SAIC 91/1065

# NUCLEAR POWER PLANT SYSTEM SOURCEBOOK

# BELLEFONTE 1 & 2

50-438, 50-439

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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.

# BELLEFONTE 1 & 2
# RECORD OF REVISIONS

| REVISION | ISSUE | COMMENTS |
|---|---|---|
| 0 | 3/91 | Original report |
| | | |
| | | |

# BELLEFONTE 1 & 2 SYSTEM SOURCEBOOK

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

| | |
|---|---|
| - Docket number | 50-438/439 |
| - Operator | TVA Division of Power Production |
| - Location | Jackson County, Alabama |
| - Commercial operation date | Construction temporarily on hold. No commercial operating dates set. |
| - Reactor type | PWR |
| - NSSS vendor | Babcock & Wilcox |
| - Number of loops | 2 |
| - Power (MWt/MWe) | 3620/1271 |
| - Architect-engineer | TVA Division of Engineering Design |
| - Containment type | Post-tensioned concrete primary containment with a steel liner and a free-standing reinforced concrete secondary containment |

## 2. IDENTIFICATION OF SIMILAR NUCLEAR POWER PLANTS

The Bellefonte 1 and 2 plants have Babcock & Wilcox 205 "raised-loop" PWR two-loop nuclear steam supply systems (NSSS) and a large, dry containment. Other Babcock & Wilcox plants in the United States include:

- ANO-1
- Crystal River
- Davis Besse (raised-loop)
- Oconee 1, 2 & 3
- Rancho Seco
- TMI-1

All of these plants are B&W "177" model PWRs with large, dry containments. In addition, the cancelled Washington Public Power Supply System plant WNP-1 is a B&W 205 model PWR that is about 60 percent complete and is being maintained in a state of preservation that may enable construction to be restarted.

A B&W "205" model PWR has a raised-loop primary coolant system similar to Davis-Besse and a larger reactor core comprised of 205 fuel assembles. The 205 model PWR core is designed to use the 17x17 Mark C fuel assemblies and 24 "finger" control rod assemblies (CRAs). In contrast, the "177" model PWR uses the 15x15 Mark B fuel assemblies and 16 finger CRAs.

The reactor vessel in the 177 and 205 model PWRs respectively have inside diameters of 171 and 182 inches. The once through steam generator (OTSG) in a 205 model PWR has greater heat transfer capability than in the 177 model plants, and the

feedwater inlets and steam outlets are located lower on the steam generator vessel. The 205 OTSG is termed an "integral economizer" OTSG.

The ECCS in the 205 model PWR is comparable to the ECCS found in the 177 lowered-loop plants. The high-head injection pumps in the B&W 205 plant double as charging pumps during normal operation. Bellefonte has provisions to dump hot leg B to the containment emergency sump approximately 24 hours after a LOCA has occurred and emergency coolant recirculation has been established.

Bellefonte has a free-standing reinforced concrete secondary containment. Many containment isolation valves are located in the secondary containment annulus.

## 3. SYSTEM INFORMATION

This section contains descriptions of selected systems at Bellefonte 1 and 2 in terms of general function, operation, system success criteria, major components, and support system requirements. A summary of major systems at Bellefonte 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.

Functionally equivalent systems at Bellefonte 1 and 2 generally are identical in design, however minor differences exist. In this sourcebook, Unit 1 system information is provided. Interconnections between Units 1 and 2 systems are indicated. Systems shared between Units 1 and 2 are as follows:

- Essential Raw Cooling Water System
- Fire Protection System
- Control Building Environmental Control System
- Auxiliary Building Common Zone HVAC System
- Fuel Handling Area HVAC System
- Spent Fuel Cooling System
- Portions of Fuel Handling Systems
- Fuel Oil Storage Tanks
- Chemical Addition and Boron Recovery System
- Portions of Waste Disposal Systems

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

| Generic System Name | Plant-Specific System Name | Report Section | FSAR Section Reference |
|---|---|---|---|
| **Reactor Heat Removal Systems** | | | |
| - Reactor Coolant System (RCS) | Same | 3.1 | 5 |
| - Auxiliary Feedwater (AFW) and Secondary Steam Relief (SSR) Systems | Same (the term SSR is not used at Bellefonte) | 3.2 | 10.4.9 |
| - Emergency Core Cooling Systems (ECCS) | | | |
| - High-Pressure Injection & Recirculation | High Pressure Injection System | 3.3 | 6.3 |
| - Low-pressure Injection & Recirculation | Low Pressure Injection System, Core Flooding System | 3.3 | 6.3 |
| - Decay Heat Removal (DHR) System (Residual Heat Removal (RHR) System) | Same | 3.3 | 5.4.7 |
| - Main Steam and Power Conversion Systems | Main Steam System, | X | 10.3 |
| | Condensate and Feedwater System, | X | 10.4.6, 10.4.7 |
| | Heat Rejection System | X | 10.4.5 |
| - Other Heat Removal Systems | None identified | X | |
| **Reactor Coolant Inventory Control Systems** | | | |
| - Chemical and Volume Control System (CVCS) (Charging System) | Makeup and Purification System, | 3.4 | 9.3.6 |
| | Chemical Addition and Boron Recovery System | X | 9.3.4 |
| - ECCS | See ECCS, above | - | - |

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

| Generic System Name | Plant-Specific System Name | Report Section | FSAR Section Reference |
|---|---|---|---|
| **Containment Systems** | | | |
| - Containment | Primary Containment, | X | 6.2.1, 6.2.4, 6.2.6 |
| | Secondary Containment | X | 6.2.3 |
| - Containment Heat Removal Systems | | | |
| - Containment Spray System | Reactor Building Spray System | 3.9 | 6.2.2 |
| - Containment Fan Cooler System | Reactor Building Cooling System | 3.9 | 6.2.2 |
| - Containment Normal Ventilation Systems | See Reactor Building Cooling System, above<br>Secondary Containment Air Cleanup System | X | 6.2.2 |
| - Combustible Gas Control Systems | Hydrogen Recombiner,<br>Hydrogen Purge System,<br>Hydrogen Sampling System,<br>Hydrogen Circulation System | X | 6.2.5 |
| **Reactor and Reactivity Control Systems** | | | |
| - Reactor Core | Same | X | 4 |
| - Control Rod System | Control Rod Drive System, | X | 4.6 |
| | Control Rod Drive Control System | X | 7.4.1.3, 7.7.1.3 |
| - Boration Systems | See Makeup & Purification System | - | - |
| **Instrumentation & Control (I&C) Systems** | | | |
| - Reactor Protection System (RPS) | Same | 3.5 | 7.2 |
| - Engineered Safety Feature Actuation System (ESFAS) | Same | 3.5 | 7.3 |

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

| Generic System Name | Plant-Specific System Name | Report Section | FSAR Section Reference |
|---|---|---|---|
| **Instrumentation & Control (I&C) Systems (continued)** | | | |
| - Remote Shutdown System | Essential Controls and Instrumentation (ECI), | 3.5 | 7.4.1.2 |
| | Auxiliary Shutdown Panel | 3.5 | 7.4.1.3 |
| - Other I&C Systems | Various systems | X | 7.6 to 7.8 |
| **Support Systems** | | | |
| - Class 1E Electric Power System | Same | 3.6 | 8 |
| - Non-Class 1E Electric Power System | Same | 3.6 | 8 |
| - Diesel Generator Auxiliary Systems | Same | 3.6 | 9.5.4, 9.5.5, 9.5.6 9.5.7, 9.5.8 |
| - Component Cooling Water (CCW) System | Component Cooling System (CCS) | 3.7 | 9.2.2 |
| - Service Water System (SWS) | Essential Raw Cooling Water System | 3.8 | 9.2.1 |
| - Other Water Systems | Ultimate Heat Sink | 3.8 | 9.2.5 |
| | Raw Cooling Water System | X | 9.2.7 |
| | Demineralized Makeup Water System | X | 9.2.3 |
| | Potable and Sanitary Water Systems | X | 9.2.4 |
| | Condensate Storage Facility | 3.2 | 9.2.6 |
| | Borated Water Storage Tank | 3.3 | 9.2.8 |
| - Fire Protection Systems | Same | X | 9.5.1 |

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

| Generic System Name | Plant-Specific System Name | Report Section | FSAR Section Reference |
|---|---|---|---|
| **Support Systems (continued)** | | | |
| - Room Heating, Ventilating, and Air-Conditioning (HVAC) Systems | Control Building Environmental Control, Fuel Handling Area Ventilation, Auxiliary Building Common Zone Environmental Control, Turbine Building HVAC, Auxiliary Building ESF Zone Environmental Control, Diesel Generator Building Environmental Control, Intake Pumping Station Heating and Ventilation, Containment Environmental Control | X | 9.4 |
| - Instrument and Service Air Systems | Compressed Air Systems -- Essential Air, Control Air, and Service Air Systems | X | 9.3.1 |
| - Refueling and Spent Fuel Systems | Fuel Storage and Handling Systems | X | 9.1 |
| - Radioactive Waste Systems | Same | X | 11 |
| - Radiation Protection Systems | Same | X | 12 |
| - Other Auxiliary Systems | Sampling and Water Quality Systems | X | 9.3.2 |
| | Equipment and Floor Drain Systems | X | 9.3.3 |
| | Failed Fuel Detection System | X | 9.3.5 |
| | Breathing Air System | X | 9.3.7 |
| | Plant Communications System | X | 9.5.2 |
| | Lighting Systems | X | 9.5.3 |

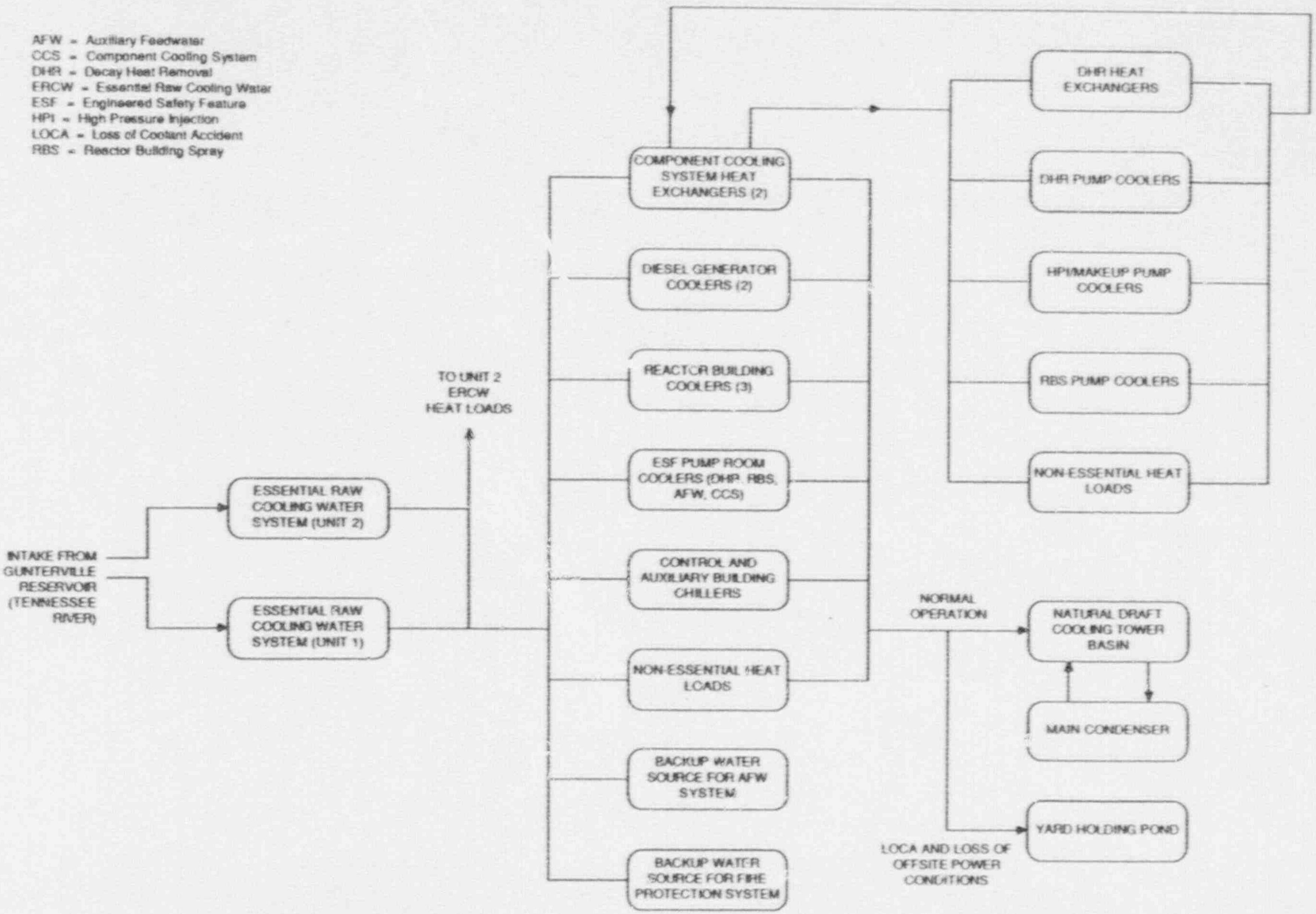



Figure 3-1. Cooling Water Systems Functional Diagram for Bellefonte

## 3.1 REACTOR COOLANT SYSTEM (RCS)

### 3.1.1 System Function

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

### 3.1.2 System Definition

The RCS includes: (a) the reactor vessel, (b) main coolant loops, (c) main coolant pumps, (d) the primary side of the steam generators, (e) pressurizer, and (f) connected piping out to a suitable isolation valve boundary. Illustrations of a B&W "205" raised-loop RCS and major RCS components similar to Bellefonte 1 and 2 are shown in Figures 3.1-1 to 3.1-5. Simplified diagrams of the RCS and important system interfaces are shown in Figures 3.1-6 and 3.1-7. 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 two main coolant pumps in each of the two main coolant loops. RCS pressure is maintained within a prescribed band by the combined action of pressurizer heaters and pressurizer spray. RCS coolant inventory is measured by pressurizer water level which is maintained within a prescribed band by the chemical and volume control system (makeup and purification system).

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

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

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

The RCS is equipped with a High Point Vent System which provides vents on each of the two hot legs, on the pressurizer, and on the reactor vessel. This system vents noncondensable gases from the primary system to the containment or the RC drain tank to aid in refilling the RCS and to promote natural circulation flow following a transient or small LOCA and loss of normal circulation. The fail-closed solenoid valves in the vent paths are remotely operated from the control room. Design and line sizing limit the flow rate through these vent paths so that the maximum vent rate will not exceed 200 gpm at normal RCS pressure (Ref. 1).

The capability exists to dump hot leg B to the containment sump for emergency decay heat removal. There are two parallel dump paths, each with two series, normally closed motor-operated valves. This dump system is used in conjunction with the ECCS, as described in 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 unmitigatable LOCA is not initiated.
- If a mitigatable LOCA is initiated, then LOCA mitigating systems are successful.
- If a transient is initiated, then either:
  - RCS integrity is maintained and transient mitigating systems are successful, or
  - RCS integrity is not maintained, leading to a LOCA-like condition (i.e., stuck-open safety or relief valve, reactor coolant pump seal failure), and LOCA mitigating systems are successful.

### 3.1.5 Component Information

A. RCS
  1. Water volume, including internals: 4,791 $ft^3$
  2. Normal operating pressure: 2195 psig

B. Pressurizer
  1. Normal water volume: 1100 $ft^3$
  2. Normal steam volume: 1500 $ft^3$

C. Reactor Coolant Pumps (4)
  1. Capacity: 104,200 gpm (each) @ 376 ft. head (162 psig)
  2. Type: Squirrel-cage induction, single-speed

D. Safety Valves (2)
  1. Set pressure: 2500 psig
  2. Relief capacity: 500,000 lb/hr each

E. Power-Operated Relief Valve
  1. Set pressure: 2295 psig
  2. Relief capacity: 150,000 lb/hr

F. Steam Generators (2)
  1. Type: Once-through
  2. Primary-side volume: 2030 $ft^3$

G. Pressurizer Heaters
  1. Capacity: 1742 kW supplied from Class 1E AC power

### 3.1.6 Support Systems and Interfaces

A. Motive Power
1. Some pressurizer heaters are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.6.
2. The main coolant pumps are supplied from Non-Class 1E switchgear.

B. Main Coolant Pump Seal Injection Water System
The makeup and purification system (see Section 3.4) supplies seal water to cool the main coolant pump shaft seals and to maintain a controlled inleakage of seal water into the RCS. Loss of seal water flow may result in RCS leakage through the pump shaft seals which will resemble a small LOCA.

C. Backup Main Coolant Pump Seal Cooling
On each main coolant pump, an integral heat exchanger supplied by the component cooling system (see Section 3.7) provides enough cooling capacity to prevent excessive seal heating if seal injection is lost.

### 3.1.7 Section 3.1 References

1. Bellefonte 1 and 2 FSAR, Section 5.4.1.

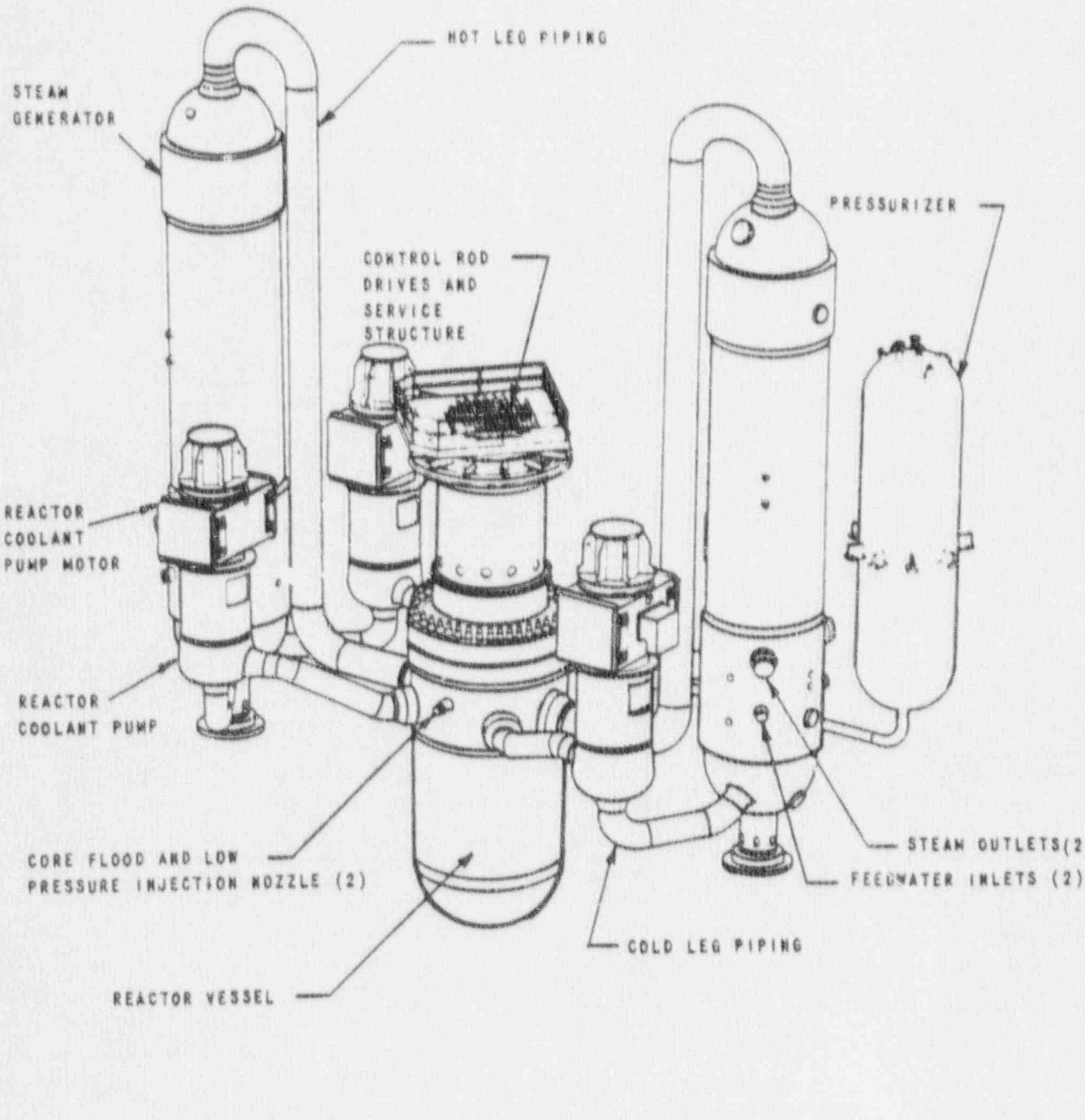



Figure 3.1-1. Isometric View of a B&W 205 Primary System

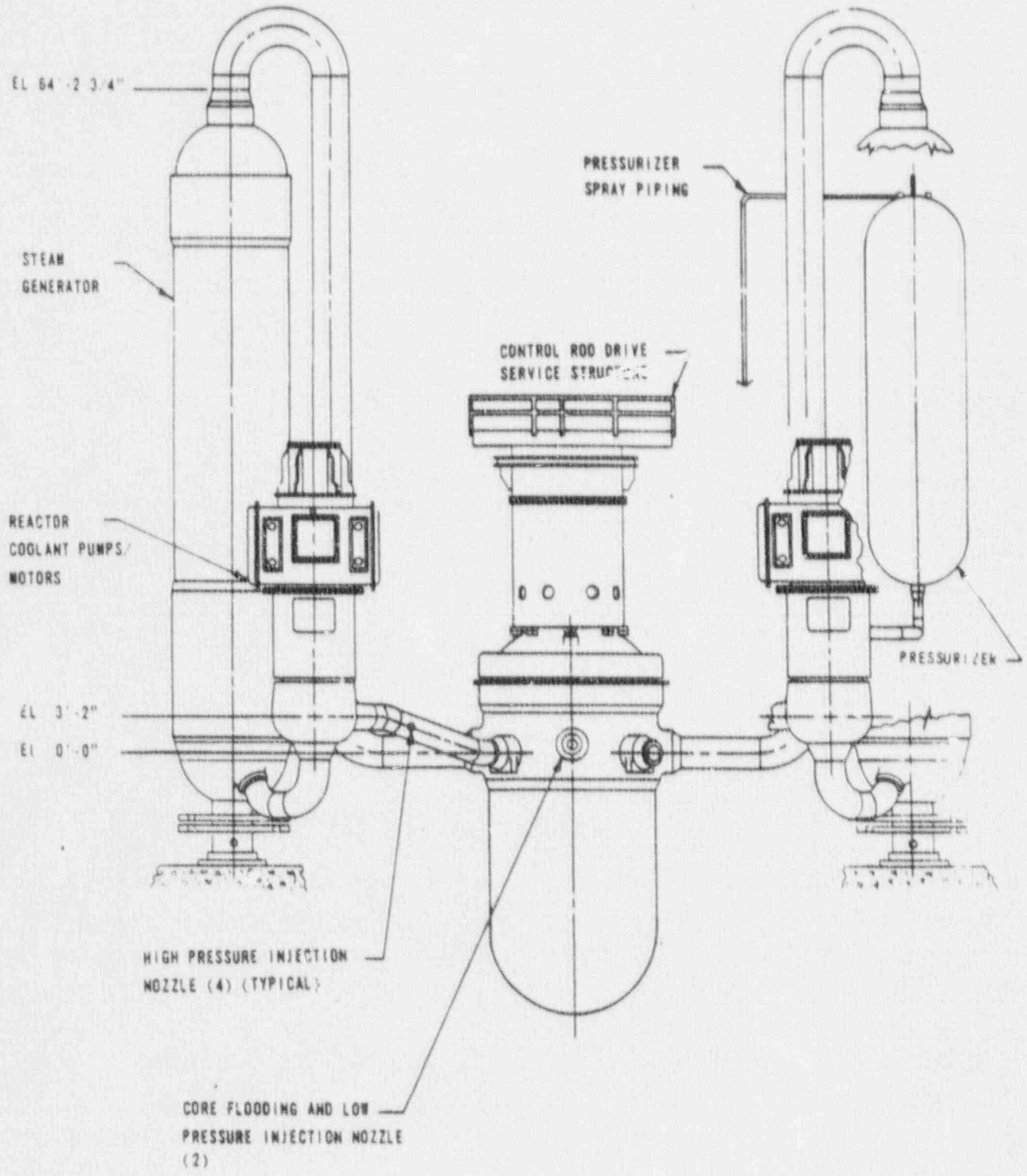



Figure 3.1-2. Elevation View of a B&W 205 Primary System

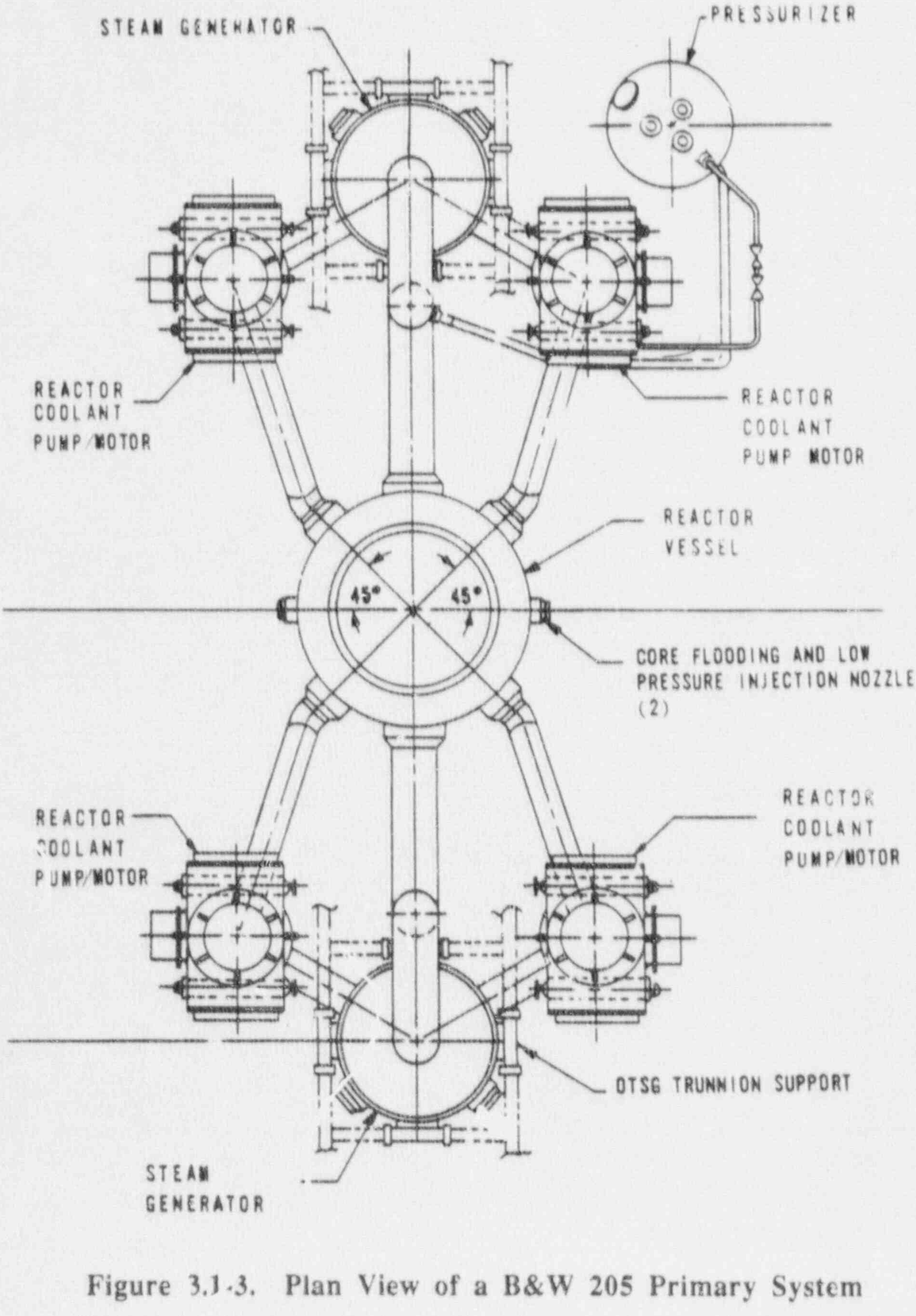



Figure 3.1-3. Plan View of a B&W 205 Primary System

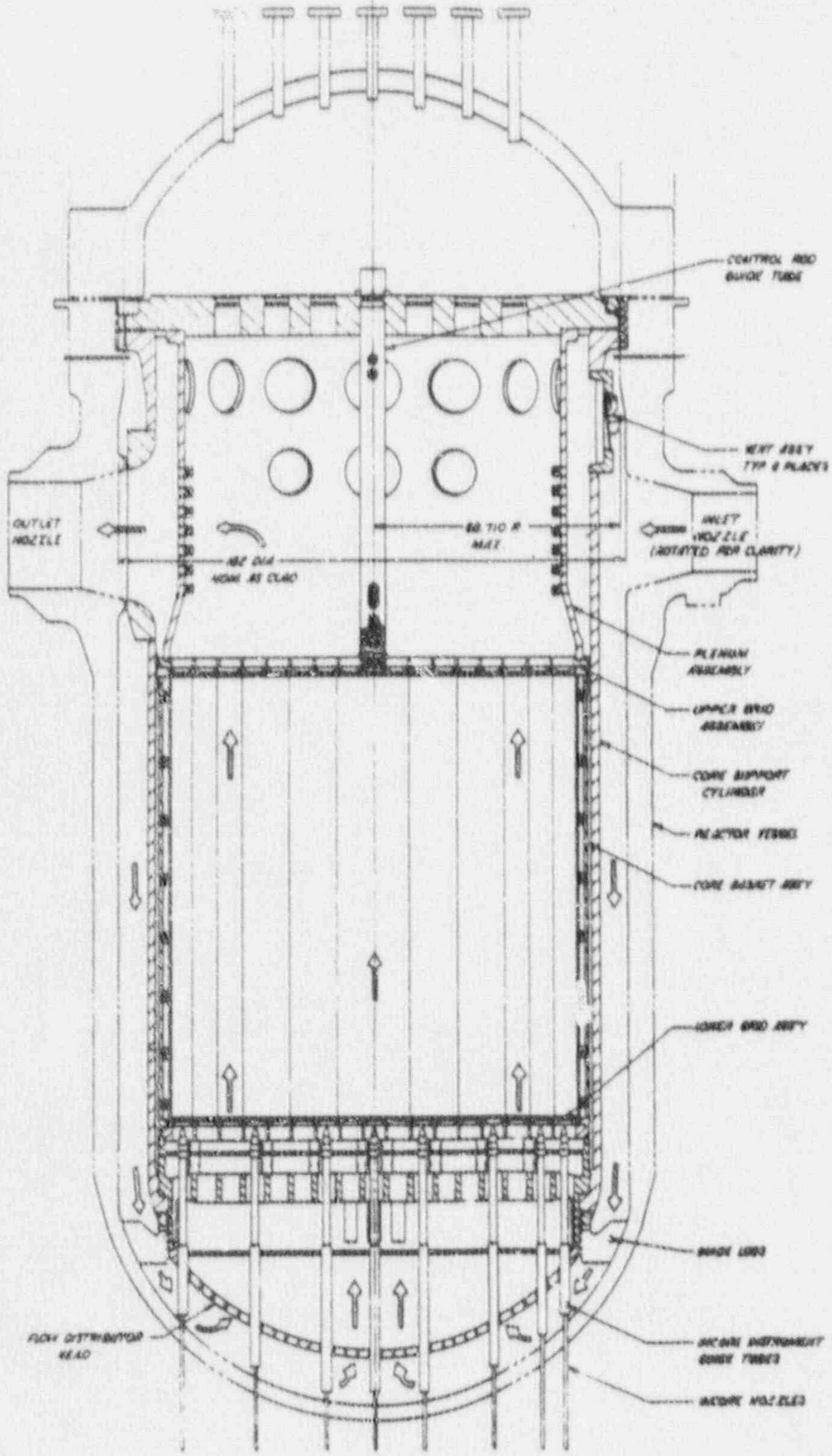



Figure 3.1-4. General Arrangement of a B&W 205 Reactor Vessel

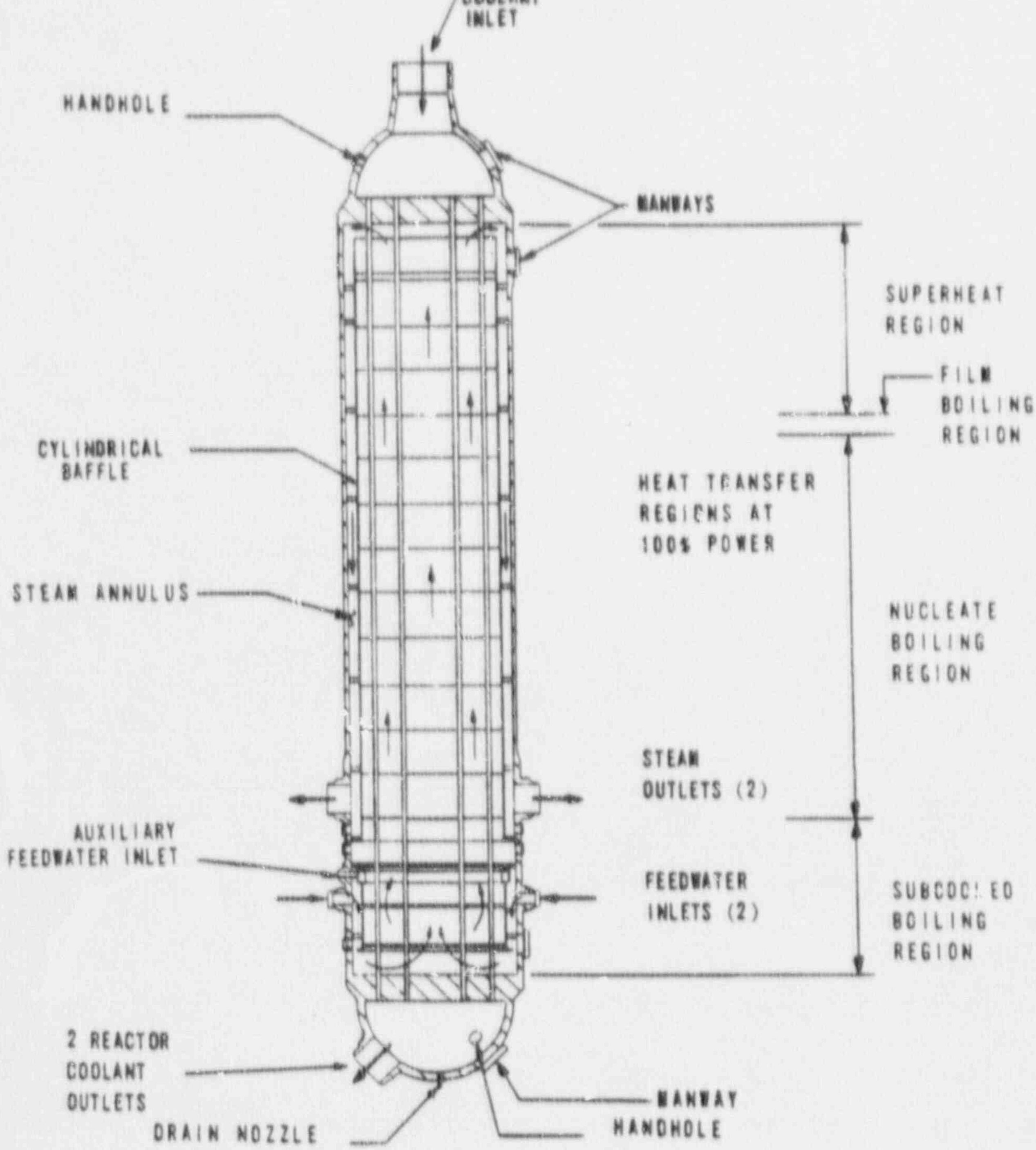
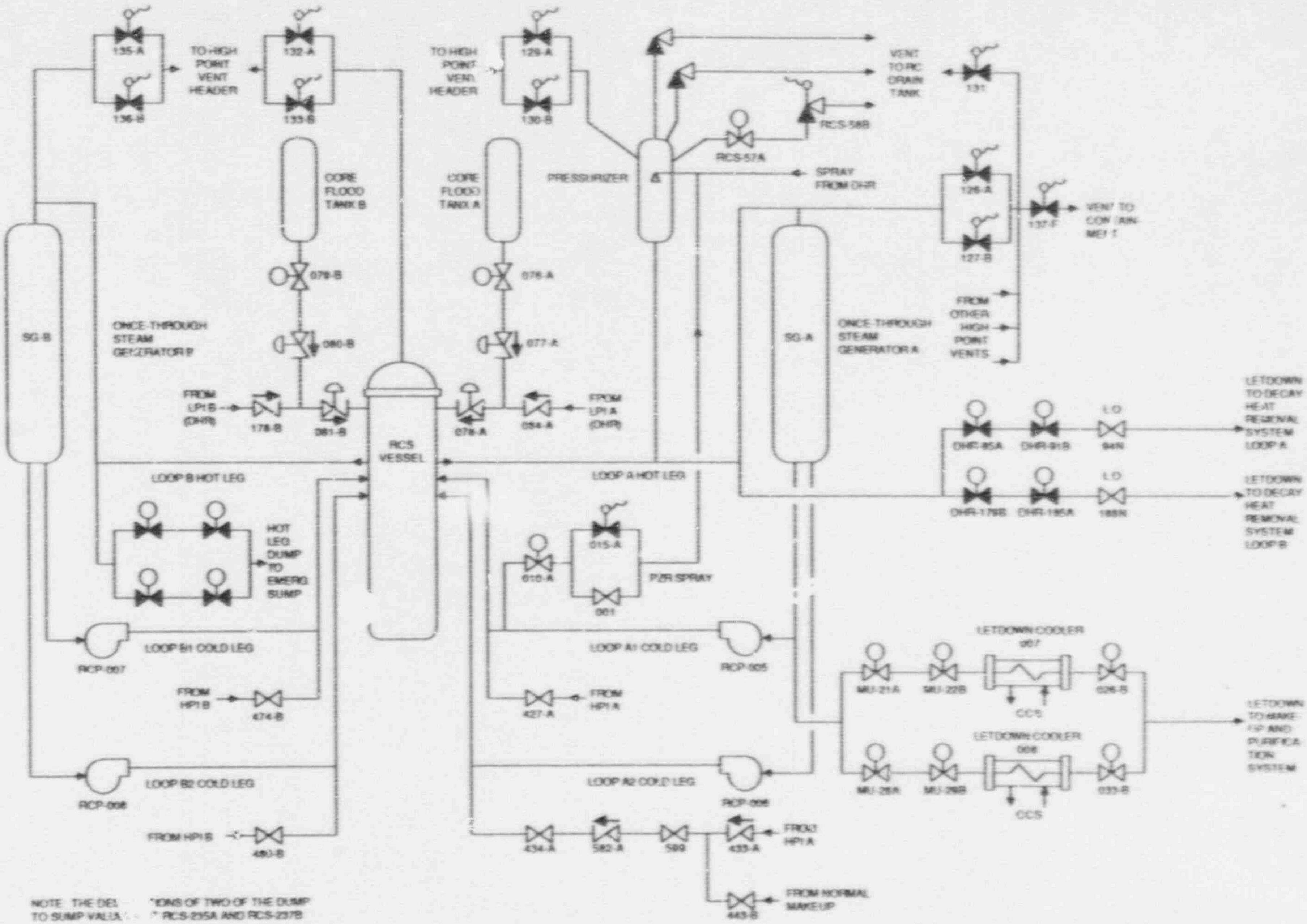



