UNITED STATES NUCLEAR REGULATORY COMMISSION

NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

SUSQUEHANNA 1 & 2

50-387 and 50-388

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NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

SUSQUEHANNA 1 & 2

50-387 and 50-388

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CAUTION

The information in this report has been developed over an extended period of time based on a site visit, the Final Safety Analysis Report, system and layout drawings, and other published information. To the best of our knowledge, it accurately reflects the plant configuration at the time the information was obtained, however, the information in this document has not been independently verified by the licensee or the NRC.

NOTICE

This sourcebook will be periodically updated with new and/or replacement pages as appropriate to incorporate additional information on this reactor plant. Technical errors in this report should be brought to the attention of the following:

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Correction and other recommended changes should be submitted in the form of marked up copies of the affected text, tables or figures. Supporting documentation should be included if possible.

SUSQUEHANNA 1 & 2
RECORD OF REVISIONS

REVISION	ISSUE	COMMENTS
0	9/89	Original report

SUSQUEHANNA 1 & 2 SYSTEM SOURCEBOOK

This sourcebook contains summary information on the Susquehanna 1 and 2 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 Susquehanna nuclear plant is listed below:

· Docket number	50-387 (Unit 1) and 50-388 (Unit 2)
· Operator	Pennsylvania Power and Light Company
· Location	Salem Township, Luzerne County, Pennsylvania
· Commercial operation date	6/83 (Unit 1), 2/85 (Unit 2)
· Reactor type	BWR/4
· NSSS vendor	General Electric
· Power (MWt/MWe)	3293/1050
· Architect-engineer	Bechtel
· Containment type	Steel lined concrete drywell and wetwell (Mark II)

2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

The Susquehanna nuclear plant has two General Electric BWR/4 nuclear steam supply systems on the site. Each unit has a Mark II BWR containment incorporating the drywell/pressure suppression concept, and has a secondary containment structure of reinforced concrete. Other BWR/4 plants in the United States are as follows:

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

3. SYSTEM INFORMATION

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

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

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor Heat Removal Systems			
- Reactor Coolant System (RCS)	Same	3.1	5
- Reactor Core Isolation Cooling (RCIC) Systems	Same	3.2	5.4.6
- Emergency Core Cooling Systems (ECCS)	Same	-	-
- High-Pressure Injection & Recirculation	High-Pressure Coolant Injection (HPCI) System	3.3	6.3.1.2.1, 6.3.2.2.1
- Low-Pressure Injection & Recirculation	Core Spray (CS) System	3.3	6.3.1.2.2, 6.3.2.2.3
	Low-Pressure Coolant Injection (LPCI) System (an operating mode of the RHR system)	3.3	5.4.7.1.1.2, 6.3.1.2.3, 6.3.2.2.4
- Automatic Depressurization System (ADS)	Same	3.3	6.3.1.2.4, 6.3.2.2.2
- Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System)	Residual Heat Removal (RHR) System (a multi-mode system)	X	5.4.7
- Main Steam and Power Conversion Systems	Main Steam Supply System,	-	10.3
	Condensate and Feedwater Systems,	X	10.4.7
	Circulating Water System	X	10.4.5
- Other Heat Removal Systems	Steam-condensing RHR/RCIC operation	3.2	5.4.6.2.5.3, 5.4.7.1.1.5

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

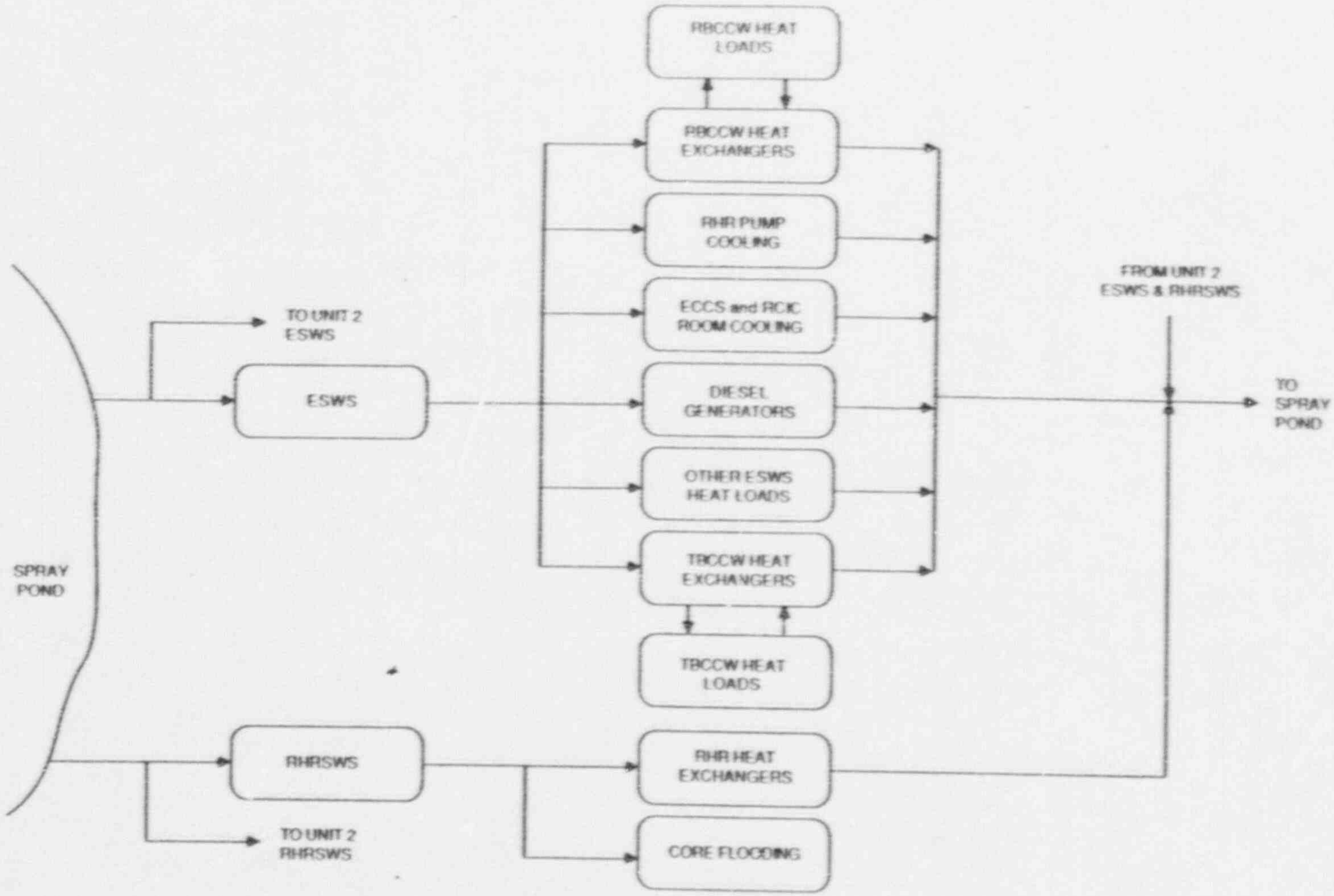
Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor Coolant Inventory Control Systems			
- Reactor Water Cleanup (RWCU) System	Same	X	5.4.8
- ECCS	See above	-	-
- Control Rod Drive Hydraulic System (CRDHS)	Same	3.6	4.6.1.1.2.4
Containment Systems			
- Primary Containment	Containment Structure (drywell and pressure suppression chamber)	X	6.2.1
- Secondary Containment	Same	X	6.2.3
- Standby Gas Treatment System (SGTS)	Same	X	6.5.1.1
- Containment Heat Removal Systems			
- Suppression Pool Cooling System	Suppression Pool Cooling Mode (an operating mode of the RHR system)	3.3	5.4.7.1.1.3
- Containment Spray System	Containment Spray Cooling Mode (an operating mode of the RHR system)	3.3	5.4.7.1.1.4, 6.2.2, 6.5.2
- Containment Fan Cooler System	None	-	-
- Containment Normal Ventilation Systems	Primary Containment Ventilation System	X	9.4.5
- Combustible Gas Control Systems	Same	X	6.2.5

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Reactor and Reactivity Control Systems			
- Reactor Core	Same	X	4
- Control Rod System	Control Rod Drive System	X	4.6.1
- Chemical Poison System	Standby Liquid Control System (SLCS)	X	9.3.5
Instrumentation & Control (I&C) Systems			
- Reactor Protection System (RPS)	Same	3.4	7.2
- Engineered Safety Feature Actuation System (ESFAS)	Engineered Safety Feature Systems	3.4	7.3
- Remote Shutdown System	Remote Shutdown Panel	3.4	7.4.1.4
- Other I&C Systems	Various other systems	X	7.4 to 7.7
Support Systems			
- Class 1E Electric Power System	Same	3.5	8.3.1, 8.3.2
- Non-Class 1E Electric Power System	Same	3.5	8
- Diesel Generator Auxiliary Systems	Same	3.5	9.4.7, 9.5.4 to 9.5.8
- Component Cooling Water (CCW) System	None	X	-

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

Generic System Name	Plant-Specific System Name	Report Section	FSAR Section Reference
Support Systems (continued)			
- Emergency Service Water System	Same	3.7	9.2.5
- Service Water System (SWS)	Same	X	9.2.1
- Residual Heat Removal Service Water (RHRSW) System	Same	3.8	9.2.6
- Other Cooling Water Systems	Turbine Building Closed Cooling Water (TBCCW) System,	X	9.2.3
	Reactor Building Closed Cooling Water System		9.2.2
- Fire Protection Systems	Same	X	9.5.1
- Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems	Same	X	9.4
- Instrument and Service Air Systems	Compressed Air Systems	X	9.3.1
- Refueling and Fuel Storage Systems	Fuel Storage and Handling Systems	X	9.[illegible]
- Radioactive Waste Systems	Radioactive Waste Management Systems	X	11
- Radiation Protection Systems	Same	X	12



RBCCW - Reactor Building Closed Cooling Water
ECCS - Emergency Closed Cooling System
TBCCW - Turbine Building Closed Cooling Water
RHRSWS - Residual Heat Removal (RHR) Service Water System
ESWS - Emergency Service Water System
RCIC - Reactor Core Isolation Cooling System

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

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) 16 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.

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 dumped to the suppression chamber via safety/relief valves on the main steam lines. A LOCA inside containment or operation of the Automatic Depressurization System (ADS) also dumps heat to the suppression chamber. Makeup to the RCS is provided by the Reactor Core Isolation Cooling (RCIC) system (see Section 3.2) or by the Emergency Core Cooling System (ECCS, see Section 3.3). Heat is transferred from the containment by the Residual Heat Removal (RHR) System operating in the containment cooling mode. The RHR Service Water System completes the heat transfer path from the containment to the ultimate heat sink (see Section 3.8). Actuation systems provide for automatic closure of the MSIVs and isolation of other lines connected to the RCS.

RCS overpressure protection is provided by sixteen 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 mitigatible LOCA is initiated, then LOCA mitigating systems are successful.

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

3.1.5 Component Information

A. RCS
  1. Steam flow: 14.15×10^6 lb/hr
  2. Normal operating pressure: 1055 psig

B. Safety/relief Valves (16)
  1. Set pressure: 2 @ 1146 psig, 862,400 lb/hr (each)
     4 @ 1175 psig, 883,950 lb/hr (each)
     4 @ 1185 psig, 891,380 lb/hr (each)
     3 @ 1195 psig, 898,800 lb/hr (each)
     3 @ 1205 psig, 906,250 lb/hr (each)

C. Recirculation Pumps (2)
  1. Rated flow: 45,200 gpm @ 710 psi
  2. Type: Single stage, variable speed, vertical centrifugal

D. Jet Pumps (20)
  1. Rated flow: 100.0×10^6 lb/hr (total)

3.1.6 Support Systems and Interfaces

A. Motive Power
  1. The recirculation pumps are supplied by non-Class 1E power.

B. MSIV Operating Power
The MSIVs are operated by pneumatic pressure and by the action of compressed springs. The control unit is attached to the air cylinder. This unit contains three types of control valves (i.e., pneumatic, AC, and AC from a second control power source) that open and close the main valve and exercise it at slow speed. Remote manual switches in the control room enable the operator to operate the valves. Operating air is supplied to the valves from the plant air system. An air tank between the control valve and a check valve provides backup operating air.

C. Recirculation Pump Cooling
A non-emergency service water system provides cooling water to the recirculation pump coolers.

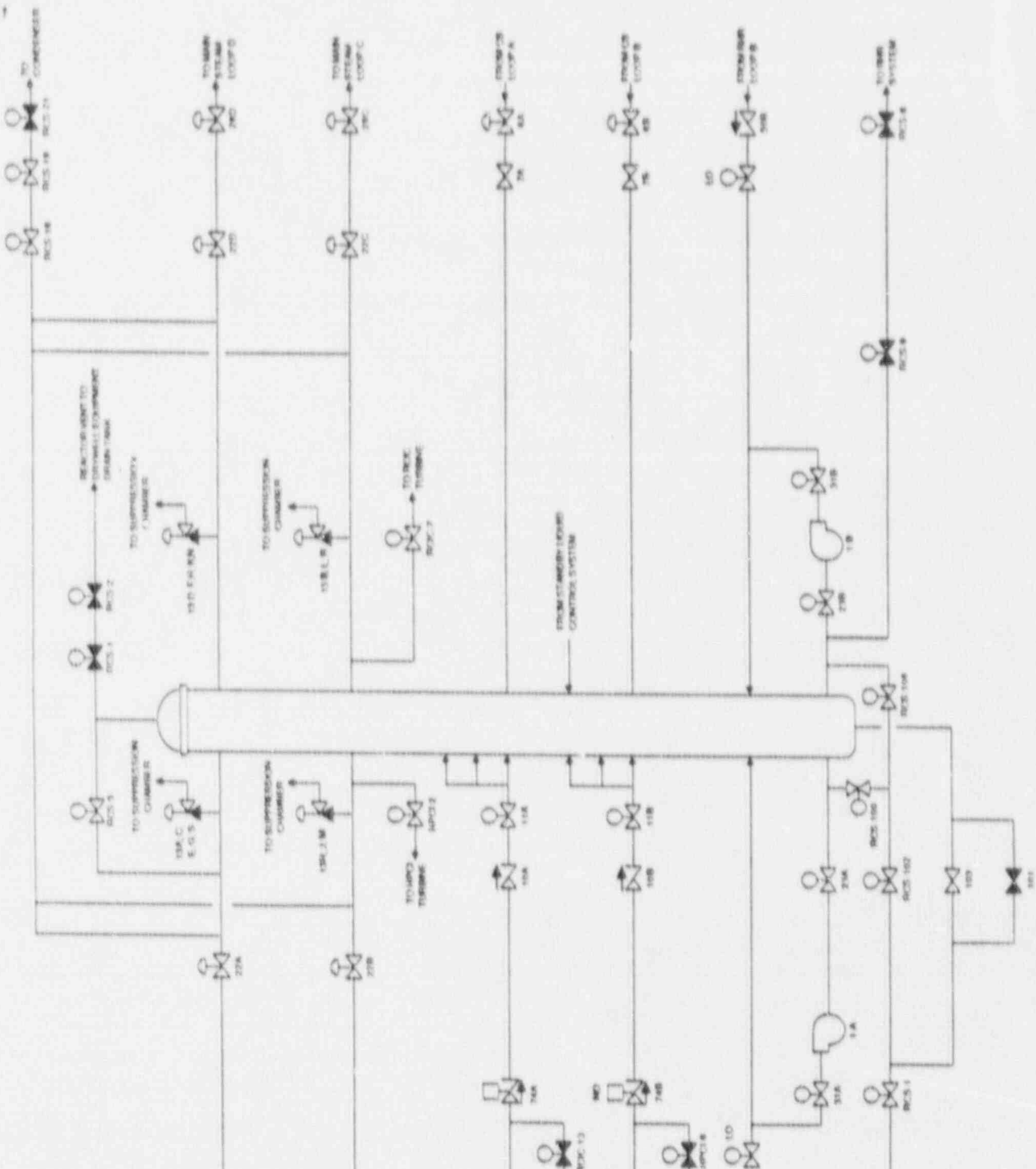


Figure 3.1-1. Susquehanna 1 Reactor Coolant System

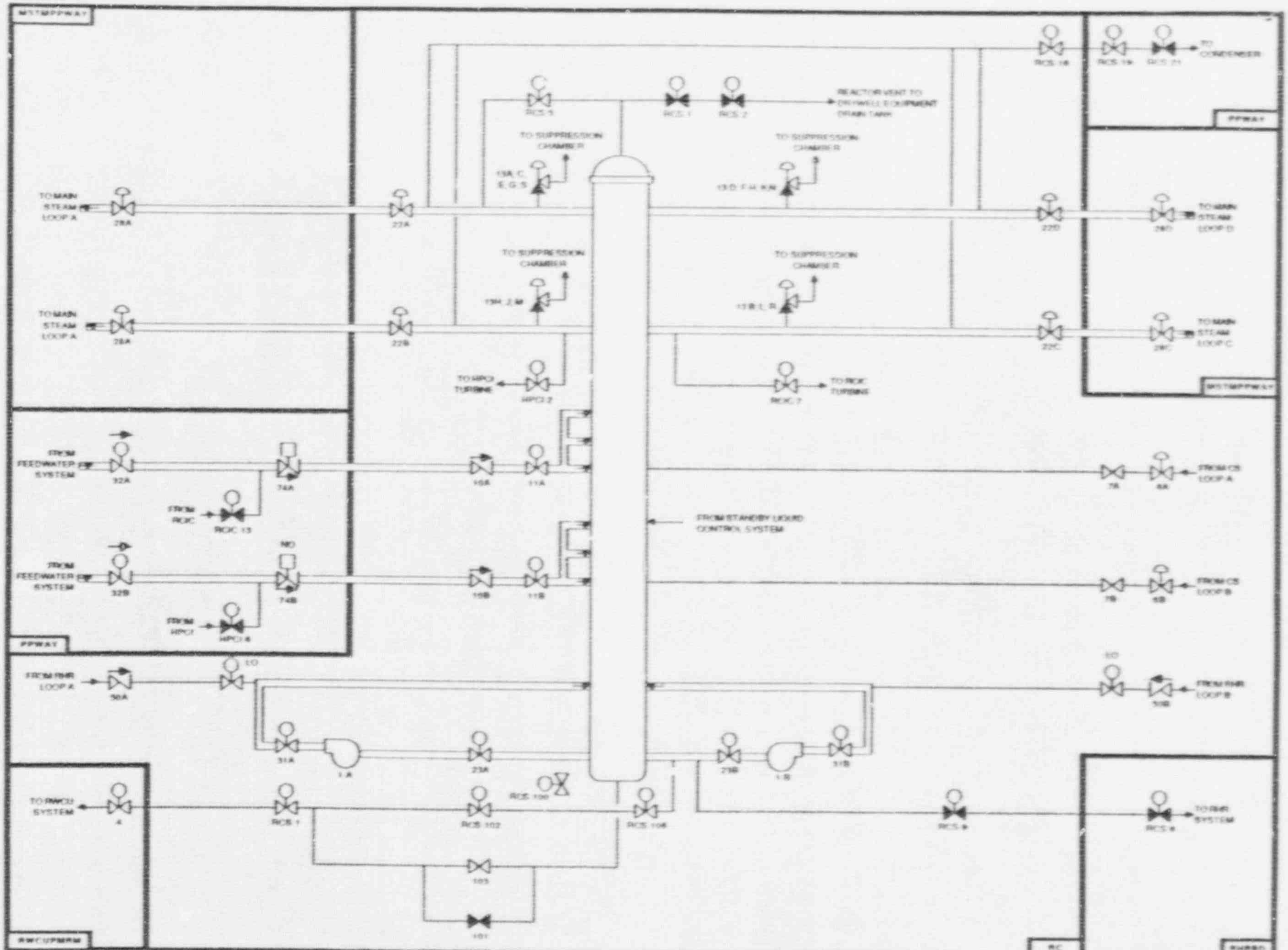


Figure 3.1-2. Susquehanna 1 Reactor Coolant System Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
HPCI-2	MOV	RC	EP-MCC-1B237	480	RB670SW	AC/C
HPCI-3	MOV	RB683	EP-MCC-1D274	250	RB670NE	DC/2
RCIC-7	MOV	RC	EP-MCC-1B246	480	SWGRM4	AC/D
RCIC-8	MOV	RB683	EP-MCC-1D254	250	RB670SW	DC/1
RCS-1	MOV	RC	EP-MCC-1B236	480	SWGRM3	AC/C
RCS-100	MOV	RC				
RCS-102	MOV	RC				
RCS-106	MOV	RC				
RCS-16	MOV	RC	EP-MCC-1B237	480	RB670SW	AC/C
RCS-19	MOV	PPWAY	EP-MCC-1D264	250	RB683NE	DC/2
RCS-2	MOV	RC	EP-MCC-1B246	480	SWGRM4	AC/D
RCS-21	MOV	PPWAY	EP-MCC-1B216	480	RB683	AC/A
RCS-5	MOV	RC	EP-MCC-1B246	480	SWGRM4	AC/D
RCS-8	MOV	RHRBD	EP-MCC-1D264	250	RB683NE	DC/2
RCS-9	MOV	RC	EP-MCC-1B236	480	SWGRM3	AC/C
RCS-V1	MOV	RC	EP-MCC-1B236	480	SWGRM3	AC/C

3.2 REACTOR CORE ISOLATION COOLING (RCIC) SYSTEM

3.2.1 System Function

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

3.2.2 System Definition

The reactor core isolation cooling system consists of a steam turbine-driven pump and associated valves and piping for delivering makeup water from the condensate storage tank or the suppression pool to the reactor pressure vessel. The RCIC originally was designed to operate in conjunction with the RHR system in the steam condensing mode, in which condensed steam is delivered from the RHR heat exchanger outlets to the RCIC pump suction, for return to the RCS. This operating mode of the RCIC has been eliminated.

The RCIC turbine is driven by steam from main steam line C. The turbine exhausts to the suppression pool.

Simplified drawings of the reactor core isolation cooling system are shown in Figures 3.2-1 and 3.2-2. Interfaces between the RCIC and the RCS are shown in Section 3.1. A summary of data on selected RCIC system components is presented in Table 3.2-1.

3.2.3 System Operation

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

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

The steam condensing mode of RCIC operation has been eliminated by disabling closed RHR steam supply valves 52A and 52B and other associated valves in the RHR pump rooms.

3.2.4 System Success Criteria

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

3.2.5 Component Information

A. Steam turbine-driven RCIC pump:
   1. Rated Flow: 600 gpm @ 2940 ft. head (1172 psid) to
      525 ft. head (165 psid)
   2. Rated Capacity: 100%
   3. Type: centrifugal

B. Condensate Storage Tank
   1. Capacity: 135,000 gal (reserved for RCIC use)

3.2.6 Support System and Interfaces

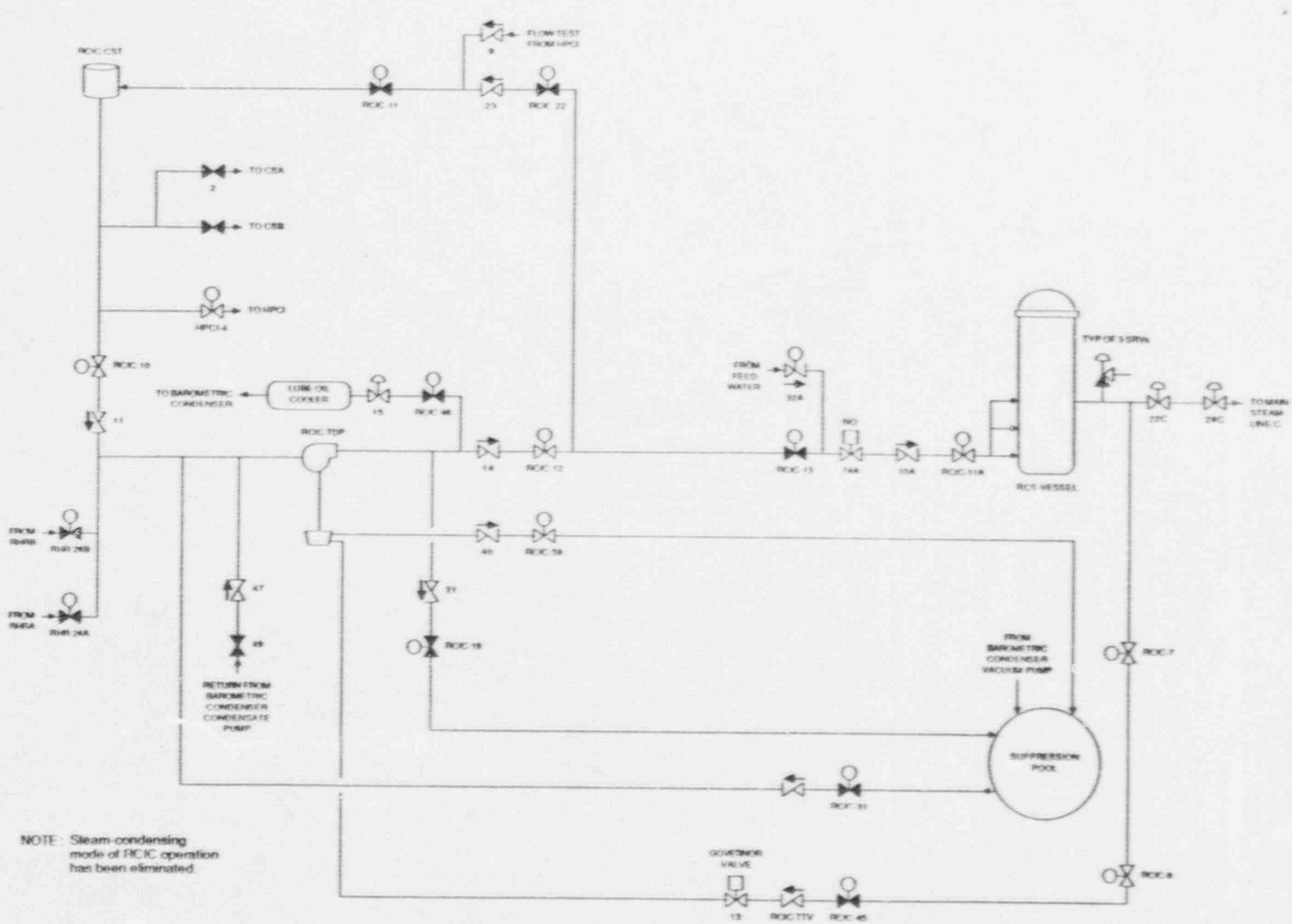
A. Control Signals
   1. Automatic
      a. The RCIC pump is automatically actuated on a reactor vessel low water level signal. The system automatically shuts down when the reactor vessel water level reaches a specified level, and automatically restarts if the level returns to the low level trip point.
      b. The RCIC pump suction is automatically switched to the suppression pool upon low condensate storage tank level or high wet well level.
      c. The RCIC pump is automatically isolated upon receipt of any of the following signals:
         - RCIC isolation signal
         - Turbine over-speed
         - Pump low suction pressure
         - Turbine high exhaust pressure

         When the signal is cleared, the trip throttle valve must be reset from the control room.

   2. Remote Manual
      The RCIC pump can be actuated by remote manual means from the control room or the remote shutdown panel.

B. Motive Power
   1. The RCIC turbine driven pump is supplied with steam from main steam line C, upstream of the main steam isolation valves.
   2. Most RCIC motor-operated valves are Class 1E DC loads that can be supplied from a station battery. Normally open RCIC steam line isolation valve RCIC-7 is a Class 1E AC load.

C. Other
   1. Lubrication for the turbine-driven pump is supplied locally.
   2. The RCIC lube oil cooler is cooled by water from the RCIC pump discharge.
   3. The RCIC pump room cooler is cooled by the Emergency Service Water System (see Section 3.7).



NOTE: Steam-condensing mode of RCIC operation has been eliminated.

Figure 3.2-1. Susquehanna Reactor Core Isolation Cooling System

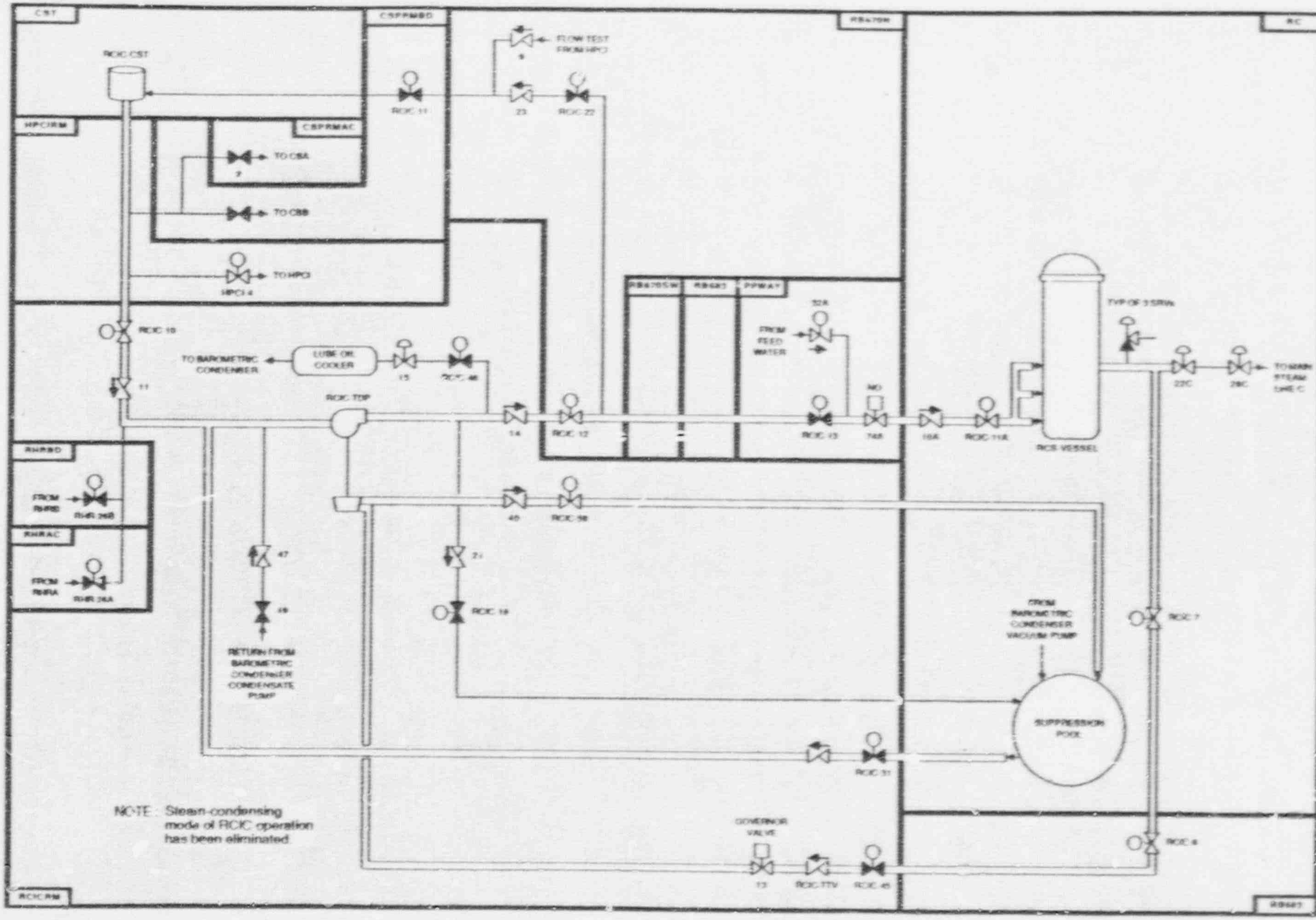


Figure 3.2-2. Susquehanna 1 Reactor Core Isolation Cooling System, Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RCIC-10	MOV	RCICRM	EP-MCC-1D254	250	RB670SW	DC/1
RCIC-11	MOV	CSPRMBD	EP-MCC-1D274	250	RB670NE	DC/2
RCIC-12	MOV	RB670N	EP-MCC-1D254	250	RB670SW	DC/1
RCIC-13	MOV	PPWAY	EP-MCC-1D254	250	RB670SW	DC/1
RCIC-22	MOV	RB670N	EP-MCC-1D254	250	RB670SW	DC/1
RCIC-31	MOV	RCICRM	EP-MCC-1D254	250	RB670SW	DC/1
RCIC-45	MOV	RCICRM	EP-MCC-1D254	250	RB670SW	DC/1
RCIC-46	MOV	RCICRM	EP-MCC-1D254	250	RB670SW	DC/1
RCIC-59	MOV	RCICRM	EP-MCC-1D254	250	RB670SW	DC/1
RCIC-7	MOV	RC	EP-MCC-1B246	480	SWGRM4	AC/D
RCIC-8	MOV	RB683	EP-MCC-1D254	250	RB670SW	DC/1
RCIC-CST	TK	CST				
RCIC-TDP	TDP	RCICRM				

3.3 EMERGENCY CORE COOLING SYSTEM (ECCS)

3.3.1 System Function

The ECCS is an integrated set of subsystems that perform emergency coolant injection and recirculation functions to maintain reactor core coolant inventory and adequate decay heat removal following a LOCA. The ECCS also performs suppression pool cooling and containment spray functions and has a capability for mitigating transients.

3.3.2 System Definition

The emergency 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, system piping, valves and controls. The HPCI pump can draw suction from either the CST or the suppression pool. Water is injected into the reactor via feedwater line B. The HPCI turbine is driven by steam from main steam line B. 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 6 of the 16 safety/relief valves that discharge the high pressure steam to the suppression pool.

The CS system supplies make-up water to the reactor vessel at low pressure. The CS system consists of two main loops with two pumps each, for a total of four loops. The four pumps with their associated loops are designated CSA, CSB, CSC, and CSD. Each loop consists of a motor-driven pump which supplies water from the suppression pool to two spray spargers in the reactor vessel above the core.

The low pressure coolant injection system is an operating mode of the residual heat removal (RHR) system, and provides make-up water to the reactor vessel at low pressure. The LPCI system consists of two main loops with two pumps each, for a total of four loops. The four pumps with their associated loops are designated LPCIA, LPCIB, LPCIC, and LPCID. Each loop consists of a motor driven pump which supplies water from the suppression pool to the reactor vessel. There are two heat exchangers in the system, one for pumps 1A and 1C and one for pumps 1B and 1D. The RHR system can be manually realigned as needed to perform suppression pool cooling or containment spray as part of the basic emergency core cooling function. The RHR system also can be aligned for steam condensing operation, where steam from the HPCI steam line is condensed in the RHR heat exchangers, then piped to the suction of the RCIC pumps for the return to the reactor. This is not an ECCS function.

Simplified drawings of the HPCI system are shown in Figures 3.3-1 and 3.3-2. The CS system is shown in Figures 3.3-3 and 3.3-4 (loops A and C), and Figures 3.3-5 and 3.3-6 (loops B and D). The LPCI system is shown in Figures 3.3-7 and 3.3-8 (loops A and C), and Figures 3.3-9 and 3.3-10 (loops B and D). Interfaces between these systems and the RCS are shown in Section 3.1. A summary of selected data on ECCS components is presented in Table 3.3-1.

3.3.3 System Operation

All ECCS systems normally are in standby. The manner in which the ECCS operates to protect the reactor core is a function of the rate at which coolant is being lost from the RCS. The HPCI system is normally aligned to take a suction on the Condensate Storage Tank (CST). The HPCI system is automatically started in response to decreasing RPV water level or high drywell pressure, and will serve as the primary source of makeup if RCS pressure remains high. Reactor core heat is dumped to the suppression pool via the safety/relief valves, which cycle as needed to limit RCS pressure. Steam to drive the HPCI turbine is routed from main steam line B. 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 two [illegible] capacity pumps. Each loop provides makeup to the reactor vessel through separate spray spargers. The source of water is the suppression pool.

The LPCI system is an operating mode of the RHR system. In the LPCI mode the four pumps take suction on the suppression pool and inject back into the vessel through the reactor recirculation loops. Other operating modes of the RHR system include: (a) suppression pool cooling, in which water is recirculated from the suppression pool through two RHR heat exchangers and back to the suppression pool; (b) containment spray, in which water is pumped to fog jet nozzles in the drywell and suppression pool; (c) steam condensing, in which condensate is delivered to the RCIC pump; and (d) shutdown cooling.

3.3.4 System Success Criteria

LOCA mitigation requires that both the emergency coolant injection (ECI) and emergency coolant recirculation (ECR) functions be accomplished. The success criteria are not clearly defined in the Susquehanna 1 FSAR but can be inferred from pump capacities that are defined based on certain design basis accidents that are considered in the licensing process. On this basis, the ECI system success criteria for a large LOCA are the following:

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

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

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

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

The ECR success criteria for LOCAs are integrated with 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 inventory control involve the following:

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

For the suppression pool cooling function to be successful, one of two RHR trains must be aligned for containment heat removal and the associated RHR service water train must be operating to complete the heat transfer path from the RHR heat exchangers to the ultimate heat sink. The success criteria for a given RHR train was not clear in the Susquehanna 1 FSAR. The success criteria of the RHR Service Water System is one of two 9,000 gpm pumps (see Section 3.8). It is possible that one 10,000 gpm RHR pump is sufficient.

3.3.5 Component Information

A. Turbine-driven HPCI pump P1
   1. Rated flow: 5,070 gpm @ 165 to 1,172 psia
   2. Rated capacity: 100%
   3. Type: centrifugal
   4. Water temperature range: 40°F to 140°F

B. Motor-driven CS pumps 1A, 1B, 1C, 1D
   1. Rated flow: 3,175 gpm @ 105 psid (vessel to drywell)
   2. Rated capacity: 50%
   3. Type: centrifugal

C. Motor-driven LPCI pumps 1A, 1B, 1C, 1D
   1. Rated flow: 10,000 gpm @ 20 psid, 7,500 gpm @ 150 psid (vessel to drywell) (Ref. 1, Figure 6.3-7)
   2. Rated capacity: 50%
   3. Type: centrifugal

D. RHR Heat Exchangers 1A and 1B
   1. Heat transfer capability: Unknown
   2. Rated capacity: 100%
   3. Type: shell and tube

E. Automatic-depressurization valves (6)
   1. Rated flow: 800,000 lb/hr @ 1,125 psid

F. Pressure Suppression Chamber
   1. Design temperature. 220°F
   2. Maximum operating temperature: 90°F
   3. Minimum water volume: 122,410 ft^3

3.3.6 Support Systems and Interfaces

A. Control signals
  1. Automatic
     a. The HPCI pump, CS pumps, and the LPCI pumps, and all their associated valves function upon receipt of low water level in the reactor vessel or high pressure in the drywell. When the reactor vessel pressure is low enough, the CS and LPCI injection valves open.
     b. The HPCI pump is automatically tripped upon turbine overspeed reactor vessel high water level, HPCI pump low suction pressure, or HPCI turbine exhaust high pressure. If an initiation signal is received after the turbine is shut down, the system restarts automatically, provided no shutdown signal exists.
     c. HPCI pump suction is automatically switched from the CST to the suppression pool upon low CST level or high suppression pool water level.
     d. The ADS system is actuated upon coincident signals of the reactor vessel low water level high drywell pressure, and a signal that at least one LPCI pump or one CS loop (two pumps per loop) are 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 and restore RCS level.
     e. LPCI initiation automatically causes all RHR components to perform their function under the LPCI mode.
  2. Remote manual
     ECCS pumps and valves and the ADS can be actuated by remote manual means from the main control room.

B. Motive Power
  1. The 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. The HPCI pump is supplied with steam from main steam line B.
  3. Most of the HPCI motor-operated valves are Class 1E DC loads that can be supplied from a station battery. Normally open HPCI steam line isolation valve HPCI-2 is a Class 1E AC load.

C. Other
  1. The HPCI pump has a DC-powered auxiliary lube oil pump that is required for pump startup (i.e. to pressurize the oil system for pump thrust bearing lubrication and for operation of the governor system and the hydraulic steam supply valves for the HPCI turbine). The power source for the HPCI DC lube oil pump is assumed to be the 250 VDC bus 1D662 (the HPCI bus). Once the HPCI pump is operating, a shaft-driven lube oil pump provides oil pressure, and the DC lube oil pump is stopped.
  2. HPCI pump gland seal leakoff is collected, condensed, and returned to the pump suction. A vacuum pump maintains condenser vacuum.
  3. Lubrication and cooling for the HPCI pump are supplied locally.
  4. Cooling for the RHR pumps is supplied by the Emergency Service Water System (see Section 3.7).
  5. ECCS pump room cooling systems are cooled by the Emergency Service Water System (see Section 3.7).

