SAIC 89/1028

# NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

# BIG ROCK POINT

50-155

Editor: Peter Lobner
Author: Stephen Finn

Prepared for:

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Washington, D.C. 20555

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SAIC

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## CAUTION

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

## NOTICE

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

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

With copy to:

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

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

# BIG ROCK POINT
# RECORD OF REVISIONS

| REVISION | ISSUE | COMMENTS |
|---|---|---|
| 0 | 2/89 | Original report |
| | | |

# BIG ROCK POINT SYSTEM SOURCEBOOK

This sourcebook contains summary information on the Big Rock Point nuclear power plant. 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 Big Rock Point nuclear power plant is listed below:

| | |
|---|---|
| - Docket number | 50-155 |
| - Operator | Consumers Power Co. |
| - Location | Michigan, 4 miles northeast of Charlevoix |
| - Commercial operation date | 12/62 |
| - Reactor type | BWR |
| - NSSS vendor | General Electric |
| - Power (MWt/MWe) | 240/75 |
| - Architect-engineer | Bechtel |
| - Containment type | Steel sphere |

## 2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

The Big Rock Point plant has a General Electric BWR/1 nuclear steam supply system (NSSS), an isolation condenser, and a dry spherical steel containment. There are no other operating BWR/1 plants in the United States, although Dresden 1 and Humboldt Bay are BWR/1 plants that are no longer in commercial operation. Other BWRs with isolation condensers as Oyster Creek and Nine Mile Point-1 (BWR/2), and Dresden 2 and 3 and Millstone-3 (BWR/3).

Big Rock Point employs different systems for core coolant injection and shutdown than most BWRs. Big Rock Point is similar to some early BWRs, but does not use a pressure suppression containment.

# 3. SYSTEM INFORMATION

This section contains descriptions of selected syste  ıs at Big Rock Point in terms of general function, operation, system success criteria, major components, and support system requirements. A summary of major systems at Big Rock Point 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 Big Rock Point 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) | Nuclear Steam Supply System | 3.1 | 5 |
| - Reactor Core Isolation Cooling (RCIC) Systems | None | - | - |
| - Emergency Core Cooling Systems (ECCS) | | - | - |
| - High-Pressure Injection & Recirculation | None | - | - |
| - Low-pressure Injection & Recirculation | Core Spray (CS) System (supplied by Fire Protection System) | 3.3 | 3.7.1, 5.9, 6.8.1 |
| - Automatic Depressurization System (ADS) | Reactor Depressurization System (RDS) | 3.3 | 5.5 |
| - Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System) | Shutdown Cooling System | X | 5.7 |
| - Main Steam and Power Conversion Systems | Main Steam System, | X | 5 |
| | Condensate and Feedwater System, | X | 6.3 |
| | Condenser Circulating Water System | X | 6.4.3 |
| - Other Heat Removal Systems | Emergency Cooling System | 3.2 | 5.8 |

Table 3-1. Summary of Big Rock Point 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 | Reactor Cleanup Demineralizer System | 3.6 | 5.11 |
| - ECCS | See above | - | - |
| - Control Rod Drive Hydraulic System (CRDHS) | Control Rod Drive Hydraulic Control System | 3.7 | 4.4.4 |
| **Containment Systems** | | | |
| - Primary Containment | Containment | X | 3.1.1 |
| - Secondary Containment | Not differentiated from primary containment | - | - |
| - Standby Gas Treatment System (SGTS) | None | - | - |
| - Containment Heat Removal Systems | | | |
| - Suppression Pool Cooling System | None | - | - |
| - Containment Spray System | Post-Incident Spray (part of the Fire Protection System) | 3.3 | 3.7.2 to 3.7.6 |
| - Containment Fan Cooler System | Containment Heating and Ventilating System | X | 6.8.4.2 to 6.8.4.4 |
| - Containment Normal Ventilation Systems | Containment Heating and Ventilating System | X | 6.8.4.2 to 6.8.4.4 |
| - Combustible Gas Control Systems | None noted | X | - |

**Table 3-1. Summary of Big Rock Point 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 | 4.8 |
| - Control Rod System | Control Rod Drive System | X | 4.3, 4.4 |
| - Chemical Poison System | Liquid Poison System | X | 4.4 |
| **Instrumentation & Control (I&C) Systems** | | | |
| - Reactor Protection System (RPS) | Reactor Safety System | 3.4 | 7.5 |
| - Engineered Safety Feature Actuation System (ESFAS) | Penetration Closure Actuation,<br>Emergency Cooling Actuation | X<br>3.2 | 7.5.5.1, 7.5.13<br>7.5.5.2 |
| - Remote Shutdown System | None noted | - | - |
| - Other I&C Systems | Various other systems | - | 7.1 to 7.4, 7.6 to 7.13 |
| **Support Systems** | | | |
| - Class 1E Electric Power System | Auxiliary and Emergency Power Systems | 3.5 | 5.10, 6.7.1.4, 6.7.2, 6.7.3 |
| - Non-Class 1E Electric Power System | Electric Power System | 3.5 | 6.7 |
| - Diesel Generator Auxiliary Systems | Same | 3.5 | Not described |
| - Component Cooling Water (CCW) System | Reactor Cooling Water System | 3.8 | 6.4.2 |

Table 3-1. Summary of Big Rock Point Systems Covered in this Report (Continued)

| Generic System Name | Plant-Specific System Name | Report Section | FSAR Section Reference |
|---|---|---|---|
| **Support Systems (continued)** | | | |
| - Service Water System (SWS) | Same | 3.9 | 6.4.1 |
| - Residual Heat Removal Service Water (RHRSW) System | Service Water System | - | - |
| - Other Cooling Water Systems | None noted | - | - |
| - Fire Protection Systems | Same | 3.3 | 3.3.1, 3.7.1, 6.8.1 |
| - Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems | Heating and Ventilating System | X | 6.8.4 |
| - Instrument and Service Air Systems | Same | X | 6.6 |
| - Refueling and Fuel Storage Systems | Fuel Handling, Spent Fuel Storage Pool | X | 5.12.2, 5.12.4 |
| - Radioactive Waste Systems | Radioactive Waste Disposal | X | 9 |
| - Radiation Protection Systems | Biological Shielding | X | 4.6 |

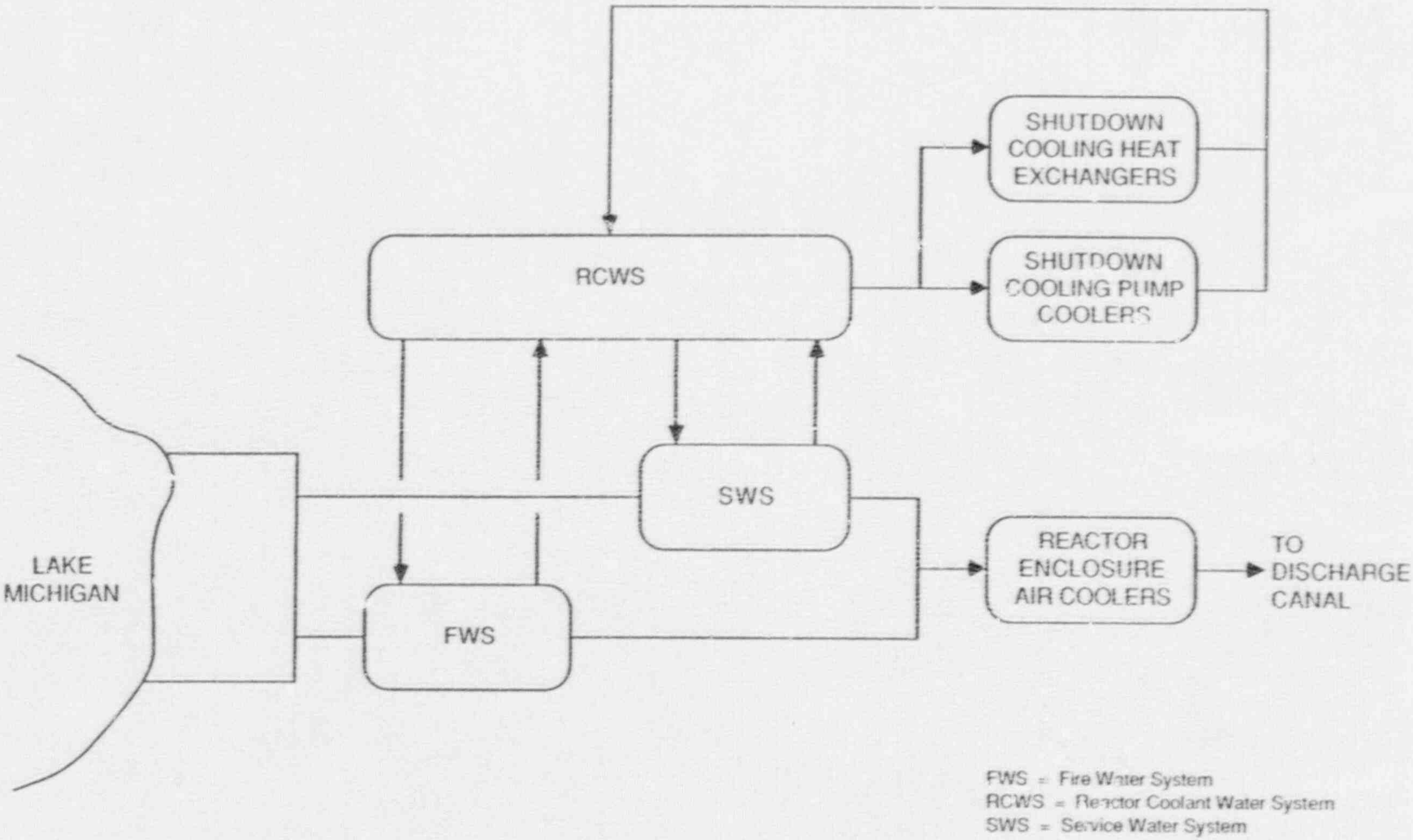



Figure 3-1. Cooling Water Systems Functional Diagram for Big Rock Point

## 3.1 REACTOR COOLANT SYSTEM (RCS)

### 3.1.1 System Function

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

### 3.1.2 System Definition

The RCS includes: (a) the reactor vessel, (b) two recirculation loops, (c) recirculation pumps, (d) steam drum, (e) safety valves, and (f) connected piping out to a suitable isolation valve boundary. A simplified schematic of the Big Rock Point primary and secondary heat transport loops is shown in Figure 3.1-1 (from Ref. 1). A more detailed diagram of the RCS and important system interfaces is shown in Figures 3.1-2 and 3.1-3. 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. The steam-water mixture is carried from the core to the steam drum by six 14" risers. The steam drum is mounted high up inside the reactor enclosure and serves to separate the steam from the steam-water mixture. The steam drum is also designed to provide water storage to accommodate surges of water level and pressure between the reactor vessel and the drum, and to assure adequate net positive suction head for the recirculation pumps. After the steam is separated, the recirculating water flows out of the drum down four 17" downcomers. In pairs, the downcomers join to form two 24" recirculation pump headers. Pump discharge is returned to the bottom of the reactor vessel.

The steam that is produced by the reactor is piped to the turbine via the main steam line. Condensate from the turbine is returned to the RCS as feedwater, into the steam drum.

Following a transient that involves the loss of the main condenser or loss of feedwater, heat transfer from the RCS is accomplished with an emergency condenser (see Section 3.2), or by opening the reactor depressurization system (RDS) valves and dumping heat into the containment sphere. In the latter case, and in the case of a LOCA, heat is transferred to the ultimate heat sink by the core spray system (see Section 3.3).

### 3.1.4 System Success Criteria

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

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

### 3.1.5 Component Information

A. RCS
1. Volume: unknown
2. Normal operating pressure: 1335 psia

B. Safety Valves (6)
1. Set pressure: 1535 to 1585 psig
2. Relief capacity: 240,000 lb/hr each

C. Power-Operated Relief Valves
None

D. Recirculation Pumps (2)
1. Rated flow: 16,000 gpm @ 76 ft. head (33 psid)
2. Type: Vertical centrifugal

### 3.1.6 Support Systems and Interfaces

A. Motive Power
1. The recirculation pumps are supplied from Non-Class 1E switchgear.

B. Recirculation Pump Cooling
The reactor cooling wat stem provides cooling water to the recirculation pump coolers.

### 3.1.7 Section 3.1 References

1. NUREG-0828, "Integrated Plant Safety Assessment, Systematic Evaluation Program, Big Rock Point Plant," USNRC, May 1984.

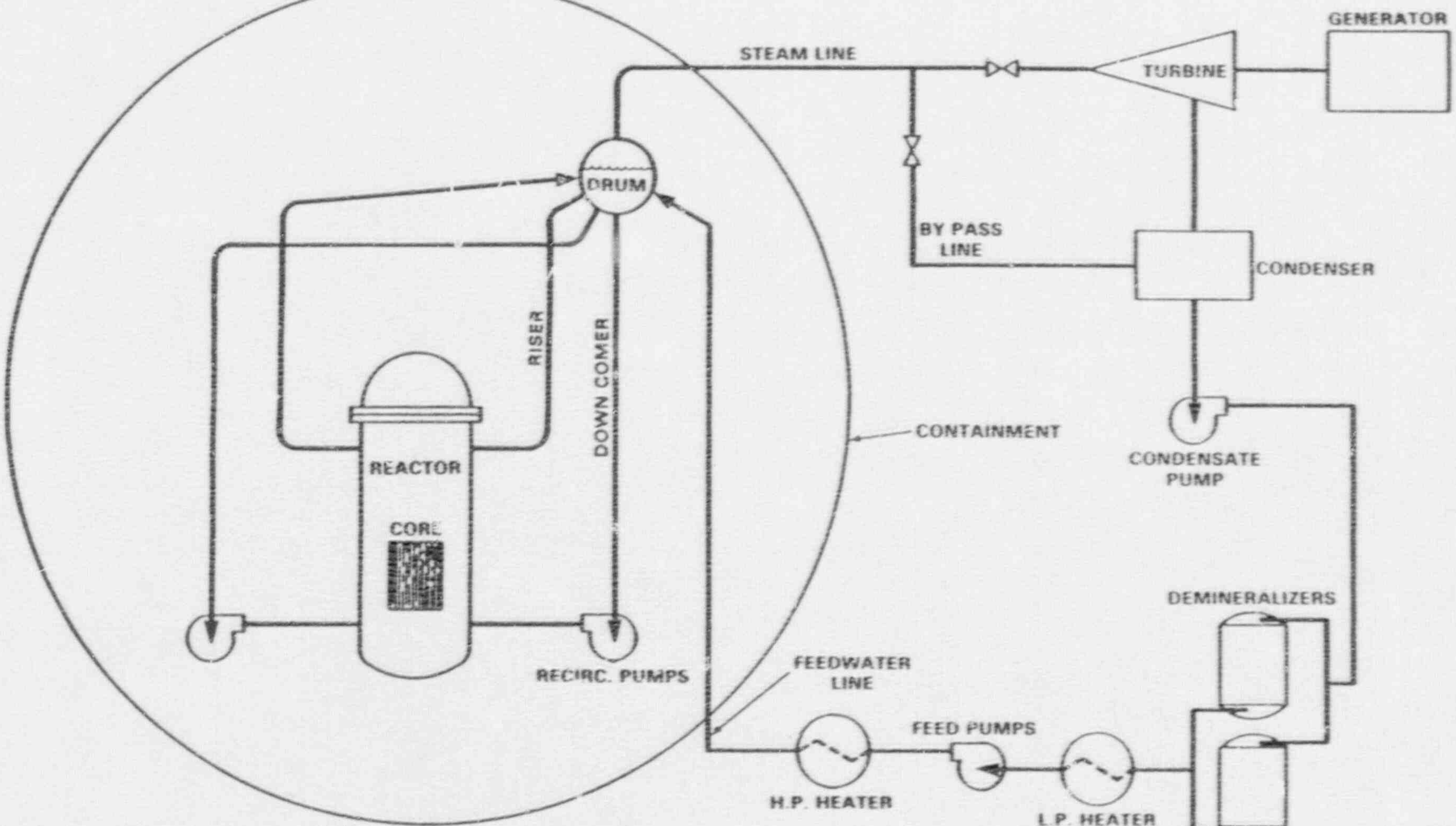



Figure 3.1-1. Simplified Schematic of Big Rock Point Primary and Secondary Heat Transport Loops

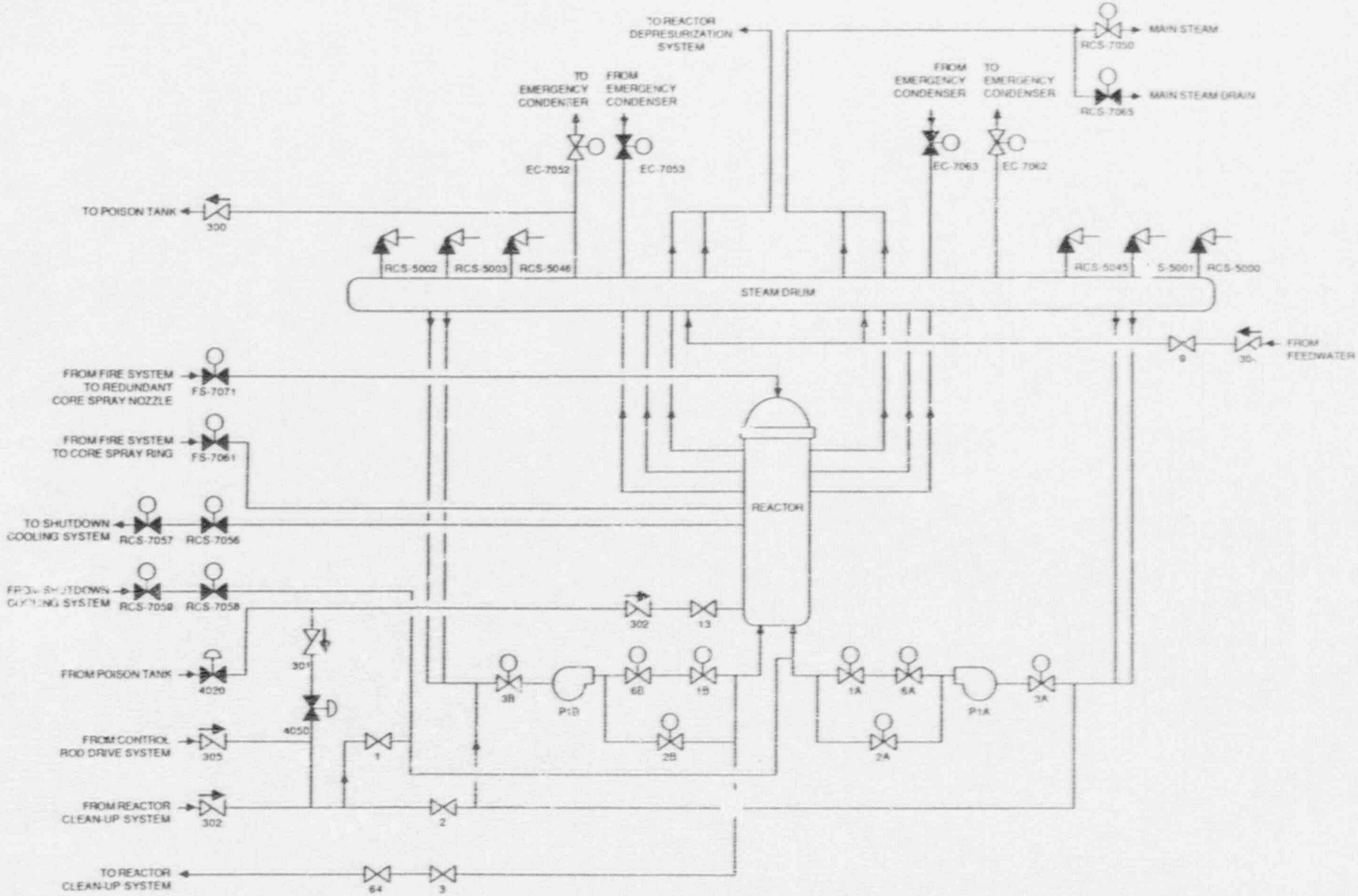



Figure 3.1-2. Big Rock Point Reactor Coolant System

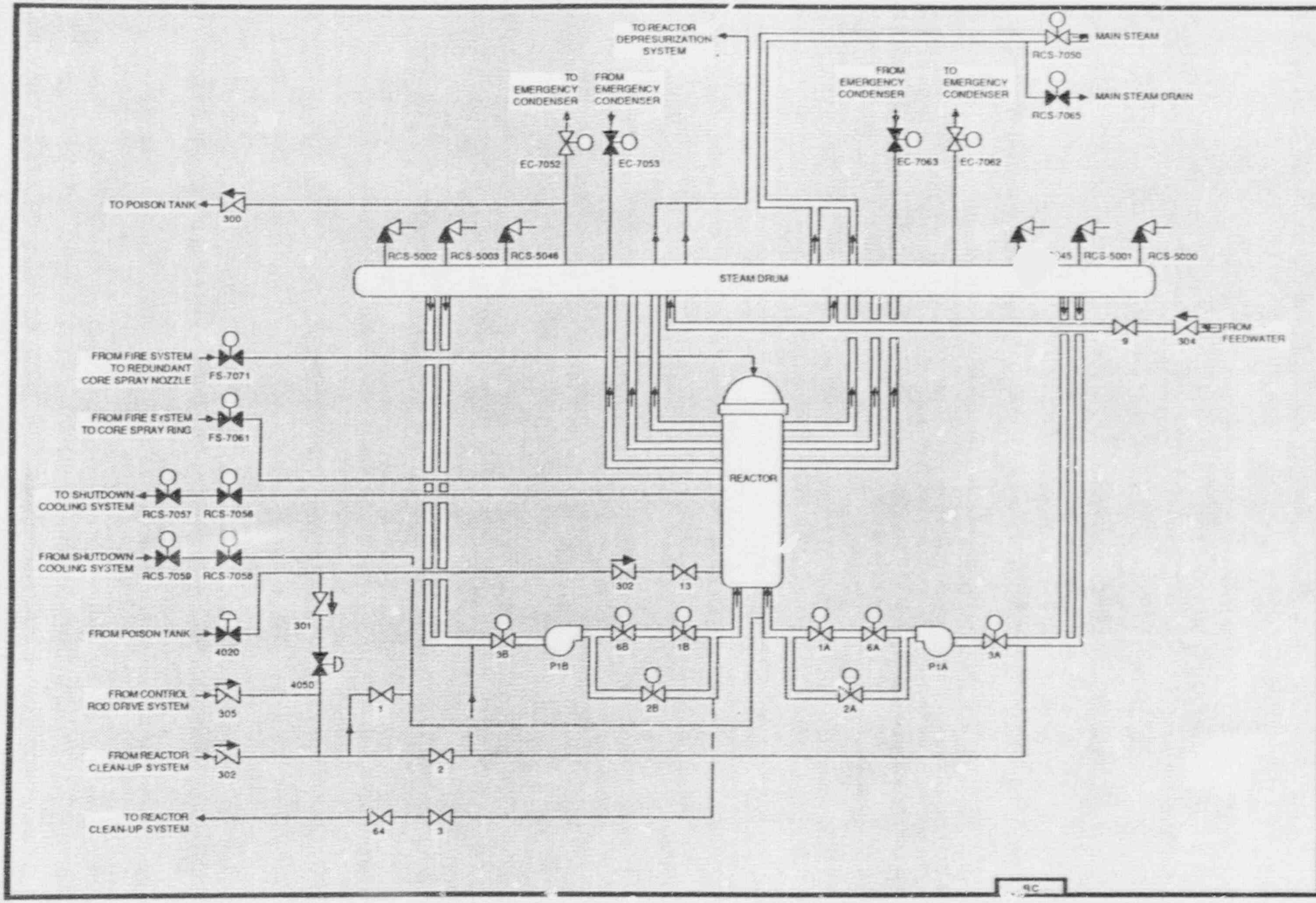



**Figure 3.1-3. Big Rock Point Reactor Coolant System Showing Component Locations**

Table 3.1-1. Big Rock Point Reactor Coolant System Data Summary for Selected Components

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| RCS-5000 | SRV | RC | | | | |
| RCS-5001 | SRV | RC | | | | |
| RCS-5002 | SRV | RC | | | | |
| RCS-5003 | SRV | RC | | | | |
| RCS-5045 | SRV | RC | | | | |
| RCS-5046 | SRV | RC | | | | |
| RCS-7050 | MOV | RC | BUS-D01 | 125 | ELECEQRM | DC |
| RCS-7056 | MOV | RC | MCC-2P | 480 | ELECEQRM | AC-2A |
| RCS-7057 | MOV | RC | MCC-2P | 480 | ELECEQRM | AC-2A |
| RCS-7058 | MOV | RC | MCC-2P | 480 | ELECEQRM | AC-2A |
| RCS-7059 | MOV | RC | MCC-2P | 480 | ELECEQRM | AC-2A |
| RCS-7065 | MOV | RC | BUS-D01 | 125 | ELECEQRM | DC |
| RCS-VESSEL | RV | RC | | | | |

## 3.2 EMERGENCY COOLING (EC) SYSTEM

### 3.2.1 System Function

The emergency cooling system, consisting of the emergency condenser, provides a backup heat sink for reactor heat when the main condenser is unavailable. The emergency condenser system provides a natural circulation heat transfer path on the primary side of the system. Heat is transferred to the environment by boiling secondary-side water in the condenser and venting steam directly to atmosphere.

### 3.2.2 System Definition

The emergency cooling system consists of the emergency condenser, which is a horizontal cylindrical tank with two internal sets of condensing tube bundles. The emergency condenser is located above the steam drum.