Figure 3.1-5. General Arrangement of a B&W 205 Once-Through Steam Generator




NOTE: THE DEL... TIONS OF TWO OF THE DUMP TO SUMP VALV... RCS-235A AND RCS-237B

**Figure 3.1-6. Bellefonte 1 Reactor Coolant System**

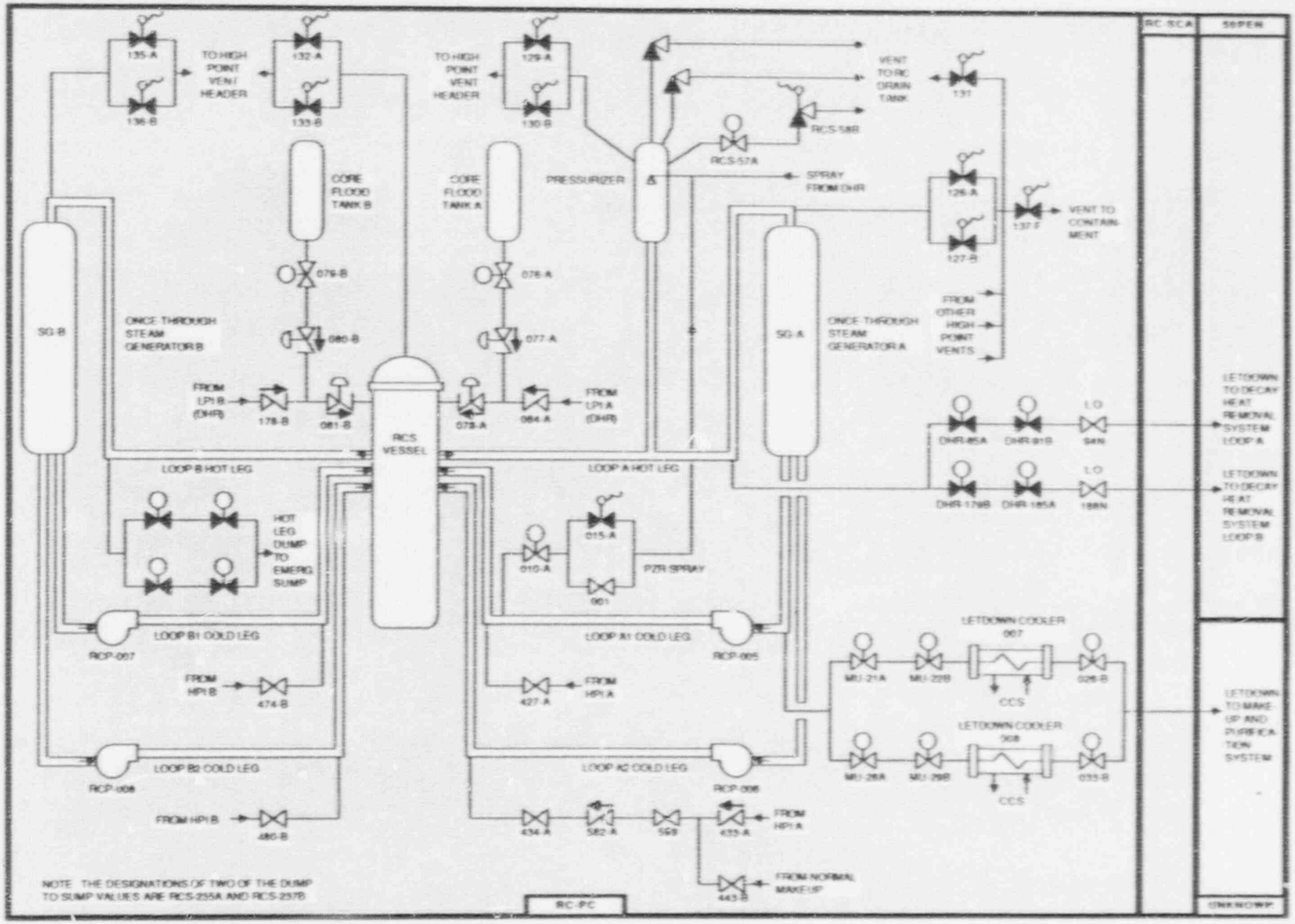



**Figure 3.1-7. Bellefonte 1 Reactor Coolant System Showing Component Locations**

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

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| MU-21A | MOV | RC-PC | MCC-1E1A | 480 | 669SGRMA | AC/A |
| MU-22B | MOV | RC-PC | MCC-1E1B | 480 | 669SGRMB | AC/B |
| MU-28A | MOV | RC-PC | MCC-1E1A | 480 | 669SGRMA | AC/A |
| MU-29B | MOV | RC-PC | MCC-1E1B | 480 | 669SGRMB | AC/B |
| RCS-235A | MOV | RC-PC | MCC-1E2A | 480 | 669SGRMA | AC/A |
| RCS-237B | MOV | RC-PC | MCC-1E2B | 480 | 669SGRMB | AC/B |
| RCS-57A | MOV | RC-PC | UNKNOWN | | | |
| RCS-58B | NV | RC-PC | UNKNOWN | | | |

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

### 3.2.1 System Function

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

### 3.2.2 System Definition

The AFW system includes two motor-driver pumps and one turbine-driven pump. The normal water source for the pumps is the condensate storage tank (CST). An alternate source of water is the Essential Raw Cooling Water System, which provides an unlimited supply of water. Each motor-driven pump is normally aligned to supply one of two steam generators, but can be aligned to supply the opposite steam generator through a cross-tie containing normally closed motor-operated valves. The turbine-driven pump receives its steam supply from both steam generators and exhausts to the atmosphere. Using the turbine-driven pump, the AFW system is capable of maintaining hot standby conditions for two hours with battery power only.

The SSR system includes eleven safety valves and two power-operated atmospheric dump valves for each of the two steam generators. One of the atmospheric dump valves on each steam generator is a pneumatic valve that is used to modulate the steam dump rate. A parallel motor-operated dump valve also is available to dump steam only at the maximum rate.

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

### 3.2.3 System Operation

During normal operation the AFW system is in standby. When needed, AFW system operation is initiated automatically. The system can also be manually started. All essential instrumentation and controls are available in both the main and auxiliary control rooms. The AFW system can operate independently of the Integrated Control System.

Each motor-driven AFW pump is normally aligned to feed one steam generator, but both pumps can be aligned to feed the opposite steam generator. The turbine-driven AFW pump is supplied with steam from both steam generators and can feed both steam generators. Following loss of all AC power, all valves and controls necessary for operation at the turbine-driven AFW pump are capable of being operated on the station batteries and qualified air reservoirs for at least two hours. For longer periods of time, the affected valves can be operated manually (Ref 1).

During AFW operation, level in the steam generators is maintained automatically by a safety-grade system which modulates level control valves located between the AFW pumps and the steam generators.

The AFW pumps are normally supplied via a common header from the condensate storage tank. The Essential Raw Cooling Water System is the backup water source for the AFW system.

When the main condenser is not available as a heat sink, reactor core decay heat is rejected to an ultimate heat sink by venting to atmosphere via a modulating atmospheric dump valve for each steam generator. A non-modulating, motor-operated dump valve is available if the modulating valve should fail.

### 3.2.4 System Success Criteria

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

- Each design basis event with the exception of secondary system pipe ruptures, requires a 1200 gpm AFW supply. The secondary system pipe rupture requires a 600 pgm AFW supply. The 1200 gpm supply can be met with two motor-driven AFW pumps or one turbine-driven pump.
- The CST or the Essential Raw Cooling Water System is a adequate source of water for the AFWS pumps.
- Makeup to one steam generator provides adequate decay heat removal from the RCS.

The SSR system success criteria are as follows:

- Either the pneumatic (modulating) dump valve or the motor-operated (non-modulating) dump valve is available to vent steam to atmosphere from a steam generator being supplied from the AFWs.
- If both atmospheric dump valves are unavailable then at least one main steam safety valve operates to limit secondary system pressure and establish the heat transfer path to the atmosphere.

### 3.2.5 Component Information

A. Motor-driven AFW pumps 1A and 1B
   1. Rated flow: 600 (net), 650 (gross) gpm @ 3300 ft. head (1426 psig)
   2. Type: Centrifugal

B. Steam turbine-driven AFW pump 1A
   1. Rated flow: 1200 (net) 1300 (gross) gpm @ 3300 ft. head (1426 psig)
   2. Type: Centrifugal

C. Condensate storage tank
   1. Capacity: 300,000 gallons reserved for AFWS

D. Safety valves (22, 5 or 6 per main steam line, 11 per steam generator)
   1. Set pressure: 1235 psig (valves 1 to 5), 1265 psig (valves 6 to 11)
   2. Relief capacity: 900,000 lb/hr (each)

E. Modulating atmospheric dump valves (2, 1 per steam generator)
   1. Valve type: Pneumatic
   2. Set pressure: 1220 psig
   3. Relief capacity: 591,500 lb/hr (each) at 1035 psig inlet pressure

F. Non-modulating atmospheric dump valve (2, 1 per steam generator)
   1. Valve type: Motor-operated
   2. Relief capacity: Not determined

### 3.2.6 Support Systems and Interfaces

A. Control Signals
  1. Automatic
    a. Pump Start
       The AFW system is actuated automatically by any of the following conditions:
       - an ESFAS signal
       - a low water level signal in either steam generator
       - loss of all reactor coolant pumps
       - loss of both main feedwater pumps.
    b. Water source switch-over
       The ERCWS water supply is automatically (or remote-manually) initiated on a two-out-of-three low pressure signal at the auxiliary feed pump suction.
    c. Steam generator isolation
       - AFW flow is automatically terminated to a steam generator affected by a main steam line or main feedwater line break. This is effected by the Feed-Only-Good-Generator (FOGG) Subsystem of the ESFAS (see Section 3.5).

  2. Remote manual
     Plant operators can place the AFW system in operation from the main control room or from the auxiliary control room.

  3. Manual
     The AFW pumps can be started and controlled locally. AFW valves can be operated locally.

B. Motive Power
  1. The motor-driven AFWS pumps and motor-operated valves are Class 1E loads that can be supplied from the standby diesel generators as described in Section 3.6.
  2. The turbine-driven pump is supplied with steam from the main steam lines of both steam generators upstream of the main steam line isolation valves.
  3. Power for the AFW turbine control system is provided from 120 VAC vital distribution panels 1-F and 1-G (see Section 3.6).
  4. Power source for the modulating atmospheric dump valves has not been determined. The motor-operated dump valves AFW-869A and -868B are powered from MCC 1E5-A and 1E5-B respectively.

C. Other
  1. Cooling for the motor-driven pumps is provided by the Essential Raw Cooling Water System. It is assumed cooling for the turbine-driven pump is provided locally.
  2. Lubrication for the AFWS pumps is provided locally.
  3. The Essential Raw Cooling Water (ERCW) system provides cooling water to the pump room coolers (air handling units, AHUs) for motor-driven AFW pumps 1A and 1B (see Section 3.8). These AHUs are powered from 480 VAC Class 1E MCCs 1E2-A (pump room 1A) and 1E2-B (pump room 1B) (see Section 3.6).

### 3.2.7 Section 3.2 References

1. Bellefonte 1 and 2 Final Safety Analysis Report, Section 10.4.9.

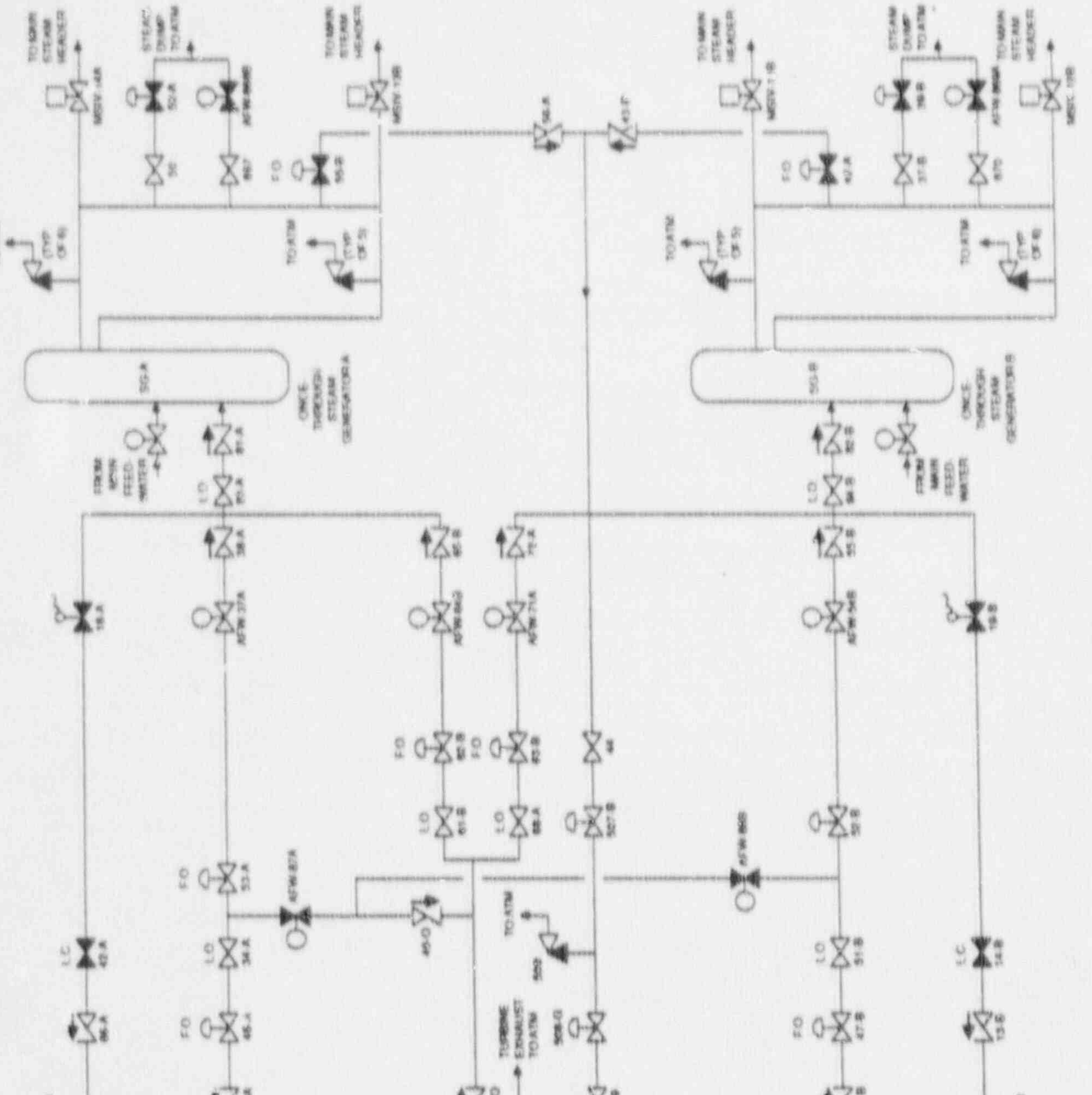


Figure 3.2-1. Bellefonte 1 Auxiliary Feedwater System

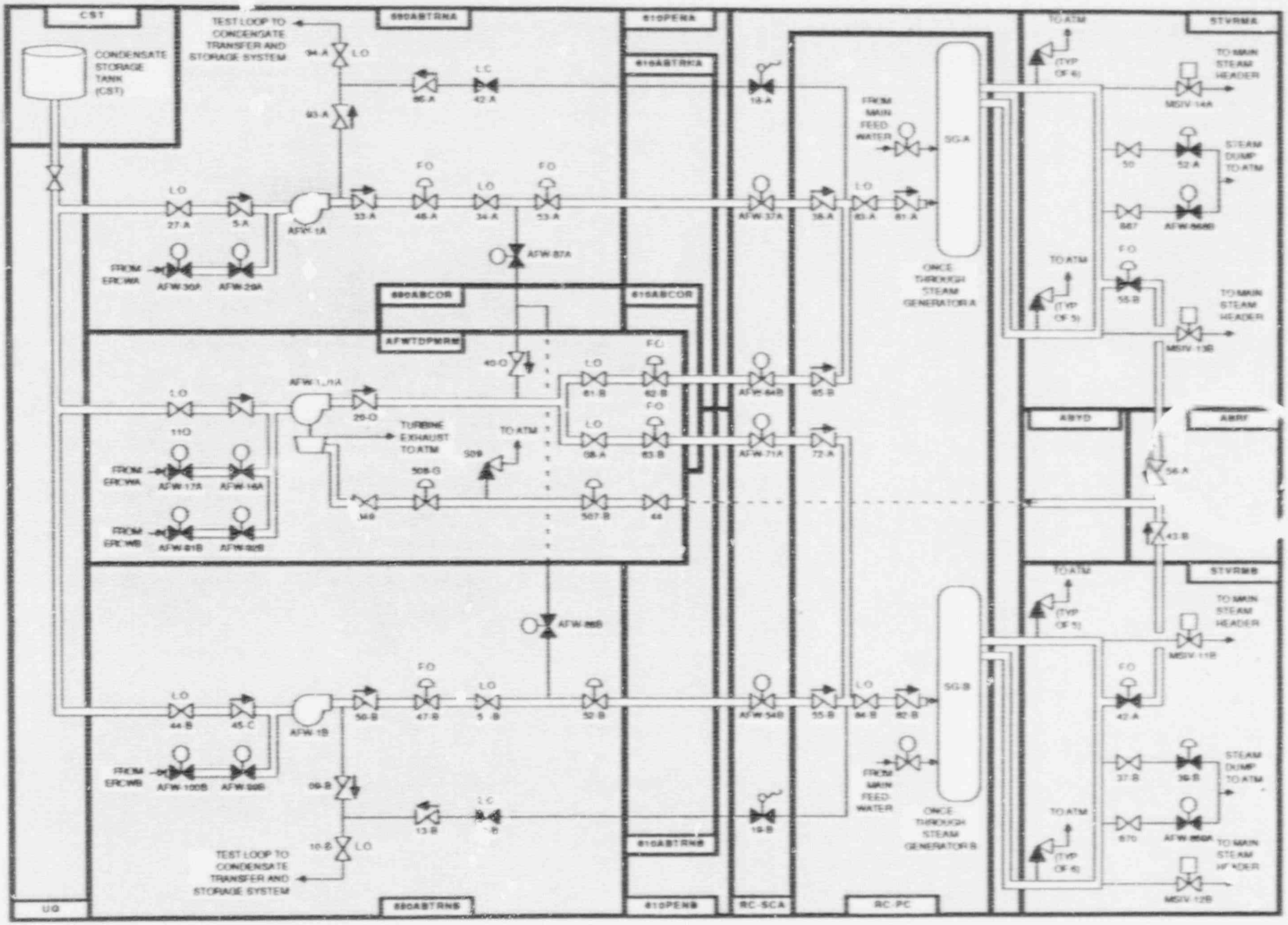



Figure 3.2-2. Bellefonte 1 Auxiliary Feedwater System Showing Component Locations

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

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| AFW-100B | MOV | 590ABTRNB | MCC-1E2B | 480 | 669SGRMB | AC/B |
| AFW-16A | MOV | AFWTDPMRM | MCC-1E5A | 480 | 649SGRMA | AC/A |
| AFW-17A | MOV | AFWTDPMRM | MCC-1E5A | 480 | 649SGRMA | AC/A |
| AFW-29A | MOV | 590ABTRNA | MCC-1E2A | 480 | 669SGRMA | AC/A |
| AFW-30A | MOV | 590ABTRNA | MCC-1E2A | 480 | 669SGRMA | AC/A |
| AFW-37A | MOV | RC-SCA | MCC-1E2A | 480 | 669SGRMA | AC/A |
| AFW-54B | MOV | RC-SCA | MCC-1E2B | 480 | 669SGRMB | AC/B |
| AFW-64B | MOV | RC-SCA | MCC-1E5B | 480 | 649SGRMB | AC/B |
| AFW-71A | MOV | RC-SCA | MCC-1E5A | 480 | 649SGRMA | AC/A |
| AFW-868B | MOV | STVRMA | MCC-1E5B | 480 | 649SGRMB | AC/B |
| AFW-869A | MOV | STVRMB | MCC-1E5A | 480 | 649SGRMA | AC/A |
| AFW-87A | MOV | 590ABTRNA | MCC-1E2A | 480 | 669SGRMA | AC/A |
| AFW-88B | MOV | 590ABTRNB | MCC-1E2B | 480 | 669SGRMB | AC/B |
| AFW-91B | MOV | AFWTDPMRM | MCC-1E5B | 480 | 649SGRMB | AC/B |
| AFW-92B | MOV | AFWTDPMRM | MCC-1E5B | 480 | 649SGRMB | AC/B |
| AFW-99B | MOV | 590ABTRNB | MCC-1E2B | 480 | 669SGRMB | AC/B |
| AFW-P1A | MDP | 590ABTRNA | BUS-1ET1A | 6900 | 649SGRMA | AC/A |
| AFW-P1B | MDP | 590ABTRNB | BUS-1ET1B | 6900 | 649SGRMB | AC/B |
| AFW-TDP1A | TDP | AFWTDPMRM | | | | |
| CST | TK | CST | | | | |

## 3.3 EMERGENCY CORE COOLING SYSTEM (ECCS)

### 3.3.1 System Function

The ECCS is an integrated set of subsystems that perform emergency coolant injection and recirculation functions to maintain reactor core coolant inventory and adequate decay heat removal following a LOCA. The coolant injection function is performed during a relatively short-term period after LOCA initiation, followed by realignment to a recirculation mode of operation to maintain long-term, post-LOCA core cooling. Heat from the reactor core is transferred to the containment. The heat transfer path to the ultimate heat sink is completed by the decay heat removal heat exchangers and by the reactor building cooling system (see Section 3.9).

### 3.3.2 System Definition

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

- Core-flooding system (passive core flood tanks)
- High pressure injection (HPI) system
- Low pressure injection (LPI) system

The core flood tanks provide makeup when RCS pressure drops below the nominal tank pressure of 600 psig. The HPI system, consisting of three HPI pumps, provides the high pressure coolant injection capability for an RCS pressure range from operating pressure down to approximately 200 psig. One HPI pump also is used as the normal source of RCS makeup (see Section 3.4). The decay heat removal (DHR) pumps perform the low pressure injection function when the RCS has depressurized below 200 psig. The Borated Water Storage Tank (BWST) is the water source for ECCS during the injection phase. The HPI system injects coolant into all four RCS cold legs while the LPI system and the core flood tanks inject directly into the reactor vessel through separate core flood nozzles.

After the injection phase is completed, recirculation (ECR) is performed by the DHR pumps taking suction from the containment sump and discharging into the reactor vessel (low pressure recirculation) or to the suction of the HPI pumps (high pressure recirculation). Decay heat is transferred to the component cooling water system by the DHR heat exchangers.

Within 24 hours following a LOCA, the operator is required to establish a flow path from one of the two hot legs to the containment emergency sump. This is accomplished by dumping hot leg B via parallel dump paths, each containing two normally closed motor-operated valves. After opening the valves in the dump-to-sump lines, power is removed to prevent instrument malfunctions from closing the valves.

Simplified drawings of the high pressure injection system are shown in Figures 3.3-1 and 3.3-2. The low pressure injection/recirculation system is shown in Figures 3.3-3 and 3.3-4. Interfaces between the core flood tanks, the ECCS injection and recirculation subsystems, and the RCS are shown in Section 3.1. A summary of data on selected ECCS components is presented in Table 3.3-1.

### 3.3.3 System Operation

During normal operation, one of three HPI pumps is normally operating as part of the makeup and purification system (see Section 3.4) and the balance of the ECCS is in standby. Following a LOCA, the core flood tanks will supply borated water to the RCS as soon as RCS pressure drops below tank pressure (about 600 psig). The engineered safety feature actuation system (ESFAS, see Section 3.5) automatically starts the two HPI pumps not used for normal RCS makeup, and the two LPI pumps. All pumps are aligned to take

suction on the BWST, and the normal makeup suction path from the makeup tank is isolated.

When the BWST water level drops to the low-level point, the low pressure injection pumps are automatically realigned to draw a suction from the containment sump and deliver water to the RCS. The suctions of the HPI pumps are automatically aligned to the discharge of the LPI system at the low-level recirculation switchover point. The HPI pumps cannot take a suction directly on the containment sump.

### 3.3.4 System Success Criteria

LOCA mitigation requires that both the emergency coolant injection and emergency coolant recirculation (ECR) functions be accomplished. The ECI success criteria are not clearly defined in the Bellefonte FSAR, but the following success criteria can be inferred (Ref. 1, Table 6.3.2-4). For a large LOCA:

- 1 of 2 core flood tanks provide makeup as RCS pressure drops below tank pressure, and
- 1 of 2 low pressure injection (DHR) pumps takes a suction on the BWST and delivers water to the RCS

If the large LOCA ECI success criteria are met, then the following large LOCA ECR success criteria will apply (Ref. 1):

- the successful establishment of at least one pumping path from the containment sump to an LPI pump to the RCS.
- after 24 hours, successful establishment of at least one hot leg "dump-to-sump" flow path.

For small LOCAs that do not result in RCS depressurization below the LPI pump shutoff head, the HPI pumps are required. The ECI success criteria for a small LOCA are the following:

- 1 of 3 HPI pumps take a suction on the BWST and delivers water to the RCS.

If the small LOCA ECI success criteria are met, then the following small LOCA ECR success criteria will apply:

- The success establishment of at least one tandem pumping path from the containment sump to an LPI pump to one HPI pump to the RCS.

It appears that the RCS can be depressurized by the following means if the LPI pumps are to provide makeup following a small LOCA:

- RCS cooldown (i.e., using the AFWS, see Section 3.2)
- Opening the power-operated relief valve on the pressurizer (see Section 3.1).

### 3.3.5 Component Information

A. High pressure injection pumps 1A, 2A, and 3B
   1. Rated flow: 540 gpm @ 3692 ft. head (1600 psid)
      306 gpm @ 6250 ft. head (2710 psid)
   2. Discharge pressure at shutoff head: 3500 psig
   3. Rated capacity: 100%
   4. Type: multi-stage centrifugal

B. Low pressure injection (decay heat removal) pumps 1A and 2B
   1. Rated flow: 5125 gpm @ 385 ft. head (167 psid)
   2. Rated capacity: 100%
   3. Discharge pressure at shutoff head: 246 psig
   4. Type: single-stage centrifugal

C. Core flood tanks (2)
   1. Accumulator total volume: 1800 $ft^3$
   2. Normal water volume: 1350 $ft^3$
   3. Normal operating pressure: 600 psig
   4. Minimum boron concentration: 2270 ppm

D. Borated water storage tank
   1. Capacity: 740,000 gallons
   2. Design pressure: Atmospheric
   3. Approximate boron concentration: 2270 ppm

E. Decay Heat Removal Heat Exchangers 3A and 4B
   1. Design duty (normal/max.) 41/146 x $10^6$ Btu/hr
   2. Type: shell-and-tube

### 3.3.6 Support Systems and Interfaces

A. Control signals
   1. Automatic
      a. The ECCS is automatically actuated by the ESFAS if any of the following conditions exist:
         - Low RCS pressure (< 1700 psig)
         - High containment pressure (> 4 psig)
         - Low steam generator pressure (< 600 psig) in steam generator A or B.
      b. Transfer of the HPI pump suction from the BWST to the LPI (DHR) pump discharge is automatically initiated when BWST level drops to the low- low setpoint.
      c. Transfer of the LPI (DHR) pump suction from the BWST to the containment emergency sump is automatic.

   2. Remote manual
      a. An ESFAS signal can be initiated by remote manual means from the main control room or the auxiliary control room.
      b. Initiation of hot leg "sump-to-sump" is manual.

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

C. Other
   1. The HPI and DHR pump lube oil coolers, the DHR pump seal coolers, and the DHR the component cooling system (CCS, see Section 3.7).
   2. Auxiliary lube oil pumps are provided for the HPI/makeup and DHR pumps. All auxiliary lube oil pumps are powered from 480 VAC Class 1E MCCs, as follows:

| ECCS Pump | Aux. LO Pump Power Source |
|---|---|
| HPI/Makeup Pump 1A | MCC 1E1-A |
| HPI/Makeup Pump 2A | MCC 1E1-A |
| HPI/Makeup Pump 3B | MCC 1E1-B |
| DHR Pump A | MCC 1E2-A |
| DHR Pump B | MCC 1E2-B |

Details on the operation of the auxiliary lube oil pump have not been determined. However, following practices noted in other nuclear power plants, it is likely that the auxiliary lube oil pumps are only used during startup of the associated ECCS pump. When the ECCS pump is running, a shaft-driven lube oil pump probably takes over and the auxiliary lube oil pump shuts down. Furthermore, it is likely that the ECCS pump can start up in an emergency without the auxiliary lube oil pump.

3. Air handling units (AHUs) are provided in the DHR and HPI/makeup pump rooms. The DRH pump room AHUs are cooled by the ERCW system (see Section 3.8). The source of cooling water (if any) of the HPI/makeup pump room AHUs has not been determined. All AHUs are powered from 480VAC Class 1E MCCs, as follows:

| Room | AHU Power Source |
|---|---|
| HPI/Makeup Pump Room 1A | MCC 1E1-A |
| HPI/Makeup Pump Room 2A | MCC 1E1-A |
| HPI/Makeup Pump Room 3B | MCC 1E1-B |
| DHR Pump Room A | MCC 1E2-A |
| DHR Pump Room B | MCC 1E2-B |

### 3.3.7 Section 3.3 References

1. Bellefonte 1 and 2 Final Safety Analysis Report, Section 6.3.

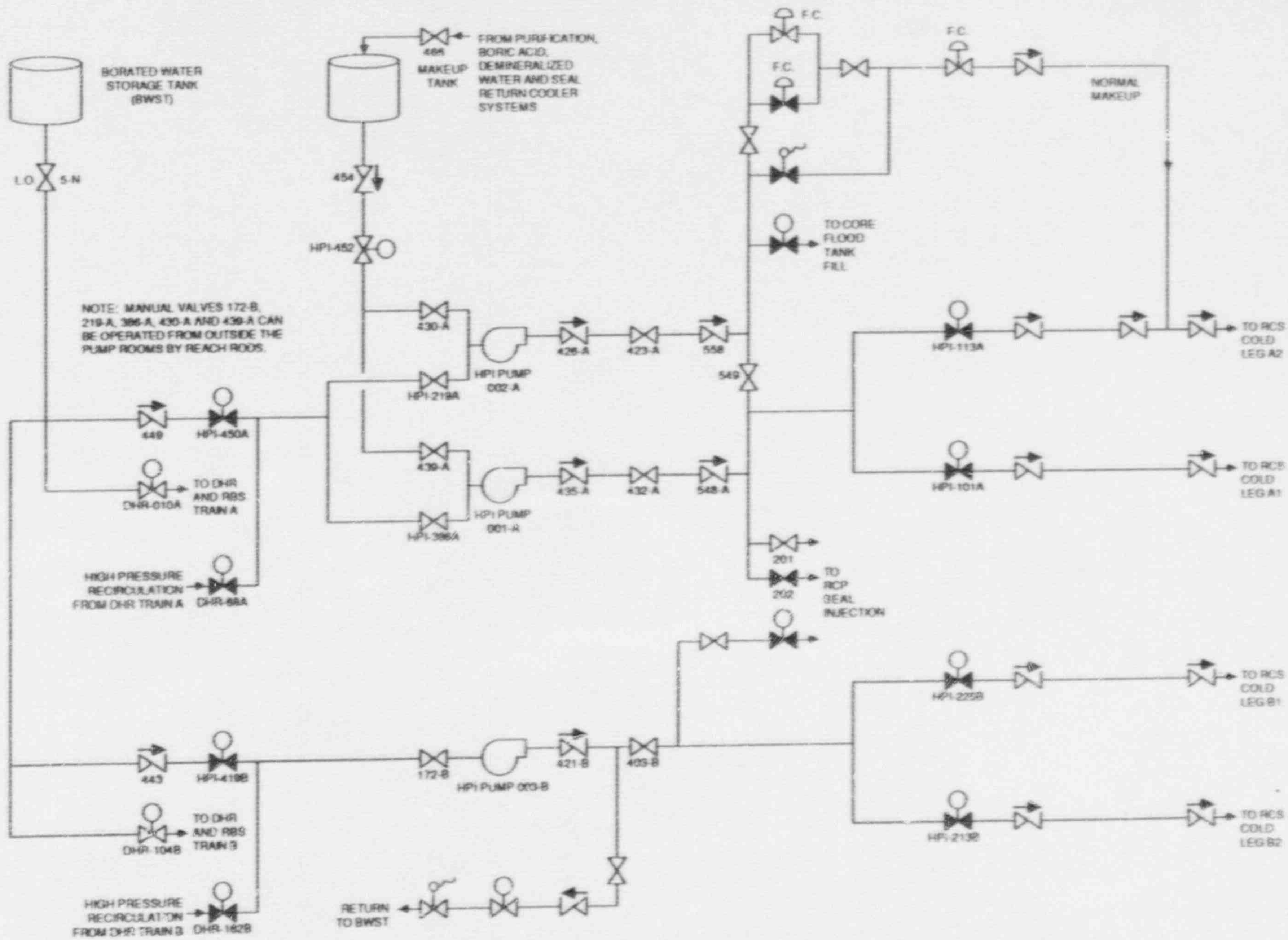



**Figure 3.3-1. Bellefonte 1 High Pressure Injection/Makeup System**

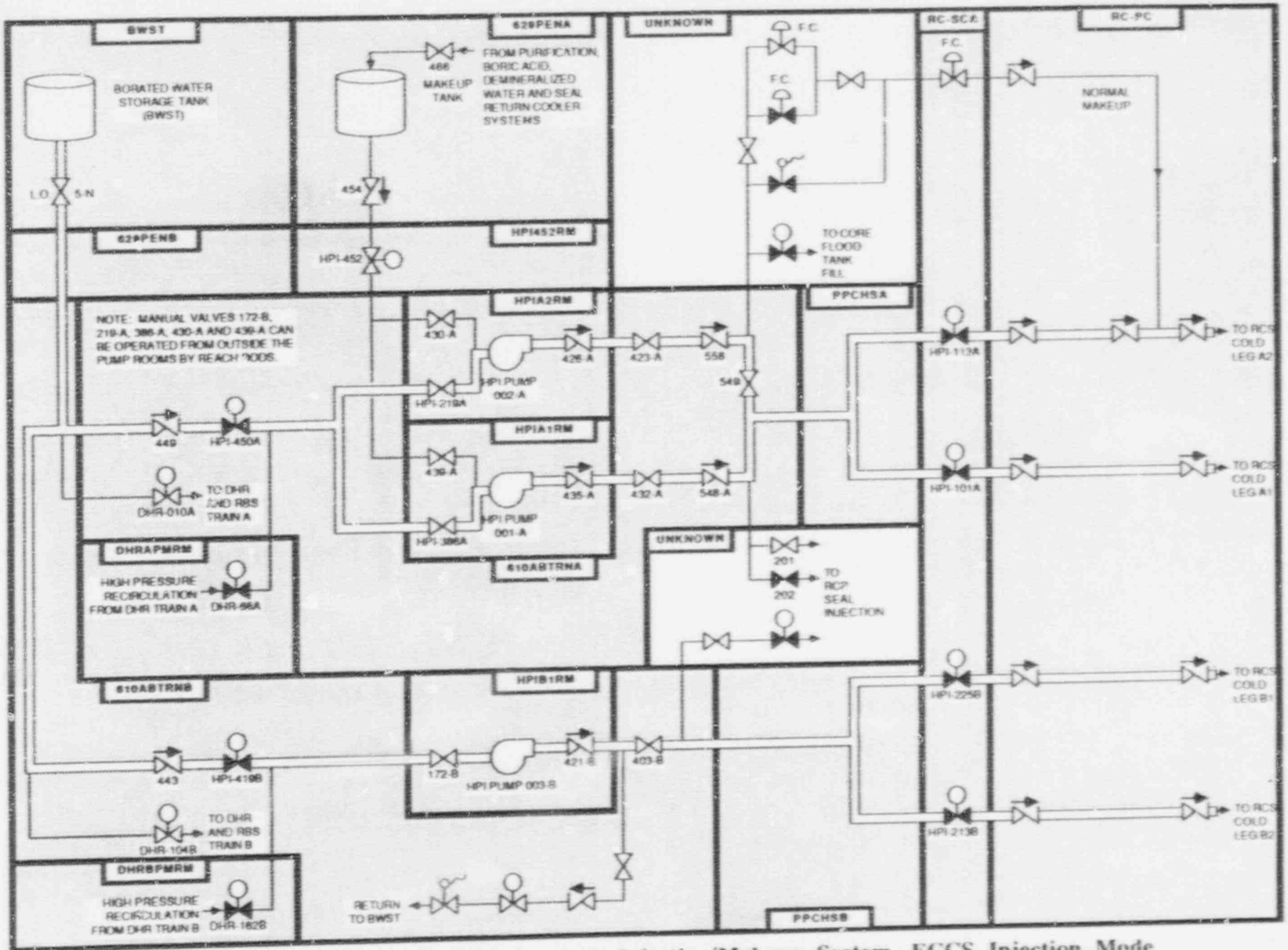



Figure 3.3-2. Bellefonte 1 High Pressure Injection/Makeup System, ECCS Injection Mode Showing Component Locations