6. The RHR heat exchangers are cooled by the RHR Service Water System (see Section 3.8).

3.3.7 Section 3.3 References

1. Susquehanna 1 FSAR, Section 6.3.

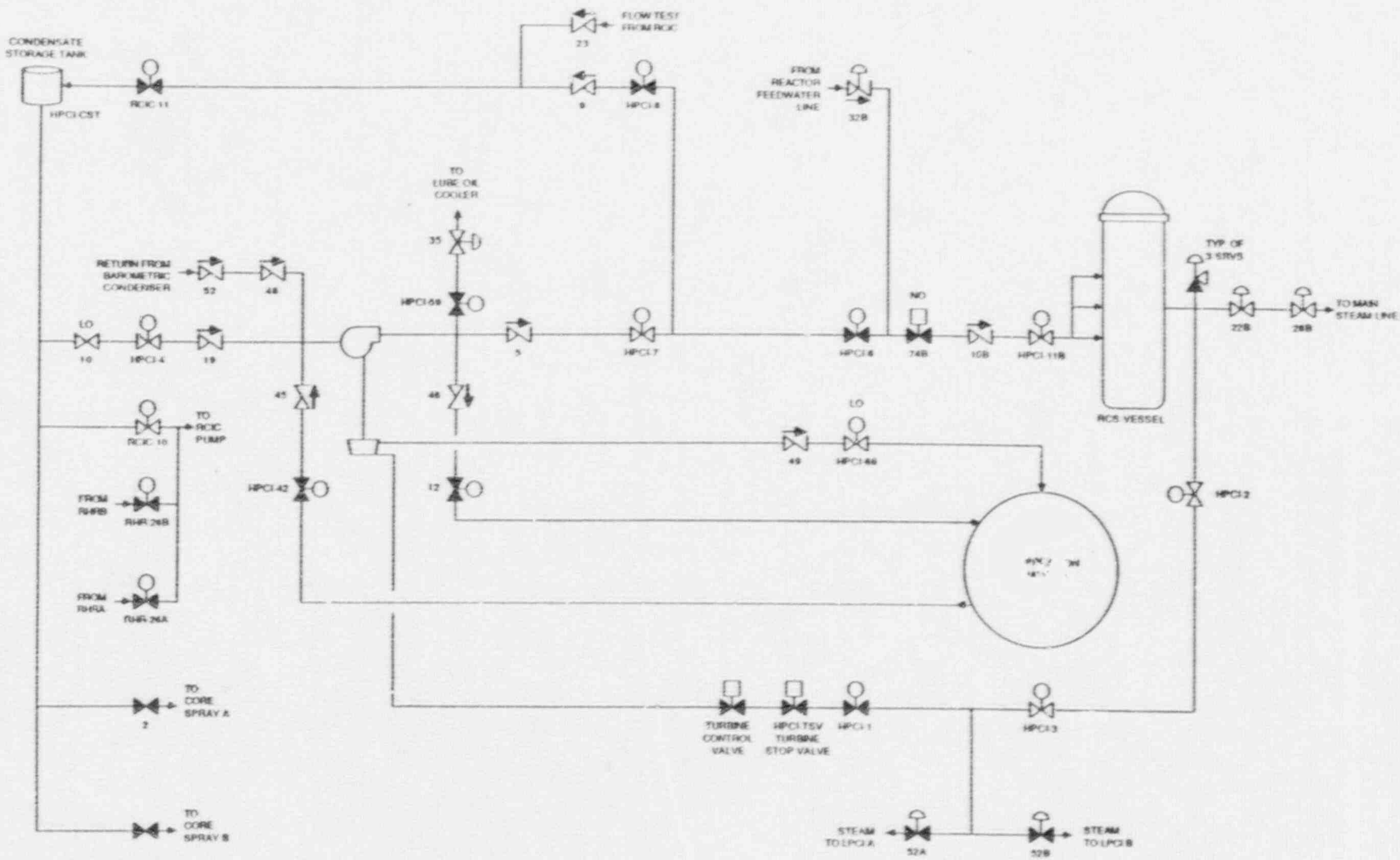


Figure 3.3-1. Susquehanna 1 High Pressure Coolant Injection Syst. m

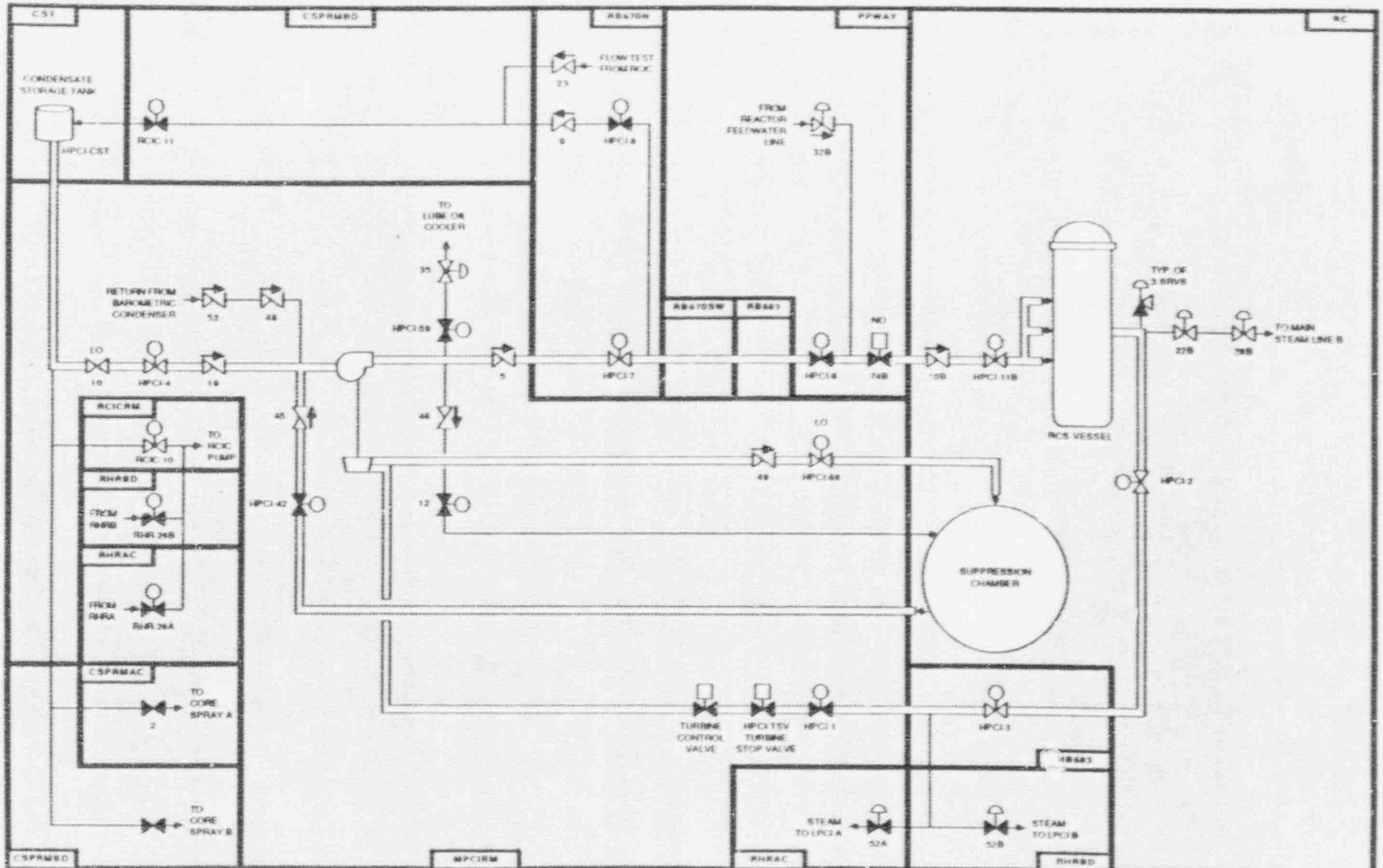


Figure 3.3-2. Susquehanna 1 High Pressure Coolant Injection System Showing Component Locations

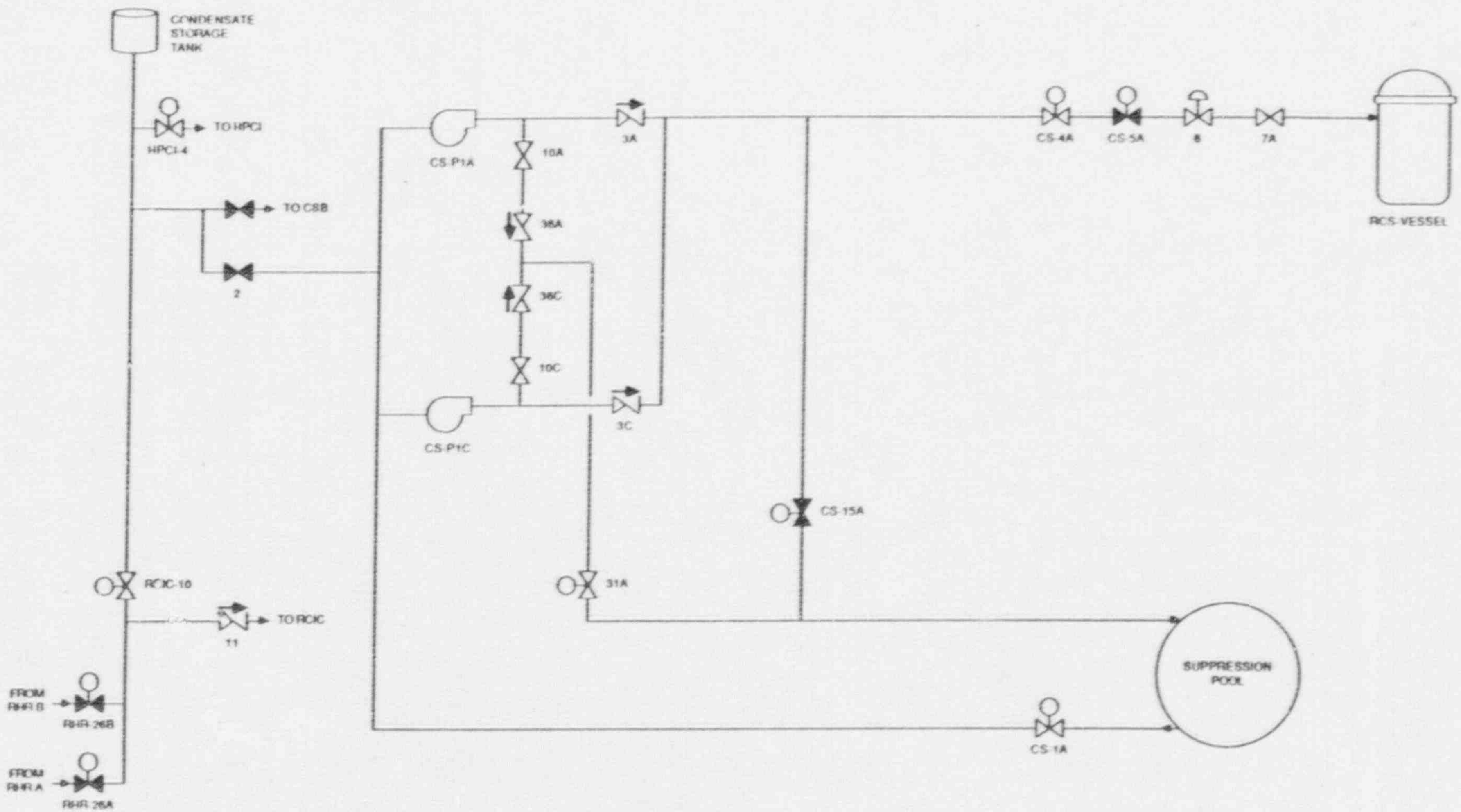


Figure 3.3-3. Susquehanna 1 Core Spray System, Loops A and C

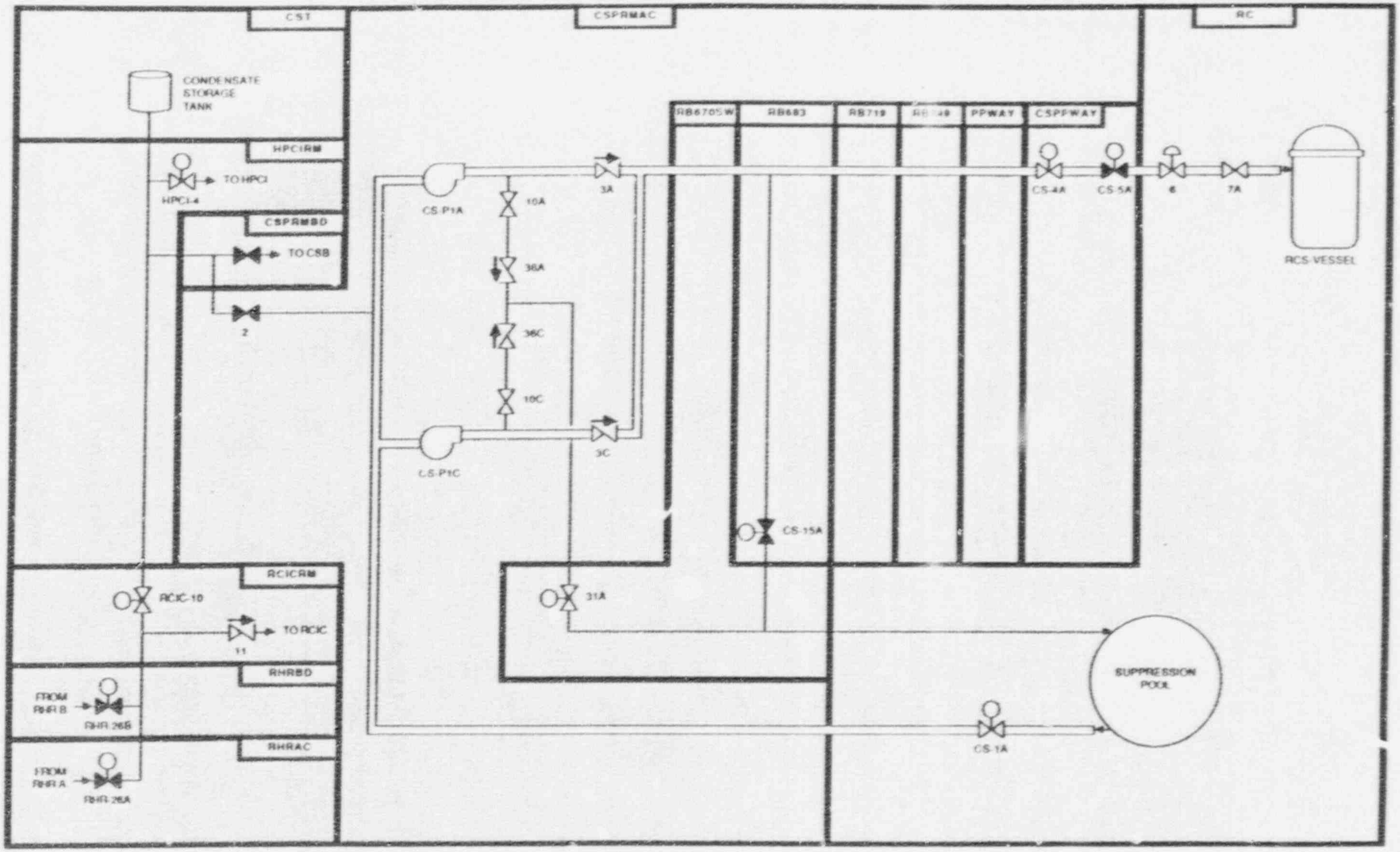


Figure 3.3-4. Susquehanna 1 Core Spray System, Loops A and C, Showing Component Locations

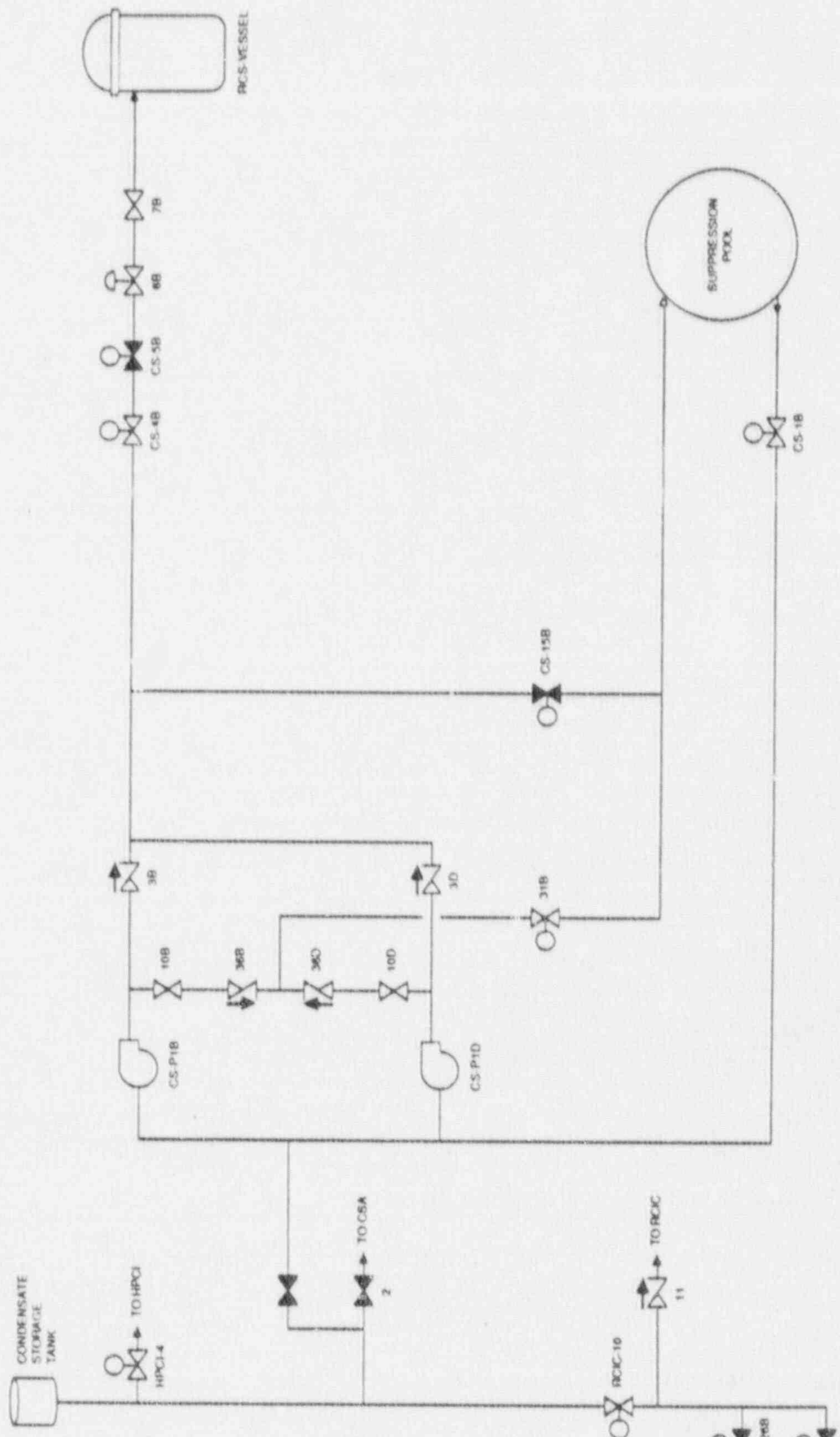


Figure 3.3-5. Susquehanna 1 Core Spray System, Loops B and D

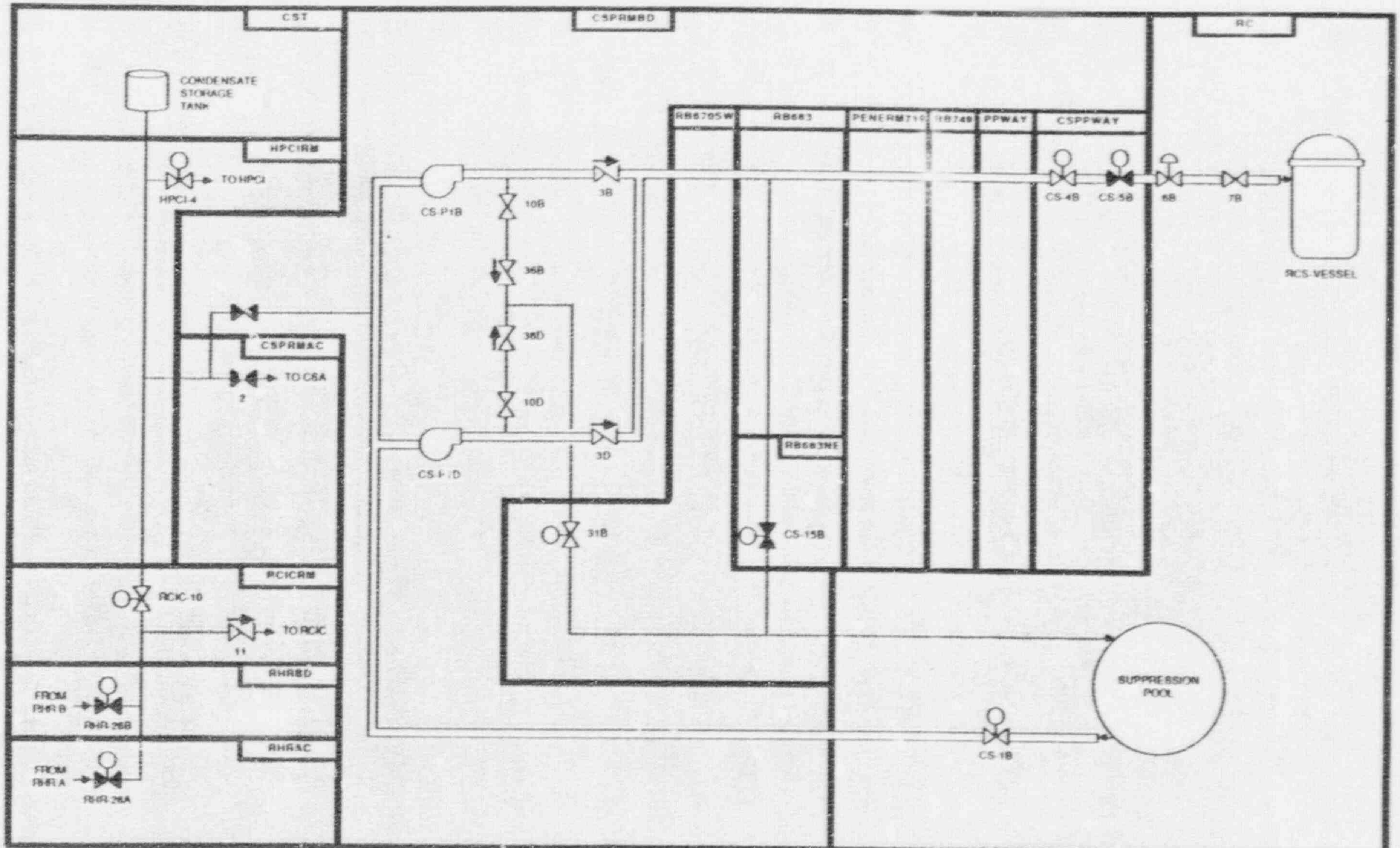


Figure 3.3-6. Susquehanna 1 Core Spray System, Loops B and D, Showing Component Locations

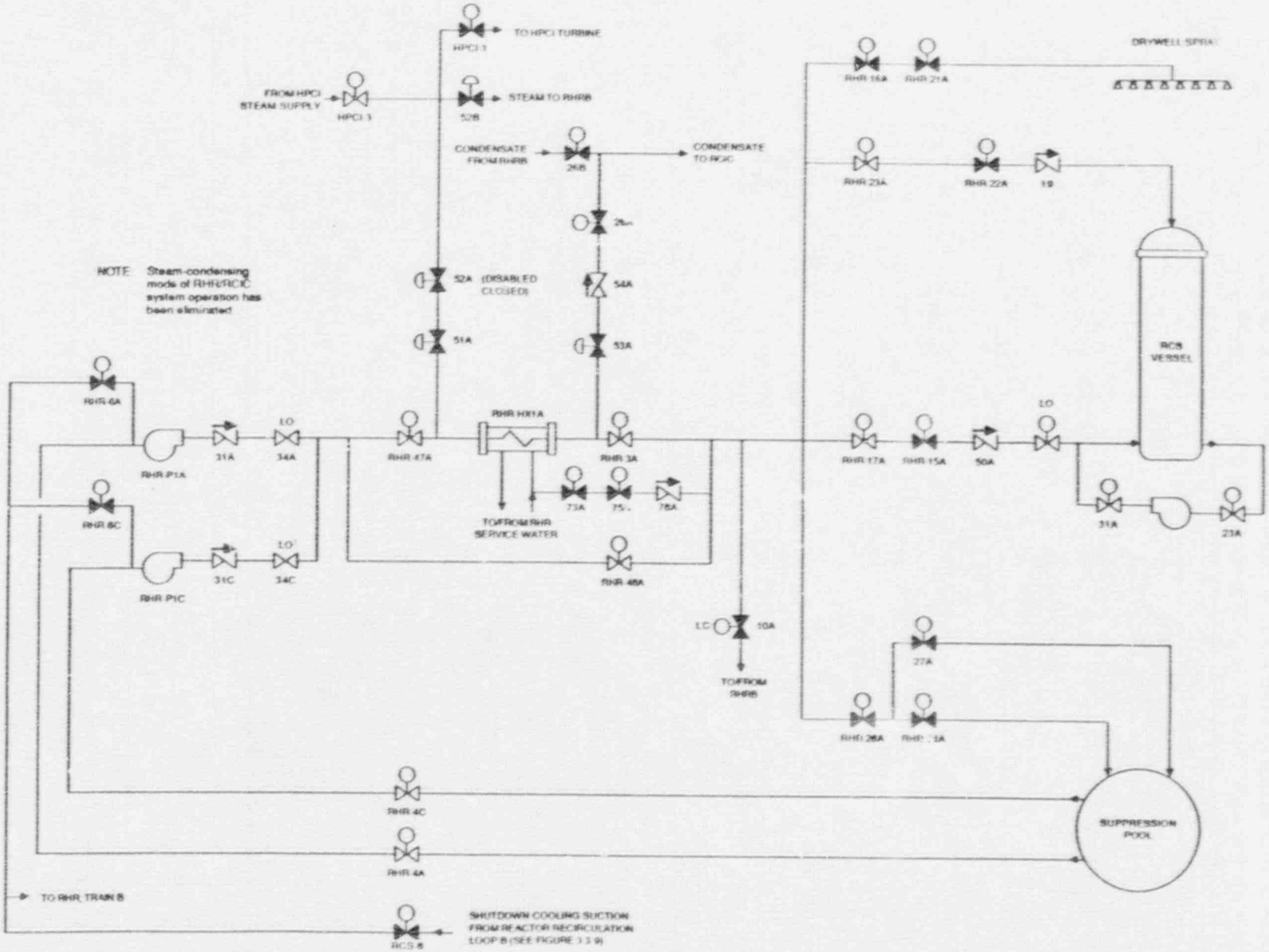


Figure 3.3-7. Susquehanna 1 Residual Heat Removal Sys'em, Loops A and C

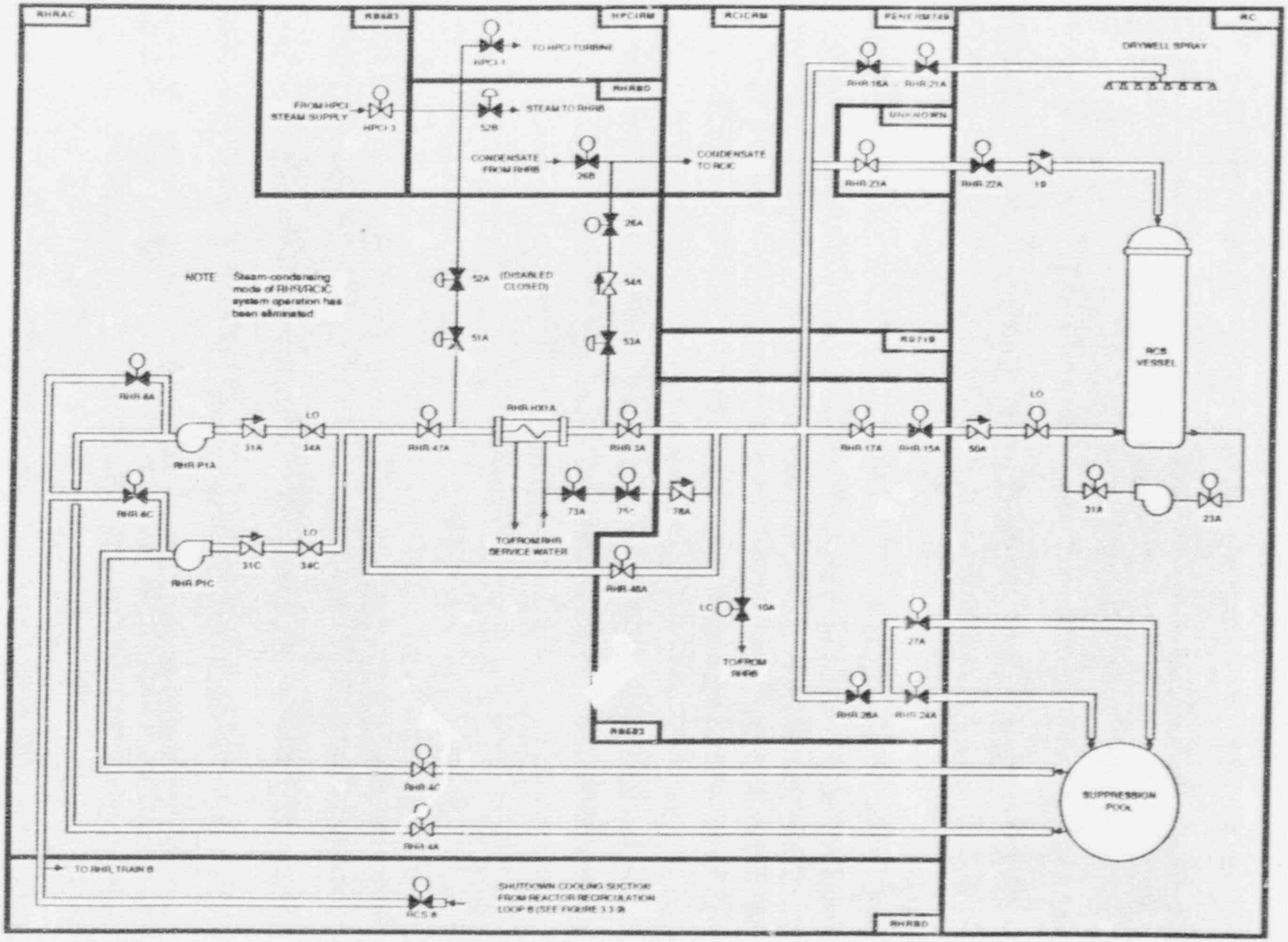


Figure 3.3-8. Susquehanna 1 Residual Heat Removal System, Loops A and C, Showing Component Locations

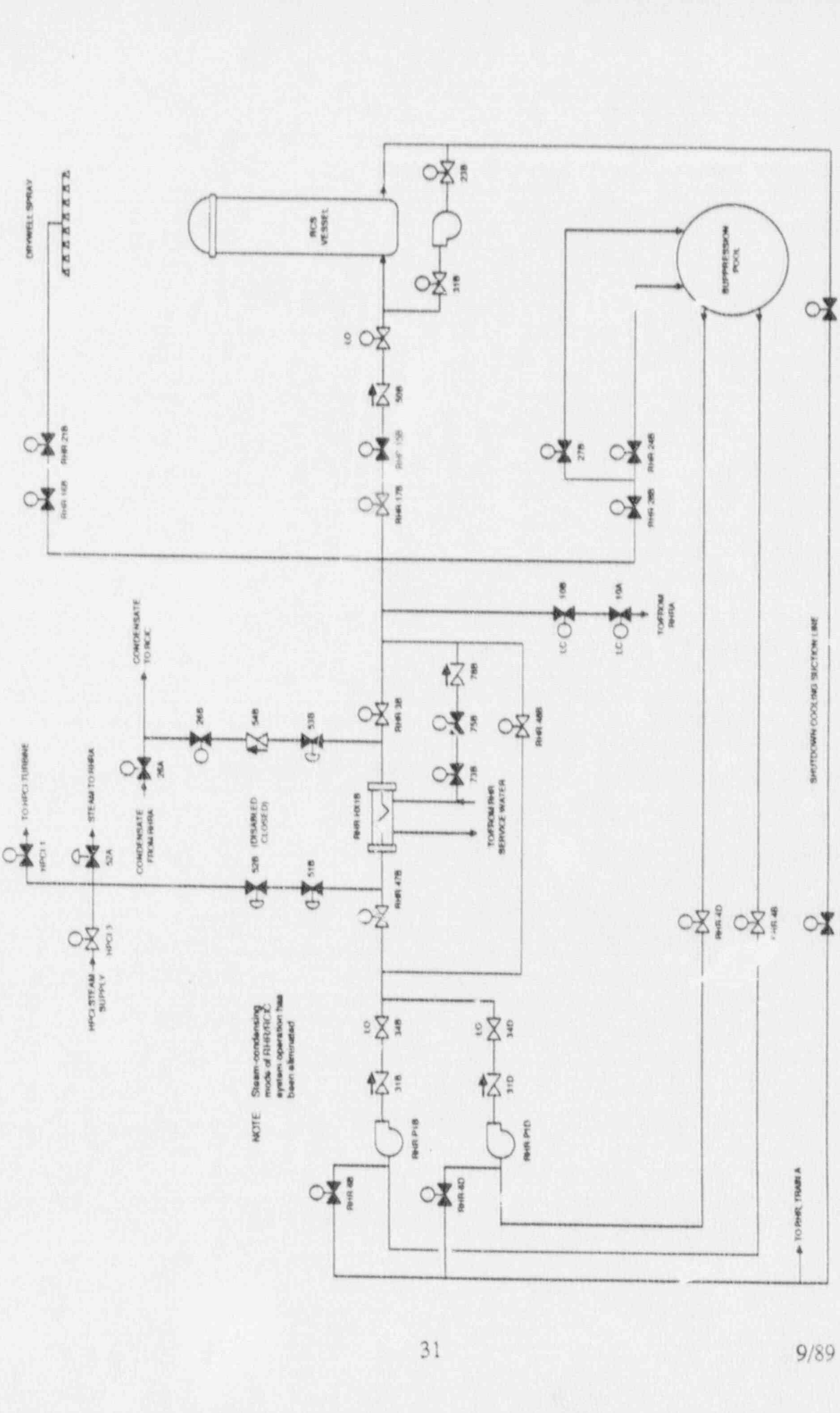


Figure 3.3-9. Susquehanna 1 Residual Heat Removal System, Loops B and D

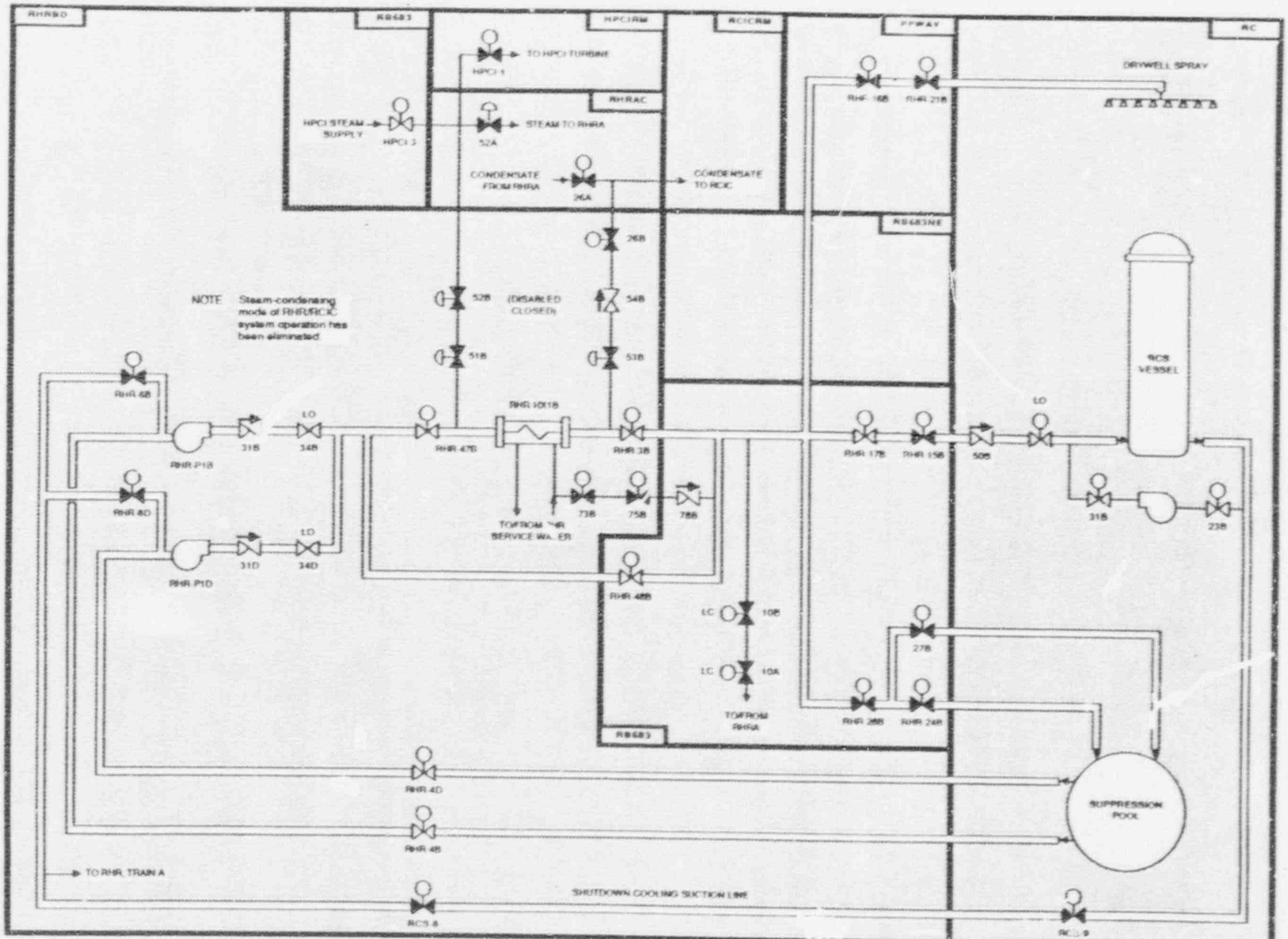


Figure 3 3-10. Susquehanna 1 Residual Heat Removal System, Loops B and D, Showing Component Locations

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CS-15A	MOV	RB683	EP-MCC-1B237	480	RB670SW	AC/C
CS-15B	MOV	RB683NE	EP-MCC-1B247	480	MCC1B247	AC/D
CS-1A	MOV	CSPRMAC	EP-MCC-1B216	480	RB683	AC/A
CS-1B	MOV	CSPRMBD	EP-MCC-1B226	480	RB683NE	AC/B
CS-4A	MOV	PPWAY	EP-MCC-1B217	480	SWGRM1	AC/A
CS-4B	MOV	PPWAY	EP-MCC-1B227	480	SWGRM2	AC/B
CS-5A	MOV	PPWAY	EP-MCC-1B217	480	SWGRM1	AC/A
CS-5B	MOV	PPWAY	EP-MCC-1B227	480	SWGRM2	AC/B
CS-P1A	MDP	CSPRMAC	EP-BS-1A201	4160	SWGRM1	AC/A
CS-P1B	MDP	CSPRMBD	EP-BS-1A202	4160	SWGRM2	AC/B
CS-P1C	MDP	CSPRMAC	EP-BS-1A203	4160	SWGRM3	AC/C
CS-P1D	MDP	CSPRMBD	EP-BS-1A204	4160	SWGRM4	AC/D
HPCI-1	MOV	HPCIRM	EP-MCC-1D274	250	RB670NE	DC/2
HPCI-10	MOV	RCICRM	EP-MCC-1D254	250	RB670SW	DC/1
HPCI-11	MOV	CSPRMBD	EP-MCC-1D274	250	RB670NE	DC/2
HPCI-11B	MOV	RC	EP-MCC-1D264	250	RB683NE	DC/2
HPCI-2	MOV	RC	EP-MCC-1B237	480	RB670SW	AC/C
HPCI-3	MOV	RB683	EP-MCC-1D274	250	RB670NE	DC/2
HPCI-4	MOV	HPCIRM	EP-MCC-1D274	250	RB670NE	DC/2
HPCI-42	MOV	HPCIRM	EP-MCC-1D274	250	RB670NE	DC/2
HPCI-46	MOV	HPCIRM	EP-MCC-1D274	250	RB670NE	DC/2
HPCI-6	MOV	PPWAY	EP-MCC-1D274	250	RB670NE	DC/2
HPCI-66	MOV	HPCIRM	EP-MCC-1D264	250	RB683NE	DC/2
HPCI-7	MOV	RB670N	EP-MCC-1D264	250	RB683NE	DC/2
HPCI-8	MOV	RB670N	EP-MCC-1D264	250	RB683NE	DC/2
HPCI-TDP	TDP	HPCIRM				
RHR-15A	MOV	RB683	EP-MCC-1B219	480	RB670SW	AC/A,C

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RHR-15B	MOV	RB683	EP-MCC-1B229	480	MCC1B229	AC/B,D
RHR-16A	MOV	PENERM749	EP-MCC-1B217	480	SWGRM1	AC/A
RHR-16A	MOV	PENERM749	EP-MCC-1B217	480	SWGRM1	AC/A
RHR-16B	MOV	PPWAY	EP-MCC-1B226	480	RB683NE	AC/B
RHR-16B	MOV	PPWAY	EP-MCC-1B226	480	RB683NE	AC/C
RHR-17A	MOV	RB683	EP-MCC-1B216	480	RB683	AC/A
RHR-17B	MOV	RB683	EP-MCC-1B226	480	RB683NE	AC/B
RHR-21A	MOV	PENERM749	EP-MCC-1B217	480	SWGRM1	AC/A
RHR-21A	MOV	PENERM749	EP-MCC-1B217	480	SWGRM1	AC/A
RHR-21B	MOV	PPWAY	EP-MCC-1B227	480	SWGRM2	AC/B
RHR-21B	MOV	PPWAY	EP-MCC-1B227	480	SWGRM2	AC/B
RHR-24A	MOV	RB683	EP-MCC-1B237	480	RB670SW	AC/C
RHR-24A	MOV	RB683	EP-MCC-1B237	480	RB670SW	AC/C
RHR-24B	MOV	RB683	EP-MCC-1B247	480	MCC1B247	AC/D
RHR-24B	MOV	RB683	EP-MCC-1B247	480	MCC1B247	AC/B
RHR-27A	MOV	RB683	EP-MCC-1B236	480	SWGRM3	AC/C
RHR-27B	MOV	RB683	EP-MCC-1B246	480	SWGRM4	AC/B
RHR-28A	MOV	RB683	EP-MCC-1B216	480	RB683	AC/A
RHR-28A	MOV	RB683	EP-MCC-1B216	480	RELAYRM1	AC/A
RHR-28B	MOV	RB683	EP-MCC-1B226	480	RB683NE	AC/B
RHR-28B	MOV	RB683	EP-MCC-1B226	480	RB683NE	AC/D
RHR-3A	MOV	RHRAC	EP-MCC-1B216	480	RB683	AC/A
RHR-3B	MOV	RHRBD	EP-MCC-1B226	480	RB683NE	AC/B
RHR-47A	MOV	RHRAC	EP-MCC-1B216	480	RB683	AC/A
RHR-47B	MOV	RHRBD	EP-MCC-1B226	480	RB683NE	AC/B
RHR-48A	MOV	RB683	EP-MCC-1B237	480	RB670SW	AC/C
RHR-48A	MOV	RB683	EP-MCC-1B237	480	RB670SW	AC/C

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RHR-48B	MOV	RB683	EP-MCC-1B246	480	SWGRM4	AC/D
RHR-48B	MOV	RB683	EP-MCC-1B246	480	SWGRM4	AC/D
RHR-4A	MOV	RHRAC	EP-MCC-1B216	480	RB683	AC/A
RHR-4B	MOV	RHRBD	EP-MCC-1B226	480	RB683NE	AC/B
RHR-4C	MOV	RHRAC	EP-MCC-1B237	480	RB670SW	AC/C
RHR-4D	MOV	RHRBD	EP-MCC-1B247	480	MCC1B247	AC/D
RHR-6A	MOV	RHRAC	EP-MCC-1B216	480	RB683	AC/A
RHR-6A	MOV	RHRAC	EP-MCC-1B216	480	RB683	AC/A
RHR-6B	MOV	RHRBD	EP-MCC-1B226	480	RB683NE	AC/B
RHR-6B	MOV	RHRBD	EP-MCC-1B226	480	RB683NE	AC/B
RHR-6C	MOV	RHRAC	EP-MCC-1B237	480	RB670SW	AC/C
RHR-6C	MOV	RHRAC	EP-MCC-1B237	480	RB670SW	AC/C
RHR-6D	MOV	RHRBD	EP-MCC-1B247	480	MCC1B247	AC/D
RHR-6D	MOV	RHRBD	EP-MCC-1B247	480	MCC1B247	AC/D
RHR-P1A	MDP	RHRAC	EP-BS-1A201	4160	SWGRM1	AC/A
RHR-P1B	MDP	RHRBD	EP-BS-1A202	4160	SWGRM2	AC/B
RHR-P1C	MDP	RHRAC	EP-BS-1A203	4160	SWGRM3	AC/C
RHR-P1D	MDP	RHRBD	EP-BS-1A204	4160	SWGRM4	AC/D

3.4 INSTRUMENTATION AND CONTROL (I & C) SYSTEMS

3.4.1 System Function

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

3.4.2 System Definition

The RPS includes sensor and transmitter units, logic units, and output trip relays that generate a reactor trip signal. The reactor trip signal deenergizes the control element drive mechanisms, allowing all control element assemblies (CEAs) to drop into the core. The Engineered Safety Features System includes independent sensor and transmitter units, logic units and relays that interface with the control circuits for the many different sets of components that can be actuated by this system. Operator instrumentation display systems consist of display panels in the control room and at the remote shutdown panel.