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

### 3.2.3 System Operation

During normal operation the emergency condenser is in standby, and is started automatically when needed to provide heat transfer to the environment. The system is started by opening a motor operated valve in each of the two condensate return lines. These valves can also be remotely actuated from the control room.

Steam from the steam drum is piped to the tube side of the emergency condenser. There are two internal sets of condensing tube bundles. Emergency cooling is accomplished by condensing steam from the drum in the tube side of the condenser, which initially heats the stored water in the tank, and within about fifteen minutes bulk boiling of the tank water commences.

Condensate flows from the tubes back to the drum. Flow is maintained by the thermal siphon established by the difference in density between the condensate in the return line and the steam in the supply line.

Steam generated in the emergency condenser shell is normally non-radioactive, and is vented directly to atmosphere through a penetration in the top of the containment vessel.

Water storage in the emergency condenser is sufficient for four hours operation without makeup. The demineralized water system (see Section 3.6) and the fire protection system (see Section 3.3) can provide makeup to the condenser.

### 3.2.4 System Success Criteria

For the emergency cooling system to accomplish the post-transient decay heat removal function, at least one of two steam supply lines to the emergency condenser and its corresponding condensate return line must be open. Makeup to the emergency condenser from either the demineralized water system or fire system is required after four hours of operation.

Due to losses and shrinkage associated with EC system operation, makeup to the RCS is required. The Control Rod Drive Hydraulic System (see Section 3.7) can provide RCS makeup at high pressure.

### 3.2.5 Component Information

A. Emergency Condenser
   1. Design duty: $32 \times 10^6$ Btu/hr

### 3.2.6 Support System and Interfaces

A. Control Signals

1. The motor operated valves in the two condensate return lines are opened automatically by signals from two duplicate pressure switches on the RCS, set above the high pressure reactor scram setting. The EC system is put into operation by the opening of these valves.
2. Remote Manual
   The condensate return MOVs can be actuated by remote manual means from the control room.

B. Motive Power

1. The EC motor operated valves are Class 1E AC and DC loads that can be supplied from the emergency diesel generator or from the station battery, as described in Section 3.5.

C. Other

1. Makeup to the secondary side of the emergency condenser can be provided by the fire protection system.

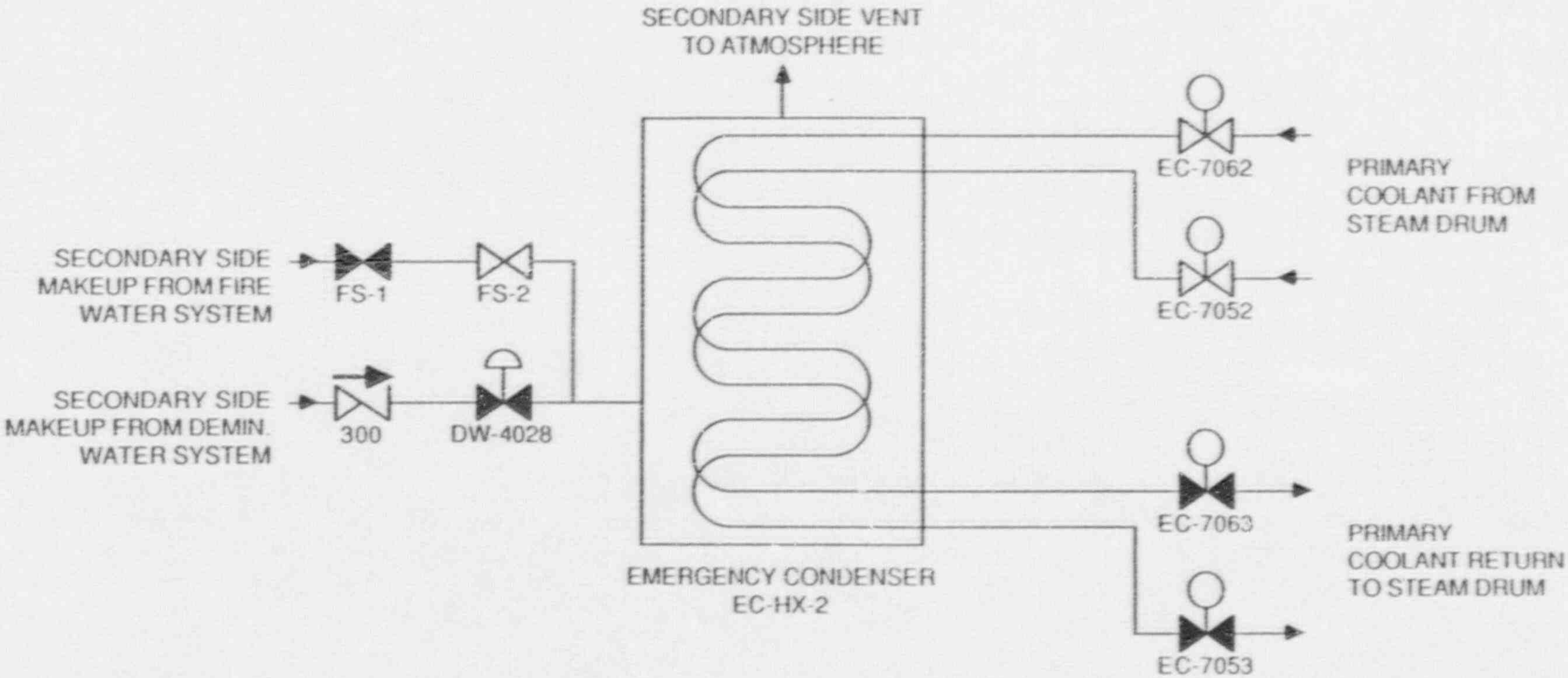



**Figure 3.2-1. Big Rock Point Emergency Cooling System**

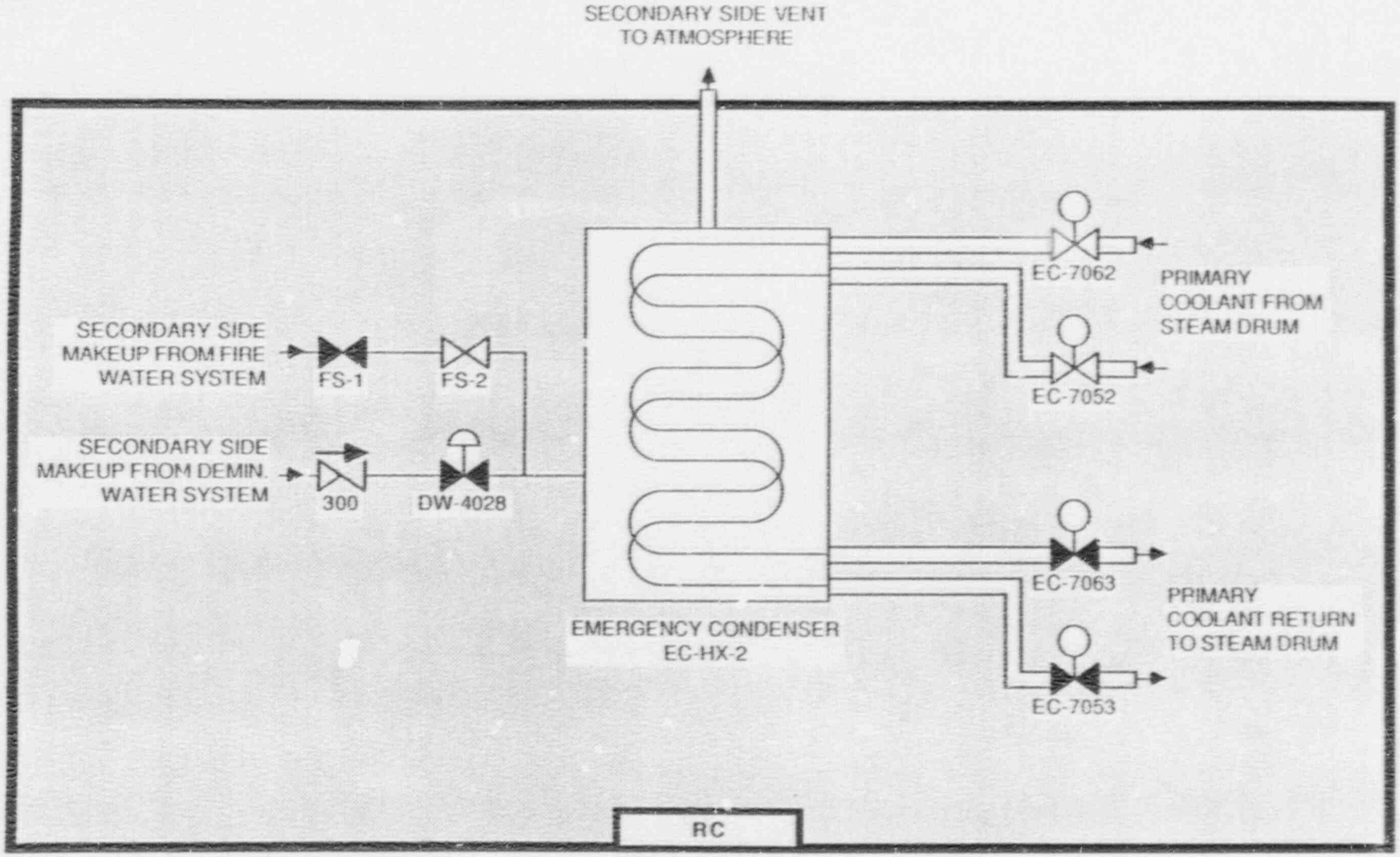



**Figure 3.2-2. Big Rock Point Emergency Cooling System Showing Component Locations**

Table 3.2-1. Big Rock Point Emergency Cooling System Data Summary for Selected Components

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| EC-7052 | MOV | RC | MCC-2P | 480 | ELECEQRM | AC-2A |
| EC-7053 | MOV | RC | BUS-D01 | 125 | ELECEQRM | DC |
| EC-7062 | MOV | RC | MCC-2P | 480 | ELECEQRM | AC-2A |
| EC-7063 | MOV | RC | BUS-D01 | 125 | ELECEQRM | DC |
| EC-HX-2 | HX | RC | | | | |

## 3.3 EMERGENCY CORE COOLING SYSTEM (ECCS)

### 3.3.1 System Function

The ECCS is an integrated set of subsystems that perform emergency coolant injection and recirculation functions to maintain reactor core coolant inventory and adequate decay heat removal following a LOCA. The coolant injection function is performed during a relatively short-term period after LOCA initiation, followed by realignment to a recirculation mode of operation to maintain long-term, post-LOCA core cooling.

### 3.3.2 System Definition

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

- Reactor Depressurization System (RDS)
- Fire Protection System (FS)

The RDS is used to depressurize the RCS to the point where the fire protection system pumps can provide makeup. The FS delivers water from the intake structure to the reactor vessel through the core spray ring and through a redundant core spray nozzle.

After the injection phase is completed, emergency coolant recirculation (ECR) is performed by the core spray system drawing suction from the containment sphere and discharging into either the core spray ring or nozzle. The core spray system includes a heat exchanger for transferring heat from the containment to the environment. The fire system is aligned during recirculation to cool the core spray heat exchanger and transfer the heat to the discharge canal.

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

### 3.3.3 System Operation

During normal operation the ECCS is in standby. Following a LOCA the fire system will be actuated to deliver water to the core spray ring, or the redundant core spray nozzle. The normal supply path is via the core spray system. An alternate path directly to the reactor vessel can be utilized by opening a manual valve in the machine shop. Either the motor driven or the diesel driven fire pump can provide adequate makeup.

For small LOCAs it is necessary to first depressurize the RCS before the fire system can provide the core spray function. This is accomplished automatically by the RDS. The RDS consists of four trains, each consisting of a solenoid-operated pressure relief valve. Any three of four RDS trains is sufficient to depressurize the system.

When water level in the containment vessel reaches elevation 587 feet (approximately 24 hours after a LOCA) the supply line from the fire system is manually shut off and one of two core spray system pumps is started. Continued injection to a water level three feet above grade would over-stress the vessel shell. The core spray pumps are supplied from a suction header in the bottom of the containment vessel. Water is recirculated through the core spray heat exchanger and back to the core spray supply header. The fire system is realigned to cool the core spray heat exchanger and transfer heat to the discharge canal.

### 3.3.4 System Success Criteria

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

- 1 of 2 fire system pumps with a suction on the intake structure.
- The fire pumps can inject via either the core spray ring or the core spray nozzle.

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

- The automatic reactor depressurization system (RDS) and 1 of 2 fire system pumps with a suction on the intake structure.

The success criterion for the RDS is the use of any 3 of 4 RDS trains. It is possible that the coolant inventory control function for some small LOCAs can be satisfied by low-capacity high-pressure injection systems such as the control rod drive hydraulic system (see Section 3.7).

The ECR success criteria for LOCAs are the following:

- 1 of 2 core spray pumps takes a suction on the bottom of the containment vessel.
- The core spray pumps can injection via either the core spray ring or the core spray nozzle.

The switchover from injection via the fire system and recirculation via the core spray system takes place after approximately 24 hours (Ref. 1).

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

- Either the emergency cooling (EC) system (not part of the ECCS, see Section 3.2), or
- Small LOCA mitigating systems.

### 3.3.5 Component Information

otor driven fire pump P6
ed flow: 1000 gpm @ 254 ft head (110 psid)
ed capacity: 100%
ype: horizontal centrifugal

sel driven fire pump P7
Rated flow: 1000 gpm @ 254 ft head (110 psid)
2. Rated capacity: 100%
3. Type: horizontal centrifugal

C. Core spray pumps P2A and P2B
   1. Rated flow: 400 gpm @ 323 ft head (140 psig)
   2. Rated capacity: 100%
   3. Type: Vertical centrifugal

D. Core spray heat exchanger
   1. Design duty: 8 x $10^6$ Btu/hr
   2. Type: Vertical, shell and U-tube

### 3.3.6 Support Systems and Interfaces

A. Control signals
   1. Automatic
      a. The motor operated core spray admission valves are opened upon a low reactor water level signal, coincident with reactor pressure below 200 psig.
      b. The RDS is actuated upon a low steam drum water level signal, coincident with low vessel water level and pressure at the fire pump header.
      c. The motor driven fire pump is started when the emergency diesel generator reaches rated voltage. The emergency diesel is started automatically upon loss of auxiliary power.

   2. Remote manual
      ECCS pumps and valves can be actuated by remote manual means from the main control room. The transition from the injection to the recirculation phase of ECCS operation requires remote manual actions. The RDS can also be controlled from the computer room.

B. Motive Power
   1. The ECCS motor-driven pumps and motor-operated valves are Class 1E AC and DC loads that can be supplied from the emergency diesel generator or station battery, as described in Section 3.5.
   2. The diesel driven fire pump has a separate battery and is started by a DC starting motor.
   3. The 125 VDC power system for the RDS is described in Section 3.5.

### 3.3.7 Section 3.3 References

1. "Final Hazards Summary Report for Big Rock Point Plant".