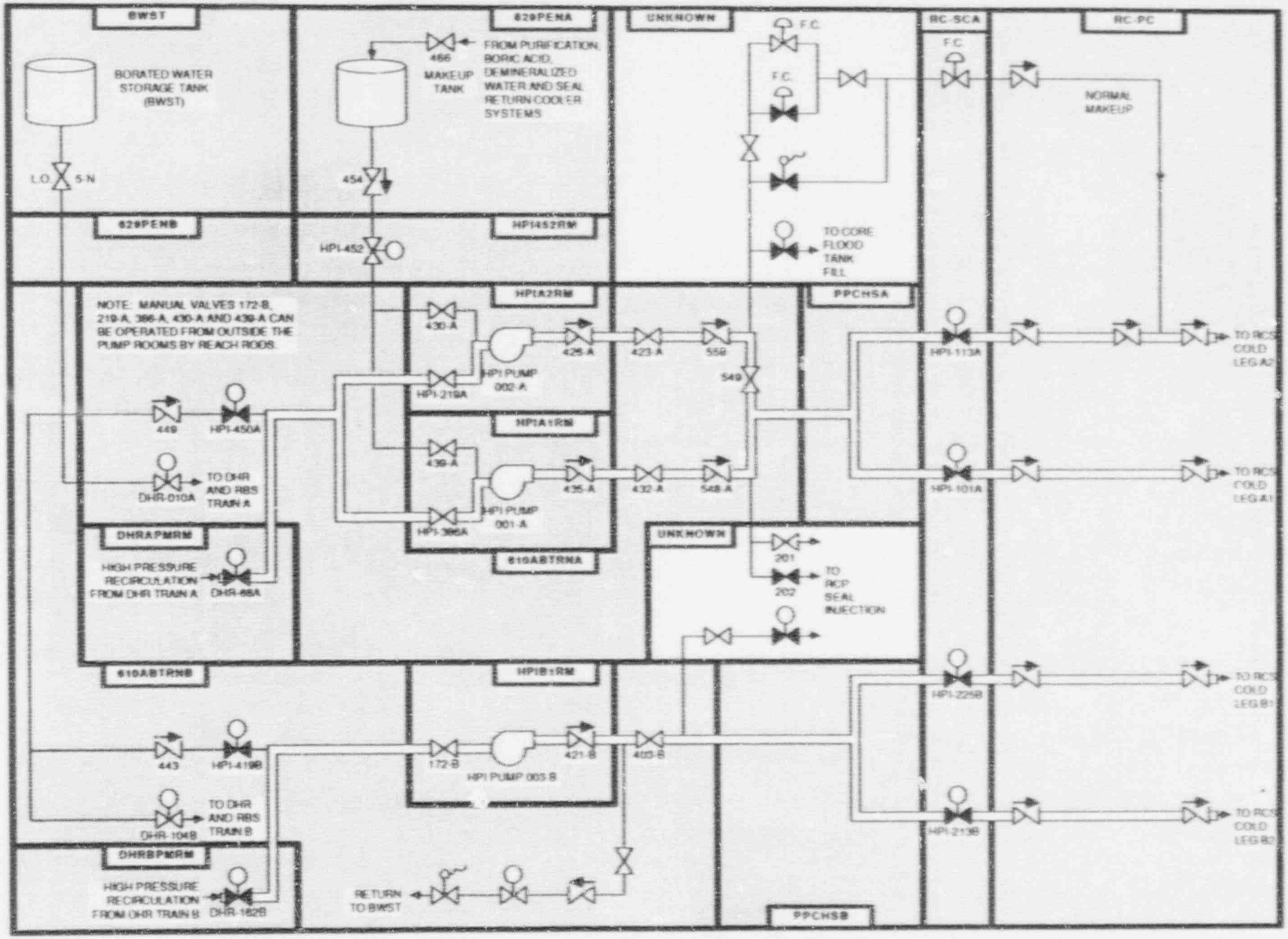



Figure 3.3-3. Bellefonte 1 High Pressure Injection/Makeup System, ECCS High Pressure Recirculation Mode Showing Component Locations

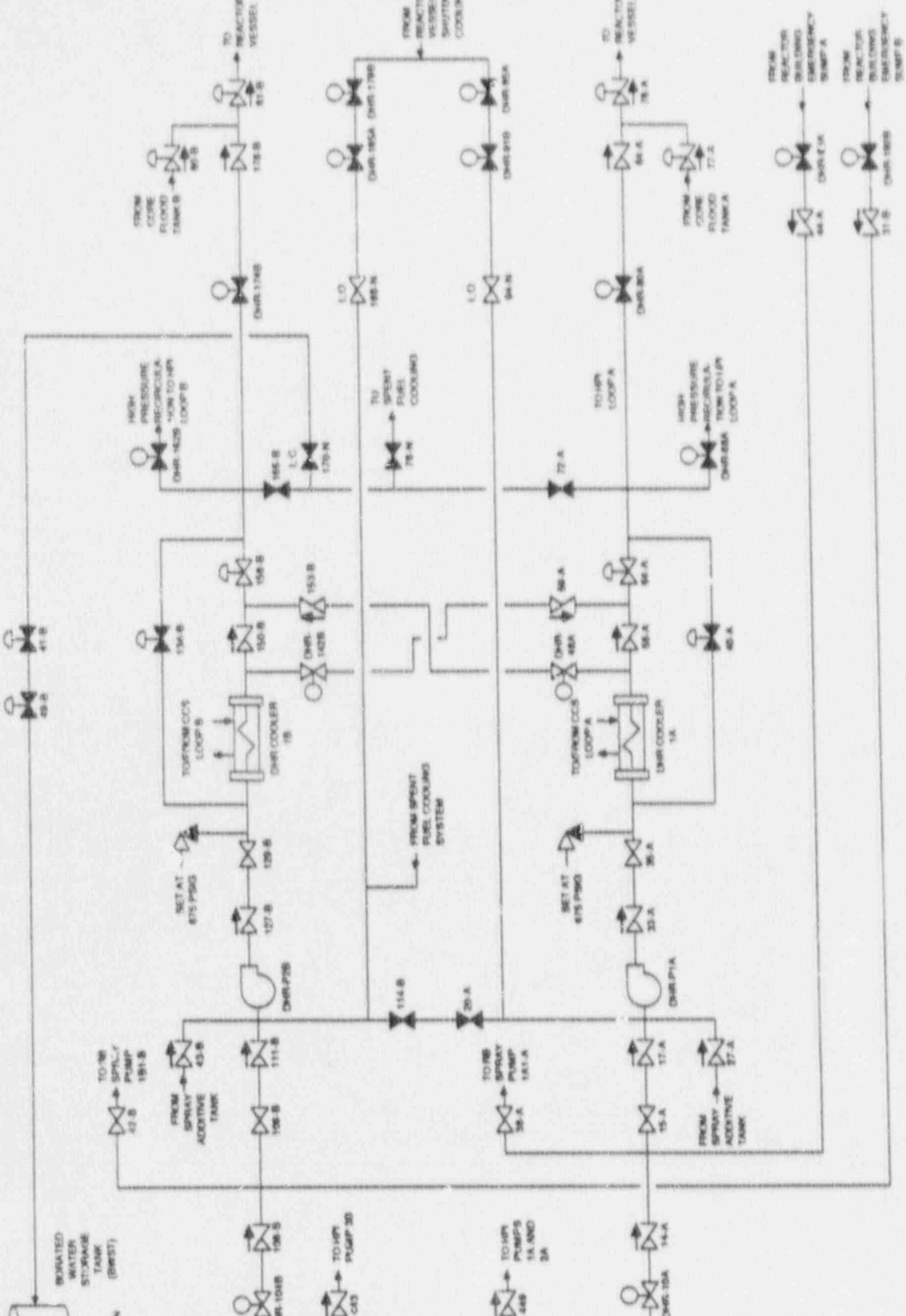
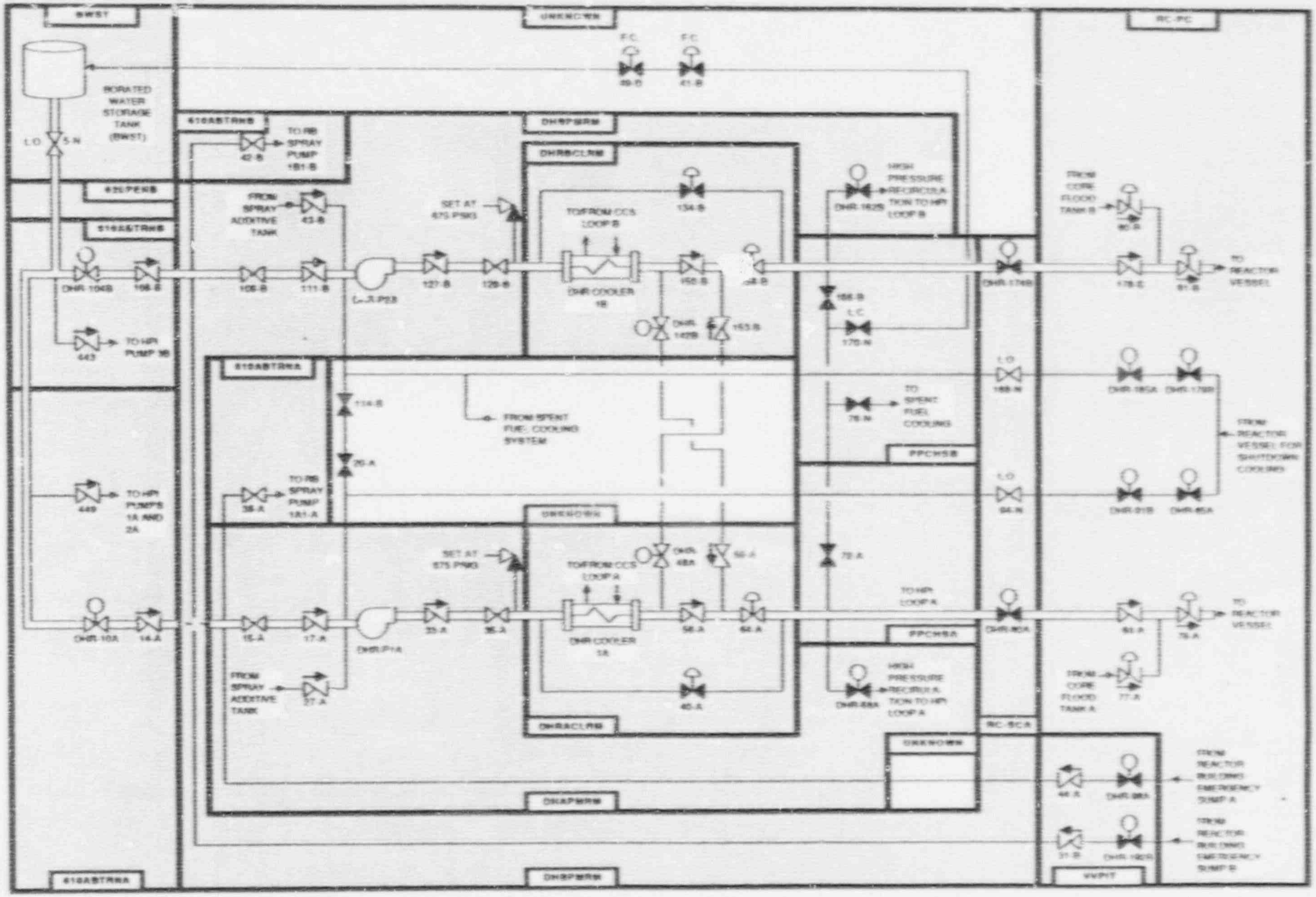


Figure 3.3-4. Bellefonte 1 Decay Heat Removal (DHR) System




Figrre 3.3-5. Bellefonte 1 Decay Heat Removal (DHR) System, ECCS Injection Mode Showing Component Locations

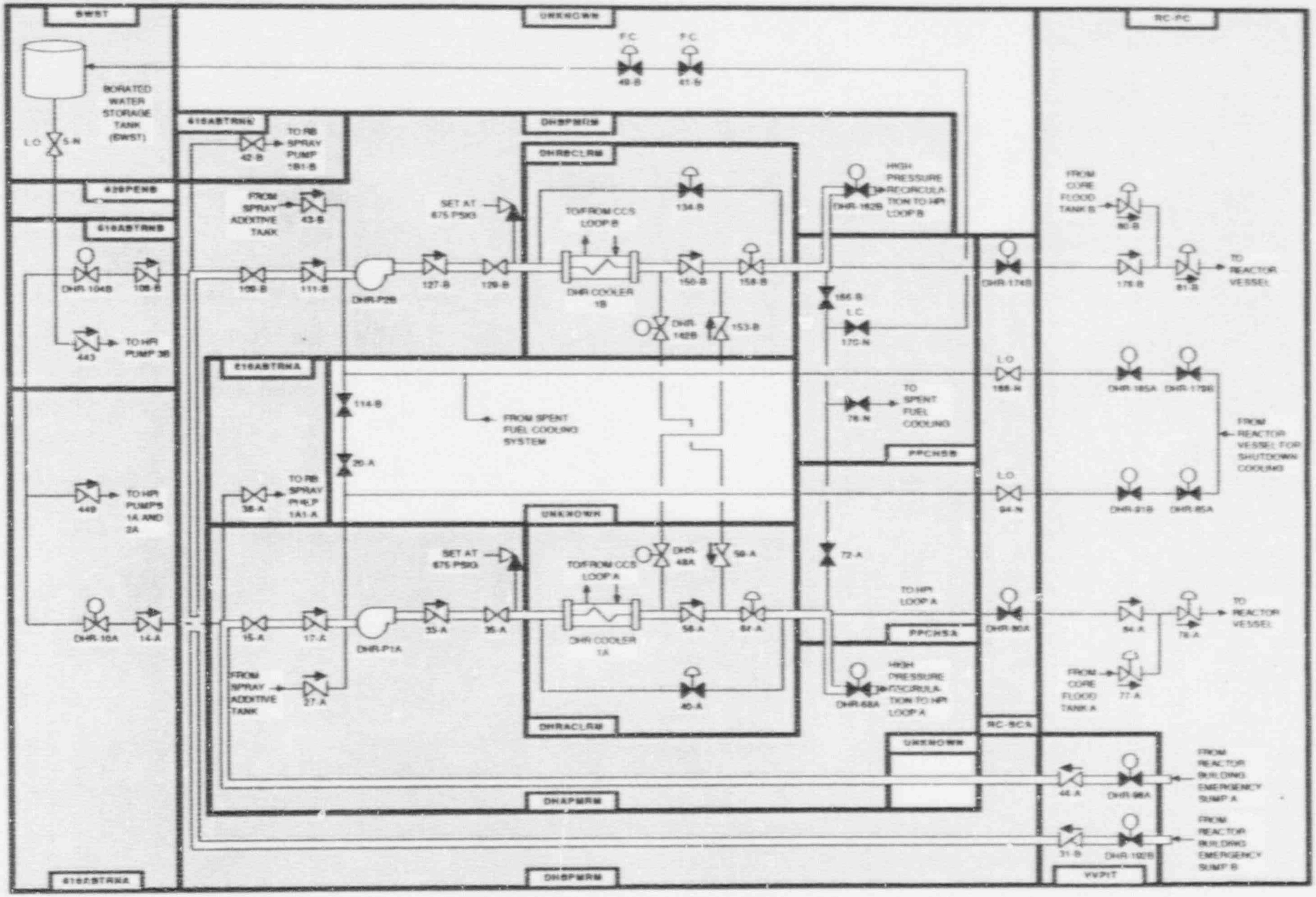



Figure 3.3-6. Bellefonte 1 Decay Heat Removal (DHR) System, ECCS High Pressure Recirculation Mode Showing Component Locations

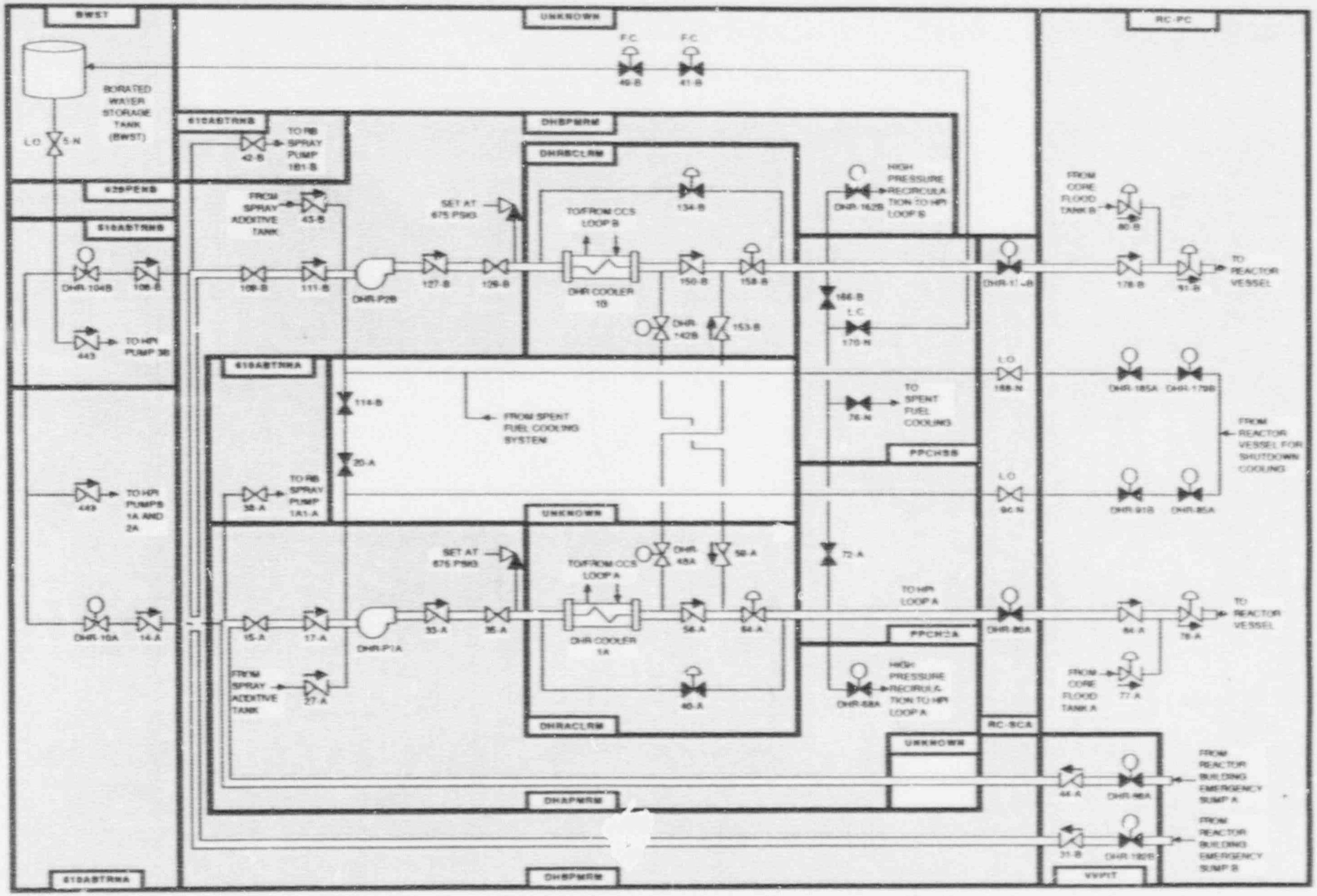



Figure 3.3-7. Bellefonte 1 Decay Heat Removal (DHR) System, Low Pressure Recirculation Mode Showing Component Locations

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

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| BWST | TK | BWST | | | | |
| DHR-104B | MOV | 610ABTRNB | MCC-1E2B | 480 | 669SGRMB | AC/B |
| DHR-10A | MOV | 610ABTRNA | MCC-1E2A | 480 | 669SGRMA | AC/A |
| DHR-142B | MOV | DHRBCLRM | MCC-1E2B | 480 | 669SGRMB | AC/B |
| DHR-162B | MOV | DHBPMRM | MCC-1E1B | 480 | 669SGRMB | AC/B |
| DHR-174B | MOV | RC-SCA | MCC-1E2B | 480 | 669SGRMB | AC/B |
| DHR-179B | MOV | RC-PC | MCC-1E2B | 480 | 669SGRMB | AC/B |
| DHR-185A | MOV | RC-PC | MCC-1E2A | 480 | 669SGRMA | AC/A |
| DHR-192B | MOV | VVPIT | MCC-1E2B | 480 | 669SGRMB | AC/B |
| DHR-48A | MOV | DHRACLRM | MCC-1E2A | 480 | 669SGRMA | AC/A |
| DHR-68A | MOV | DHAPMRM | MCC-1E1A | 480 | 669SGRMA | AC/A |
| DHR-80A | MOV | RC-SCA | MCC-1E2A | 480 | 669SGRMA | AC/A |
| DHR-85A | MOV | RC-PC | MCC-1E2A | 480 | 669SGRMA | AC/A |
| DHR-91A | MOV | RC-PC | MCC-1E2B | 480 | 669SGRMB | AC/B |
| DHR-98A | MOV | VVPIT | MCC-1E2A | 480 | 669SGRMA | AC/A |
| DHR-HX1A | HX | DHRACLRM | | | | |
| DHR-HX1B | HX | DHRBCLRM | | | | |
| DHR-P1A | MDP | DHAPMRM | BUS-1ET1A | 6900 | 649SGRMA | AC/A |
| DHR-P2B | MDP | DHBPMRM | BUS-1ET1B | 6900 | 649SGRMB | AC/B |
| HPI-101A | MOV | RC-SCA | UNKNOWN | 480 | 669SGRMA | AC/A |
| HPI-113A | MOV | RC-SCA | MCC-1E1A | 480 | 669SGRMA | AC/A |

**Table 3.3-1. Bellefonte 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. |
|---|---|---|---|---|---|---|
| HPI-213B | MOV | RC-SCA | UNKNOWN | 480 | 669SGRMB | AC/B |
| HPI-219A | XV | HPIA2RM | | | | |
| HPI-225B | MOV | RC-SCA | MCC-1E1B | 480 | 669SGRMB | AC/B |
| HPI-386A | XV | HPIA1RM | | | | |
| HPI-419B | MOV | 610ABTRNB | MCC-1E1B | 480 | 669SGRMB | AC/B |
| HPI-450A | MOV | 610ABTRNA | MCC-1E1A | 480 | 669SGRMA | AC/A |
| HPI-P1A | MDP | HPIA1RM | BUS-1ET1A | 6900 | 649SGRMA | AC/A |
| HPI-P2A | MDP | HPIA2RM | BUS-1ET1A | 6900 | 649SGRMA | AC/A |
| HPI-P3B | MDP | HPIB1RM | BUS-1ET1B | 6900 | 649SGRMB | AC/B |
| SUMP-1A | TK | RC-PC | | | | |
| SUMP-1B | TK | RC-PC | | | | |

## 3.4 MAKEUP AND PURIFICATION SYSTEM

### 3.4.1 System Function

The makeup system, in conjunction with the purification system, is responsible for maintaining the proper water inventory in the Reactor Coolant System and maintaining water purity and the proper concentration of neutron absorbing and corrosion inhibiting chemicals in the reactor coolant. Its safety-related function as part of the Emergency Core Cooling System (ECCS, see Section 3.3) is to mitigate consequences of loss of reactor coolant through an offset rupture of a 3/4 inch line.

### 3.4.2 System Definition

The makeup and purification system provides a means for the injection of control poison in the form of boric acid solution, chemical additions for corrosion control, and reactor coolant cleanup and degasification. This system also adds makeup water to the RCS, draws off a small side stream of reactor coolant for purification, and provides seal water injection to the reactor coolant pump seals.

The RCS water makeup function [illegible]rmed using portions of the High Pressure Injection (HPI) System, which [illegible] the ECCS. In particular, one HPI/makeup pump is operated continuously [illegible]igh pressure makeup water into the RCS during normal and transient operation. H[illegible]p 3B is not used for normal makeup since its pump suction is not connected to the makeup tank.

The HPI/makeup pumps are shown supplying water from the makeup tank to the Reactor Coolant System and to other services in the simplified system drawings in Figures 3.4-1 to 3.4-4. A summary of data on selected HPI makeup system components is presented in Section 3.3.

### 3.4.3 System Operation

During normal plant operation, one high pressure injection pump (pump 1A or 2A) is running with its suction aligned to the makeup tank. The normal letdown flow of 50 to 200 gpm from RCS cold leg 1 (loop A) is cooled on the tube side of the letdown heat exchanger, then directed to the purification system and the makeup tank. The pressurizer level control system regulates the letdown flow rate in order to maintain the desired water inventory in the pressurizer. A fraction of the makeup flow is pumped back to the RCS through cold leg 2 A2. The majority of the charging flow is directed to the reactor coolant pumps through a seal injection filter with a total seal injection flow of 8 to 15 gpm per reactor coolant pump and a seal in-leakage to the RCS of 7 to 14 gpm per pump (i.e., total RCS makeup via reactor coolant pump seal in-leakage of 28 to 50 gpm).

When the ESFAS actuates the ECCS, normal operation of the makeup and purification system is terminated by isolating the letdown line, the normal charging path and the makeup tank, aligning all HPI pump suctions to the BWST, and starting all HPI pumps (see Section 3.3).

If seal injection is lost during normal operation, a second HPI/makeup pump (1A or 2A) is automatically started. If the second pump fails to start, HPI/makeup pump 3B is started after a time delay to provide seal injection with water from the BWST. To accomplish this, the pump 3B BWST suction valve and seal injection supply valve must be opened and train B of the component cooling system must be started (this CCS train is not normally operating, see Section 3.7).

### 3.4.4 System Success Criteria

For post-transient makeup to the RCS the following makeup system success criteria is assumed:

- One of three HPI pumps is available.

- A makeup path to the RCS is available (i.e., the normal makeup path via cold leg 2A and the reactor coolant pump seals, or the ECCS injection paths).
- A long-term water source must be available to the charging pumps. Available water sources for pumps 1A and 2A include the makeup tank (supplied from the demineralized water and boric acid systems) and the BWST. The only available water source for pump 3B is the BWST.

### 3.4.5 Component Information

A. High pressure injection pumps 1A, 2A, and 3B
   1. Rated flow: 306 gpm @ 6250 ft. head (2710 psid)
   2. Rated capacity: 100% (based on makeup function)
   3. Type: centrifugal

B. Borated Water Storage Tank (BWST)
   1. Capacity: 740,000 gallons
   2. Minimum water volume: 482,778 gallons
   3. Boron concentration: 2,270 ppm minimum
   4. Operating pressure: atmospheric

C. Makeup Tank
   1. Volume: 1200 $ft^3$
   2. Nominal water volume: 800 $ft^3$ (about 6000 gallons)
   3. Operating pressure: 15 to 35 psig
   4. Design pressure: 100 psig

### 3.4.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. During normal operation, either Train A HPI pump 1A or 2A is aligned to provide continuous makeup to the RCS. The second Train A HPI pump (1A or 2A) is automatically started on low injection flow to the reactor coolant pump seals.
      b. HPI pump 3B is automatically started and aligned to supply seal injection flow from the BWST if both HPI pumps 1A and 2A are not available.

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

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

C. Other
   1. The HPI pump lube oil coolers are cooled by the Component Cooling System (see Section 3.7).
   2. Auxiliary lube oil pumps are provided for the HPI/makeup pumps. The auxiliary lube oil pumps are powered from 480 VAC Class 1E MCC 1E1-A (for HPI/makeup pumps 1A and 2A), and MCC 1E1-B (for HPI/makeup pump 3B).

3. Air handling units (AHUs) are provided for the HPI/makeup pump rooms. The AHUs are powered from 480 VAC Class 1E and MCC 1E1-A (pump rooms 1A and 2A) and MCC 1E1-B (pump room 3B). The source of cooling water for the AHUs (if any) has not been determined.

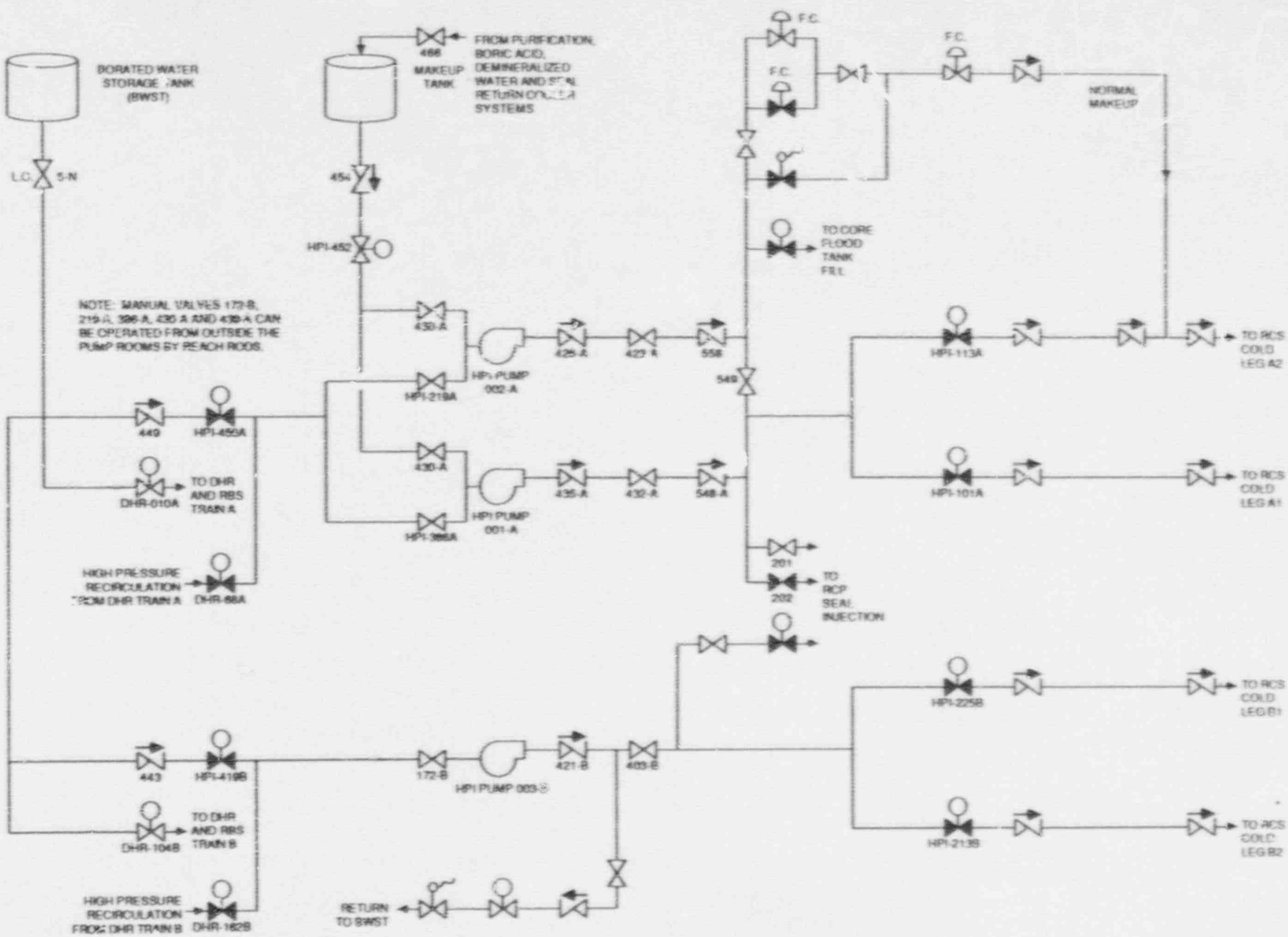



**Figure 3.4-1. Bellefonte 1 High Pressure Injection/Makeup System**

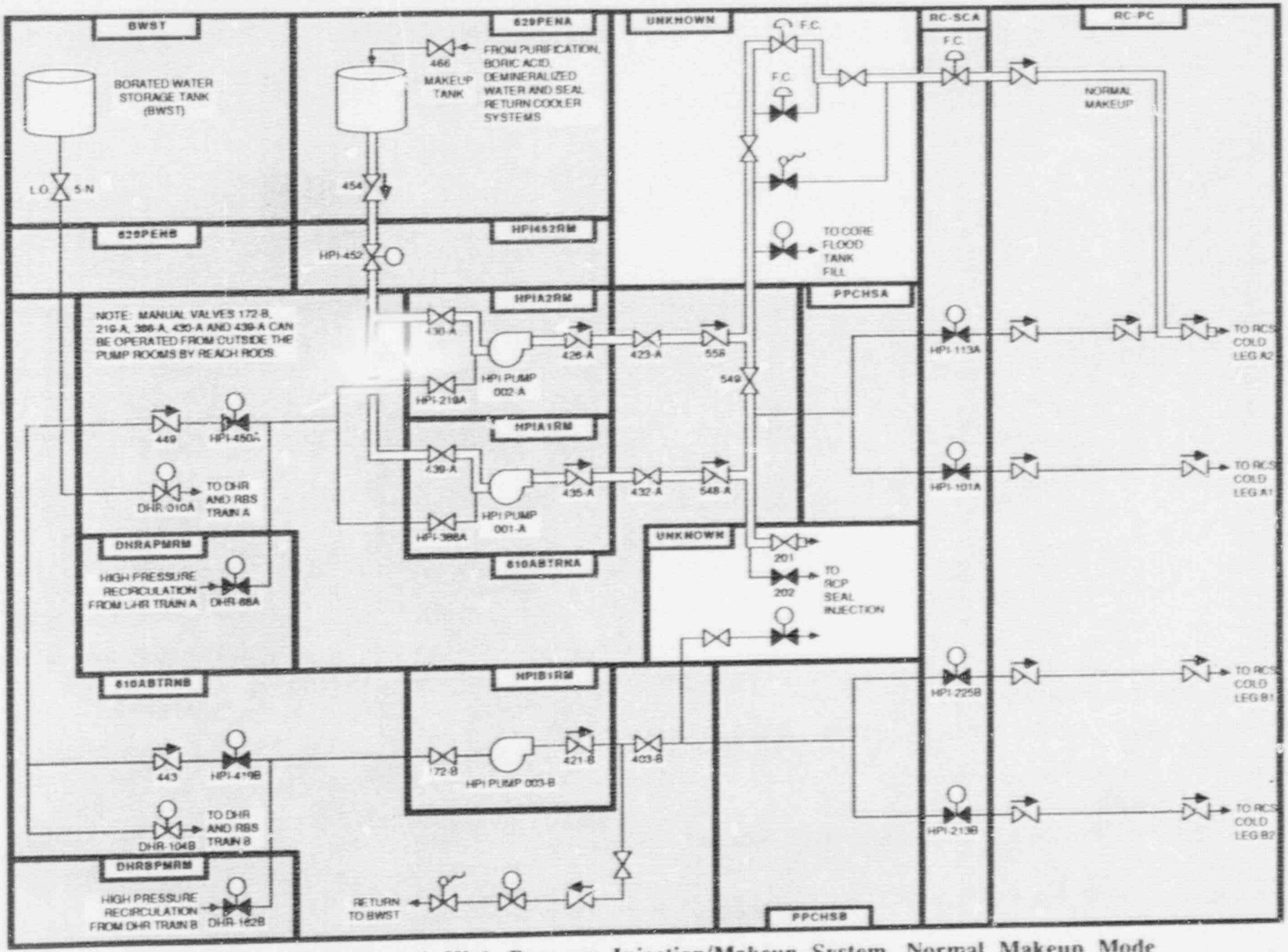



Figure 3.4-2. Bellefonte 1 High Pressure Injection/Makeup System, Normal Makeup Mode Showing Component Locations

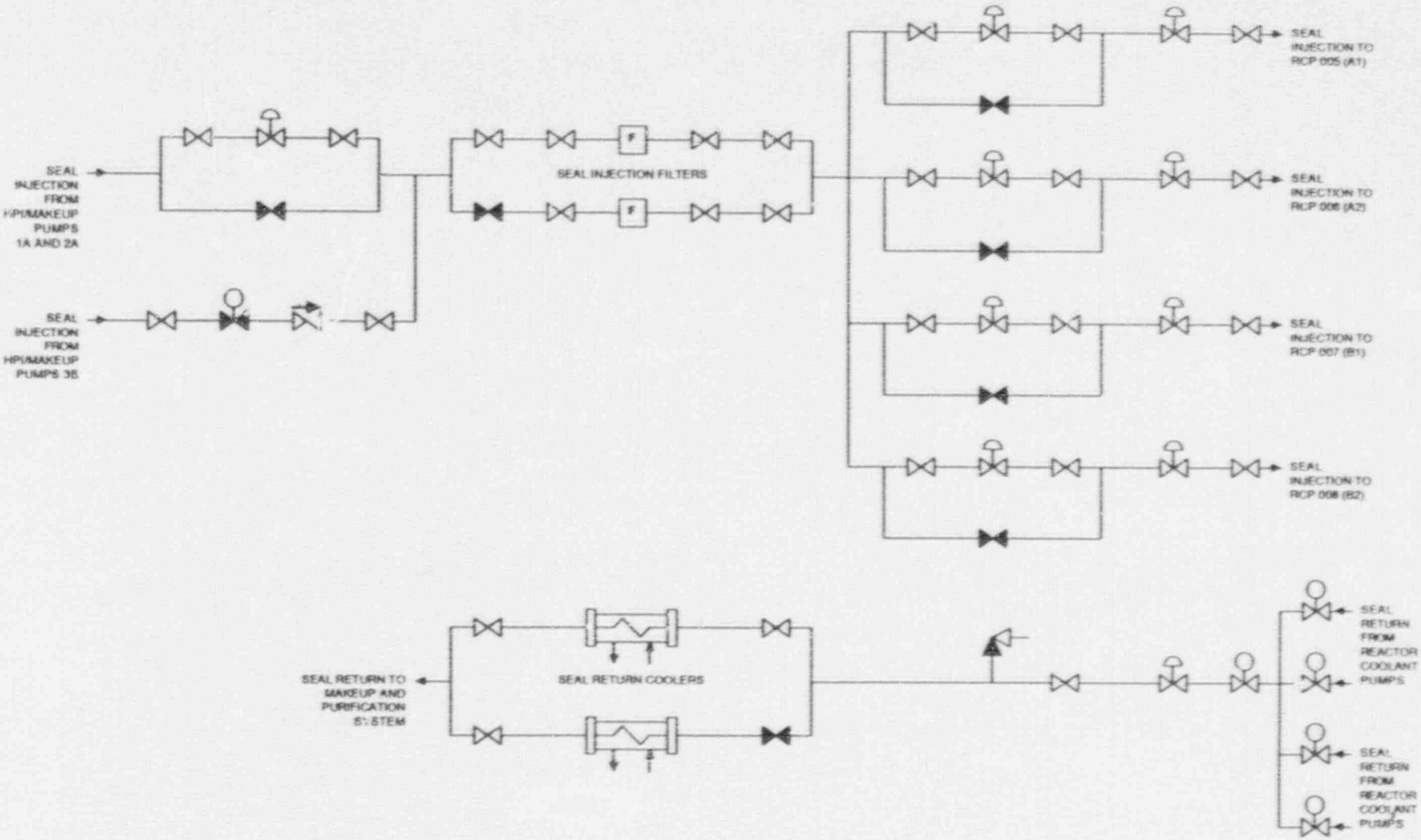



Figure 3.4-3. Bellefonte 1 Seal Injection/Return Portion of the Makeup and Purification System

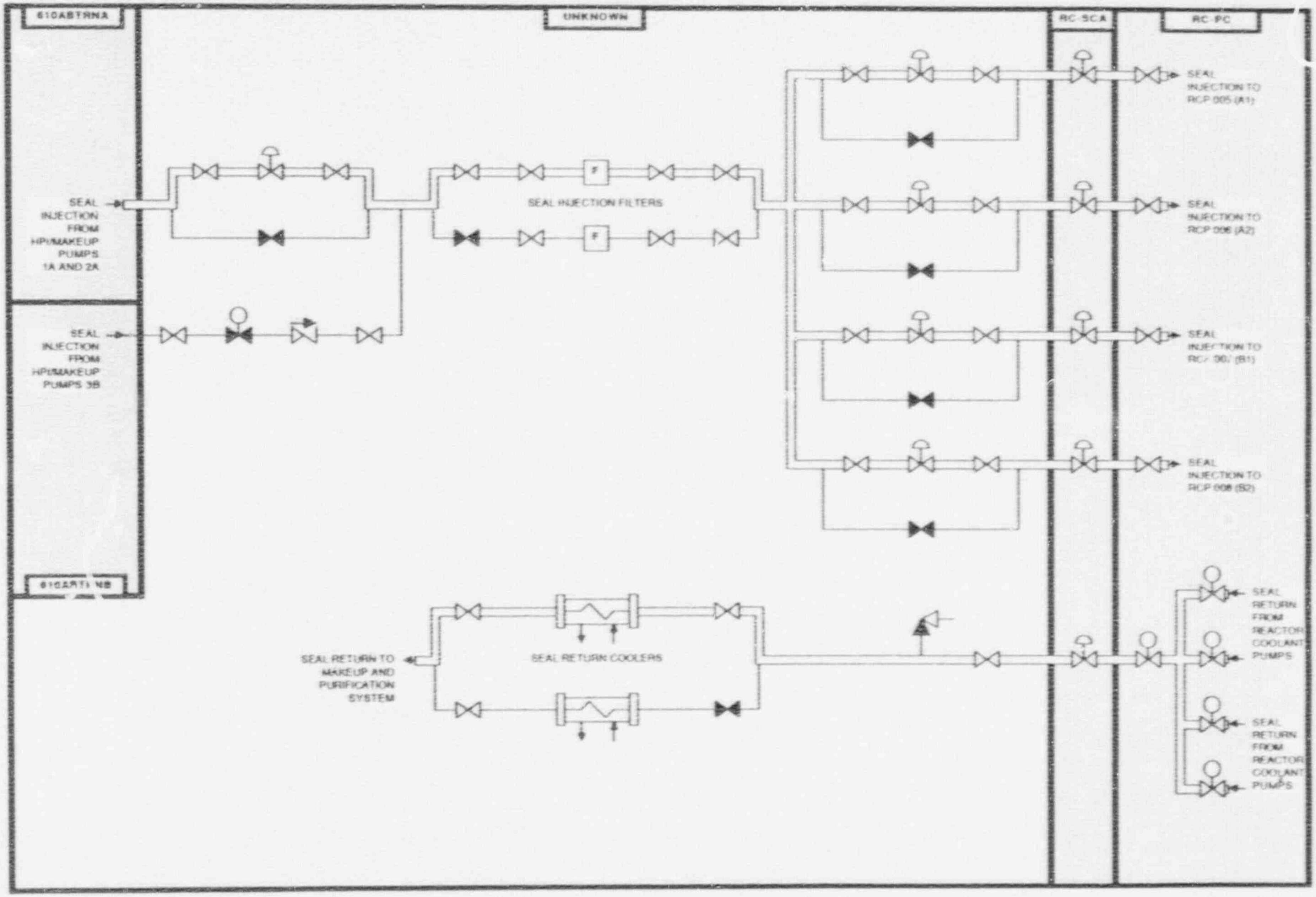



**Figure 3.4-4. Bellefonte 1 Seal Injection/Return Portion of the Makeup and Purification System Showing Component Locations**

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

### 3.5.1 System Function

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

### 3.5.2 System Definition

The RPS includes sensor and transmitter units, logic units, and output trip relays that generate a reactor trip signal. The reactor trip signal de-energizes the control rod drives, allowing mechanical springs to separate the roller-nut halves, disengaging the leadscrew and allowing the control rod assemblies (CRAs) to fall into the core. The ESFAS includes independent sensor and transmitter units, logic units, and relays that interface with the control circuits for the many different sets of engineered safety features components that can be actuated. Operator instrumentation display systems consist of display panels in the control room and at local control stations that are powered by the 120 VAC electric power system. (see Section 3.6)

### 3.5.3 System Operation

A. RPS

The RPS is comprised of four identical protection channels which are redundant and independent. Each channel is served by its own independent sensors, which are physically isolated from the sensors of the other protection channels. Each sensor supplies an input signal to one or more signal processing strings in the RPS channel. Each signal processing string terminates in a bistable that electronically compares the processed signal with trip setpoints. All bistable trip outputs are connected in series. In the normal, untripped state, the output associated with each bistable will be closed, thereby energizing the channel terminating device. The bistable is reset with a toggle switch located on the front plate of the bistable module. The bistable will reset only if the trip condition has cleared.