A summary of data on selected I & C system components is presented in Table 3.4-1.

3.4.3 System Operation

A. RPS

The RPS has four redundant input instrument channels for each sensed parameter. A two-out-of-four coincidence of like trip signals is required to generate a reactor trip signal. The four RPS instrument channels allow for bypassing one channel while maintaining a two-out-of-three system. The following conditions result in reactor trip:

- Neutron monitoring (APRM) system
- Neutron monitoring (IRM) system
- Reactor vessel high pressure
- Reactor vessel low water level
- Turbine stop valve closure
- Turbine control valve fast closure
- Main steam line isolation valve closure
- Scram discharge volume high water level
- Drywell high pressure
- Main steam line high radiation
- Manual

B. ESF

The ESF also utilizes a two-out-of-four coincidence of like initiating trip signals from four independent measurement channels, with two output actuation trains. The ESF logic is similar to that of the RPS. The ESF systems that can be automatically actuated include the following (not a complete listing):

- Emergency Core Cooling System
  - HPCI
  - CS
  - LPCI/RHR
  - ADS
- Standby power systems
- Emergency service water system
- Various room cooling systems
  - ECCS equipment room HVAC system
  - Essential switchgear heat removal HVAC system
  - Diesel generator HVAC system
  - Emergency service water pump room HVAC system
  - Main control room HVAC system

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

C. Remote Shutdown

The Susquehanna units are designed with a main control room that is common to Unit 1 and 2. If this main control room becomes uninhabitable and must be evacuated, a remote shutdown panel is provided for each unit. The remote shutdown panels are equipped with sufficient control and monitoring devices to bring the reactor to a hot shutdown condition, and subsequently to cold shutdown condition. The remote shutdown panel for each unit is located within a locked room in the reactor building of each unit. Access to this room is controlled by a locked door with a keycard. The keycards are under administrative control.

With exception of indication circuits which have no corresponding device located in the control room, all control and indicating devices on the remote shutdown panel are normally deenergized and must be connected to the active circuitry by transfer switches located on the remote shutdown panel. This action bypasses the main control room circuits for control and indication, except for the suppression pool temperature indication, and generates an alarm in the control room as part of the Bypass Indication System (BIS). During an accident situation, main steamline isolation is likely to occur; hence, reactor pressure will be relieved to the suppression pool through the RPV relief valves. Control of three pressure relief valves is provided on the remote shutdown panel. Reactor pressure can be monitored.

The operation of the RCIC system can be manually initiated, controlled, and monitored to maintain water level in the reactor pressure vessel. Reactor vessel level can be monitored. Condensate Storage Tank display information is not provided on the remote shutdown panel, but is provided locally at the tank, should the operator desire this information.

The remote shutdown panel provides control for the "B" RHR pump on Unit 1, and the "A" RHR pump on Unit 2. RHR flow indication (0 to 30,000 GPM) is provided on the remote shutdown panel for the appropriate RHR loop. RHR suction for shutdown cooling is taken from the "B" reactor recirculation loop on both units. Control for the "B" reactor recirculation pump suction valve (F023) is provided on the remote shutdown panel on both units. This valve will be closed prior to initiating RHR shutdown cooling. Closing this valve will trip the "B" recirculation pump, thereby protecting both the applicable RHR pump, and the "B" recirculation pump from cavitation. All remaining recirculation suction and discharge valves will remain in an "as-is" position throughout the remote shutdown operation.

Monitoring and control of the RHR service water system and emergency service water system is provided for cooling water to RHR heat exchangers, RHR and RCIC room coolers, and diesel generators. Controls for the containment (drywell) instrument gas supply suction and injection valve make it possible to provide operating gas pressure to the RPV relief valves. Monitoring of containment pressure/temperature, suppression pool level/temperature and suppression chamber temperature is provided by indicators.

3.4.4 System Success Criteria

A. RPS

The RPS uses hindrance logic (normal = 1, trip = 0) in both the input and output logic. Therefore, a channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e. the channel has a fail-safe failure mode). A reactor scram will occur upon loss of control power to the RPS. A reactor scram usually is implemented by the scram circuit breakers which must open in response to a scram signal. Typically, there are two series scram circuit breakers in the power path to the scram rods. In this case, one of two circuit breakers must open. Details of the scram system for Susquehanna have not been determined.

B. ESF

A single component usually receives a signal from only one ESF output train. ESF Trains A and B must be available in order to automatically actuate their respective components. ESF typically uses hindrance input logic (normal = 1, trip = 0) and transmission output logic (normal = 0, trip = 1). In this case, an input channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e. the channel has a fail-safe failure mode). Control power is needed for the ESF output channels to send an actuation signal. Note that there may be some ESF 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 ESF system for Susquehanna have not been determined.

C. Manually-Initiated Protective Actions

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

3.4.5 Support Systems and Interfaces

A. Control Power

1. RPS

a. The reactor protection system (RPS) power supply is a non-Class 1E system. The normal 120 VAC power to each of the two reactor protection systems is supplied, via a separate bus, by its own high inertia motor generator set. The drive motor is supplied from a 480 VAC Class 1E motor control center. High inertia is provided by a flywheel. The inertia is sufficient to maintain voltage and frequency within 5 percent of rated values for at least 1.0 sec following a loss of power to the drive motor.

b. The alternate 120 VAC power for each of the reactor protection systems is supplied by a non-Class 1E motor control center through a 480-120 VAC transformer. A selector switch is provided for the selection of the two power supplies. The switch also prevents paralleling the motor generator set with the alternate supply.

2. Other Actuation and Control Systems

The control power interfaces for the various front-line systems are summarized in Table 3.4-2. This table was developed using information concerning the MCCs and busses used to actuate the motor operated valves and pumps of the front line systems because direct information concerning the control of these valves and pumps was not available.

3. Operator Instrumentation

Operator instrumentation displays are powered from the 480 VAC MCCs, via 120 VAC distribution panels. The 120 VAC vital distribution panel, 1Y629, is powered from 250 VDC bus 1D662 or the 480 VAC MCC 1B246 (see Section 3.5).

Table 3.4-1. Susquehanna 1 Instrumentation and Control Systems Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
EP-PNL-1Y629	PNL	ELECRM	EP-PS-1D666	120	ELECRM	DC/2
EP-PS-1D666	PNL	ELECRM	EP-BS-1D662	250	ELECRM	DC/2
EP-PS-1D666	PNL	ELECRM	EP-MCC-1B246	480	SWGRM4	AC/D

Table 3.4-2. Matrix of Susquehanna 1 Control Power Sources

SYSTEM	125 VDC Division			
	1	2	3	4
RCIC PUMP	■			
RCIC VALVES	■	■	■	■
HPCI PUMP		■		
HPCI VALVES		■	■	
ADS A	■		■	
ADS B		■		■
RHR (LPCI) PUMP A	■			
RHR (LPCI) A VALVES	■		■	
RHR (LPCI) PUMP B		■		
RHR (LPCI) B VALVES		■		■
RHR (LPCI) PUMP C			■	
RHR (LPCI) C VALVES	■		■	
RHR (LPCI) PUMP D				■
RHR (LPCI) D VALVES		■		■
CS PUMP A	■			
CS A VALVES	■		■	
CS PUMP B		■		
CS B VALVES		■		■
CS PUMP C			■	
CS C VALVES	■			
CS PUMP D				■
CS D VALVES		■		■
DIESEL 1 & AUXILIARIES	■			
DIESEL 2 & AUXILIARIES		■		
DIESEL 3 & AUXILIARIES			■	
DIESEL 4 & AUXILIARIES				■
ESW PUMP A	■			
ESW PUMP B		■		
ESW PUMP C			■	
ESW PUMP D				■
RHRSWA			■	
RHRSWB				■

3.5 ELECTRIC POWER SYSTEM

3.5.1 System Function

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

3.5.2 System Definition

The onsite Class 1E electric power system for each unit consists of four independent 4160 VAC trains. In Unit 1, the 4160 VAC trains are denoted 1A201, 1A202, 1A203, and 1A204 and the four independent 480 VAC trains denoted 1B210, 1B220, 1B230, and 1B240. 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. A fifth diesel generator (E-diesel generator) can be aligned to take the place of any of the four primary diesel generators.

The Class 1E 120 VAC instrumentation and control power consists of four independent Class 1E 120 VAC instrumentation and control power supplies which supply the four channels of engineered safety features load groups. The four bus arrangement provides a separate single-phase electric power supply to each of the four protection channels that are electrically and physically isolated from the other protection channels. Each power supply consists of a 480/120 VAC transformer and a distribution panel. The 480 VAC power supply is provided by the corresponding 480 VAC Class 1E motor control center.

There are two non-Class 1E instrument AC power supplies per unit which furnish reliable power to non-Class 1E miscellaneous instrumentation systems. The non-Class 1E instrument AC power supply for each unit consists of two subsystems, each with a regulating transformer, an automatic transfer switch, and a 208/120 VAC distribution panel. Each distribution panel is supplied as an associated circuit from two Class 1E motor control centers. The transfer switch maintains separation between the two Class 1E power supplies, and the redundant breakers act as an isolation system between the Class 1E power supply and the non-Class 1E load. The non-Class 1E vital AC power supplies essential non-Class 1E equipment such as the plant computer. Normally, the 120 VAC panel is supplied by an inverter. The inverter is supplied by a Class 1E 250 VDC bus. If the inverter is unavailable, a transfer to the backup supply is made through the manual bypass switch. The backup supply is a regulating type transformer from a 480 VAC Class 1E motor control center. A transfer switch provides the automatic switch-over in case of inverter failure.

Two Class 1E 250 VDC subsystems are provided for each unit and identified as Divisions I and II. The two subsystems supply the DC power required for larger loads such as DC motor driven pumps and valves, inverters for the plant computer, and the vital 120 VAC power supplies. The Division I 250 VDC subsystem is provided with one 250 VDC battery bank, one load center (1D652), two equal capacity chargers, and motor control centers. The Division II 250 VDC subsystem is provided with one 250 VDC battery bank, one distribution load center (1D662), one battery charger, and motor control center.

Four Class 1E 125 VDC power subsystems are provided for each unit. These four subsystems are identified as channels A, B, C, and D. The buses in these channels are denoted 1D612, 1D622, 1D632, and 1D642 respectively. Each subsystem provides the control power for its associated Class 1E AC power load group channel: 4.16 kV switchgear, 480 V load centers, and standby diesel generator. Also these DC subsystems provide DC power to the engineered safety feature valve actuation, diesel generator auxiliaries, plant alarm and indication circuits, and emergency lighting system. Each 125 VDC subsystem consists of one load center, one Class 1E and one non-Class 1E distribution panel, one 125 VDC battery bank, and one battery charger. The non-Class 1E distribution panel is connected to the Class 1E DC power supply through an isolation system. The battery charger of each system is supplied with 480 VAC Class 1E AC power from the motor control center associated with the same load group channel. One spare 125 VDC battery charger is provided for both generating units.

Simplified one-line diagrams of the electric power system are shown in Figures 3.5-1 to 3.5-10. A summary of data on selected electric power system components is presented in Table 3.5-1. A partial listing of electrical sources and loads is presented in Table 3.5-2.

3.5.3 System Operation

Each Class 1E 4160 VAC bus is provided with a preferred and alternate offsite power supply feeder and one standby diesel generator. The normal power source for buses 1A201 and 1A203 is bus 10 and the normal power source for buses 1A202 and 1A204 is bus 20. Details of the station electric power system are shown in Figures 3.5-1 and 3.5-2. The connection of the E-diesel generator to the station electric power system is not shown in Figures 3.5-1 and 3.5-2, however, it is known that the E-diesel generator can be aligned to back up any of the four primary diesel generators and to provide power to 13.2 kV startup bus 10.

The four standby diesel generators are started upon loss of offsite power at the 4.16 kV bus, or a safety injection signal, or manual actuation, either locally or in the control room. Diesel generators 501A, B, C, and D are connected to the 4160 VAC safeguard buses 1A201, 1A202, 1A203, and 1A204, 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 3.5-3 to 3.5-4.

The Class 1E 120 VAC system consists of four independent divisions. Each division consists of a 480/120 VAC transformer and a distribution panel. There are two non-Class 1E AC power supplies also, consisting of an automatic transfer switch and two distribution panels each. Vital AC power consists of the vital distribution panel, an uninterruptible power supply, an inverter, and a transformer. Details of the 120 VAC system are shown in Figures 3.5-5 and 3.5-6.

The Class 1E 250 VDC system consists of two independent divisions. Each division is comprised of a 250 V bank of batteries and Division I has two chargers while Division II has one charger. Each battery bank will supply its loads for 4 hours without recharging. Motor control center 1D254 in Division I supplies power to the RCIC valves and motor control centers 1D264 and 1D274 supply power to the HPCI valves. Details of the 250 VDC system are shown in Figures 3.5-7 and 3.5-8.

The Class 1E 125 VDC system consists of four independent divisions. Each division is comprised of a 125 VDC bank of batteries and a battery charger. Each battery bank will supply its loads for 4 hours without recharging. Details of the 125 VDC system are shown in Figures 3.5-9 and 3.5-10.

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." Load group "AC/A" contains components receiving electric power either directly of indirectly from 4160 bus 1A201. Load group "AC/B" contains components powered either directly or indirectly from 4160 bus 1A202. Load group "AC/C" contains components powered either directly or indirectly from 4160 bus 1A203. Load group "AC/D" contains components powered either directly or indirectly from 4160 bus 1A204. Components receiving 125 VDC pow are assigned to load groups "A," "B," "C," or "D," based on the MCC providing power to the associated battery charger. Components receiving 250 VDC power are assigned to load groups "I" if they receive power from 250 VDC bus 1D652 and load group "II" if they receive power from 250 VDC bus 1D662.

3.5.4 System Success Criteria

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

- Each Class 1E DC load group is supplied initially from its respective battery (also needed for starting diesels A to D)
- 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 A to D) or the E-diesel generator is aligned to supply power to a load group served by a diesel generator that has failed.
- Power distribution paths to essential loads are intact
- Power to the battery chargers is restored before the station batteries are exhausted

3.5.5 Component Information

A. Standby diesel generators 501A, 501B, 501C, 501D
   1. Continuous power rating: 4000 kW
   2. Rated voltage: 4160 VAC
   3. Manufacturer: unknown

B. E-diesel generator: No details available

C. 250 VDC station batteries 1D650, 1D660
   1. Type: lead-calcium
   2. Rated voltage: 250 VDC
   3. Design capacity: 4 hours minimum with design loads

D. 125 VDC station batteries 1D610, 1D620, 1D630, 1D640
   1. Type: lead-calcium
   2. Rated voltage: 250 VDC
   3. Design capacity: 4 hours minimum with design loads

3.5.6 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 on either unit or on a Safety Injection Signal. During emergency situations, the diesel generators are tripped under conditions of engine overspeed, low lube oil pressure, or generator differential.
   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 A, B, C, and D Auxiliary Systems
   The following auxiliaries are provided for emergency diesel generators A to D.
   - Cooling
     The emergency service water system (see Section 3.7) provides for diesel cooling.
   - Fueling
     An independent 550 gallon day tank with enough fuel for two hours of operation is provided for each diesel. 50,000 gallon long-term fuel tanks with enough fuel for 7 days of operation are located underground adjacent to the diesel generator rooms.
   - Lubrication
     Each diesel generator has a self-contained lubrication system.
   - Starting
     An independent starting air accumulator is provided for each diesel generator.
   - Control power
     Each diesel generator is dependent on 125 VDC power from a station battery for control power.
   - Diesel room ventilation fans provide room cooling during diesel operation.

C. Diesel Generator E Auxiliary Systems
   - Cooling
     The emergency service water system provides for diesel cooling, however, details on the interface with the ESW system have not been determined.
   - Control power
     A separate battery and DC power system provides control power (i.e. not dependent on station batteries for starting)
   - Other auxiliaries systems for Diesel Generator E
     Details have not been determined, however, it appears that independent fueling, lubrication, starting, and room ventilation systems have been provided.

D. Switchgear and Battery Room Ventilation
   Ventilation capabilities for the essential switchgear rooms and battery rooms could not be determined.

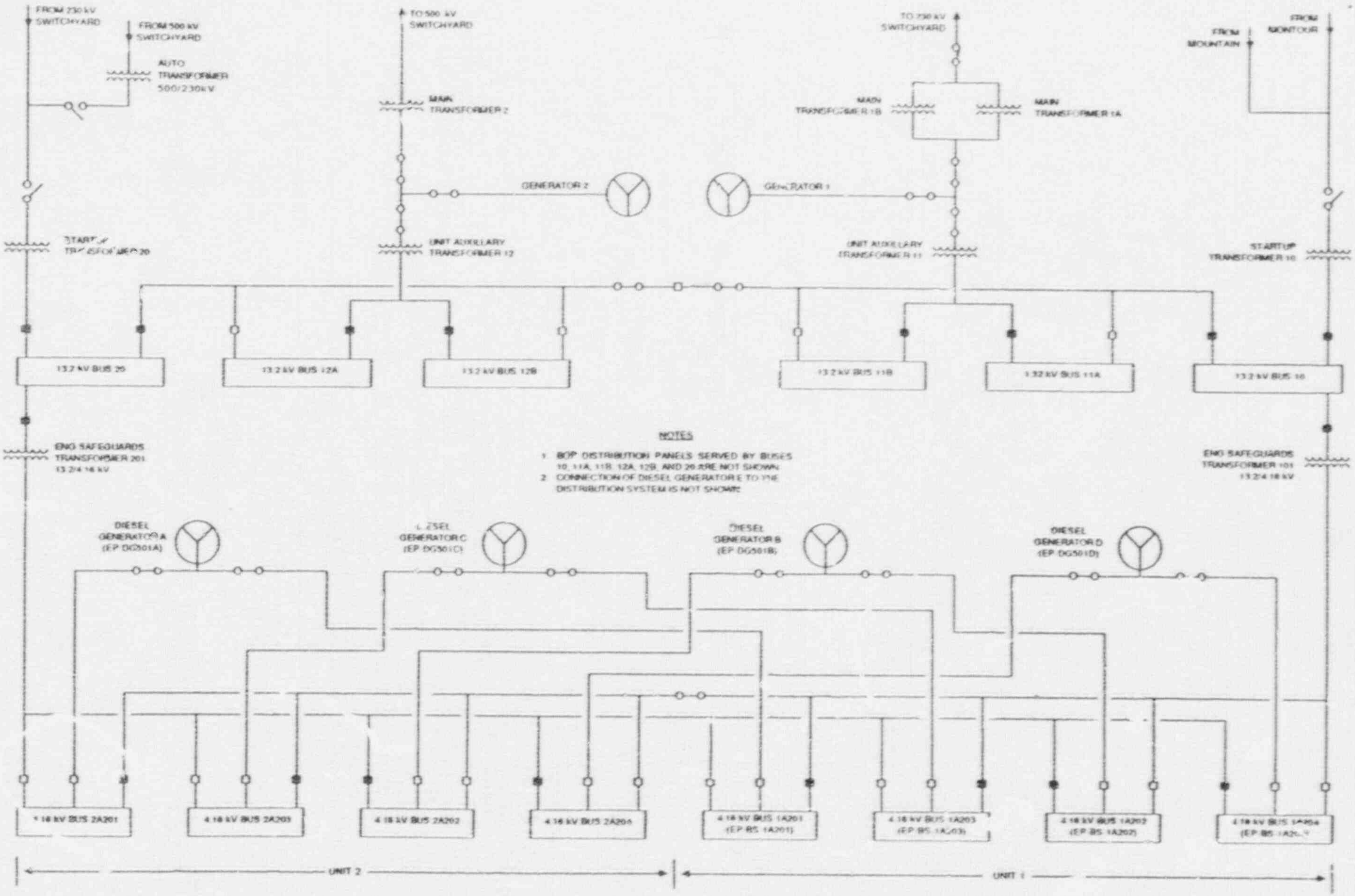


Figure 3.5-1. Susquehanna 1 and 2 4160 VAC Electric Power Distribution System

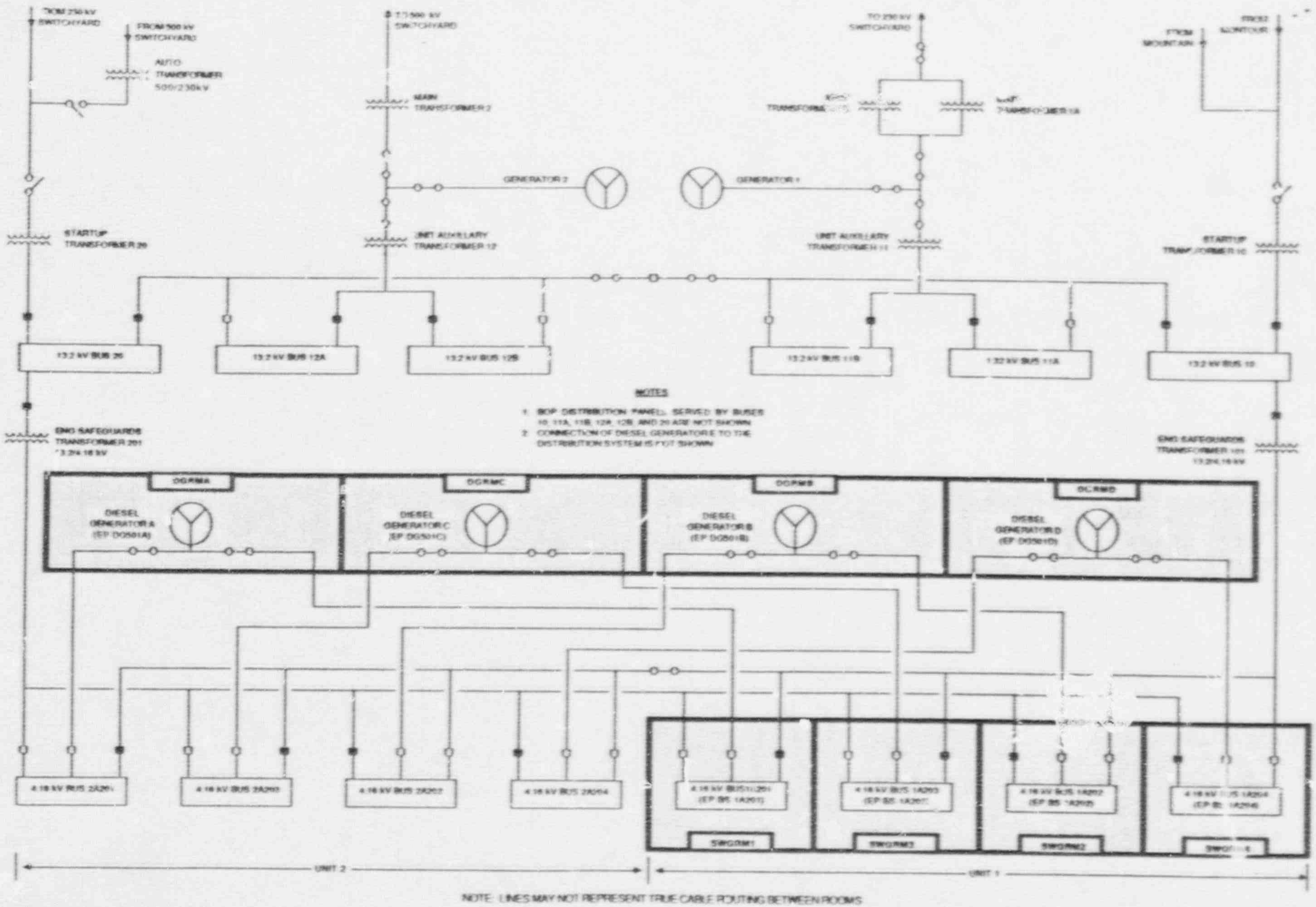


Figure 3.5-2. Susquehanna 1 and 2 4160 VAC Electric Power Distribution System Showing Component Locations

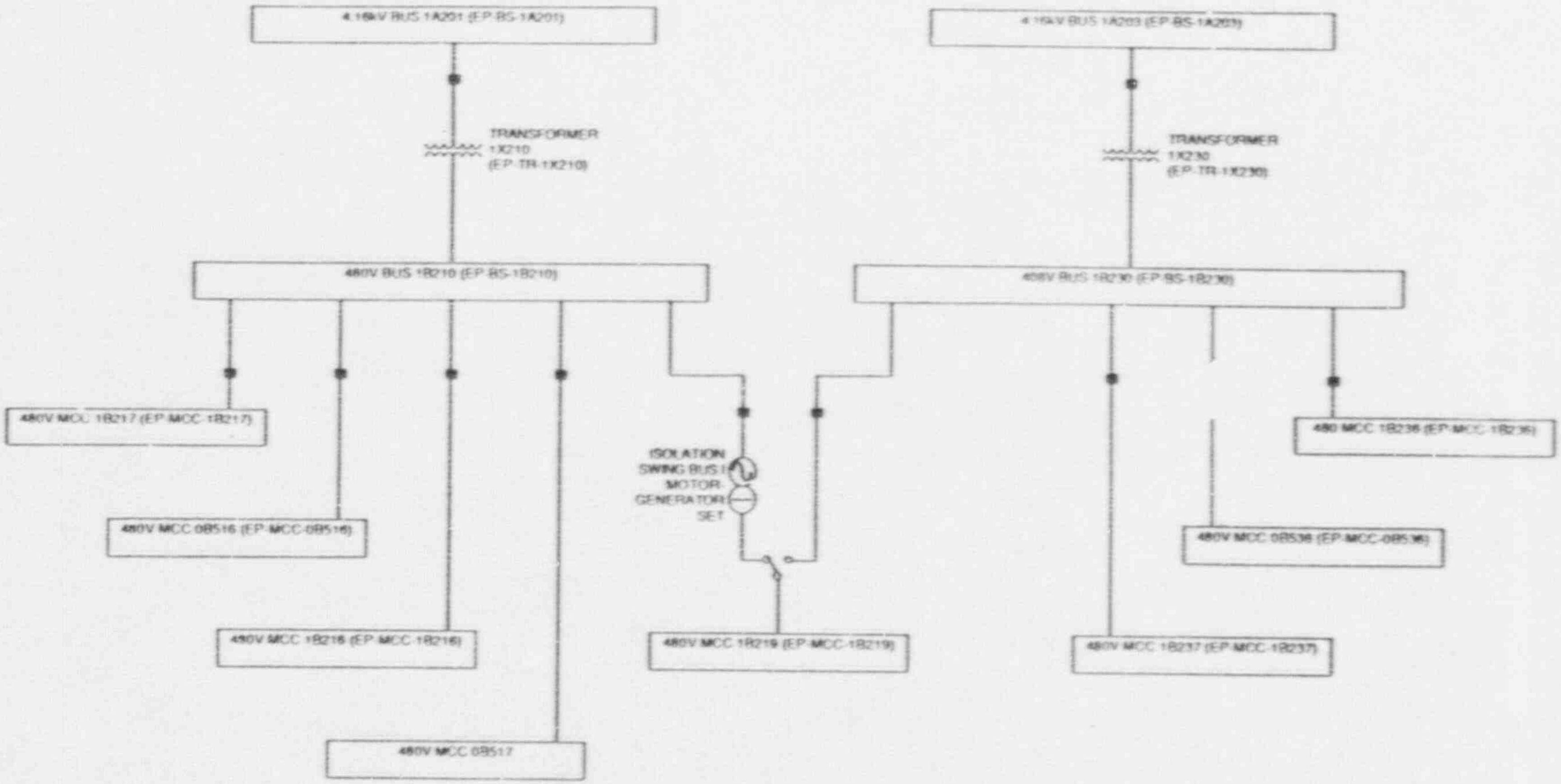


Figure 3.5-3. Susquehanna 1 480 VAC Electric Power Distribution System
(Sheet 1 of 2)

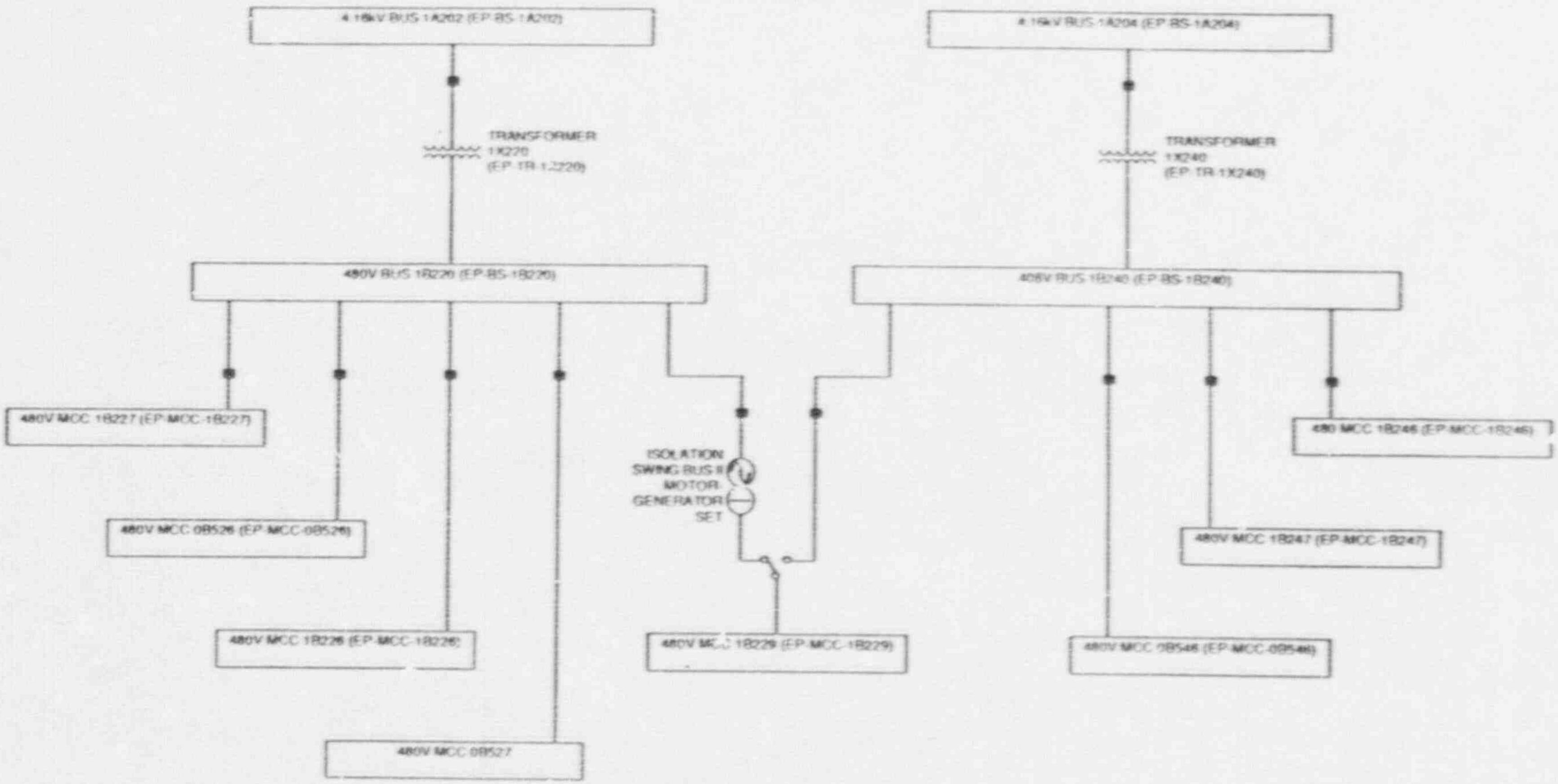
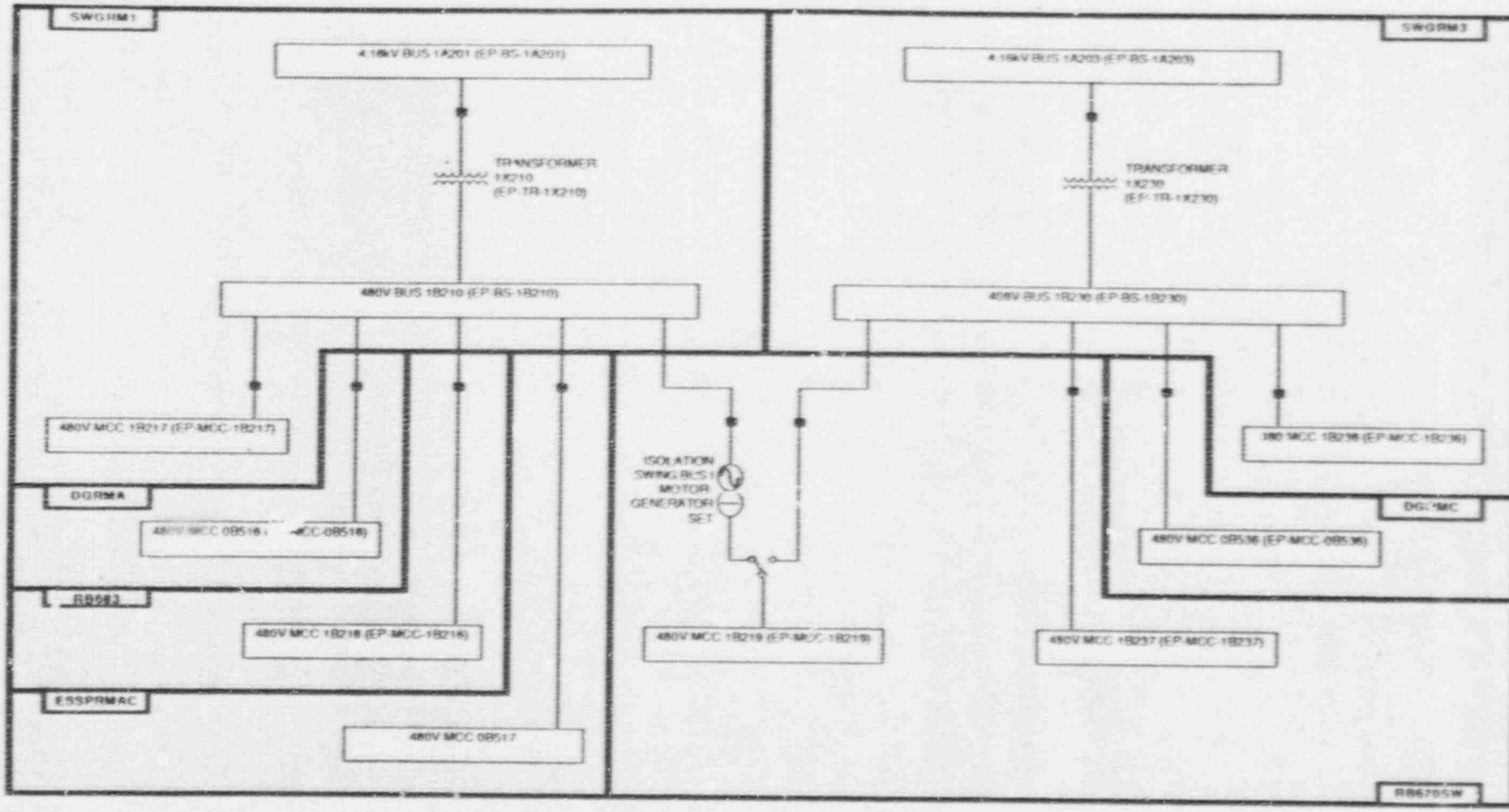
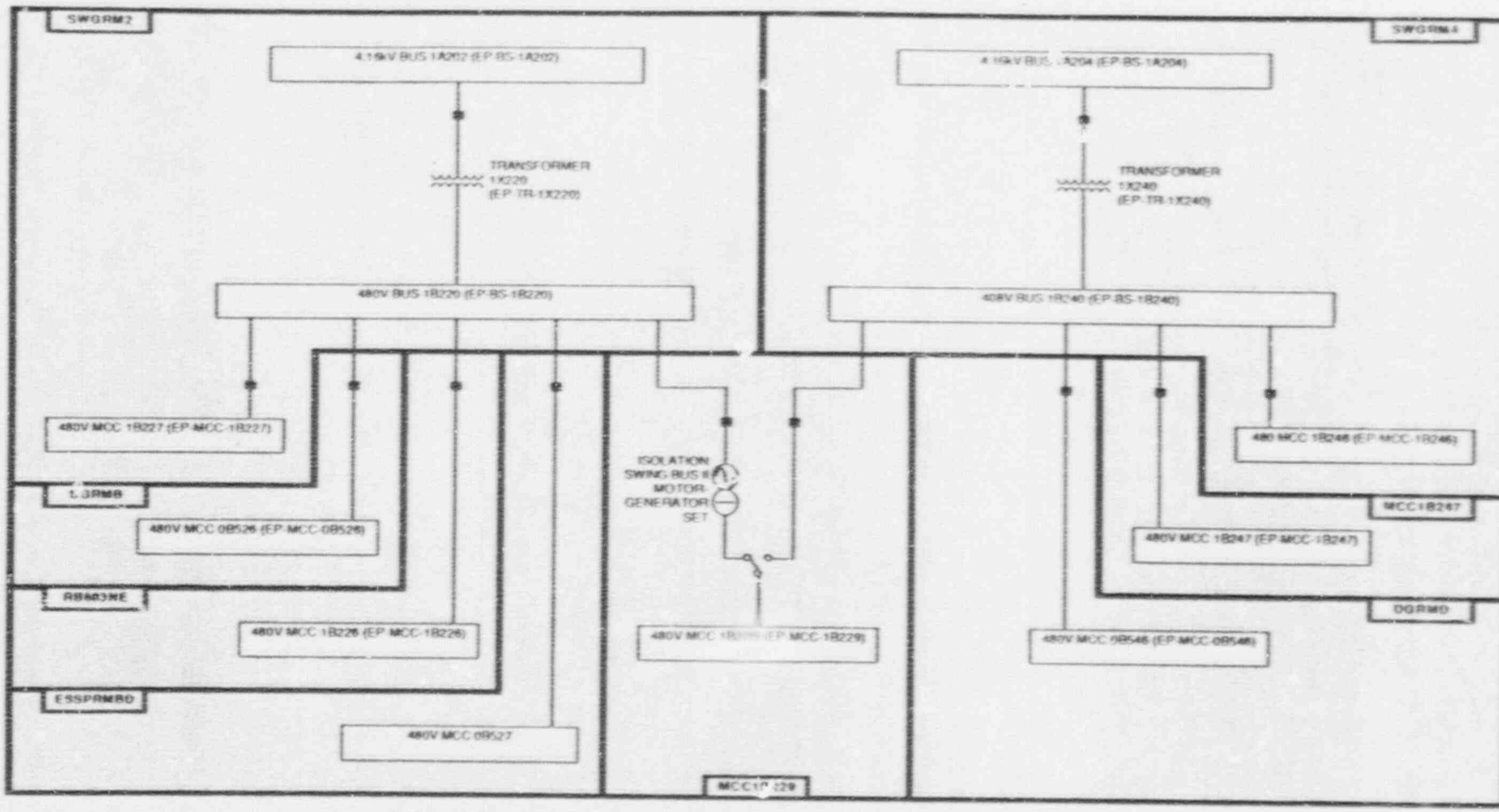


Figure 3.5-3 Susquehanna 1 480 VAC Electric Power Distribution System
(Sheet 2 of 2)



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-4. Susquehanna 1 430 VAC Electric Power Distribution System Showing Component Locations (Sheet 1 of 2)