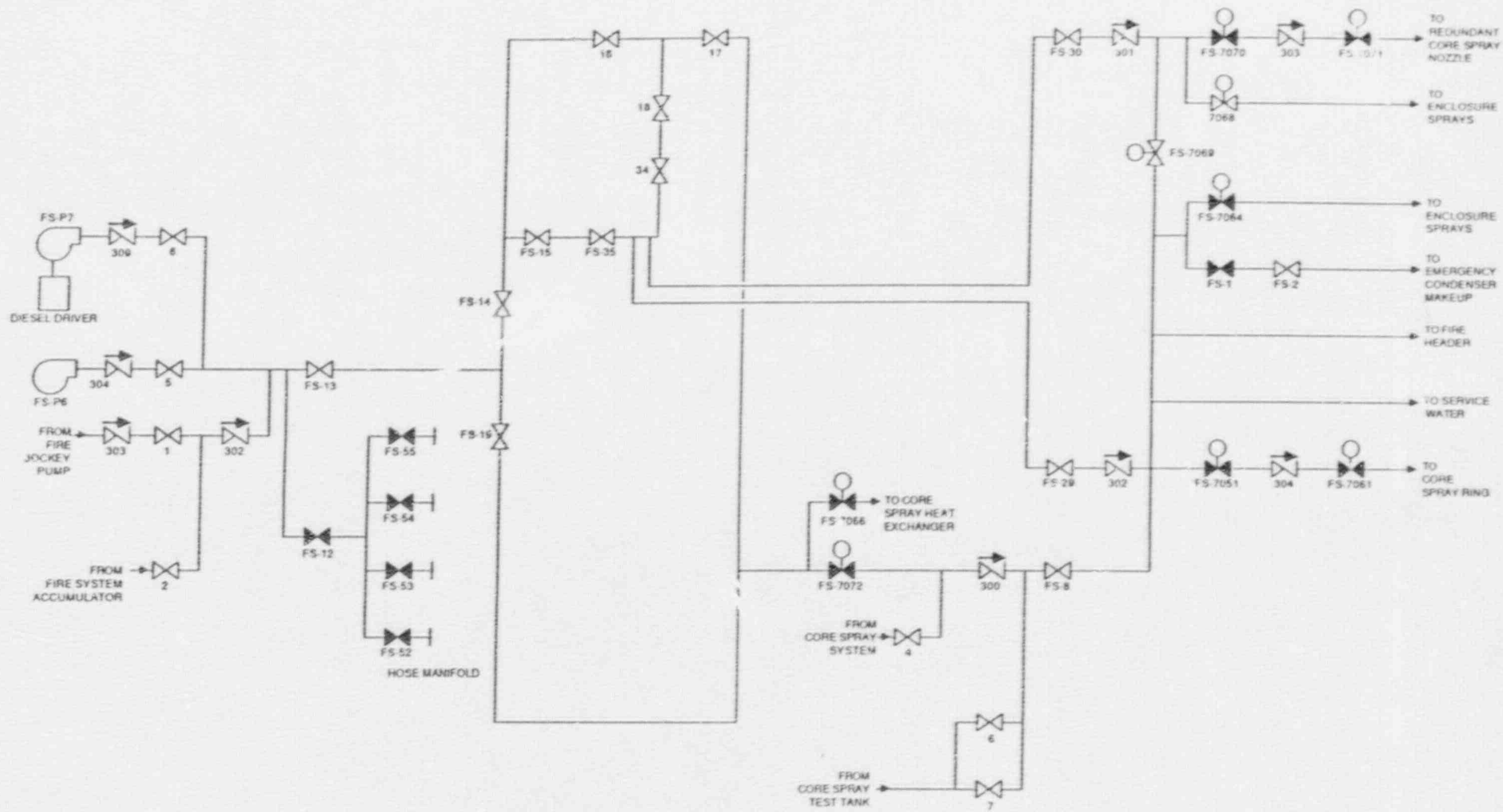



Figure 3.3-1. Big Rock Point Fire Protection System

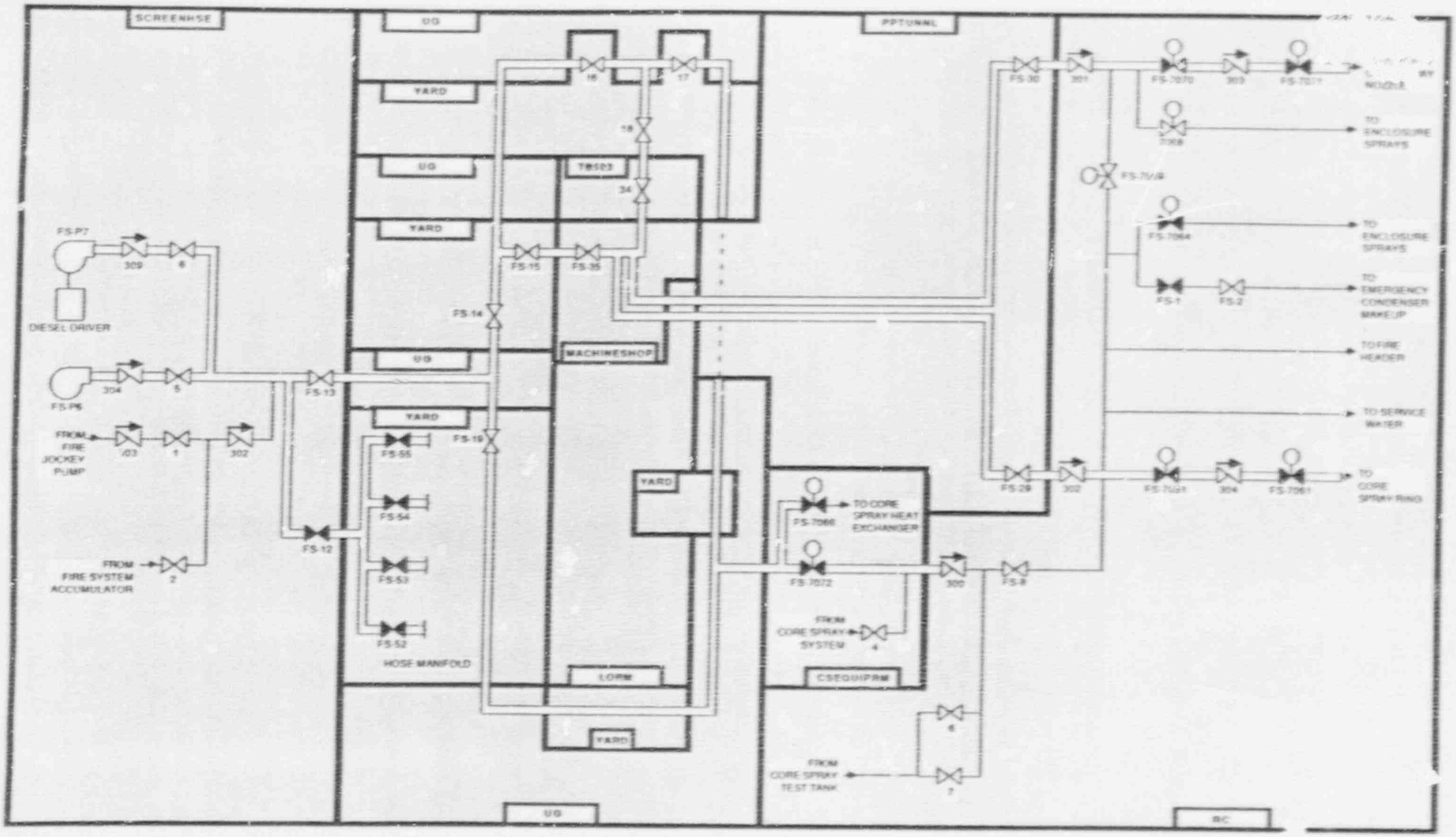



Figure 3.3-2. Big Rock Point Fire Protection System Showing Component Locations

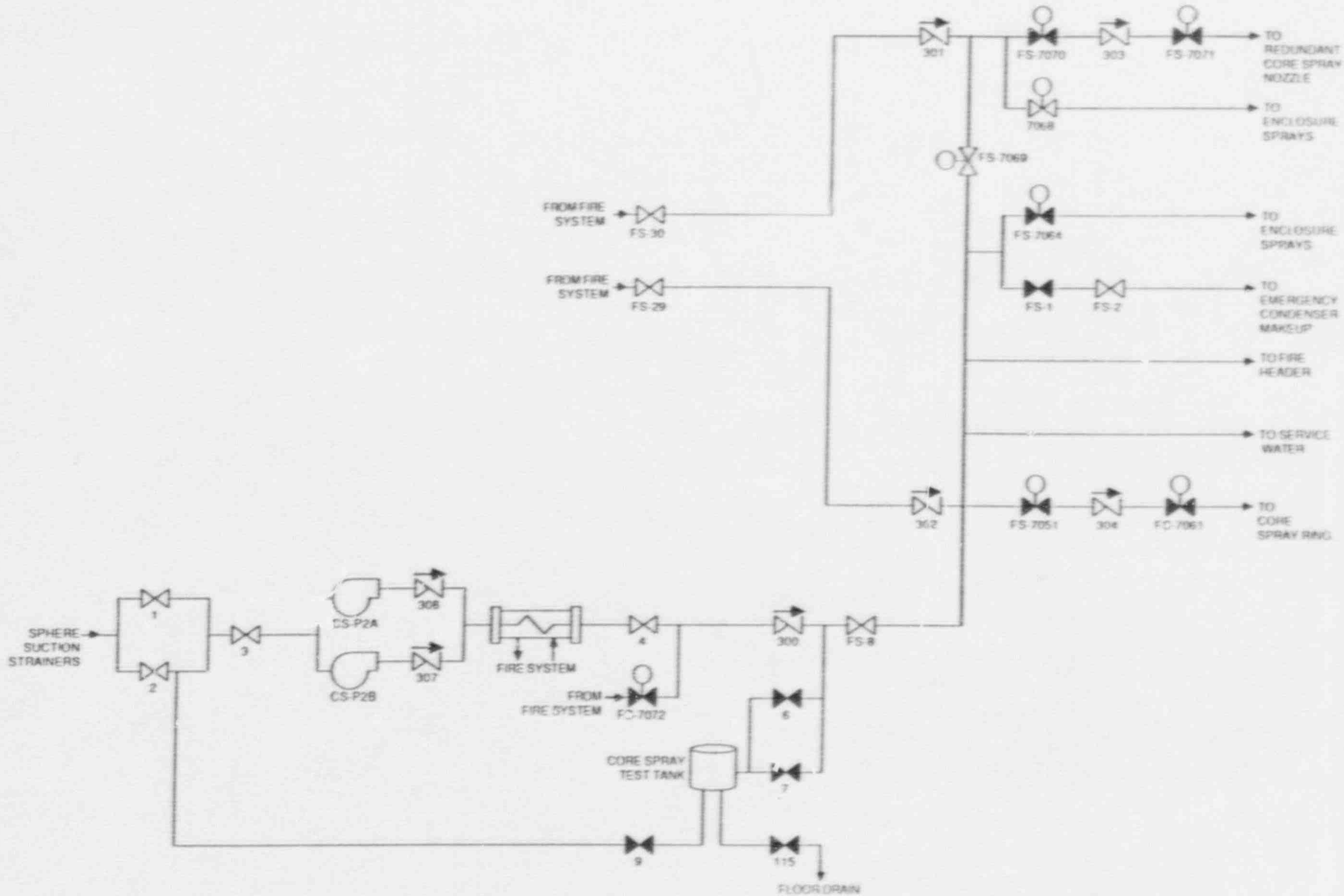



Figure 3.3-3. Big Ro[illegible] Point Core Spray System

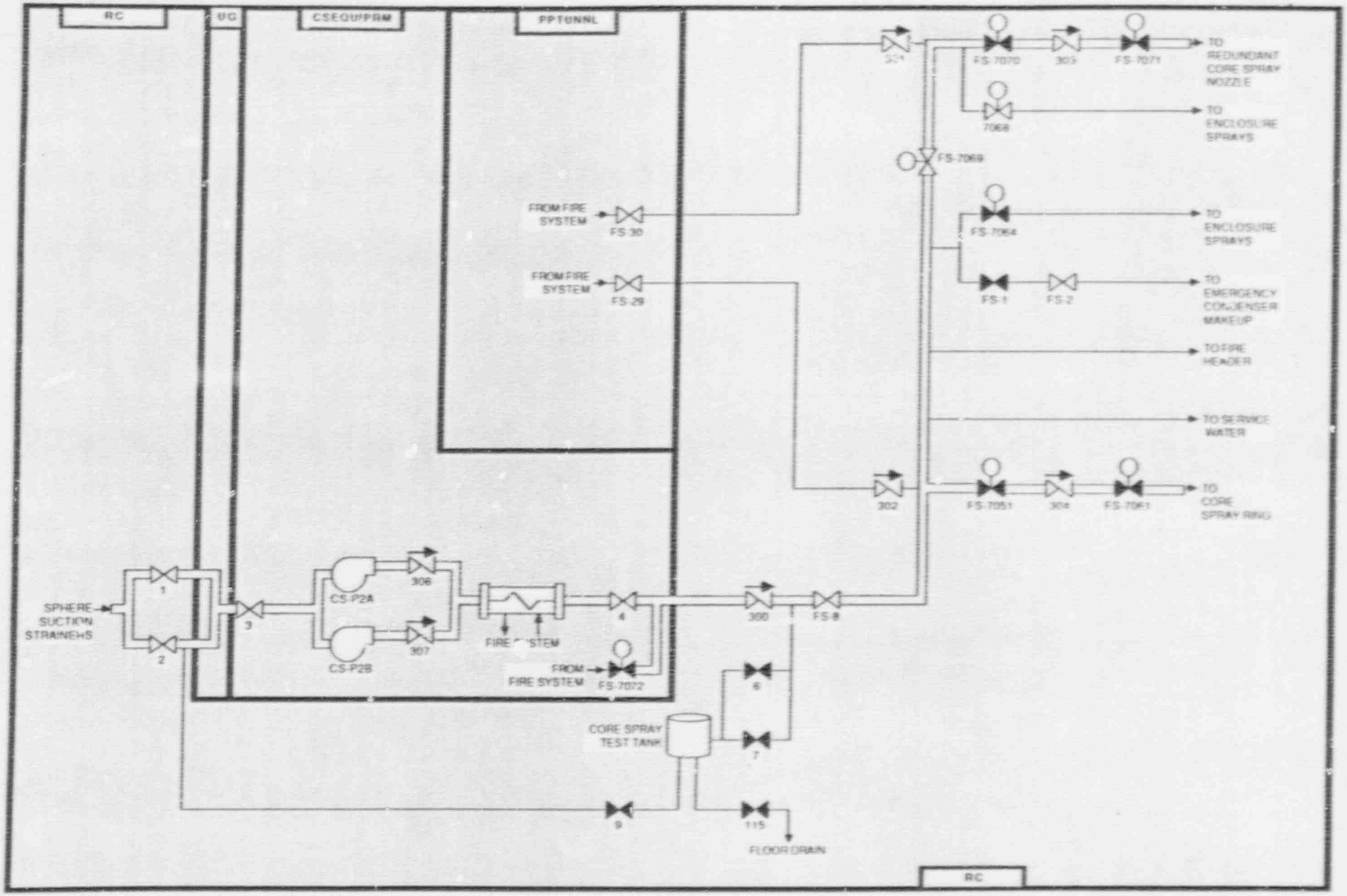



Figure 3.3-4. Big Rock Point Core Spray System Showing Component Locations

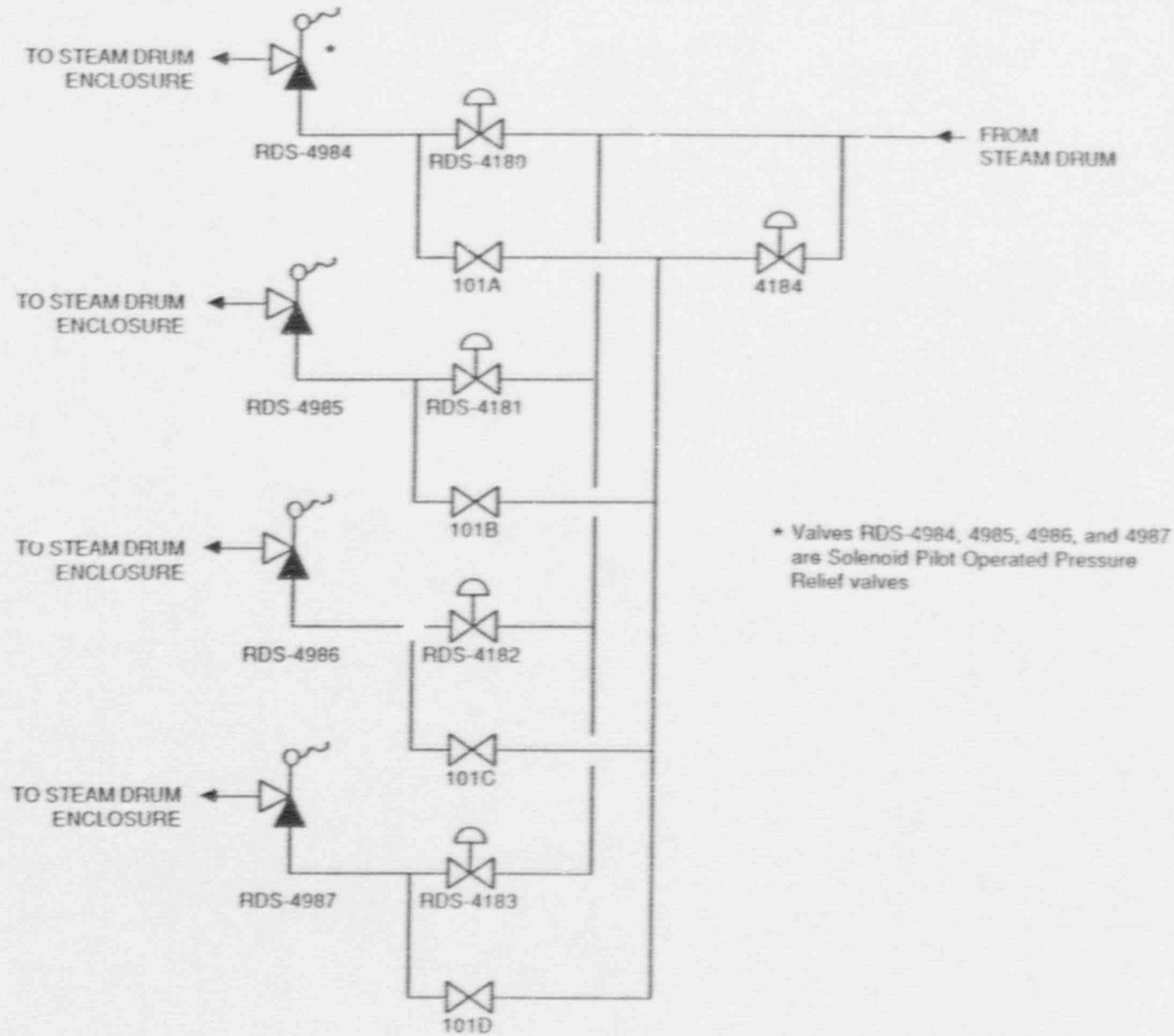



Figure 3.3-5. Big Rock Point Reactor Depressurization System

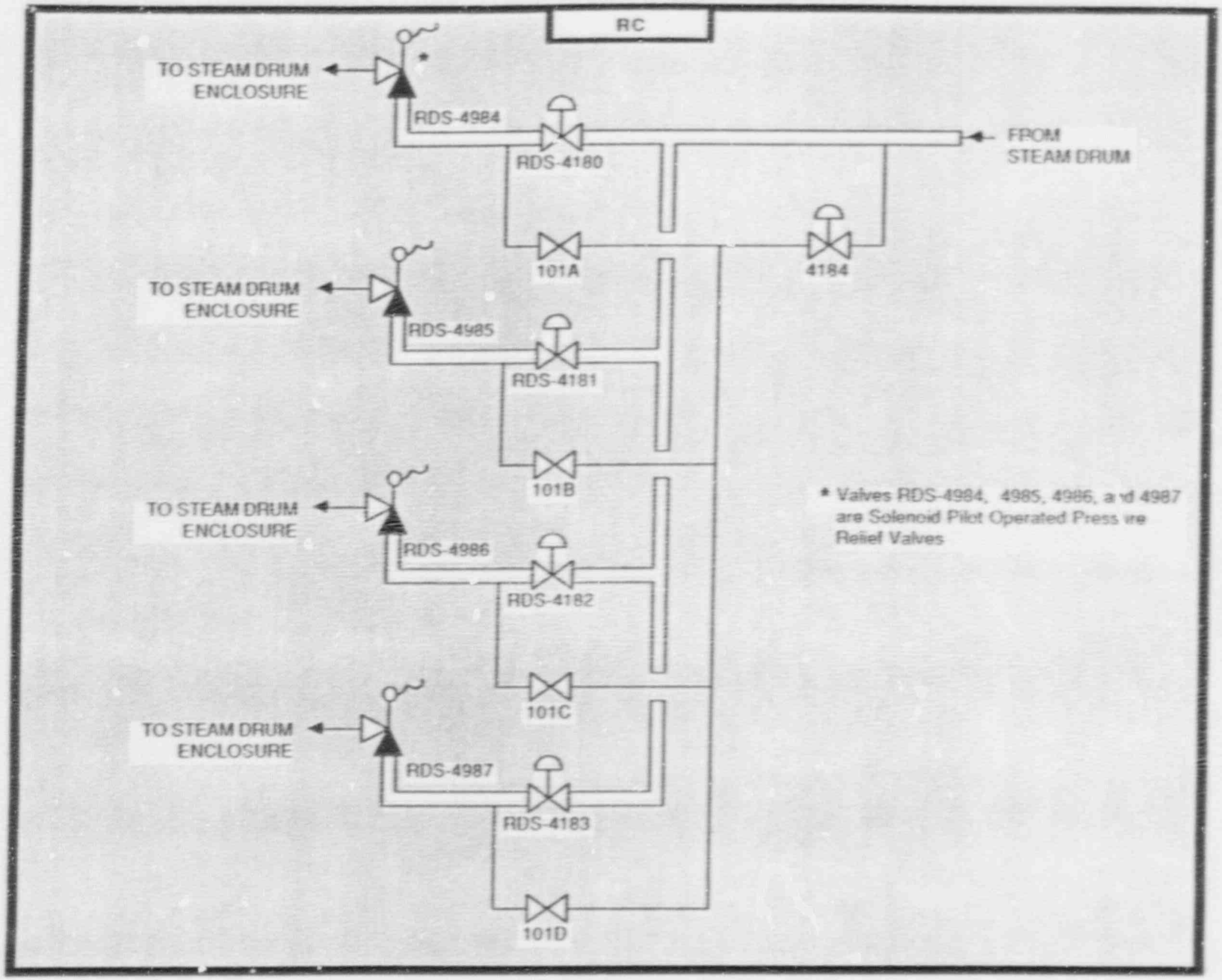



**Figure 3.3-6. Big Rock Point Reactor Depressurization System Showing Component Locations**

Table 3.3-1. Big Rock Point Emergency Core Cooling System Data Summary for Selected Components

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| CS-P2A | MDP | CSEQUIPRM | BUS-1A | 480 | ELECEQRM | AC-1A |
| CS-P2B | MDP | CSEQUIPRM | BUS-2A | 480 | ELECEQRM | AC-2A |
| FS-1 | XV | RC | | | | |
| FS-12 | XV | SCREENHSE | | | | |
| FS-12 | XV | YARD | | | | |
| FS-13 | XV | SCREENHSE | | | | |
| FS-14 | XV | YARD | | | | |
| FS-14 | XV | YARD | | | | |
| FS-15 | XV | YARD | | | | |
| FS-15 | XV | YARD | | | | |
| FS-19 | XV | YARD | | | | |
| FS-29 | XV | PPTUNNL | | | | |
| FS-30 | XV | PPTUNNL | | | | |
| FS-35 | XV | MACHINESHOP | | | | |
| FS-35 | XV | MACHINESHOP | | | | |
| FS-52 | XV | YARD | | | | |
| FS-53 | XV | YARD | | | | |
| FS-54 | XV | YARD | | | | |
| FS-55 | XV | YARD | | | | |
| FS-7051 | MOV | RC | BUS-D01 | 125 | ELECEQRM | DC |
| FS-7061 | MOV | RC | BUS-D01 | 125 | ELECEQRM | DC |
| FS-7064 | MOV | RC | PANEL-D10 | 125 | ELECEQRM | DC |
| FS-7066 | MOV | CSEQUIPRM | BUS-2A | 480 | ELECEQRM | AC-2A |
| FS-7069 | MOV | RC | BUS-2B | 480 | ELECEQRM | AC-2B |
| FS-7070 | MOV | RC | BUS-2B | 480 | ELECEQRM | AC-2B |
| FS-7071 | MOV | RC | BUS-2B | 480 | ELECEQRM | AC-2B |
| FS-7072 | MOV | CSEQUIPRM | PANEL-D10 | 125 | ELECEQRM | DC |

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

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| FS-8 | XV | RC | | | | |
| FS-P6 | MDP | SCREENHSE | BUS-2B | 480 | ELECEQRM | AC-2B |
| FS-P7 | DDP | SCREENHSE | | | | |
| RDS-120-A | PNL | UPS1 | RDS-UPS-A | 120 | UPS1 | AC-1A |
| RDS-120-B | PNL | UPS2 | RDS-UPS-B | 120 | UPS2 | AC-1A |
| RDS-120-C | PNL | UPS3 | RDS-UPS-C | 120 | UPS3 | AC-2A |
| RDS-120-D | PNL | UPS4 | RDS-UPS-D | 120 | UPS4 | AC-2A |
| RDS-125-A | PNL | UPS1 | RDS-UPS-A | 125 | UPS1 | AC-1A |
| RDS-125-B | PNL | UPS2 | RDS-UPS-B | 125 | UPS2 | AC-1A |
| RDS-125-C | PNL | UPS3 | RDS-UPS-C | 125 | UPS3 | AC-2A |
| RDS-125-D | PNL | UPS4 | RDS-UPS-D | 125 | UPS4 | AC-2A |
| RDS-4180 | NV | RC | | | | |
| RDS-4181 | NV | RC | | | | |
| RDS-4182 | NV | RC | | | | |
| RDS-4183 | NV | RC | | | | |
| RDS-4984 | SRV | RC | | | | |
| RDS-4985 | SRV | RC | | | | |
| RDS-4986 | SRV | RC | | | | |
| RDS-4987 | SRV | RC | | | | |
| RDS-BT-A | BATT | UPS1 | BUS-1A | 125 | ELECEQRM | AC-1A |
| RDS-BT-B | BATT | UPS2 | BUS-1A | 125 | ELECEQRM | AC-1A |
| RDS-BT-C | BATT | UPS3 | BUS-2A | 125 | ELECEQRM | AC-2A |
| RDS-BT-D | BATT | UPS4 | BUS-2A | 125 | ELECEQRM | AC-2A |
| RDS-UPS-A | UPS | UPS1 | RDS-BT-A | 125 | UPS1 | AC-1A |
| RDS-UPS-B | UPS | UPS2 | RDS-BT-B | 125 | UPS2 | AC-1A |
| RDS-UPS-C | UPS | UPS3 | RDS-BT-C | 125 | UPS3 | AC-2A |
| RDS-UPS-D | UPS | UPS4 | RDS-BT-D | 125 | UPS4 | AC-2A |

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

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| XV | XV | RC | | | | |

## 3.4 INSTRUMENTATION AND CONTROL (I&C) SYSTEMS

### 3.4.1 System Function

The Instrumentation and Control systems include the Reactor Protection System (RPS) and other systems for the display of plant information to the operators. The RPS monitors the reactor plant, and alerts the operator to take corrective action before specified limits are exceeded. The RPS will initiate an automatic reactor trip (scram) to rapidly shutdown the reactor when plant conditions exceed one or more specified limits. It will also automatically actuate selected safety systems based on the specific limits or combinations of limits that are exceeded.

### 3.4.2 System Definition

The RPS includes sensor and transmitter units, logic units, and output trip relays that interface with the control circuits for components in the Control Rod Drive Hydraulic System (see Section 3.7) Under certain circumstances components in other safety systems will also be actuated.

### 3.4.3 System Operation

A. RPS

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

- High neutron flux
- Short reactor period
- High reactor pressure
- Low water level in reactor vessel
- Low water level in steam drum
- Closure of steam line backup isolation valve
- Closure of recirculation water line valves
- High condenser pressure
- Loss of auxiliary power
- High scram dump tank level
- Manual

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

B. Other Safety Systems

In addition to the scram function, RPS instrumentation is used to actuate other safety systems. The Emergency Cooling system (see Section 3.2) is actuated upon very high reactor pressure, corresponding to 100 psi above the desired operating pressure. The system is actuated by opening the motor operated valves in the condensate return line from the emergency condenser. The core spray admission valves are opened upon low reactor water level, coincident with reactor pressure below 200 psig. The reactor depressurization system is actuated upon low steam drum water level, coincident with low reactor water level and pressure at the fire pump header. The emergency diesel generator is started automatically upon loss of auxiliary power. The motor driven fire pump is started automatically when the emergency diesel generator reaches rated voltage.

C. Remote Shutdown
No information was found in the FSAR regarding a remote shutdown capability. Such a capability is expected to exist based on a proposal by the licensee to install an alternate shutdown control station in the immediate vicinity of the core spray room. This panel would include controls needed to operate the emergency condenser. Work was expected to be completed in 1985. (Ref. 1, Section 5.3.2.1.)

### 3.4.4 System Success Criteria

A. RPS
The RPS uses hindrance logic (normal = 1, trip = 0) in both the input and output logic. Therefore, a channel will be in a trip state when input signals are lost, when control power is lost, or when the channel is temporarily removed from service for testing or maintenance (i.e. the channel has a fail-safe failure mode). A reactor scram will occur upon loss of control power to the RPS. A reactor scram is implemented by the scram pilot valves in the control rod drive hydraulic system (see Section 3.7). In addition to the scram function, RPS instrumentation is used to actuate other safety systems. Details of the RPS for Big Rock Point have not been determined.

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

### 3.4.5 Support Systems and Interfaces

A. Control Power
1. RPS
The RPS is powered from two 120 VAC buses (see Section 3.5).
2. Circuit breaker control power
DC control power is provided from RDS battery A to operate the diesel generator output circuit breaker. All other AC circuit breakers use AC control power. This results in the AC power system being largely independent of the DC power system (Ref 1, Section 4.23).

### 3.4.6 Section 3.4 References

1. NUREG-0828, "Integrated Plant Safety Assessment, Systematic Evaluation Program, Big Rock Point Plant," USNRC, May 1984.

## 3.5 ELECTRIC POWER SYSTEM

### 3.5.1 System Function

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

### 3.5.2 System Definition

The onsite Class 1E electric power system consists of two 480 VAC trains, a 125 VDC subsystem, and a 120 VAC subsystem. An emergency diesel generator supplies power to the 480 VAC system for motor operated valve and pump operation. A station battery supplies power to the 125 VDC system for normal switchgear control, turbine control, annunciators, and various emergency functions. The 120 VAC system supplies power to the reactor instrumentation and protection circuits.

Simplified one-line diagrams of the electric power system are shown in Figures 3.5-1 tc 3.5-6. A summary of data on selected electric power system components is presented in Table 3.5-1. A partial listing of electrical sources and loads is presented in Table 3.5-2.

### 3.5.3 System Operation

The auxiliary power system is the normal source of station service power under both normal operating and shutdown conditions. Auxiliary power is obtained from the main generator, through the station service transformer connected to the 2400 volt switchgear bus. Each of the two 480 VAC trains receive power from a separate transformer connected to the 2400 volt bus.

Upon loss of auxiliary power the emergency diesel generator is automatically started, supplying power to 480 VAC bus 2B, which in turn supplies power to 480 VAC motor control center buses 1A and 2A. These buses constitute the two separate 480 VAC trains, distributing power to rest of the system.

The normal source of power for the 125 VDC system is a single station battery. The battery can be energized by either of two battery chargers that are connected to bus 2A. The battery supplies power to 125 VDC motor control center bus D01, which supplies power to other DC distribution panels.

There are three 120 VAC Reactor Protection System (RPS) buses. Two of these buses are supplied by motor generator sets, connected to 480 VAC buses 1A and 2A. The third instrument bus normally is supplied by the DC system through a static inverter.

A separate 4-channel 125 VDC power system is provided for the Reactor Depressurization System (RDS). As shown in Figure 3.5-5, RDS channel A also supply DC control power for operating the emergency diesel generator output circuit breaker.

Redundant safety equipment such as motor driven pumps and motor operated valves are supplied by different 480 VAC buses. For the purpose of discussion, this equipment has been grouped into "load groups". Load group 1A contains components receiving electric power from bus 1A. Load group 2A contains components powered by bus 2A. Load group 2B contains components powered by bus 2B. Load group DC contains components receiving DC power. However, it should be noted that since there is only one emergency diesel generator the above load groups are not truly redundant.

### 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:

- The single station DC load group and the four RDS DC channels are supplied initially from their respective battery
- The emergency diesel generator is started by its dedicated starting battery and the output circuit breaker is closed remotely (requires 125 VDC RDS channel A) or locally (manually)
- Each 480 VAC Class 1E AC load group is isolated from the non-Class 1E system and is supplied from the emergency diesel generator
- Power distribution paths to essential loads are intact
- Power to the battery chargers is restored before the batteries are exhausted

### 3.5.5 Component Information

A. Standby diesel generator
   1. Power rating: 200 kW
   2. Rated voltage: 480 VAC
   3. Manufacturer: Caterpillar

B. Station battery
   1. Type: Lead-acid
   2. Cells: 60
   3. Rated voltage: 125 VDC
   4. Rated capacity: unknown

### 3.5.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The standby diesel generator is automatically started based on loss of auxiliary power.
   2. Remote manual
      The diesel generators can be started, and many distribution circuit breakers can be operated from the main control room.

B. Diesel Generator Auxiliary Systems
   The following auxiliaries are provided for the emergency diesel generator:
   - Cooling
     No information on diesel cooling is available in the Final Hazards Summary Report (FHSR)
   - Fueling
     No information on the diesel fuel oil system is available in the FHSR
   - Lubrication
     No information on the diesel lube oil system is available in the FSAR
   - Starting
     A separate battery is provided for starting the diesel generator. It appears that the diesel generator uses a DC starting motor
   - Ventilation
     Diesel room ventilation is provided by intake louvers and an automatic exhaust fan. The system is temperature controlled. The exhaust fan is powered from a bus supplied from the diesel generator

C. Switchgear and Battery Room Ventilation
   Details on the ventilation system serving the switchgear and battery rooms have not been determined.