Should there be a trip of one of the bistables on the trip string, it will de-energize the channel terminating device, which de-energizes the photo-optic isolators, causing one input into the two-of-four logic in each RPS channel to trip.

Should another channel trip with one channel already tripped, its terminating device will de-energize, which in turn will de-energize that channel's photo-optical isolators. When these devices de-energize, another input into the two-of-four logic in each RPS channel will trip. Thus, when two-out-of-four RPS trip logic is satisfied, a reactor trip will occur.

The following conditions result in a reactor trip:

- High or low reactor coolant pressure
- High or low pressurizer water level

- High coolant outlet temperature
- Overpower
- High power/reactor coolant flow
- Calculated trips:
  - Offset (High local linear heat rate)
  - Low departure from nucleate boiling (DNBR) ratio
  - RC pump status (2/0, 1/0, or 0/0 pump configuration)
  - Power delta T (startup) trip
- Anticipatory trips:
  - ESFAS actuation
  - High power/main feedwater flow
  - Loss of both main feedwater pumps

B. ESFAS

The Engineered Safety Features Actuation System (ESFAS) is a protection system that initiates actions of various Engineered Safety Feature (ESF) systems to mitigate the consequences of a LOCA or transient. The ESFAS initiates the following functions:

- Emergency Core Cooling Injection and secondary system isolation and cooling (ECCI)
- Feed Only Good Generator (FOGG)
- Containment Isolation and Cooling (CIC)
- Reactor Building Spray (RBS)
- Borated Water Storage Tank (BWST) to RB emergency sump switchover
- Main steam isolation and modulating atmospheric dump valve control (MSIV/MADV)
- Automatic Reactor Coolant Pump Trip (ARCPT)
- Main feedwater overfill prevention
- Select "Mode C" (small LOCA) auxiliary feedwater (AFW) level control in Essential Controls and Instrumentation (ECI)

The ESFAS is divided into an analog and digital subsystem. The analog subsystem contains signal processing, setpoints, analog-to-digital conversion, FOGG logic, and isolation devices. The digital subsystem contains logic, manual trip, reset, and output devices. There are two digital systems: one for actuation of Train A Engineered Safety Features and one for actuation of Train B Engineered Safety Features. Digital subsystems are composed of actuation channels. Each actuation channel is tripped by two-out-of-three coincidence of the analog subsystems for the actuation channels trip parameters.

The design of the ESFAS logic can be summarized in terms of the system operation as follows:

- Each protective action is initiated by either of two actuation channels with a 2-out-of-3 coincidence between input signals.
- Protective action is initiated by applying power from the actuation channel coincidence logic to individual output relays in the unit control modules. This in turn energizes the safety features device controller.

- There are two identical and isolated output actuation command circuits provided by each unit control module for operating safety features devices (valves, pumps, etc.). The unit control module trip input circuits are connected in common for an entire ESFAS digital channel.

C. Essential Controls and Instrumentation (ECI)
The ECI provides the capability to establish and maintain a hot shutdown capability. There are two ECI channels: ECI-A (also designated ECI-X) and ECI-B (also designated ECI-Y), that are powered from 120 VAC divisions D and E, respectively (Refs. 1 and 2). A summary of the Bellefonte ECI capability is provided in Table 3.5-1.

D. Remote Shutdown
The main control room is the primary station for safe shutdown control of the plant. In the event that the main control room becomes uninhabitable, the plant can be brought to and maintained in a hot standby condition using alternate controls on the Auxiliary Shutdown Panel. The following functions can be performed at the Auxiliary Shutdown Panel:

- Maintain RCS inventory by monitoring pressurizer level and controlling:
  - HPI/makeup pumps and valves
  - Letdown isolation valves
- Maintain RCS pressure by monitoring pressurizer pressure and controlling pressurizer heaters
- Maintain decay heat removal by monitoring reactor coolant temperature and steam generator pressure and level and controlling auxiliary feedwater flow.

After hot shutdown has been achieved, the instrumentation and controls provided at the Auxiliary Shutdown Panel, in conjunction with control stations provided locally, could be used to bring the plant to a cold shutdown condition.

### 3.5.4 System Success Criteria

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

B. ESFAS
In general, the loss of instrument power to the sensors, instruments, or logic devices places that channel in the trip mode. Details of the ESFAS for Bellefonte 1 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 ESFAS subsystem. The control room operators also may send qualified persons into the plant to operate components locally or from some other remote control location (i.e., a motor control center or local control panel). To make these judgments, data on key plant parameters must be available to the operators.

### 3.5.5 Support Systems and Interfaces

A. Control Power
1. Instrumentation and control power sources are summarized in Tables 3.5-2 and 3.5-3.
2. Operator instrumentation displays are powered from the 120 VAC system (see Section 3.6).

B. Control Room and Essential Instrumentation Area Ventilation Systems
1. The control building water chiller and the auxiliary control room chiller are cooled by the Essential Raw Cooling Water (ERCW) System (see Section 3.8).
2. Specific sources of auxiliary building ventilation have not been identified, however, Zone 1A and 1B fans and air handling units are known to serve essential electrical equipment areas and auxiliary instrument rooms.

### 3.5.6 Section 3.5 References

1. Bellefonte 1 & 2 FSAR, Section 7.4.1.2

2. Bellefonte 1 & 2 FSAR, Table 8.3.1-18

## Table 3.5-1. Summary of Bellefonte Essential Controls and Instrumentation (ECI)

### ECI Automatic Controls

| Function Controlled | Controlled Variable | System Action Initiated by | Controlled Components |
|---|---|---|---|
| AFW flow to SGs A and B (ECI-X) | SG A and B water level | AFW pumps 1A and TD1A running | AFW control valves, pumps |
| AFW flow to SGs A and B (ECI-Y) | SG A and B water level | AFW pumps 1B and TD1A running | AFW control valves, pumps |

### ECI Manual Controls

| Component | Type of Control |
|---|---|
| Pressurizer heaters (bank 2, groups 8 & 9) | on/off |
| HPI/makeup pumps (1A, 2A, 3B) | on/off |
| HPI/BWST suction valves (HP1-450A, -419B) | open/shut |
| HPI injection valves | jog |
| Normal makeup isolation valve | open/shut |
| Letdown isolation valves (MU-21A, -22B, -28A, -29B) | open/shut |
| Atmospheric dump valves | modulate |
| Pressurizer PORV | open/shut |
| CCW cooler outlet valves (28A/28B) | modulating |
| DH cooler outlet valves (3A/3B) | modulating |
| DH cooler bypass valves (14A/14B) | modulating |

## Table 3.5-2. Bellefonte 1 125 VDC Control Power Summary

<u>125 VDC Board D</u>

- 13.8 kV unit board 1RA (1EA-EMVS-01) circuit breakers
- 6.9 kV shutdown board 1ET1-A circuit breakers
- 6.9 kV intake pumping station board 1ET2-A circuit breakers
- 480 VAC shutdown boards 1EX1-A and 1EX2-A circuit breakers
- 480 VAC pressurizer heater MCC 1A6 circuit breakers
- Diesel generator 1A-A control system (primary)

<u>125 VDC Board E</u>

- 13.8 kV unit board 1RB (1EA-EMVS-02) circuit breakers
- 6.9 kV shutdown board 1ET1-B circuit breakers
- 6.9 kV intake pumping station board 1ET2-B circuit breakers
- 480 VAC shutdown boards 1EX1-B and 1EX2-B circuit breakers
- 480 VAC pressurizer heater MCC 1D5 circuit breakers
- Diesel generator 1B-B control system (primary)

<u>125 VDC Board F</u>

- Diesel generator 1A-A control system (alternate)

<u>125 VDC Board G</u>

- Diesel generator 1B-B control system (alternate)

Note: Availability of diesel generator control power from 125 VDC boards F and G is based on incomplete information and should be confirmed.

## Table 3.5-3. Bellefonte 1 120 VAC Instrumentation and Control Power Distribution

120 VAC Board D

- NIRPS channel D
- ESFAS analog (sensor) channel A
- ESFAS digital (actuation) train B
- Essential control and instrumentation A (ECI-X)
- Main steam isolation valve 59-A and 60-A controls
- Main feedwater isolation valve 68-A and 70-A controls

120 VAC Board E

- NIRPS Channel E
- ESFAS digital (actuation) train B
- Essential controls and instrumentation B (ECI-Y)
- Main steam isolation valves 57-B and 58-B controls

120 VAC Board F

- NIPRS Channel F
- ESFAS analog (sensor) Channel C
- AFWS turbine controls
- ESF "A" solenoid valves

120 VAC Board G

- NIRPS Channel G
- ESFAS analog (sensor) Channel B
- AFWS turbine controls
- ESF "B" solenoid valves

Note: ESFAS has three sensor (input) channels (A, B, and C) and two actuation (output) trains (A and B)

## 3.6 ELECTRIC POWER SYSTEM

### 3.6.1 System Function

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

### 3.6.2 System Definition

The onsite Class 1E electric power system consists of two 6.9 kV buses for each unit. These buses are designated 1A and 1B. There is a standby diesel generator connected to each bus. Diesel generator 1A is connected to bus 1A, and diesel generator 1B is connected to bus 1B. Similarly, in Unit 2 diesel generator 2A is connected to bus 2A, and diesel generator 2B is connected to bus 2B. There are also four Class 1E 480 VAC load center buses in Unit 1, designated 24A, 25A, 28B, and 29B. Buses 24A and 25A are connected to 6.9kV bus 1A through transformers, and buses 28B and 29B are connected to 6.9kV bus 1B. Various motor control centers receive their power from the 480 VAC buses. In addition, two 6.9 kV buses in the Intake Pumping Station are connected to 6.9 kV buses 1A and 1B. A 480 VAC bus in the Intake Structure is powered by each of the 6.9 kV buses. These buses in the Intake Pumping Station power the Essential Raw Cooling Water System. Details of the 6.9kV and 480 VAC systems are shown in Figures 3.6-3 and 3.6-4.

The configuration of the 120 VAC control power system for Unit 1 is similar to Unit 2. Each unit has four identical power channels (designated Channels D, E, F, and G), with the equipment of each channel being electrically and physically independent from the equipment of other channels. Each channel consists of an uninterruptible power supply (UPS) and a distribution which facilitates load grouping and provides circuit protection. The UPS is normally powered by a 480 VAC MCC through a transformer and has a 125 VDC battery board as a standby power source. Each UPS has an auctioneered solid state transfer switch between the 480 VAC and 125 VDC sources. In addition, there is one maintenance supply shared between channels D and F and another maintenance supply shared between channels E and G. An automatically synchronized manual transfer between the output of the UPS and the maintenance supply is provided so that the UPS may be taken out of service for maintenance without interrupting power to the loads. Details of the 120 VAC system are shown in Figures 3.6-5 and 3.6-6.

The Class 1E DC system for the two units consists of four 125 VDC divisions for each unit. The divisions are designated Channels 1D, 1E, 1F, and 1G. The 125 VDC buses are each normally supplied by a battery charger and a battery. Each unit also has a spare battery charger that can supply Channel D or F and one that can supply Channel E or G. Details of the 125 VDC system are shown in Figures 3.6-7 and 3.6-8.

Simplified one-line diagrams of the electric power system are shown in Figures 3.6-1 to 3.6-8. 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.

### 3.6.3 System Operation

The 6.9 kV Class 1E switchgear in each power train normally is powered from the main generator via the unit station service transformers. When this preferred source of power is unavailable, power via the reserve station service transformers can be supplied from a 161 kV substation (to 6.9 kV train A) or the 500 kV switchyard (to 6.9 kV train B). During conditions when neither normal nor alternate power is available, each 6.9 kV switchgear is energized from a separate standby diesel generator.

Loss of voltage to the 6.9 kV switchgear initiates an automatic transfer from the preferred source to the alternate supply if the alternate supply has normal voltage. The transfer is delayed until the residual voltage has decreased to less than 30 percent of nominal system voltage. The return transfer to the preferred supply is initiated manually and is a high-speed transfer, completed in approximately six cycles.

A sustained loss (less than or equal to 70 percent of nominal system voltage for 0.5 second) on the 6.9 kV switchgear starts the diesel generator and initiates the load shedding logic. After reaching rated speed and voltage, the diesel generator is automatically connected to the 6.9 kV switchgear. The 6.9 kV switchgear bus then initiates logic which connects the required loads in sequence.

The normal supply of power to the 120 VAC distribution panels is from the UPS in each channel. The UPS consists of three major subassemblies: a DC power supply, an auctioneering circuit, and a UPS circuit. The DC power supply converts the 480 VAC normal UPS input into direct current. The auctioneering circuit accepts the DC power supply (normal supply) and battery (emergency supply) inputs and permits a transfer between them in the event of 480 VAC supply failure or restoration. The DC output of the auctioneering circuit is converted to 120 VAC by the inverter circuit.

The DC power system normally is supplied through the battery chargers, with the batteries "floating" on the system, maintaining a full charge. Upon loss of AC power, the entire DC load draws from the batteries. The batteries can support the design DC load for a minimum of two hours.

Redundant safety equipment such as motor driven pumps and motor operated valves are supplied by different Class 1E buses. For the purpose of discussion, this equipment has been grouped into "load groups". Load group "AC/A" contains components receiving electric power either directly or indirectly from 6.9 kV bus 1A. Load group "AC/B" contains components powered either directly or indirectly from 6.9 kV bus 1B. Components receiving DC power or 120 VAC power are assigned to load groups "DC/D", "DC/E", "DC/F", "DC/G", based on the battery power source.

### 3.6.4 System Success Criteria

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

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

### 3.6.5 Component Information

A. Standby diesel generators 1A, 1B
   1. Maximum continuous rating: 7000 kW
   2. Rated voltage: 6900 VAC
   3. Manufacturer: DeLaval

B. Batteries 1D, 1E, 1F, 1G
   1. Rated Voltage: 125 VDC
   2. Capacity: 2 hours minimum (Ref. 1, Section 8.3.2.1.1)

### 3.6.6 Support Systems and Interfaces

A. Control Signals

1. Automatic
   The standby diesel generators are automatically started when an accident signal or loss of offsite power signal is received.
2. Remote manual
   The diesel generators can be started by manually-operated emergency start switches located on the unit control board in the main control room and auxiliary control room. The diesel generators can be started locally as well as a remote-manually from the main control room for testing purposes.

B. Diesel Generator Auxiliary Systems

1. Diesel Cooling Water System
   Heat is transferred from a jacket water system to the Essential Raw Cooling Water System (see Section 3.8).
2. Diesel Control System
   Controls for diesel generators 1A and 1B are powered respectively from 125 VDC diesel generator distribution panels 1A and 1B.
3. Diesel Starting System
   Each diesel generator starting system consists of two independent and redundant pneumatic starting subsystems. Each of the two starting subsystems is capable of cranking a cold diesel engine five times without recharging the air accumulator.
4. Diesel Fuel Oil Transfer and Storage System
   A 550 gallon "day tank" is provided for each diesel generator. The day tanks are automatically replenished from separate fuel oil storage tanks during engine operation. The fuel oil storage tanks are embedded in concrete in the diesel generator building base slab and can store 104,000 gallons of fuel for each diesel generator unit. This is sufficient for seven days of continuous operation.
5. Diesel Lubrication System
   Each diesel generator has its own lubrication system located on the diesel generator "skid".
6. Combustion Air Intake and Exhaust System
   Each diesel generator is equipped with an independent combustion air intake and exhaust system which supplies fresh air to the diesel intake, and directs the diesel exhaust outside of the diesel building. The intake air filters and exhaust silencers are located on the second level of the diesel building.
7. Diesel Room Ventilation System
   Diesel room ventilation is provided by fans, ventilation air intakes, and exhausts that are located on the second level of the diesel building.
8. Power for Diesel Auxiliary Systems
   Except as noted above, diesel auxiliary systems are powered from 480 VAC MCCs 1E4-A (diesel 1A-A) and 1E4-B (diesel 1B-B).

C. Switchgear and Battery Room Ventilation Systems
Specific sources of switchgear and battery room ventilation have not been identified, however, zone 1A and 1B fans and air handling units are known to serve essential electrical equipment areas.

### 3.6.7 Section 3.6 References

1. Bellefonte 1 & 2 FSAR, Section 8.3.

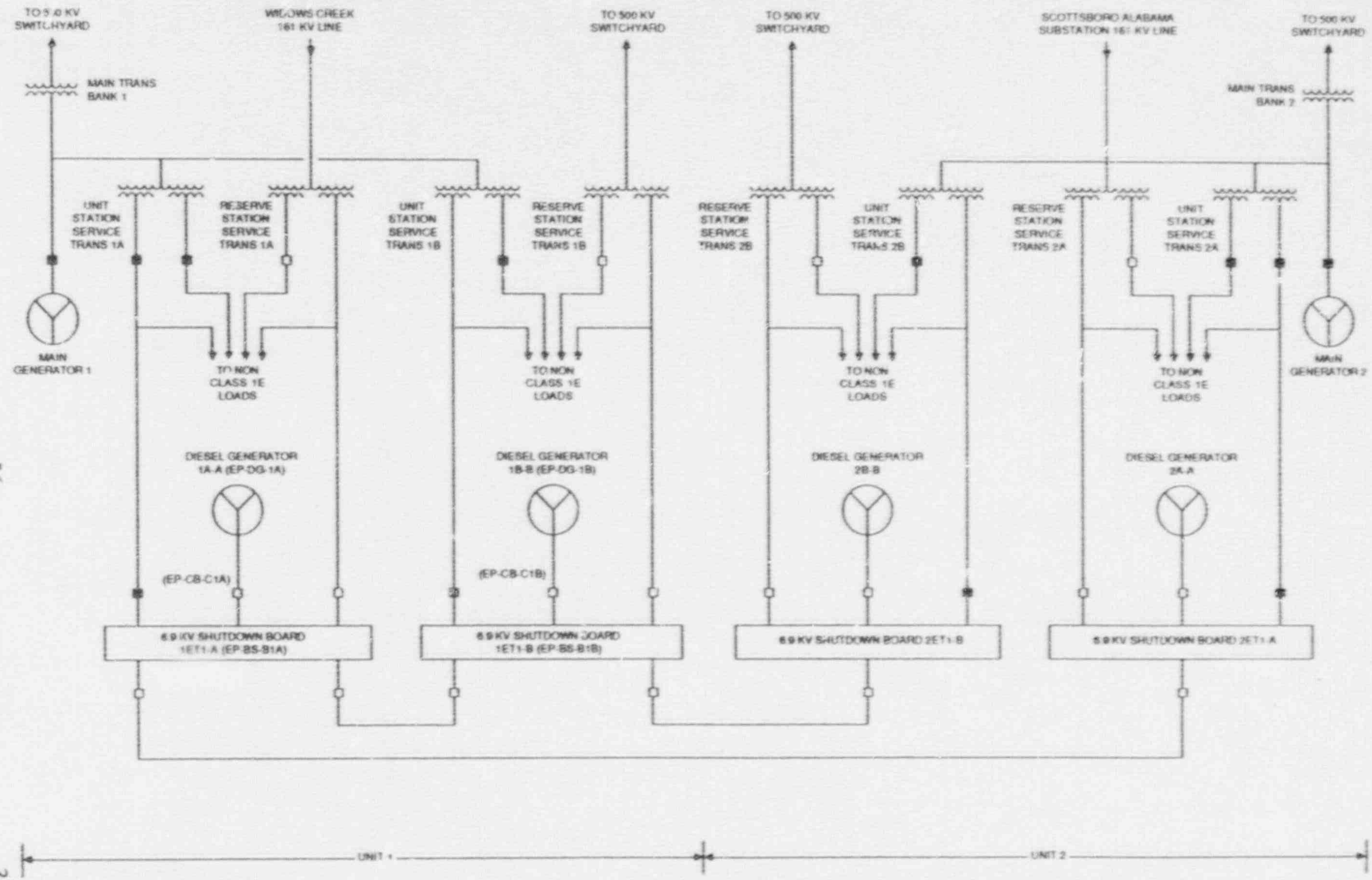
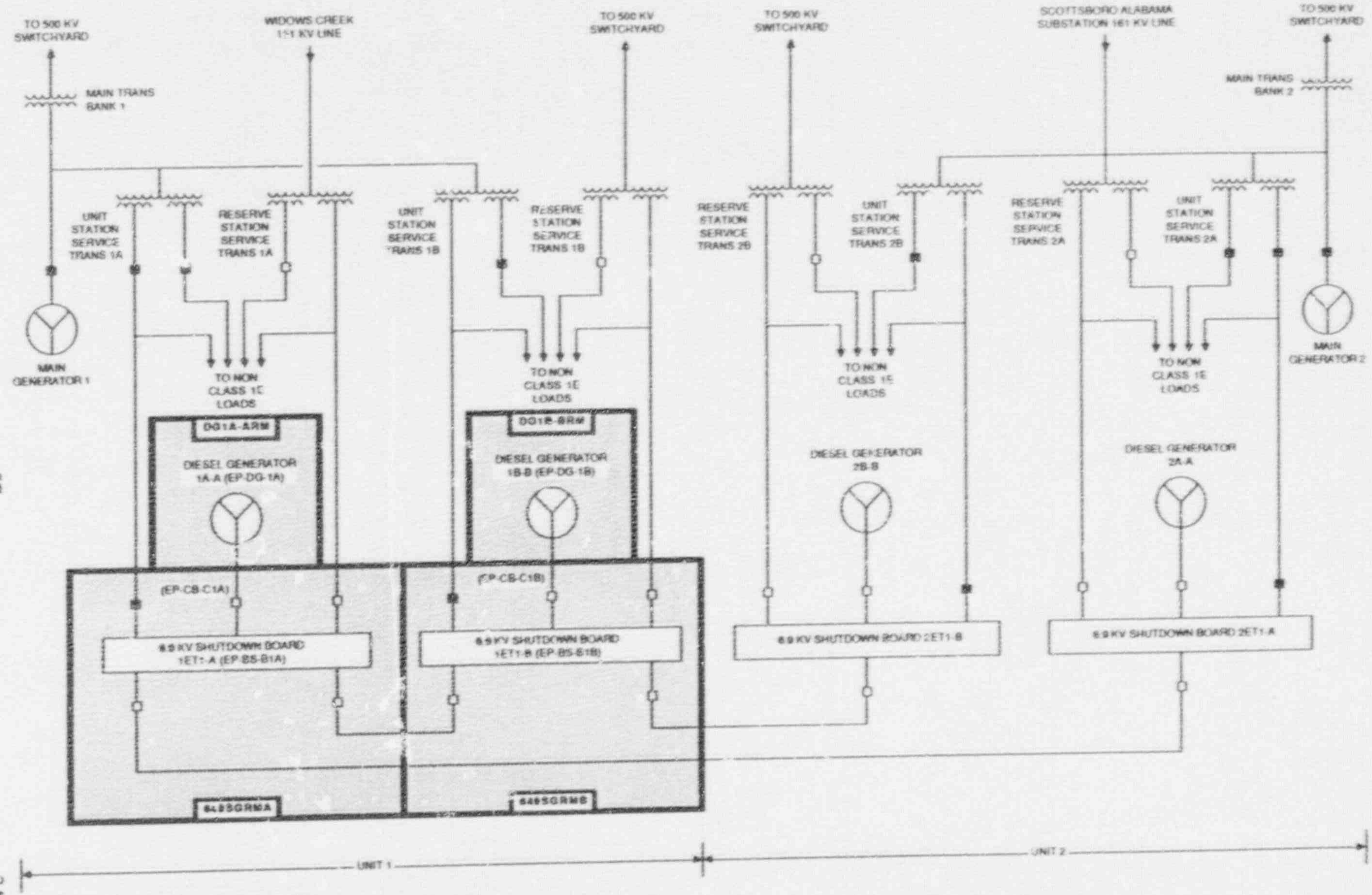



Figure 3.6-1. Bellefonte 1 and 2 Station Electric Power System




NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

**Figure 3.6-2. Bellefonte 1 and 2 Station Electric Power System Showing Component Locations**

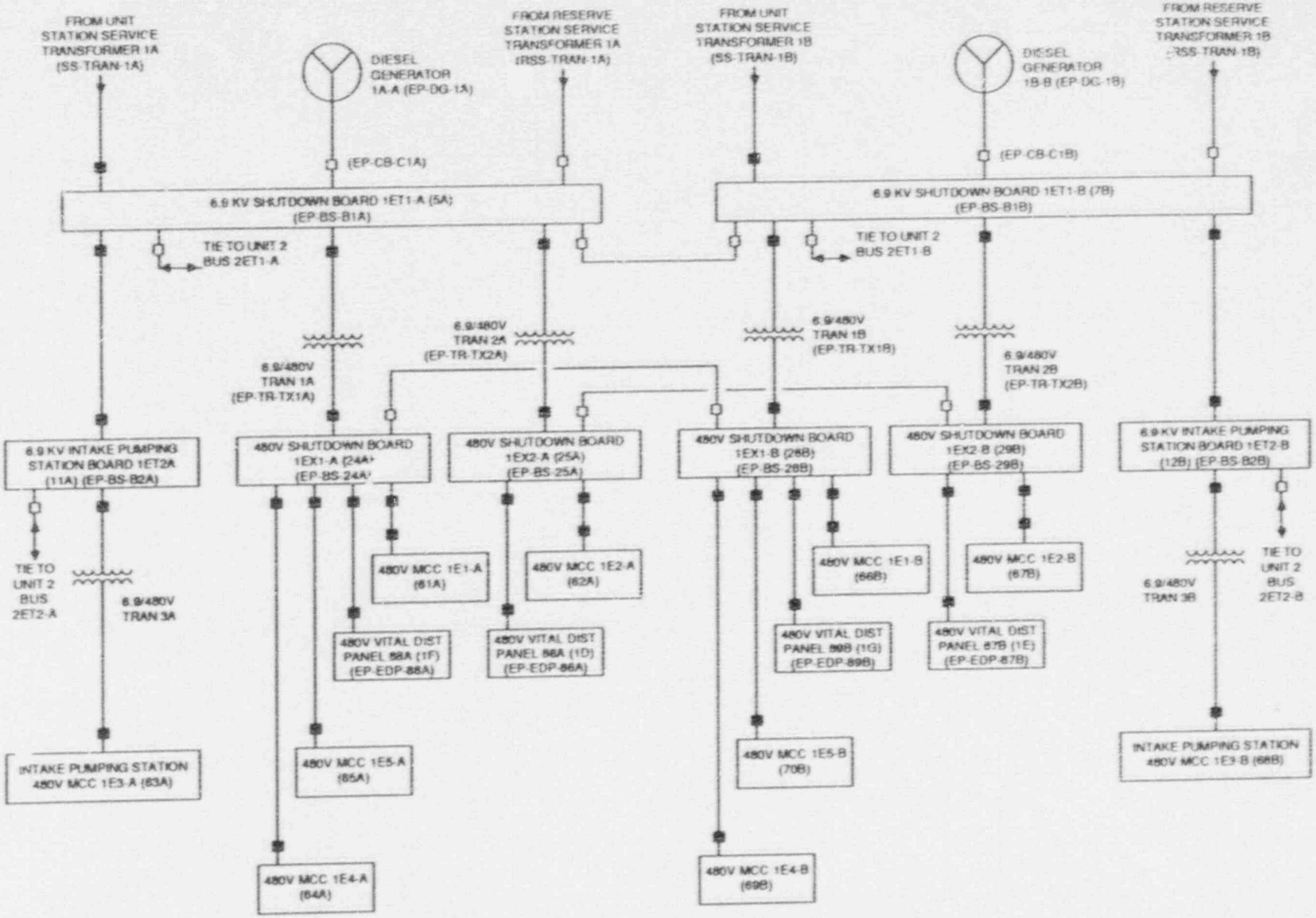
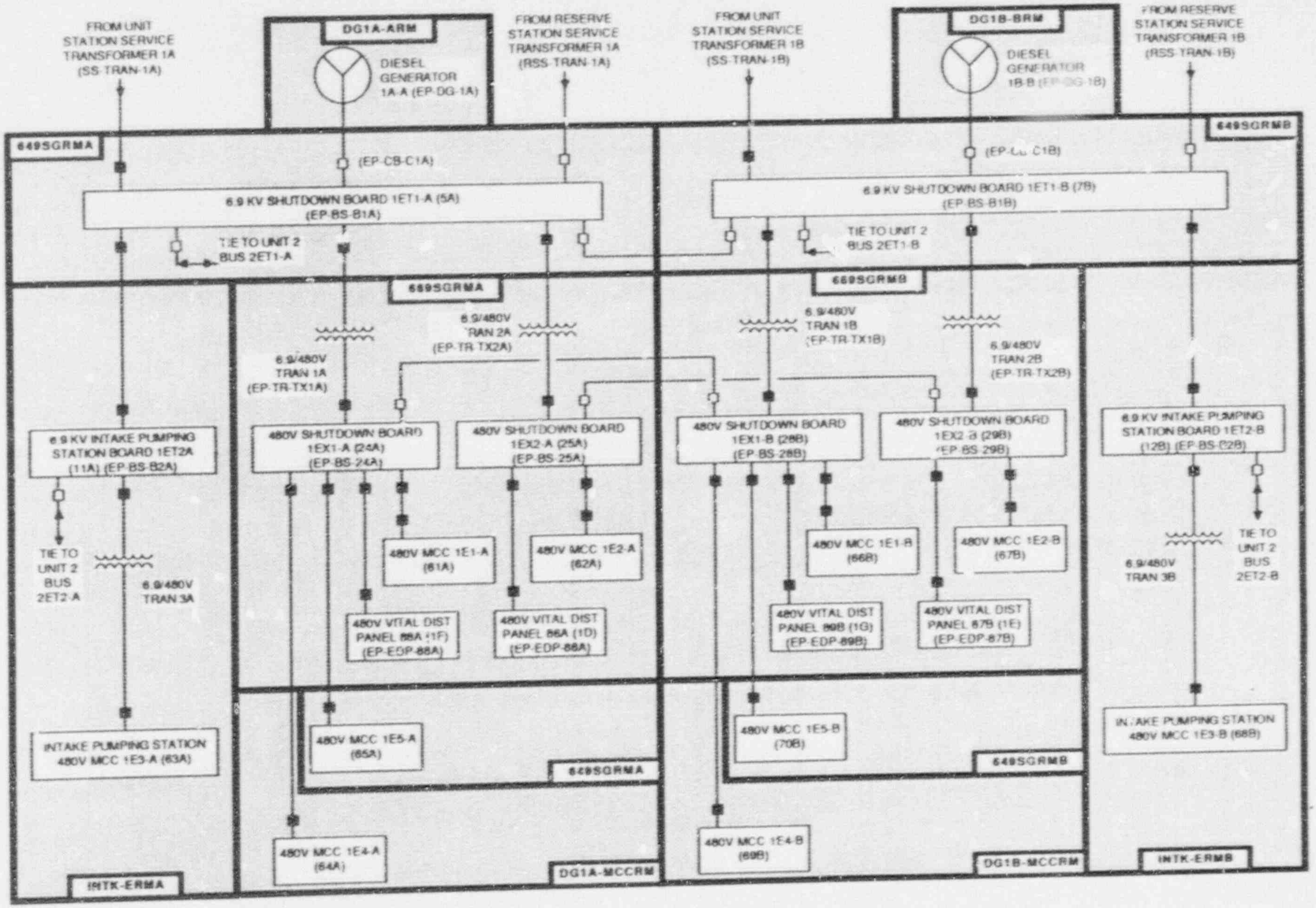



Figure 3.6-3. Bellefonte 1 4160 and 480 VAC Electric Power Systems




NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

**Figure 3.6-4. Bellefonte 1 4160 and 480 VAC Electric Power Systems Showing Component Locations**

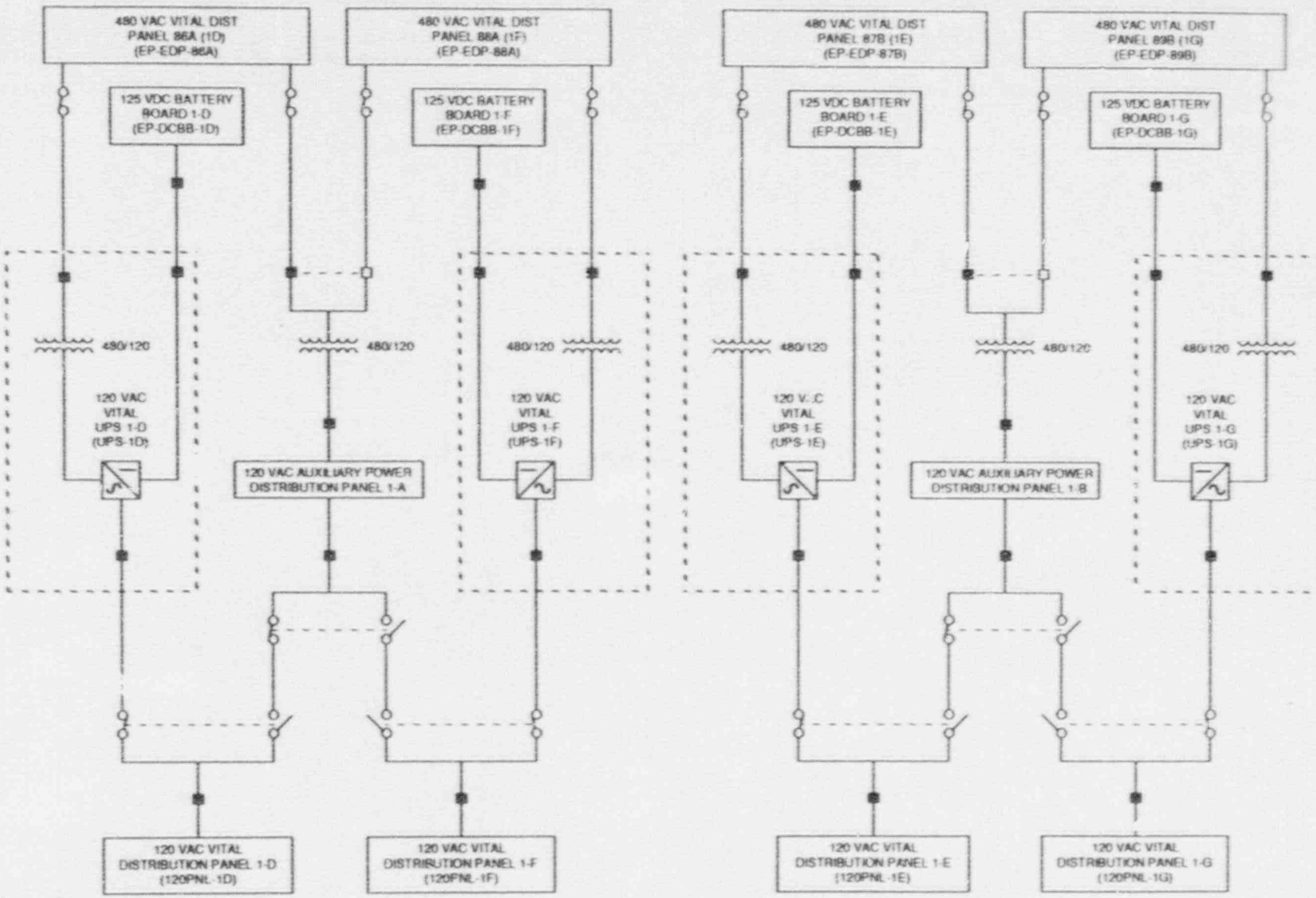
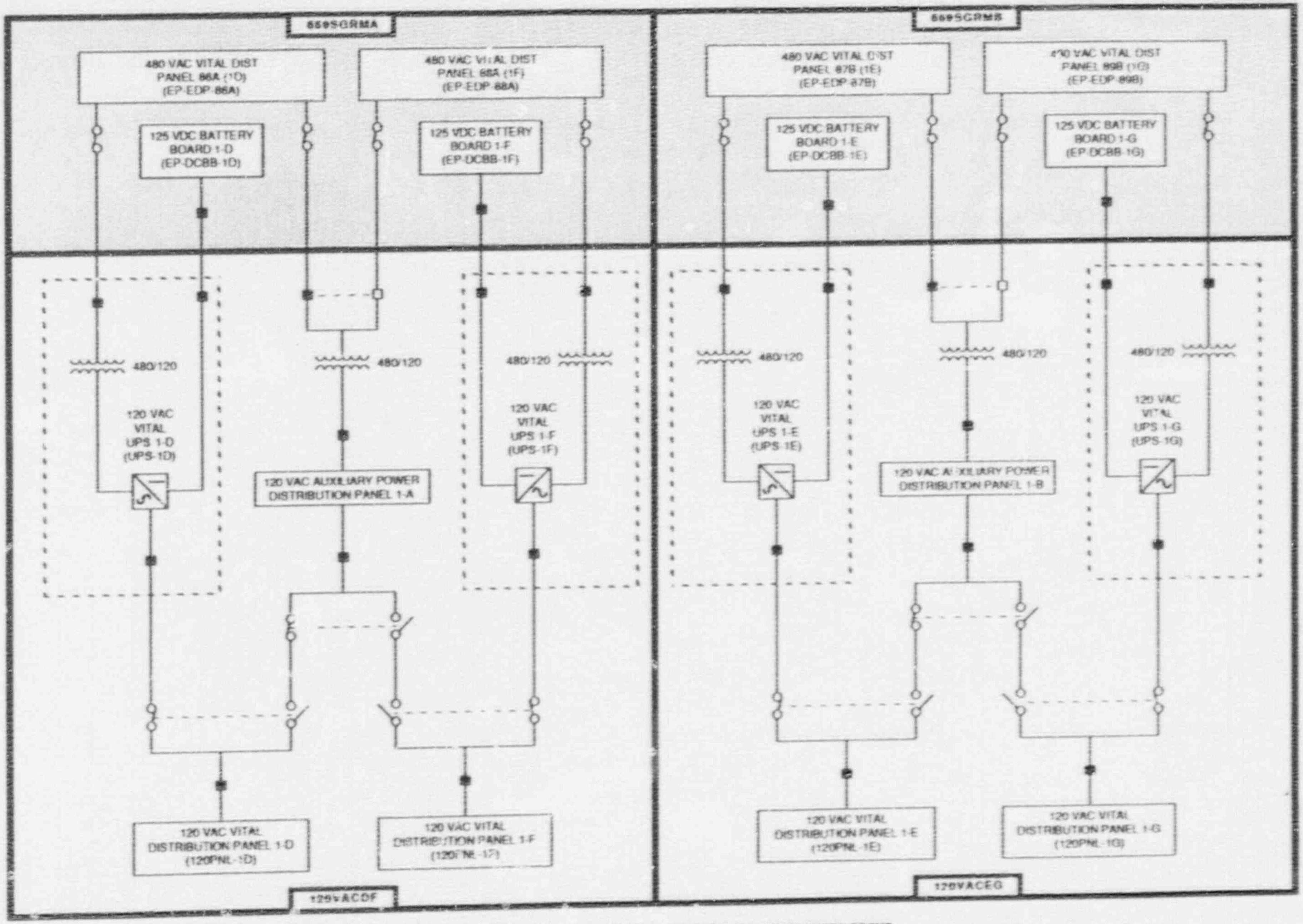