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-4. Susquehanna 1 480 VAC Electric Power Distribution System Showing Component Locations (Sheet 2 of 2)

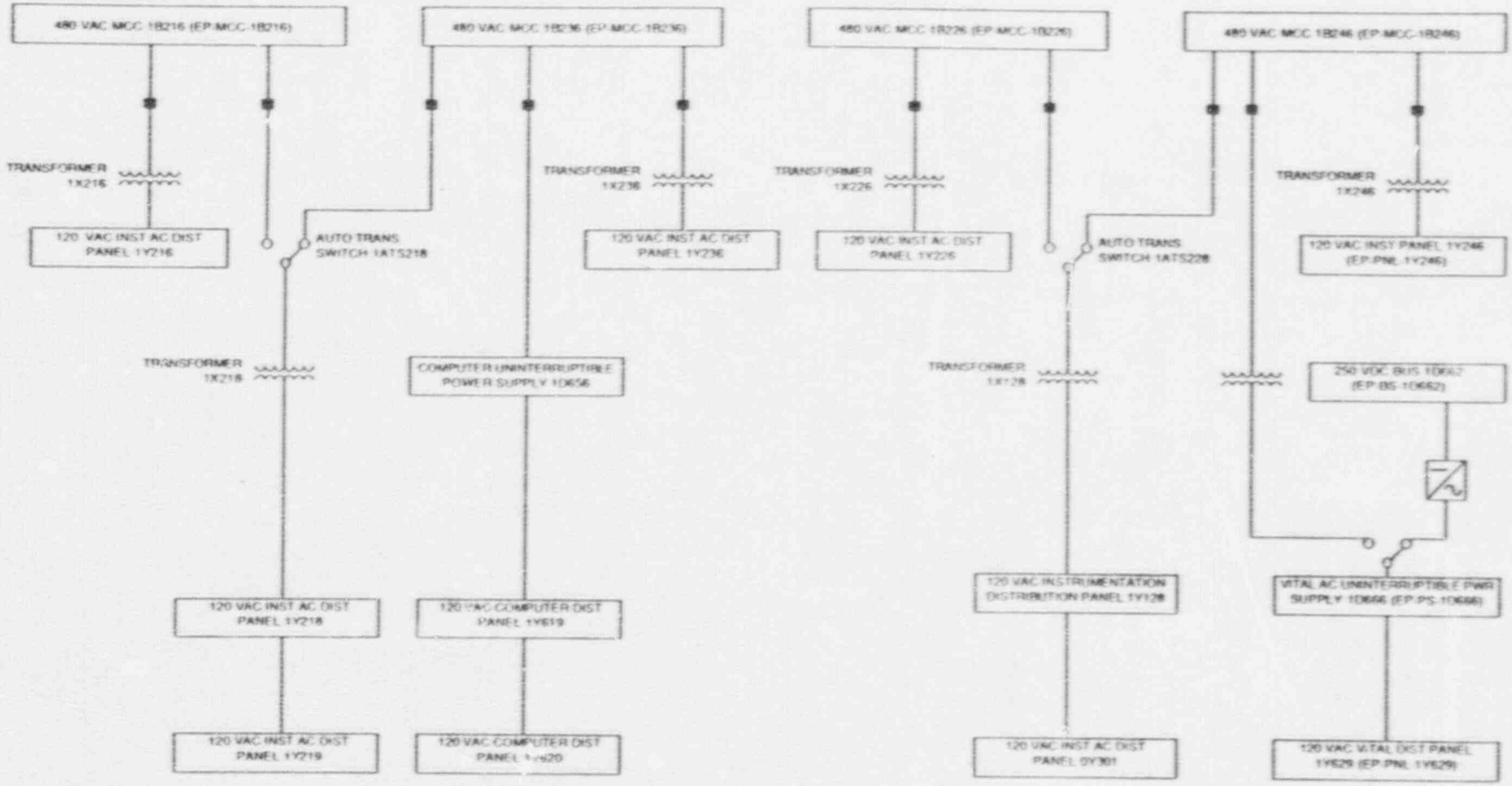
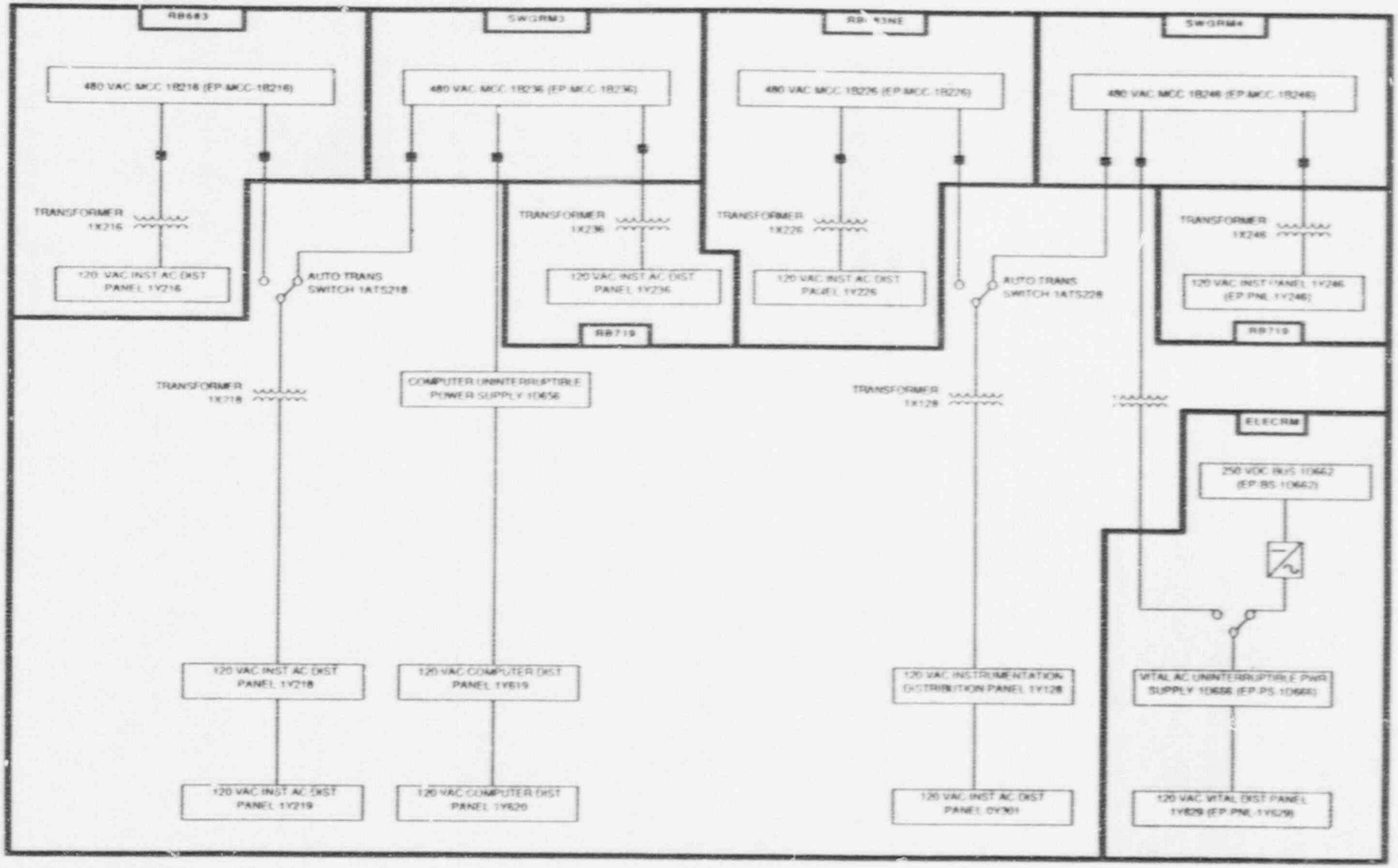


Figure 3.5-5. Susquehanna 1 120 VAC Instrumentation Power



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-6. Susquehanna 1 120 VAC Instrumentation Power Showing Component Locations

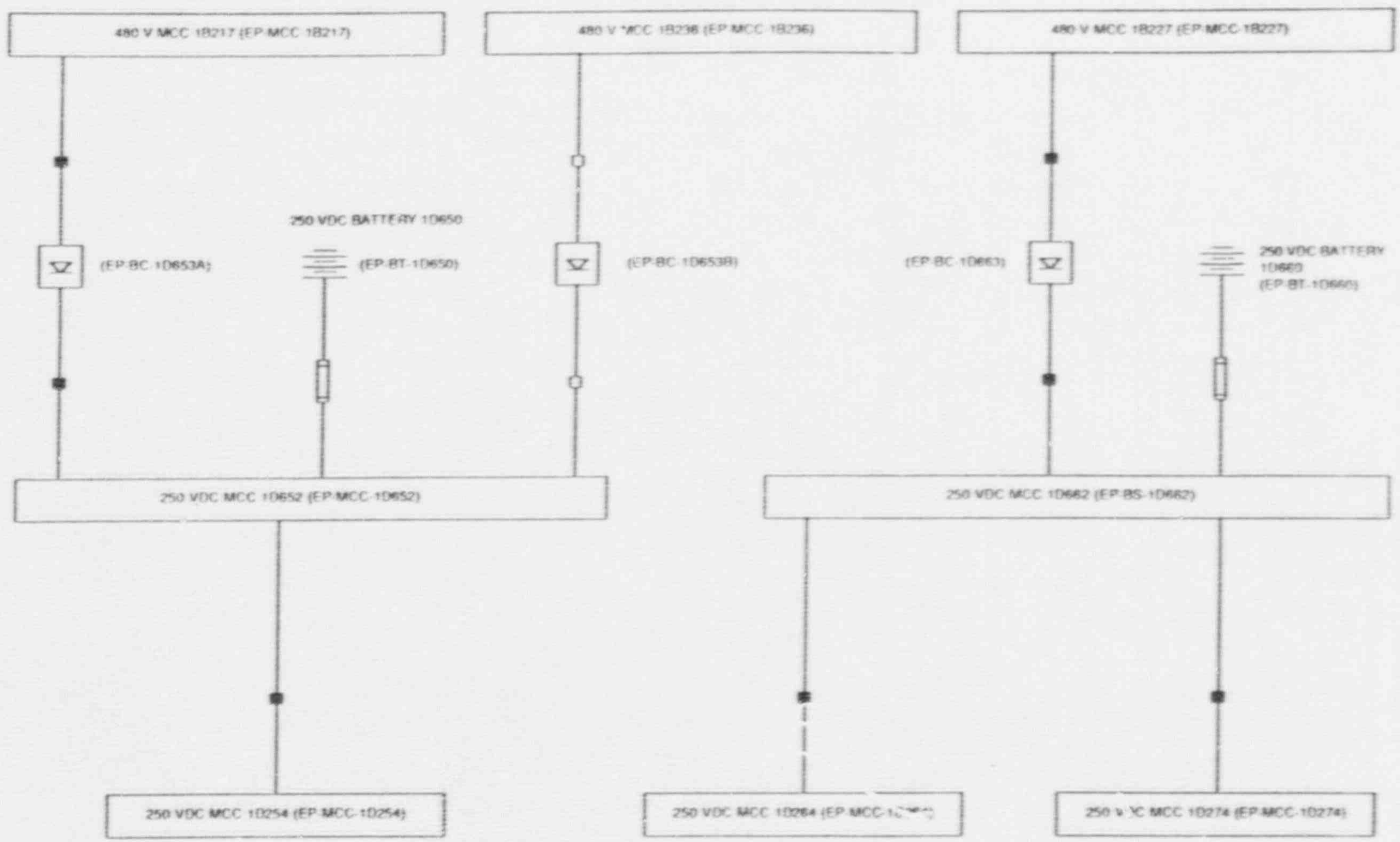
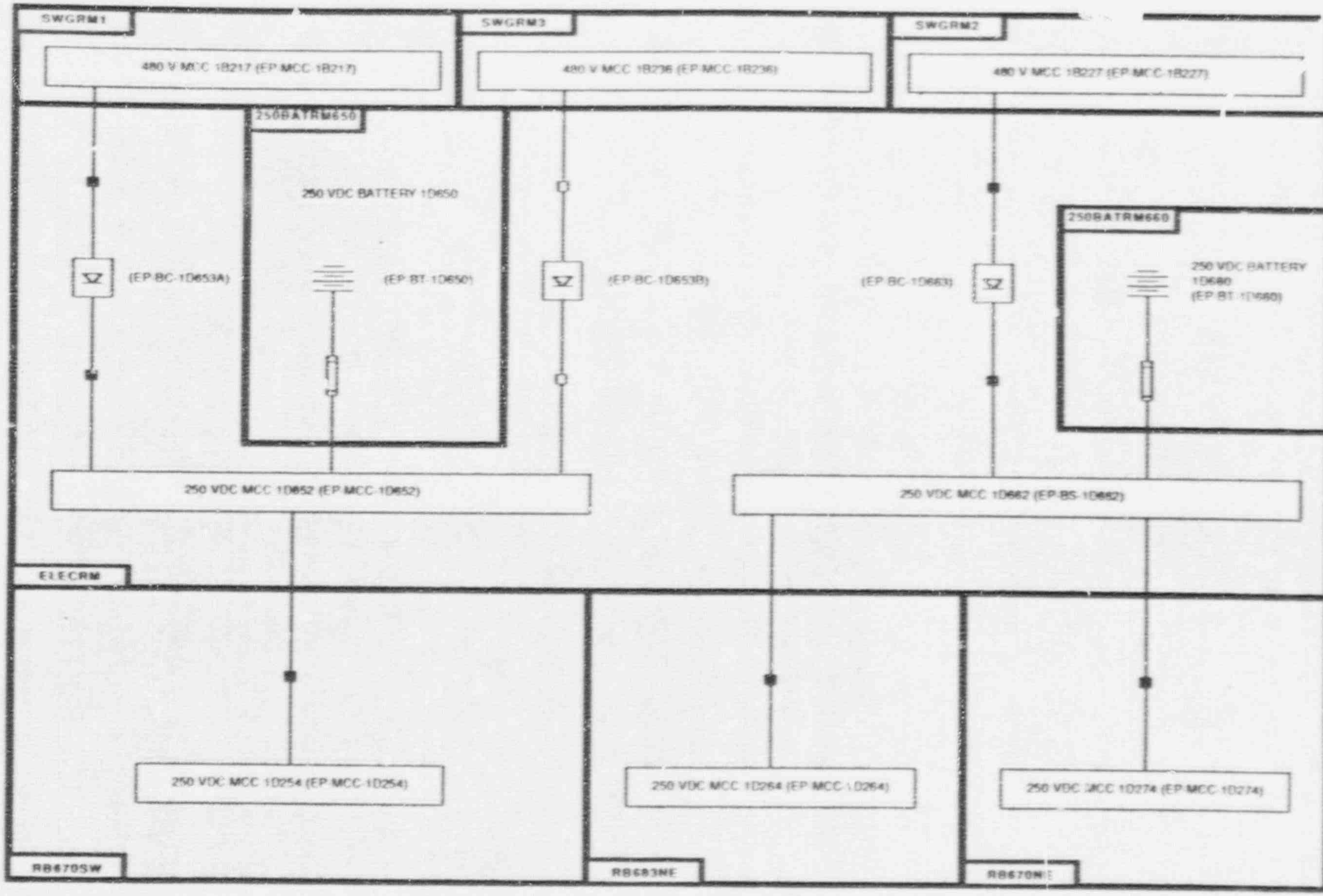


Figure 3.5-7. Susquehanna 1 250 VDC Electric Power Distribution System



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-8. Susquehanna 1 250 VDC Electric Power Distribution System Showing Component Locations

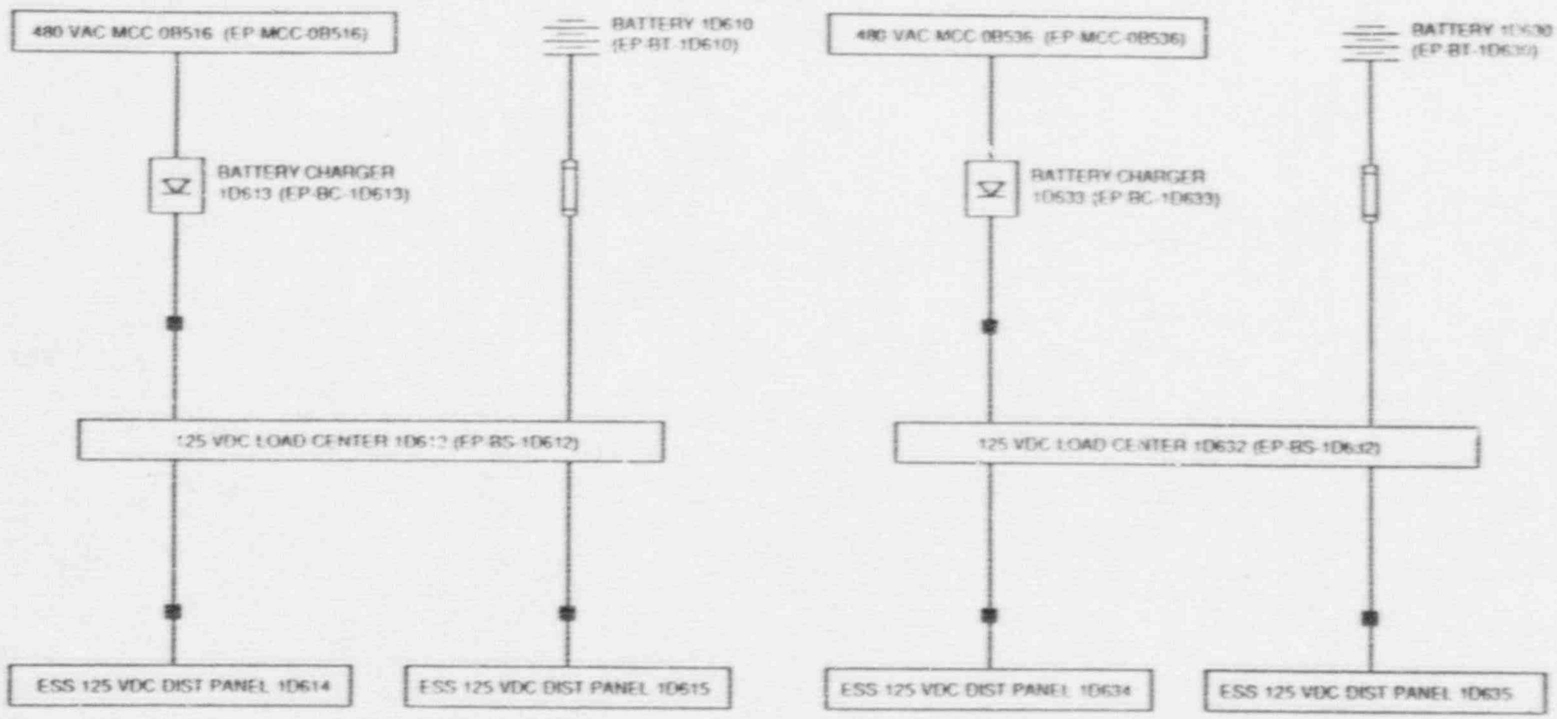


Figure 3.5-9. Susquehanna 1 125 VDC Electric Power Distribution System
(Sheet 1 of 2)

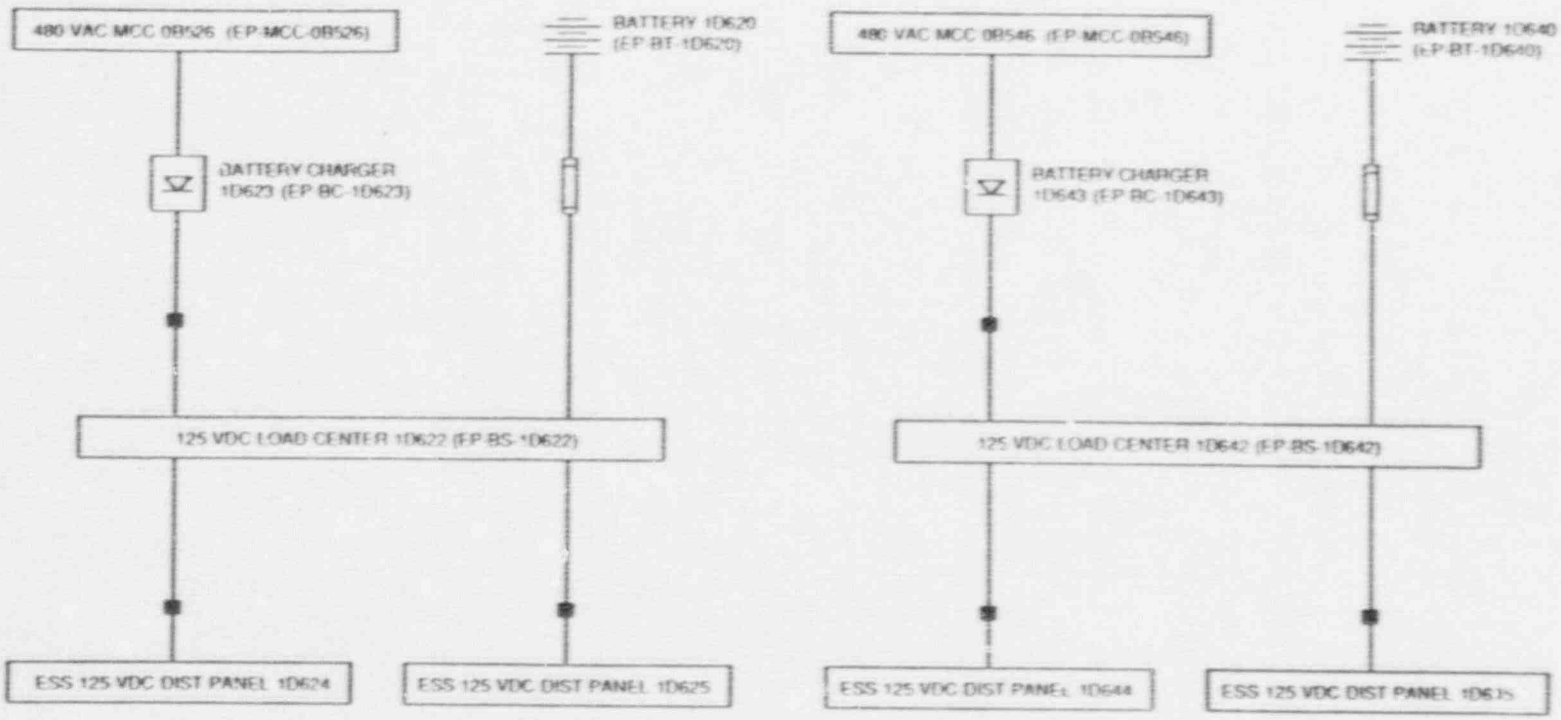
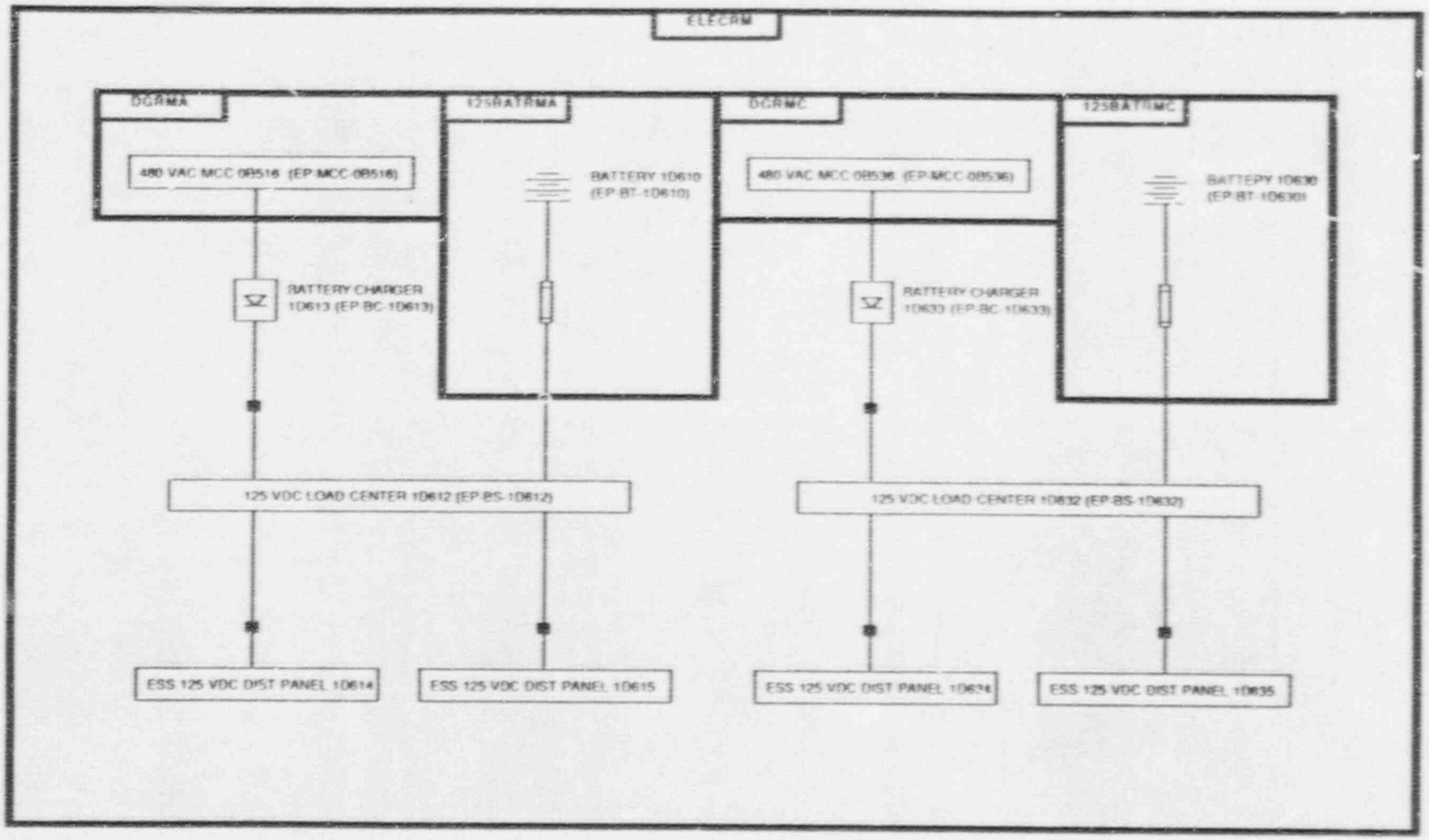
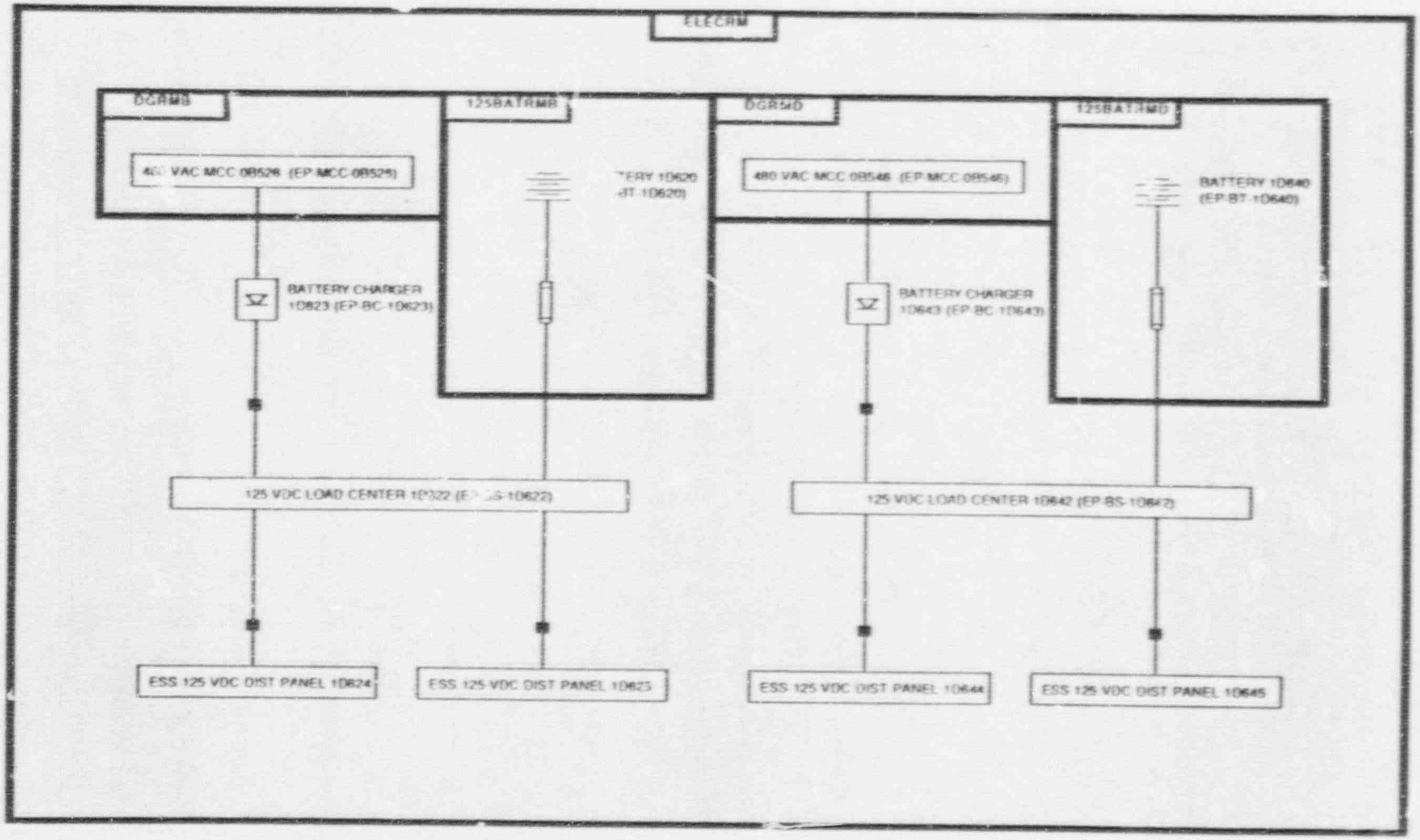


Figure 3.5-9. Susquehanna 1 125 VDC Electric Power Distribution System (Sheet 2 of 2)



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-10. Susquehanna 1 125 VDC Electric Power Distribution System Showing Component Locations (Sheet 1 of 2)



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure 3.5-10. Susquehanna 1 125 VDC Electric Power Distribution System Showing Component Locations (Sheet 2 of 2)

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
CB-C1A201	CB	SWGRM1	EP-DG501A	4160	DGRMA	AC/A
CB-C1A202	CB	SWGRM2	EP-DG501B	4160	DGRMB	AC/B
CB-C1A203	CB	SWGRM3	EP-DG501C	4160	DGRMC	AC/C
CB-C1A204	CB	SWGRM4	EP-DG501D	4160	DGRMD	AC/D
EP-BC-1D613	BC	ELECRM	EP-MCC-0B516	125	DGRMA	AC/A
EP-BC-1D623	BC	ELECRM	EP-MCC-0B526	125	DGRMB	DC/B
EP-BC-1D633	BC	ELECRM	EP-MCC-0B536	125	DGRMC	DC/C
EP-BC-1D643	BC	ELECRM	EP-MCC-0B546	125	DGRMD	DC/D
EP-BC-1D653A	BC	ELECRM	EP-MCC-1B217	250	SWGRM1	DC/1
EP-BC-1D653B	BC	ELECRM	EP-MCC-1B236	250	SWGRM3	DC/1
EP-BC-1D663	BC	ELECRM	EP-MCC-1B227	250	SWGRM2	DC/2
EP-BS-1A201	BS	SWGRM1	EP-DG501A	4160	DGRMA	AC/A
EP-BS-1A202	BS	SWGRM2	EP-DG501B	4160	DGRMB	AC/B
EP-BS-1A203	BS	SWGRM3	EP-DG501C	4160	DGRMC	AC/C
EP-BS-1A204	BS	SWGRM4	EP-DG501D	4160	DGRMD	AC/D
EP-BS-1B210	BS	SWGRM1	EP-TR-1X210	480	SWGRM1	AC/A
EP-BS-1B220	BS	SWGRM2	EP-TR-1X220	480	SWGRM2	AC/B
EP-BS-1B230	BS	SWGRM3	EP-TR-1X230	480	SWGRM3	AC/C
EP-BS-1B240	BS	SWGRM4	EP-TR-1X240	480	SWGRM4	AC/D
EP-BS-1D612	BS	ELECRM	EP-BC-1D613	125	ELECRM	DC/A
EP-BS-1D622	BS	ELECRM	EP-BC-1D623	125	ELECRM	DC/B
EP-BS-1D632	BS	ELECRM	EP-BC-1D633	125	ELECRM	DC/C
EP-BS-1D642	BS	ELECRM	EP-BC-1D643	125	ELECRM	DC/D
EP-BS-1D652	BS	ELECRM	EP-BC-1D653A	250	ELECRM	DC/1
EP-BS-1D652	BS	ELECRM	EP-BC-1D653B	250	ELECRM	DC/1
EP-BS-1D652	BS	ELECRM	EP-BC-1D653B	250	ELECRM	DC/1
EP-BS-1D662	BS	ELECRM	EP-BC-1D663	250	ELECRM	DC/2

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
EP-BT-1A	BATT	125BATRMA	EP-BS-1D612	125	ELECRM	DC/A
EP-BT-1B	BATT	125BATRMB	EP-BS-1D622	125	ELECRM	DC/B
EP-BT-1C	BATT	125BATRMC	EP-BS-1D632	125	ELECRM	DC/C
EP-BT-1D	BATT	125BATRMD	EP-BS-1D642	125	ELECRM	DC/D
EP-DG-501A	DG	DGRMA				AC/A
EP-DG-501B	DG	DGRMB				AC/B
EP-DG-501C	DG	DGRMC				AC/C
EP-DG-501D	DG	DGRMD				AC/D
EP-MCC-0B516	MCC	DGRMA	EP-BS-1B210	480	SWGRM1	AC/A
EP-MCC-0B517	MCC	ESSPRMAC	EP-BS-1B210	480	SWGRM1	AC/A
EP-MCC-0B526	MCC	DGRMB	EP-BS-1B220	480	SWGRM2	AC/B
EP-MCC-0B527	MCC	ESSPRMBD	EP-BS-1B220	480	SWGRM2	AC/B
EP-MCC-0B536	MCC	DGRMC	EP-BS-1B230	480	SWGRM3	AC/C
EP-MCC-0B546	MCC	DGRMD	EP-BS-1B240	480	SWGRM4	AC/D
EP-MCC-1B216	MCC	RB683	EP-BS-1B210	480	SWGRM1	AC/A
EP-MCC-1B217	MCC	SWGRM1	EP-BS-1B210	480	SWGRM1	AC/A
EP-MCC-1B219	MCC	RB670SW	EP-BS-1B210	480	SWGRM1	AC/A
EP-MCC-1B219	MCC	RB670SW	EP-BS-1B230	480	SWGRM3	AC/C
EP-MCC-1B226	MCC	RB683NE	EP-BS-1B220	480	SWGRM2	AC/B
EP-MCC-1B227	MCC	SWGRM2	EP-BS-1B220	480	SWGRM2	AC/B
EP-MCC-1B229	MCC	MCC1B229	EP-BS-1B220	480	SWGRM2	AC/B
EP-MCC-1B229	MCC	MCC1B229	EP-BS-1B240	480	SWGRM4	AC/D
EP-MCC-1B236	MCC	SWGRM3	EP-BS-1B230	480	SWGRM3	AC/C
EP-MCC-1B237	MCC	RB670SW	EP-BS-1B220	480	SWGRM3	AC/C
EP-MCC-1B246	MCC	SWGRM4	EP-BS-1B240	480	SWGRM4	AC/D
EP-MCC-1B247	MCC	MCC1B247	EP-BS-1B240	480	SWGRM4	AC/D
EP-MCC-1D254	MCC	RB670SW	EP-BS-1D652	250	ELECRM	DC/1

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

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
EP-MCC-1D264	MCC	RB683NE	EP-BS-1D662	250	ELECRM	DC/2
EP-MCC-1D274	MCC	RB670NE	EP-BS-1D274	250	ELECRM	DC/2
EP-TR-1X210	TR	SWGRM1	EP-BS-1A201	480	SWGRM1	AC/A
EP-TR-1X220	TR	SWGRM2	EP-BS-1A202	480	SWGRM2	AC/B
EP-TR-1X230	TR	SWGRM3	EP-BS-1A203	480	SWGRM3	AC/C
EP-TR-1X240	TR	SWGRM4	EP-BS-1A204	480	SWGRM4	AC/D

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Susquehanna 1

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-BC-1D613	125	DC/A	ELECRM	EP	EP-BS-1D612	BS	ELECRM
EP-BC-1D623	125	DC/B	ELECRM	EP	EP-BS-1D622	BS	ELECRM
EP-BC-1D633	125	DC/C	ELECRM	EP	EP-BS-1D632	BS	ELECRM
EP-BC-1D643	125	DC/D	ELECRM	EP	EP-BS-1D642	BS	ELECRM
EP-BC-1D653A	250	DC/1	ELECRM	EP	EP-BS-1D652	BS	ELECRM
EP-BC-1D653B	250	DC/1	ELECRM	EP	EP-BS-1D652	BS	ELECRM
EP-BC-1D653B	250	DC/1	ELECRM	EP	EP-BS-1D652	BS	ELECRM
EP-BC-1D663	250	DC/2	ELECRM	EP	EP-BS-1D662	BS	ELECRM
EP-BS-0B516	480	AC/A	DGRMA	ESW	ESW-1112A	MOV	DGRMA
EP-BS-0B516	480	AC/A	DGRMA	ESW	ESW-1122A	MOV	DGRMA
EP-BS-0B517	480	AC/A	ESSPRMAC	ESW	ESW-1224A1	MOV	ESWAMOV
EP-BS-0B517	480	AC/A	ESSPRMAC	ESW	ESW-1224A2	MOV	ESWAMOV
EP-BS-0B517	480	AC/A	ESSPRMAC	ESW	ESW-21224A2	MOV	ESWAMOV
EP-BS-0B526	480	AC/B	DGRMB	ESW	ESW-1110B	MOV	DGRMB
EP-BS-0B526	480	AC/B	DGRMB	ESW	ESW-1120B	MOV	DGRMB
EP-BS-0B527	480	AC/B	ESSPRMBD	ESW		MOV	ESWBMOV
EP-BS-0B527	480	AC/B	ESSPRMBD	ESW	ESW-1224B2	MOV	ESWBMOV
EP-BS-0B527	480	AC/B	ESSPRMBD	ESW	ESW-F1223B	MOV	ESWBMOV
EP-BS-0B536	480	AC/C	DGRMC	ESW	ESW-1112C	MOV	DGRMC
EP-BS-0B536	480	AC/C	DGRMC	ESW	ESW-1122C	MOV	DGRMC
EP-BS-0B546	480	AC/D	DGRMD	ESW	ESW-1110D	MOV	DGRMD
EP-BS-0B546	480	AC/D	DGRMD	ESW	ESW-1120D	MOV	DGRMD
EP-BS-1A201	4160	AC/A	SWGRM1	ECCS	CS-P1A	MDP	CSPRMAC
EP-BS-1A201	4160	AC/A	SWGRM1	ECCS	RHR-P1A	MDP	RHRAC
EP-BS-1A201	480	AC/A	SWGRM1	EP	EP-TR-1X210	TR	SWGRM1
EP-BS-1A201	4160	AC/A	SWGRM1	ESW	ESW-PA	MDP	ESSPRMAC
EP-BS-1A202	4160	AC/B	SWGRM2	ECCS	CS-P1B	MDP	CSPRMBD
EP-BS-1A202	4160	AC/B	SWGRM2	ECCS	RHR-P1B	MDP	RHRBD
EP-BS-1A202	480	AC/B	SWGRM2	EP	EP-TR-1X220	TR	SWGRM2
EP-BS-1A202	4160	AC/B	SWGRM2	ESW	ESW-PB	MDP	ESSPRMBD
EP-BS-1A203	4160	AC/C	SWGRM3	ECCS	CS-P1C	MDP	CSPRMAC

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Susquehanna 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-BS-1A203	4160	AC/C	SWGRM3	ECCS	RHR-P1C	MDP	RHRAC
EP-BS-1A203	480	AC/C	SWGRM3	EP	EP-TR-1X230	TR	SWGRM3
EP-BS-1A203	4160	AC/C	SWGRM3	ESW	ESW-PC	MDP	ESSPRMAC
EP-BS-1A203	4160	AC/C	SWGRM3	RHRSW	RHRSW-P1A	MDP	ESSPRMAC
EP-BS-1A204	4160	AC/D	SWGRM4	ECCS	CS-P1D	MDP	CSPRMBD
EP-BS-1A20[illegible]	[illegible]160	AC/D	SWGRM4	ECCS	RHR-P1D	MDP	RHRBD
EP-BS-1A204	480	AC/D	SWGRM4	EP	EP-TR-1X240	TR	SWGRM4
EP-BS-1A204	4160	AC/D	SWGRM4	ESW	ESW-PD	MDP	ESSPRMBD
EP-BS-1A204	4160	AC/D	SWGRM4	RHRSW	RHRSW-P1B	MDP	ESSPRMBD
EP-BS-1B210	480	AC/A	SWGRM1	EP	EP-MCC-0B516	MCC	DGRMA
EP-BS-1B210	480	AC/A	SWGRM1	EP	EP-MCC-0B517	MCC	ESSPRMAC
EP-BS-1B210	480	AC/A	SWGRM1	EP	EP-MCC-1B216	MCC	RB683
EP-BS-1B210	480	AC/A	SWGRM1	EP	EP-MCC-1B217	MCC	SWGRM1
EP-BS-1B210	480	AC/A	SWGRM1	EP	EP-MCC-1B219	MCC	RB670SW
EP-BS-1B220	480	AC/B	SWGRM2	EP	EP-MCC-0B526	MCC	DGRMB
EP-BS-1B220	480	AC/B	SWGRM2	EP	EP-MCC-0B527	MCC	ESSPRMBD
EP-BS-1B220	480	AC/B	SWGRM2	EP	EP-MCC-1B226	MCC	RB683NE
EP-BS-1B220	480	AC/B	SWGRM2	EP	EP-MCC-1B227	MCC	SWGRM2
EP-BS-1B220	480	AC/B	SWGRM2	EP	EP-MCC-1B229	MCC	MCC1B229
EP-BS-1B220	480	AC/C	SWGRM3	EP	EP-MCC-1B237	MCC	RB670SW
EP-BS-1B230	480	AC/C	SWGRM3	EP	EP-MCC-0B536	MCC	DGRMC
EP-BS-1B230	480	AC/C	SWGRM3	EP	EP-MCC-1B219	MCC	RB670SW
EP-BS-1B230	480	AC/C	SWGRM3	EP	EP-MCC-1B236	MCC	SWGRM3
EP-BS-1B240	480	AC/D	SWGRM4	EP	EP-MCC-0B546	MCC	DGRMD
EP-BS-1B240	480	AC/D	SWGRM4	EP	EP-MCC-1B229	MCC	MCC1B229
EP-BS-1B240	480	AC/D	SWGRM4	EP	EP-MCC-1B246	MCC	SWGRM4
EP-BS-1B240	480	AC/D	SWGRM4	EP	EP-MCC-1B247	MCC	MCC1B247
EP-BS-1D274	250	DC/2	ELECRM	EP	EP-MCC-1D274	MCC	RB670NE
EP-BS-1D612	125	DC/A	ELECRM	ECCS		SRV	RC
EP-BS-1D612	125	DC/A	ELECRM	EP	EP-BT-1A	BATT	125BATRMA
EP-BS-1D612	125	DC/A	ELECRM	RCS		SRV	RC