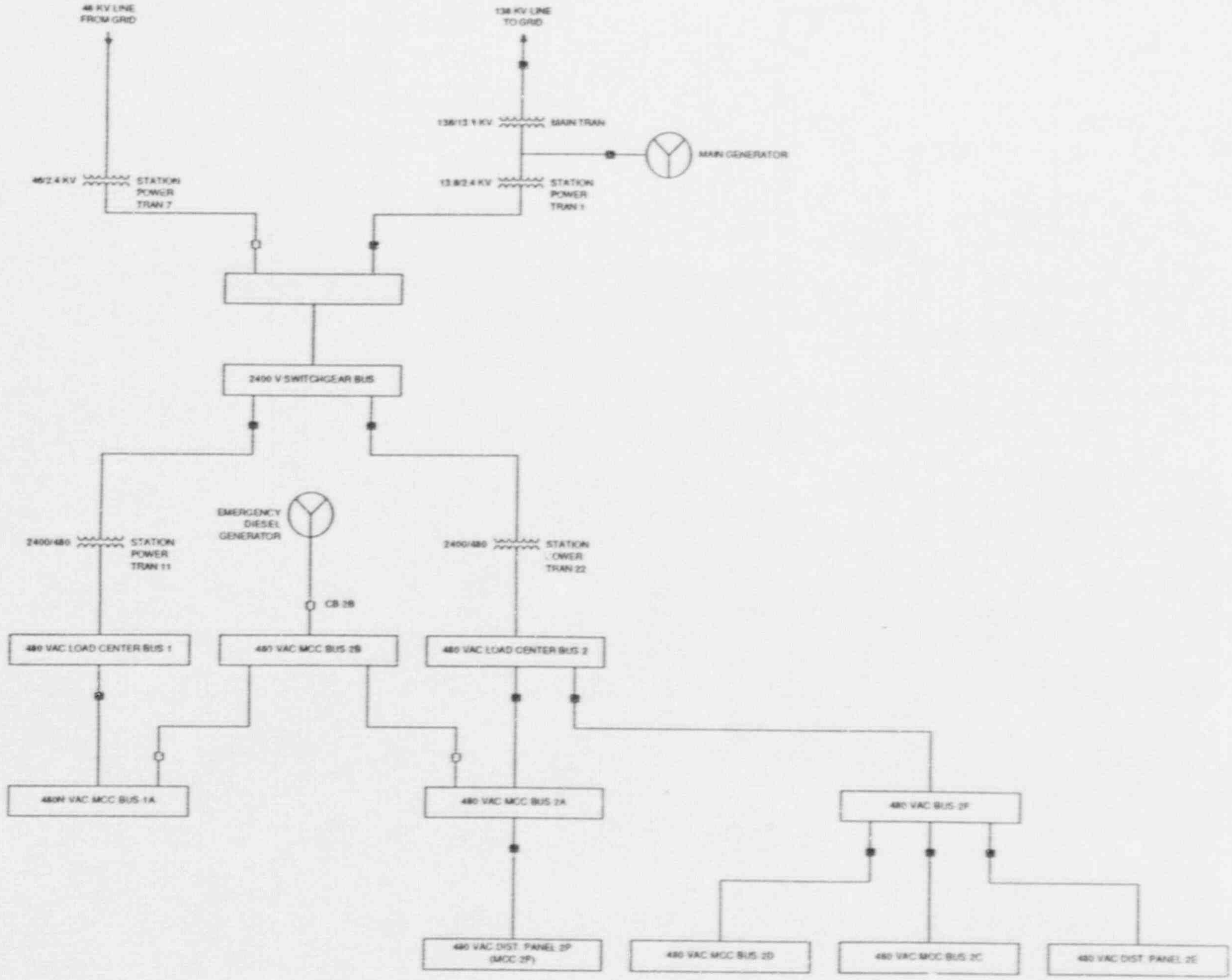



**Figure 3.5-1. Big Rock Point 2400 and 480 VAC Electric Power Distribution System**

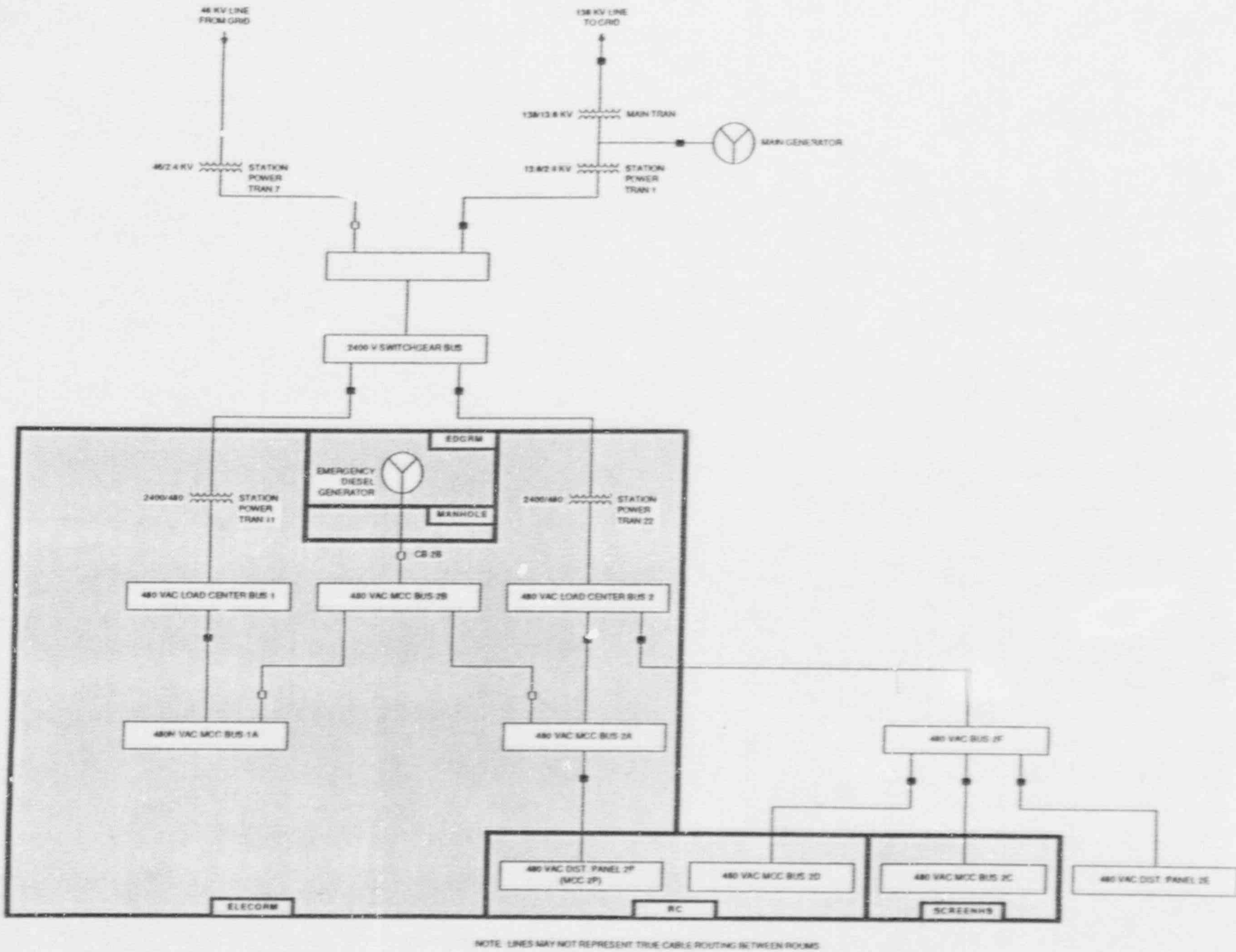



Figure 3.5-2. Big Rock Point 2400 and 480 VAC Electric Power Distribution System Showing Component Locations

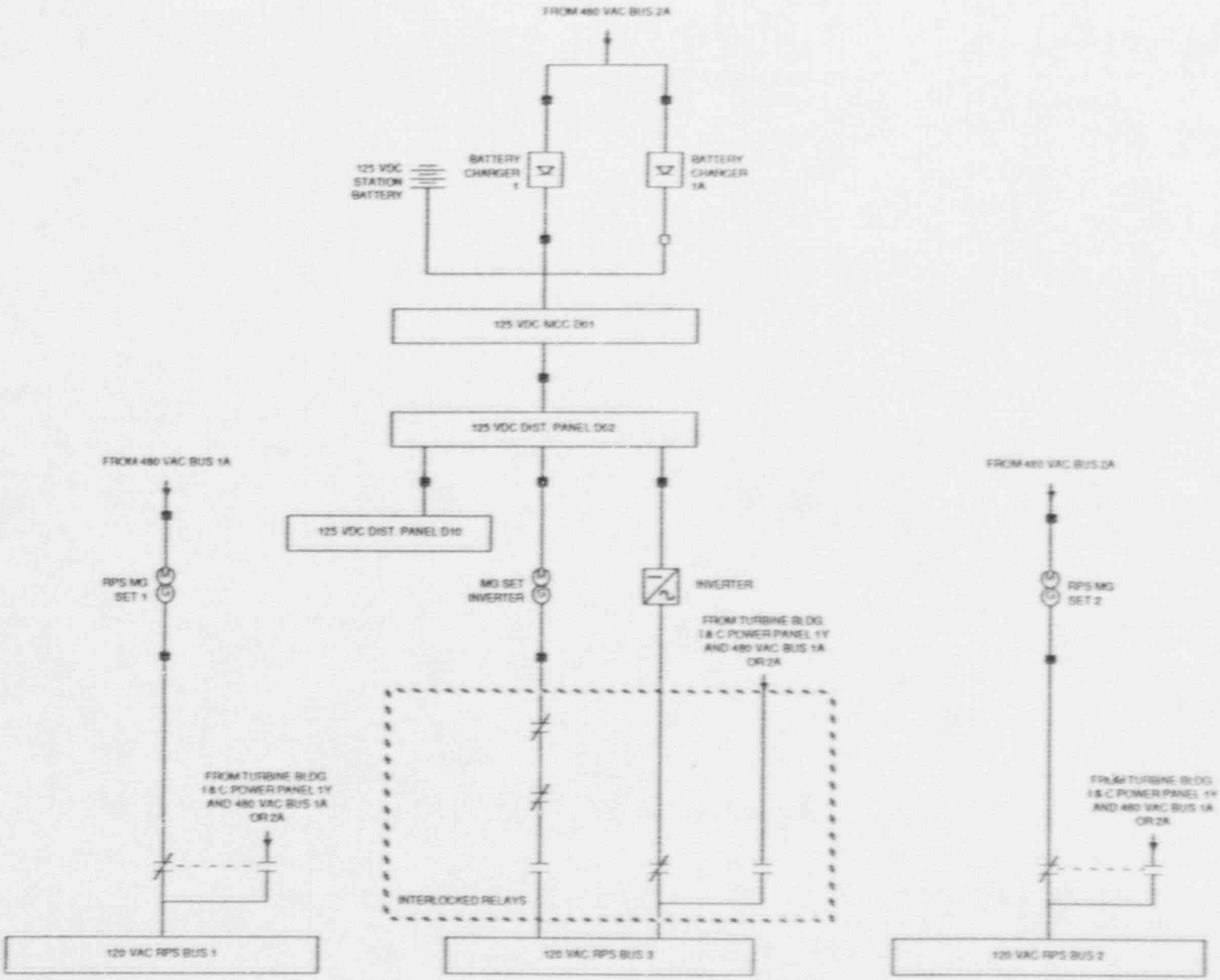
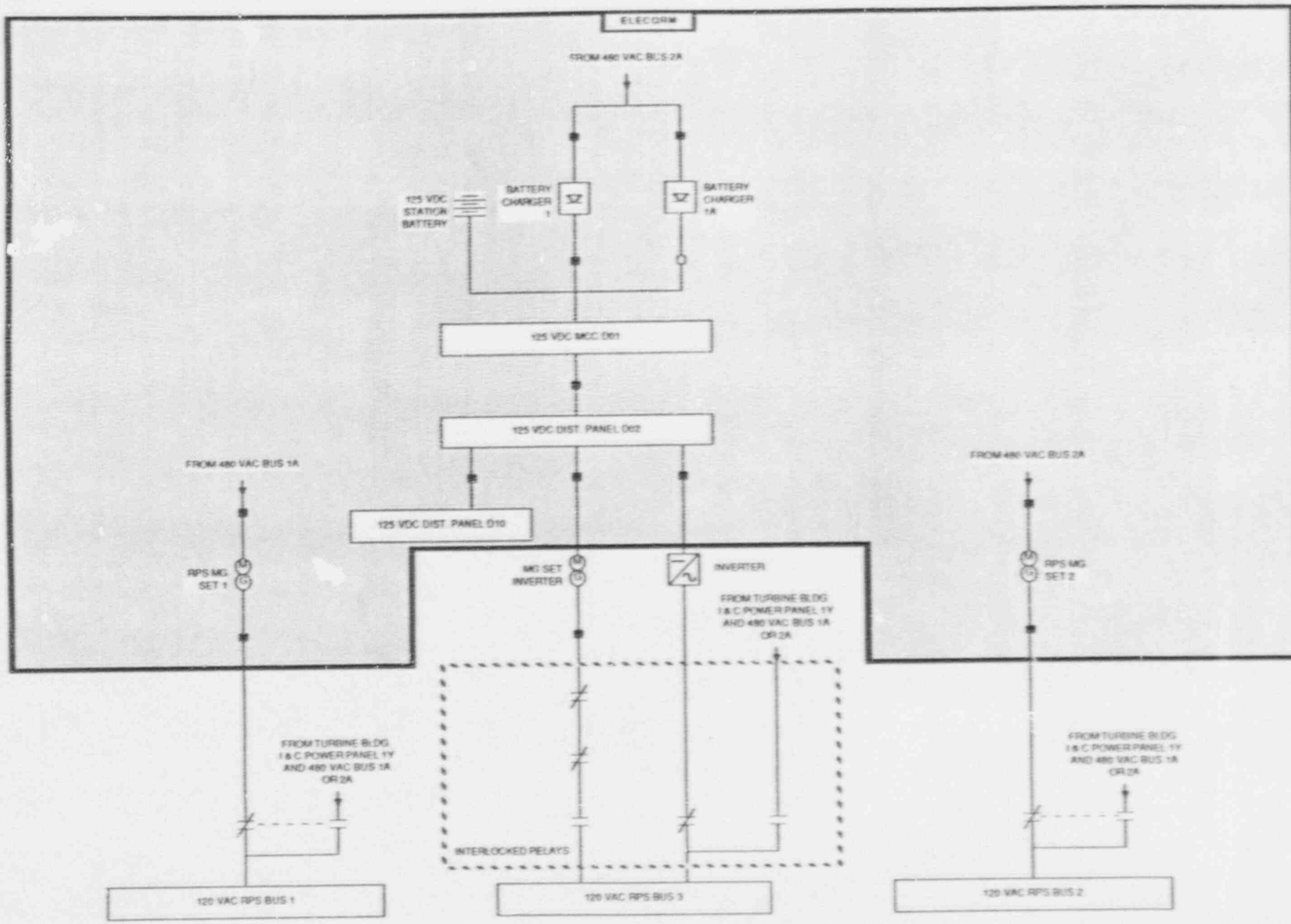



Figure 3.5-3. Big Rock Point 125 VDC Station Power and 120 VAC RPS Power Distribution Systems




NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

**Figure 3.5-4. Big Rock Point 125 VDC Station Power and 120 VAC RPS Power Distribution Systems Showing Component Locations**

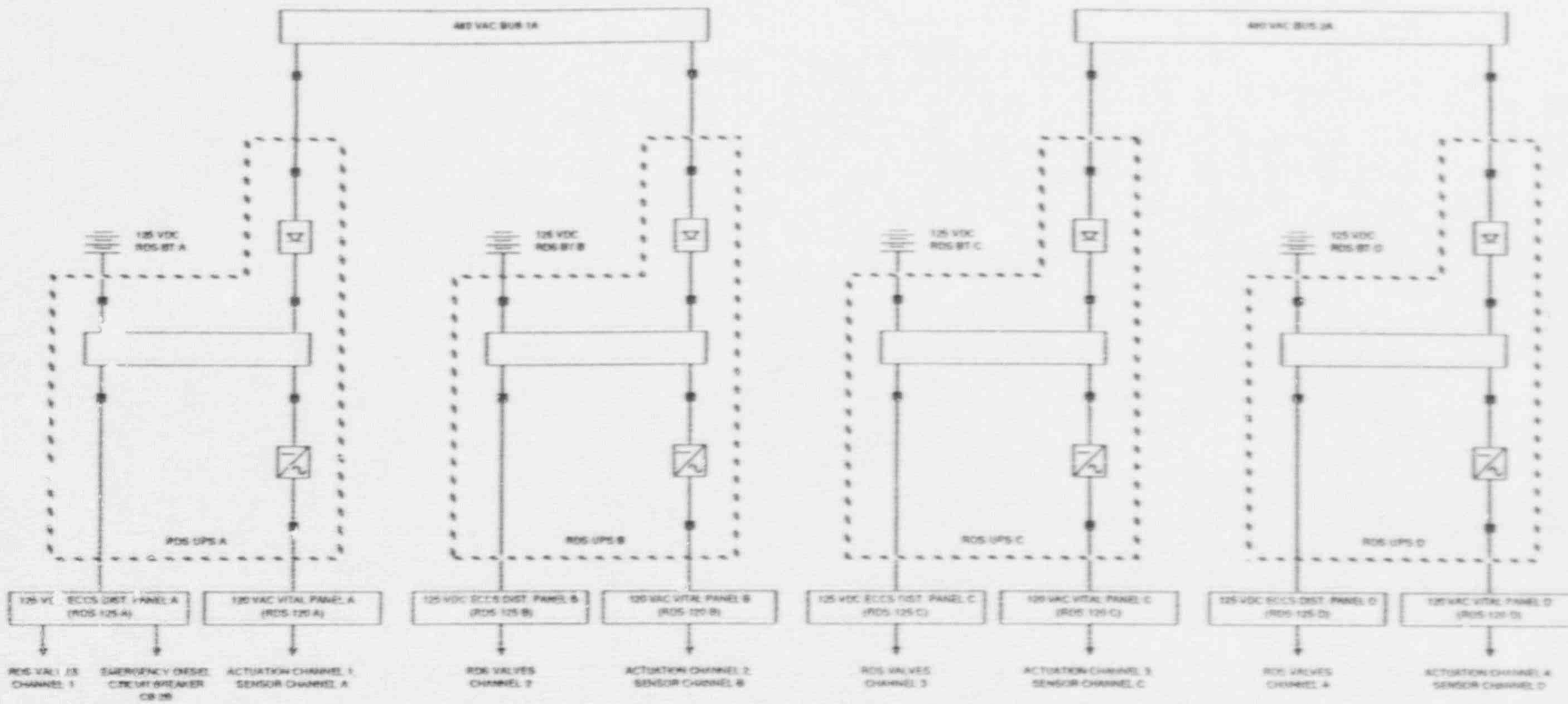



Figure 3.5-5. Big Rock Point 125 VDC and 120 VAC Reactor Depressurization System Power Distribution Systems

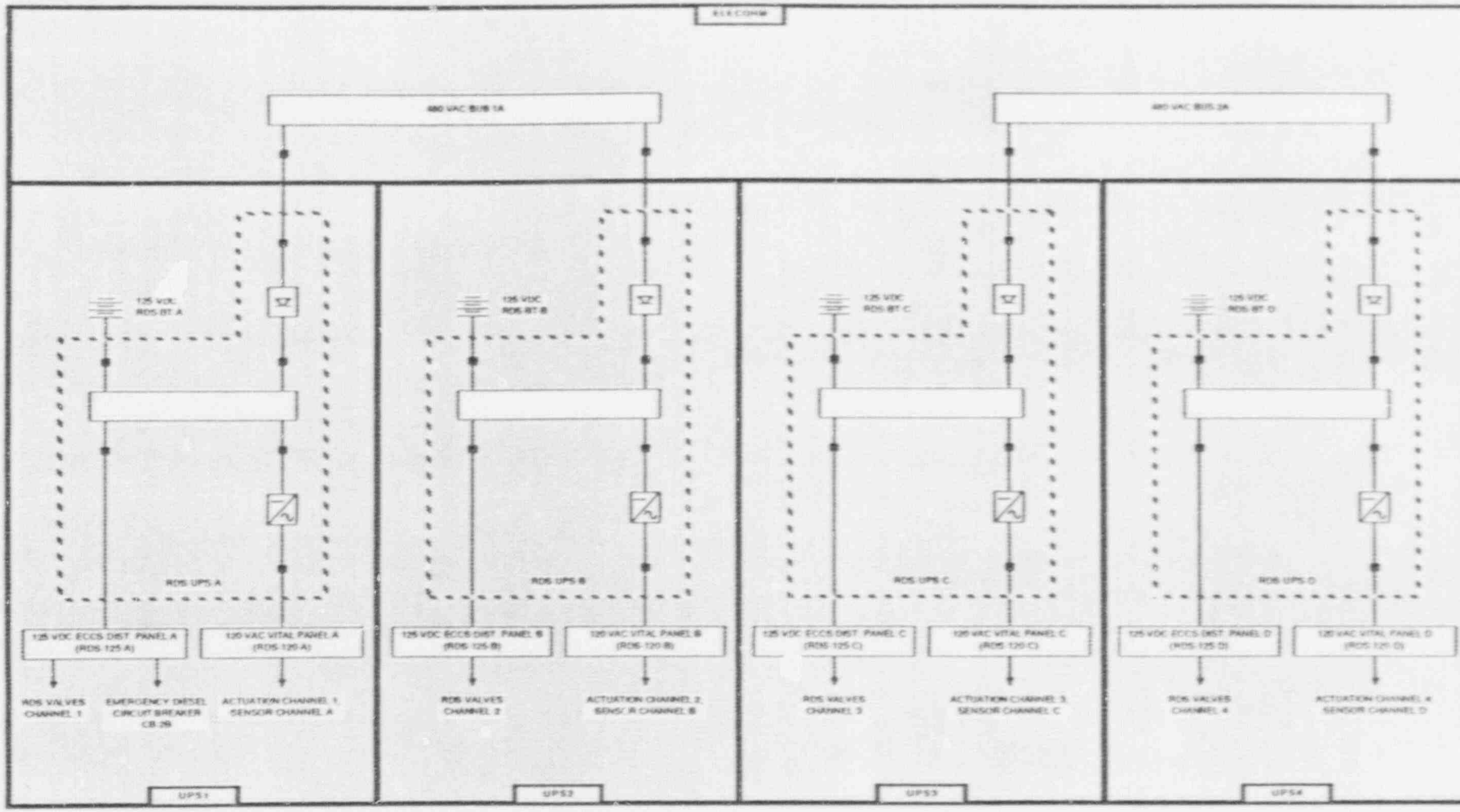



Figure 3.5-6. Big Rock Point 125 VDC and 120 VAC Reactor Depressurization System Power Distribution Systems Showing Component Locations

Table 3.5-1. Big Rock Point Electric Power System Data Summary for Selected Components

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| BCH-1 | BC | ELECEQRM | BUS-2A | 480 | ELECEQRM | AC-2A |
| BCH-1A | BC | ELECEQRM | BUS-2A | 480 | ELECEQRM | AC-2A |
| BUS-1A | BUS | ELECEQRM | BUS-2B | 480 | ELECEQRM | AC-1A |
| BUS-2A | BUS | ELECEQRM | BUS-2B | 480 | ELECEQRM | AC-2A |
| BUS-2B | BUS | ELECEQRM | DG | 480 | EDGRM | AC-2B |
| BUS-D01 | BUS | ELECEQRM | EP-BT | 125 | ELECEQRM | DC |
| CB-2B | CB | ELECEQRM | | | | |
| DG | DG | EDGRM | | | | |
| EP-BT | BATT | ELECEQRM | BCH-1 | 125 | ELECEQRM | DC |
| EP-BT | BATT | ELECEQRM | BCH-1A | 125 | ELECEQRM | DC |
| EP-INV | INV | ELECEQRM | BUS-D10 | 125 | ELECEQRM | DC |
| MCC-1A | MCC | ELECEQRM | BUS-1A | 480 | ELECEQRM | AC-1A |
| MCC-2A | MCC | ELECEQRM | BUS-2A | 480 | ELECEQRM | AC-2A |
| MCC-2B | MCC | ELECEQRM | BUS-2B | 480 | ELECEQRM | AC-2B |
| MCC-2P | MCC | ELECEQRM | BUS-2A | 480 | ELECEQRM | AC-2A |
| MGSET1 | MG | ELECEQRM | BUS-1A | 120 | ELECEQRM | AC-1A |
| MGSET2 | MG | ELECEQRM | BUS-2A | 120 | ELECEQRM | AC-2A |
| PANEL-D02 | PNL | ELECEQRM | BUS-D01 | 125 | ELECEQRM | DC |
| PANEL-D10 | PNL | ELECEQRM | BUS-D02 | 125 | ELECEQRM | DC |
| RPS-BUS-1 | BUS | ELECEQRM | MGSET1 | 120 | ELECEQRM | AC-1A |
| RPS-BUS-2 | BUS | ELECEQRM | MGSET2 | 120 | ELECEQRM | AC-2A |
| RPS-BUS-3 | BUS | ELECEQRM | EP-INV | 120 | ELECEQRM | DC |