**Figure 3.6-5. Bellefonte 1 120 VAC Electric Power System**




NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

**Figure 3.6-6. Bellefonte 1 120 VAC Electric Power System Showing Component Locations**

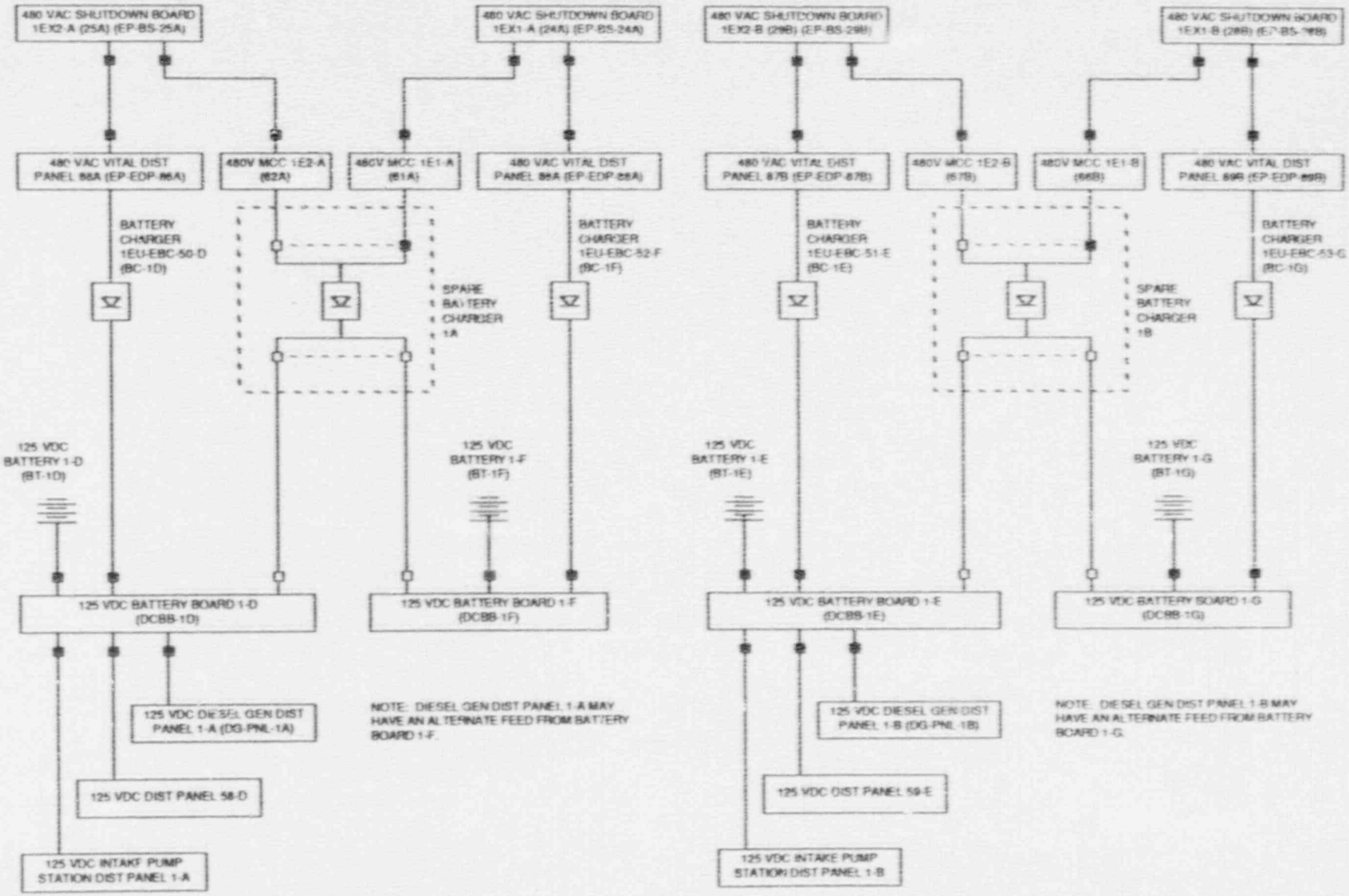
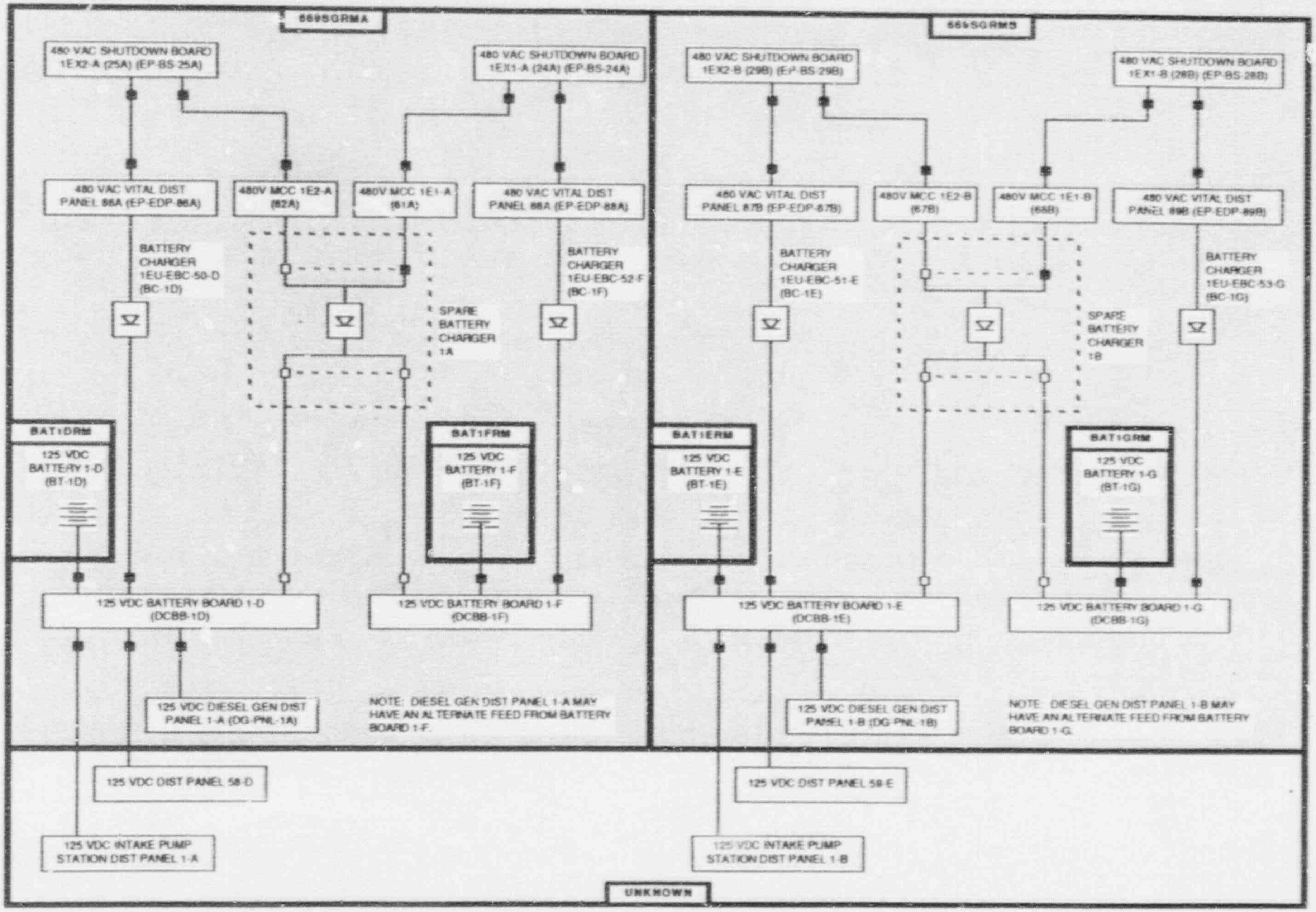



Figure 3.6-7. Bellefonte 1 125 VDC Electric Power System




NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS.

**Figure 3.6-8. Bellefonte 1 125 VDC Electric Power System Showing Component Locations**

**Table 3.6-1. Bellefonte 1 Electric Power System Data Summary for Selected Components**

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| 120PNL-1D | BUS | 120VACDF | UPS-1D | 120 | 120VACDF | AC/D |
| 120PNL-1D | BUS | 120VACDF | 120PNL-1A | 120 | 120VACDF | AC/D-F |
| 120PNL-1E | BUS | 120VACEG | UPS-1E | 120 | 120VACEG | AC/E |
| 120PNL-1E | BUS | 120VACEG | 120PNL-1B | 120 | 120VACEG | AC/E-G |
| 120PNL-1F | BUS | 120VACDF | UPS-1F | 120 | 120VACDF | AC/F |
| 120PNL-1F | BUS | 120VACDF | 120PNL-1A | 120 | 120VACDF | AC/D-F |
| 120PNL-1G | BUS | 120VACEG | UPS-1G | 120 | 120VACEG | AC/G |
| 120PNL-1G | BUS | 120VACEG | 120PNL-1B | 120 | 120VACEG | AC/E-G |
| BC-1D (50D) | BC | 669SGRMA | PANEL-86A | 480 | 669SGRMA | AC/A |
| BC-1E (51E) | BC | 669SGRMB | PANEL-87B | 480 | 669SGRMB | AC/B |
| BC-1F (52F) | BC | 669SGRMA | PANEL-88A | 480 | 669SGRMA | AC/A |
| BC-1G (53G) | BC | 669SGRMB | PANEL-89B | 480 | 669SGRMB | AC/B |
| BT 1D | BT | BAT1DRM | | 125 | | DC/D |
| BT 1E | BT | BAT1ERM | | 125 | | DC/E |
| BT 1F | BT | BAT1FRM | | 125 | | DC/F |
| BT 1G | BT | BAT1GRM | | 125 | | DC/G |
| BUS 24A | BUS | 669SGRMA | TRAN 1A | 6900/480 | 669SGRMA | AC/A |
| BUS 25A | BUS | 669SGRMA | TRAN 2A | 6990/480 | 669SGRMA | AC/A |
| BUS 28B | BUS | 669SGRMB | TRAN 1B | 6900/480 | 669SGRMB | AC/B |
| BUS 29B | BUS | 669SGRMB | TRAN 2B | 6990/480 | 669SGRMB | AC/B |
| BUS-1ET1A | BUS | 649SGRMA | DG-1A-A | 6900 | DG1A-ARM | AC/A |

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

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| BUS-1ET1A | BUS | 649SGRMA | SS-TRAN-1A | 6900 | UNKNOWN | AC/A |
| BUS-1ET1A | BUS | 649SGRMA | RSS-TRAN-1A | 6900 | UNKNOWN | AC/A |
| BUS-1ET1B | BUS | 649SGRMB | DG-1B-B | 6900 | DG1B-ARM | AC/B |
| BUS-1ET1B | BUS | 649SGRMB | SS-TRAN-1B | 6900 | UNKNOWN | AC/B |
| BUS-1ET1B | BUS | 649SGRMA | RSS-TRAN-1B | 6900 | UNKNOWN | AC/B |
| BUS-1ET2A | BUS | INTK-ERMA | BUS-1ET1A | 6900 | 649SGRMA | AC/A |
| BUS-1ET2B | BUS | INTK-ERMB | BUS-1ET1B | 6900 | 649SGRMB | AC/B |
| DCBB-1D | BUS | 669SGRMA | BC-1A | 480/125 | 669SGRMA | DC/D-F |
| DCBB-1D | BUS | 669SGRMA | BT-1D | 125 | BAT1DRM | DC/D |
| DCBB-1D | BUS | 669SGRMA | BC-1D | 480/125 | 669SGRMA | DC/D |
| DCBB-1E | BUS | 669SGRMB | BC-1E | 480/125 | 669SGRMB | DC/E |
| DCBB-1E | BUS | 669SGRMB | BC-1B | 480/125 | 669SGRMB | DC/E-G |
| DCBB-1E | BUS | 669SGRMB | BT-1E | 125 | BAT1ERM | DC/E |
| DCBB-1F | BUS | 669SGRMA | BT-1F | 125 | BAT1FRM | DC/F |
| DCBB-1F | BUS | 669SGRMA | BC-1F | 480/125 | 669SGRMA | DC/F |
| DCBB-1F | BUS | 669SGRMA | BC-1A | 480/125 | 669SGRMA | DC/D-F |
| DCBB-1G | BUS | 669SGRMB | BT-1G | 125 | BAT1GRM | DC/G |
| DCBB-1G | BUS | 669SGRMB | BC-1G | 480/125 | 669SGRMB | DC/G |
| DCBB-1G | BUS | 669SGRMB | BC-1B | 480/125 | 669SGRMB | DC/E-G |
| DG-1A-A | DG | DG1A-ARM | | 6900 | | AC/A |
| DG-1B-B | DG | DG1B-BRM | | 6900 | | AC/A |

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

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| DG-PNL-1A | BUS | 669SGRMA | DCBB-1D | 125 | 669SGRMA | DC/B |
| DG-PNL-1A | BUS | 669SGRMA | DCBB-1F | 125 | 669SGRMA | DC/F |
| DG-PNL-1B | BUS | 669SGRMB | DCBB-1G | 125 | 669SGRMB | DC/G |
| DG-PNP-1B | BUS | 669SGRMB | DCBB-1E | 125 | 669SGRMB | DC/E |
| EP-CB-C1A | CB | 649SGRMA | | | | |
| EP-CB-C1B | CB | 649SGRMB | | | | |
| MCC-1E1A | MCC | 669SGRMA | BUS-24A | 480 | 669SGRMA | AC/A |
| MCC-1E1B | MCC | 669SGRMB | BUS-28B | 480 | 669SGRMB | AC/B |
| MCC-1E2A | MCC | 669SGRMA | BUS-25A | 480 | 669SGRMA | AC/A |
| MCC-1E2B | MCC | 669SGRMB | BUS-29B | 480 | 669SGRMB | AC/B |
| MCC-1E3A | MCC | INTK-ERMA | TRAN-3A | 6900/480 | INTK-ERMA | AC/A |
| MCC-1E3B | MCC | INTK-ERMB | TRAN-3B | 6900/480 | INTK-ERMB | AC/B |
| MCC-1E4A | MCC | DG1A-MCCRM | BUS-24A | 480 | 669SGRMA | AC/A |
| MCC-1E4B | MCC | DG1B-MCCRM | BUS-28B | 480 | 669SGRMB | AC/B |
| [illegible]E5A | MCC | 649SGRMA | BUS-24A | 480 | 669SGRMA | AC/A |
| [illegible]5B | MCC | 649SGRMB | BUS-28B | 480 | 669SGRMB | AC/B |
| [illegible]EL-86A | BUS | 669SGRMA | BUS-25A | 480 | 669SGRMA | AC/A |
| PANEL-87D | BUS | 669SGRMB | BUS-29B | 480 | 669SGRMB | AC/B |
| PANEL-88A | BUS | 669SGRMA | BUS-24A | 480 | 669SGRMA | AC/A |
| PANEL-89D | BUS | 669SGRMB | BUS-28B | 480 | 669SGRMB | AC/B |
| TRAN 1A | TRAN | 669SGRMA | BUS-1ET1A | 6900 | 649SGRMA | AC/A |

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

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| TRAN 1B | TRAN | 669SGRMB | BUS-1ET1B | 6900 | 649SGRMB | AC/B |
| TRAN 2A | TRAN | 669SGRMA | BUS-1ET1A | 6900 | 649SGRMA | AC/A |
| TRAN 2B | TRAN | 669SGRMB | BUS-1ET1B | 6900 | 649SGRMB | AC/B |
| TRAN-3A | TRAN | INTK-ERMA | BUS-1ET2A | 6900/480 | INTK-ERMA | AC/A |
| TRAN-3B | TRAN | INTK-ERMB | BUS-1ET2B | 6900/480 | INTK-ERMB | AC/B |
| UPS-1D | UPS | 120VACDF | PANEL-86A | 480 | 669SGRMA | AC/A |
| UPS-1D | UPS | 120VACDF | DCBB-1D | 125 | 669SGRMA | DC/D |
| UPS-1E | UPS | 120VACEG | PANEL-87D | 480 | 669SGRMB | AC/B |
| UPS-1E | UPS | 120VACEG | DCBB-1E | 125 | 669SGRMB | DC/E |
| UPS-1F | UPS | 120VACDF | PANEL-88A | 480 | 669SGRMA | AC/A |
| UPS-1F | UPS | 120VACDF | DCBB-1F | 125 | 669SGRMA | DC/F |
| UPS-1G | UPS | 120VACEG | PANEL-89D | 480 | 669SGRMB | AC/B |
| UPS-1G | UPS | 120VACEG | DCBB-1G | 125 | 669SGRMB | DC/G |

Table 3.6-2. Partial Listing of Electrical Sources and Loads at Bellefonte 1

| POWER SOURCE | VOLTAGE | EMERG LOAD GRP | POWER SOURCE LOCATION | LOAD SYSTEM | LOAD COMPONENT ID | COMP TYPE | COMPONENT LOCATION |
|---|---|---|---|---|---|---|---|
| 120PNL-1A | 120 | AC/D-F | 120VACDF | EP | 120PNL-1D | BUS | 120VACDF |
| 120PNL-1A | 120 | AC/D-F | 120VACDF | EP | 120PNL-1F | BUS | 120VACDF |
| 120PNL-1B | 120 | AC/E-G | 120VACEG | EP | 120PNL-1E | BUS | 120VACEG |
| 120PNL-1B | 120 | AC/E-G | 120VACEG | EP | 120PNL-1G | BUS | 120VACEG |
| BC-1A | 480/125 | DC/D-F | 669SGRMA | EP | DCBB-1D | BUS | 669SGRMA |
| BC-1A | 480/125 | DC/D-F | 669SGRMA | EP | DCBB-1F | BUS | 669SGRMA |
| BC-1B | 480/125 | DC/E-G | 669SGRMB | EP | DCBB-1E | BUS | 669SGRMB |
| BC-1B | 480/125 | DC/E-G | 669SGRMB | EP | DCBB-1G | BUS | 669SGRMB |
| BC-1D | 480/125 | DC/D | 669SGRMA | EP | DCBB-1D | BUS | 669SGRMA |
| BC-1E | 480/125 | DC/E | 669SGRMB | EP | DCBB-1E | BUS | 669SGRMB |
| BC-1F | 480/125 | DC/F | 669SGRMA | EP | DCBB-1F | BUS | 669SGRMA |
| BC-1G | 480/125 | DC/G | 669SGRMB | EP | DCBB-1G | BUS | 669SGRMB |
| BT-1D | 125 | DC/D | BAT1DRM | EP | DCBB-1D | BUS | 669SGRMA |
| BT-1E | 125 | DC/E | BAT1ERM | EP | DCBB-1E | BUS | 669SGRMB |
| BT-1F | 125 | DC/F | BAT1FRM | EP | DCBB-1F | BUS | 669SGRMA |
| BT-1G | 125 | DC/G | BAT1GRM | EP | DCBB-1G | BUS | 669SGRMB |
| BUS-1ET1A | 6900 | AC/A | 649SGRMA | AFW | AFW-P1A | MDP | 590ABTRNA |
| BUS-1ET1A | 6900 | AC/A | 649SGRMA | CCS | CCS-P1A | MDP | CCWPMRMA |
| BUS-1ET1A | 6900 | AC/A | 649SGRMA | CCS | CCS-P3A | MDP | CCWPMRMA |
| BUS-1ET1A | 6900 | AC/A | 649SGRMA | ECCS | DHR-P1A | MDP | DHAPMRM |
| BUS-1ET1A | 6900 | AC/A | 649SGRMA | ECCS | HPI-P1A | MDP | HPIA1RM |
| BUS-1ET1A | 6900 | AC/A | 649SGRMA | ECCS | HPI-P2A | MDP | HPIA2RM |
| BUS-1ET1A | 6900 | AC/A | 649SGRMA | EP | BUS-1ET2A | BUS | INTK-ERMA |
| BUS-1ET1A | 6900 | AC/A | 649SGRMA | EP | TRAN 1A | TRAN | 669SGRMA |
| BUS-1ET1A | 6900 | AC/A | 649SGRMA | EP | TRAN 2A | TRAN | 669SGRMA |
| BUS-1ET1A | 6900 | AC/A | 649SGRMA | PAHR | RBS-P1A | MDP | RBSAPMRM |
| BUS-1ET1B | 6900 | AC/B | 649SGRMB | AFW | AFW-P1B | MDP | 590ABTRNB |
| BUS-1ET1B | 6900 | AC/B | 649SGRMB | CCS | CCS-P2B | MDP | CCWPMRMB |
| BUS-1ET1B | 6900 | AC/B | 649SGRMB | ECCS | DHR-P2B | MDP | DHBPMRM |
| BUS-1ET1B | 6900 | AC/B | 649SGRMB | ECCS | HPI-P3B | MDP | HPIB1RM |
| BUS-1ET1B | 6900 | AC/B | 649SGRMB | EP | BUS-1ET2B | BUS | INTK-ERMB |

Table 3.6-2. Partial Listing of Electrical Sources and Loads at Bellefonte 1 (Continued)

| POWER SOURCE | VOLTAGE | EMERG LOAD GRP | POWER SOURCE LOCATION | LOAD SYSTEM | LOAD COMPONENT ID | COMP TYPE | COMPONENT LOCATION |
|---|---|---|---|---|---|---|---|
| BUS-1ET1B | 6900 | AC/B | 649SGRMB | EP | TRAN 1B | TRAN | 669SGRMB |
| BUS-1ET1B | 6900 | AC/B | 649SGRMB | EP | TRAN 2B | TRAN | 669SGRMB |
| BUS-1ET1B | 6900 | AC/B | 649SGRMB | PAHR | RBS-P1B | MDP | RBSBPMRM |
| BUS-1ET2A | 6900/480 | AC/A | INTK-ERMA | EP | TRAN-3A | TRAN | INTK-ERMA |
| BUS-1ET2A | 6900 | AC/A | INTK-ERMA | ERCW | ERCW-P1A | MDP | INTK-PRMA |
| BUS-1ET2A | 6900 | AC/A | INTK-ERMA | ERCW | ERCW-P2A | MDP | INTK-PRMA |
| BUS-1ET2B | 6900/480 | AC/B | INTK-ERMB | EP | TRAN-3B | TRAN | INTK-ERMB |
| BUS-1ET2B | 6900 | AC/B | INTK-ERMB | ERCW | ERCW-P3B | MDP | INTK-PRMB |
| BUS-1ET2B | 6900 | AC/B | INTK-ERMB | ERCW | ERCW-P4B | MDP | INTK-PRMB |
| BUS-24A | 480 | AC/A | 669SGRMA | EP | MCC-1E1A | MCC | 669SGRMA |
| BUS-24A | 480 | AC/A | 669SGRMA | EP | MCC-1E4A | MCC | DG1A-MCCPM |
| BUS-24A | 480 | AC/A | 669SGRMA | EP | MCC-1E5A | MCC | 649SGRMA |
| BUS-24A | 480 | AC/A | 669SGRMA | EP | PANEL-88A | BUS | 669SGRMA |
| BUS-25A | 480 | AC/A | 669SGRMA | EP | MCC-1E2A | MCC | 669SGRMA |
| BUS-25A | 480 | AC/A | 669SGRMA | EP | PANEL-86A | BUS | 669SGRMA |
| BUS-25A | 480 | AC/A | 669SGRMA | ERCW | ERCW-BP13A | MDP | CCWPMRMA |
| BUS-25A | 480 | AC/A | 669SGRMA | PAHR | RBC-FAN-1A | FAN | RC-PC |
| BUS-28B | 480 | AC/B | 669SGRMB | EP | MCC-1E1B | MCC | 669SGRMB |
| BUS-28B | 480 | AC/B | 669SGRMB | EP | MCC-1E4B | MCC | DG1B-MCCRM |
| BUS-28B | 480 | AC/B | 669SGRMB | EP | MCC-1E5B | MCC | 649SGRMB |
| BUS-28B | 480 | AC/B | 669SGRMB | EP | PANEL 89D | BUS | 669SGRMB |
| BUS-28B | 480 | AC/B | 669SGRMB | ERCW | ERCW-BP11B | MDP | CCWPMRMB |
| BUS-28B | 480 | AC/B | 669SGRMB | PAHR | RBC-FAN-1B | FAN | RC-PC |
| BUS-29B | 480 | AC/B | 669SGRMB | EP | MCC-1E2B | MCC | 669SGRMB |
| BUS-29B | 480 | AC/B | 669SGRMB | EP | PANEL-87D | BUS | 669SGRMB |
| BUS-29B | 480 | AC/B | 669SGRMB | ERCW | ERCW-BP12B | MDP | CCWPMRMB |
| BUS-29B | 480 | AC/B | 669SGRMA | PAHR | RBC-FAN-2B | FAN | RC-PC |
| DCBB-1D | 125 | DC/B | 669SGRMA | EP | DG-PNL-1A | BUS | 669SGRMA |
| DCBB-1D | 125 | DC/D | 669SGRMA | EP | UPS-1D | UPS | 120VACDF |
| DCBB-1E | 125 | DC/E | 669SGRMB | EP | DG-PNP-1B | BUS | 669SGRMB |
| DCBB-1E | 125 | DC/E | 669SGRMB | EP | UPS-1E | UPS | 120VACEG |

Table 3.6-2. Partial Listing of Electrical Sources and Loads at Bellefonte 1 (Continued)

| POWER SOURCE | VOLTAGE | EMERG LOAD GRP | POWER SOURCE LOCATION | LOAD SYSTEM | LOAD COMPONENT ID | COMP TYPE | COMPONENT LOCATION |
|---|---|---|---|---|---|---|---|
| DCBB-1F | 125 | DC/F | 669SGRMA | EP | DG-PNL-1A | BUS | 669SGRMA |
| DCBB-1F | 125 | DC/F | 669SGRMA | EP | UPS-1F | UPS | 120VACDF |
| DCBB-1G | 125 | DC/G | 669SGRMB | EP | DG-PNL-1B | BUS | 669SGRMB |
| DCBB-1G | 125 | DC/G | 669SGRMB | EP | UPS-1G | UPS | 120VACEG |
| DG-1A-A | 6900 | AC/A | DG1A-ARM | EP | BUS-1ET1A | BUS | 649SGRMA |
| DG-1B-B | 6900 | AC/B | DG1B-ARM | EP | BUS-1ET1B | BUS | 649SGRMB |
| MCC-1E1A | 480 | AC/A | 669SGRMA | ECCS | DHR-68A | MOV | DHAPMRM |
| MCC-1E1A | 480 | AC/A | 669SGRMA | ECCS | HPI-113A | MOV | RC-SCA |
| MCC-1E1A | 480 | AC/A | 669SGRMA | ECCS | HPI-450A | MOV | 610ABTRNA |
| MCC-1E1A | 480 | AC/A | 669SGRMA | ERCW | ERCW-295A | MOV | DG1A-ARM |
| MCC-1E1A | 480 | AC/A | 669SGRMA | RCS | MU-21A | MOV | RC-PC |
| MCC-1E1A | 480 | AC/A | 669SGRMA | RCS | MU-28A | MOV | RC-PC |
| MCC-1E1B | 480 | AC/B | 669SGRMB | ECCS | DHR-162B | MOV | DHBPMRM |
| MCC-1E1B | 480 | AC/B | 669SGRMB | ECCS | HPI-225B | MOV | RC-SCA |
| MCC-1E1B | 480 | AC/B | 669SGRMB | ECCS | HPI-419B | MOV | 610ABTRNB |
| MCC-1E1B | 480 | AC/B | 669SGRMB | ERCW | ERCW-296B | MOV | DG1B-BRM |
| MCC-1E1B | 480 | AC/B | 669SGRMB | ERCW | ERCW-310B | MOV | RC-SCA |
| MCC-1E1B | 480 | AC/B | 669SGRMB | ERCW | ERCW-316B | MOV | RC-SCA |
| MCC-1E1B | 480 | AC/B | 669SGRMB | RCS | MU-22B | MOV | RC-PC |
| MCC-1E1B | 480 | AC/B | 669SGRMB | RCS | MU-29B | MOV | RC-PC |
| MCC-1E2A | 480 | AC/A | 669SGRMA | AFW | AFW-29A | MOV | 590ABTRNA |
| MCC-1E2A | 480 | AC/A | 669SGRMA | AFW | AFW-30A | MOV | 590ABTRNA |
| MCC-1E2A | 480 | AC/A | 669SGRMA | AFW | AFW-37A | MOV | RC-SCA |
| MCC-1E2A | 480 | AC/A | 669SGRMA | AFW | AFW-87A | MOV | 590ABTRNA |
| MCC-1E2A | [illegible] | AC/A | 669SGRMA | ECCS | DHR-10A | MOV | 610ABTRNA |
| MCC-1E2A | 480 | AC/A | 669SGRMA | ECCS | DHR-185A | MOV | RC-PC |
| MCC-1E2A | 480 | AC/A | 669SGRMA | ECCS | DHR-48A | MOV | DHRACLRM |
| MCC-1E2A | 480 | AC/A | 669SGRMA | ECCS | DHR-80A | MOV | RC-SCA |
| MCC-1E2A | 480 | AC/A | 669SGRMA | ECCS | DHR-85A | MOV | RC-PC |
| MCC-1E2A | 480 | AC/A | 669SGRMA | ECCS | DHR-[illegible]8A | MOV | VVPIT |
| MCC-1E2A | 480 | AC/A | 669SGRMA | ERCW | ERCW-161A | MOV | 610ABCOR |

## Table 3.6-2. Partial Listing of Electrical Sources and Loads at Bellefonte 1 (Continued)

| POWER SOURCE | VOLTAGE | EMERG LOAD GRP | POWER SOURCE LOCATION | LOAD SYSTEM | LOAD COMPONENT ID | COMP TYPE | COMPONENT LOCATION |
|---|---|---|---|---|---|---|---|
| MCC-1E2A | 480 | AC/A | 669SGRMA | ERCW | ERCW-268A | MOV | RC-SCA |
| MCC-1E2A | 480 | AC/A | 669SGRMA | ERCW | ERCW-275A | MOV | RC-SCA |
| MCC-1E2A | 480 | AC/A | 669SGRMA | PAHR | DHR-104A | MOV | 610ABTRNA |
| MCC-1E2A | 480 | AC/A | 669SGRMA | PAHR | RBS-31A | MOV | RC-SCA |
| MCC-1E2A | 480 | AC/A | 669SGRMA | RCS | RCS-235A | MOV | RC-PC |
| MCC-1E2B | 480 | AC/B | 669SGRMB | AFW | AFW-100B | MOV | 590ABTRNB |
| MCC-1E2B | 480 | AC/B | 669SGRMB | AFW | AFW-54B | MOV | RC-SCA |
| MCC-1E2B | 480 | AC/B | 669SGRMB | AFW | AFW-88B | MOV | 590ABTRNB |
| MCC-1E2B | 480 | AC/B | 669SGRMB | AFW | AFW-99B | MOV | 590ABTRNB |
| MCC-1E2B | 480 | AC/B | 669SGRMB | ECCS | DHR-104B | MOV | 610ABTRNB |
| MCC-1E2B | 480 | AC/B | 669SGRMB | ECCS | DHR-142B | MOV | DHRBCLRM |
| MCC-1E2B | 480 | AC/B | 669SGRMB | ECCS | DHR-174B | MOV | [illegible]-SCA |
| MCC-1E2B | 480 | AC/B | 669SGRMB | ECCS | DHR-179B | MOV | RC-PC |
| MCC-1E2B | 480 | AC/B | 669SGRMB | ECCS | DHR-19[illegible]B | MOV | VVPIT |
| MCC-1E2B | 480 | AC/B | 669SGRMB | ECCS | DHR-91A | MOV | RC-PC |
| MCC-1E2B | 480 | AC/B | 669SGRMB | ERCW | ERCW-279B | MOV | CCWPMRMB |
| MCC-1E2B | 480 | AC/B | 669SGRMB | ERCW | ERCW-323B | MOV | RC-SCA |
| MCC-1E2B | 480 | AC/B | 669SGRMB | ERCW | ERCW-330B | MOV | RC-SCA |
| MCC-1E2B | 480 | AC/B | 669SGRMB | ERCW | ERCW-59B | MOV | 610ABCOR |
| MCC-1E2B | 480 | AC/B | 669SGRMB | PAHR | DHR-104B | MOV | 610ABTRNB |
| MCC-1E2B | 480 | AC/B | 669SGRMB | PAHR | RBS-64B | MOV | RC-SCA |
| MCC-1E2B | 480 | AC/B | 669SGRMB | RCS | RCS-237B | MOV | RC-PC |
| MCC-1E5A | 480 | AC/A | 649SGRMA | AFW | AFW-16A | MOV | AFWTDPMRM |
| MCC-1E5A | 480 | AC/A | 649SGRMA | AFW | AFW-17A | MOV | AFWTDPMRM |
| MCC-1E5A | 480 | AC/A | 649SGRMA | AFW | AFW-71A | MOV | RC-SCA |
| MCC-1E5A | 480 | AC/A | 649SGRMA | AFW | AFW-869A | MOV | STVRMB |
| MCC-1E5B | 480 | AC/B | 649SGRMB | AFW | AFW-64B | MOV | RC-SCA |
| MCC-1E5B | 480 | AC/B | 649SGRMB | AFW | AFW-868B | MOV | STVRMA |
| MCC-1E5B | 480 | AC/B | 649SGRMB | AFW | AFW-91B | MOV | AFWTDPMRM |
| MCC-1E5B | 480 | AC/B | 649SGRMB | AFW | AFW-92B | MOV | AFWTDPMRM |
| PANEL-86A | 480 | AC/A | 669SGRMA | EP | BC-1D (50D) | BC | 669SGRMA |

Table 3.6-2. Partial Listing of Electrical Sources and Loads at Bellefonte 1 (Continued)

| POWER SOURCE | VOLTAGE | EMERG LOAD GRP | POWER SOURCE LOCATION | LOAD SYSTEM | LOAD COMPONENT ID | COMP TYPE | COMPONENT LOCATION |
|---|---|---|---|---|---|---|---|
| PANEL-86A | 480 | AC/A | 669SGRMA | EP | UPS-1D | UPS | 120VACDF |
| PANEL-87B | 480 | AC/B | 669SGRMB | EP | BC-1E (51E) | BC | 669SGRMB |
| PANEL-87D | 480 | AC/B | 669SGRMB | EP | UPS-1E | UPS | 120VACEG |
| PANEL-88A | 480 | AC/A | 669SGRMA | EP | BC-1F (52F) | BC | 669SGRMA |
| PANEL-88A | 480 | AC/A | 669SGRMA | EP | UPS-1F | UPS | 120VACDF |
| PANEL-89B | 480 | AC/B | 669SGRMB | EP | BC-1G (53G) | BC | 669SGRMB |
| PANEL-89D | 480 | AC/B | 669SGRME | EP | UPS-1G | UPS | 120VACEG |
| RSS-TRAN-1A | 6900 | AC/A | UNKNOWN | EP | BUS-1ET1A | BUS | 649SGRMA |
| RSS-TRAN-1B | 6900 | AC/B | UNKNOWN | EP | BUS-1ET1B | BUS | 649SGRMA |
| SS-TRAN-1A | 6900 | AC/A | UNKNOWN | EP | BUS-1ET1A | BUS | 649SGRMA |
| SS-TRAN-1B | 6900 | AC/B | UNKNOWN | EP | BUS-1ET1B | BUS | 649SGRMB |
| TRAN 1A | 6900/480 | AC/A | 669SGRMA | EP | BUS 24A | BUS | 669SGRMA |
| TRAN 1B | 6900/480 | AC/B | 669SGRMB | EP | BUS 28B | BUS | 669SGRMB |
| TRAN 2A | 6990/480 | AC/A | 669SGRMA | EP | BUS 25A | BUS | 669SGRMA |
| TRAN 2B | 6990/480 | AC/B | 669SGRMB | EP | BUS 29B | BUS | 669SGRMB |
| TRAN-3A | 6900/480 | AC/A | INTK-ERMA | EP | MCC-1E3A | MCC | INTK-ERMA |
| TRAN-3B | 6900/480 | AC/B | INTK-ERMB | EP | MCC-1E3B | MCC | INTK-ERMB |
| UNKNOWN | 480 | AC/B | 669SGRMB | CCS | CCS-136 | MOV | CCWPMRMA |
| UNKNOWN | 480 | AC/A | 669SGRMA | CCS | CCS-137 | MOV | CCWPMRMA |
| UNKNOWN | 480 | AC/A | 669SGRMA | CCS | CCS-313A | MOV | CCWPMRMA |
| UNKNOWN | 480 | AC/B | 669SGRMB | CCS | CCS-316B | MOV | CCWPMRMB |
| UNKNOWN | 480 | AC/A | 669SGRMA | CCS | CCS-375 | MOV | CCWPMRMA |
| UNKNOWN | 480 | AC/B | 669SGRMB | CCS | CCS-376 | MOV | CCWPMRMA |
| UNKNOWN | 480 | AC/A | 669SGRMA | ECCS | HPI-101A | MOV | RC-SCA |
| UNKNOWN | 480 | AC/B | 669SGRMB | ECCS | HPI-213B | MOV | RC-SCA |
| UNKNOWN | | | | RCS | RCS-57A | MOV | RC-PC |
| UNKNOWN | | | | RCS | RCS-58B | NV | RC-PC |
| UPS-1D | 120 | AC/D | 120VACDF | EP | 120PNL-1D | BUS | 120VACDF |
| UPS-1E | 120 | AC/E | 120VACEG | EP | 120PNL-1E | BUS | 120VACEG |
| UPS-1F | 120 | AC/F | 120VACDF | EP | 120PNL-1F | BUS | 120VACDF |
| UPS-1G | 120 | AC/G | 120VACEG | EP | 120PNL-1G | BUS | 120VACEG |

## 3.7 COMPONENT COOLING SYSTEM (CCS)

### 3.7.1 System Function

The CCS is designed to provide cooling for various components and remove residual and sensible heat from the RCS during plant shutdown cooling via the Decay Heat Removal (DHR) heat exchangers. The CCS is an intermediate cooling loop between the heat loads and the Essential Raw Cooling Water (ERCW) System (see Section 3.8).