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Susquehanna 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-BS-1D622	125	DC/B	ELECRM	ECCS		SRV	RC
EP-BS-1D622	125	DC/B	ELECRM	EP	EP-BT-1B	BATT	125BATRMB
EP-BS-1D622	125	DC/B	ELECRM	RCS		SRV	RC
EP-BS-1D632	125	DC/C	ELECRM	ECCS		SRV	RC
EP-BS-1D632	125	DC/C	ELECRM	EP	EP-BT-1C	BATT	125BATRMC
EP-BS-1D632	125	DC/C	ELECRM	RCS		SRV	RC
EP-BS-1D642	125	DC/D	ELECRM	ECCS		SRV	RC
EP-BS-1D642	125	DC/D	ELECRM	EP	EP-BT-1D	BATT	125BATRMD
EP-BS-1D642	125	DC/D	ELECRM	RCS		SRV	RC
EP-BS-1D652	250	DC/1	ELECRM	EP	EP-MCC-1D25 4	MCC	RB670SW
EP-BS-1D662	250	DC/2	ELECRM	EP	EP-MCC-1D26 4	MCC	RB683NE
EP-BS-1D662	250	DC/2	ELECRM	I&C	EP-PS-1D666	PNL	ELECRM
EP-DG501A	4160	AC/A	DGRMA	EP	CB-C1A201	CB	SWGRM1
EP-DG501A	4160	AC/A	DGRMA	EP	EP-BS-1A201	BS	SWGRM1
EP-DG501B	4160	AC/B	DGRMB	EP	CB-C1A202	CB	SWGRM2
EP-DG501B	4160	AC/B	DGRMB	EP	EP-BS-1A202	BS	SWGRM2
EP-DG501C	4160	AC/C	DGRMC	EP	CB-C1A203	CB	SWGRM3
EP-DG501C	4160	AC/C	DGRMC	EP	EP-BS-1A203	BS	SWGRM3
EP-DG501D	4160	AC/D	DGRMD	EP	CB-C1A204	CB	SWGRM4
EP-DG501D	4160	AC/D	DGRMD	EP	EP-BS-1A204	BS	SWGRM4
EP-MCC-0B51 6	125	AC/A	DGRMA	EP	EP-BC-1D613	BC	ELECRM
EP-MCC-0B52 6	125	DC/B	DGRMB	EP	EP-BC-1D623	BC	ELECRM
EP-MCC-0B53 6	125	DC/C	DGRMC	EP	EP-BC-1D633	BC	ELECRM
EP-MCC-0B54 6	125	DC/D	DGRMD	EP	EP-BC-1D643	BC	ELECRM
EP-MCC-1B21 6	480	AC/A	RB683	ECCS	CS-1A	MOV	CSPRMAC
EP-MCC-1B21 6	480	AC/A	RB683	ECCS	RHR-17A	MOV	RB683
EP-MCC-1B21 6	480	AC/A	RB683	ECCS	RHR-28A	MOV	RB683
EP-MCC-1B21 6	480	AC/A	RELAYRM1	ECCS	RHR-26A	MOV	RB683
EP-MCC-1B21 6	480	AC/A	RB683	ECCS	RHR-3A	MOV	RHRAC
EP-MCC-1B21 6	480	AC/A	RB683	ECCS	RHR-47A	MOV	RHRAC
EP-MCC-1B21 6	480	AC/A	RB683	ECCS	RHR-4A	MOV	RHRAC

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Susquehanna 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-MCC-1B216	480	AC/A	RB683	ECCS	RHR-6A	MOV	RHRAC
EP-MCC-1B216	480	AC/A	RB683	ECCS	RHR-6A	MOV	RHRAC
EP-MCC-1B216	480	AC/A	RB683	RCS	RCS-21	MOV	PPWAY
EP-MCC-1B217	480	AC/A	SWGRM1	ECCS	CS-4A	MOV	PPWAY
EP-MCC-1B217	480	AC/A	SWGRM1	ECCS	CS-5A	MOV	PPWAY
EP-MCC-1B217	480	AC/A	SWGRM1	ECCS	RHR-16A	MOV	PENERM749
EP-MCC-1B217	480	AC/A	SWGRM1	ECCS	RHR-16A	MOV	PENERM749
EP-MCC-1B217	480	AC/A	SWGRM1	ECCS	RHR-21A	MOV	PENERM749
EP-MCC-1B217	480	AC/A	SWGRM1	ECCS	RHR-21A	MOV	PENERM749
EP-MCC-1B217	250	DC/1	SWGRM1	EP	EP-BC-1D653A	BC	ELECRM
EP-MCC-1B219	480	AC/A,C	RB670SW	ECCS	RHR-15A	MOV	RB683
EP-MCC-1B226	480	AC/B	RB683NE	ECCS	CS-1B	MOV	CSPRMBD
EP-MCC-1B226	480	AC/B	RB683NE	ECCS	RHR-16B	MOV	PPWAY
EP-MCC-1B226	480	AC/C	RB683NE	ECCS	RHR-16B	MOV	PPWAY
EP-MCC-1B226	480	AC/B	RB683NE	ECCS	RHR-17B	MOV	RB683
EP-MCC-1B226	480	AC/B	RB683NE	ECCS	RHR-28B	MOV	RB683
EP-MCC-1B226	480	AC/B	RB683NE	ECCS	RHR-28B	MOV	RB683
EP-MCC-1B226	480	AC/B	RB683NE	ECCS	RHR-3B	MOV	RHRBD
EP-MCC-1B226	480	AC/B	RB683NE	ECCS	RHR-47B	MOV	RHRBD
EP-MCC-1B226	480	AC/B	RB683NE	ECCS	RHR-4B	MOV	RHRBD
EP-MCC-1B226	480	AC/B	RB683NE	ECCS	RHR-6B	MOV	RHRBD
EP-MCC-1B226	480	AC/B	RB683NE	ECCS	RHR-6B	MOV	RHRBD
EP-MCC-1B227	480	AC/B	SWGRM2	ECCS	CS-4B	MOV	PPWAY
EP-MCC-1B227	480	AC/B	SWGRM2	ECCS	CS-5B	MOV	PPWAY
EP-MCC-1B227	480	AC/B	SWGRM2	ECCS	RHR-21B	MOV	PPWAY
EP-MCC-1B227	480	AC/B	SWGRM2	ECCS	RHR-21B	MOV	PPWAY
EP-MCC-1B227	250	DC/2	SWGRM2	EP	EP-BC-1D663	BC	ELECRM
EP-MCC-1B229	480	AC/B,D	MCC1B229	ECCS	RHR-15B	MOV	RB683
EP-MCC-1B236	480	AC/C	SWGRM3	ECCS	RHR-27A	MOV	RB683
EP-MCC-1B236	250	DC/1	SWGRM3	EP	EP-BC-1D653B	BC	ELECRM
EP-MCC-1B236	480	AC/C	SWGRM3	RCS	RCS-1	MOV	RC

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Susquehanna 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-MCC-1B236	480	AC/C	SWGRM3	RCS	RCS-9	MOV	RC
EP-MCC-1B236	480	AC/C	SWGRM3	RCS	RCS-V1	MOV	RC
EP-MCC-1B237	480	AC/C	RB670SW	ECCS	CS-15A	MOV	RB683
EP-MCC-1B237	480	AC/C	RB670SW	ECCS	HPCI-2	MOV	RC
EP-MCC-1B237	480	AC/C	RB670SW	ECCS	RHR-24A	MOV	RB683
EP-MCC-1B237	480	AC/C	RB670SW	ECCS	RHR-24A	MOV	RB683
EP-MCC-1B237	480	AC/C	RB670SW	ECCS	RHR-48A	MOV	RB683
EP-MCC-1B237	480	AC/C	RB670SW	ECCS	RHR-48A	MOV	RB683
EP-MCC-1B237	480	AC/C	RB670SW	ECCS	RHR-4C	MOV	RHRAC
EP-MCC-1B237	480	AC/C	RB670SW	ECCS	RHR-6C	MOV	RHRAC
EP-MCC-1B237	480	AC/C	RB670SW	ECCS	RHR-6C	MOV	RHRAC
EP-MCC-1B237	480	AC/C	RB670SW	RCS	HPCI-2	MOV	RC
EP-MCC-1B237	480	AC/C	RB670SW	RCS	RCS-16	MOV	RC
EP-MCC-1B237	480	AC/C	RB670SW	RHRSW	RHRSW-11210A	MOV	RSWAPIPE
EP-MCC-1B237	480	AC/C	RB670SW	RHRSW	RHRSW-11215A	MOV	RSWAPIPE
EP-MCC-1B246	480	AC/B	SWGRM4	ECCS	RHR-27B	MOV	RB683
EP-MCC-1B246	480	AC/D	SWGRM4	ECCS	RHR-48B	MOV	RB683
EP-MCC-1B246	480	AC/D	SWGRM4	ECCS	RHR-48B	MOV	RB683
EP-MCC-1B246	480	AC/D	SWGRM4	I&C	EP-PS-1D666	PNL	ELECRM
EP-MCC-1B246	480	AC/D	SWGRM4	RCIC	RCIC-7	MOV	RC
EP-MCC-1B246	480	AC/D	SWGRM4	RCS	RCIC-7	MOV	RC
EP-MCC-1B246	480	AC/D	SWGRM4	RCS	RCS-2	MOV	RC
EP-MCC-1B246	480	AC/D	SWGRM4	RCS	RCS-5	MOV	RC
EP-MCC-1B247	480	AC/D	MCC1B247	ECCS	CS-15B	MOV	RB683NE
EP-MCC-1B247	480	AC/D	MCC1B247	ECCS	RHR-24B	MOV	RB683
EP-MCC-1B247	480	AC/B	MCC1B247	ECCS	RHR-24B	MOV	RB683
EP-MCC-1B247	480	AC/D	MCC1B247	ECCS	RHR-4D	MOV	RHRBD
EP-MCC-1B247	480	AC/D	MCC1B247	ECCS	RHR-6D	MOV	RHRBD
EP-MCC-1B247	480	AC/D	MCC1B247	ECCS	RHR-6D	MOV	RHRBD
EP-MCC-1B247	480	AC/D	MCC1B247	RHRSW	RHRSW-11210B	MOV	RSWBPIPE
EP-MCC-1B247	480	AC/D	MCC1B247	RHRSW	RHRSW-11215B	MOV	RSWBPIPE

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Susquehanna 1 (Continued)

POWER SOURCE	VOLTAGE	EMERG LOAD GRP	POWER SOURCE LOCATION	LOAD SYSTEM	LOAD COMPONENT ID	COMP TYPE	COMPONENT LOCATION
EP-MCC-1D254	250	DC/1	RB670SW	ECCS	HPCI-10	MOV	RCICRM
EP-MCC-1D254	250	DC/1	RB670SW	RCIC	RCIC-10	MOV	RCICRM
EP-MCC-1D254	250	DC/1	RB670SW	RCIC	RCIC-12	MOV	RB670N
EP-MCC-1D254	250	DC/1	RB670SW	RCIC	RCIC-13	MOV	PPWAY
EP-MCC-1D254	250	DC/1	RB670SW	RCIC	RCIC-22	MOV	RB670N
EP-MCC-1D254	250	DC/1	RB670SW	RCIC	RCIC-31	MOV	RCICRM
EP-MCC-1D254	250	DC/1	RB670SW	RCIC	RCIC-45	MOV	RCICRM
EP-MCC-1D254	250	DC/1	RB670SW	RCIC	RCIC-46	MOV	RCICRM
EP-MCC-1D254	250	DC/1	RB670SW	RCIC	[illegible]C-59	MOV	RCICRM
EP-MCC-1D254	250	DC/1	RB670SW	RCIC	RCIC-8	MOV	RB683
EP-MCC-1D254	250	DC/1	RB670SW	RCS	RCIC-8	MOV	RB683
EP-MCC-1D264	250	DC/2	RB683NE	ECCS	HPCI-11B	MOV	RC
EP-MCC-1D264	250	DC/2	RB683NE	ECCS	HPCI-66	MOV	HPCIRM
EP-MCC-1D264	250	DC/2	RB683NE	ECCS	HPCI-7	MOV	RB670N
EP-MCC-1D264	250	DC/2	RB683NE	ECCS	HPCI-8	MOV	RB670N
EP-MCC-1D264	250	DC/2	RB683NE	RCS	RCS-19	MOV	PPWAY
EP-MCC-1D264	250	DC/2	RB683NE	RCS	RCS-8	MOV	RHRBD
EP-MCC-1D274	250	DC/2	RB670NE	ECCS	HPCI-1	MOV	HPCIRM
EP-MCC-1D274	250	DC/2	RB670NE	ECCS	HPCI-11	MOV	CSPRMBD
EP-MCC-1D274	250	DC/2	RB670NE	ECCS	HPCI-3	MOV	RB683
EP-MCC-1D274	250	DC/2	RB670NE	ECCS	HPCI-4	MOV	HPCIRM
EP-MCC-1D274	250	DC/2	RB670NE	ECCS	HPCI-42	MOV	HPCIRM
EP-MCC-1D274	250	DC/2	RB670NE	ECCS	HPCI-46	MOV	HPCIRM
EP-MCC-1D274	250	DC/2	RB670NE	ECCS	HPCI-6	MOV	PPWAY
EP-MCC-1D274	250	DC/2	RB670NE	RCIC	RCIC-11	MOV	CSPRMBD
EP-MCC-1D274	250	DC/2	RB670NE	RCS	HPCI-3	MOV	RB683
EP-PS-1D666	120	DC/2	ELECRM	I&C	EP-PNL-1Y629	PNL	ELECRM
EP-TR-1X210	480	AC/A	SWGRM1	EP	EP-BS-1B210	BS	SWGRM1
EP-TR-1X220	480	AC/B	SWGRM2	EP	EP-BS-1B220	BS	SWGRM2
EP-TR-1X230	480	AC/C	SWGRM3	EP	EP-BS-1B230	BS	SWGRM3
EP-TR-1X240	480	AC/D	SWGRM4	EP	EP-BS-1B240	BS	SWGRM4

3.6 CONTROL ROD DRIVE HYDRAULIC SYSTEM (CRDHS)

3.6.1 System Function

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

3.6.2 System Definition

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

Details of the scram portion of a typical BWR CRDHS is shown in Figure 3.6-1.

3.6.3 System Operation

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

A reactor scram is implemented by pneumatic scram valves in the CRDHS. An inlet scram valve opens to align the insert side of each control rod drive mechanism (CRDM) to the scram accumulator. An outlet scram valve opens to vent the opposite side of each CRDM to the 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. The insertion time, however, will be slower than the scram time with a properly functioning scram system.

Although not intended as a makeup system, the CRDHS can provide a source of cooling water to the RCS during vessel isolation. In BWR/4 plants, RCS makeup at high pressure is performed by the RCIC (see Section 3.2) and HPCI (see Section 3.3) systems. The maximum RCS makeup rate of the CRDHS is about 200 gpm with both pumps operating (Ref. 1).

3.6.4 System Success Criteria

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

- A scram signal must be transmitted by the RPS to the actuated devices (i.e., pilot valves) in the CRDHS.
- The pneumatic inlet scram valve and outlet scram valve must open in the hydraulic control units (HCUs) for the individual control rod drives. This is accomplished by venting the instrument air supply to each valve as follows:
  - Both scram pilot valves in each HCU must be deenergized, or
  - Either backup scram pilot valve must be energized.

- A high-pressure water source must be available from the scram accumulator in each HCU.
- A hydraulic vent path to the scram discharge volume must be available and sufficient collection volume must exist in the scram discharge volume.
- A specified number of control rods must respond and insert into the reactor core (specific number needed is not known).

3.6.5 Component Information

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

B. Condensate Storage Tank
   1. Capacity: 300,000 gal

C. Scram Accumulator
   1. Normal pressure: 1400 to 1500 psig

D. Scram Discharge Volume
   1. Normal pressure: Atmospheric

3.6.6 Support Systems and Interfaces

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

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

3.6.7 Section 3.6 References

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

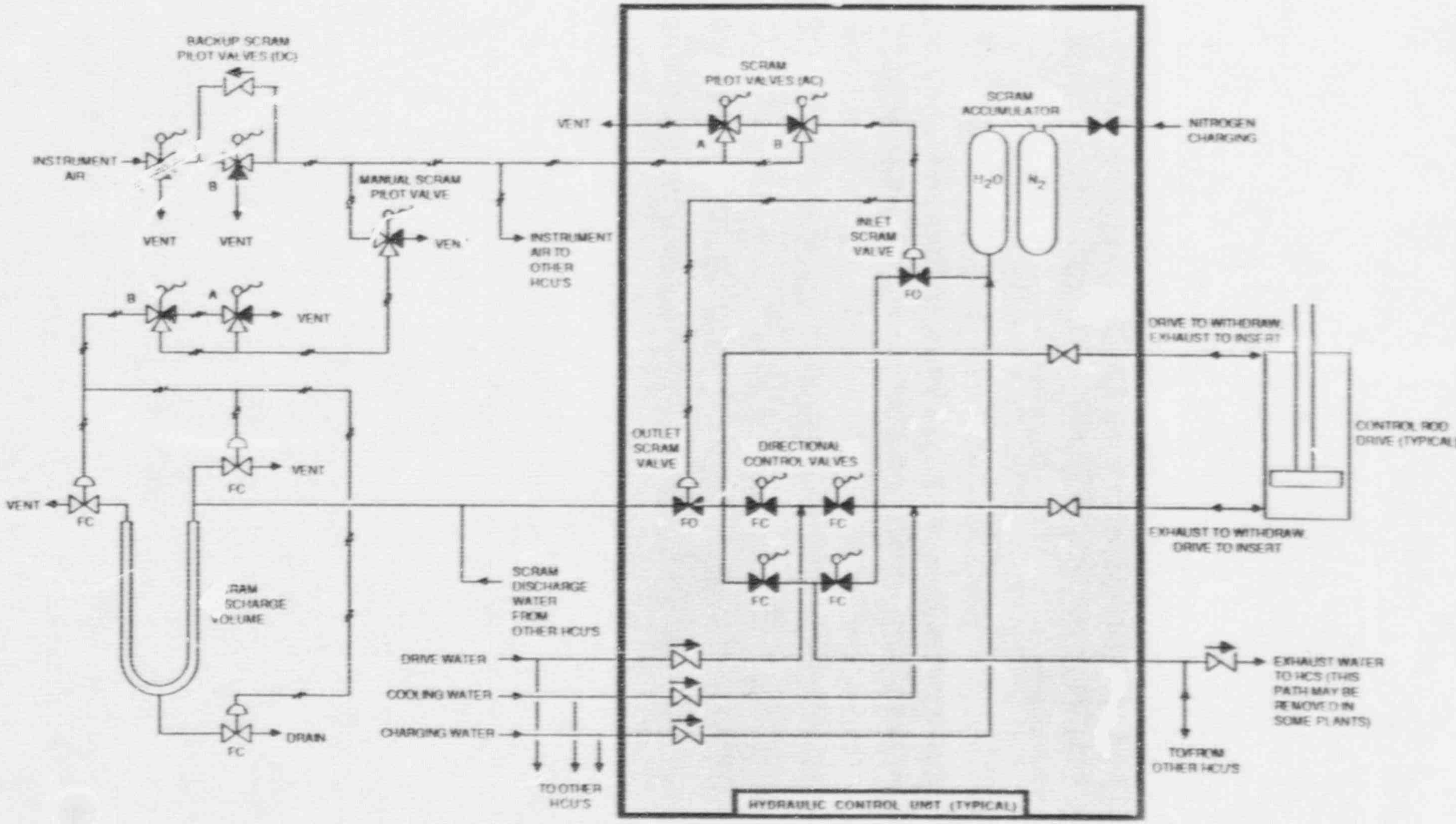


Figure 3.6-1. Simplified Diagram of Portions of the Control Rod Drive Hydraulic System That are Related to the Scram Function

3.7 EMERGENCY SERVICE WATER SYSTEM (ESWS)

3.7.1 System Function

The Emergency Service Water System (ESWS) is designed to supply cooling water to the emergency diesel generator units, RHR pumps, and to those room coolers (except for the emergency switchgear and load center room coolers, which are normally supplied by the control structure chilled water system in Unit 1 or the direct expansion cooling system in Unit 2) required during normal and emergency conditions necessary to safely shutdown the plant.

The ESWS is designed to take water from the spray pond (the ultimate heat sink), pump it to the various heat exchangers and return it to the spray pond by way of a network of sprays that dissipate the heat to the atmosphere.

3.7.2 System Definition

The system consists of two loops, each of which is designed to supply 100 percent of the ESW requirements to both units and the common emergency diesel generators simultaneously. The ESWS is required to supply cooling water to the following:

- The RHR pump room unit cooler, the motor bearing oil cooler, and seal cooler of each RHR pump during all modes of operation of the RHR system.
- All the heat exchangers associated with the diesel generators during operation and test modes.
- The room coolers for the core spray (CS) pumps, the high pressure coolant injection (HPCI) pumps, and reactor core isolation cooling (RCIC) pumps during the operation of these systems.
- The control structure chiller, the Unit 2 emergency switchgear cooling condensing unit, reactor building closed cooling water (RBCCW) heat exchangers, and the turbine building closed cooling water heat exchanger (TBCCW) during emergency operation
- Makeup to the fuel pools.

Connections are provided for serving a fifth diesel generator which may be installed at a future date. Each loop has two vertical, turbine type, single stage pumps rated at 6000 gpm each. These are located in the engineered safeguard service water pumphouse which is built at the edge of the spray pond Simplified drawings of the ESWS are shown in Figures 3.7-1 and 3.7-2. A summary of data on selected ESWS components is presented in Table 3.7-1.

3.7.3 System Operation

During normal power operation, the ESWS is not operating but is available for shutdown or emergencies. The ESWS starts automatically within approximately 40 to 100 seconds after the diesel generators receive a start signal. The ESWS can also be started manually from either the main control room or from one of the two remote shutdown panels (ESWS loop A can only be started from the Unit 2 remote shutdown panel and ESWS loop B can only be started from the Unit 1 remote shutdown panel). Upon loss of power, all safety related components (pumps, valves, and instruments) of the ESWS will automatically be switched to the standby power supply.

Each of the two ESWS loops supplies cooling water to separate equipment in each unit, except in the case of the common emergency diesel generators. The emergency diesel generator heat exchangers are connected to both ESWS loops and they can be supplied by either. Motor-operated valves are installed in each loop so that these heat exchangers can be isolated from a failed loop and still be supplied with cooling water from the other loop. The ESWS return headers to the spray pond are combined with the RHRSWS return headers before discharging into the pond. Loss of one RHRSWS/ESWS loop does not affect the capability of the second loop to safety shutdown either or both units during emergency conditions.

3.7.4 System Success Criteria

The ESWS contains two loops with two pumps in each loop. The FSAR states that each pump is a 50 percent capacity pump and that two pumps in a loop are required for each loop. Since the success criteria given in the FSAR is for two units, it can be inferred that only one pump is required for Unit 1.

3.7.5 Component Information

A. Emergency Service Water System Pumps 504A, 504B, 504C, 504D
   1. Rated flow: 6000 gpm each @ unknown head
   2. Rated capacity: 100%
   3. Type: Vertical, turbine, single stage

3.7.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The ESWS starts automatically within approximately 40-100 seconds after the diesel generators receive their start initiation signal
   2. Remote Manual
      The ESWS can be started manually from either the main control room or from one of the two remote shutdown panels.

B. Motive Power
   The ESWS pumps are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.5.

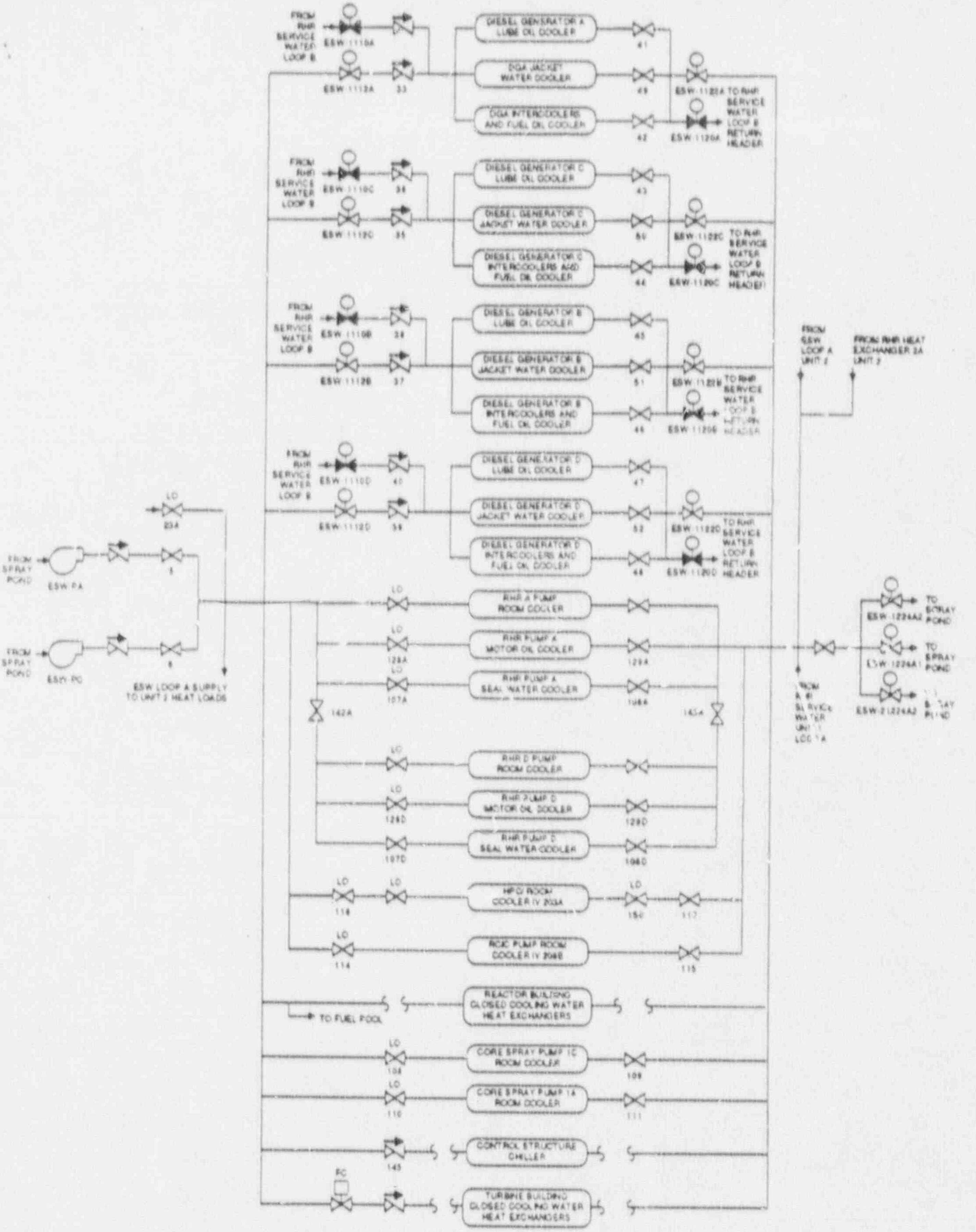


Figure 3.7-1. Susquehanna 1 Emergency Service Water System, T..in A

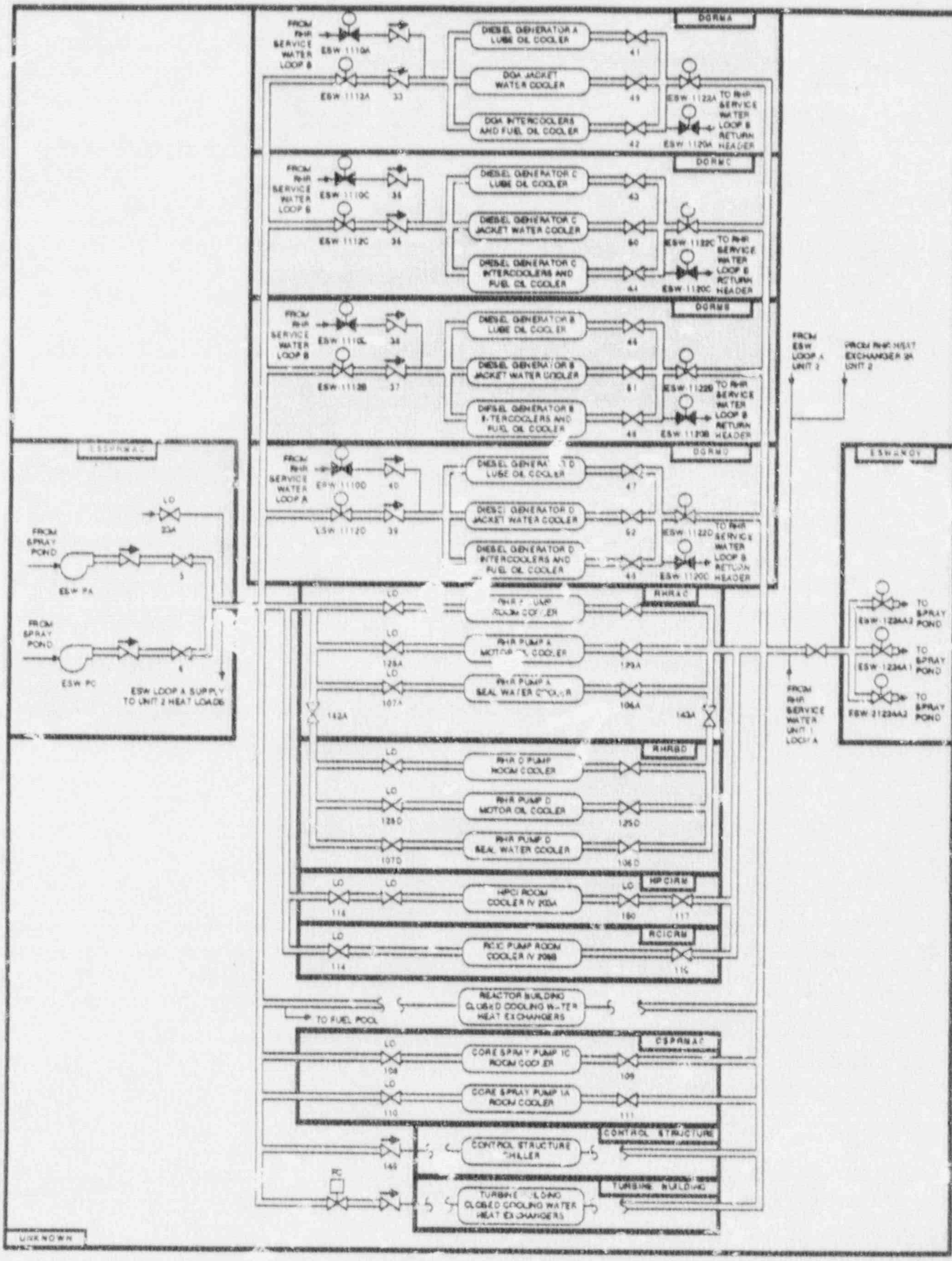


Figure 3.7-2. Susquehanna 1 Emergency Service Water System, Train A, Showing Component Locations

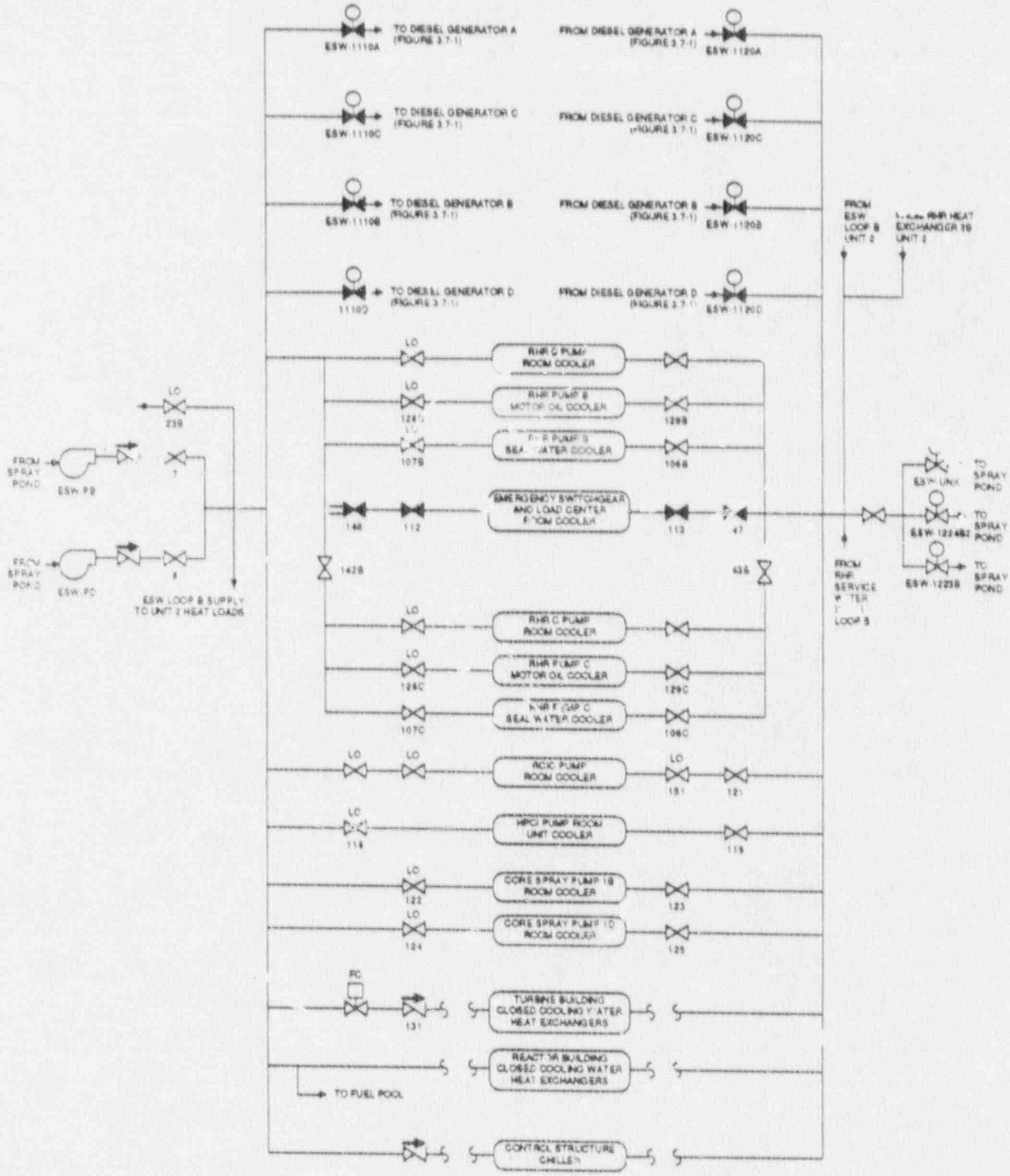


Figure 3.7-?. Susquehanna 1 Emergency Service Water System, Train B

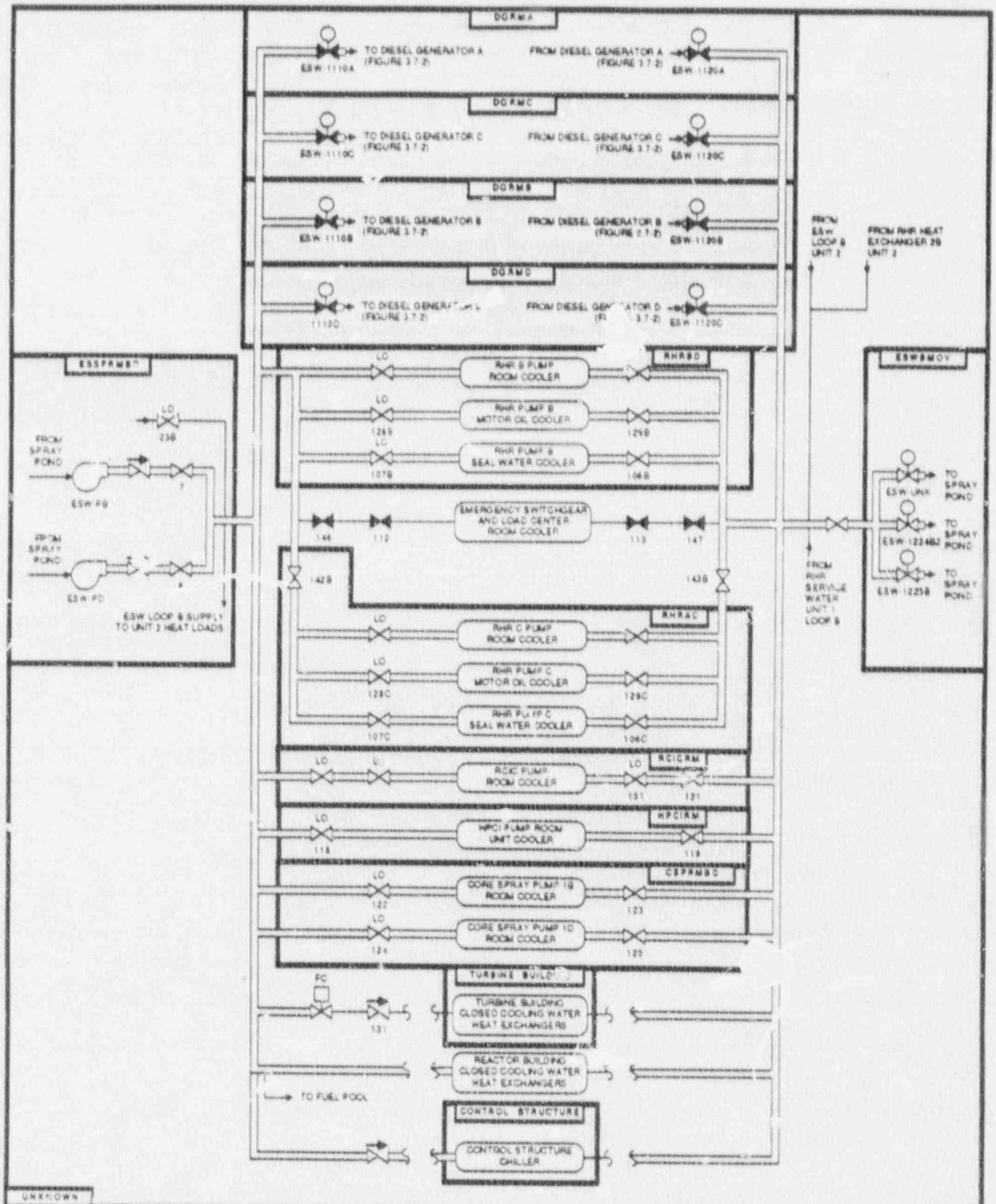


Figure 3.7-4. Susquehanna 1 Emergency Service Water System, Train B, Showing Component Locations

Table 3.7-1. Susquehanna 1 Emergency Service Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
ESW-1110B	MOV	DGRMB	EP-BS-0B526	480	DGRMB	AC/B
ESW-1110D	MOV	DGRMD	EP-BS-0B546	480	DGRMD	AC/D
ESW-1112A	MOV	DGRMA	EP-BS-0B516	480	DGRMA	AC/A
ESW-1112C	MOV	DGRMC	EP-BS-0B536	480	DGRMC	AC/C
ESW-1120B	MOV	DGRMB	EP-BS-0B526	480	DGRMB	AC/B
ESW-1120D	MOV	DGRMD	EP-BS-0B546	480	DGRMD	AC/D
ESW-1122A	MOV	DGRMA	EP-BS-0B516	480	DGRMA	AC/A
ESW-1122C	MOV	DGRMC	EP-BS-0B536	480	DGRMC	AC/C
ESW-1224A1	MOV	ESWAMOV	EP-BS-0B517	480	ESSPRMAC	AC/A
ESW-1224A2	MOV	ESWAMOV	EP-BS-0B517	480	ESSPRMAC	AC/A
ESW-1224B2	MOV	ESWBMOV	EP-BS-0B527	480	ESSPRMBD	AC/B
ESW-21224A2	MOV	ESWAMOV	EP-BS-0[illegible]17	480	ESSPRMAC	AC/A
ESW-F1223B	MOV	ESWBMOV	EP-B[illegible]527	480	ESSPRMBD	AC/B
ESW-PA	MDP	ESSPRMAC	[illegible]BS-1A201	4160	SWGRM1	AC/A
ESW-PB	MDP	ESSPRMBD	EP-BS-1A202	4160	SWGRM2	AC/B
ESW-PC	MDP	ESSPRMAC	EP-BS-1A203	4160	SWGRM3	AC/C
ESW-PD	MDP	ESSPRMBD	EP-BS-1A204	4160	SWGRM4	AC/D

3.8 RESIDUAL HEAT REMOVAL SERVICE WATER SYSTEM (RHRSWS)

3.8.1 System Function

The Residual Heat Removal Service Water System (RHRSWS) is designed to supply cooling water to the residual heat removal (RHR) heat exchangers of both units. The RHRSWS is designed to take water from the spray pond (the ultimate heat sink), pump it through the RHR heat exchangers, and return it to the spray pond by way of a spray network that dissipates the heat to the atmosphere.