## Table 3.5-2. Partial Listing of Electrical Sources and Loads at Big Rock Point

| POWER SOURCE | VOLTAGE | EMERG LOAD GRP | POWER SOURCE LOCATION | LOAD SYSTEM | LOAD COMPONENT ID | COMP TYPE | COMPONENT LOCATION |
|---|---|---|---|---|---|---|---|
| BCH-1 | 125 | DC | ELECEQRM | EP | EP-BT | BATT | ELECEQRM |
| BCH-1A | 125 | DC | ELECEQRM | EP | EP-BT | BATT | ELECEQRM |
| BUS-1A | 480 | AC-1A | ELECEQRM | CRDHS | CRDHS-P4A | MDP | RC |
| BUS-1A | 480 | AC-1A | ELECEQRM | DW | DW-P37 | MDP | TB593NORTH |
| BUS-1A | 480 | AC-1A | ELECEQRM | ECCS | CS-P2A | MDP | CSEQUIPRM |
| BUS-1A | 125 | AC-1A | ELECEQRM | ECCS | RDS-BT-A | BATT | UPS1 |
| BUS-1A | 125 | AC-1A | ELECEQRM | ECCS | RDS-BT-B | BATT | UPS2 |
| BUS-1A | 480 | AC-1A | ELECEQRM | EP | MCC-1A | MCC | ELECEQRM |
| BUS-1A | 120 | AC-1A | ELECEQRM | EP | MGSET1 | MG | ELECEQRM |
| BUS-2A | 480 | AC-2A | ELECEQRM | CRDHS | CRDHS-P4B | MDP | RC |
| BUS-2A | 480 | AC-2A | ELECEQRM | ECCS | CS-P2B | MDP | CSEQUIPRM |
| BUS-2A | 480 | AC-2A | ELECEQRM | ECCS | FS-7066 | MOV | CSEQUIPRM |
| BUS-2A | 125 | AC-2A | ELECEQRM | ECCS | RDS-BT-C | BATT | UPS3 |
| BUS-2A | 125 | AC-2A | ELECEQRM | ECCS | RDS-BT-D | BATT | UPS4 |
| BUS-2A | 480 | AC-2A | ELECEQRM | EP | BCH-1 | BC | ELECEQRM |
| BUS-2A | 480 | AC-2A | ELECEQRM | EP | BCH-1A | BC | ELECEQRM |
| BUS-2A | 480 | AC-2A | ELECEQRM | EP | MCC-2A | MCC | ELECEQRM |
| BUS-2A | 480 | AC-2A | ELECEQRM | EP | MCC-2P | MCC | ELECEQRM |
| BUS-2A | 120 | AC-2A | ELECEQRM | EP | MGSET2 | MG | ELECEQRM |
| BUS-2B | 480 | AC-2B | ELECEQRM | ECCS | FS-7069 | MOV | RC |
| BUS-2B | 480 | AC-2B | ELECEQRM | ECCS | FS-7070 | MOV | RC |
| BUS-2B | 480 | AC-2B | ELECEQRM | ECCS | FS-7070 | MOV | RC |
| BUS-2B | 480 | AC-2B | ELECEQRM | ECCS | FS-7071 | MOV | RC |
| BUS-2B | 480 | AC-2B | ELECEQRM | ECCS | FS-7071 | MOV | RC |
| BUS-2B | 480 | AC-2B | ELECEQRM | ECCS | FS-P6 | MDP | SCREENHSE |
| BUS-2B | 480 | AC-1A | ELECEQRM | EP | BUS-1A | BUS | ELECEQRM |
| BUS-2B | 480 | AC-2A | ELECEQRM | EP | BUS-2A | BUS | ELECEQRM |
| BUS-2B | 480 | AC-2B | ELECEQRM | EP | MCC-2B | MCC | ELECEQRM |
| BUS-D01 | 125 | DC | ELECEQRM | EC | EC-7053 | MOV | RC |
| BUS-D01 | 125 | DC | ELECEQRM | EC | EC-7063 | MOV | RC |
| BUS-D01 | 125 | DC | ELECEQRM | ECCS | FS-7051 | MOV | RC |

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Big Rock Point (Continued)

| POWER SOURCE | VOLTAGE | EMERG LOAD GRP | POWER SOURCE LOCATION | LOAD SYSTEM | LOAD COMPONENT ID | COMP TYPE | COMPONENT LOCATION |
|---|---|---|---|---|---|---|---|
| BUS-D01 | 125 | DC | ELECEQRM | ECCS | FS-7051 | MOV | RC |
| BUS-D01 | 125 | DC | ELECEQRM | ECCS | FS-7061 | MOV | RC |
| BUS-D01 | 125 | DC | ELECEQRM | ECCS | FS-7061 | MOV | RC |
| BUS-D01 | 125 | DC | ELECEQRM | EP | PANEL-D02 | PNL | ELECEQRM |
| BUS-D01 | 125 | DC | ELECEQRM | RCS | RCS-7050 | MOV | RC |
| BUS-D01 | 125 | DC | ELECEQRM | RCS | RCS-7065 | MOV | RC |
| BUS-D02 | 125 | DC | ELECEQRM | EP | PANEL-D10 | PNL | ELECEQRM |
| BUS-D10 | 125 | DC | ELECEQRM | EP | EP-INV | INV | ELECEQRM |
| DG | 480 | AC-2B | EDGRM | EP | BUS-2B | BUS | ELECEQRM |
| EP-BT | 125 | DC | ELECEQRM | EP | BUS-D11 | BUS | ELECEQRM |
| EP-INV | 120 | DC | ELECEQRM | EP | RPS-BUS-3 | BUS | ELECEQRM |
| MCC-2P | 480 | AC-2A | ELECEQRM | EC | EC-7052 | MOV | RC |
| MCC-2P | 480 | AC-2A | ELECEQRM | EC | EC-7062 | MOV | RC |
| MCC-2P | 480 | AC-2A | ELECEQRM | RCS | RCS-7056 | MOV | RC |
| MCC-2P | 480 | AC-2A | ELECEQRM | RCS | RCS-7057 | MOV | RC |
| MCC-2P | 480 | AC-2A | ELECEQRM | RCS | RCS-7058 | MOV | RC |
| MCC-2P | 480 | AC-2A | ELECEQRM | RCS | RCS-7059 | MOV | RC |
| MGSET1 | 120 | AC-1A | ELECEQRM | EP | RPS-BUS-1 | BUS | ELECEQRM |
| MGSET2 | 120 | AC-2A | ELECEQRM | EP | RPS-BUS-2 | BUS | ELECEQRM |
| PANEL-D10 | 125 | DC | ELECEQRM | ECCS | FS-7064 | MOV | RC |
| PANEL-D10 | 125 | DC | ELECEQRM | ECCS | FS-7072 | MOV | CSEQUIPRM |
| PANEL-D10 | 125 | DC | ELECEQRM | ECCS | FS-7072 | MOV | CSEQUIPRM |
| RDS-BT-A | 125 | AC-1A | UPS1 | ECCS | RDS-UPS-A | UPS | UPS1 |
| RDS-BT-B | 125 | AC-1A | UPS2 | ECCS | RDS-UPS-B | UPS | UPS2 |
| RDS-BT-C | 125 | AC-2A | UPS3 | ECCS | RDS-UPS-C | UPS | UPS3 |
| RDS-BT-D | 125 | AC-2A | UPS4 | ECCS | RDS-UPS-D | UPS | UPS4 |
| RDS-UPS-A | 120 | AC-1A | UPS1 | ECCS | RDS-120-A | PNL | UPS1 |
| RDS-UPS-A | 125 | AC-1A | UPS1 | ECCS | RDS-125-A | PNL | UPS1 |
| RDS-UPS-B | 120 | AC-1A | UPS2 | ECCS | RDS-120-B | PNL | UPS2 |
| RDS-UPS-B | 125 | AC-1A | UPS2 | ECCS | RDS-125-B | PNL | UPS2 |
| RDS-UPS-C | 120 | AC-2A | UPS3 | ECCS | RDS-120-C | PNL | UPS3 |

Table 3.5-2. Partial Listing of Electrical Sources and Loads at Big Rock Point (Continued)

| POWER SOURCE | VOLTAGE | EMERG LOAD GRP | POWER SOURCE LOCATION | LOAD SYSTEM | LOAD COMPONENT ID | COMP TYPE | COMPONENT LOCATION |
|---|---|---|---|---|---|---|---|
| RDS-UPS-C | 125 | AC-2A | UPS3 | ECCS | RDS-125-C | PNL | UPS3 |
| RDS-UPS-D | 120 | AC-2A | UPS4 | ECCS | RDS-120-D | PNL | UPS4 |
| RDS-UPS-D | 125 | AC-2A | UPS4 | ECCS | RDS-125-D | PNL | UPS4 |

## 3.6 REACTOR CLEAN-UP/DEMINERALIZED WATER (DW) SYSTEM

### 3.6.1 System Function

The demineralized water system provides demineralized water to various components in the plant. The system can be used to provide makeup to the emergency condenser. It is assumed that the system can also provide makeup to the RCS by interfacing with the reactor clean-up system

### 3.6.2 System Definition

The demineralized water system consists of a single motor driven pump, and piping and valving to the various components that are served. The main source of demineralized water is the 5,000 gallon demineralized water storage tank. The demineralized water pump can also be aligned to draw suction off the 25,000 gallon condensate storage tank.

It is assumed that the demineralized water system provides makeup to the RCS through the reactor clean-up system. The reactor clean-up system is a closed loop consisting of four regenerative heat exchangers, one non-regenerative heat exchanger, a clean-up pump, and a clean-up demineralizer. Demineralized water interfaces with the reactor clean-up system through the clean-up demineralizer.

Simplified drawings of the reactor clean-up/demineralized water system are shown in Figures 3.6-1 and 3.6-2. A summary of data on selected DW system components is presented in Table 3.6-1.

### 3.6.3 System Operation

During normal operation the reactor clean-up system controls primary water chemistry and level. Water flows from the reactor through the tubes of the regenerative heat exchangers where it is cooled by water being returned from the clean-up demineralizer. The water is further cooled in the non-regenerative heat exchanger by the reactor cooling water system (see Section 3.8). Water is then pumped through the clean-up demineralizer. After leaving the demineralizer the water passes through the shell side of the regenerative heat exchangers and re-enters the reactor.

As an alternate, reactor water can be made up with clean condensate while discharging contaminated water to the radwaste demineralizer (Ref. 1). It is assumed that this makeup is provided by demineralized water entering the clean-up demineralizer.

Makeup to the shell side of the emergency condenser is required after four hours of operation. Makeup to the emergency condenser is normally supplied by the demineralized water system.

The demineralized water pump can draw suction on either the demineralized water storage tank or the condensate storage tank.

### 3.6.4 System Success Criteria

To provide makeup to the emergency condenser and RCS the demineralized water pump can take suction on either the demineralized water storage tank or the condensate storage tank.

### 3.6.5 Component Information

A. Demineralized Water Pump P37
   1. Rated flow: unknown
   2. Rated capacity: 100%
   3. Type: horizontal centrifugal

B. Demineralized Water Storage Tank
   1. Capacity: 5,000 gallons
   2. Design pressure: atmospheric

C. Condensate Storage Tank
   1. Capacity: 25,000 gallons
   2. Design pressure: atmospheric

### 3.6.6 Support Systems and Interfaces

A. Control Signals
   1. Remote Manual
      The demineralized water pump ca 1 be actuated by remote manual means from the control room.

B. Motive Power
   1. The demineralized water pump is a Class 1E AC load that can be supplied form the emergency diesel generator as described in Section 3.5.

### 3.6.7 Section 3.6 References

1. "Final Hazards Summary Report for Big Rock Point Plant,".

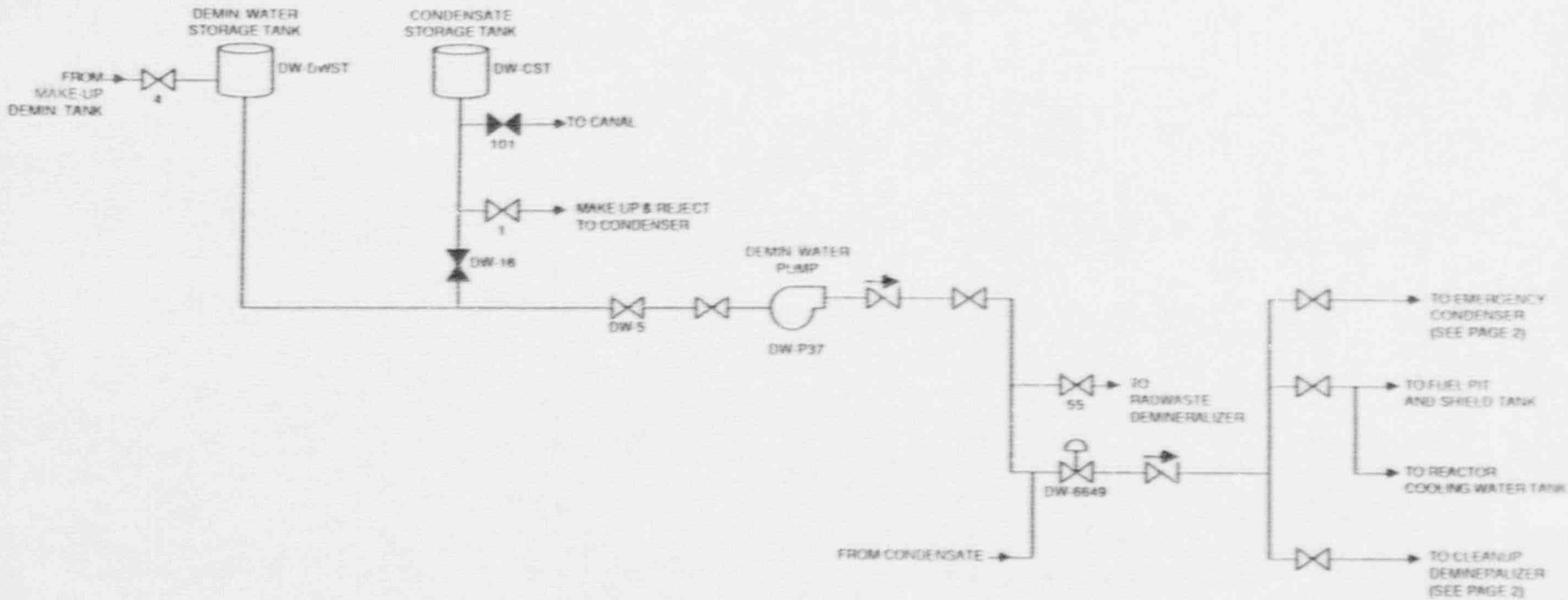



Figure 3.6-1. Big Rock Point Reactor Cleanup/Demineralized Water System (Page 1 of 2)

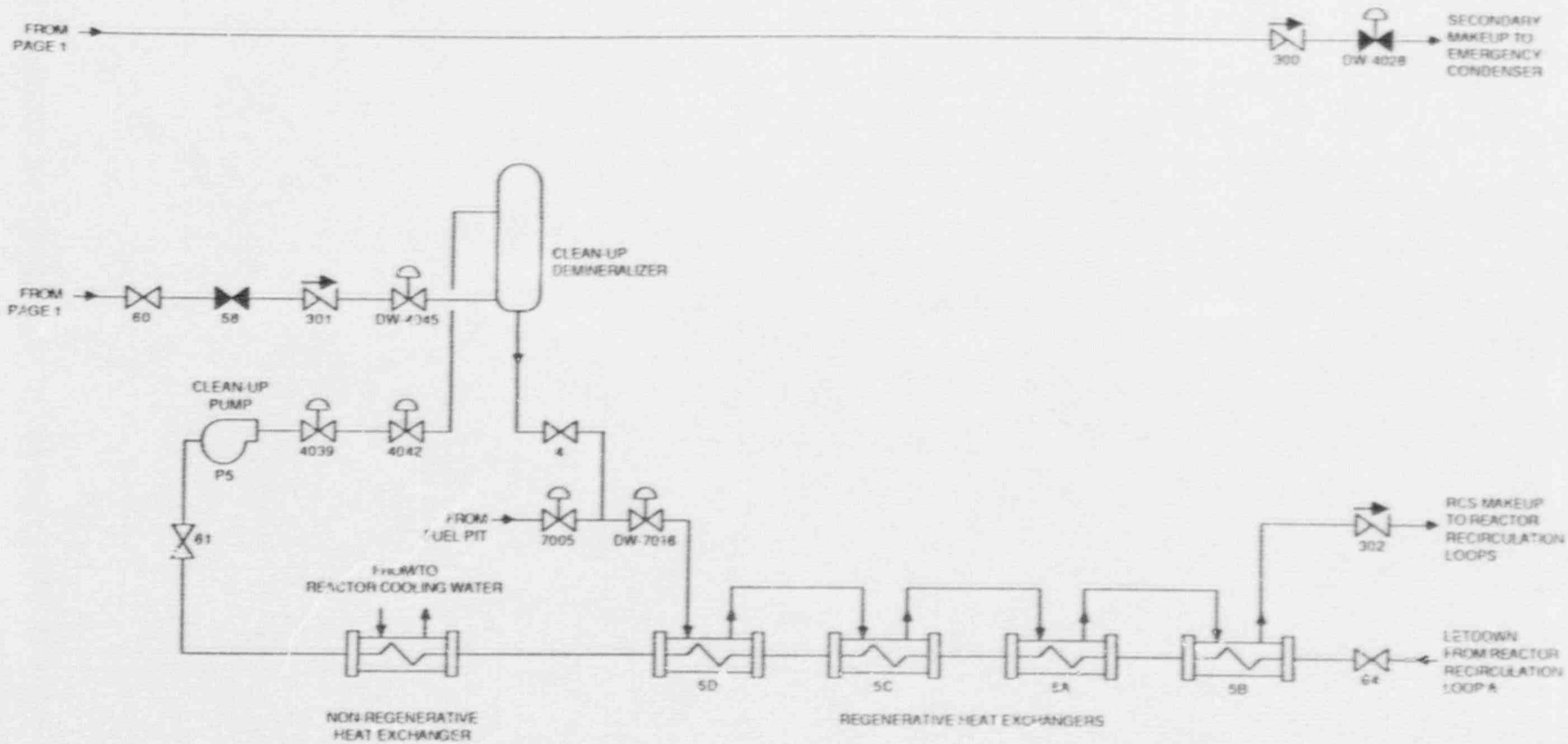



Figure 3.6-1. Big Rock Point Reactor Cleanup/Demineralized Water System (Page 2 of 2)

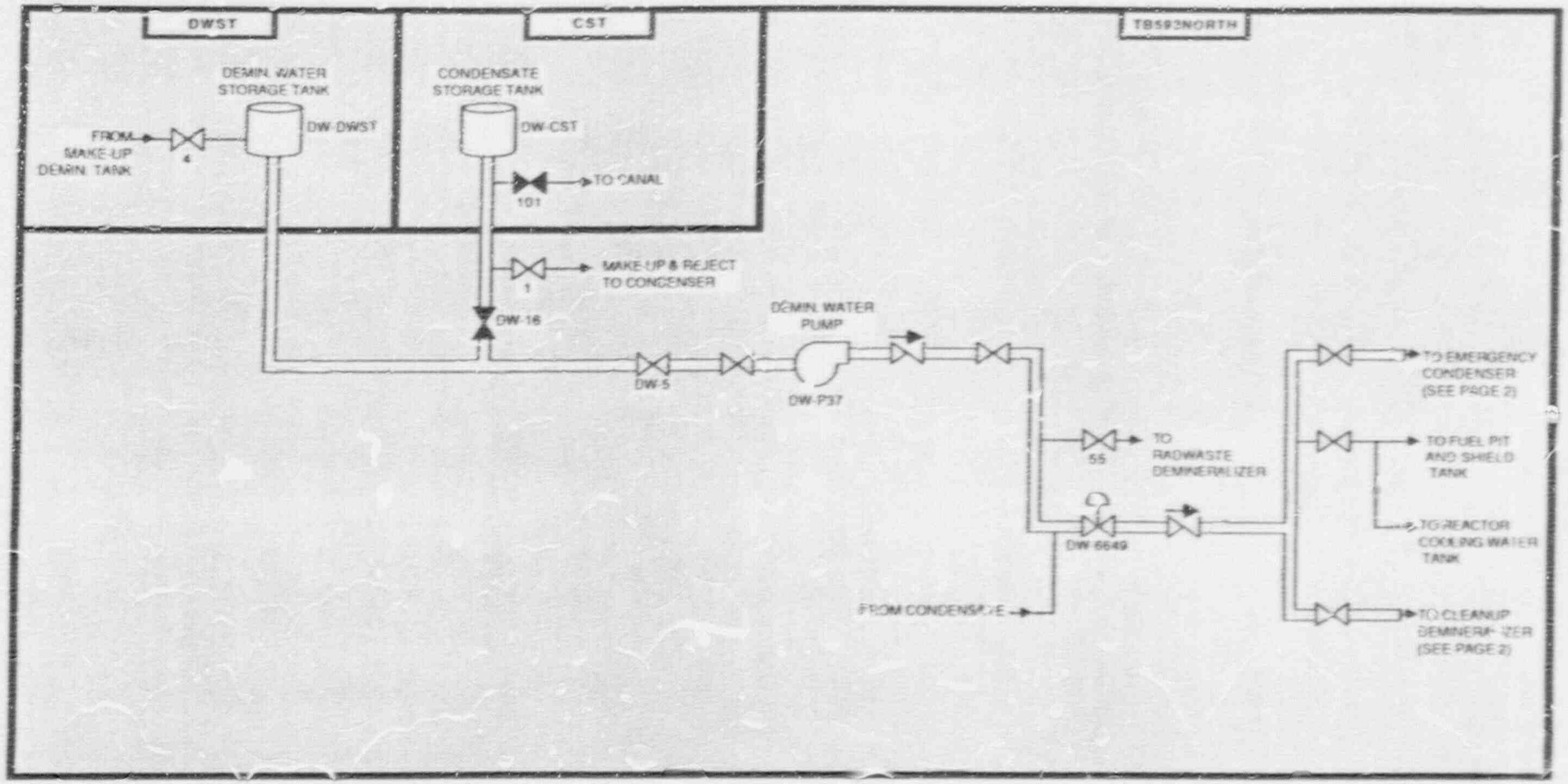



Figure 3.6-2. Big Rock Point Reactor Cleanup/Demineralized Water System Showing Component Locations (Page 1 of 2)

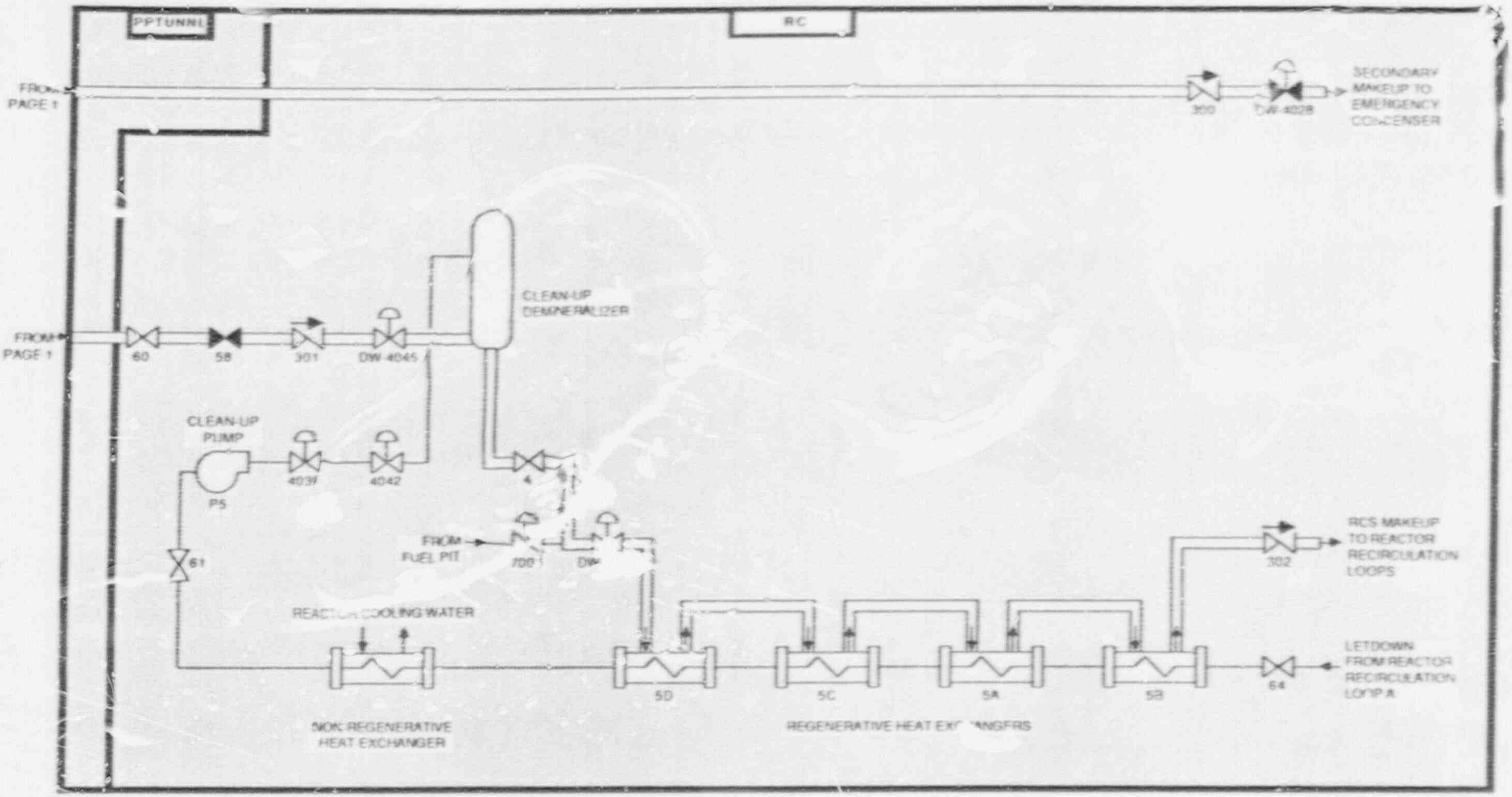



Figure 3.6-2. Big Rock Point Reactor Cleanup/Demineralized Water System Showing Component Locations (Page 2 of 2)

Table 3.6-1. Big Rock Point Reactor Clean-up/Demineralized Water System Data Summay for Selected Components

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| DW-16 | XV | TB593NORTH | | | | |
| DW-4028 | NV | RC | | | | |
| DW-4045 | NV | RC | | | | |
| DW-5 | XV | TB593NORTH | | | | |
| DW-5 | XV | TB593NORTH | | | | |
| DW-6649 | NV | TB593NORTH | | | | |
| DW-7016 | NV | RC | | | | |
| DW-CST | TANK | CST | | | | |
| DW-DWST | TANK | DWST | | | | |
| DW-P37 | MDP | TB593NORTH | BUS-1A | 480 | ELECEQRM | AC-1A |

## 3.7 CONTROL ROD DRIVE HYDRAULIC SYSTEM (CRDHS)

### 3.7.1 System Function

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

### 3.7.2 System Definition

The CRDHS consists of two high-head, low-flow, 100% capacity pumps, piping, filters, control valves, one hydraulic control unit for each control rod drive mechanism, and instrumentation. Water is supplied from condensate and from the condensate storage tank. The CRDHS also includes scram valves, scram accumulators, and a scram discharge volume (dump tank).