### 3.7.2 System Definition

The CCS is a closed-loop cooling system consisting of two essential cooling loops and two non-essential loops. The CCS A loop consists of two CCS pumps (one is an "installed spare"), one CCS heat exchanger and necessary distribution piping and valves. CCS loop B is similar except that it has only one CCS pump. The CCS essential loops A and B serve the corresponding trains of safety-related components such that each CCS loop can provide cooling necessary to establish and maintain a safe shutdown condition following a design basis accident. The CCS also provides cooling to two non-essential loops, one in the reactor building and one in the auxiliary building. Valving is provided so that the non-essential cooling loads can be served from either essential loop, however, the normal system alignment has CCS loop A serving the non-essential loops. The CCS heat exchangers transfer heat to the Essential Raw Cooling Water System. CCS surge tanks accommodate expansion and contraction, protect against potential overpressurization due to inleakage of water, and maintain the net positive suction head for the pumps.

Simplified drawings of the CCS essential loops are shown in Figures 3.7-1 and 3.7-2. A summary of data on selected CCS components is presented in Table 3.7-1. A summary of the heat loads served by the CCS is presented in Table 3.7-2.

### 3.7.3 System Operation

During normal operation CCS train A is operating with one CCS pump supplying essential loop A and both non-essential loops. CCS train B is idle. Maximum normal CCS water temperature at the CCS heat exchanger outlet is less than 105°F. The standby pump in train A will automatically start if CCS supply header pressure decreases to a low pressure setpoint which is indicative of loss of the operating CCS pump.

Both CCS train are used during a normal cooldown which can reduce RCS temperature to 140°F in about 20 hours. Cooldown can be accomplished with a single CCS train, however, RCS cooldown to 140°F will take longer than 20 hours (Ref. 1).

Following a LOCA, an ESFAS signal automatically starts the idle CCS train B, isolates the non-essential loops, and opens the CCS control valves downstream of the DHR heat exchangers. During the injection phase of ECCS operation, the DHR heat exchangers do not transfer a significant heat load to the CCS. During the recirculation phase of ECCS operation, the DHR heat exchangers, ECCS and Reactor Building Spray pumps can impose design heat loads on the CCS. The CCS is monitored for high radiation levels in the A and B train coolant. Radiation monitors are located in a CCS side-stream flow path parallel to the CCS heat exchangers.

### 3.7.4 System Success Criteria

A CCS train can successfully perform its safety-related cooling function if: (a) flow is maintained to essential heat loads with one CCS pump, (b) the respective CCS heat exchanger is cooled by the Essential Raw Cooling Water System, (c) water inventory in the CCS train is maintained, and for train A, (d) the non-essential loops are isolated.

### 3.7.5 Component Information

A. Component Cooling Water Pumps 1A, 2B, and 3A
   1. Rated flow: 8745 gpm @ 250 ft. head (109 psid)
   2. Rated capacity: 100%
   3. Type: centrifugal

B. Component Cooling Heat Exchangers 6A, 7B
   1. Design duty: $113 \times 10^6$ Btu/hr
   2. Rated capacity: 100%
   3. Type: shell-and-tube

C. Component Cooling Surge Tank
   1. Volume: 343 $ft^3$
   2. Design Pressu.· 50 psig

### 3.7.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. Low supply header pressure in CCS train A will automatically start the standby pump in that train.
      b. Loss of reactor coolant pump seal injection may cause HPI/makeup pump 3B to be started (see Section 3.4). CCS train B will be automatically started to cool HPI/makeup pump 3B.
      c. An ESFAS signal automatically starts CCS train B, isolates the non-essential loop supply and return headers from CCS train A, and opens the CCS control valves downstream of the DHR heat exchangers. The standby CCS pump in train A does not receive a start signal.
   2. Remote Manual
      The CCS pumps can be actuated by remote manual means from the control room.

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

C. Other
   1. The CCS heat exchangers are cooled by the Essential Raw Cooling Water System (ERCWS, see Section 3.8).
   2. Lubrication and cooling are assumed to be provided locally for the CCS pumps.
   3. CCS pump room coolers are cooled by the ERCWS (see Section 3.8). Power sources for these room coolers have not been determined.

### 3.7.7 Section 3.7 References

1. Bellefonte 1 and 2 Final Safety Analysis Report, Section 9.2.2.

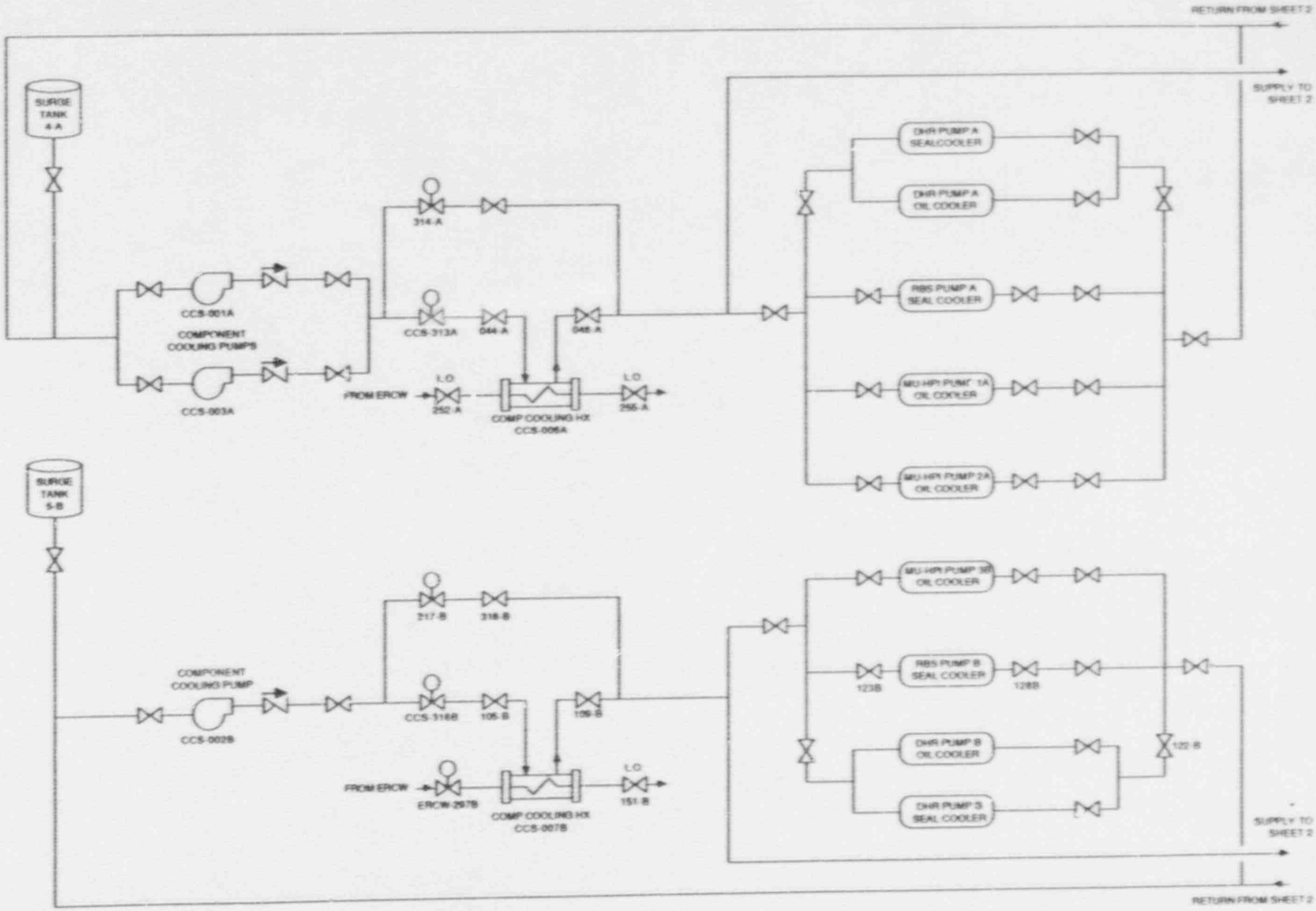



Figure 3.7-1. Bellefonte 1 Component Cooling System (Sheet 1 of 2)

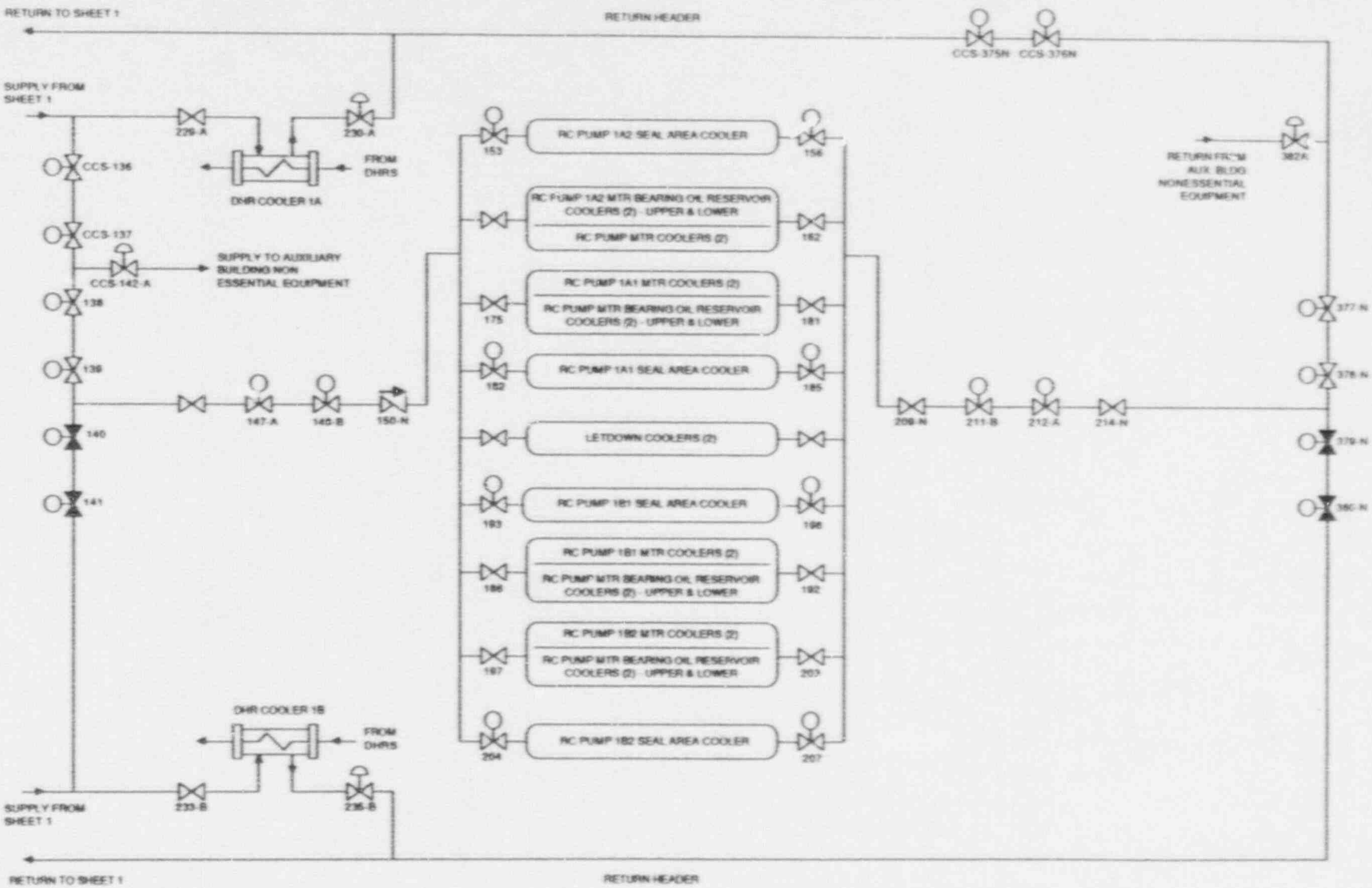



Figure 3.7-1. Bellefonte 1 Component Cooling System (Sheet 2 of 2)

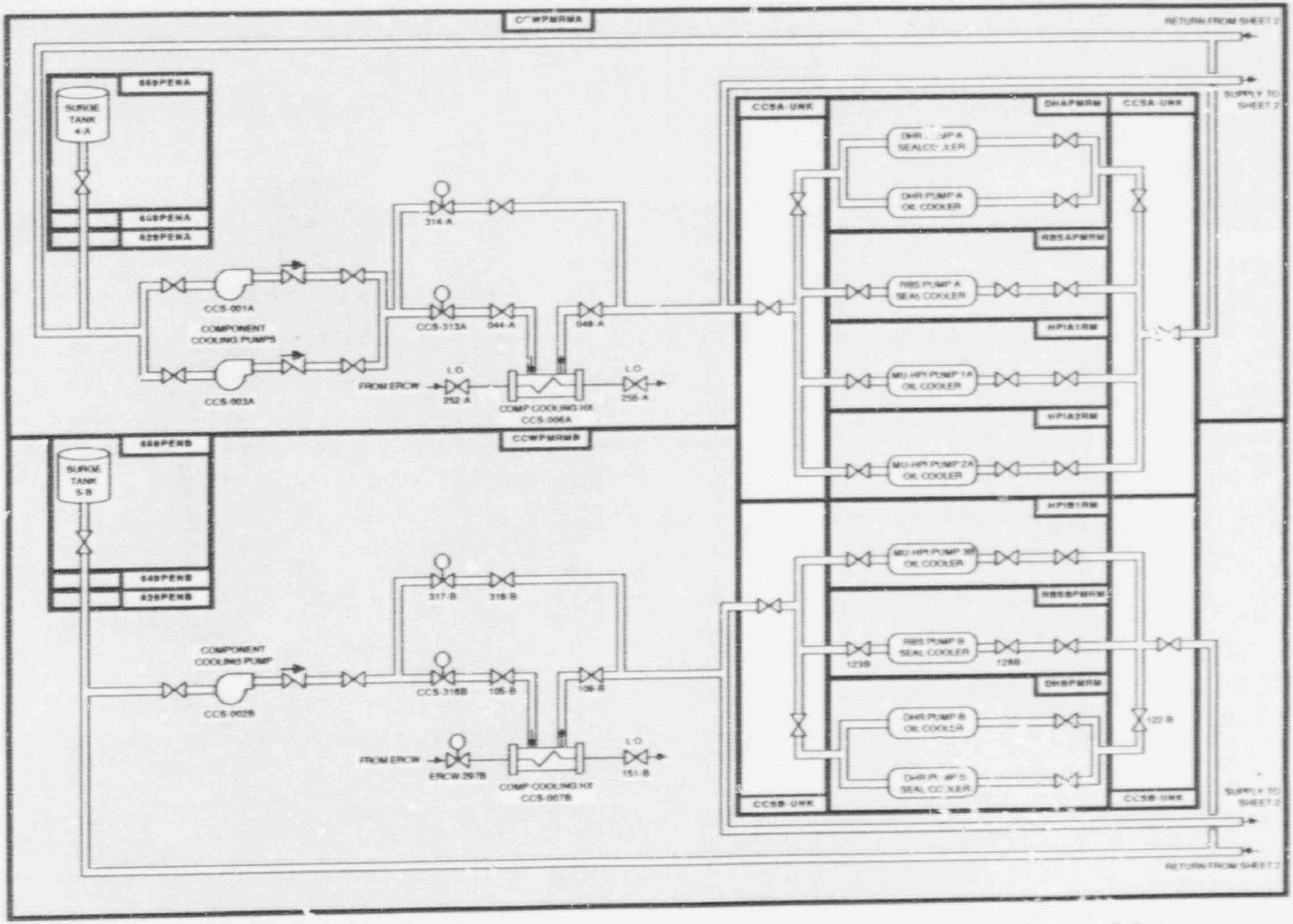



Figure 3.7-2. Bellefonte 1 Component Cooling System Showing Component Locations (Sheet 1 of 2)

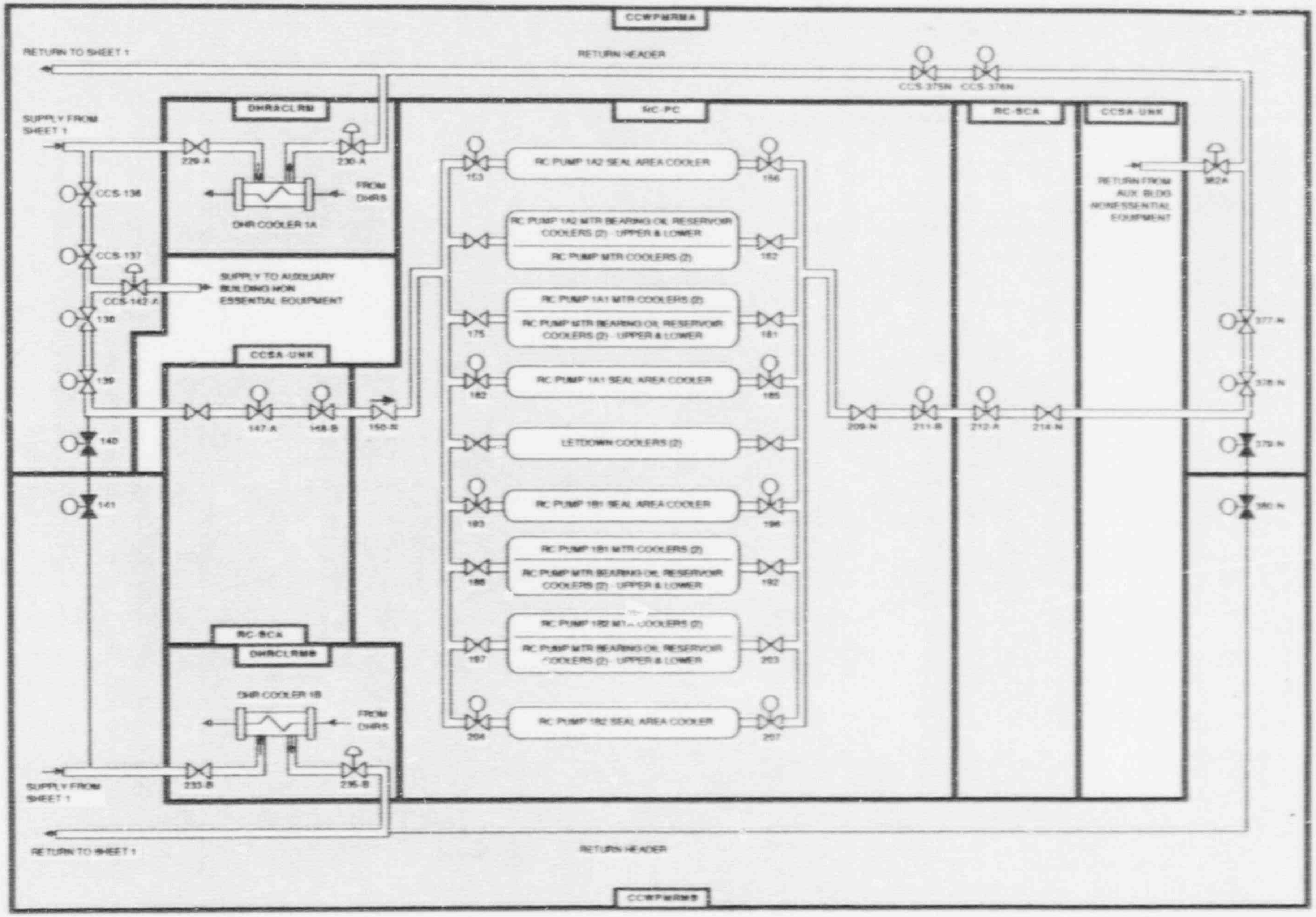



Figure 3.7-2. Bellefonte 1 Component Cooling System Showing Component Locations (Sheet 2 of 2)

Table 3.7-1. Bellefonte 1 Component Cooling System Data Summary for Selected Components

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| CCS-136 | MOV | CCWPMRMA | UNKNOWN | 480 | 669SGRMB | AC/B |
| CCS-137 | MOV | CCWPMRMA | UNKNOWN | 480 | 669SGRMA | AC/A |
| CCS-313A | MOV | CCWPMRMA | UNKNOWN | 480 | 669SGRMA | AC/A |
| CCS-316B | MOV | CCWPMRMB | UNKNOWN | 480 | 669SGRMB | AC/B |
| CCS-375 | MOV | CCWPMRMA | UNKNOWN | 480 | 669SGRMA | AC/A |
| CCS-376 | MOV | CCWPMRMA | UNKNOWN | 480 | 669SGRMB | AC/B |
| CCS-HX6A | HX | CCWPMRMA | | | | |
| CCS-HX7B | HX | CCWPMRMB | | | | |
| CCS-P1A | MDP | CCWPMRMA | BUS-1ET1A | 6900 | 649SGRMA | AC/A |
| CCS-P2B | MDP | CCWPMRMB | BUS-1ET1B | 6900 | 649SGRMB | AC/B |
| CCS-P3A | MDP | CCWPMRMA | BUS-1ET1A | 6900 | 649SGRMA | AC/A |

## Table 3.7-2. Summary of Bellefonte CCS Heat Loads

<u>Essential Loop A</u>

- HPI/makeup pump 1A and 2A lube oil coolers
- DHR pump 1A seal and lube oil cooler
- DHR heat exchanger 1A
- Reactor building spray pump 1A seal and bearing cooler

<u>Essential Loop B</u>

- HPI/makeup pump 3B lube oil cooler
- DHR pump 1B seal and lube oil coolers
- DHR heat exchanger 1B
- Reactor building spray pump 1B seal and bearing cooler

<u>Non-Essential Loop (inside containment)</u>

- Letdown coolers
- Reactor coolant pump seal area coolers
- Reactor coolant pump motor and lube oil coolers

<u>Non-Essential Loop (outside containment)</u>

- Spent fuel pool coolers
- Reactor coolant pump seal return coolers
- Reactor coolant drain tank cooler
- Waste disposal evaporators
- Waste gas compressor
- Reactor coolant bleed evaporators
- Sample coolers (pressurizer, steam generator)

## 3.8 ESSENTIAL RAW COOLING WATER SYSTEM

### 3.8.1 System Function

The Essential Raw Cooling Water System (ERCWS) supplies cooling water from the ultimate heat sink, the Tennessee River, to essential and non-essential components and systems, including the component cooling system heat exchangers and diesel generator coolers. The system is designed to provide a continuous flow of cooling water to systems and components necessary for plant safety either during normal operation or under abnormal and accident conditions. The system also serves as a backup source of water for the Auxiliary Feedwater System (see Section 3.2).

### 3.8.2 System Definition

The ERCWS is a once-through system that provides cooling to engineered safety features and various non-safety equipment of each unit. Each unit has two ERCW trains, A and B. The two A trains are normally cross-tied, and operate in a "hydraulically-shared" configuration. The two B trains also are cross-tied. There are a total of eight ERCW pumps for both units (two per train) located in the Intake Pumping Station which supply water from the river to the components to be cooled, and discharge the water into the cooling tower basins. The intake well for each unit is divided into a Train A half and a Train B half by a stationary screen which has grid openings that allow water flow between the halves.

There are three ERCWS booster pumps per unit, one in train A and two in train B. These pumps increase the ERCW pressure in the supply lines to the reactor building cooling units located inside the primary containment.

Simplified drawings of the ERCWS are shown in Figures 3.8-1 through 3.8-4. A summary of data on selected ERCWS components is presented in Table 3.8-1.

### 3.8.3 System Operation

Water enters the ERCWS from the Tennessee River through the intake structure and travelling water screens. The ERCWS can be operated as either a hydraulically shared (i.e., Units 1 and 2 cross-tied) or unitized (i.e., Units 1 and 2 isolated from each other) system. The normal configuration for ERCWS operation is as a hydraulically shared system. In the hydraulically shared configuration, the supply headers of one unit are cross-connected though normally locked-open, manual valves to the corresponding supply header of the other unit. In this configuration, the system is designed to supply, with only one plant-wide train consisting of three main pumps and all booster pumps on that train, the minimum flow requirements for a postulated worst case accident condition. As a shared system, two main ERCW pumps (one in each shared train) are considered installed spares. A single spare uninstalled booster pump is also provided.

To operate the ERCWS on a unitized basis, manual valves must be closed to remove the cross-tie that exists between the units. In this configuration, only one unitized train (two main ERCW pumps and all booster pumps on that train) is necessary to supply the minimum flow requirements during accident conditions.

In either mode of operation, cooling water discharging from the various heat exchangers is normally conveyed to the two natural draft cooling tower basins in the Heat Rejection System (evaporation in the cooling towers removes heat transferred from the main condenser to the Raw Water System). During normal operation, when the cooling towers are in operation, the discharged cooling water provides all makeup requirements for the evaporative and drift losses in the Heat Rejection System. During LOCA or loss of off-site power conditions, the ERCWS water is discharged to the yard holding pond.

The ERCW booster pumps are provided to supply a pressurized source of cooling water to the reactor building coolers. These pumps provide sufficient pressure to prevent flashing of the water due to the high temperatures in those coolers during a LOCA. There is one booster pump for each reactor building cooler. During normal operation, the

booster pumps are used to supply cooling water to the reactor building coolers and the auxiliary control room air conditioning units. Flow to the secondary containment air clean-up unit also is provided from the booster pumps during a LOCA.

The ERCWS also provides an alternate source of fire protection water in safety related areas under conditions when the primary source of fire protection water is no longer available. These provisions consist of an inter-tie between the ERCWS and fire protection piping in both the Intake Station and in the Auxiliary Building. Separating the two systems at each interconnection is a minimum of two locked closed valves.

In the event of a loss of offsite power, all available ERCW pumps are automatically restarted in sequence and powered from the standby diesel generators.

### 3.8.4 System Success Criteria

In the hydraulically shared mode of ERCW operation (i.e., Unit 1 and 2 ERCW cross-connected) and the worst case design conditions, the total ERCWS flow requirements to both units is 36,319 gpm (Ref. 1, Table 9.2.1-2). This flow can be provided by three of the eight ERCWS pumps available at both units. The worst case design conditions include a LOCA in one unit, shutdown of the other unit, loss of offsite power, loss of train A power plant-wide, loss of the downstream dam, ERCW source water temperature of 95°F, a safe shutdown earthquake, and AFW makeup to both units supplied from the ERCW system. The ERCWS pumps must also have access to a water supply from the intake pumping station, and an intact and unblocked flow path to supply the essential heat loads served by the ERCWS described under the conditions deserved above, the Bellefonte FSAR (Ref. 1, Table 9.2.1-2) lists the following ERCW needs:

- Plant experiencing the LOCA: 19,939 gpm
- Plant proceeding to hot shutdown following loss of offsite power: 15,485 gpm

An additional 895 gpm is required for ERCW strainer backwash.

In the unitized mode of operation, this backwash flow rate would have to be provided for each unit, resulting in flow requirements of 20,834 gpm (LOCA plant) and 16,380 gpm (hot shutdown plant). The rated flow from a single ERCW pump is 13,300 gpm @ 200 ft. head. Based on this information, it appears that the ERCW success criteria for unitized (i.e., not cross-connected) operation is two of four ERCW pumps per unit. Most likely this implies that two of two pumps in one ERCW train are needed.

### 3.8.5 Component Information

A. Emergency Raw Cooling Water Pumps (8, 4 per unit)
   1. Rated flow: 13,300 gpm each @ 200 ft. head (86.4 psid)
   2. Type: horizontal centrifugal

B. Booster Pumps (6, 3 per unit)
   1. Rate flow: 2,800 gpm @ 135 ft. heat (58.4 psid)
   2. Type: horizontal

### 3.8.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      An ESFAS signal at either unit automatically starts all ERCWS pumps.

2. Remote Manual
   Adequate instrumentation and controls are provided in the main control room and the auxiliary control panel for the operator to control and monitor the ERCWS as needed to achieve a safe shutdown condition.

B. Motive Power
1. The ERCWS pumps are Class 1E AC loads that can be supplied from the standby diesel generators as described in Section 3.6.
2. ERCW control power is supplied via 125 VDC Intake Pump Station Distribution Panels 1A and 1B (see Section 3.6).

C. Other
1. The ERCWS pumps are assumed to be self-cooled.
2. ERCWS pump lubrication is provided locally.
3. Ventilation fans and heaters for the Intake Pumping Station are powered from 480 VAC MCCs 1E3-A and 1E3-B (Unit 1).

### 3.8.7 Section 3.8 References

1. Bellefonte 1 and 2 Final Safety Analysis Report, Section 9.2.1.

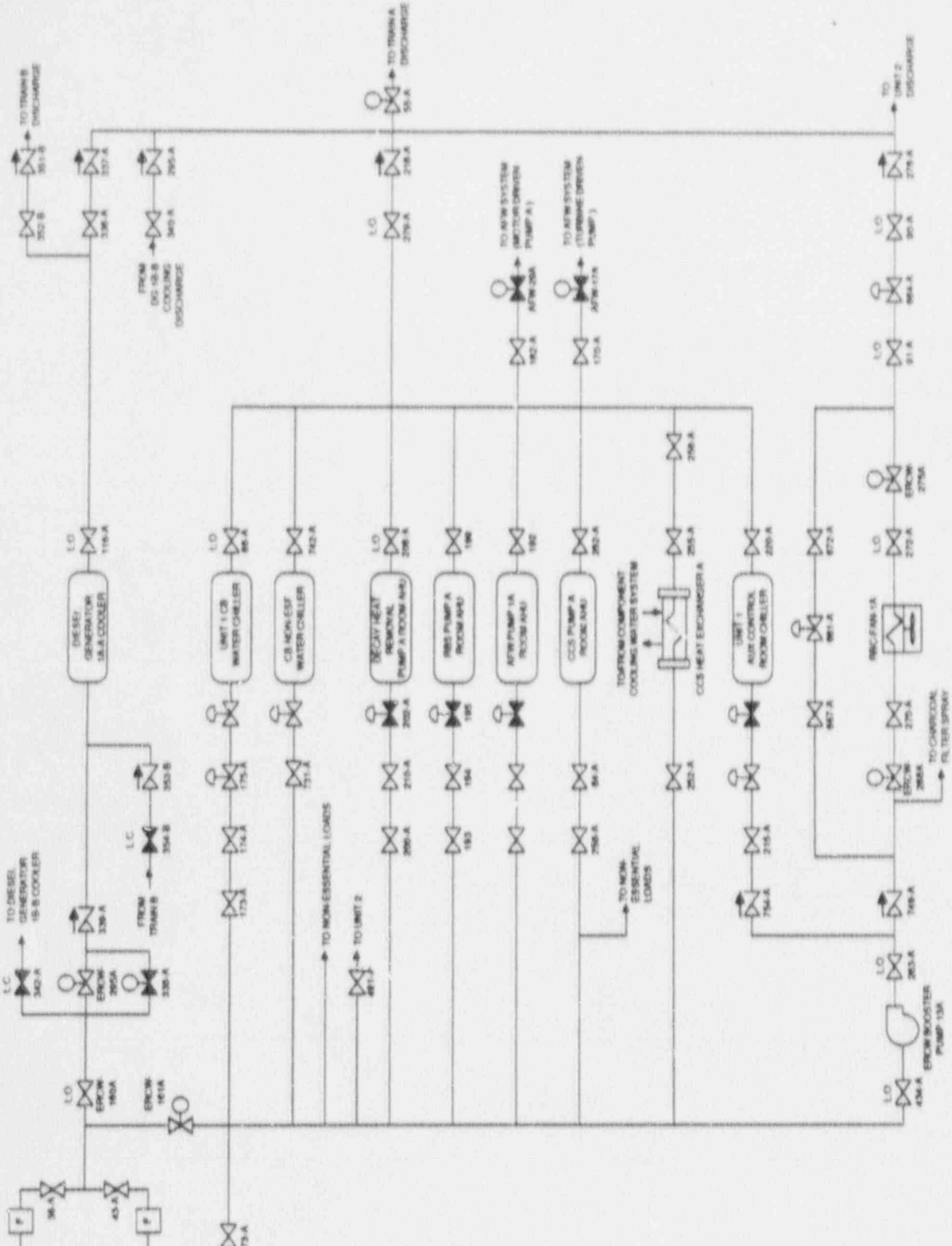
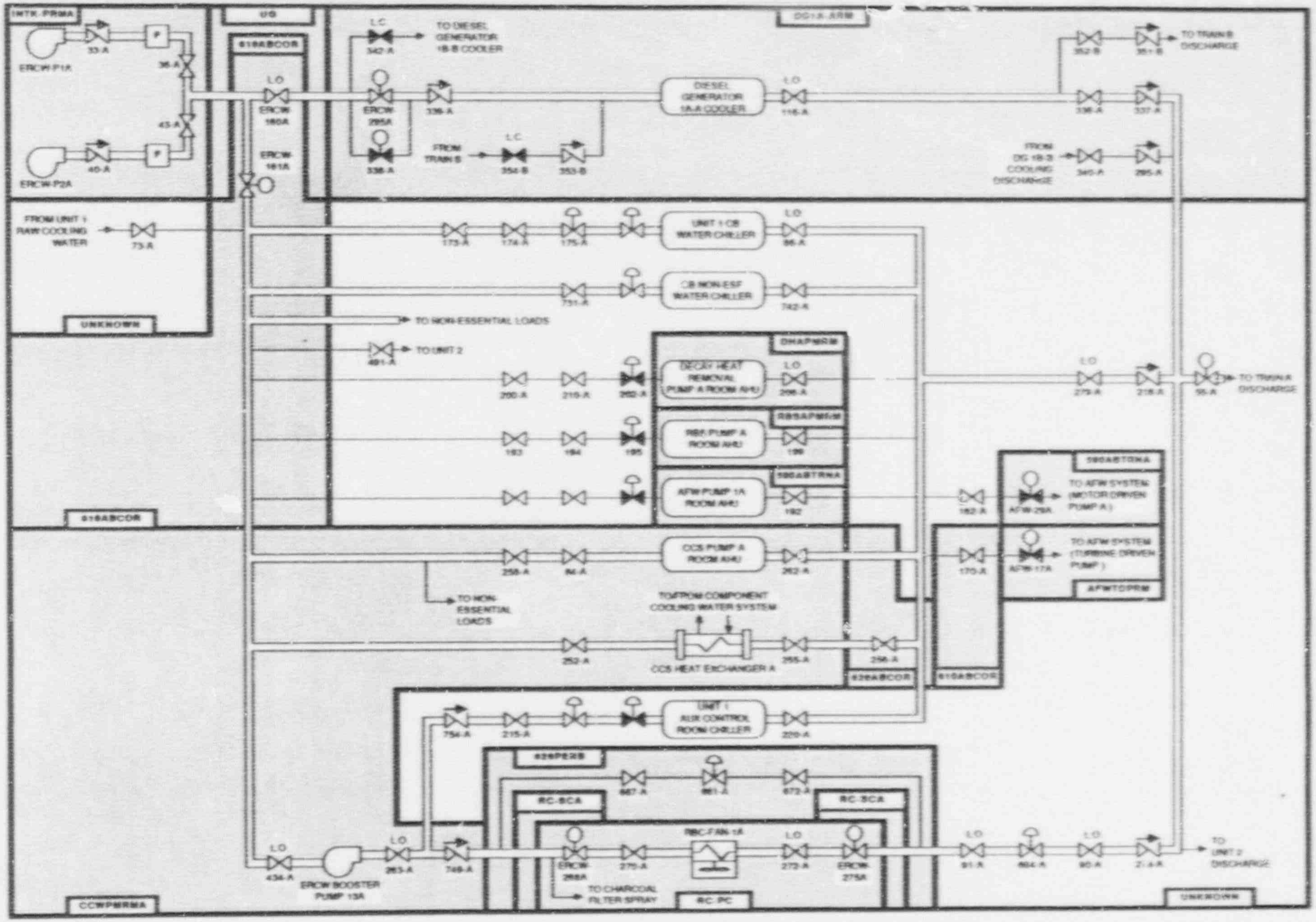


Figure 3.8-1. Bellefonte 1 Essential Raw Cooling Water System Train A




NOTE: LOCATIONS ' ICATED IN THIS DRAWING ARE BEST ESTIMATES BASED ON INCOMPLETE INFORMATION

Figure 3.8-2. Bellefonte 1 Essential Raw Cooling Water System Train A Showing Component Locations