The RHRSWS is designed to provide a reliable source of cooling water for all operating modes of the RHR system including heat removal under post-accident conditions, and also to provide water to flood the reactor core or the primary containment after an accident, should it be necessary.

3.8.2 System Definition

The system consists of two RHRSWS loops (A and B) per unit. Each loop has a 100 percent capacity, vertical, turbine type, two stage pump operating at a rated capacity of 9000 gpm. The Unit 1 A and Unit 2 A loop pumps are cross-connected so that they can supply cooling water to either the Unit 1 A or the Unit 2 A loop heat exchanger. The same is true for the Unit 1 B and Unit 2 B loop pumps. The four RHRSWS pumps are located in the ESSW pumphouse at the edge of the spray pond.

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

3.8.3 System Operation

During normal power generation the RHRSWS is not operating, but is available for normal shutdown or emergencies. Under emergency conditions, the RHRSW pump motors obtain their power from the standby power supply. The pumps are started manually 10 minutes after the diesel generators start. Waiting 10 minutes allows sequential loading of the diesel generators so that they will not be overloaded.

Both the cooling water discharging from the RHR heat exchanger and the cooling water headers to the spray pond discharging from the corresponding ESW system are returned to the spray pond in a common header. Loss of one RHRSWS/ESWS loop does not affect the capability of the second loop to safely shut down either or both units during emergency conditions.

Motors of the four RHRSWS pumps are connected to each of the four diesel generator buses that serve as backup in the case of loss of offsite power. When loss of offsite power occurs, the diesel generators start automatically, providing emergency power for the pumps and motor operated valves. This transfer from the offsite power source to the standby power supply is automatic. Although the transfer from offsite power to standby power supply is automatic, the pumps themselves have to be started manually.

3.8.4 System Success Criteria

The RHRSWS contains two 100 percent capacity loops. The success criteria for this system is given on a per loop basis. For each loop, the pump must operate and the flow path to the heat load must be open and remain intact. It is also possible to cross-connect the associated RHRSW pump in Unit 2 to the heat exchanger in Unit 1.

3.8.5 Component Information

A. Residual Heat Removal Service Water System Pumps 506A, 506B
   1. Rated flow: 9000 gpm @ unknown head
   2. Rated capacity: 100%
   3. Type: Vertical, turbine, two stage

3.8.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      None.
   2. Remote Manual
      The RHRSWS pumps can be actuated by remote means from the control room.

B. Motive power
   The RHRSWS pumps are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.5.

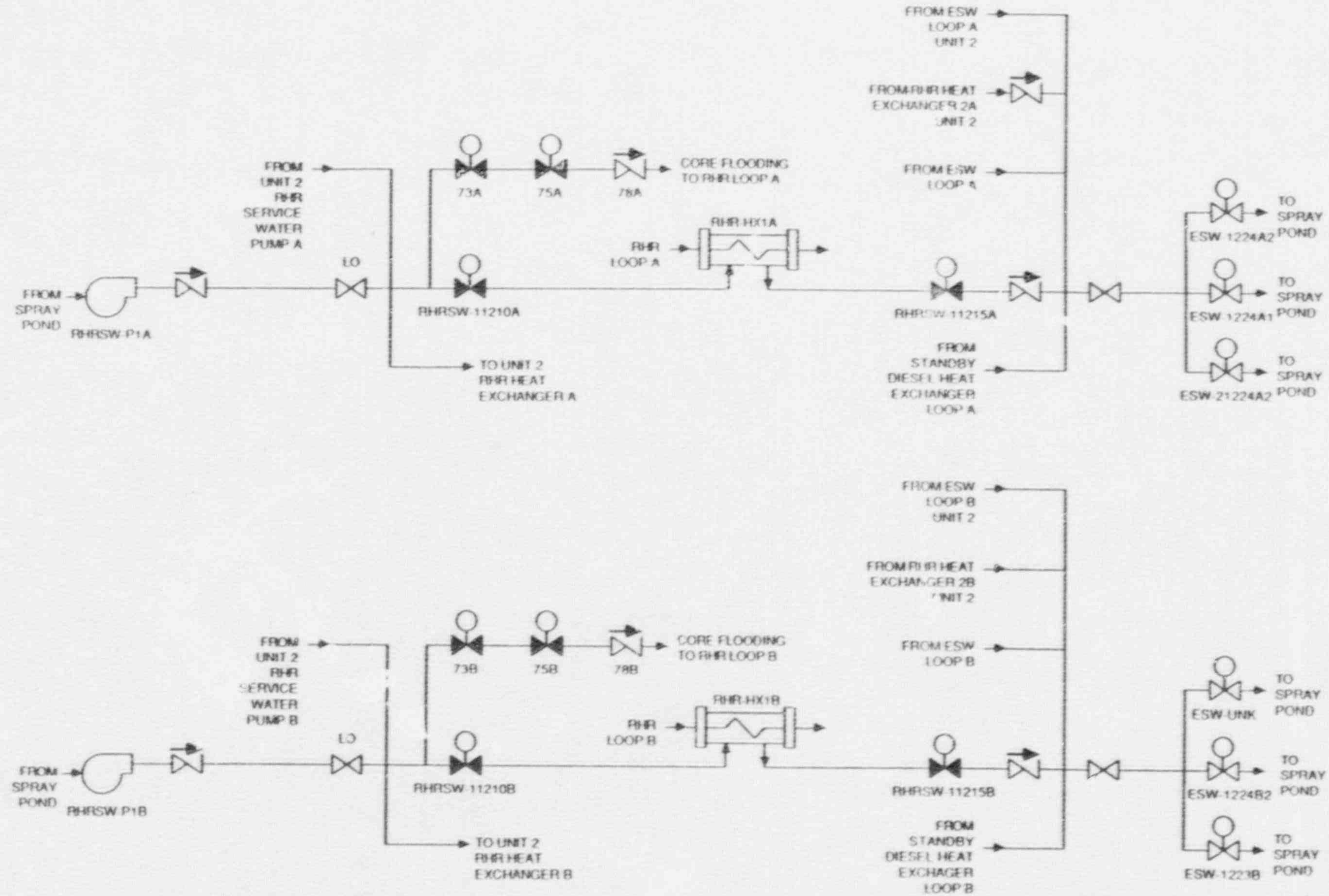


Figure 3.8-1. Susquehanna 1 RHR Service Water System

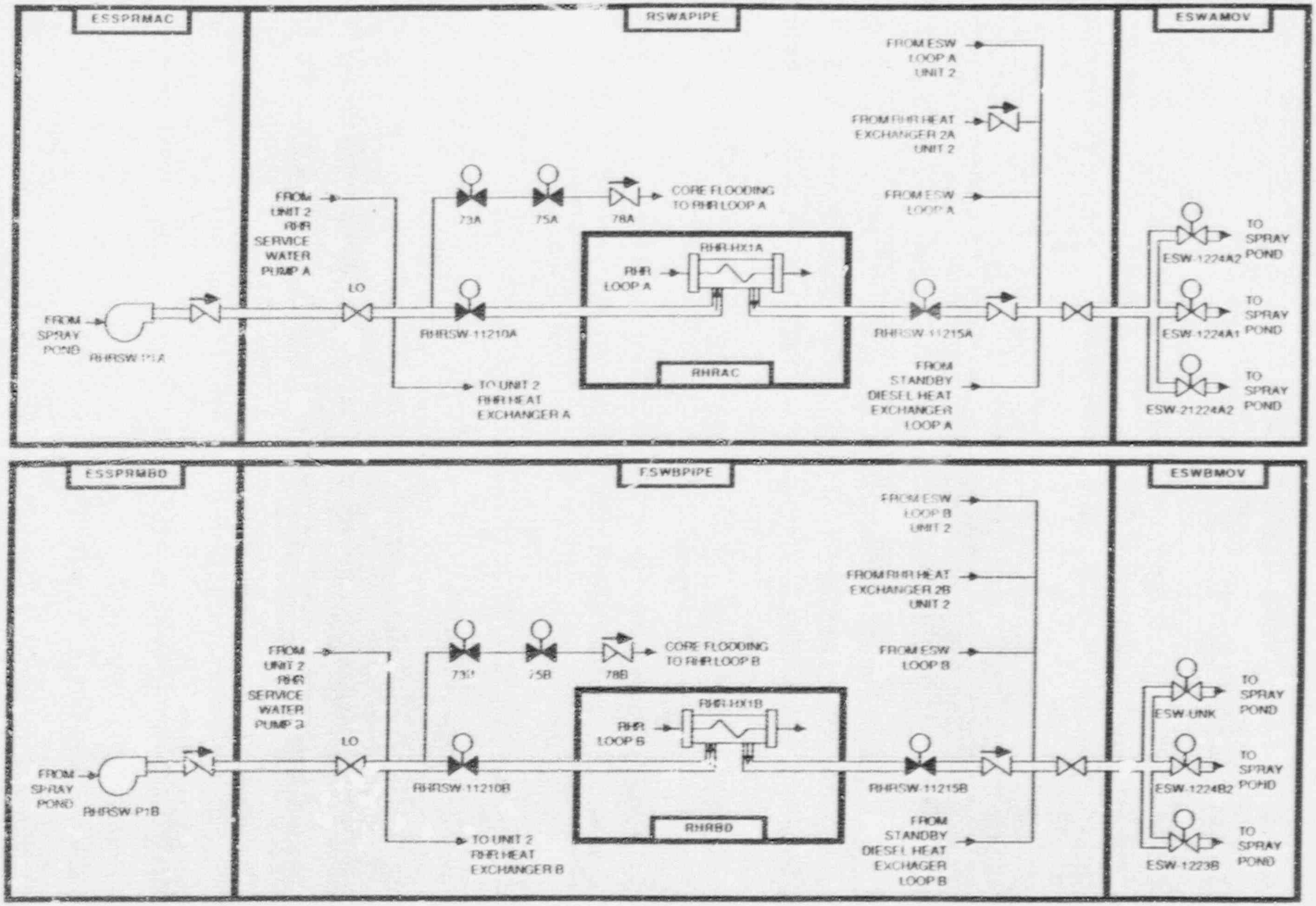


Figure 3.8-2. Susquehanna 1 RHR Service Water System Showing Component Locations

Table 3.8-1. Susquehanna 1 Residual Heat Removal Service Water System Data Summary for Selected Components

COMPONENT ID	COMP. TYPE	LOCATION	POWER SOURCE	VOLTAGE	POWER SOURCE LOCATION	EMERG. LOAD GRP.
RHRSW-11210A	MOV	RSWAPIPE	EP-MCC-1B237	480	RB670SW	AC/C
RHRSW-11210B	MOV	RSWBPIPE	EP-MCC-1B247	480	MCC1B247	AC/D
RHRSW-11215A	MOV	RSWAPIPE	EP-MCC-1B237	480	RB670SW	AC/C
RHRSW-11215B	MOV	RSWBPIPE	EP-MCC-1B247	480	MCC1B247	AC/D
RHRSW-P1A	MDP	ESSPRMAC	EP-BS-1A203	4160	SWGRM3	AC/C
RHRSW-P1B	MDP	ESSPRMBD	EP-BS-1A204	4160	SWGRM4	AC/D

4. PLANT INFORMATION

4.1 SITE AND BUILDING SUMMARY

The Susquehanna 1 and 2 site is located on the west bank of the Susquehanna River in Salem Township, Luzerne Country, Pennsylvania. It is four miles south of Shickshinny and five miles northeast of Berwick. 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 1 and 2 are adjacent to each other and just east of the turbine building and the shared control building. The turbine building contains the Unit 1 and 2 main turbine and balance of plant systems. The control building contains the control room, cable spreading rooms, battery rooms, electrical equipment room, and the relay rooms. The control rooms for Units 1 and 2 are in a common area on the 729 foot level.

The diesel generator A-D building is located to the north of the reactor building and east of the turbine building. The long-term fuel oil storage tanks are located below ground adjacent to the diesel generator building. Diesel generator E building is located to the east of the diesel generator A-D building.

Cooling towers are located to the west of the turbine building. North of the cooling towers is the spray pond and emergency service water pumphouse. The emergency service water pumphouse contains the emergency service water system pumps and residual heat removal service water system pumps.

One condensate storage tank (CST) is provided for each unit. The Unit 1 CST is located just north of the reactor building and the Unit 2 CST is located just south of the reactor building. The refueling water storage tank is located north of the Unit 1 CST.

4.2 FACILITY LAYOUT DRAWINGS

Figures 4-3 and 4-4 are section views of the Susquehanna reactor building (typical for Units 1 and 2). Simplified building layouts for the Susquehanna reactor and control buildings are shown in Figures 4-5 to 4-12. Section views of diesel generator building A-D are shown in Figures 4-13 and 4-14. Layout drawings for this building are shown in Figures 4-15 to 4-18. The ESW pumphouse is shown in Figures 4-19 and 4-20. The turbine building, service and administration building, radwaste building, diesel generator building E, and other outlying buildings are not shown on these drawings.

Major rooms, stairways, elevators, and doorways are shown in the simplified layout drawings, however, many interior walls have been omitted for clarity. Labels printed in uppercase correspond to the location codes listed in Table 4-1 and used in the component data listings and system drawings in Section 3. Some additional labels are included for information and are printed in lowercase type.

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

4.3 SECTION 4 REFERENCES

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

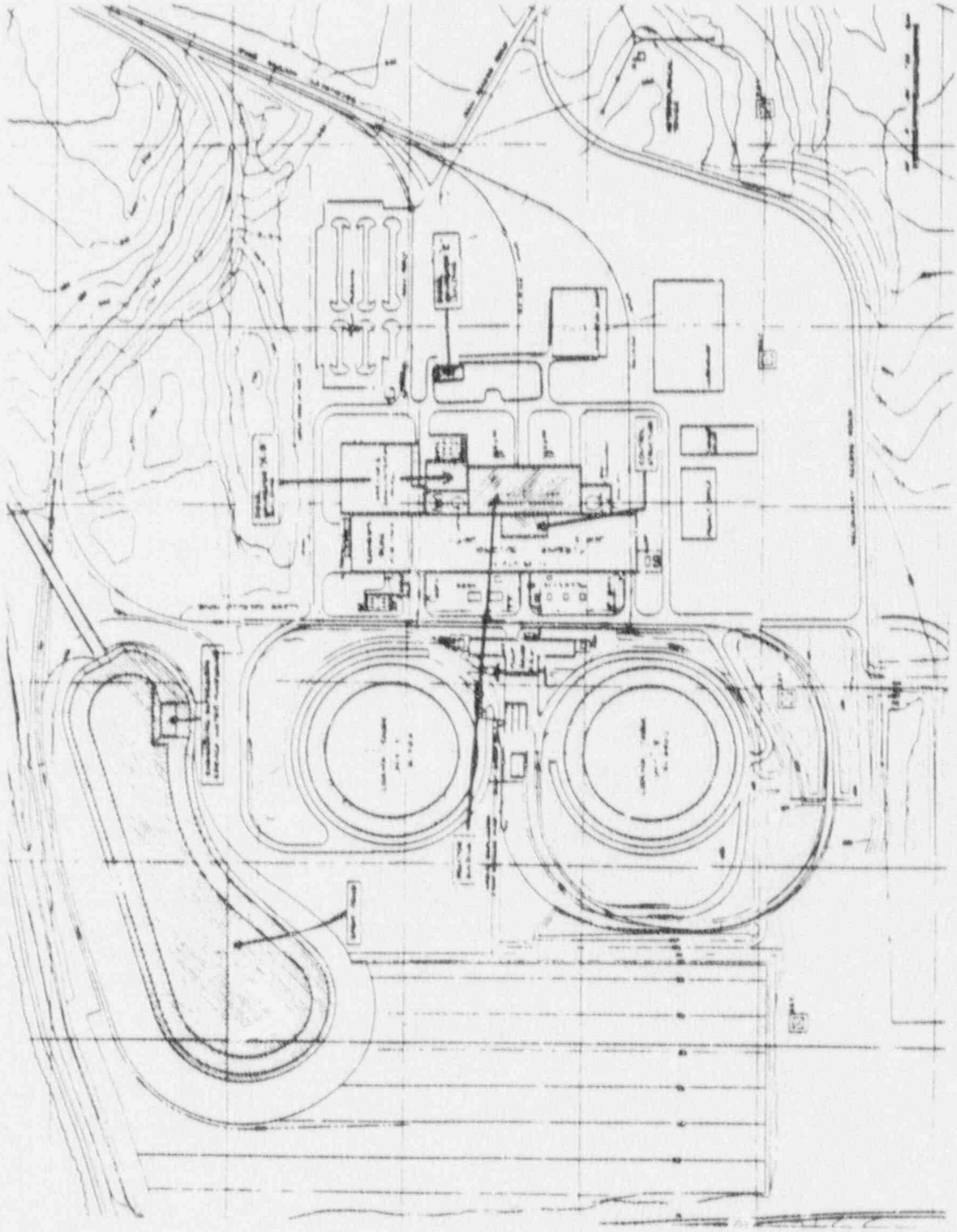


Figure 4-1. General View of the Susquehanna Site and Vicinity

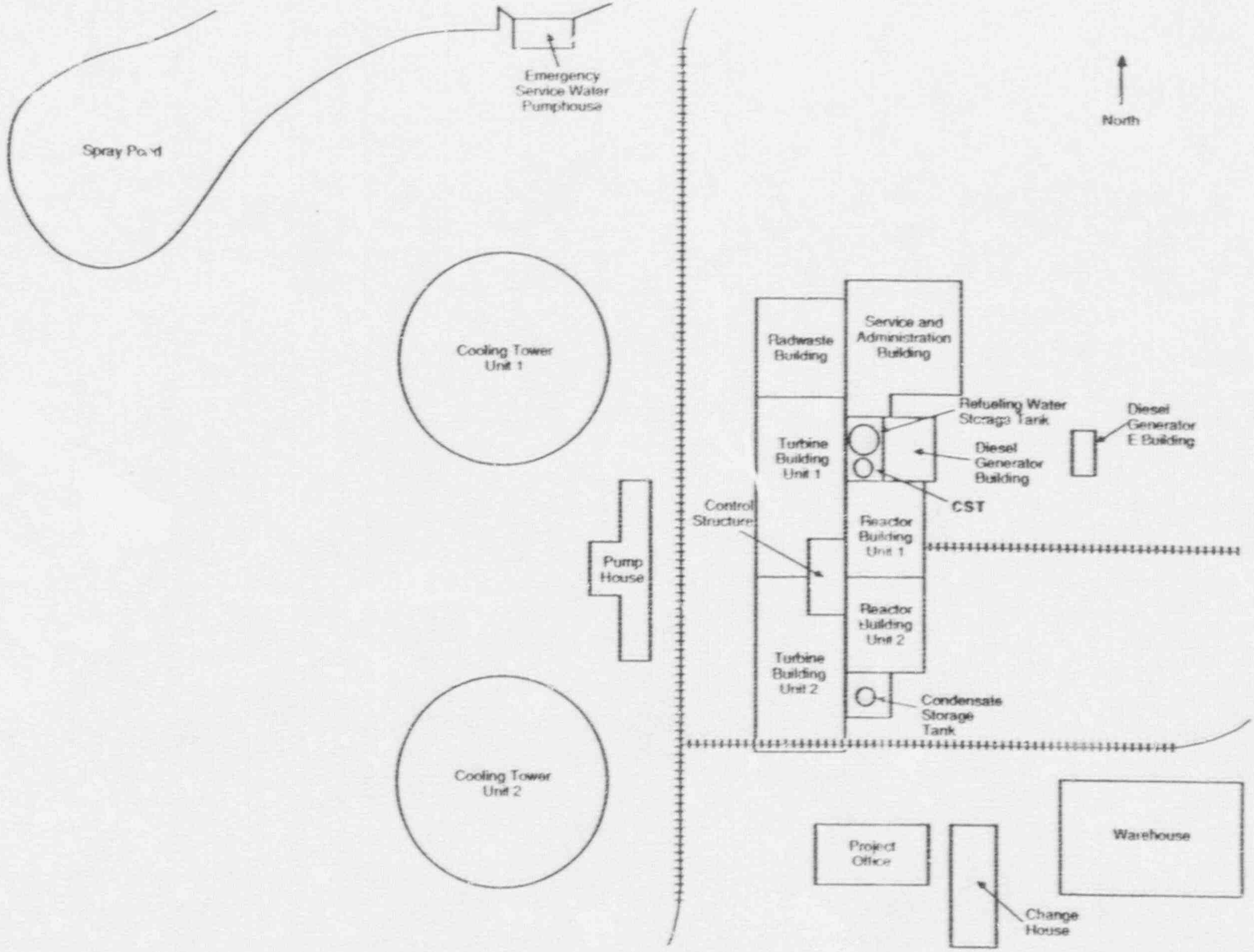


Figure 4-2. Susquehanna 1 and 2 Simplified Site Plan

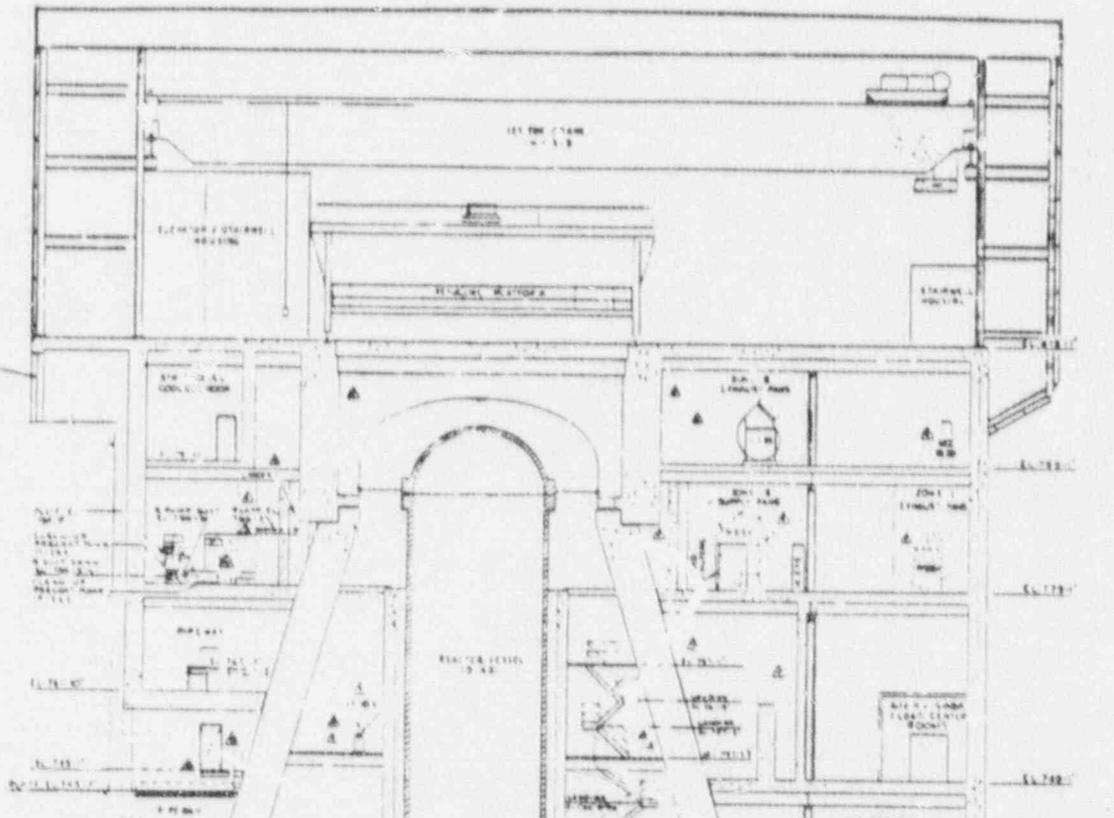


Figure 4-3. Susquehanna Reactor Building Looking North

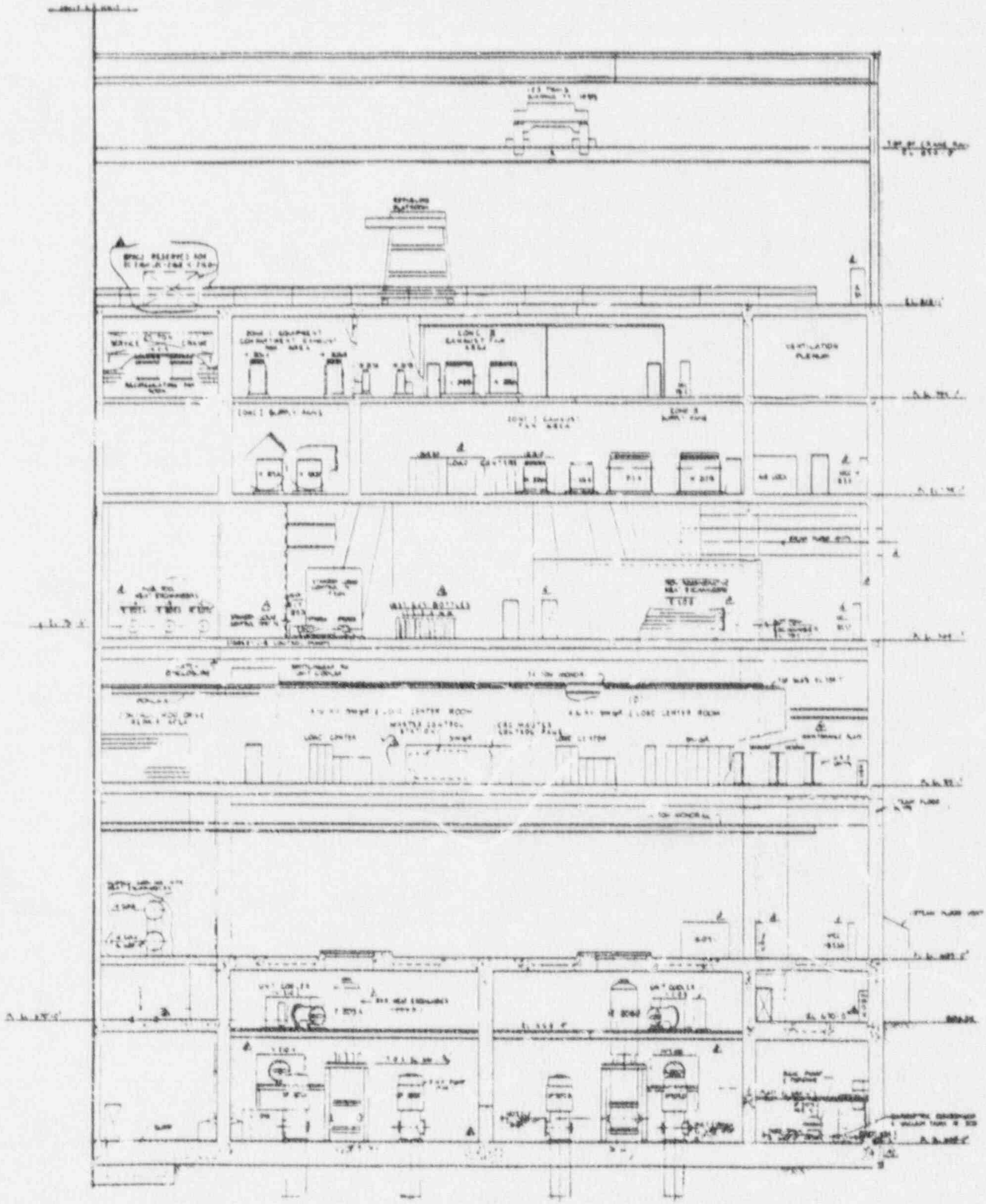


Figure 4-4. Susquehanna Reactor Building Looking West

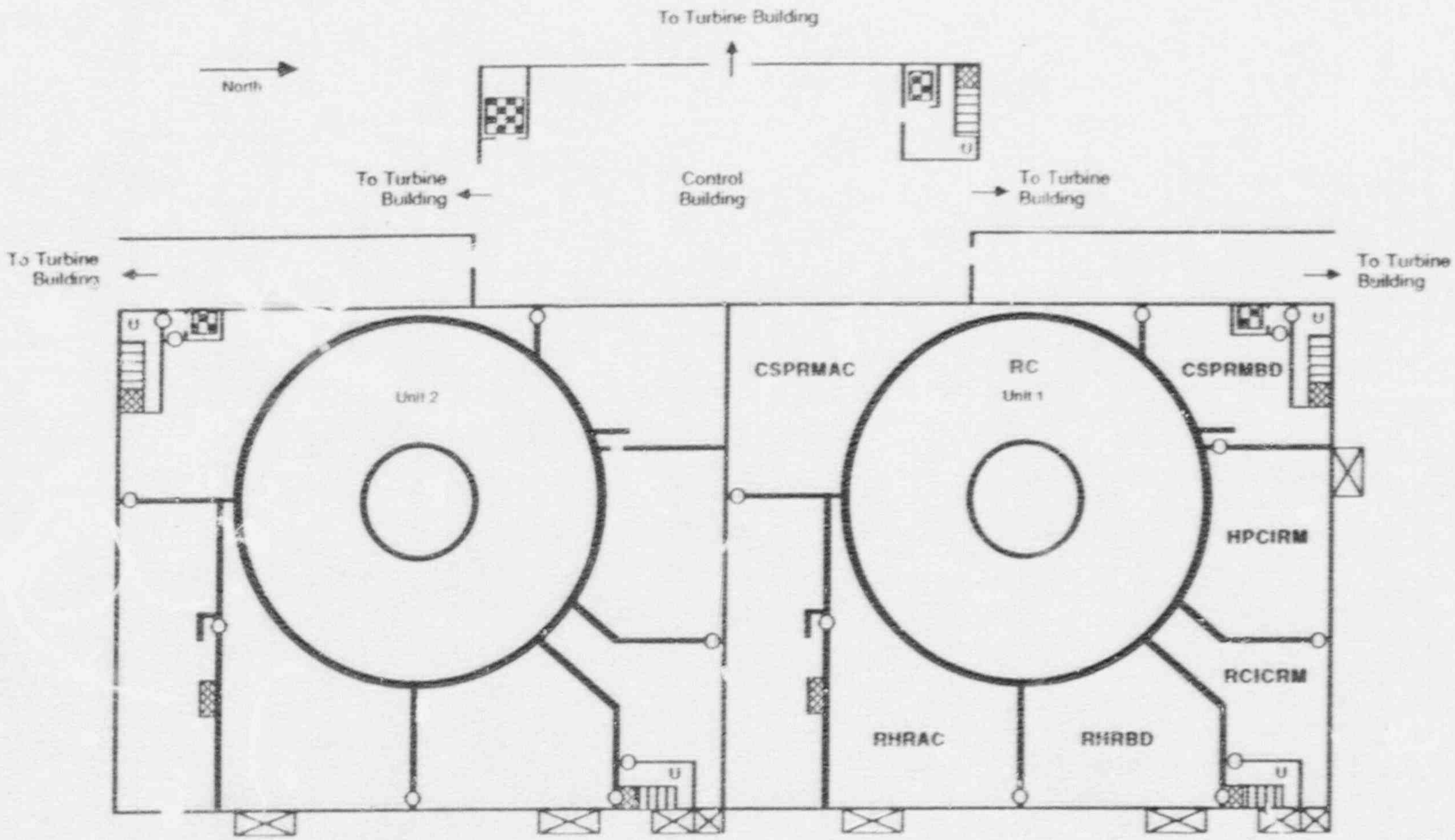


Figure 4-5. Susquehanna 1 and 2 Reactor Building, Elevation 645' and Control Building, Elevation 6[illegible]

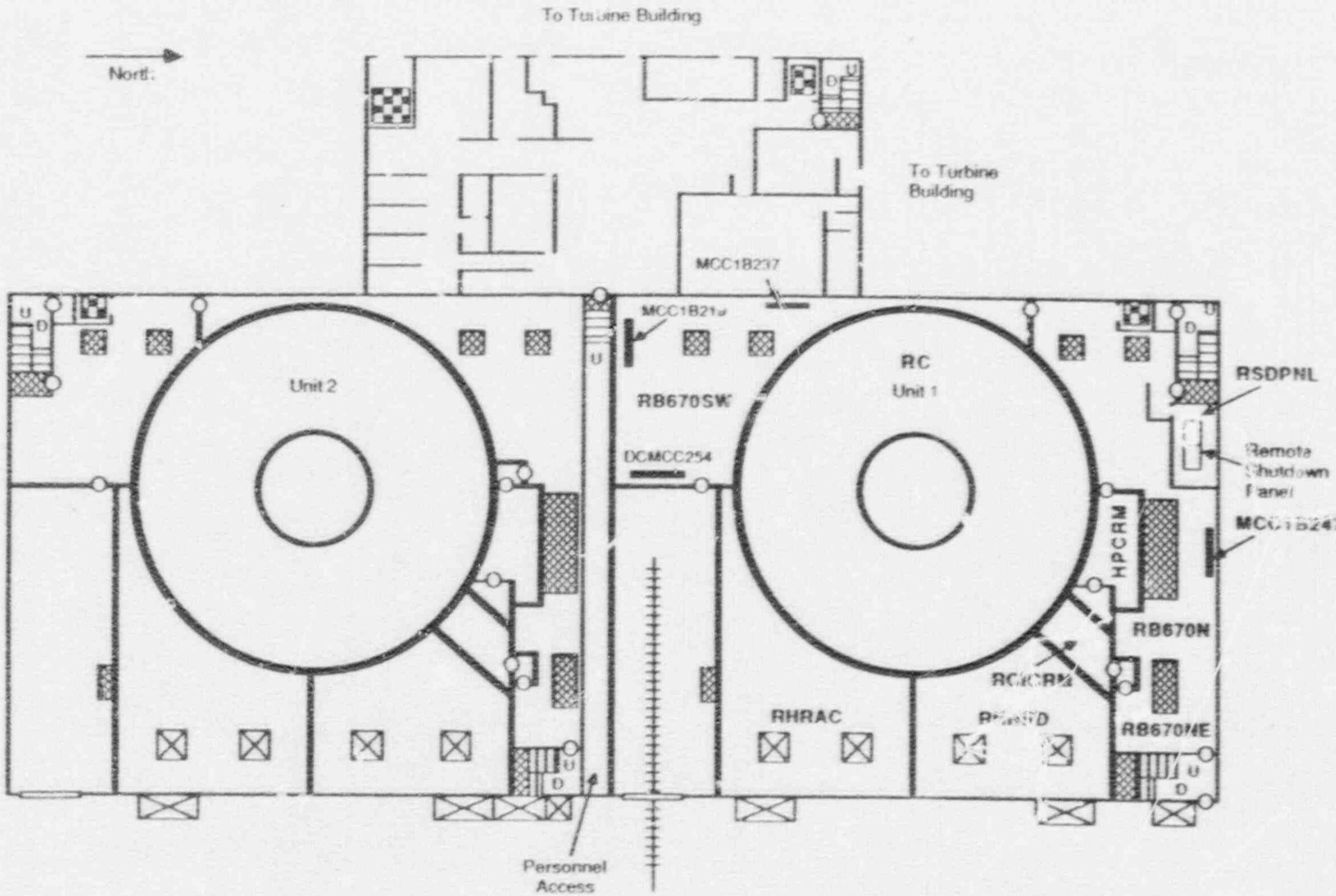
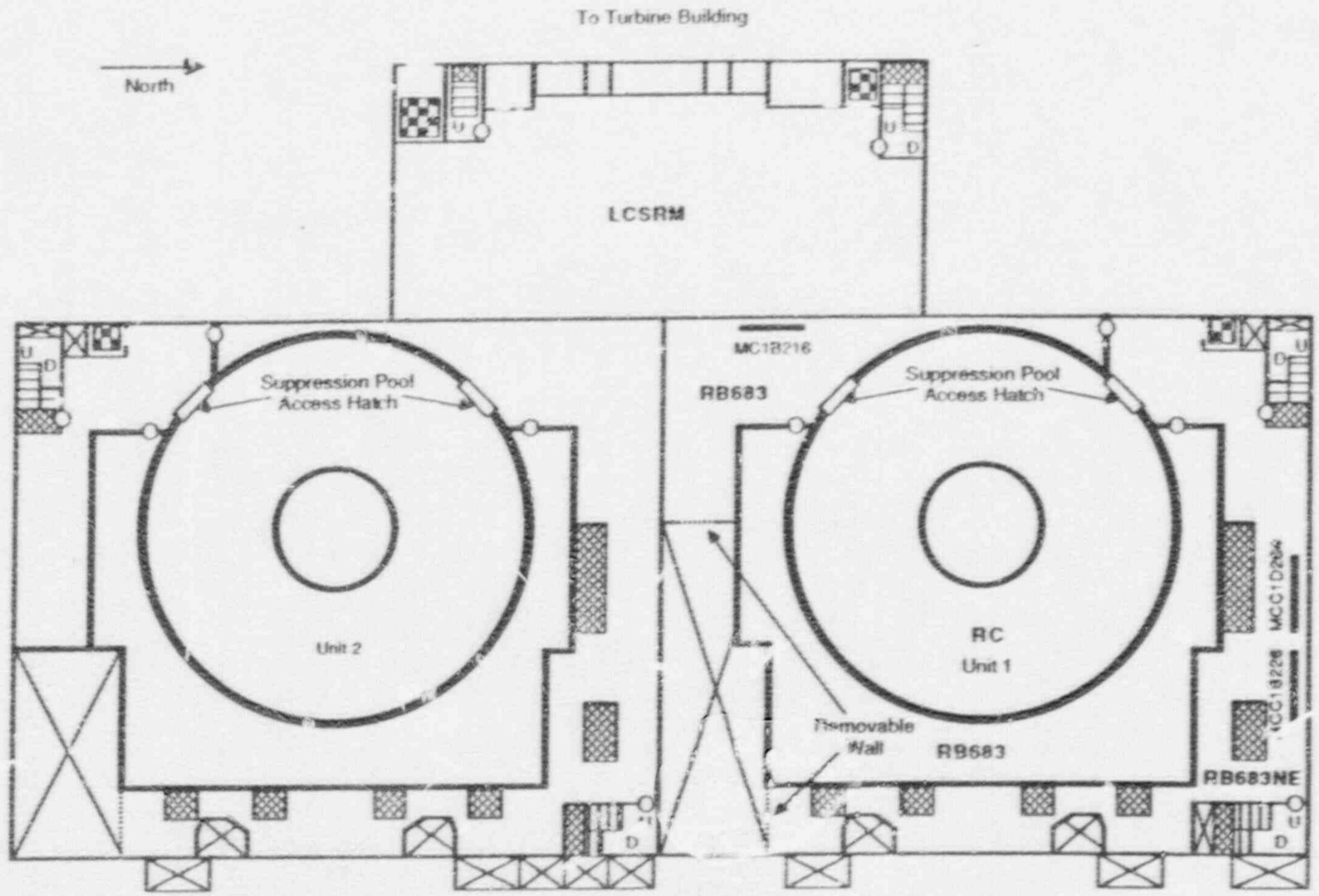
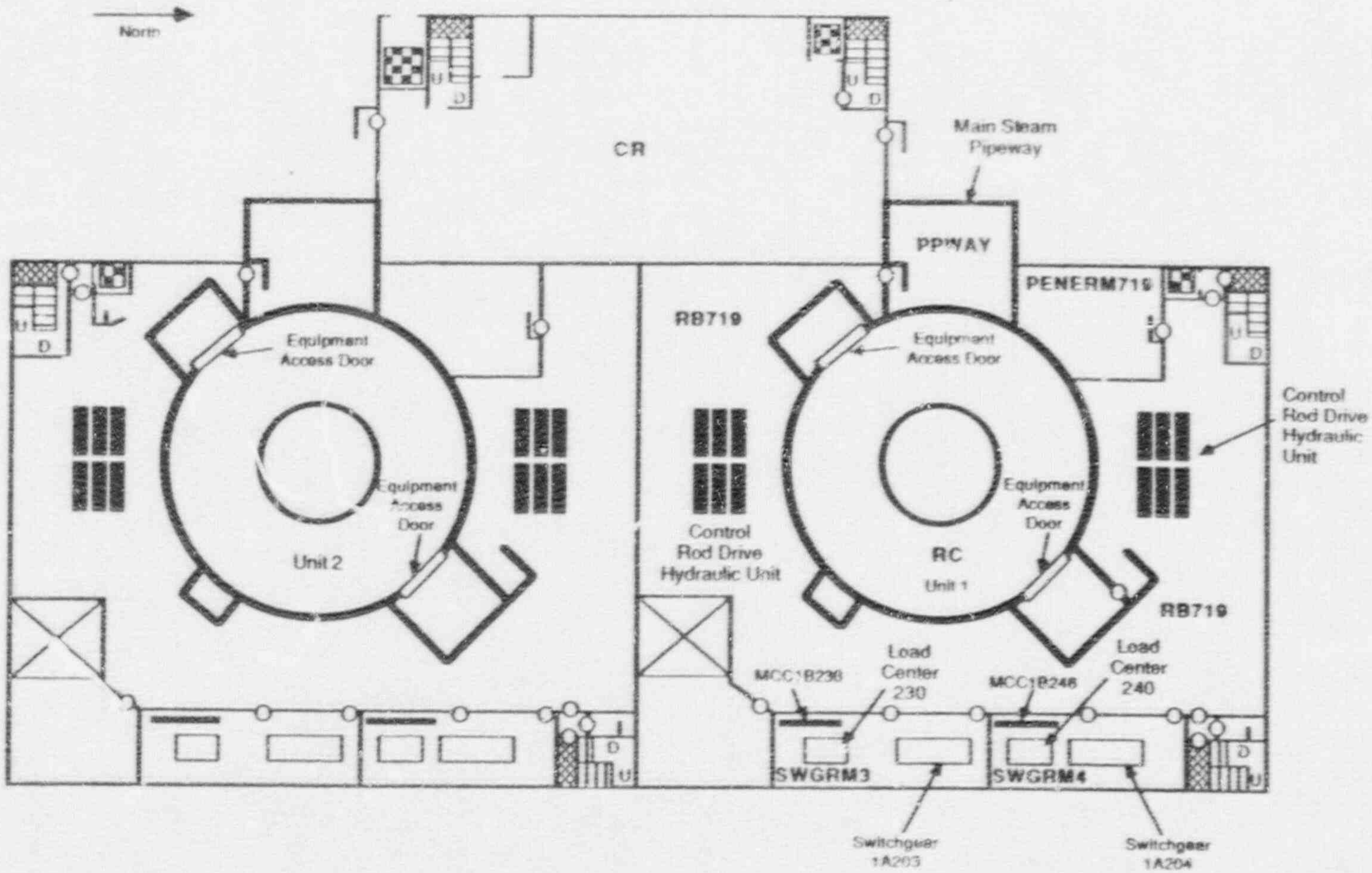