A simplified drawing of the CRDHS is shown in Figure 3.7-1. A summary of data on selected CRDHS components is presented in Table 3.7-1.

### 3.7.3 System Operation

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

A reactor scram is implemented by pneumatic scram valves in the CRDHS. An inlet scram valve opens to align the insert side of each control rod drive mechanism (CRDM) to the scram accumulator. An outlet scram valve opens to vent the opposite side of each CRDM to the dump tank. This coordinated action results in rapid insertion of control rods into the reactor. As shown in Figure 3.7-1, the scram portion of the CRDHS overrides the normal rod control portion of the system.

Although not intended as a makeup system, the CRDHS can provide a source of cooling water to the RCS during vessel isolation. It is noted in NUREG-0626 (Ref. 2), that this function is particularly important for some BWR/1 plants (i.e. Big Rock Point) and BWR/2 plants for which the CRDHS is the primary source of makeup on vessel isolation.

### 3.7.4 System Success Criteria

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

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

During emergency condenser operation, RCS makeup can be provided by one of two control rod drive pumps taking suction on the condensate storage tank.

### 3.7.5 Component Information

A. Control rod drive pumps (2)
   1. Rated capacity: 100%

### 3.7.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      The RPS transmits scram commands to solenoid pilot valves which control the pneumatic scram valves
   2. Remote Manual
      a. A reactor scram can be initiated manually from the control room

      b. The CRDHS can be operated manually from the control room to insert and withdraw rods, or to inject water into the RCS

B. Motive Power
   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.

### 3.7.7 Section 3.7 References


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

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

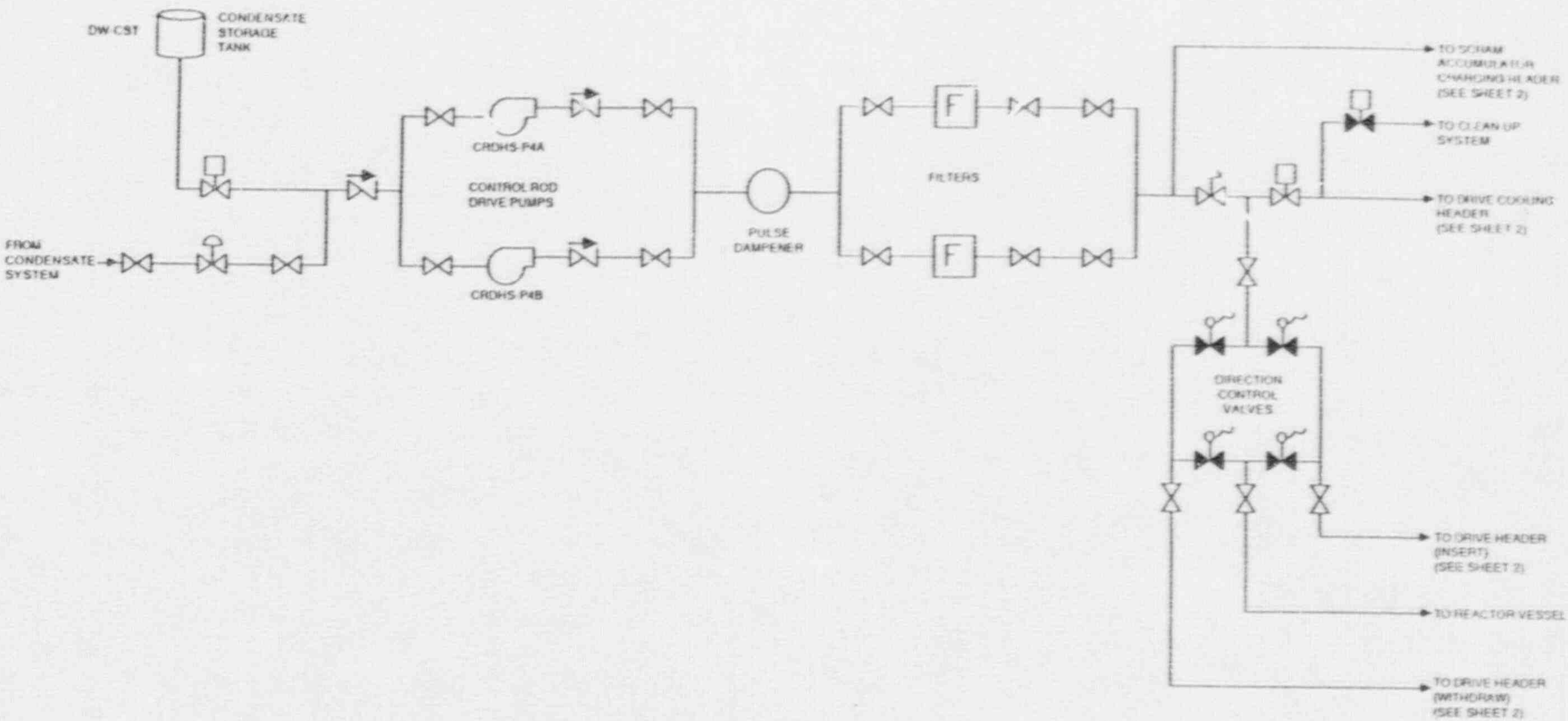



**Figure 3.7-1. Big Rock Point Control Rod Drive Hydraulic System (Sheet 1 of 2)**

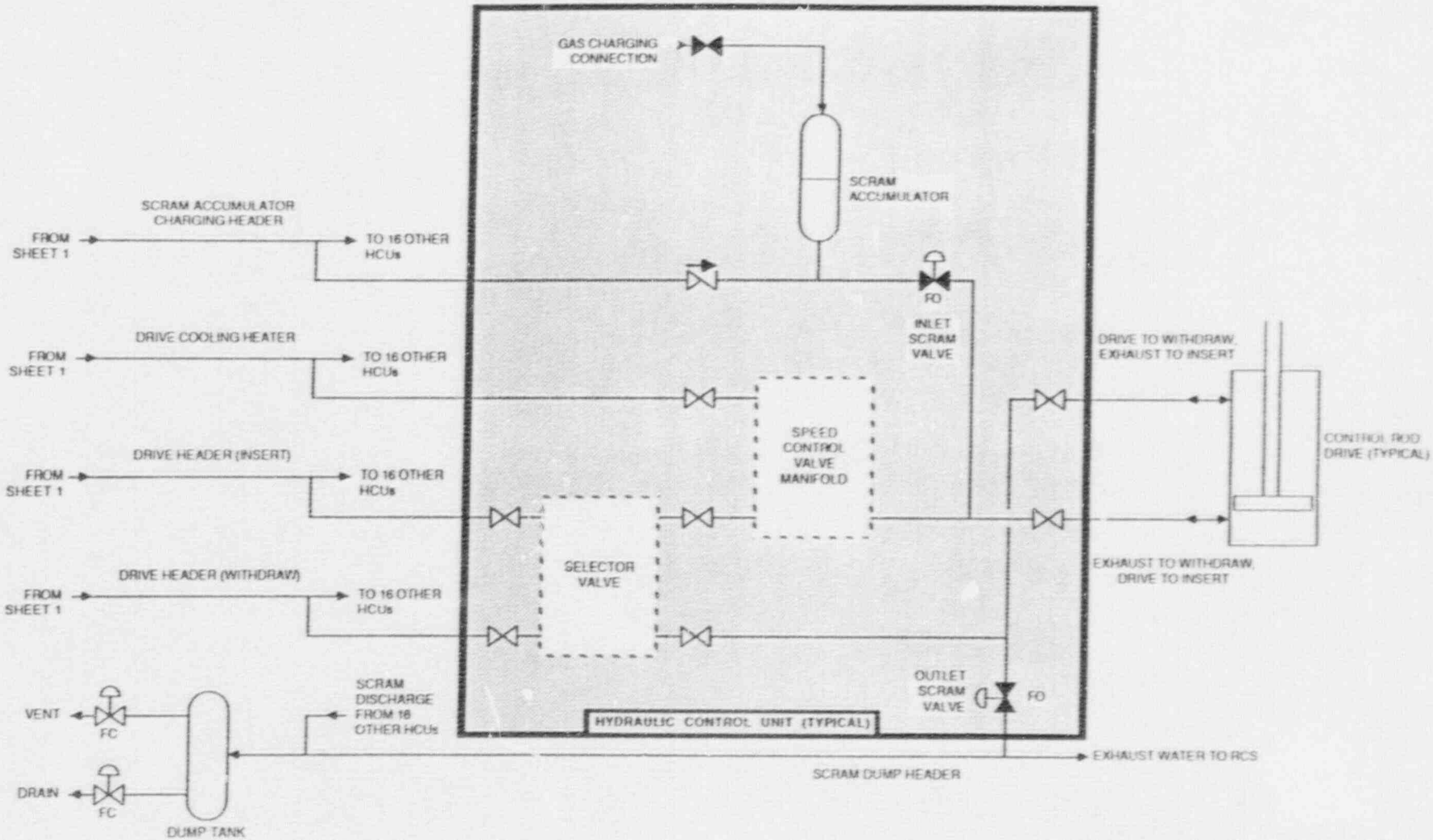



Figure 3.7-1. Big Rock Point Control Rod Drive Hydraulic System (Sheet 2 of 2)

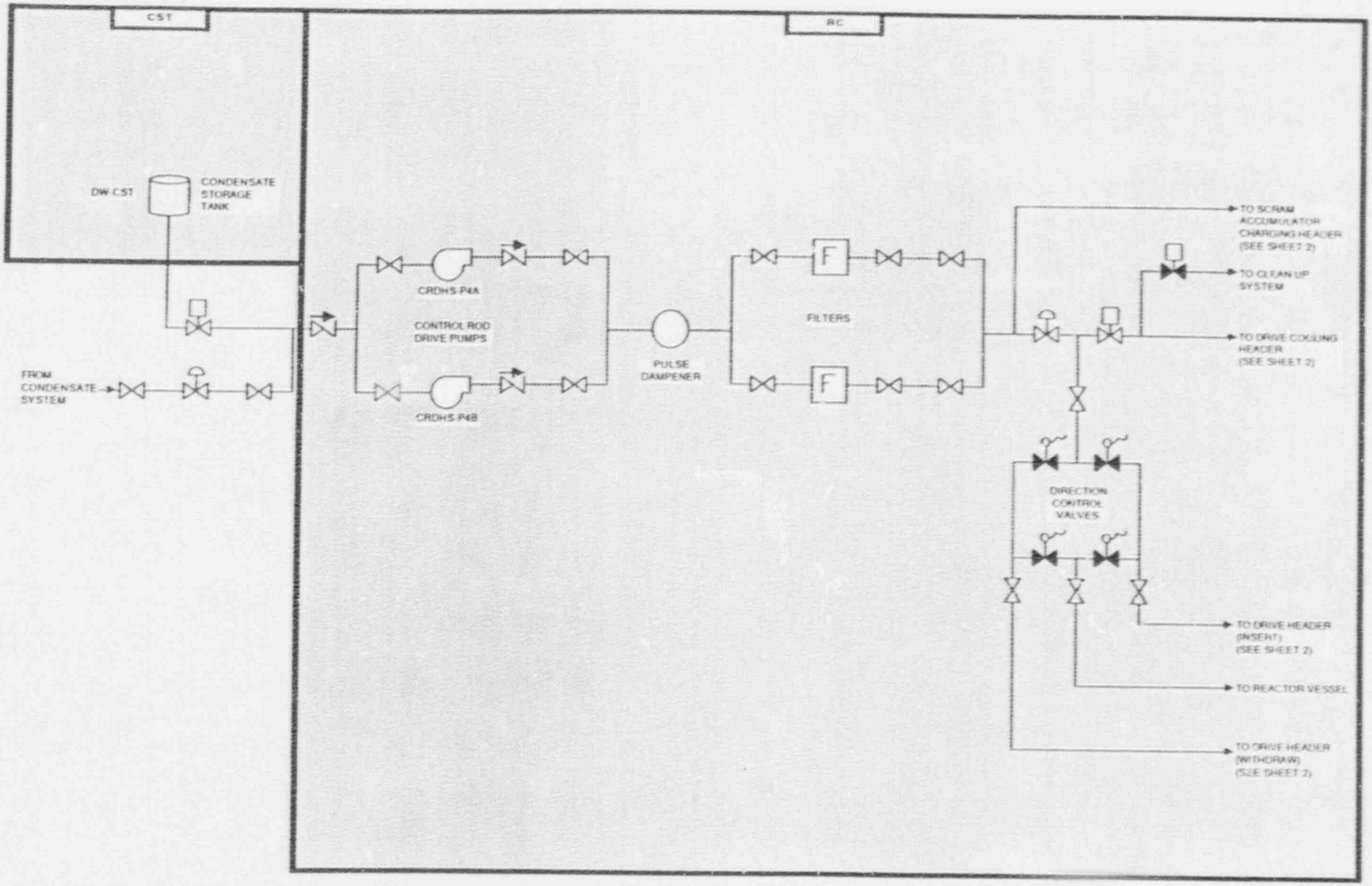



Figure 3.7-2. Big Rock Point Control Rod Drive Hydraulic System Showing Component Locations (Sheet 1 of 2)

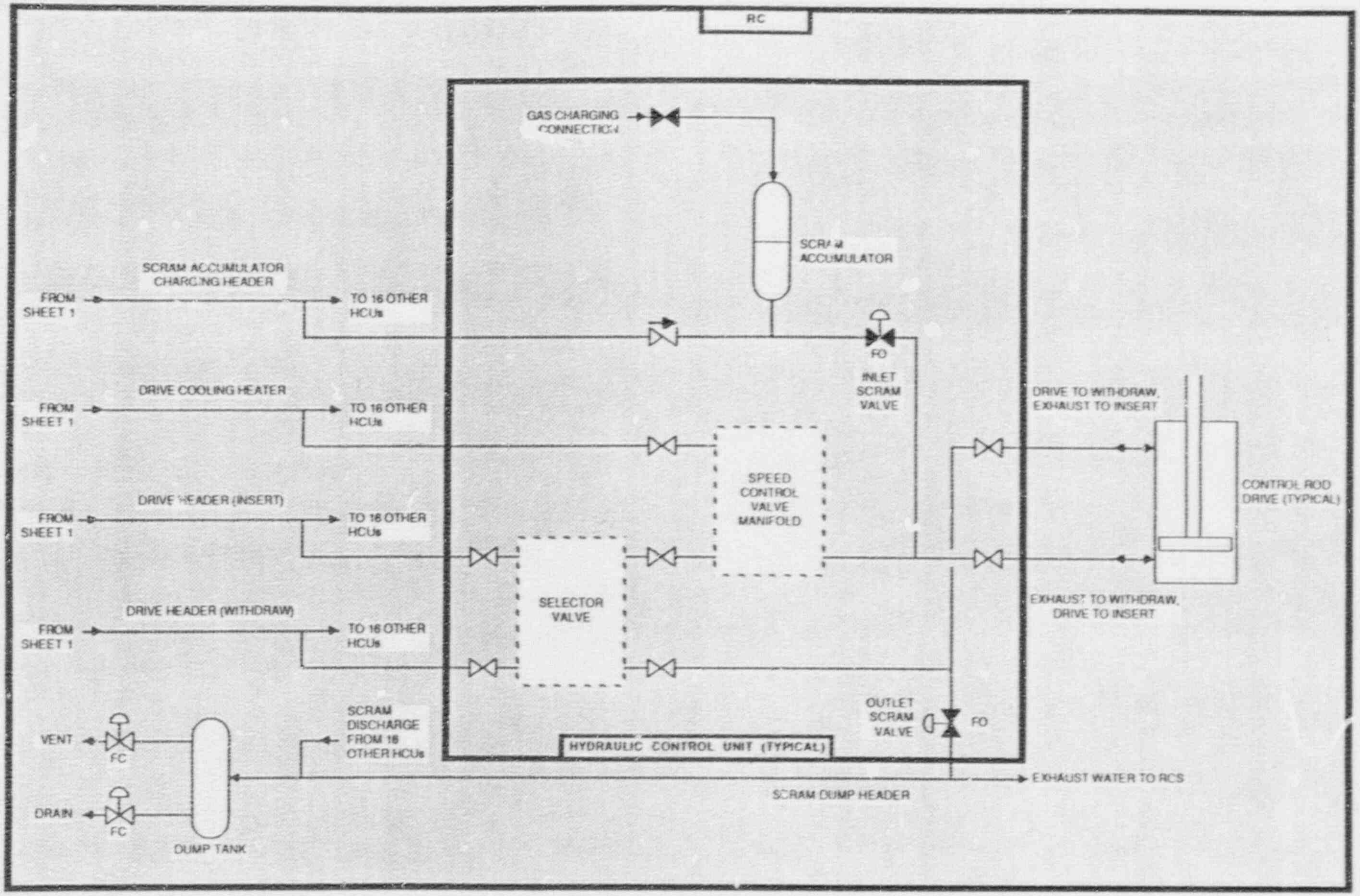



**Figure 3.7-2. Big Rock Point Control Rod Drive Hydraulic System Showing Component Locations (Sheet 2 of 2)**

Table 3.7-1. Big Rock Point Control Rod Drive Hydraulic System Data Summay for Selected Components

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| CRDHS-P4A | MDP | RC | BUS-1A | 480 | ELECEQRM | AC-1A |
| CRDHS-P4B | MDP | RC | BUS-2A | 480 | ELECEQRM | AC-2A |

## 3.8 REACTOR COOLING WATER SYSTEM (RCWS)

### 3.8.1 System Function

The RCWS is designed to remove heat from various plant components, namely the reactor recirculation pumps, non-regenerative heat exchanger, shutdown cooling pumps and heat exchangers, fuel pit heat exchangers, and reactor shield panels.

### 3.8.2 System Definition

The RCWS is a closed loop cooling system consisting of two parallel pumps and two parallel heat exchangers. The two pumps draw on the reactor cooling water tank and discharge to a common header from which the heat loads are supplied. The two heat exchangers are downstream of the heat loads. Simplified drawings of the RCWS are shown in Figures 3.8-1 and 3.8-2.

### 3.8.3 System Operation

During normal operation one reactor cooling water pump and one heat exchanger are sufficient to cool the following heat loads:

- reactor recirculation pump coolers
- reactor clean-up non-regenerative heat exchanger
- shutdown cooling heat exchangers
- shutdown cooling pump coolers
- fuel pit heat exchangers
- reactor shield cooling panels
- miscellaneous sample coolers

The pumps draw suction from the reactor cooling water tank. Heat removed by the reactor cooling water heat exchangers is transferred to the service water system. After exiting the heat exchangers water is returned to the reactor cooling water tank. The demineralized water system can provide makeup to the reactor cooling water tank.

### 3.8.4 System Success Criteria

During normal operation one of two RCWS pumps and one of two heat exchangers are sufficient to cool the system heat loads.

### 3.8.5 Component Information

A. Reactor cooling water pumps P11A and P11B
   1. Rated flow: 1500 gpm @ 100 ft. head (43 psid)
   2. Rated capacity: 100%
   3. Type: vertical centrifugal

B. Reactor cooling water heat exchangers (2)
   1. Design duty: $9.0 \times 10^6$ Btu/hr

### 3.8.6 Support Systems and Interfaces

A. Control Signals
   1. Remote manual
      The RCWS pumps can be actuated by remote manual means from the control room.

B. Motive Power

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

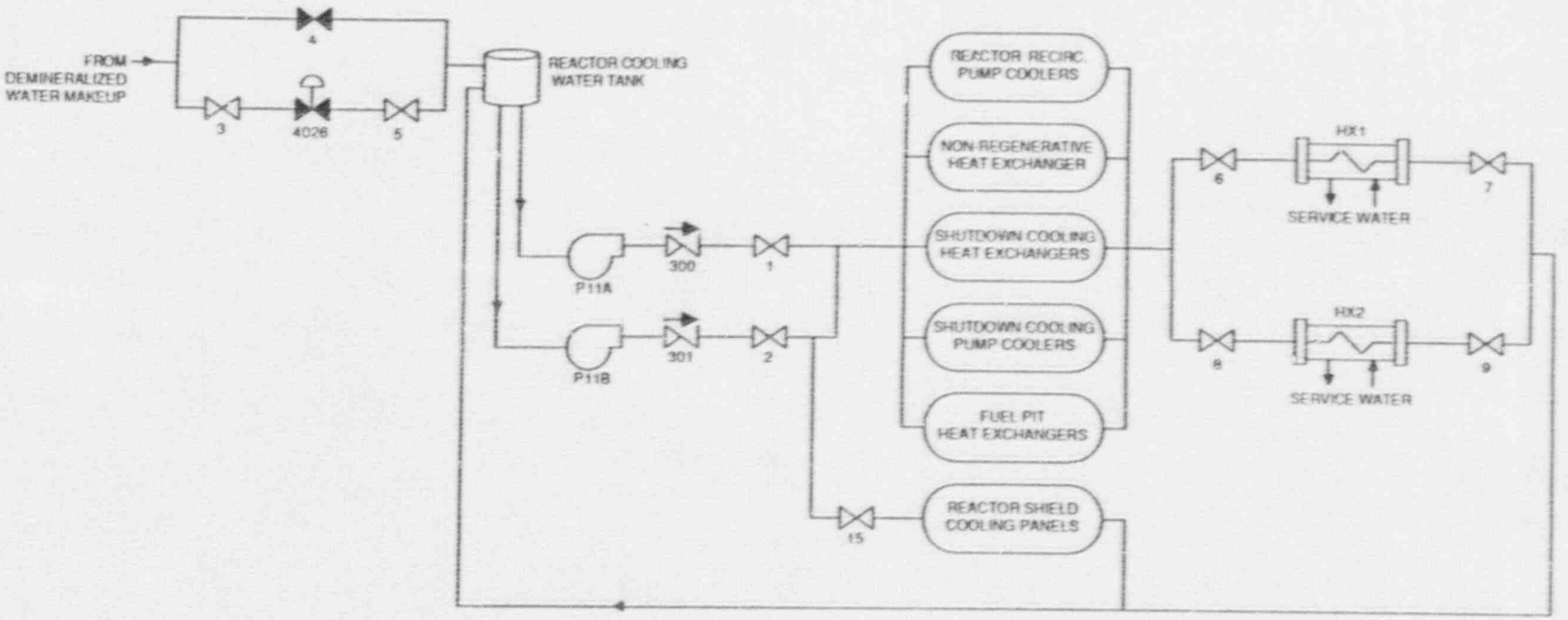



Figure 3.8-1. Big Rock Point Reactor Cooling Water System

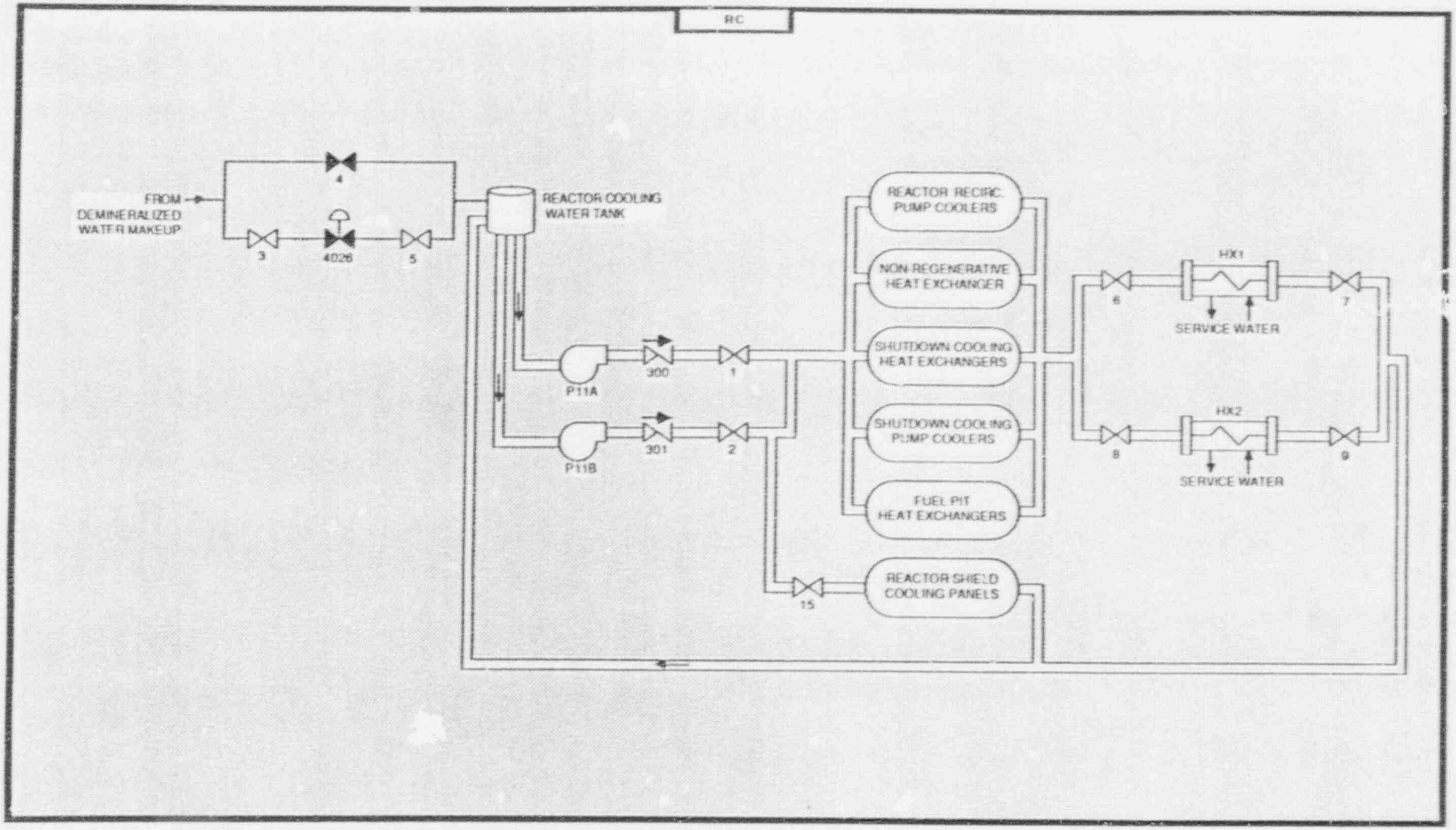



Figure 3.8-2. Big Rock Point Reactor Cooling Water System
Showing Component Locations

## 3.9 SERVICE WATER SYSTEM (SWS)

### 3.9.1 System Function

The Service Water System provides cooling water from the ultimate heat sink, Lake Michigan, to various heat loads in the plant.