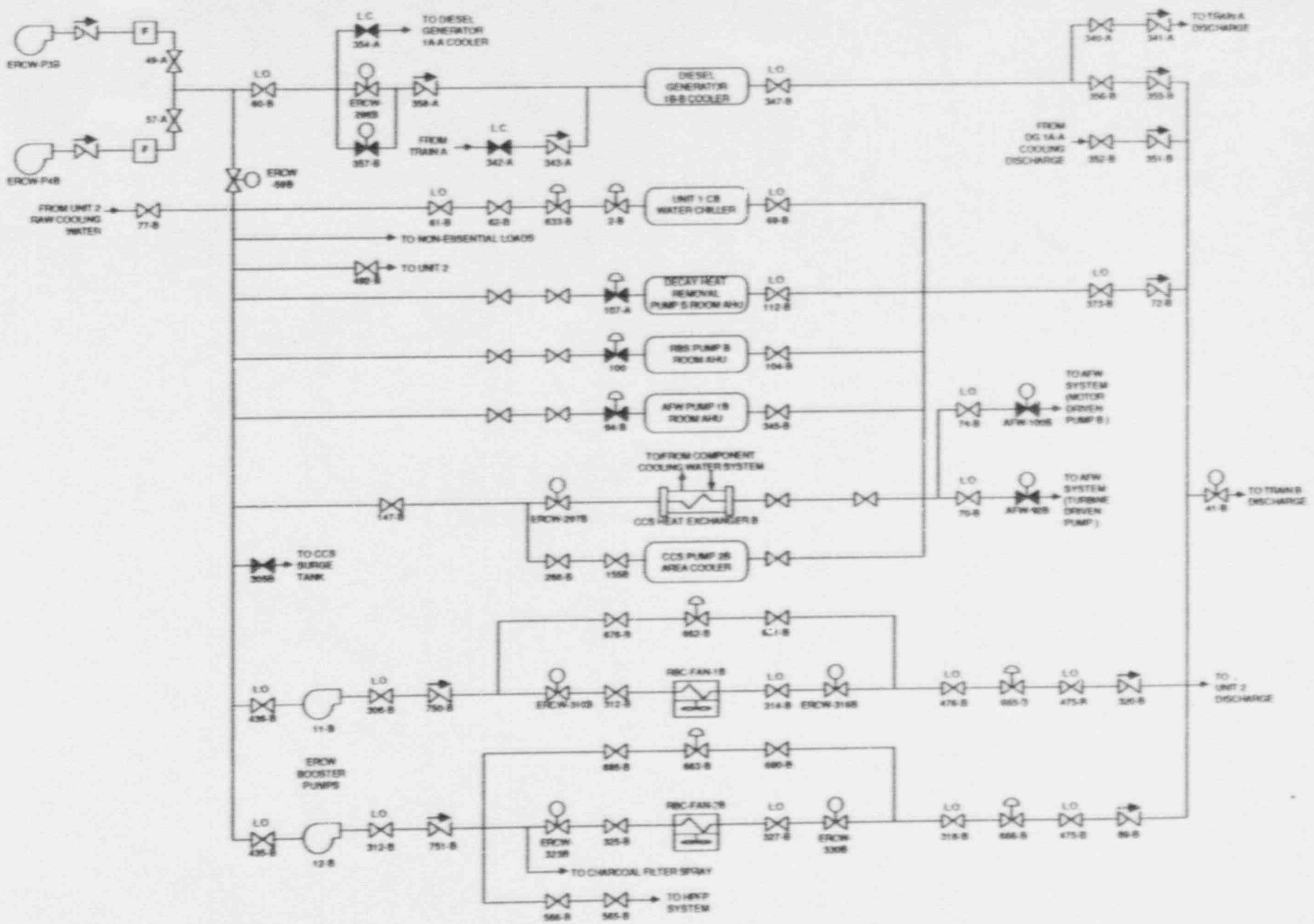
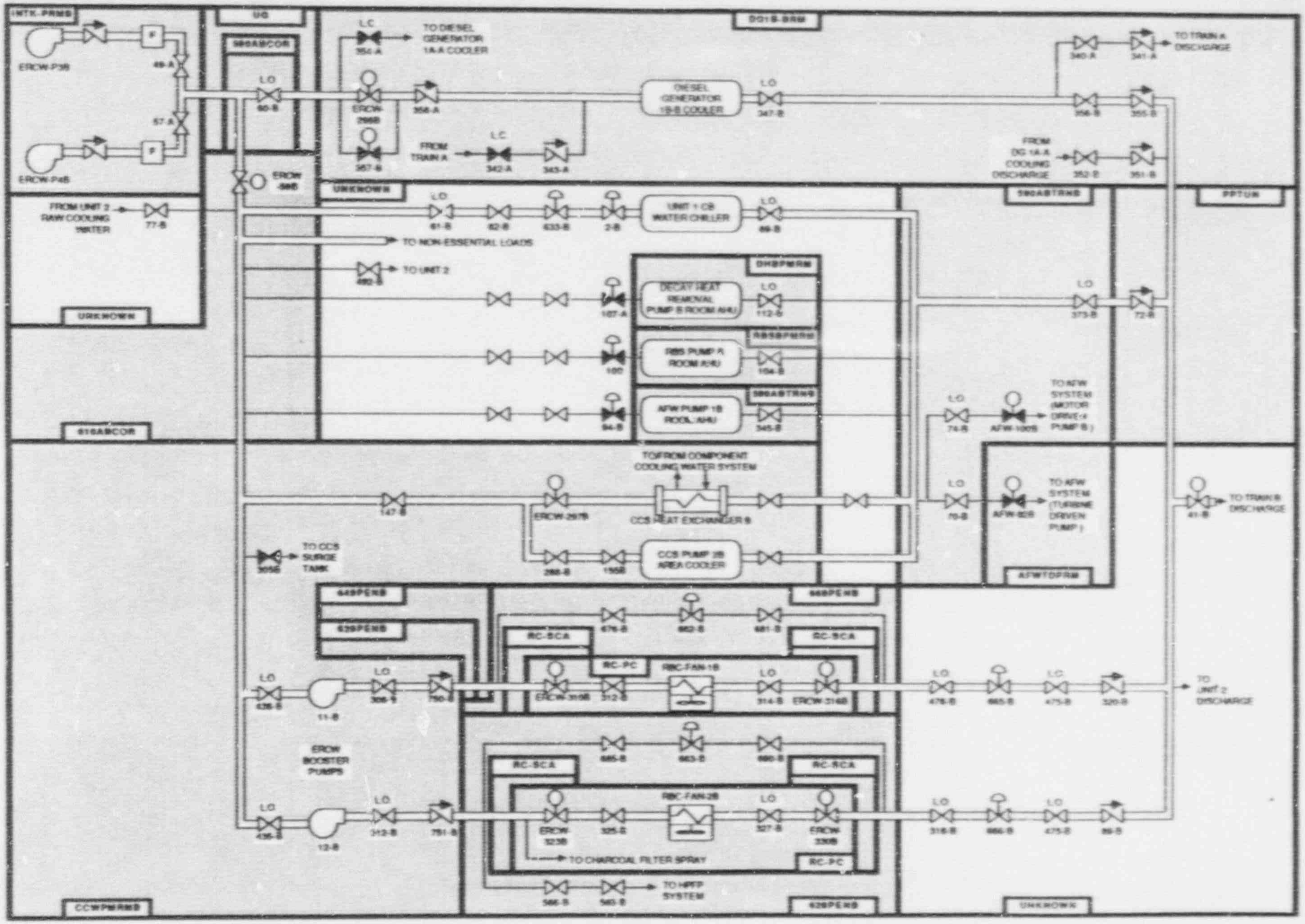



Figure 3.8-3. Bellefonte 1 Essential Raw Cooling Water System Train B




NOTE: LOCATIONS INDICATED IN THIS DRAWING ARE BEST ESTIMATES BASED ON INCOMPLETE INFORMATION.

**Figure 3.8-4. Bellefonte 1 Essential Raw Cooling Water System Train B Showing Component Locations**

**Table 3.8-1. Bellefonte 1 Essential Raw Cooling Water System Data Summary for Selected Components**

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| ERCW-161A | MOV | 610ABCOR | MCC-1E2A | 480 | 669SGRMA | AC/A |
| ERCW-268A | MOV | RC-SCA | MCC-1E2A | 480 | 669SGRMA | AC/A |
| ERCW-275A | MOV | RC-SCA | MCC-1E2A | 480 | 669SGRMA | AC/A |
| ERCW-279B | MOV | CCWPMRMB | MCC-1E2B | 480 | 669SGRMB | AC/B |
| ERCW-295A | MOV | DG1A-ARM | MCC-1E1A | 480 | 669SGRMA | AC/A |
| ERCW-296B | MOV | DG1B-BRM | MCC-1E1B | 480 | 669SGRMB | AC/B |
| ERCW-310B | MOV | RC-SCA | MCC-1E1B | 480 | 669SGRMB | AC/B |
| ERCW-316B | MOV | RC-SCA | MCC-1E1B | 480 | 669SGRMB | AC/B |
| ERCW-323B | MOV | RC-SCA | MCC-1E2B | 480 | 669SGRMB | AC/B |
| ERCW-330B | MOV | RC-SCA | MCC-1E2B | 480 | 669SGRMB | AC/B |
| ERCW-59B | MOV | 610ABCOR | MCC-1E2B | 480 | 669SGRMB | AC/B |
| ERCW-BP11B | MDP | CCWPMRMB | BUS-28B | 480 | 669SGRMB | AC/B |
| ERCW-BP12B | MDP | CCWPMRMB | BUS-29B | 480 | 669SGRMB | AC/B |
| ERCW-BP13A | MDP | CCWPMRMA | BUS-25A | 480 | 669SGRMA | AC/A |
| ERCW-P1A | MDP | INTK-PRMA | BUS-1ET2A | 6900 | INTK-ERMA | AC/A |
| ERCW-P2A | MDP | INTK-PRMA | BUS-1ET2A | 6900 | INTK-ERMA | AC/A |
| ERCW-P3B | MDP | INTK-PRMB | BUS-1ET2B | 6900 | INTK-ERMB | AC/B |
| ERCW-P4B | MDP | INTK-PRMB | BUS-1ET2B | 6900 | INTK-ERMB | AC/B |

# 3.9 CONTAINMENT COOLING SYSTEMS

## 3.9.1 System Function

The containment cooling systems consist of the Reactor Building Spray (RBS) system and the Reactor Building Cooling (RBC) System. These systems cool the containment atmosphere and reduce containment pressure following a loss of coolant accident. The RBC system also provides reactor building cooling during normal operation. The Essential Raw Cooling Water (ERCW) system completes the heat transfer path from the RBC system to the ultimate heat sink.

## 3.9.2 System Definition

The Reactor Building Spray system consists of two redundant loops that contain a motor-driven pump, valves, a series of spray nozzles inside containment, and necessary piping and controls to draw water from the Borated Water Storage Tank (BWST) during the injection phase of operation, and from the reactor building emergency sumps during the recirculation mode of operation. There are no heat exchangers in the RBS system.

The Reactor Building Cooling System consists of three independent units, each consisting of a cooling coil and a two-speed fan enclosed in a ducting network inside the primary containment.

Simplified drawings of the RBS system are shown in Figures 3.9-1 and 3.9-2 and the RBC system is shown in Figures 3.9-3 and 3.9-4. A summary of data on selected containment cooling system components is presented in Table 3.9-1.

## 3.9.3 System Operation

During normal operation two of the three RBC units operate at full fan speed; the standby unit is isolated from the containment by a damper, but has continuous cooling water flow. Following a LOCA, the two operating units automatically provide initial cooling. An ESFAS signal indicating reactor building high pressure transfers the RBC system to its emergency mode and will: (a) reduce fan speed (to reduce power requirements), (b) reconfigure the cooling system valves, and (c) start the idle fan. The RBC system is fully operational within 30 seconds of the ESFAS signal. Cooling water is provided by the Essential Raw Cooling Water System.

The RBS system is in standby during normal operation. The reactor building high pressure signal starts the RBS pumps and opens the valves. The system is at full capacity 121 seconds after the LOCA initiation. Suction is taken initially from the BWST, but after tank water level falls to the low level setpoint, the pump suctions are automatically transferred to the reactor building emergency sumps.

## 3.9.4 System Success Criteria

Success of the containment cooling systems is based on removal of 100% of the required heat ($296 \times 10^6$ Btu/hr) from the containment. Minimum system availability required to adequately cool the Reactor Building can be any of the following combinations of the RBS and RBC trains:

- Full capacity of the RBS System (i.e., two of two RBS trains)
- Two-thirds capacity of the RBC System, or (i.e.,two of three RBC coolers)
- One-third capacity of the RBC System and one-half capacity of the RBS System (i.e., one of three RBC coolers plus one of two RBS trains)

### 3.9.5 Component Information

A. Reactor Building Spray Pumps 1A, 2B
   1. Rated flow: 2040 gpm @ 575 ft. heat (250 psid)
   2. Rated capacity: 50%
   3. Type: Centrifugal

B. Reactor Building Cooling Units 1A1-A, 1B1-B, 1B2-B
   1. Design heat load: $148 \times 10^6$ Btu/hr
   2. Rated capacity: 50%

### 3.9.6 Support Systems and Interfaces

A. Control Signals
   1. Automatic
      a. An ES[illegible] signal will start the RBS pumps and any idle RBC units on high p[illegible] in the primary containment.
      b. On[illegible]C units will be shifted from fast to slow speed.
   2. Rem[illegible]
      The [illegible] and RBC units can be started by remote manual means from [illegible]oom.

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

C. Other
   1. The RBC units are cooled by the Essential Raw Cooling Water System (ERCWS, see Section 3.8). Note that the ERCW booster pumps increase the water pressure in the supply line to each RBC unit so that any leakage will be into the containment, and flashing will not occur in the coolers.
   2. The RBS pump seals are cooled by the Component Cooling System (see Section 3.7).
   3. The RBS pumps and RBC fan cooler units are assumed to be locally lubricated.
   4. Room coolers (air handling units, AHUs) are provided for each RBS pump room. The AHUs are cooled by the ERCWS (see Section 3.8) and are powered from 480 VAC Class 1E MCCs 1E2-A (pump room 1A) and 1E2-B (pump room 1B).

### 3.9.7 Section 3.9 References

1. Bellefonte 1 & 2 Final Safety Analysis Report, Section 6.2.2.

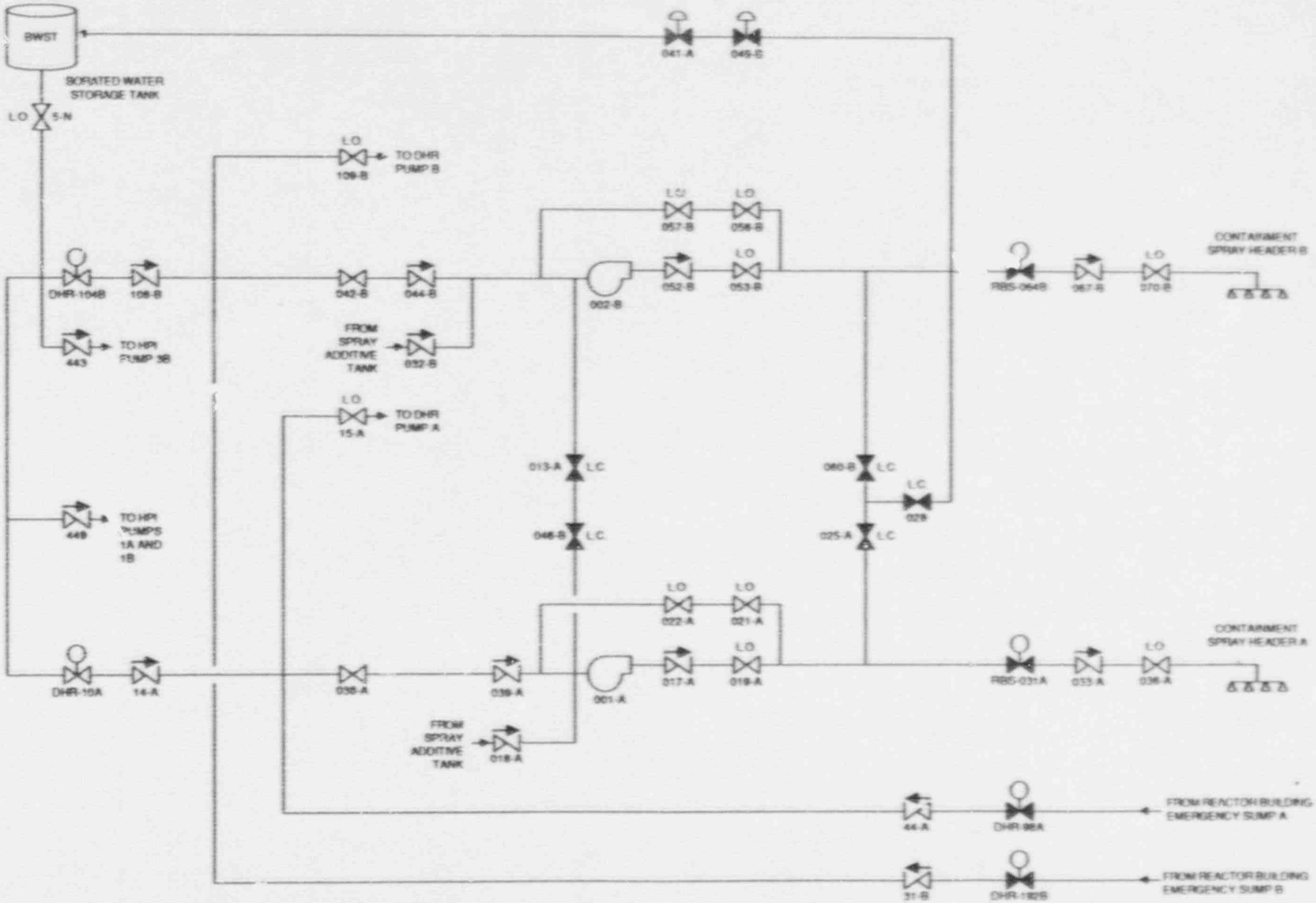



**Figure 3.9-1. Bellefonte 1 Reactor Building Spray System**

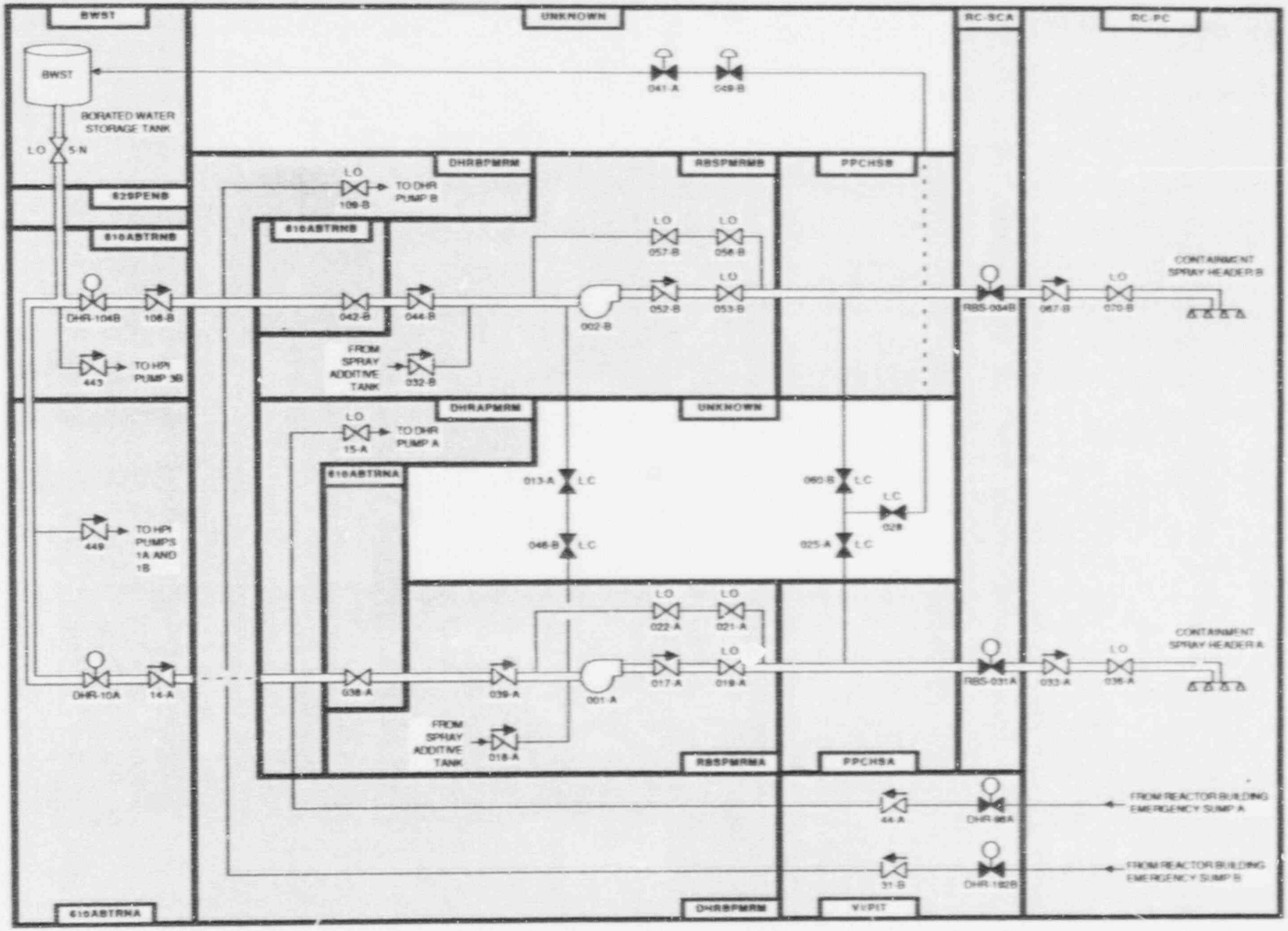



Figure 3.9-2. Bellefonte 1 Reactor Building Spray System, Injection Mode Showing Component Locations

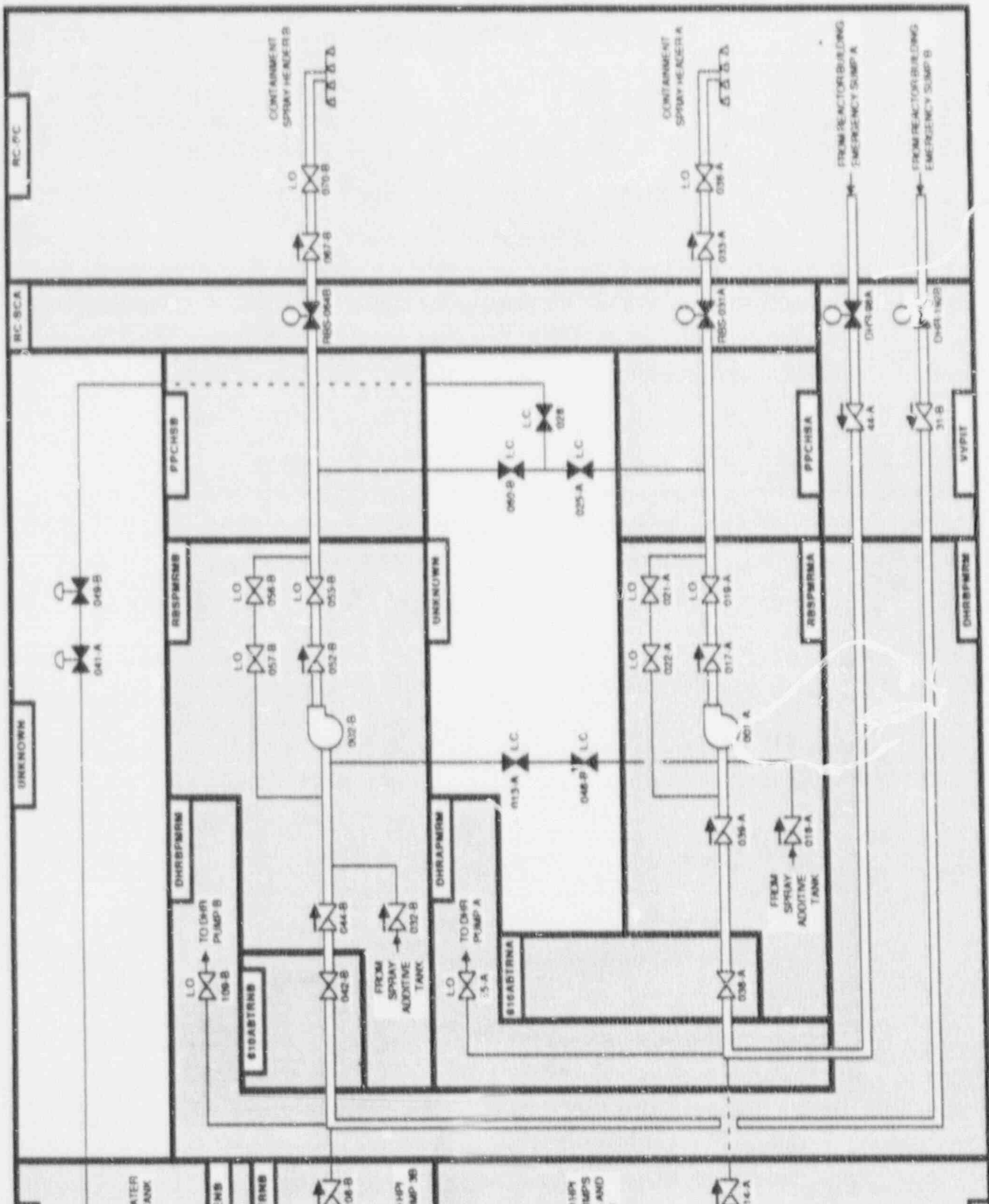



Figure 3.9-3. Bellefonte 1 Reactor Building Spray System, Recirculation Mode Showing Component Locations

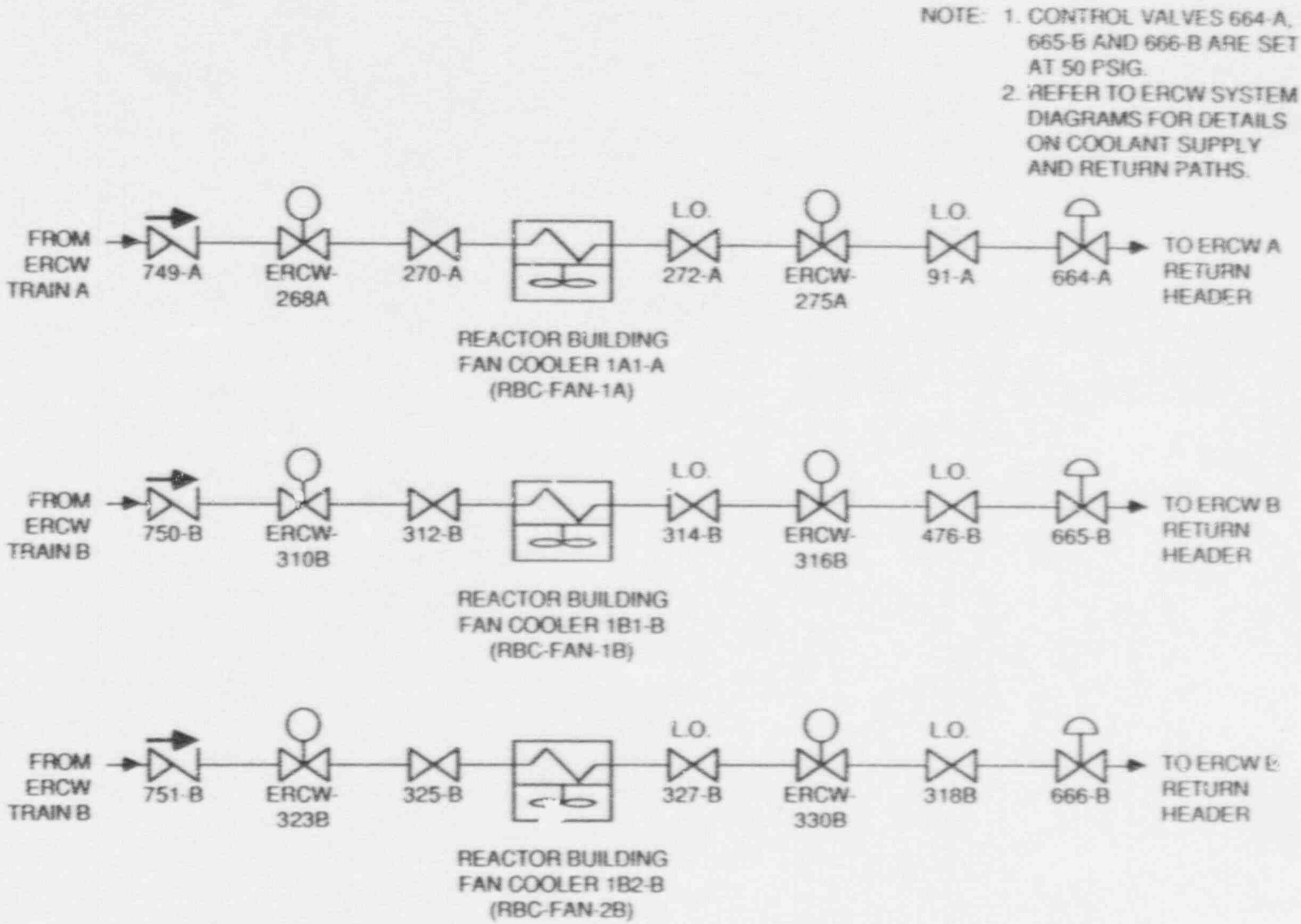



**Figure 3.9-4. Bellefonte 1 Reactor Building Cooling System**

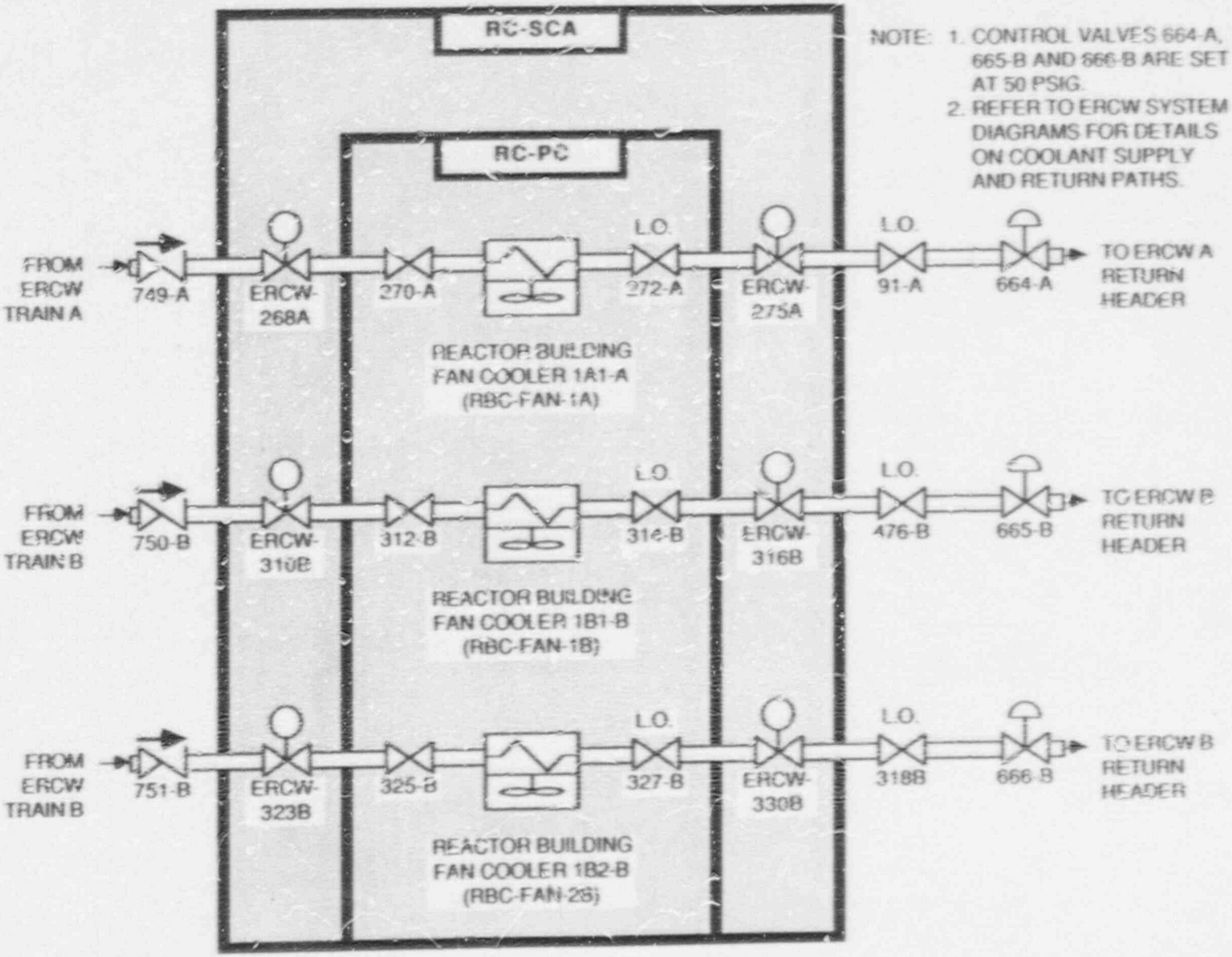



**Figure 3.9-5. Bellefonte 1 Reactor Building Cooling System Showing Component Locations**

Table 3.9-1. Bellefonte 1 Containment Cooling System Data Summary for Selected Components

| COMPONENT ID | COMP. TYPE | LOCATION | POWER SOURCE | VOLTAGE | POWER SOURCE LOCATION | EMERG. LOAD GRP. |
|---|---|---|---|---|---|---|
| BWST | TK | BWST | | | | |
| DHR-104A | MOV | 610ABTRNA | MCC-1E2A | 480 | 669SGRMA | AC/A |
| DHR-104B | MOV | 610ABTRNB | MCC-1E2B | 480 | 669SGRMB | AC/B |
| RBC-FAN-1A | FAN | RC-PC | BUS-25A | 480 | 669SGRMA | AC/A |
| RBC-FAN-1B | FAN | RC-PC | BUS-28B | 480 | 669SGRMB | AC/B |
| RBC-FAN-2B | FAN | RC-PC | BUS-29B | 480 | 669SGRMA | AC/B |
| RBS-31A | MOV | RC-SCA | MCC-1E2A | 480 | 669SGRMA | AC/A |
| RBS-64B | MOV | RC-SCA | MCC-1E2B | 480 | 669SGRMB | AC/B |
| RBS-P1A | MDP | RBSAPMRM | BUS-1ET1A | 6900 | 649SGRMA | AC/A |
| RBS-P1B | MDP | RBSBPMRM | BUS-1ET1B | 6900 | 649SGRMB | AC/B |
| SUMP-1A | TK | RC-PC | | | | |
| SUMP-1B | TK | RC-PC | | | | |

# 4. PLANT INFORMATION

## 4.1 SITE AND BUILDING SUMMARY

The Bellefonte site is located about seven miles from the city of Scottsboro, in Jackson County in north-east Alabama on the west side of the Gunterville Reservoir which is supplied from the Tennessee River. A general view of the Bellefonte site and vicinity is shown in Figure 4-1 (from Ref. 1) and a simplified plot plan is shown in Figure 4-2. The major structures at this two-unit site include the containment buildings, auxiliary, control, turbine, and service/office buildings, and two hyperbolic natural draft cooling towers.

Bellefonte 1 and 2 have steel-lined, post-tensioned concrete primary containments surrounded by a free-standing reinforced concrete secondary containment building. The Auxiliary Building, located between the two containments, houses the purification and makeup system, component cooling system, the Class 1E electric power distribution system, and the spent fuel storage pools as well as front-line transient and LOCA mitigating systems (i.e., AFW system, ECCS, and Reactor Building Spray System). The Auxiliary Control Room also is located in the Auxiliary Building.

The Control Building is located on the west side of the Auxiliary Building, with the Unit 1 Diesel Generator Building to the north, the Unit 2 Diesel Generator Building to the south and the Turbine Building to the West. The main control room is on the 673 foot elevation of the Control Building, with the cable spreading room immediately below.

The Intake Pumping Station is located at the end of an intake channel from the Gunterville Reservoir and houses the Essential Raw Cooling Water pumps for both units. The ERCW system provides cooling to the Component Cooling System and other essential equipment and systems.

Each unit has a closed-cycle cooling system single hyperbolic natural draft cooling tower that rejects heat from the Balance-of-Plant to the atmosphere. These cooling towers do not serve as the ultimate heat sink for safety-related systems. ERCW discharge water serves as makeup to the natural draft cooling tower basins.

## 4.2 FACILITY LAYOUT DRAWINGS

Elevation views of the the Bellefonte containment and auxiliary, control and turbine buildings are shown in Figures 4-3 to 4-5. Simplified layout drawings for the Bellefonte 1 containment, auxiliary, and control buildings are presented in Figures 4-6 to 4-13. Similar layout drawings for Bellefonte 2 are shown in Figures 4-14 to 4-21. Elevation views of the diesel generator building are shown in Figure 4-22. Layout drawings for the Unit 1 and Unit 2 diesel generator buildings are shown in Figures 4-23 to 4-28. The Intake Pumping Station is shown in elevation in Figure 4-29 and in plan view in Figures 4-30 to 4-32. The fire water pump room is shown in Figure 4-33.

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

## 4.3 SECTION 4 REFERENCES

1. Heddleson, F. A., "Design Data and Safety Features of Commercial Nuclear Power Plants", ORNL-NSIC-55. Volume III, Oak Ridge National Laboratory, April 1974.