Figure 4-6. Susquehanna 1 and 2 Reactor Building, Elevation 670' and Control Building, Elevation 676'



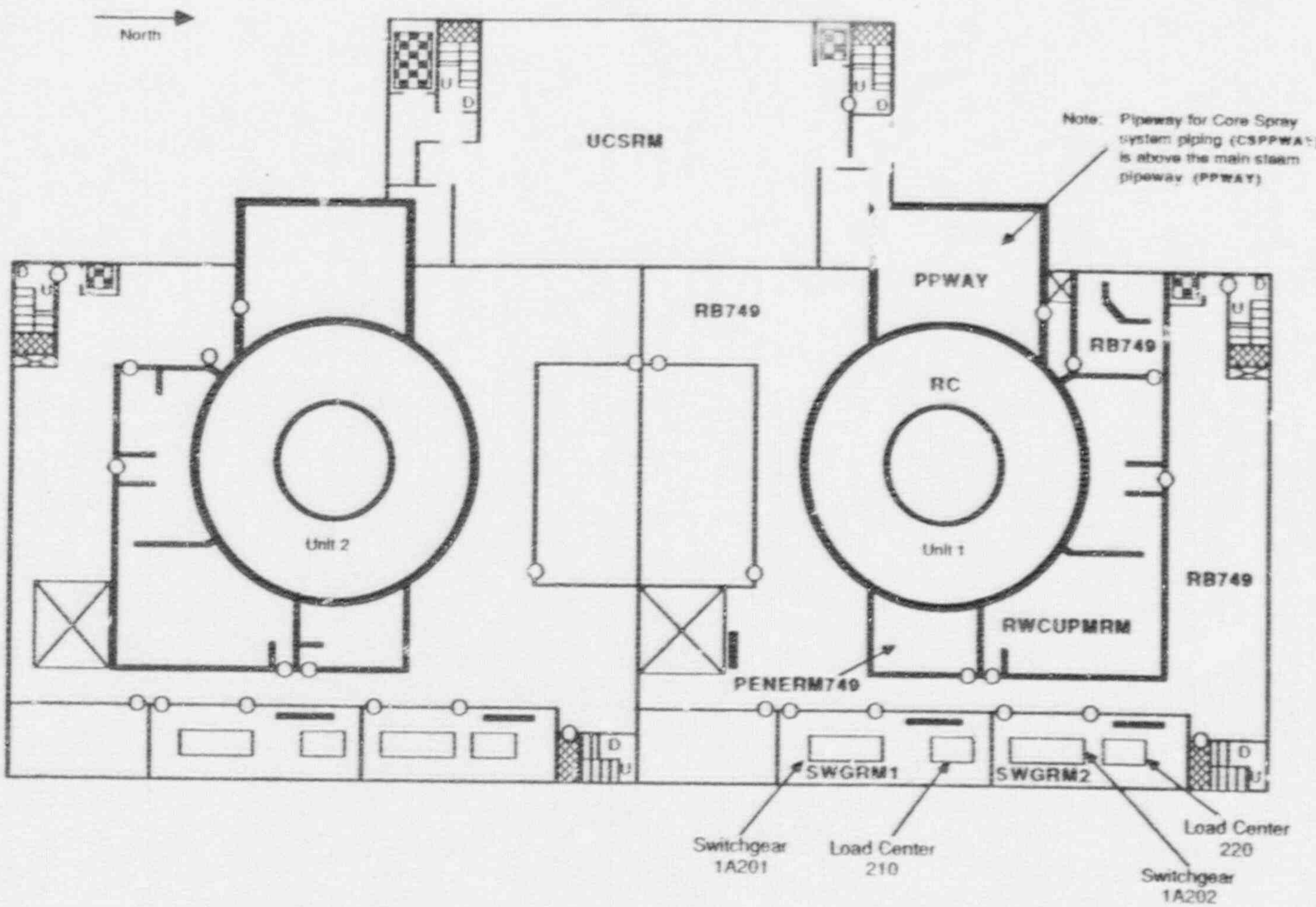
NOTE: RELAYRM1 IS LOCATED IN THE CONTROL BUILDING AT THIS ELEVATION

Figure 4-7. Susquehanna 1 and 2 Reactor Building, Elevation 683' and Control Building, Elevation 689'



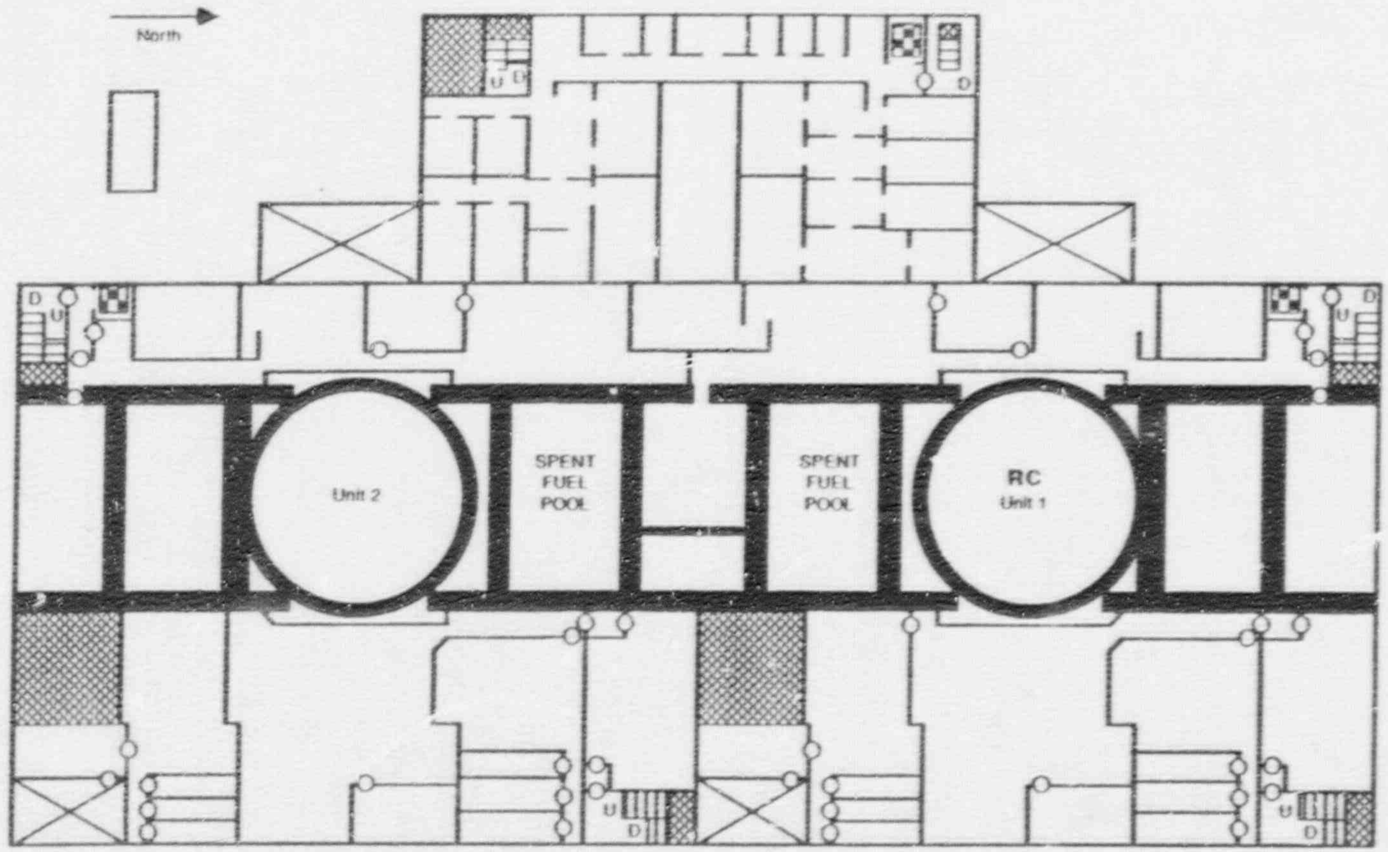
NOTE: MCC1B229 IS LOCATED IN THE CONTROL BUILDING AT THIS ELEVATION

Figure 4-8. Susquehanna 1 and 2 Reactor Building, Elevation 719' and Control Building, Elevation 729'



NOTE: RELAYRM2 IS LOCATED IN THE CONTROL BUILDING AT THIS ELEVATION

Figure 4-9. Susquehanna 1 and 2 Reactor Building, Elevation 749' and Control Building, Elevation 753'



NOTE: ELECRM, 125BATRMA, 125BATRMB, 125BATRMC, AND 125BATRMD ARE LOCATED IN THE CONTROL BUILDING AT THIS ELEVATION

Figure 4-10. Susquehanna 1 and 2 Reactor Building, Elevation 779'1" and Control Building, Elevation 771'

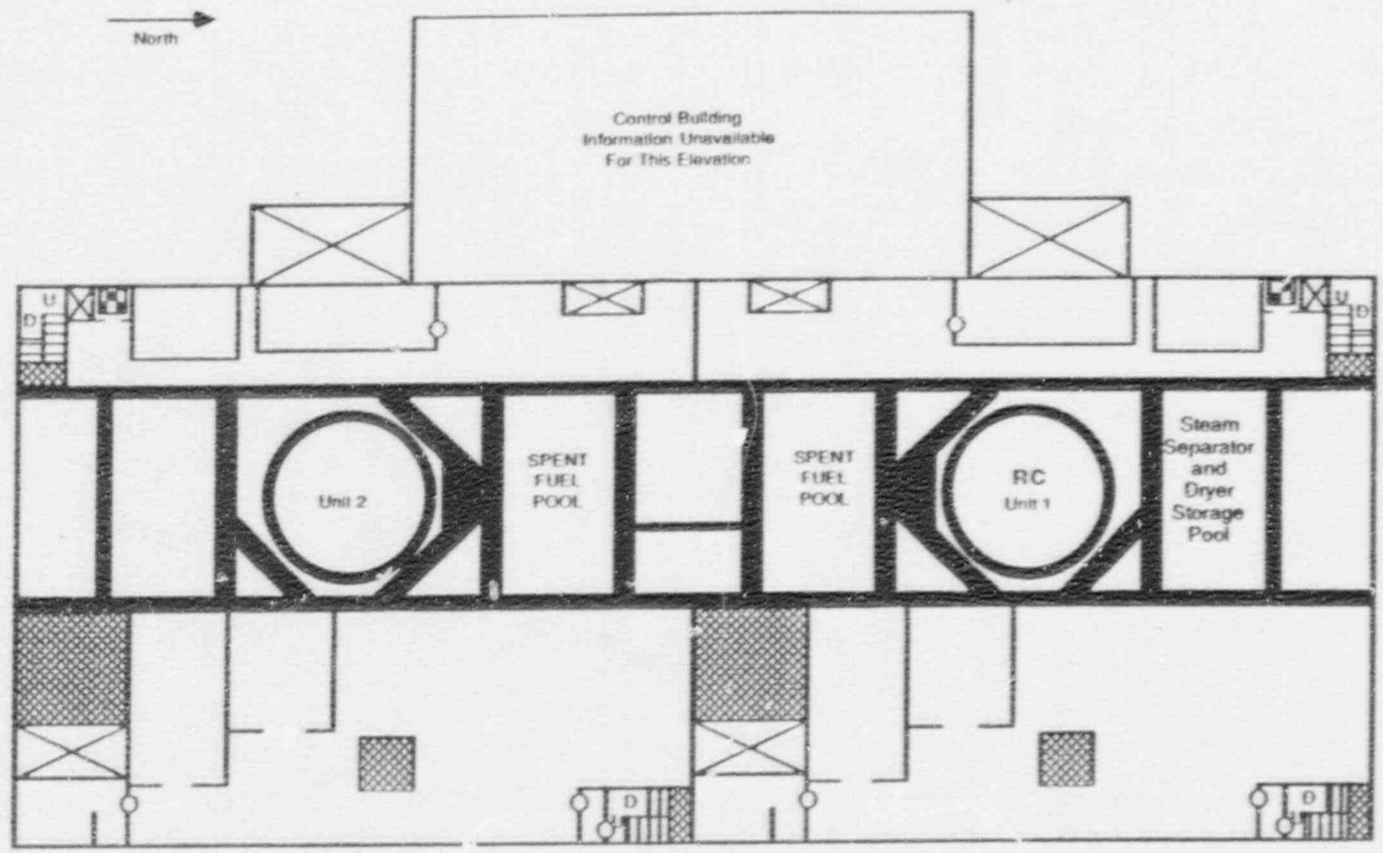


Figure 4-11. Susquehanna 1 and 2 Diesel Generator Building, Elevation 799' and Control Building, Elevation 799'

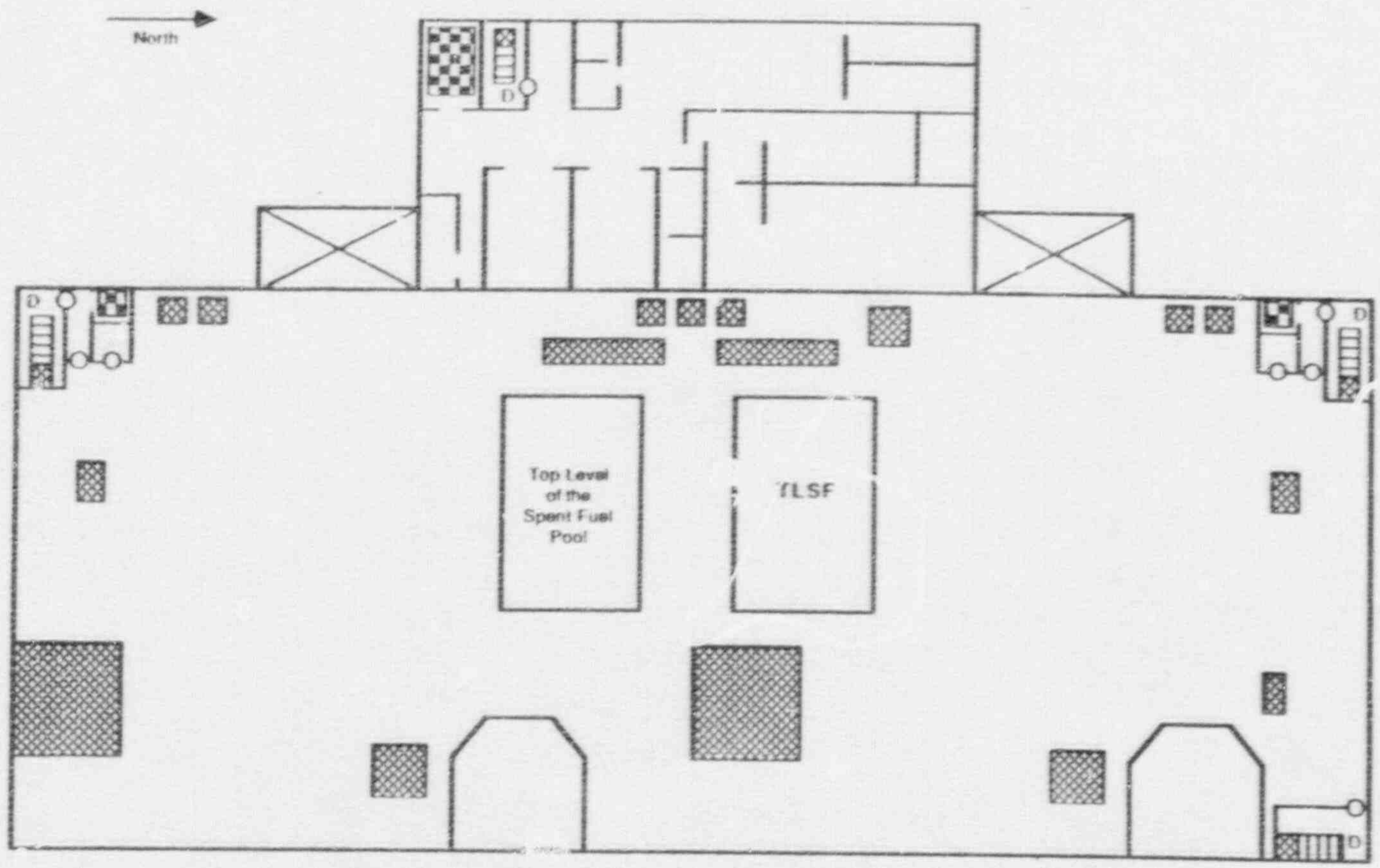


Figure 4-12. Susquehanna 1 and 2 Diesel Generator Building, Elevation 818' and Control Building, Elevation 806'

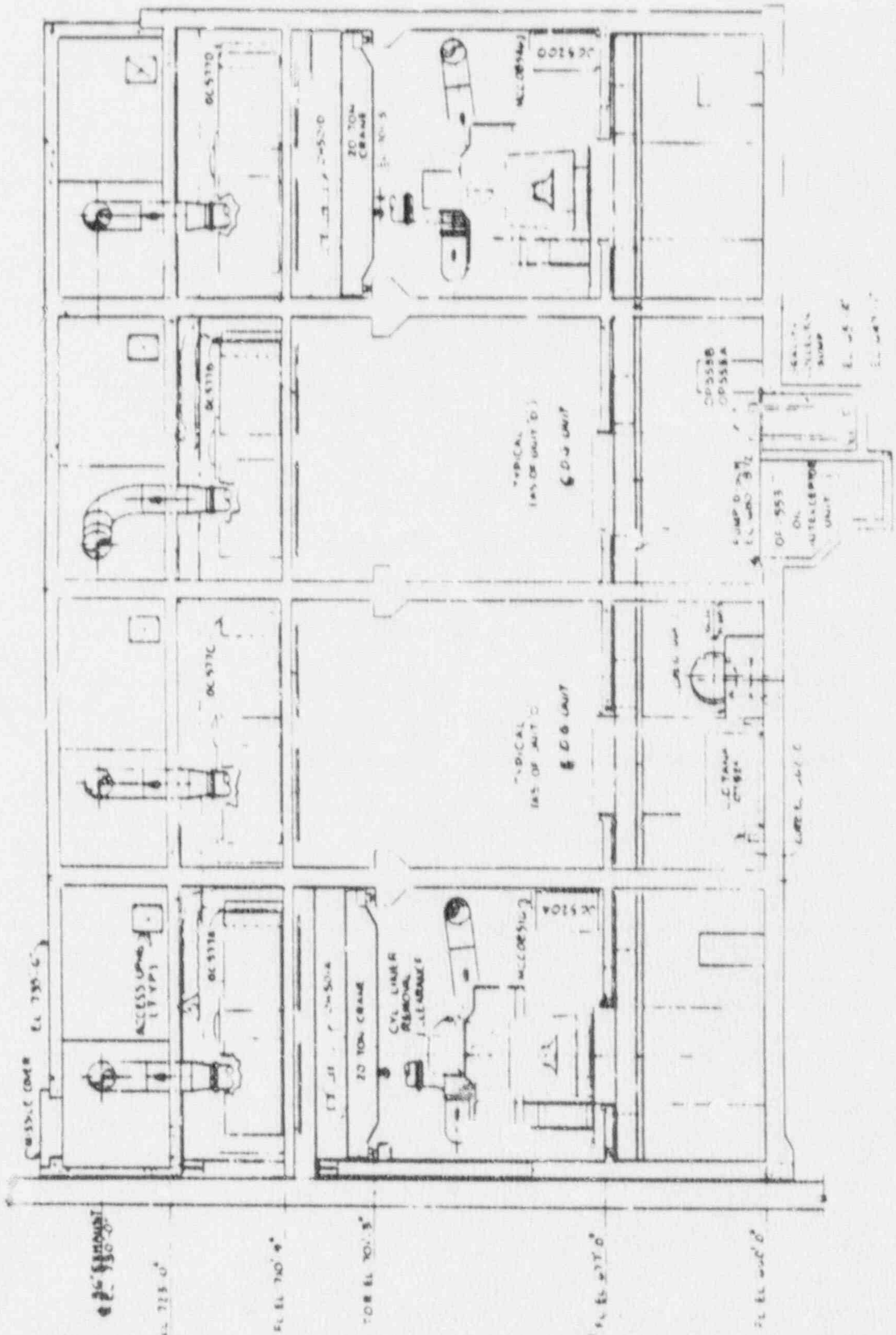


Figure 4-13. Susquehanna Diesel Generator A-D Building Looking West

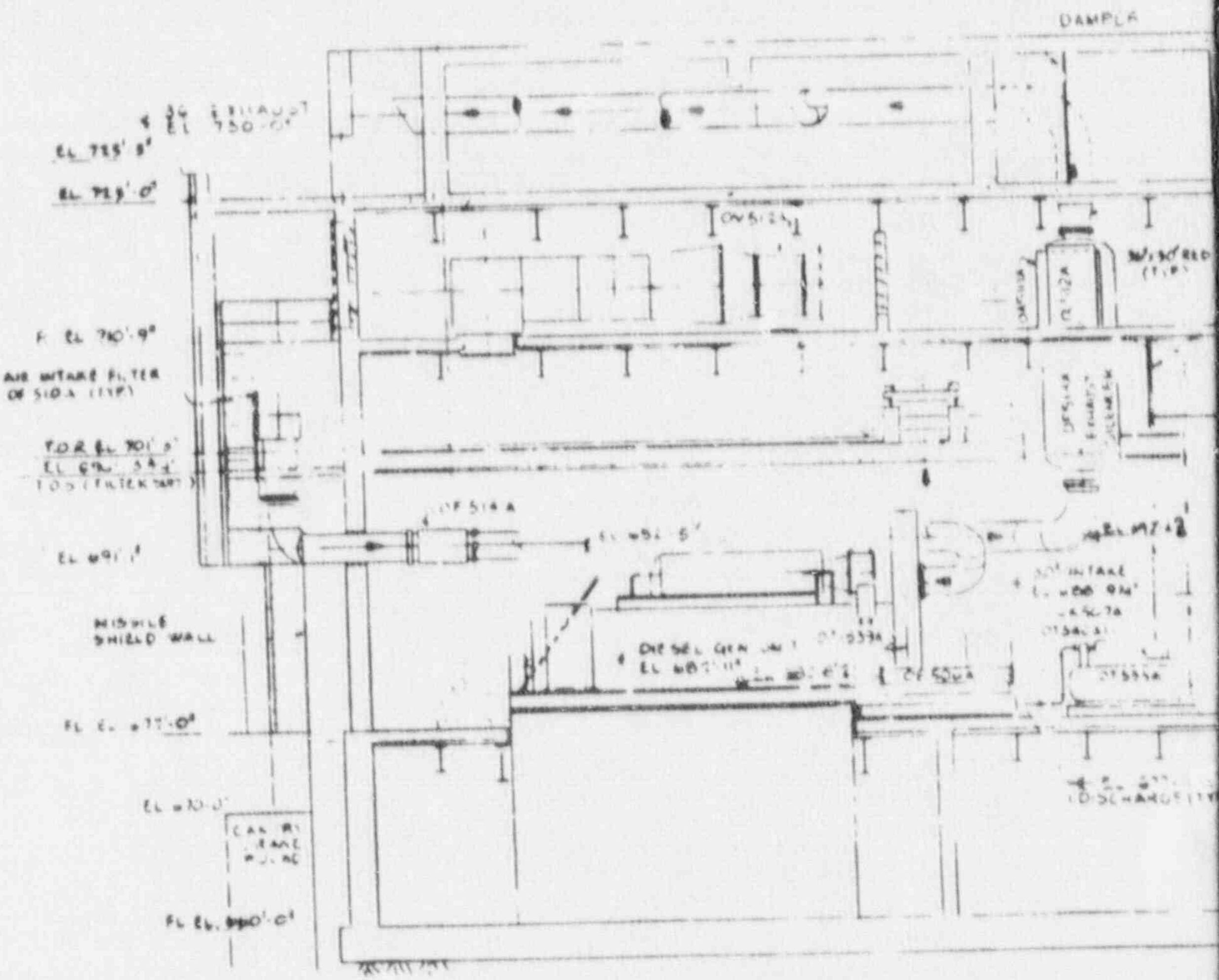


Figure 4-14. Susquehanna Diesel Generator A-D Building Look

2

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

PHOTOGRAPHIC SCIENCES CORPORATION
770 BASKET ROAD
P.O. BOX 338
WEBSTER, NEW YORK 14580
(716) 265-1600

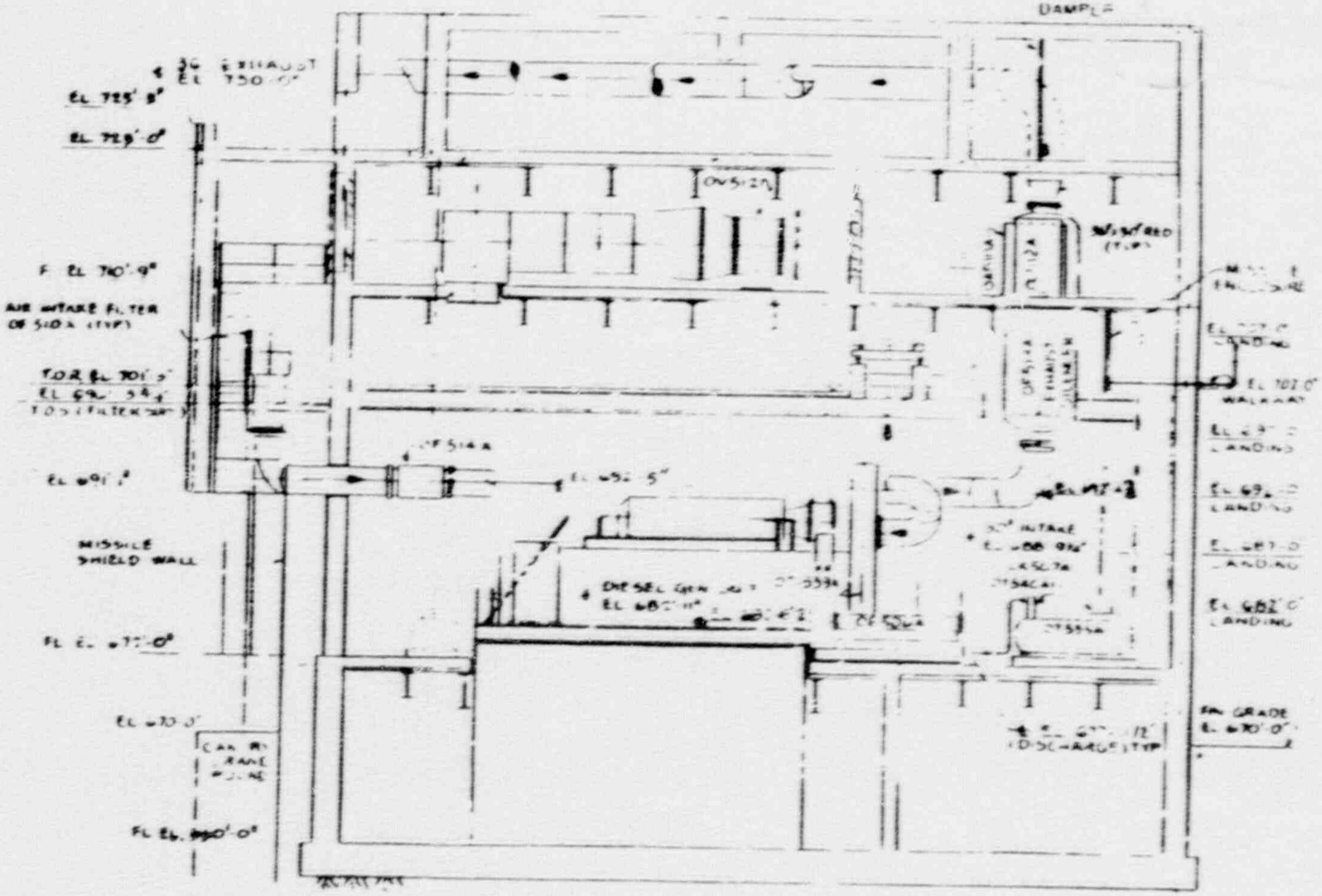


Figure 4-14. Susquehanna Diesel Generator A-D Building Looking South

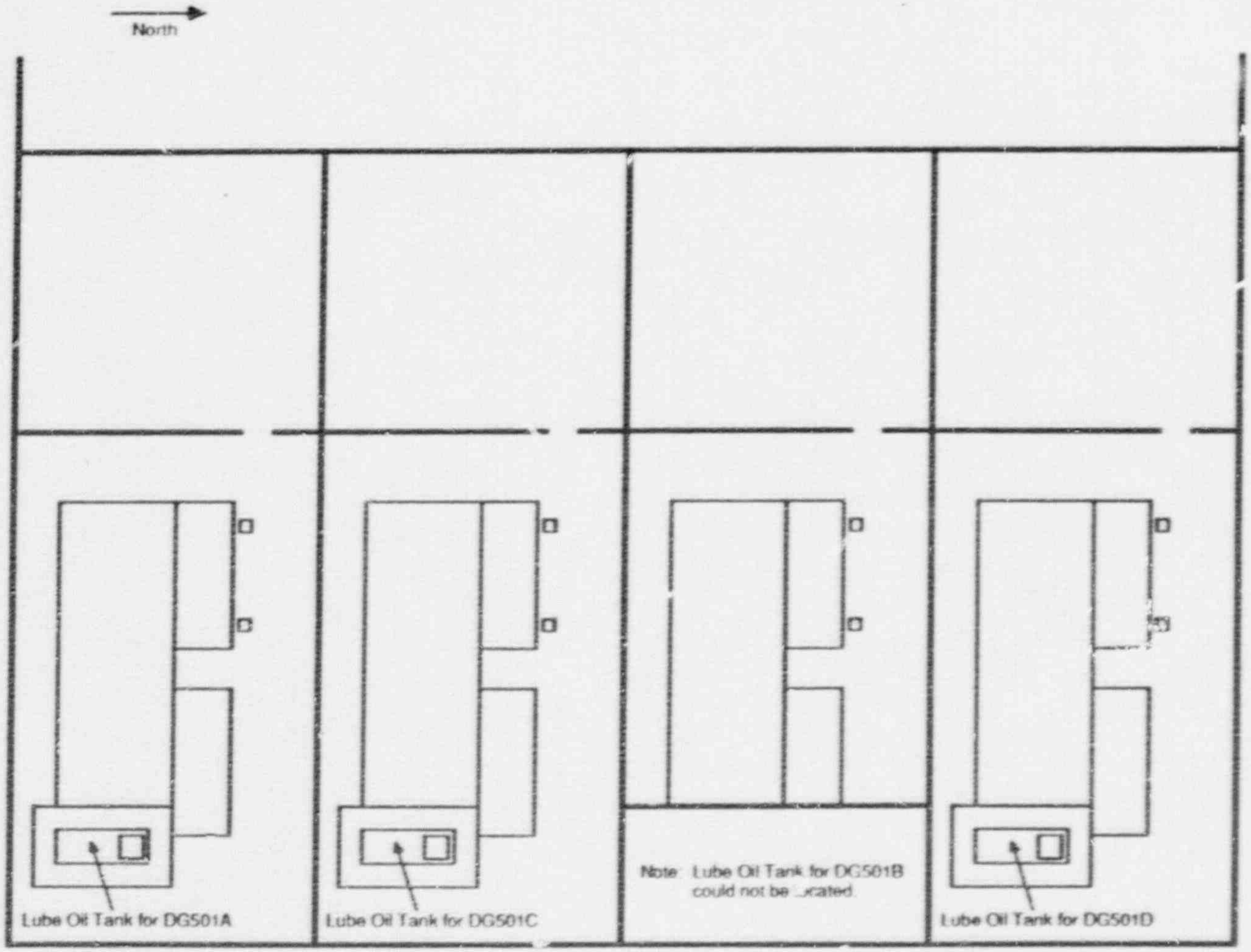


Figure 4-15. Susquehanna 1 and 2 Diesel Generator A-D Building, Elevation 660'

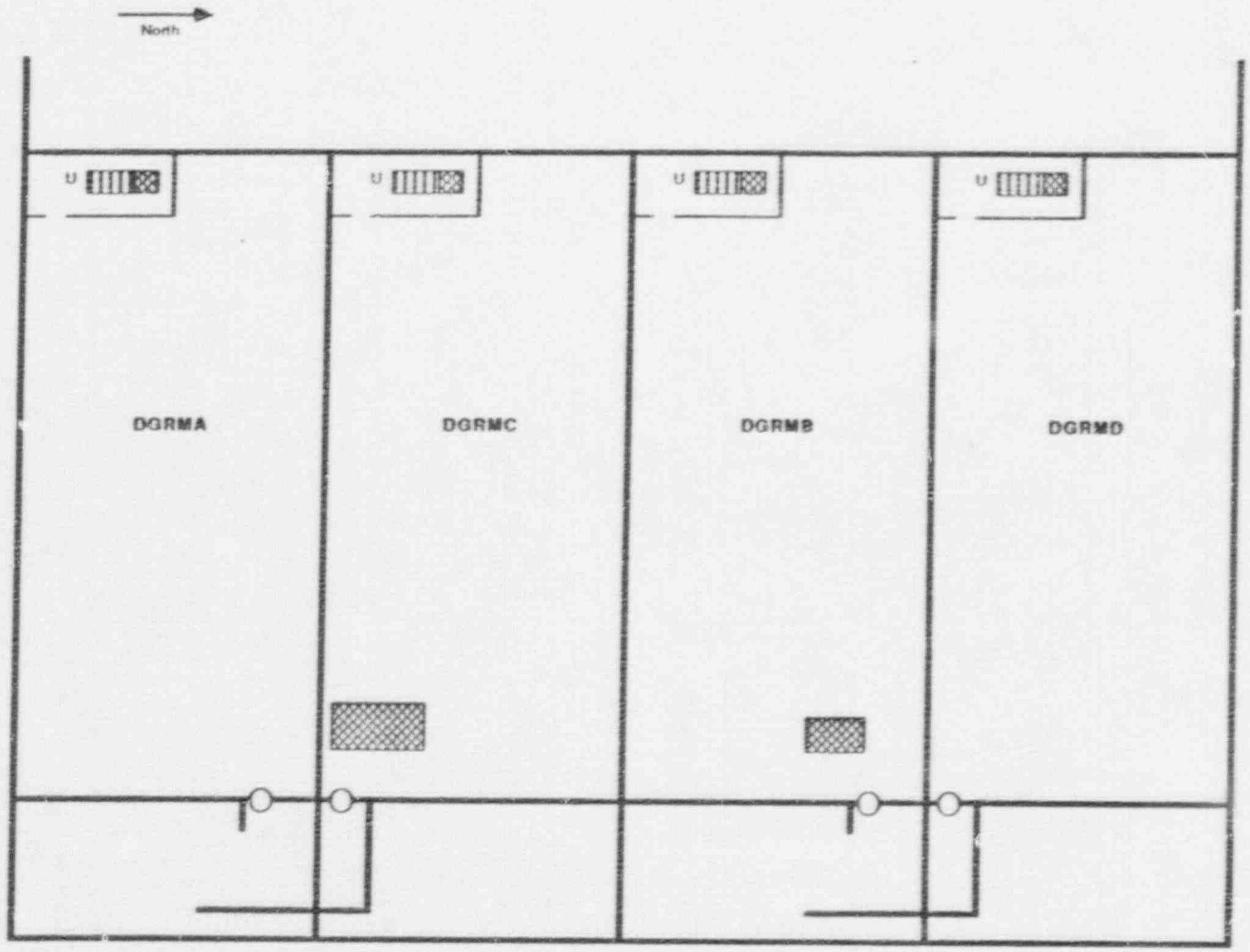


Figure 4-16 Susquehanna 1 and 2 Diesel Generator A-D Building, Elevation 677'

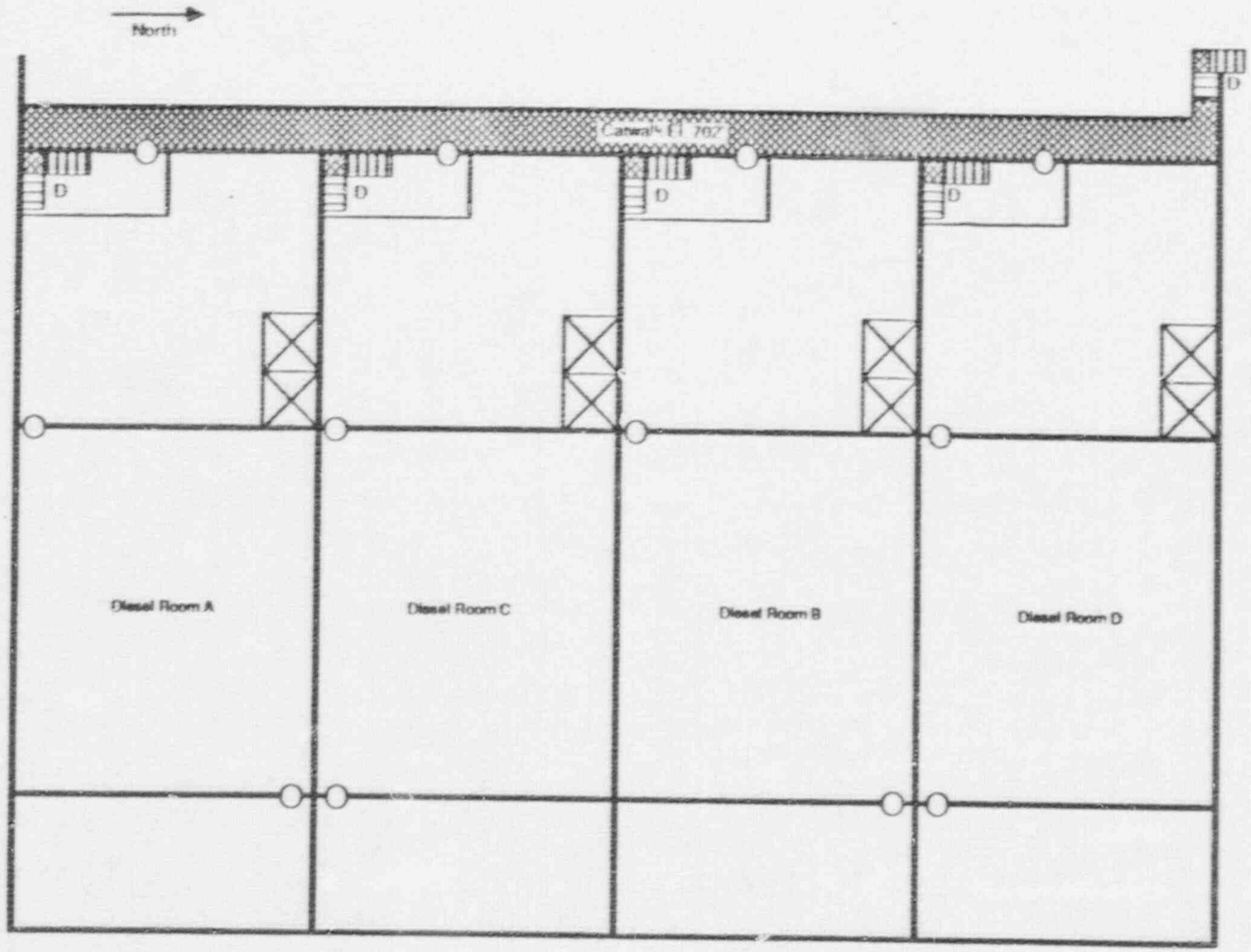


Figure 4-17. Susquehanna 1 and 2 Diesel Generator A-D Building, Elevation 710' 9"