### 3.9.2 System Definition

The SWS contains two motor driven pumps which take suction through strainers at the intake structure. The pumps supply a common header from which the heat loads are supplied. Simplified drawings of the SWS are shown in Figures 3.9-1 and 3.9-2.

### 3.9.3 System Operation

During normal operation one service water pump is sufficient to cool the following heat loads:

- generator hydrogen coolers
- turbine lube oil coolers
- feed pump bearings and oil coolers
- air compressor aftercoolers and jackets
- miscellaneous sample coolers
- air conditioning system
- reactor enclosure air coolers
- space heating and cooling
- reactor cooling water heat exchangers

Water is returned to the lake via the discharge canal.

### 3.9.4 System Success Criteria

During normal operation one of two service water pumps is sufficient to cool the system heat loads.

### 3.9.5 Component Information

A. Service Water Pumps 12A and 12B
   1. Rated flow: 2100 gpm @ 88 ft. head (38 psid)
   2. Rated capacity: 100%
   3. Type: vertical centrifugal

### 3.9.6 Support Systems and Interfaces

A. Control Signals
   1. Remote manual
      The SWS pumps can be actuated by remote manual means from the control room.

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

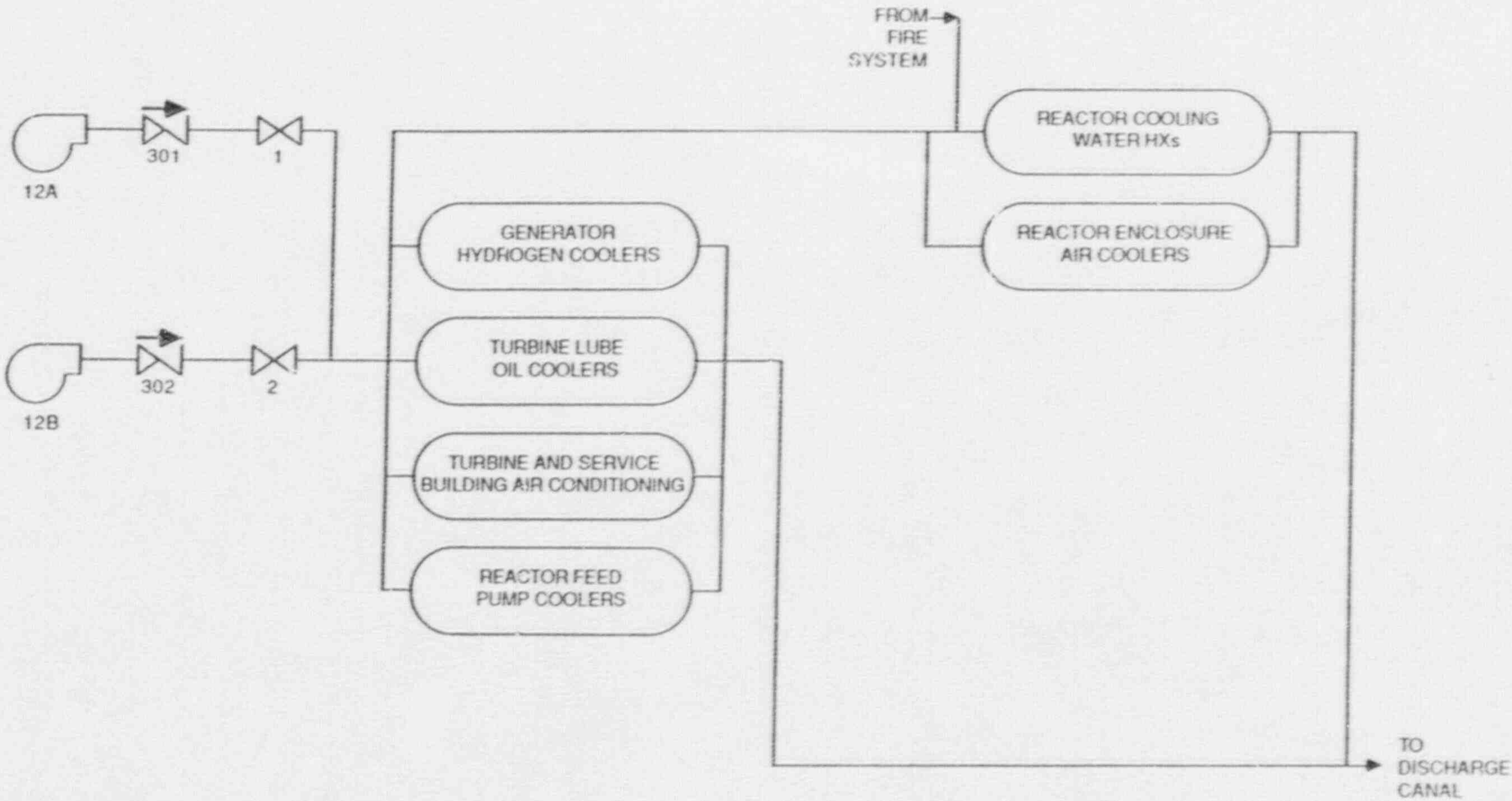



Figure 3.9-1. Big Rock Point Service Water System

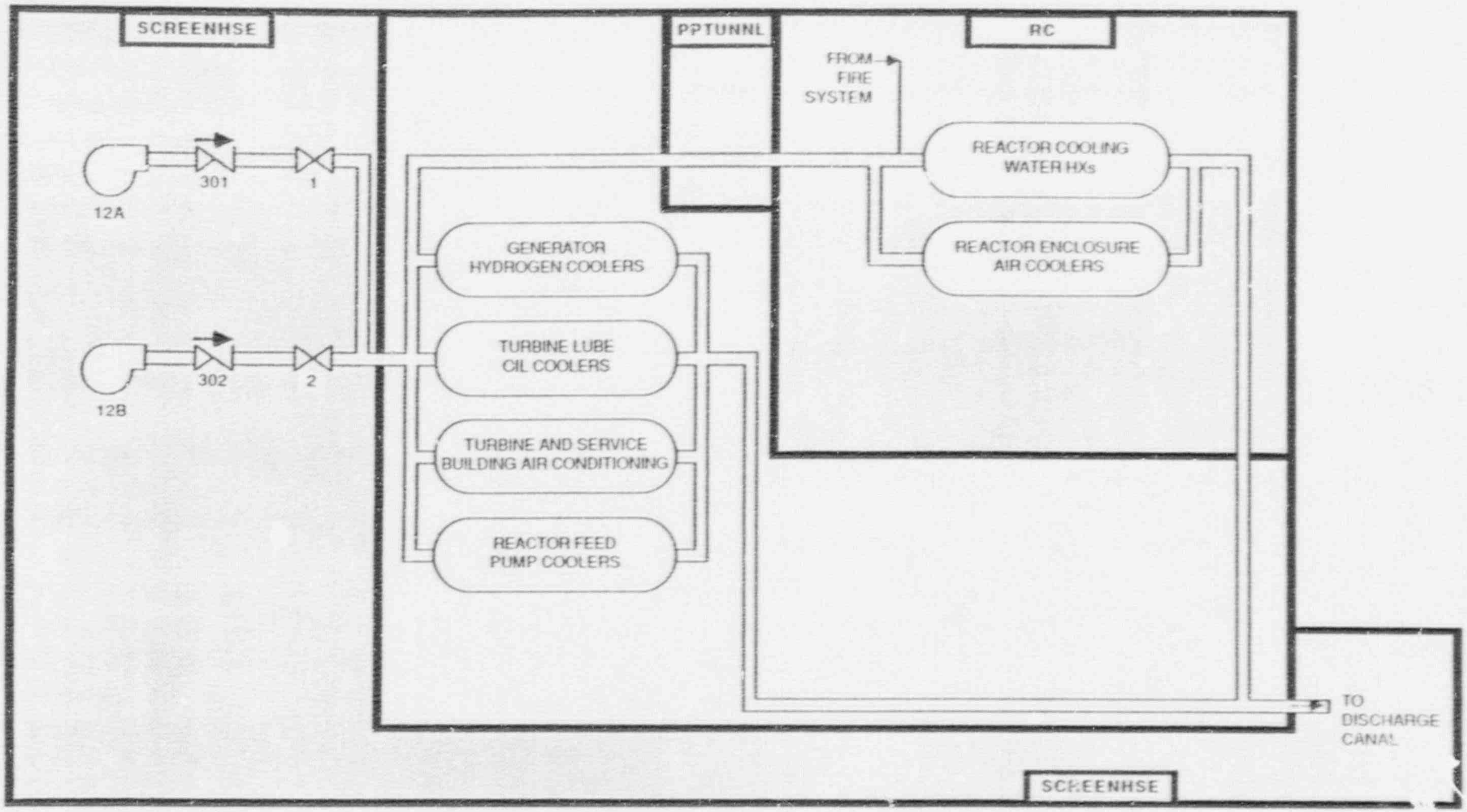



Figure 3.9-2. Big Rock Point Service Water System
Showing Component Locations

# 4. PLANT INFORMATION

## 4.1 SITE AND BUILDING SUMMARY

The Big Rock Point nuclear power plant is located on a site of approximately 600 acres of land on Lake Michigan, on the northern shore of Michigan's lower peninsula. The site is in Charlevoix County, between the towns of Charlevoix, about 4 miles SoE, and Petoskey. The site is 228 miles NNW of Detroit and 262 miles NNE of Chicago. Figure 4-1 (from Ref. 1) is a general view of the plant and vicinity.

The major structures at this unit include the reactor building, turbine generator building, service building, and screenhouse. A site plot plan is shown in Figure 4-2.

The containment structure is a spherical steel vessel 130 feet in diameter. It houses the reactor, recirculation piping and pumps, steam drum, spent fuel pool, and equipment for sutdown cooling. Access to the containment is through the following: an equipment lock, a personnel lock, and an escape lock.

The turbine generator building, located south of the containment, houses the turbine generator and the associated power generating auxiliaries. This building includes the control room, electrical equipment room, and computer room.

The screenhouse, located northeast of the containment, contains the water intake facilities and the fire protection system pumps.

## 4.2 FACILITY LAYOUT DRAWINGS

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

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

## 4.3 SECTION 4 REFERENCES

1. Heddleson, F.A., "Design Data and Safety Features of Commercial Nuclear Power Plants," ORNL-NSIC-55, Volume 1, Oak Ridge National Laboratory, Nuclear Safety Information Center, December 1973.

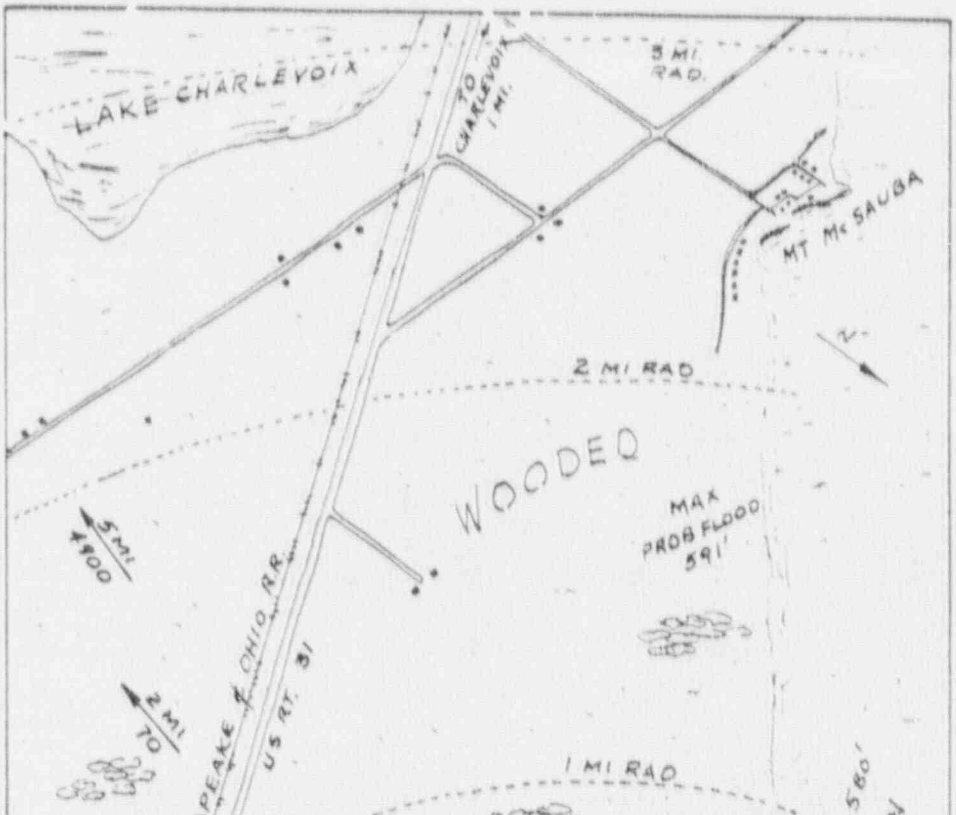



Figure 4-1. General View of Big Rock Point Nuclear Power Plant and Vicinity

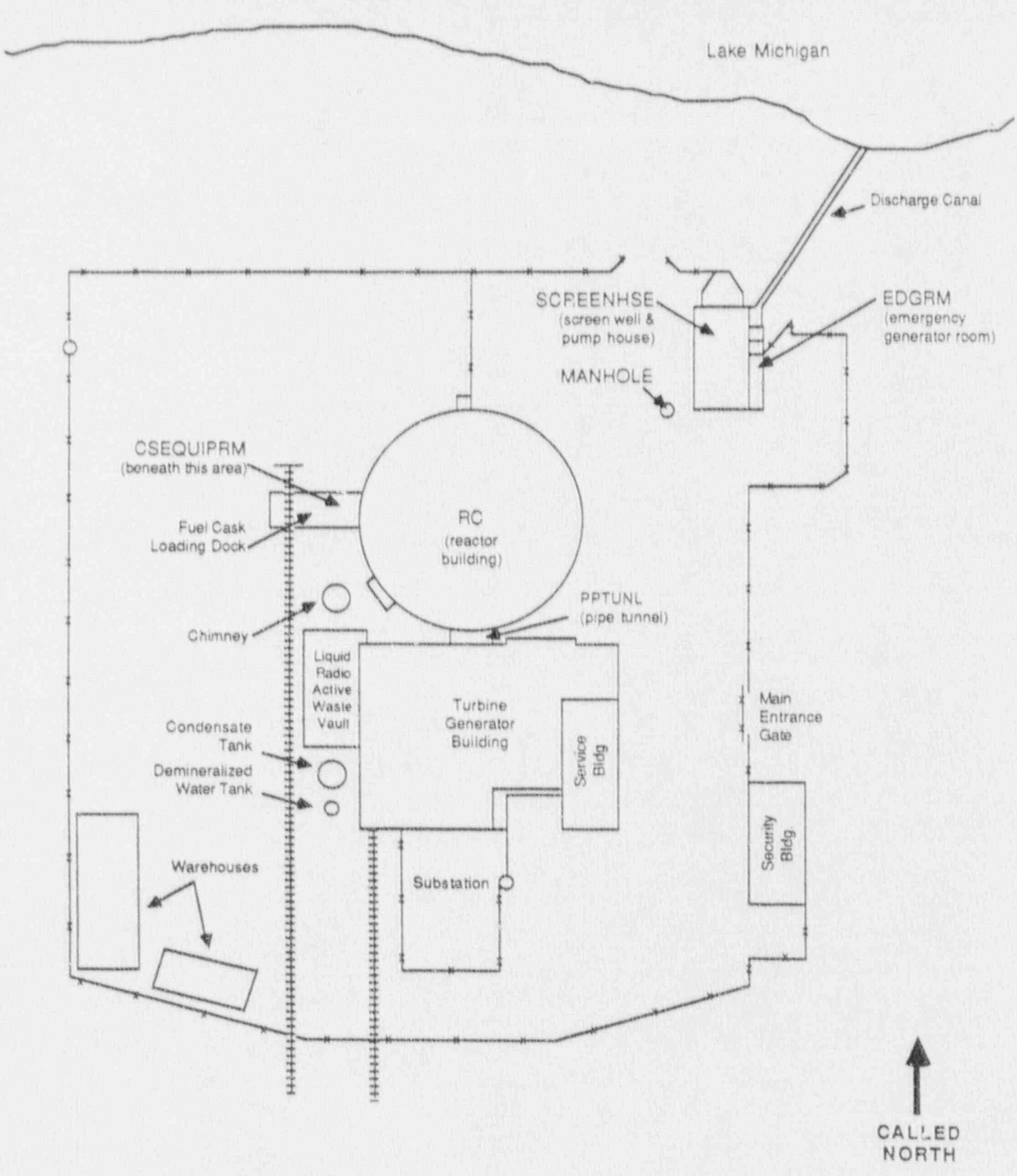



Figure 4-2. Big Rock Point Plot Plan

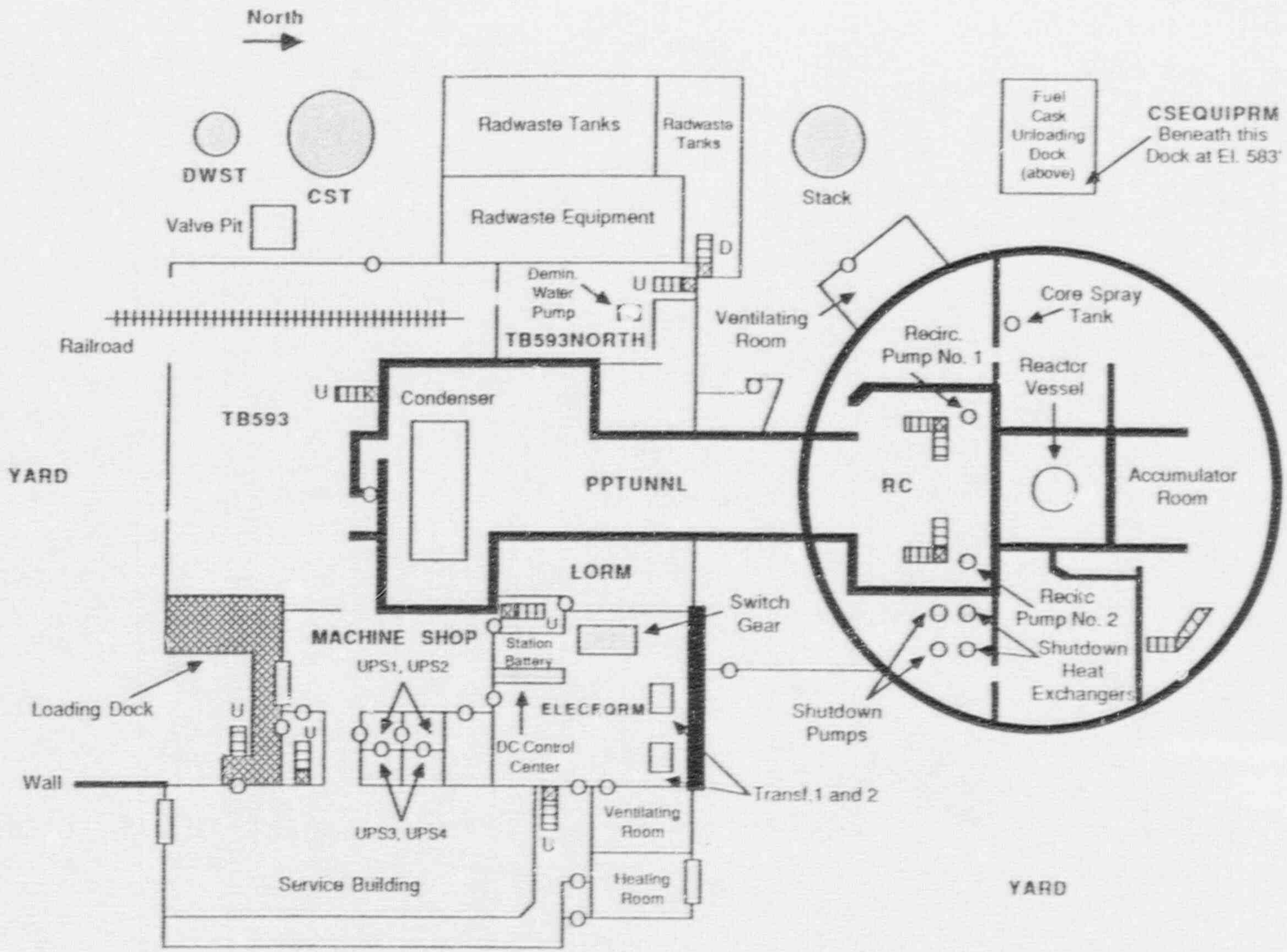



Figure 4-3. Big Rock Point Station Arrangement, Plan Above Grade (Below Elevation 598')

## Table 4-1. Definition of Big Rock Point Building and Location Codes

| | Codes | Descriptions |
|---|---|---|
| 1. | COMPRM | Computer Room, located approximately on the 610' elevation of the Turbine Generator Building - northeast corner |
| 2. | CR | Control Room, located on the 618' elevation of the Turbine Generator Building |
| 3. | CSEQUIPRM | Core Spray Equipment Room, located on the 583' elevation - beneath the Fuel Cask Unloading Dock |
| 4. | CST | Condensate Storage Tank, located in the yard |
| 5. | DWST | Demineralized Water Storage Tank, located in the yard |
| 6. | EDGRM | Emergency Diesel Generator Room |
| 7. | ELECEQRM | Electrical Equipment Room, located on the 593' elevation of the Turbine Generator Building - north side |
| 8. | LORM | Lubrication Oil Room, located on the 593' elevation of the Turbine Generator Building - north side |
| 9. | MACHINESHOP | Machine Shop, located on the 593' elevation of the Turbine Generator Building |
| 10. | MANHOLE | Manhole - provides access to Emergency Diesel Generator Electrical Cables, located next to the Screen House - west side |
| 11. | PPTUNNL | Pipe Tunnel, located on the 593' elevation of the Turbine Generator Building |
| 12. | RC | Reactor Containment |
| 13. | SCREENHSE | Screen House |
| 14. | TB593 | 593' elevation of the Turbine Building - south side |
| 15. | TB593NORTH | 593' elevation of the Turbine Building - north side |
| 16. | UPS1 | Uninterruptible Power Supply Room 1, located on the 593' elevation of the Turbine Generator Building |
| 17. | UPS2 | Uninterruptible Power Supply Room 2, located on the 593' elevation of the Turbine Generator Building |
| 18. | UPS3 | Uninterruptible Power Supply Room 3, located on the 593' elevation of the Turbine Generator Building |

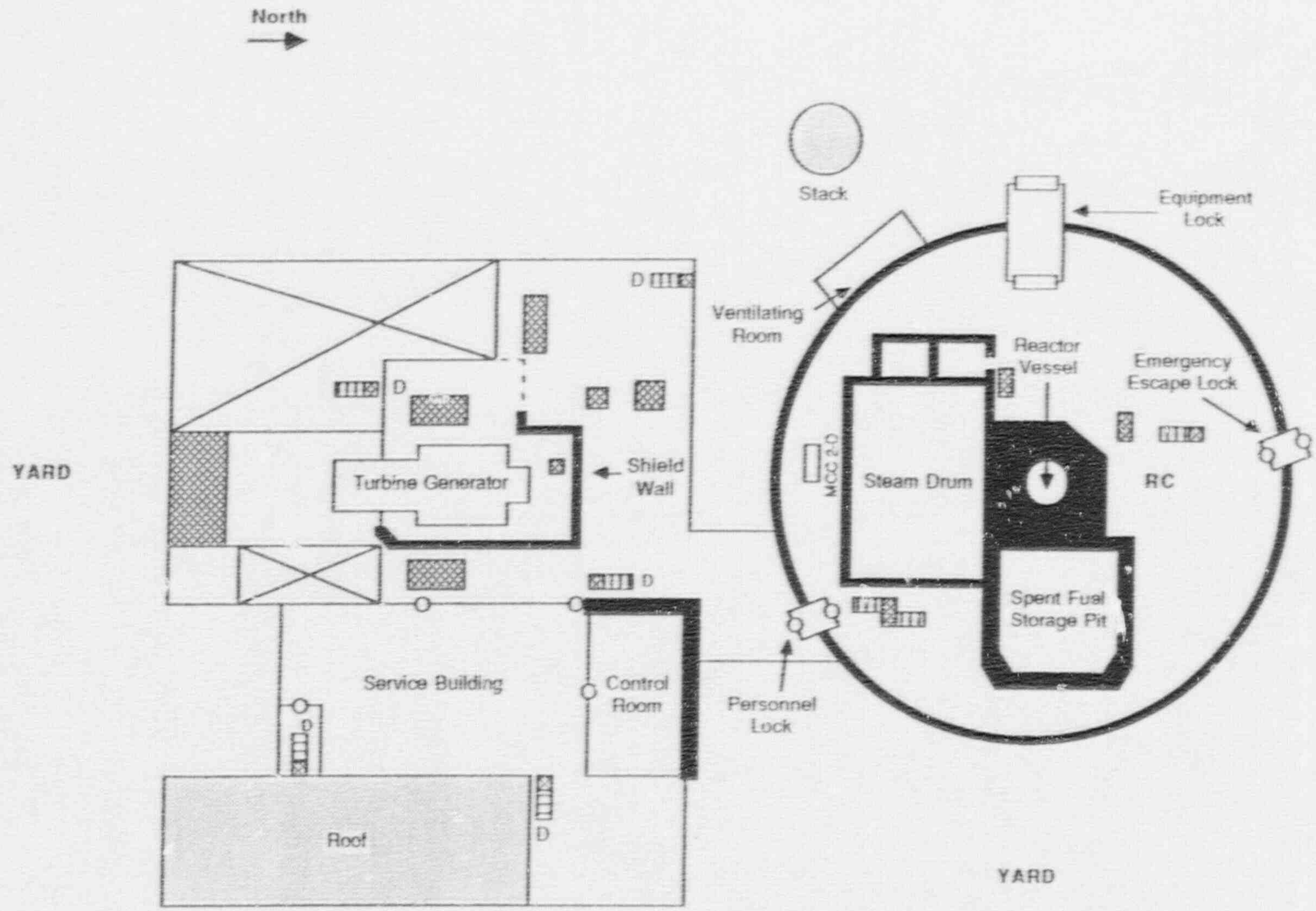



Figure 4-4. Big Rock Point Station Arrangement, Plan Above Operating Floor (Below Elevation 618')

