


Figure A-1. Key To Symbols In Fluid System Drawings (Continued)

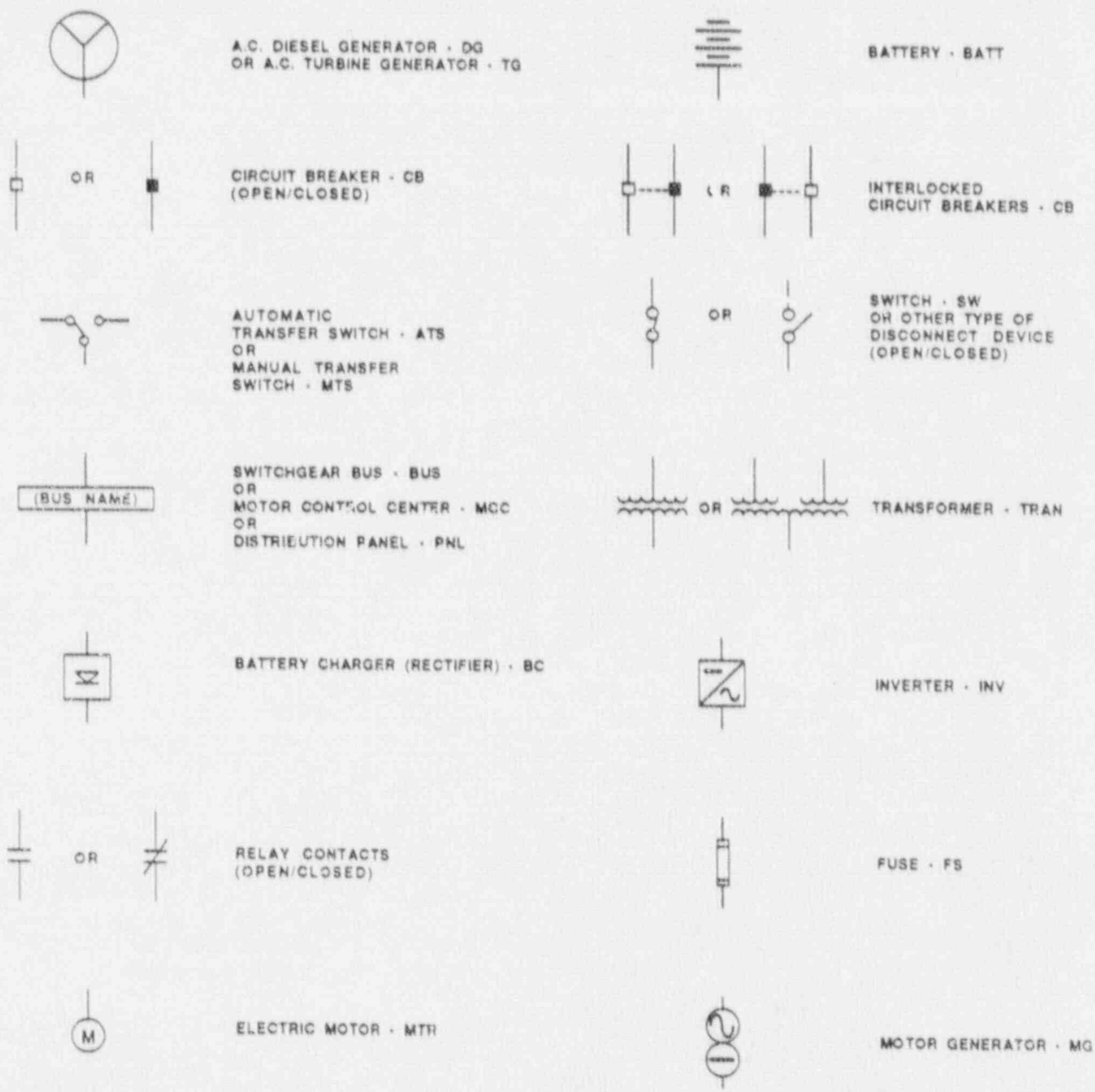


Figure A-2. Key To Symbols In Electrical System Drawings

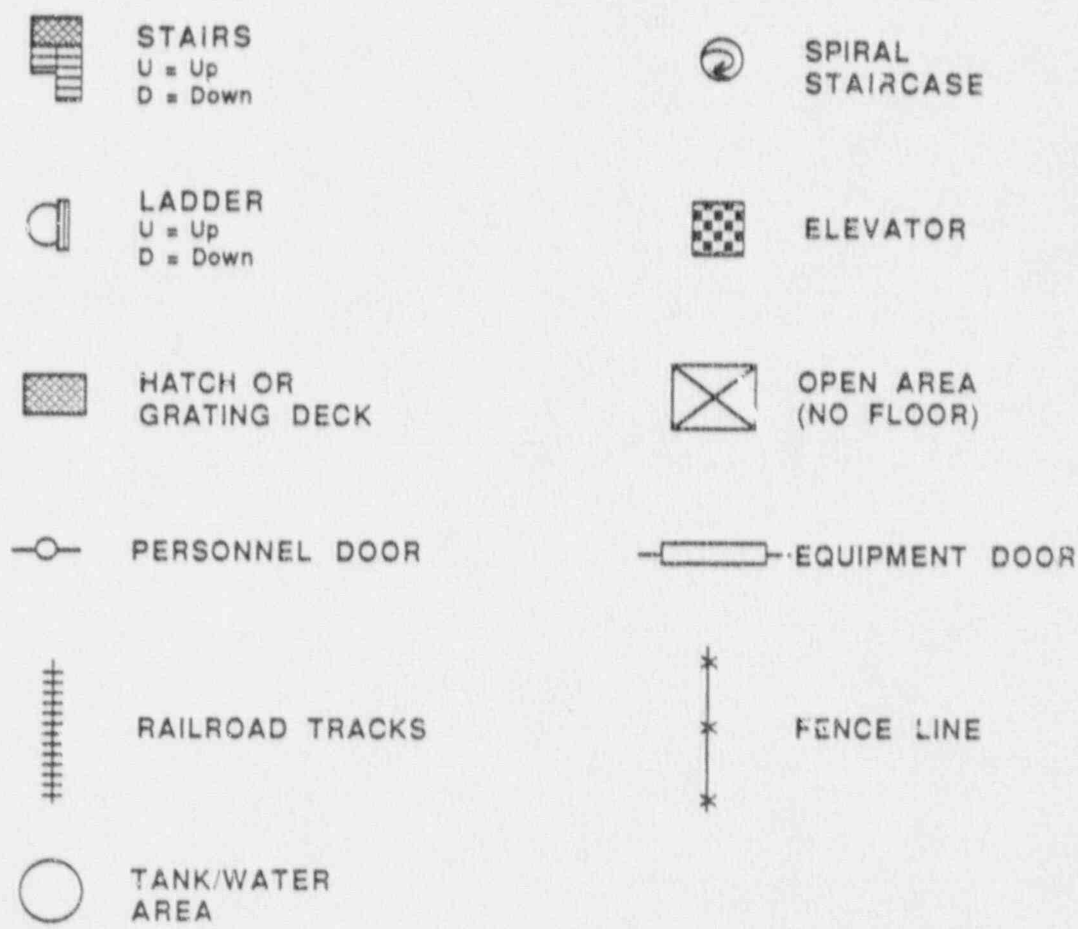


Figure A-3. Key To Symbols In Facility Layout Drawings

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
IC	Isolation Condenser System
IC-MU	Condensate Transfer System and Fire Protection System Makeup to the Isolation Condenser
ECCS	Emergency Core Cooling Systems (including HPCI, LPCI, CS and ADS)
CRDHS	Control Rod Drive Hydraulic System
I&C	Instrumentation and Control Systems
EP	Electric Power System
DGCW	Diesel Generator Cooling Water system
CCSW	Containment Cooling Service Water System
RHR	Shutdown Cooling System

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

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

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

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

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

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

TABLE B-1. COMPONENT TYPE CODES

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

TABLE B-1. COMPONENT TYPE CODES (Continued)

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