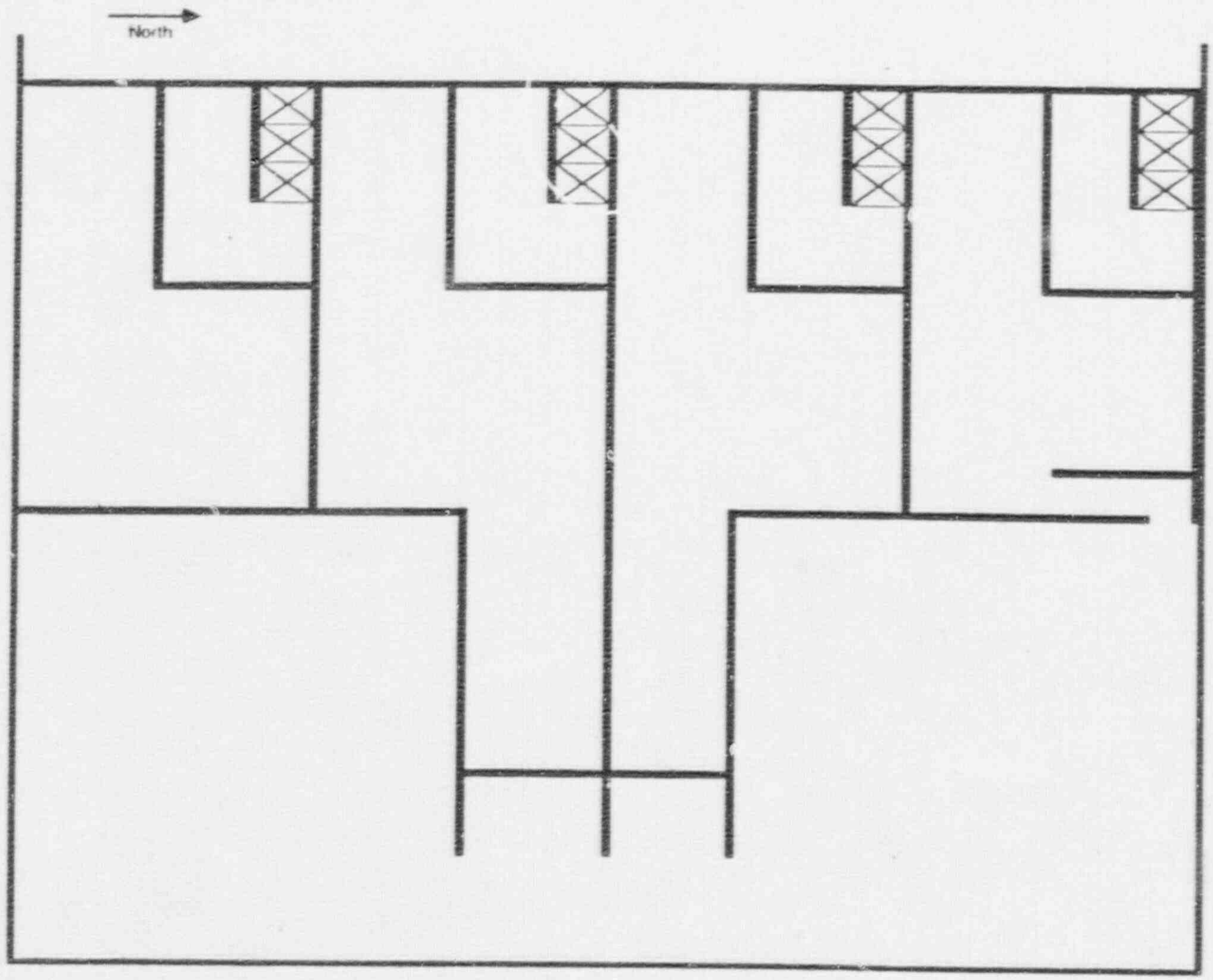


Figure 4-18. Susquehanna 1 and 2 Diesel Generator A-D Building, Elevation 723'

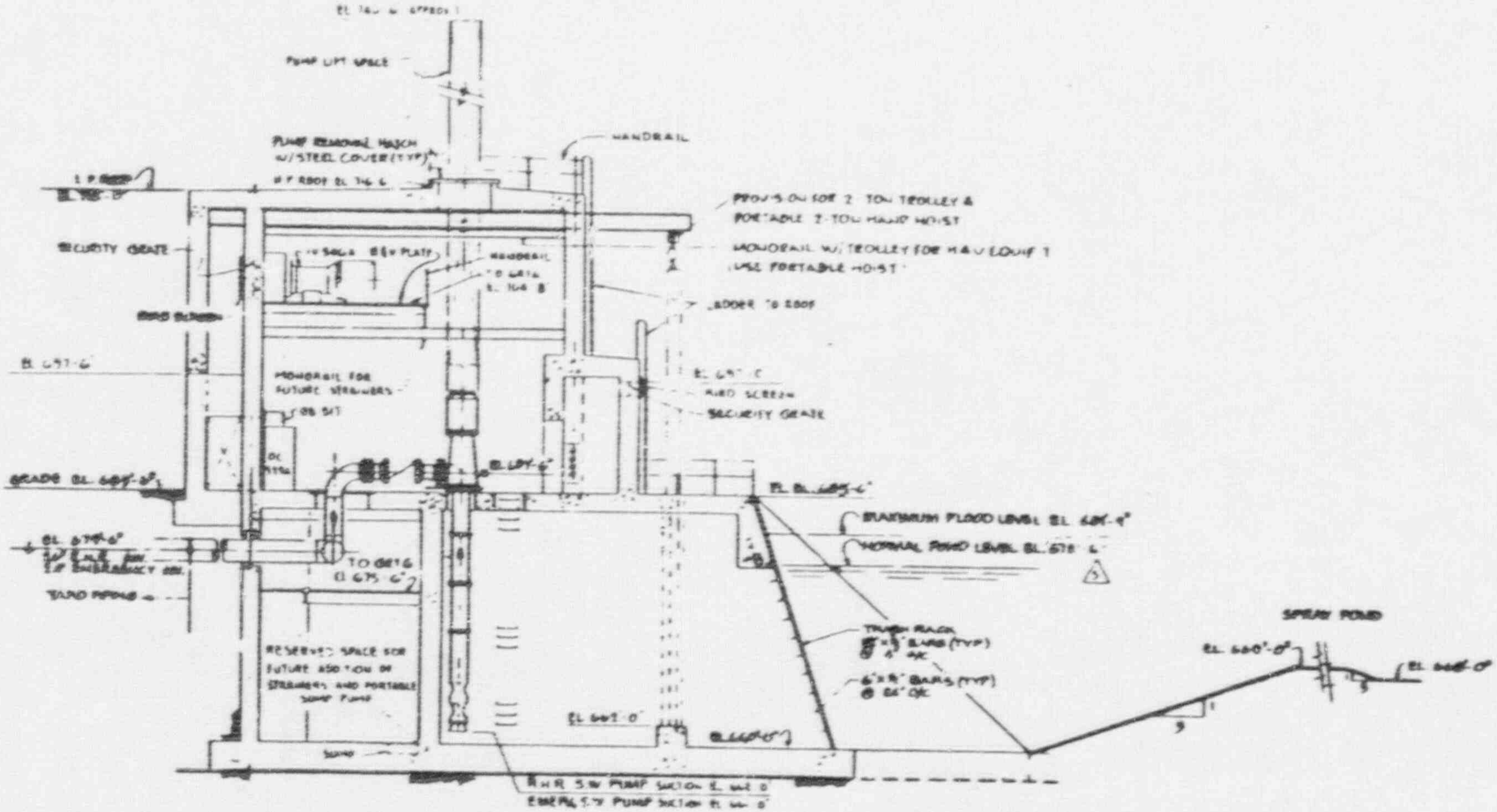


Figure 4-19. Susquehanna Emergency Service Water Pumphouse Looking South

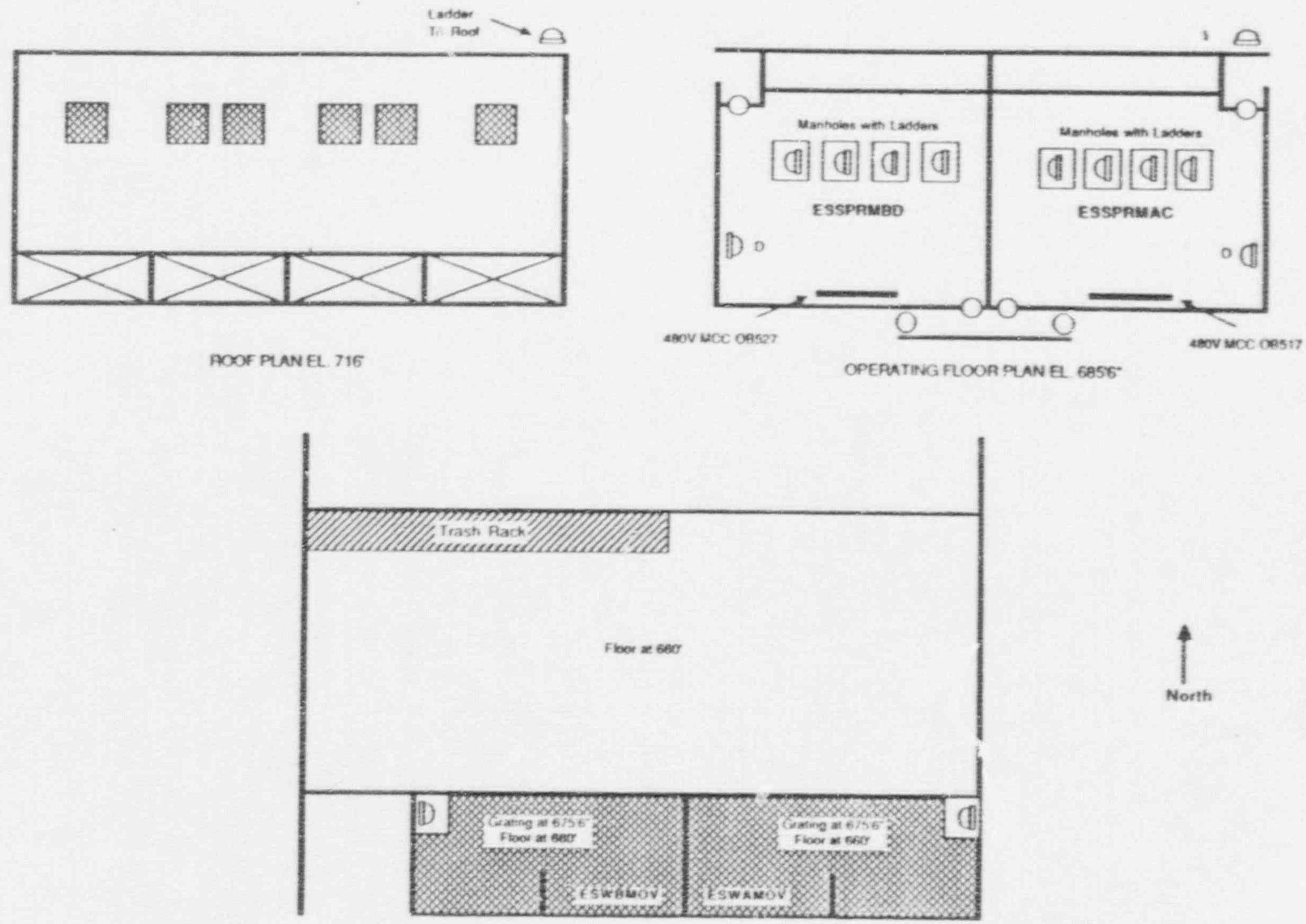


Figure 4-20. Susquehanna 1 and 2 Emergency Service Water Pumphouse, Elevations 660', 675'6", 685'6", and 716'

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

	Codes	Descriptions
1.	125BATRMA	125 Volt Battery Room 1A, located at the north end of the Control Building at the 771' elevation
2.	125BATRMB	125 Volt Battery Room 1B, located at the north end of the Control Building at the 771' elevation
3.	125BATRMC	125 Volt Battery Room 1C, located at the north end of the Control Building at the 771' elevation
4.	125BATRMD	125 Volt Battery Room 1D, located at the north end of the Control Building at the 771' elevation
5.	CR	Control Room located at the 729' elevation of the Control Building
6.	CSPPWAY	Core Spray Pipeway, located above the main steam pipeway (area PPWAY)
7.	CSPRMAC	Core Spray Pump Room containing Trains A and C pumps located northwest of containment at the 645' elevation of the Reactor Building
8.	CSPRMBD	Core Spray Pump Room containing Trains B and D pumps located southwest of containment at the 645' elevation of the Reactor Building
9.	CST	Condensate Storage Tank located in Yard
10.	DGRMA	Room in the Diesel Generator Building at the 677' elevation housing Diesel Generator "A" and its associated equipment
11.	DGRMB	Room in the Diesel Generator Building at the 677' elevation housing Diesel Generator "B" and its associated equipment
12.	DGRMC	Room in the Diesel Generator Building at the 677' elevation housing Diesel Generator "C" and its associated equipment
13.	DGRMD	Room in the Diesel Generator Building at the 677' elevation housing Diesel Generator "D" and its associated equipment
14.	ELECRM	Electrical Equipment Room located at the 771' elevation of the Control Building
15.	ESSPRMAC	Emergency Service Water Pump Room AC containing pumps 504A and 504C located in the Emergency Service Water Building at the Coolant Pond

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

Codes	Descriptions
16. ESSPRMBD	Emergency Service Water Pump Room BD containing pumps 504B and 504D located in the Emergency Service Water Building at the Coolant Pond
17. ESWAMOV	Represents the location of the discharge valves to the spray pond in Loop A of the Emergency Service Water System and the RHR Emergency Service Water System. Physically located in the valve vault on the 675'6" elevation of the ESW pumphouse.
18. ESWBMOV	Represents the location of the discharge valves to the spray pond in Loop B of the Emergency Service Water System and the RHR Emergency Service Water System. Physically located in the valve vault on the 675'6" elevation of the ESW pumphouse.
19. HPCIRM	High Pressure Coolant Injection System Equipment Room located between the 645' and 670' elevations of the Reactor Building
20. LCSRM	Lower Cable Spreading Room located at the 714' elevation of the Control Building
21. LTFUELA	Represents the long-term fuel storage tank for diesel generator A. It is located underground adjacent to the Diesel Generator Building
22. LTFUELB	Represents the long-term fuel storage tank for diesel generator B. It is located underground adjacent to the Diesel Generator Building
23. LTFUELC	Represents the long-term fuel storage tank for diesel generator C. It is located underground adjacent to the Diesel Generator Building
24. LTFUELD	Represents the long-term fuel storage tank for diesel generator D. It is located underground adjacent to the Diesel Generator Building
25. MCC1B229	Motor Control Center #1B229 located in the Reactor Building at the 719' elevation

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

Codes	Descriptions
26. MCC1B247	Motor Control Center #1B247 located in the Reactor Building at the 670' elevation
27. MSTMPPWAY	Main Steam Pipeway between containment and the Turbine Building beginning at the 719' elevation of the Reactor Building
28. PENERM719	Penetration Room located northwest of containment at the 719' elevation of the Reactor Building
29. PENERM749	Penetration Room on the east side of containment at the 749' elevation of the Reactor Building
30. PPWAY	Pipeway located north of containment between the 719' and 749' elevations of the Reactor Building
31. RB670N	Area north of containment at the 670' elevation of the Reactor Building
32. RB670NE	Area northeast of containment at the 670' elevation of the Reactor Building
33. RB670SW	Area southwest of containment at the 670' elevation of the Reactor Building
34. RB683	683' elevation of the Reactor Building
35. RB683NE	Room located north and east of containment at the 683' elevation of the Reactor Building
36. RB719	719' elevation of the Reactor Building
37. RB749	749' elevation of the Reactor Building
38. RC	Reactor Containment
39. RCICRM	Reactor Core Isolation Cooling System Equipment Room located between the 645' and 670' elevation of the Reactor Building
40. RELAYRM1	Relay Room No. 1 located at the 754' elevation of the Control Building
41. RELAYRM2	Relay Room No. 2 located at the 698' elevation of the Control Building

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

Codes	Descriptions
42. RHRAC	Residual Heat Removal System Trains A and C Equipment Room located southeast of containment between 645' and 670' of the Reactor Building
43. RHRBD	Residual Heat Removal System Trains B and D Equipment Room located northeast of containment between the 645' and 670' of the Reactor Building
44. RSDPNL	Remote Shutdown Panel Room located at the 670' elevation of the Reactor Building
45. RWCUPMRM	Reactor Water Clean-Up Pump Room located north of containment at the 749' elevation of the Reactor Building.
46. RSWAPIPE	Represents the location of components in Loop A of the RHR Service Water System that are located on the 650' to 670' elevations of the Reactor Building.
47. RSWBPIPE	Represents the location of components in Loop B of the RHR Service Water System that are located on the 650' to 670' elevations of the Reactor Buildings
48. SWGRM1	Switchgear Room No. 1 located on the east side of the Reactor Building at the 749' elevation
49. SWGRM2	Switchgear Room No. 2 located on the east side of the Reactor Building at the 749' elevation
50. SWGRM3	Switchgear Room No. 3 located on the east side of the Reactor Building at the 719' elevation
51. SWGRM4	Switchgear Room No. 4 located on the east side of the Reactor Building at the 719' elevation
52. TB729	729' elevation of the Turbine Building, east side of the building
53. TLSF	Spent fuel pool operating floor located at 818' elevation of the Reactor Building
54. UCSRM	Upper Cable Spreading Room located at the 754' elevation of the Control Building

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
125BATRMA	EP	EP-BT-1A	BATT
125BATRMB	EP	EP-BT-1B	BATT
125BATRMC	EP	EP-BT-1C	BATT
125BATRMD	EP	EP-BT-1D	BATT
CSPRMAC	ECCS	CS-1A	MOV
CSPRMAC	ECCS	CS-P1A	MDP
CSPRMAC	ECCS	CS-P1C	MDP
CSPRMBD	ECCS	CS-1B	MOV
CSPRMBD	ECCS	CS-P1B	MDP
CSPRMBD	ECCS	CS-P1D	MDP
CSPRMBD	ECCS	HPCI-16	MOV
CSPRMBD	RCIC	RCIC-11	MOV
CST	ECCS	HPCI-CST	TANK
CST	RCIC	RCIC-CST	TANK
DGRMA	EP	EP-DG-501A	DG
DGRMA	EP	EP-MCC-0B516	MCC
DGRMA	ESW	ESW-1112A	MOV
DGRMA	ESW	ESW-1122A	MOV
DGRMB	EP	EP-DG-501B	DG
DGRMB	EP	EP-MCC-0B526	MCC
DGRMB	ESW	ESW-1110B	MOV
DGRMB	ESW	ESW-1120B	MOV
DGRMC	EP	EP-DG-501C	DG
DGRMC	EP	EP-MCC-0B536	MCC
DGRMC	ESW	ESW-1112C	MOV
DGRMC	ESW	ESW-1122C	MOV
DGRMD	EP	EP-DG-501D	DG
DGRMD	EP	EP-MCC-0B546	MCC
DGRMD	ESW	ESW-1110D	MOV
DGRMD	ESW	ESW-1120D	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
ELECRM	EP	EP-BC-1D613	BC
ELECRM	EP	EP-BC-1D623	BC
ELECRM	EP	EP-BC-1D633	BC
ELECRM	EP	EP-BC-1D643	BC
ELECRM	EP	EP-BC-1D653A	BC
ELECRM	EP	EP-BC-1D653B	BC
ELECRM	EP	EP-BC-1D663	BC
ELECRM	EP	EP-BS-1D642	BS
ELECRM	EP	EP-BS-1D612	BS
ELECRM	EP	EP-BS-1D622	BS
ELECRM	EP	EP-BS-1D632	BS
ELECRM	EP	EP-BS-1D652	BS
ELECRM	EP	EP-BS-1D662	BS
ELECRM	EP	EP-BS-1D652	BS
ELECRM	EP	EP-BS-1D6[illegible]2	BS
ELECRM	I&C	EP-PS-1D666	PNL
ELECRM	I&C	EP-PNL-1Y629	PNL
ELECRM	I&C	EP-PS-1D666	PNL
ESSPRMAC	EP	EP-MCC-0B517	MCC
ESSPRMAC	ESW	ESW-PA	MDP
ESSPRMAC	ESW	ESW-PC	MDP
ESSPRMAC	RHRSW	RHRSW-P1A	MDP
ESSPRMBD	EP	EP-MCC-0B527	MCC
ESSPRMBD	ESW	ESW-PB	MDP
ESSPRMBD	ESW	ESW-PD	MDP
ESSPRMBD	RHRSW	RHRSW-P1B	MDP
ESWAMOV	ESW	ESW-21224A2	MOV
ESWAMOV	ESW	ESW-1224A1	MOV
ESWAMOV	ESW	ESW-1224A2	MOV
ESWBMOV	ESW	ESW-1224B2	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
ESWBMOV	ESW	ESW-F1223B	MOV
HPCIRM	ECCS	HPCI-1	MOV
HPCIRM	ECCS	HPCI-4	MOV
HPCIRM	ECCS	HPCI-42	MOV
HPCIRM	ECCS	HPCI-66	MOV
HPCIRM	ECCS	HPCI-TDP	TDP
HPCIRM	ECCS	HPCI-46	MOV
MCC1B229	EP	EP-MCC-1B229	MCC
MCC1B229	EP	EP-MCC-1B229	MCC
MCC1B247	EP	EP-MCC-1B247	MCC
PENERM749	ECCS	RHR-16A	MOV
PENERM749	ECCS	RHR-21A	MOV
PENERM749	ECCS	RHR-16A	MOV
PENERM749	ECCS	RHR-21A	MOV
PPWAY	ECCS	CS-4A	MOV
PPWAY	ECCS	CS-4B	MOV
PPWAY	ECCS	CS-5A	MOV
PPWAY	ECCS	CS-5B	MOV
PPWAY	ECCS	HPCI-6	MOV
PPWAY	ECCS	RHR-16B	MOV
PPWAY	ECCS	RHR-21B	MOV
PPWAY	ECCS	RHR-16B	MOV
PPWAY	ECCS	RHR-21B	MOV
PPWAY	RCIC	RCIC-13	MOV
PPWAY	RCS	RCS-19	MOV
PPWAY	RCS	RCS-21	MOV
RB670N	ECCS	HPCI-7	MOV
RB670N	ECCS	HPCI-8	MOV
RB670N	RCIC	RCIC-12	MOV
RB670N	RCIC	RCIC-22	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RB670NE	EP	EP-MCC-1D274	MCC
RB670SW	EP	EP-MCC-1B237	MCC
RB670SW	EP	EP-MCC-1B219	MCC
RB670SW	EP	EP-MCC-1B219	MCC
RB670SW	EP	EP-MCC-1D254	MCC
RB683	ECCS	CS-15A	MOV
RB683	ECCS	HPCI-3	MOV
RB683	ECCS	RHR-17A	MOV
RB683	ECCS	RHR-15A	MOV
RB683	ECCS	RHR-15B	MOV
RB683	ECCS	RHR-17B	MOV
RB683	ECCS	RHR-24B	MOV
RB683	ECCS	RHR-24A	MOV
RB683	ECCS	RHR-28A	MOV
RB683	ECCS	RHR-28B	MOV
RB683	ECCS	RHR-48A	MOV
RB683	ECCS	RHR-48B	MOV
RB683	ECCS	RHR-28A	MOV
RB683	ECCS	RHR-27A	MOV
RB683	ECCS	RHR-24A	MOV
RB683	ECCS	RHR-48A	MOV
RB683	ECCS	RHR-28B	MOV
RB683	ECCS	RHR-27B	MOV
RB683	ECCS	RHR-24B	MOV
RB683	ECCS	RHR-48B	MOV
RB683	EP	EP-MCC-1B216	MCC
RB683	RCIC	RCIC-8	MOV
RB683	RCS	HPCI-3	MOV
RB683	RCS	RCIC-8	MOV
RB683NE	ECCS	CS-15B	MOV

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RB683NE	EP	EP-MCC-1B226	MCC
RB683NE	EP	EP-MCC-1D264	MCC
RC	ECCS	HPCI-2	MOV
RC	ECCS	HPCI-11B	MOV
RC	RCIC	RCIC-7	MOV
RC	RCS	HPCI-2	MOV
RC	RCS	RCS-16	MOV
RC	RCS	RCIC-7	MOV
RC	RCS	RCS-9	MOV
RC	RCS	RCS-1	MOV
RC	RCS	RCS-100	MOV
RC	RCS	RCS-102	MOV
RC	RCS	RCS-106	MOV
RC	RCS	RCS-V1	MOV
RC	RCS	RCS-2	MOV
RC	RCS	RCS-5	MOV
RCICRM	ECCS	HPCI-10	MOV
RCICRM	RCIC	RCIC-10	MOV
RCICRM	RCIC	RCIC-31	MOV
RCICRM	RCIC	RCIC-45	MOV
RCICRM	RCIC	RCIC-59	MOV
RCICRM	RCIC	RCIC-TDP	TDP
RCICRM	RCIC	RCIC-46	MOV
RHRAC	ECCS	RHR-3A	MOV
RHRAC	ECCS	RHR-4A	MOV
RHRAC	ECCS	RHR-4C	MOV
RHRAC	ECCS	RHR-6A	MOV
RHRAC	ECCS	RHR-6C	MOV
RHRAC	ECCS	RHR-47A	MOV
RHRAC	ECCS	RHR-P1A	MDP

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
RHRAC	ECCS	RHR-P1C	MDP
RHRAC	ECCS	RHR-6A	MOV
RHRAC	ECCS	RHR-6C	MOV
RHRBD	ECCS	RHR-3B	MOV
RHRBD	ECCS	RHR-4B	MOV
RHRBD	ECCS	RHR-4D	MOV
RHRBD	ECCS	RHR-6B	MOV
RHRBD	ECCS	RHR-6D	MOV
RHRBD	ECCS	RHR-47B	MOV
RHRBD	ECCS	RHR-P1B	MDP
RHRBD	ECCS	RHR-P1D	MDP
RHRBD	ECCS	RHR-8B	MOV
RHRBD	ECCS	RHR-6D	MOV
RHRBD	RCS	RCS-8	MOV
RSWAPIPE	RHRSW	RHRSW-11210A	MOV
RSWAPIPE	RHRSW	RHRSW-11215A	MOV
RSWBPIPE	RHRSW	RHRSW-11210B	MOV
RSWBPIPE	RHRSW	RHRSW-11215B	MOV
SWGRM1	EP	CB-C1A201	CB
SWGRM1	EP	EP-BS-1A201	BS
SWGRM1	EP	EP-BS-1B210	BUS
SWGRM1	EP	EP-TR-1X210	TRANS
SWGRM1	EP	EP-MCC-1B217	MCC
SWGRM2	EP	CB-C1A202	CB
SWGRM2	EP	EP-BS-1A202	BS
SWGRM2	EP	EP-BS-1B220	BS
SWGRM2	EP	EP-TR-1X220	TRANS
SWGRM2	EP	EP-MCC-1B227	MCC
SWGRM3	EP	CB-C1A203	CB
SWGRM3	EP	EP-BS-1A203	BS

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

LOCATION	SYSTEM	COMPONENT ID	COMP TYPE
SWGRM3	EP	EP-BS-1B230	BUS
SWGRM3	EP	EP-TR-1X230	TRANS
SWGRM3	EP	EP-MCC-1B236	MCC
SWGRM4	EP	CB-C1A204	CB
SWGRM4	EP	EP-BS-1A204	BS
SWGRM4	EP	EP-BS-1B240	BUS
SWGRM4	EP	EP-TR-1X240	TRANS
SWGRM4	EP	EP-MCC-1B246	MCC

5. BIBLIOGRAPHY FOR SUSQUEHANNA 1 & 2

1. NUREG-0546, "Final Environmental Statement Related to the Operation of Susquehanna Steam Electric Station, Units 1 and 2", USNRC, June 1981

2. NUREG-0776, "Safety Evaluation Report Related to the Operation of Susquehanna Steam Electric Station, Units 1 and 2", USNRC

3. NUREG-0931, "Technical Specifications for Susquehanna Steam Electric Station, Unit No. 1", USNRC

4. NUREG-1042, "Technical Specifications for Susquehanna Steam Electric Station, Unit No. 2", USNRC

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

A1. SYSTEM DRAWINGS

A1.1 Fluid System Drawings

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

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

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

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

A1.2 Electrical System Drawings

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

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

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

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

A2. SITE AND LAYOUT DRAWINGS

A2.1 Site Drawings

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

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

A2.2 Layout Drawings

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

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

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

A3. APPENDIX A REFERENCES

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

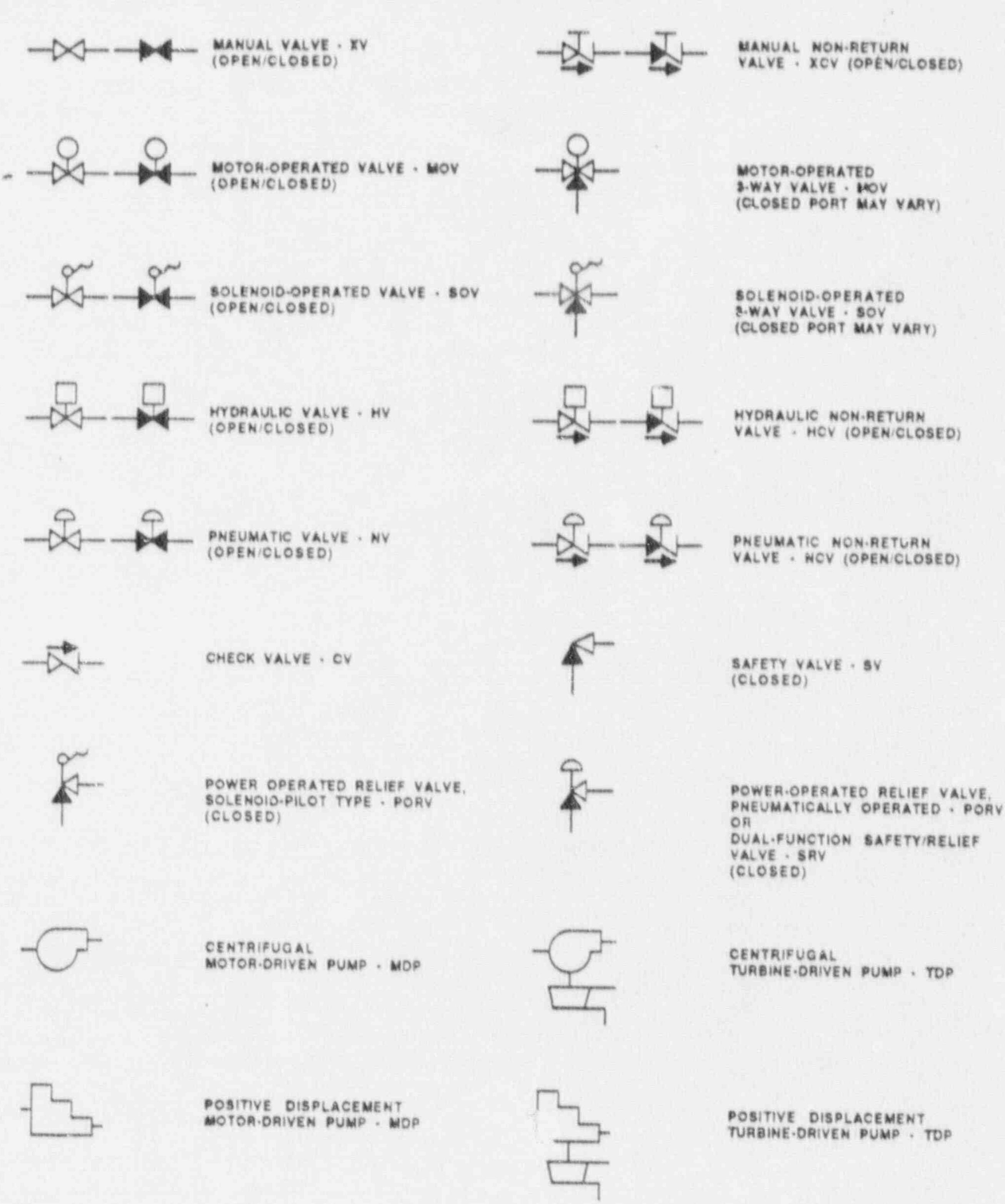


Figure A-1. Key To Symbols In Fluid System Drawings

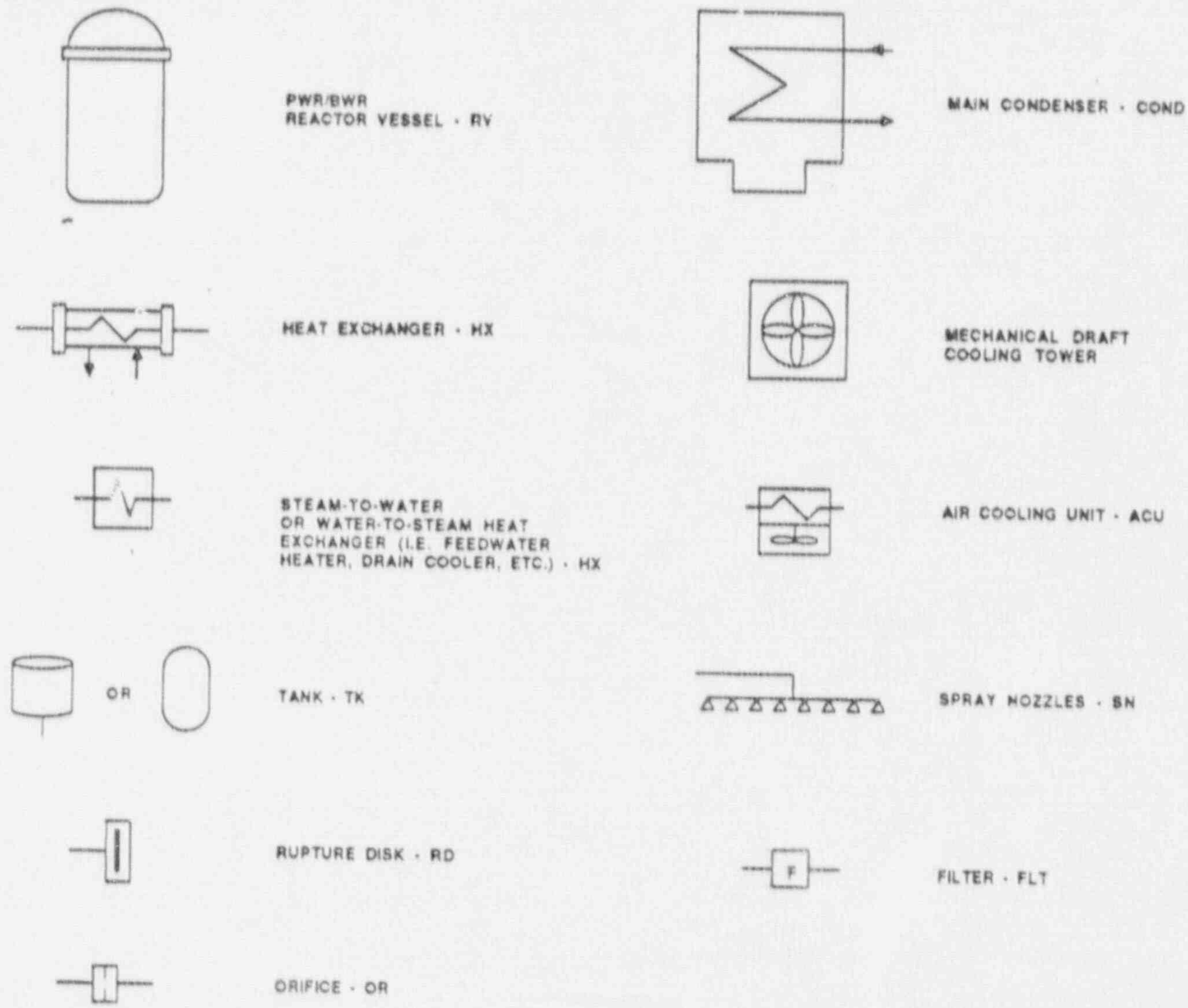


Figure A-1. Key To Symbols In Fluid System Drawings
(Continued)

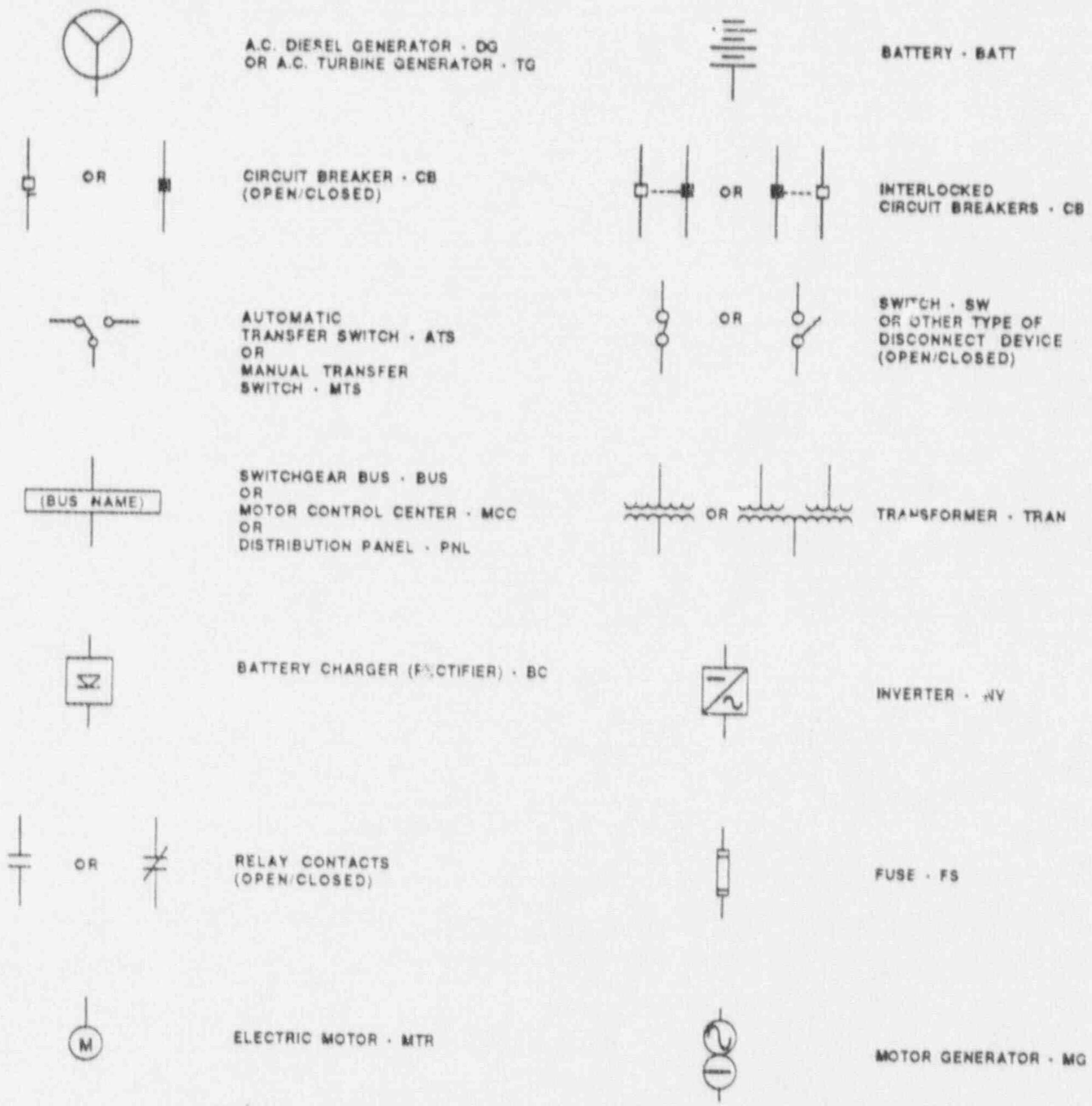


Figure A-2. Key To Symbols In Electrical System Drawings

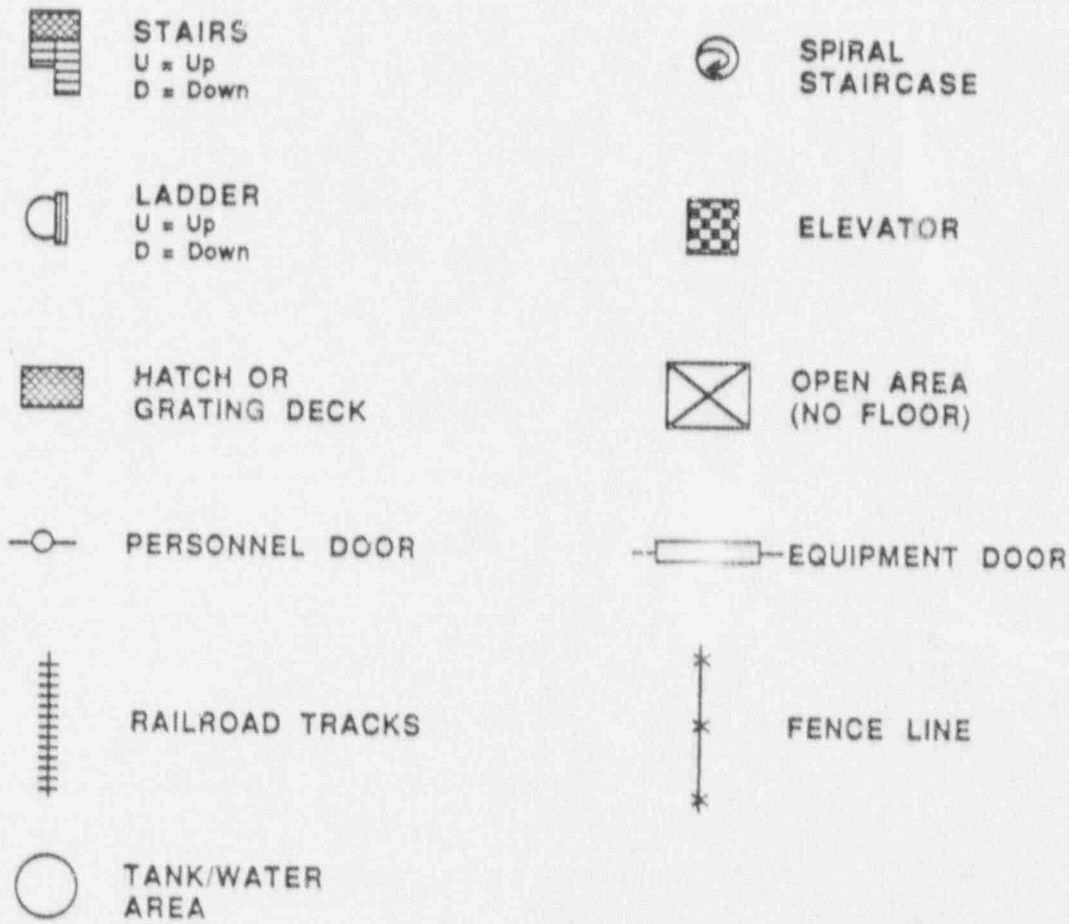


Figure A-3. Key To Symbols In Facility Layout Drawings

APPENDIX B
DEFINITION OF TERMS USED IN THE DATA TABLES

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

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

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

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

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

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

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

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

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

TABLE B-1. COMPONENT TYPE CODES

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

TABLE B-1. COMPONENT TYPE CODES (Continued)

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