Table 4-1. Definition of Big Rock Point Building and Location Codes (Continued)

| Codes | Descriptions |
|---|---|
| 19. UPS4 | Uninterruptible Power Supply Room 4, located on the 593' elevation of the Turbine Generator Building |
| 20. YARD | Yard - open area within site boundary |

## Table 4-2. Partial Listing of Components by Location at Big Rock Point

| LOCATION | SYSTEM | COMPONENT ID | COMP TYPE |
|---|---|---|---|
| CSEQUIPRM | ECCS | FS-7072 | MOV |
| CSEQUIPRM | ECCS | CS-P2A | MDP |
| CSEQUIPRM | ECCS | CS-P2B | MDP |
| CSEQUIPRM | ECCS | FS-7066 | MOV |
| CSEQUIPRM | ECCS | FS-7072 | MOV |
| CST | CRDHS | DW-CST | TANK |
| CST | DW | DW-CST | TANK |
| DWST | DW | DW-DWST | TANK |
| EDGRM | EP | DG | DG |
| ELECEQRM | EP | CB-2B | CB |
| ELECEQRM | EP | BCH-1 | BC |
| ELECEQRM | EP | BUS-2B | BUS |
| ELECEQRM | EP | BUS-D01 | BUS |
| ELECEQRM | EP | EP-BT | BATT |
| ELECEQRM | EP | MCC-1A | MCC |
| ELECEQRM | EP | MCC-2A | MCC |
| ELECEQRM | EP | MCC-2B | MCC |
| ELECEQRM | EP | BUS-1A | BUS |
| ELECEQRM | EP | BUS-2A | BUS |
| ELECEQRM | EP | EP-BT | BATT |
| ELECEQRM | EP | MCC-2P | MCC |
| ELECEQRM | EP | BCH-1A | BC |
| ELECEQRM | EP | PANEL-D02 | PNL |
| ELECEQRM | EP | PANEL-D10 | PNL |
| ELECEQRM | EP | EP-INV | INV |
| ELECEQRM | EP | MGSET1 | MG |
| ELECEQRM | EP | MGSET2 | MG |
| ELECEQRM | EP | RPS-BUS-1 | BUS |
| ELECEQRM | EP | RPS-BUS-2 | BUS |
| ELECEQRM | EP | RPS-BUS-3 | BUS |
| MACHINESHOP | ECCS | FS-35 | XV |

Table 4-2. Partial Listing of Components by Location at Big Rock Point (Continued)

| LOCATION | SYSTEM | COMPONENT ID | COMP TYPE |
|---|---|---|---|
| MACHINESHOP | ECCS | FS-35 | XV |
| MACHINESHOP | ECCS | FS-35 | XV |
| MACHINESHOP | ECCS | FS-35 | XV |
| PPTUNNL | ECCS | FS-30 | XV |
| PPTUNNL | ECCS | FS-29 | XV |
| PPTUNNL | ECCS | FS-30 | XV |
| PPTUNNL | ECCS | FS-29 | XV |
| RC | CRDHS | CRDHS-P4A | MDP |
| RC | CRDHS | CRDHS-P4B | MDP |
| RC | DW | DW-4028 | NV |
| RC | DW | DW-4045 | NV |
| RC | DW | DW-7016 | NV |
| RC | EC | EC-7052 | MOV |
| RC | EC | EC-7053 | MOV |
| RC | EC | EC-7062 | MOV |
| RC | EC | EC-7063 | MOV |
| RC | EC | EC-HX-2 | HX |
| RC | EC | RCS-VESSEL | RV |
| RC | ECCS | FS-7051 | MOV |
| RC | ECCS | FS-7061 | MOV |
| RC | ECCS | FS-7070 | MOV |
| RC | ECCS | FS-7071 | MOV |
| RC | ECCS | RCS-VESSEL | RV |
| RC | ECCS | FS-7051 | MOV |
| RC | ECCS | FS-7061 | MOV |
| RC | ECCS | FS-7070 | MOV |
| RC | ECCS | FS-7071 | MOV |
| RC | ECCS | RCS-VESSEL | RV |
| RC | ECCS | RDS-4984 | SRV |
| RC | ECCS | EC-HX-2 | HX |
| RC | ECCS | XV | XV |

Table 4-2. Partial Listing of Components by Location at Big Rock Point (Continued)

| LOCATION | SYSTEM | COMPONENT ID | COMP TYPE |
|---|---|---|---|
| RC | ECCS | FS-1 | XV |
| RC | ECCS | FS-7064 | MOV |
| RC | ECCS | FS-7069 | MOV |
| RC | ECCS | FS-8 | XV |
| RC | ECCS | FS-8 | XV |
| RC | ECCS | RDS-4985 | SRV |
| RC | ECCS | RDS-4986 | SRV |
| RC | ECCS | RDS-4987 | SRV |
| RC | ECCS | RDS-4180 | NV |
| RC | ECCS | RDS-4181 | NV |
| RC | ECCS | RDS-4182 | NV |
| RC | ECCS | RDS-4183 | NV |
| RC | RCS | RCS-7056 | MOV |
| RC | RCS | RCS-7057 | MOV |
| RC | RCS | RCS-7058 | MOV |
| RC | RCS | RCS-7059 | MOV |
| RC | RCS | RCS-7050 | MOV |
| RC | RCS | RCS-7065 | MOV |
| RC | RCS | RDS-4984 | SRV |
| RC | RCS | RCS-VESSEL | RV |
| RC | RCS | RCS-5000 | SRV |
| RC | RCS | RCS-5001 | SRV |
| RC | RCS | RCS-5002 | SRV |
| RC | RCS | RCS-5003 | SRV |
| RC | RCS | RCS-5045 | SRV |
| RC | RCS | RCS-5046 | SRV |
| RC | RCS | RDS-4985 | SRV |
| RC | RCS | RDS-4986 | SRV |
| RC | RCS | RDS-4987 | SRV |
| RC | RCS | RDS-4180 | NV |
| RC | RCS | RDS-4181 | NV |

## Table 4-2. Partial Listing of Components by Location at Big Rock Point (Continued)

| LOCATION | SYSTEM | COMPONENT ID | COMP TYPE |
|---|---|---|---|
| RC | RCS | RDS-4182 | NV |
| RC | RCS | RDS-4183 | NV |
| SCREENHSE | ECCS | FS-P6 | MDP |
| SCREENHSE | ECCS | FS-P7 | DDP |
| SCREENHSE | ECCS | FS-12 | XV |
| SCREENHSE | ECCS | FS-13 | XV |
| TB593NORTH | DW | DW-6649 | NV |
| TB593NORTH | DW | DW-P37 | MDP |
| TB593NORTH | DW | DW-5 | XV |
| TB593NORTH | DW | DW-16 | XV |
| TB593NORTH | DW | DW-5 | XV |
| UPS1 | ECCS | RDS-UPS-A | UPS |
| UPS1 | ECCS | RDS-BT-A | BATT |
| UPS1 | ECCS | RDS-120-A | PNL |
| UPS1 | ECCS | RDS-125-A | PNL |
| UPS2 | ECCS | RDS-UPS-B | UPS |
| UPS2 | ECCS | RDS-BT-B | BATT |
| UPS2 | ECCS | RDS-120-B | PNL |
| UPS2 | ECCS | RDS-125-B | PNL |
| UPS3 | ECCS | RDS-UPS-C | UPS |
| UPS3 | ECCS | RDS-BT-C | BATT |
| UPS3 | ECCS | RDS-120-C | PNL |
| UPS3 | ECCS | RDS-125-C | PNL |
| UPS4 | ECCS | RDS-UPS-D | UPS |
| UPS4 | ECCS | RDS-BT-D | BATT |
| UPS4 | ECCS | RDS-120-D | PNL |
| UPS4 | ECCS | RDS-125-D | PNL |
| YARD | ECCS | FS-12 | XV |
| YARD | ECCS | FS-52 | XV |
| YARD | ECCS | FS-15 | XV |
| YARD | ECCS | FS-15 | XV |

## Table 4-2 Partial Listing of Components by Location at Big Rock Point (Continued)

| LOCATION | SYSTEM | COMPONENT ID | COMP TYPE |
|---|---|---|---|
| YARD | ECCS | FS-14 | XV |
| YARD | ECCS | FS-14 | XV |
| YARD | ECCS | FS-19 | XV |
| YARD | ECCS | FS-14 | XV |
| YARD | ECCS | FS-15 | XV |
| YARD | ECCS | FS-14 | XV |
| YARD | ECCS | FS-15 | XV |
| YARD | ECCS | FS-19 | XV |
| YARD | ECCS | FS-53 | XV |
| YARD | ECCS | FS-54 | XV |
| YARD | ECCS | FS-55 | XV |

## 5. BIBLIOGRAPHY FOR BIG ROCK POINT

1. NUREG-0828, "Integrated Plant Safety Assessment, Systematic Evaluation Program, Big Rock Point Plant," USNRC, May 1984.

# 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)

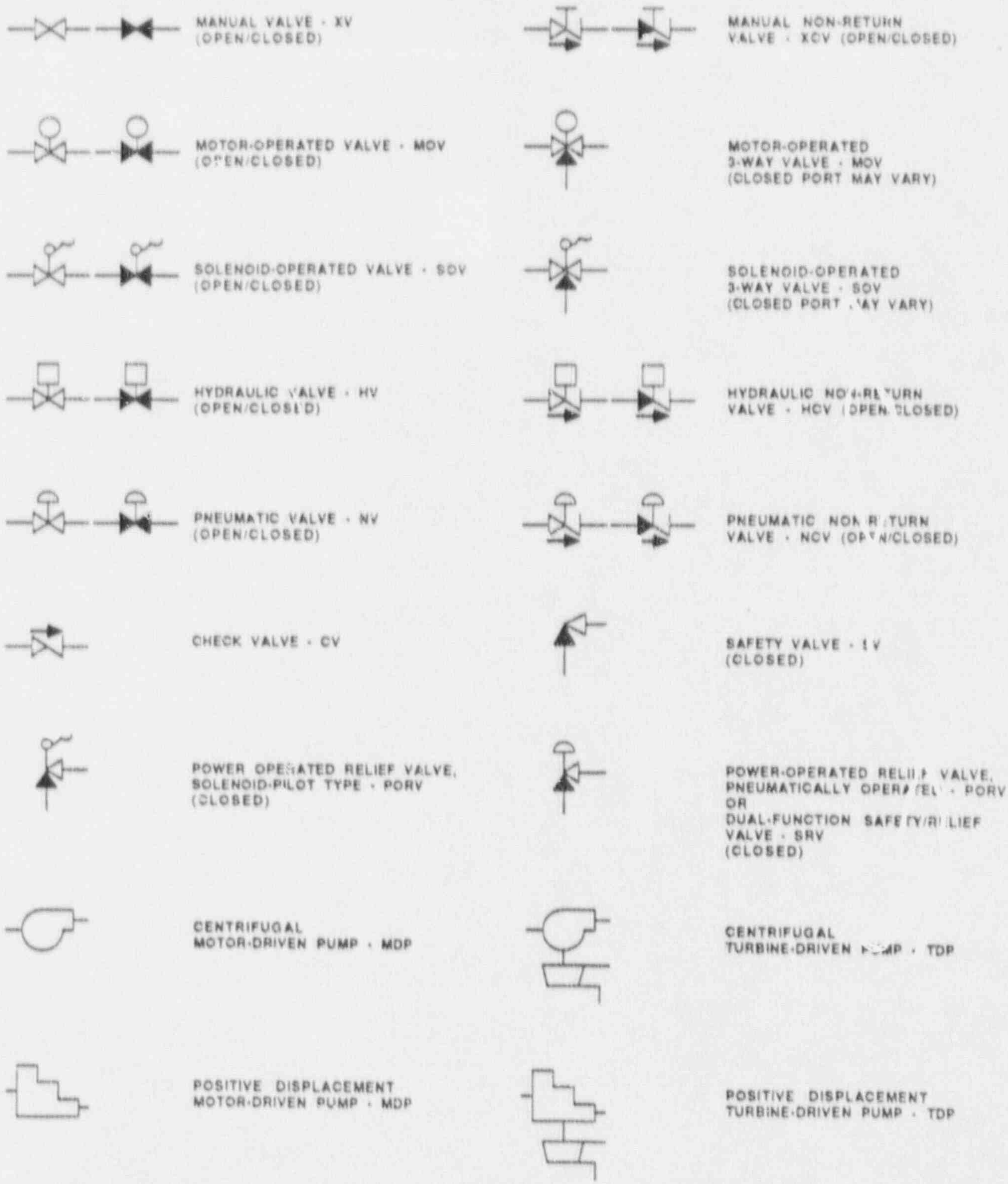



Figure A-1. Key To Symbols In Fluid System Drawings

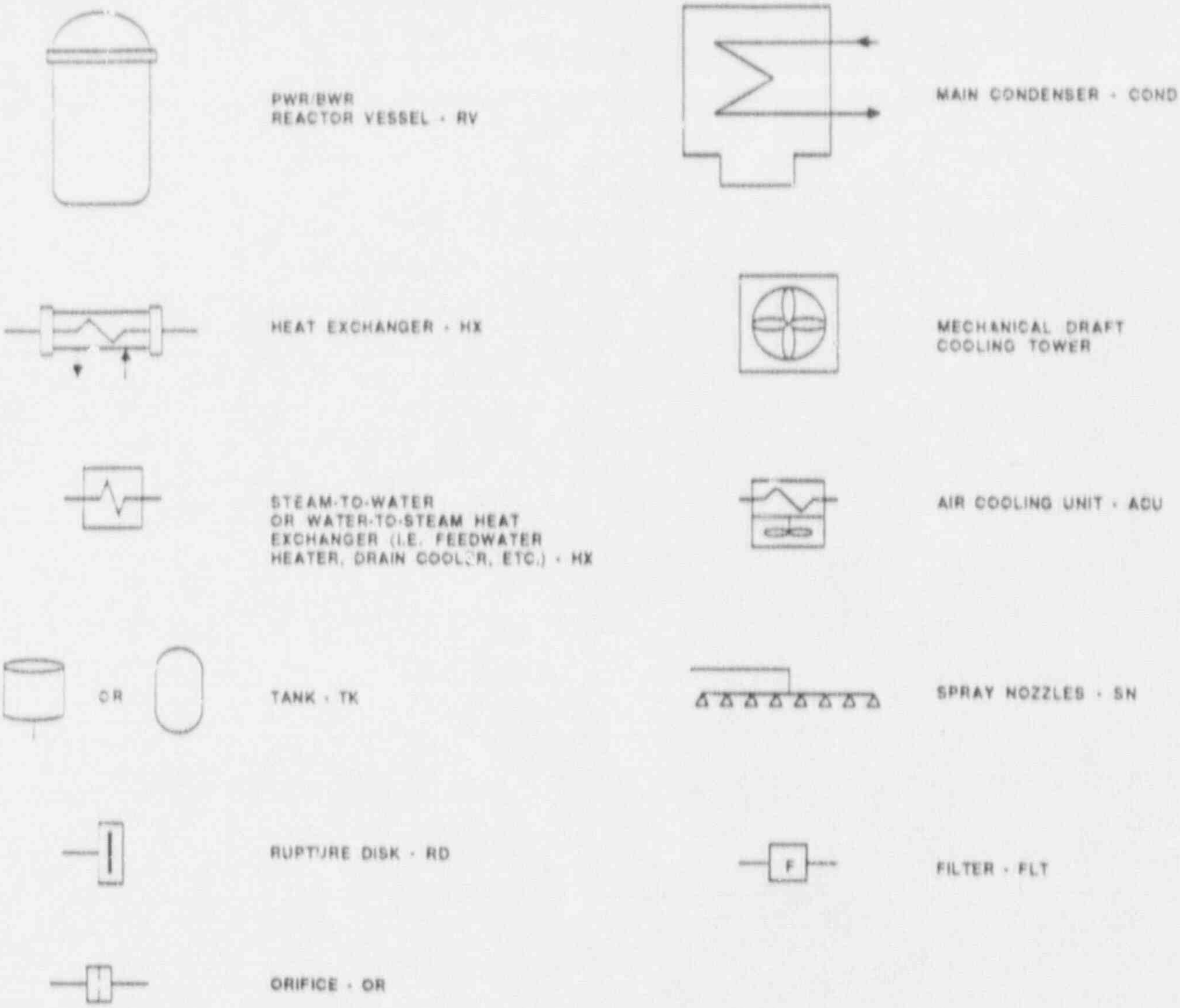



Figure A-1. Key To Symbols In Fluid System Drawings (Continued)

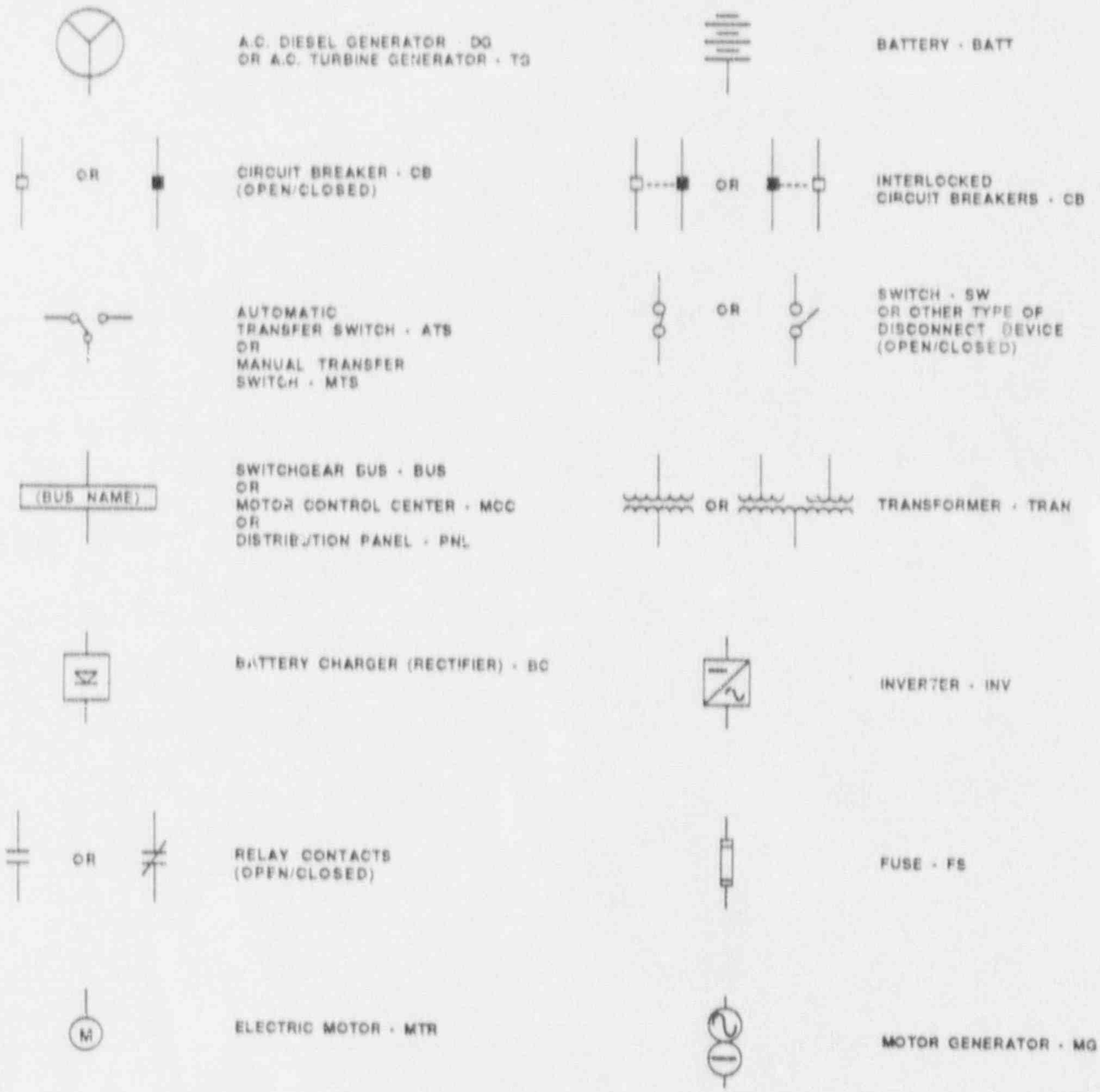



Figure A-2. Key To Symbols In Electrical System Drawings

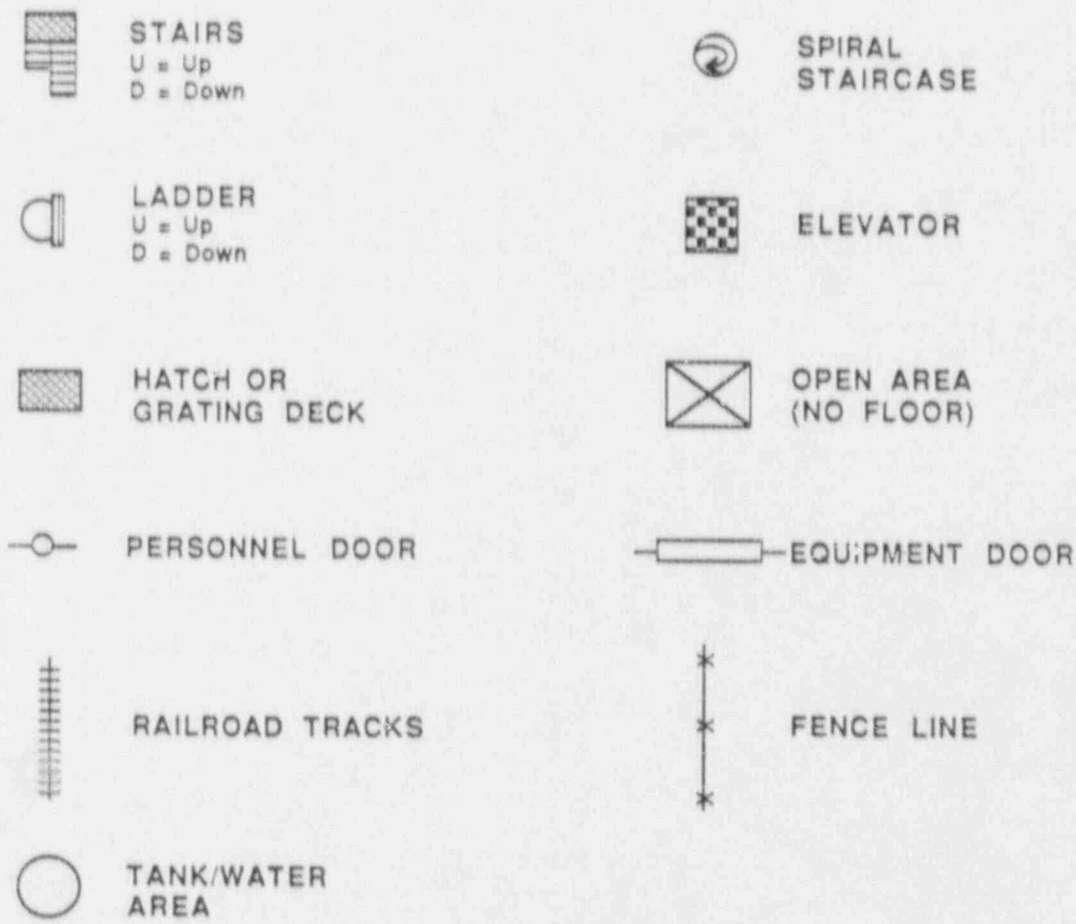



Figure A-3. Key To Symbols In Facility Layout Drawings

# 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 |
| EC | Emergency Cooling System (isolation condenser system) |
| ECCS | Emergency Core Cooling Systems (including fire water system and reactor depressurization system) |
| EP | Electric Power System |
| DW | Cleanup/Demineralized Water System |
| CRDHS | Control Rod Drive Hydraulic 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 |