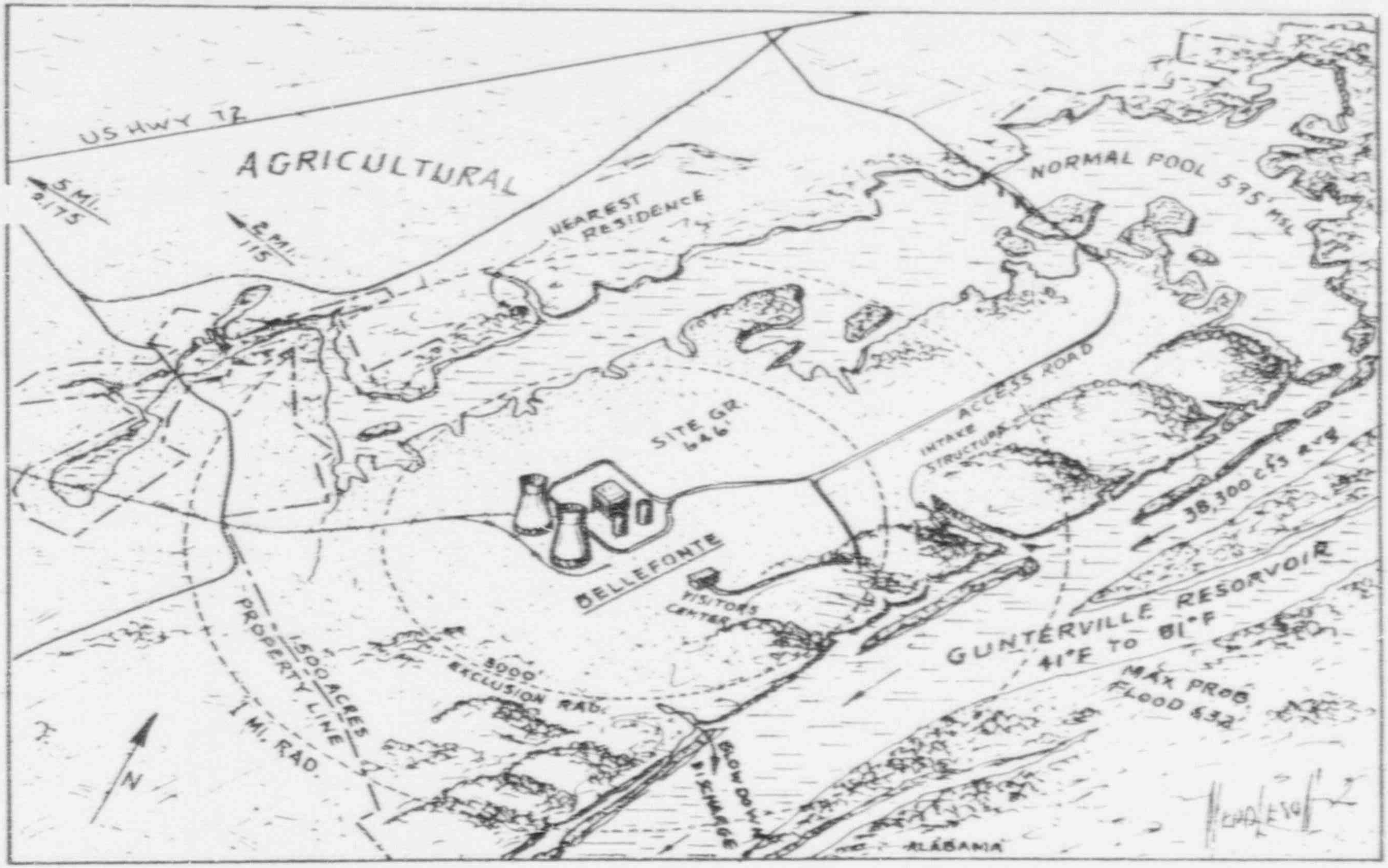



Figure 4-1. General View of the Bellefonte Site and Vicinity

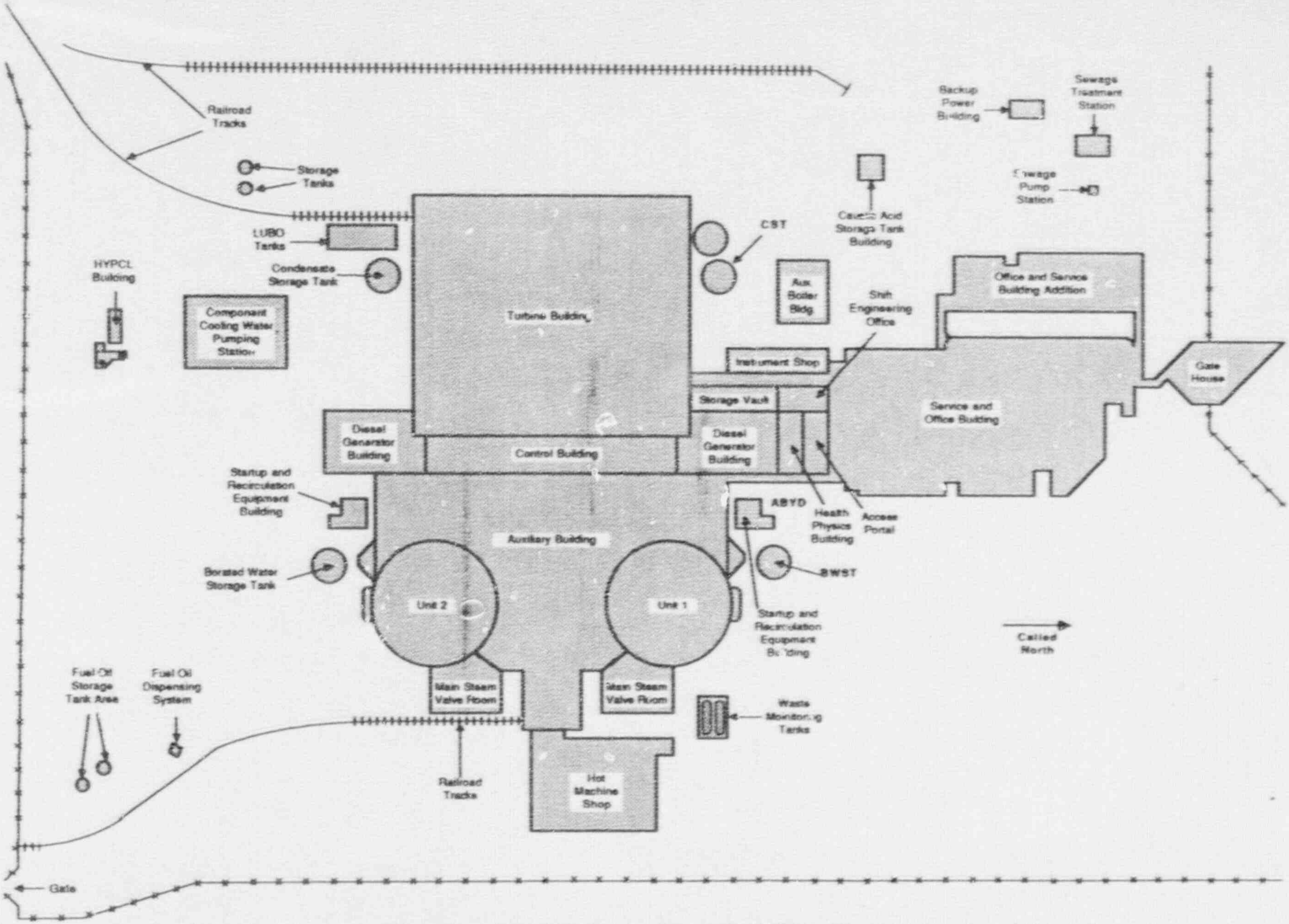



**Figure 4-2. Bellefonte Simplified Plot Plan**

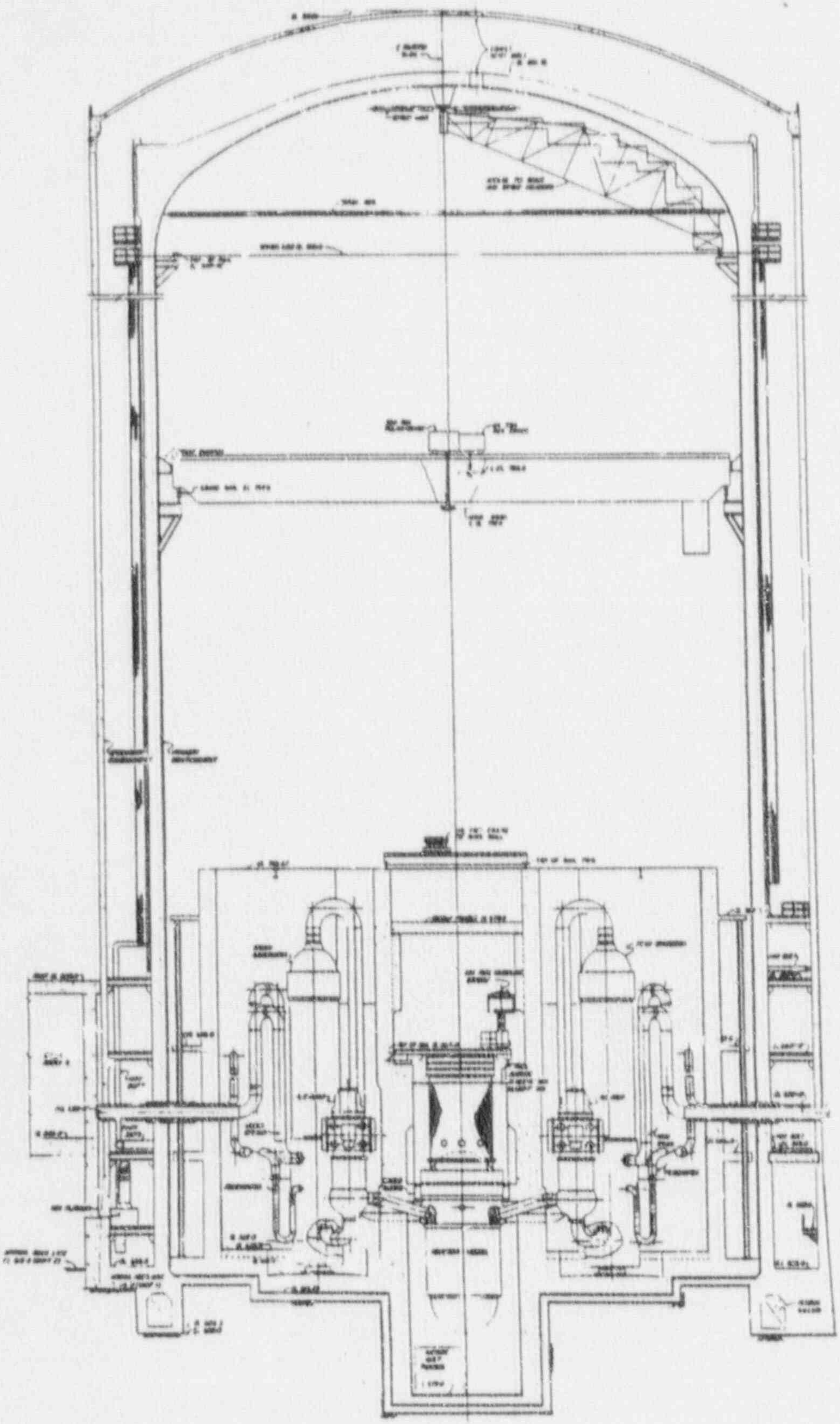


Figure 4-3. Elevation View of the Bellefonte Containment

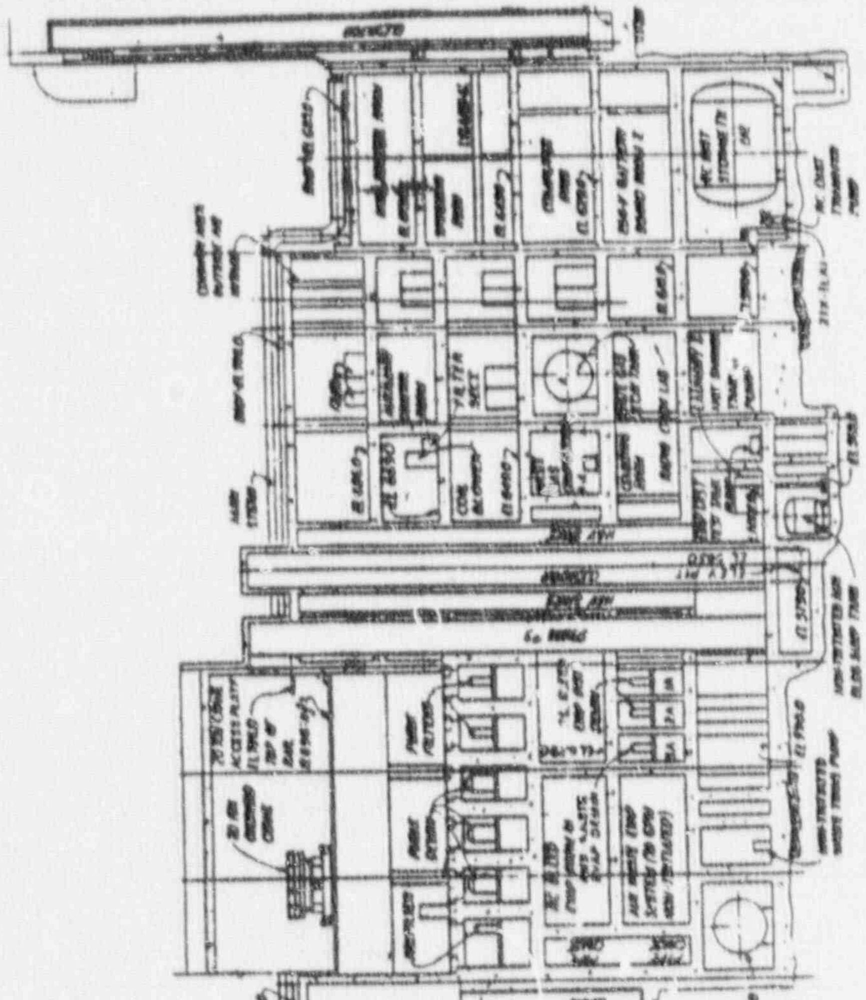


Figure 4-4. Elevation Views of the Bellefonte Auxiliary and Control Buildings (Sheet 1 of 2)

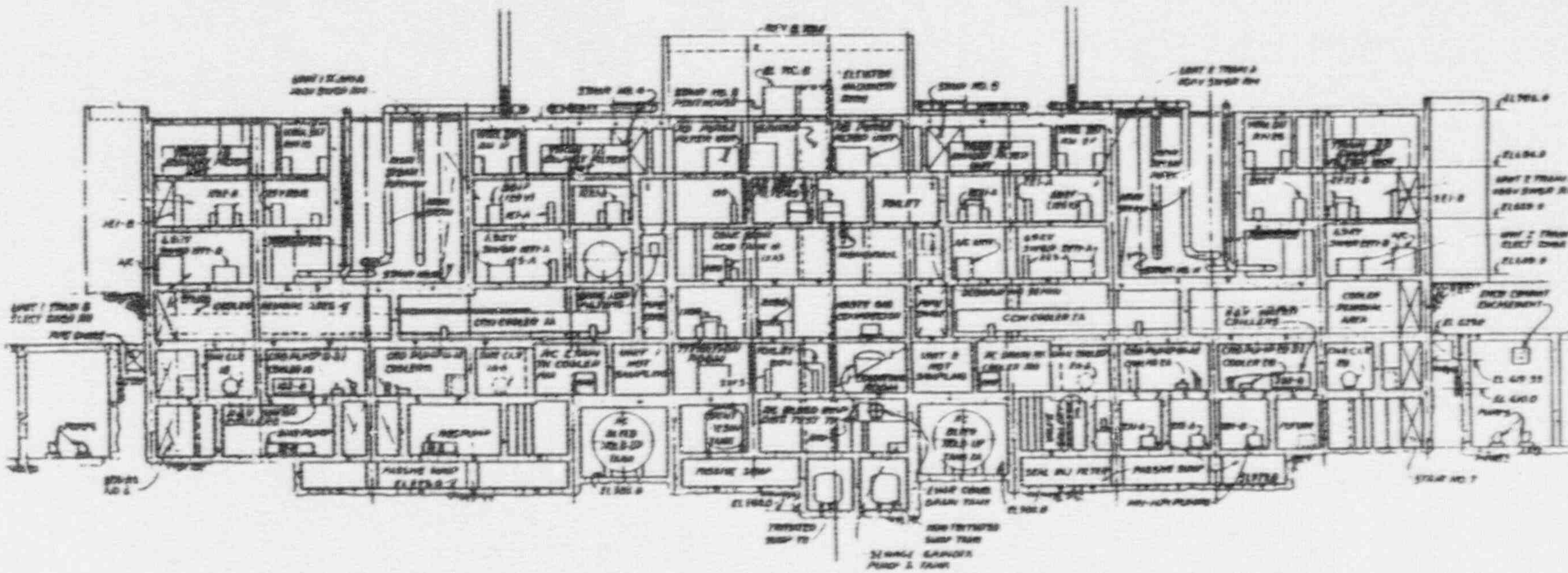


Figure 4-4. Elevation Views of the Bellefonte Auxiliary and Control Buildings (Sheet 2 of 2)

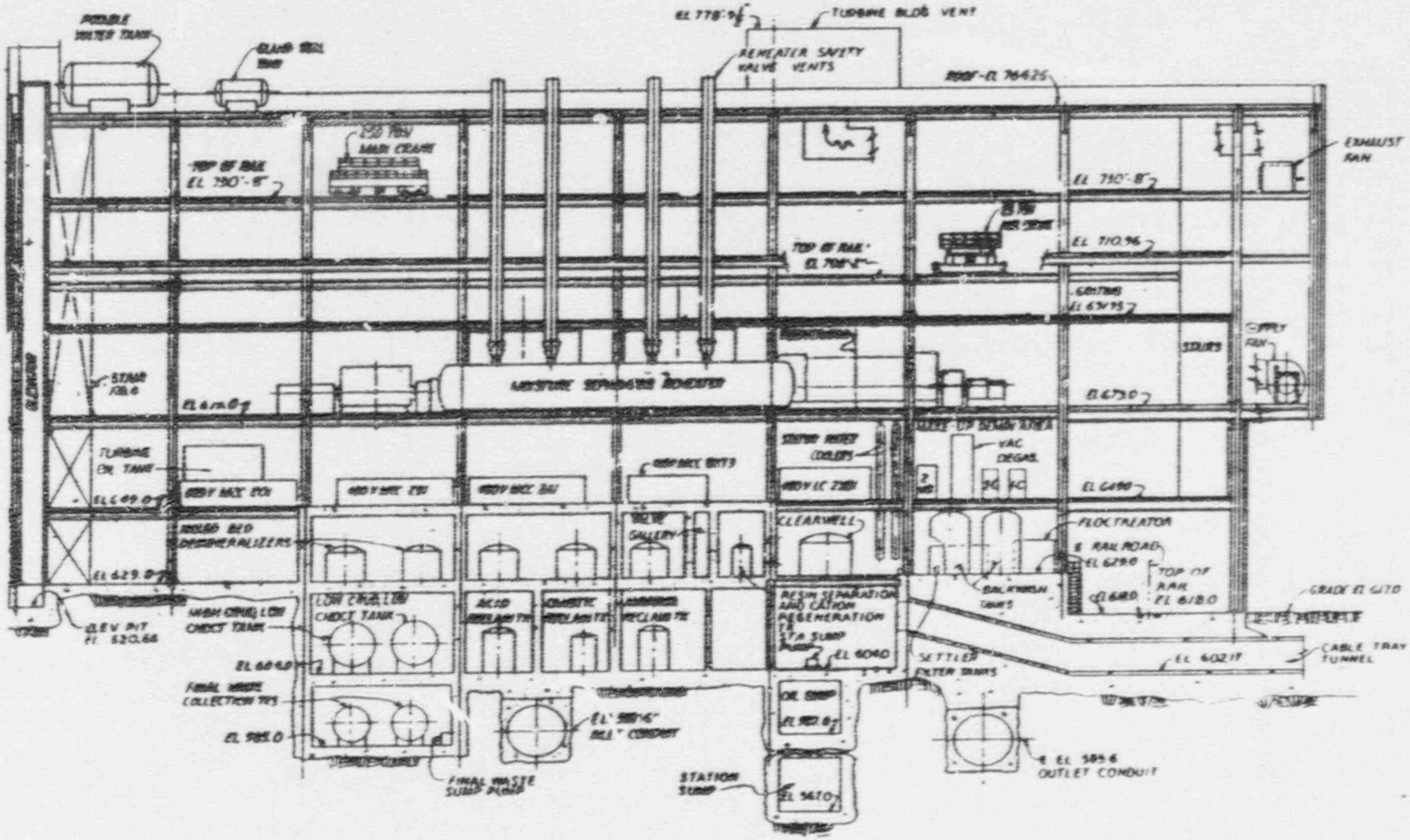



Figure 4-5. Elevation Views of the Bellefonte Turbine Building (Sheet 1 of 2)

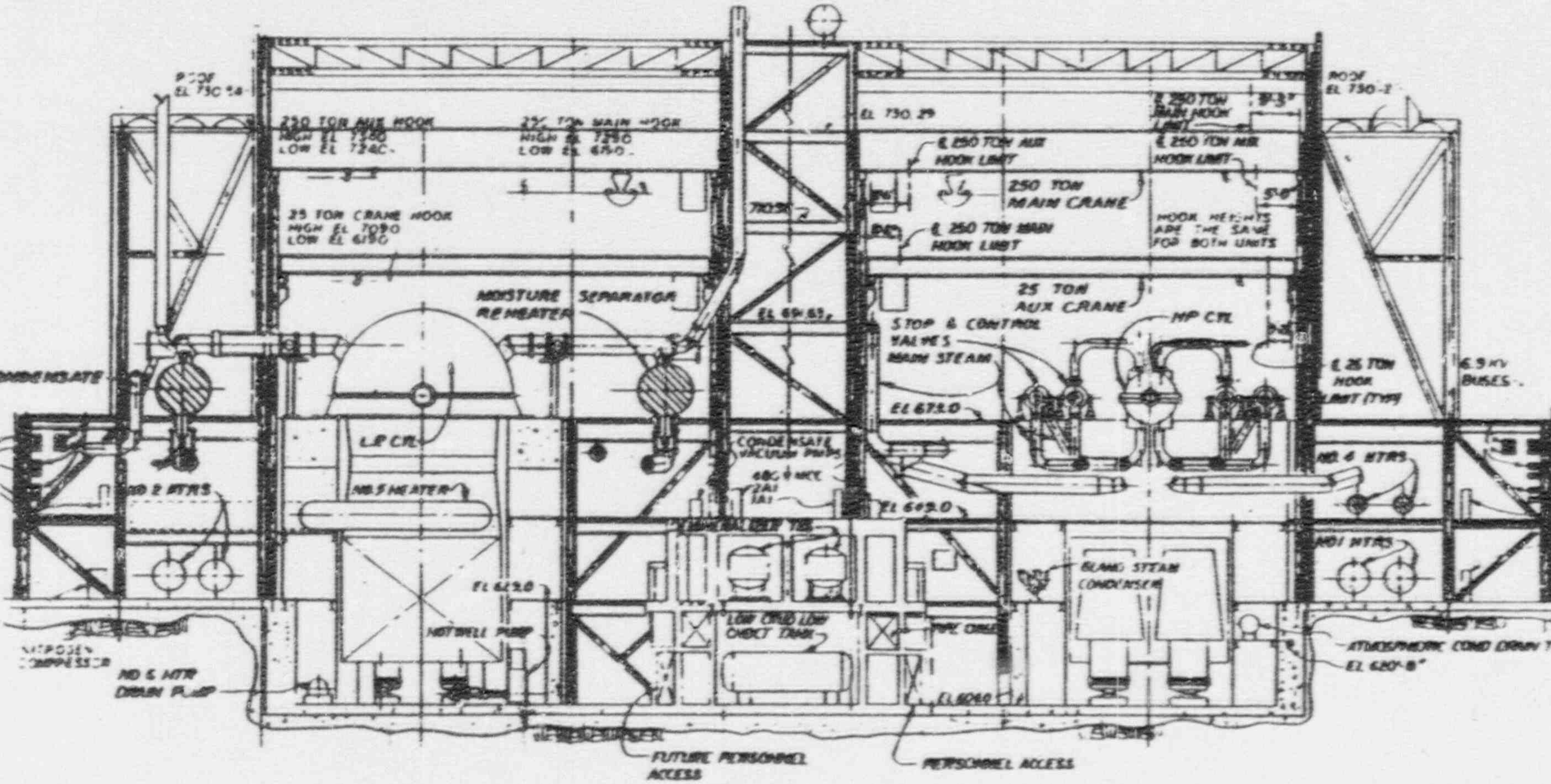



Figure 4-5. Elevation Views of the Bellefonte Turbine Building (Sheet 2 of 2)

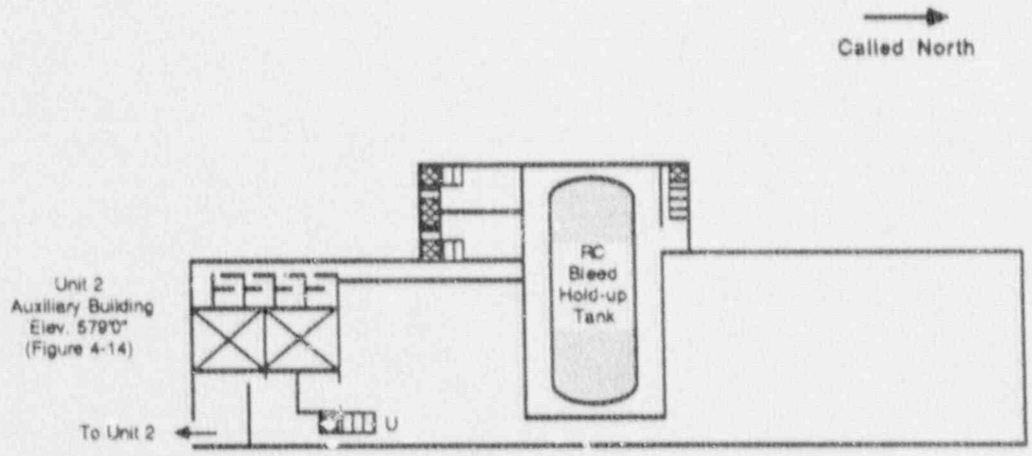



Figure 4-6. Bellefonte 1 Auxiliary Building, Elevation 579'-0"

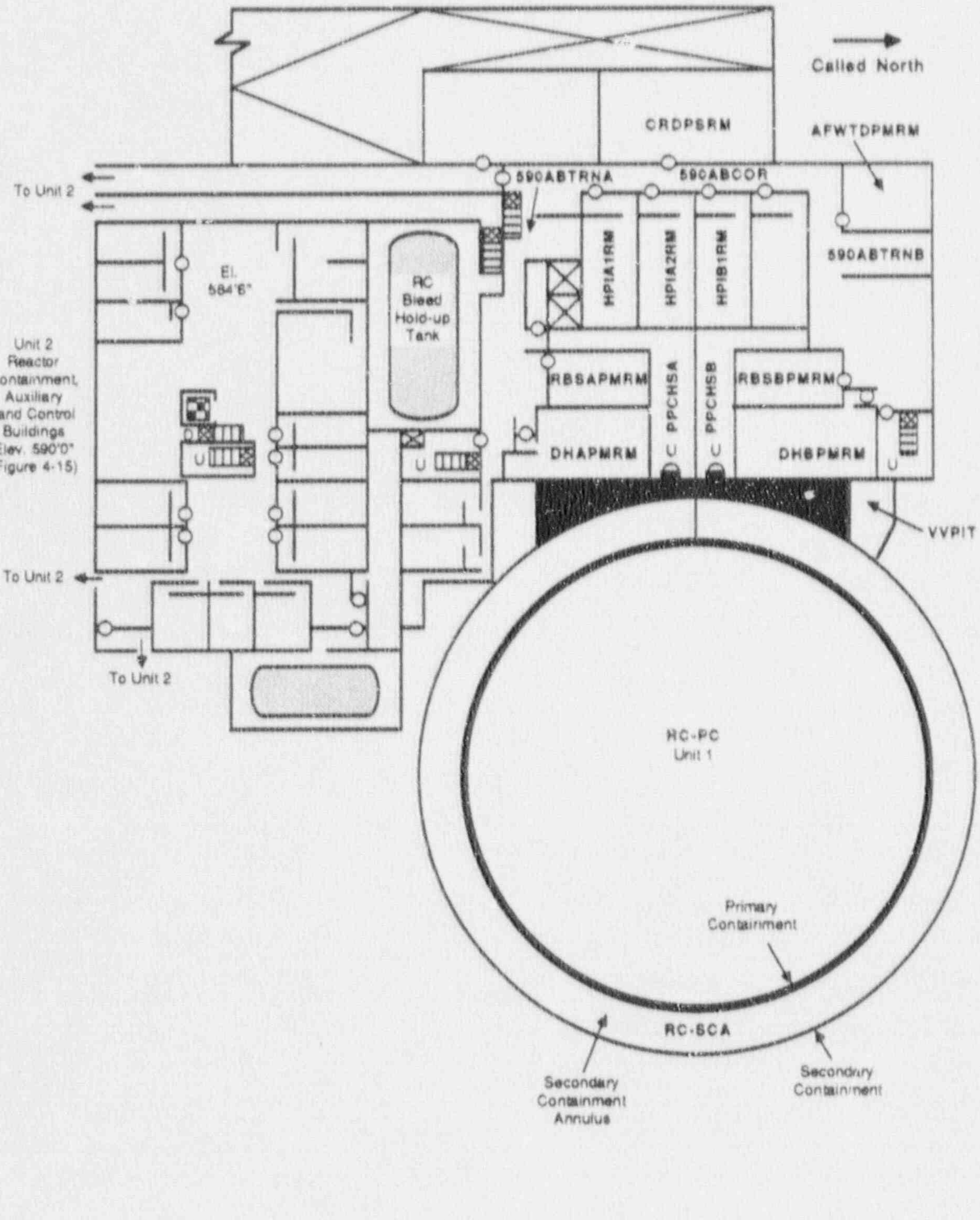



Figure 4-7. Bellefonte 1 Reactor Containment, Auxiliary and Control Buildings, Elevation 590'-0"

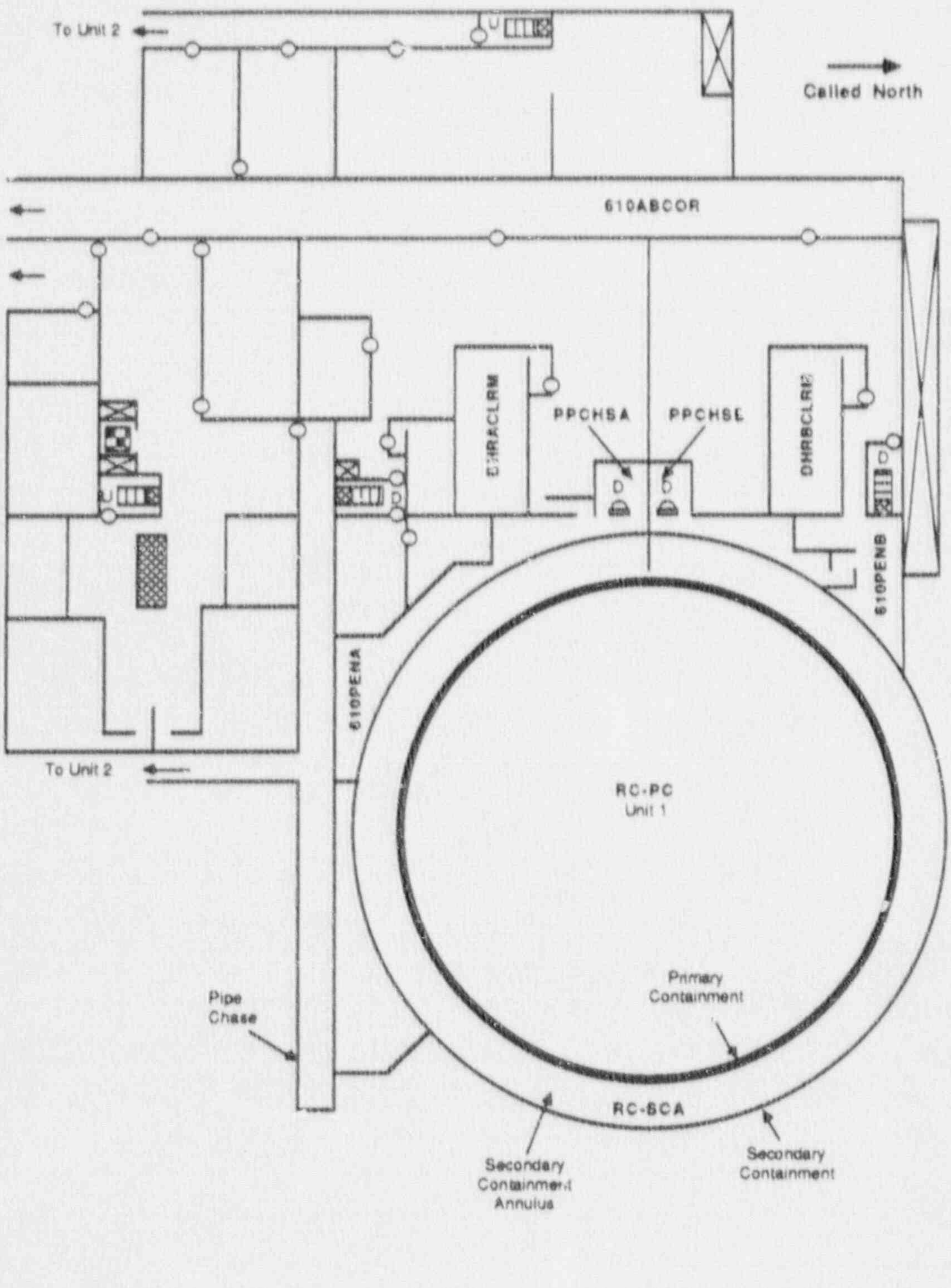



Figure 4-8. Bellefonte 1 Reactor Containment, Auxiliary and Control Buildings, Elevation 610'-0"

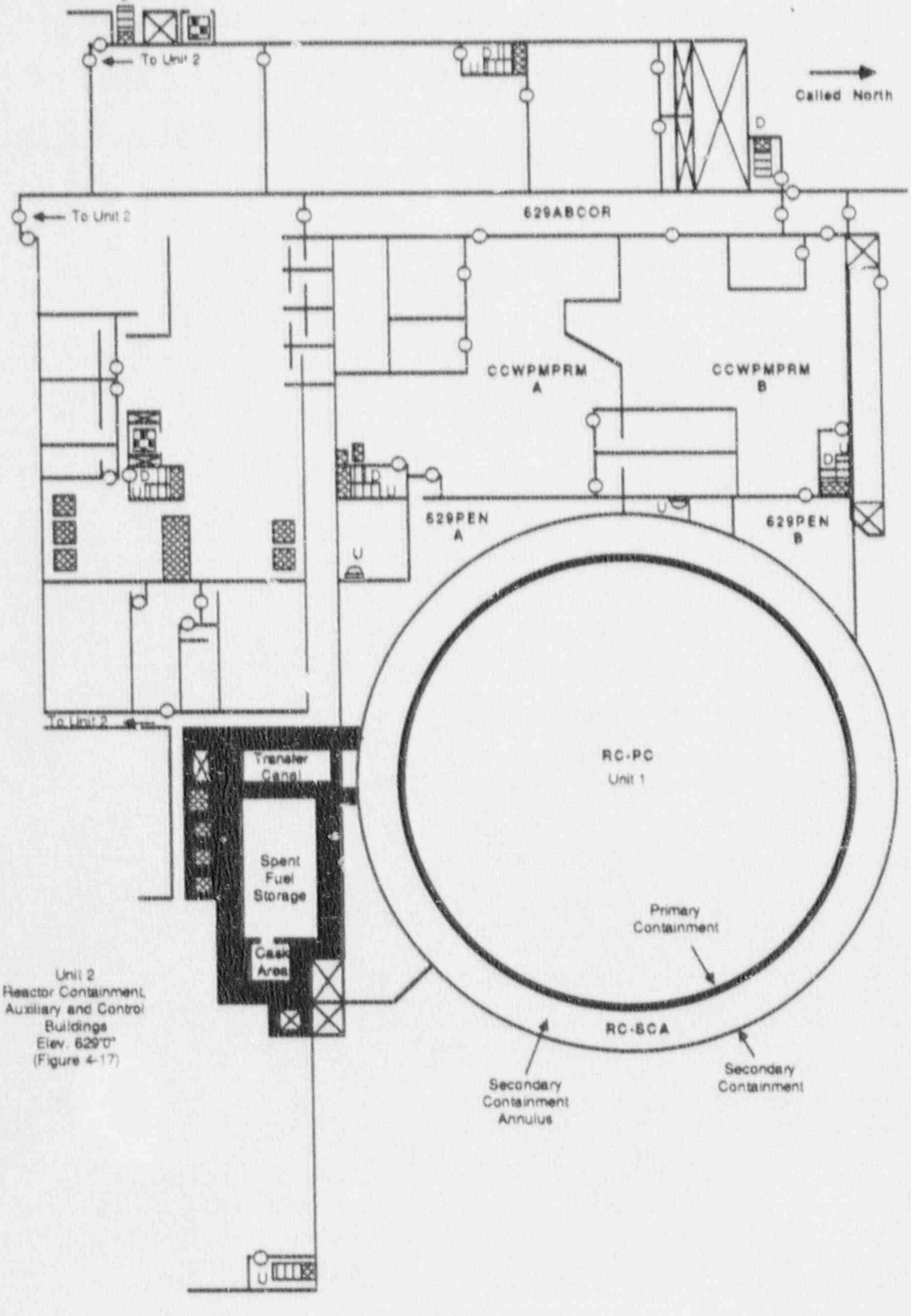



Figure 4-9. Bellefonte 1 Reactor Containment, Auxiliary and Control Buildings, Elevation 629'0"

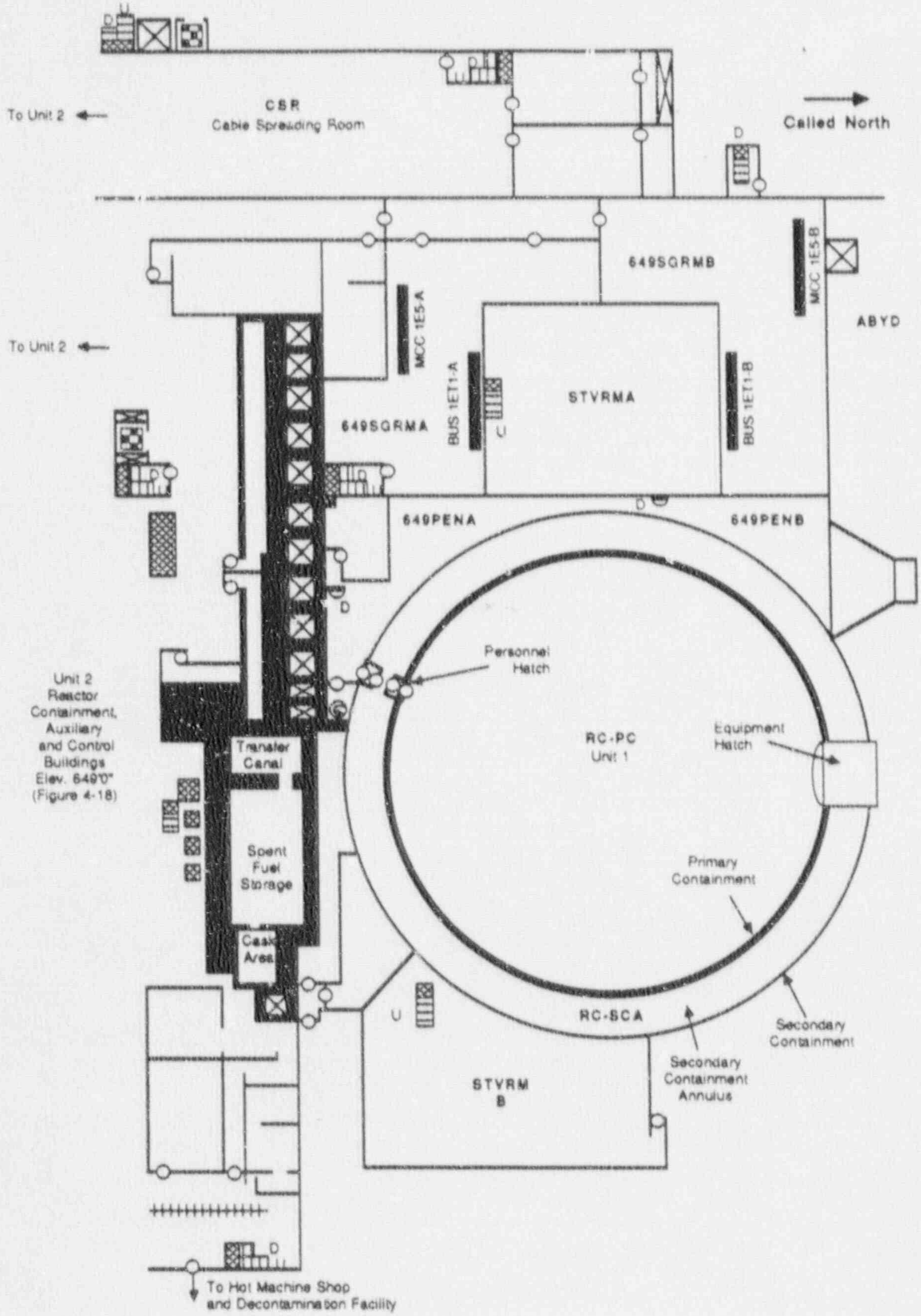



Figure 4-10. Bellefonte 1 Reactor Containment, Auxiliary and Control Buildings, Elevation 649'0"

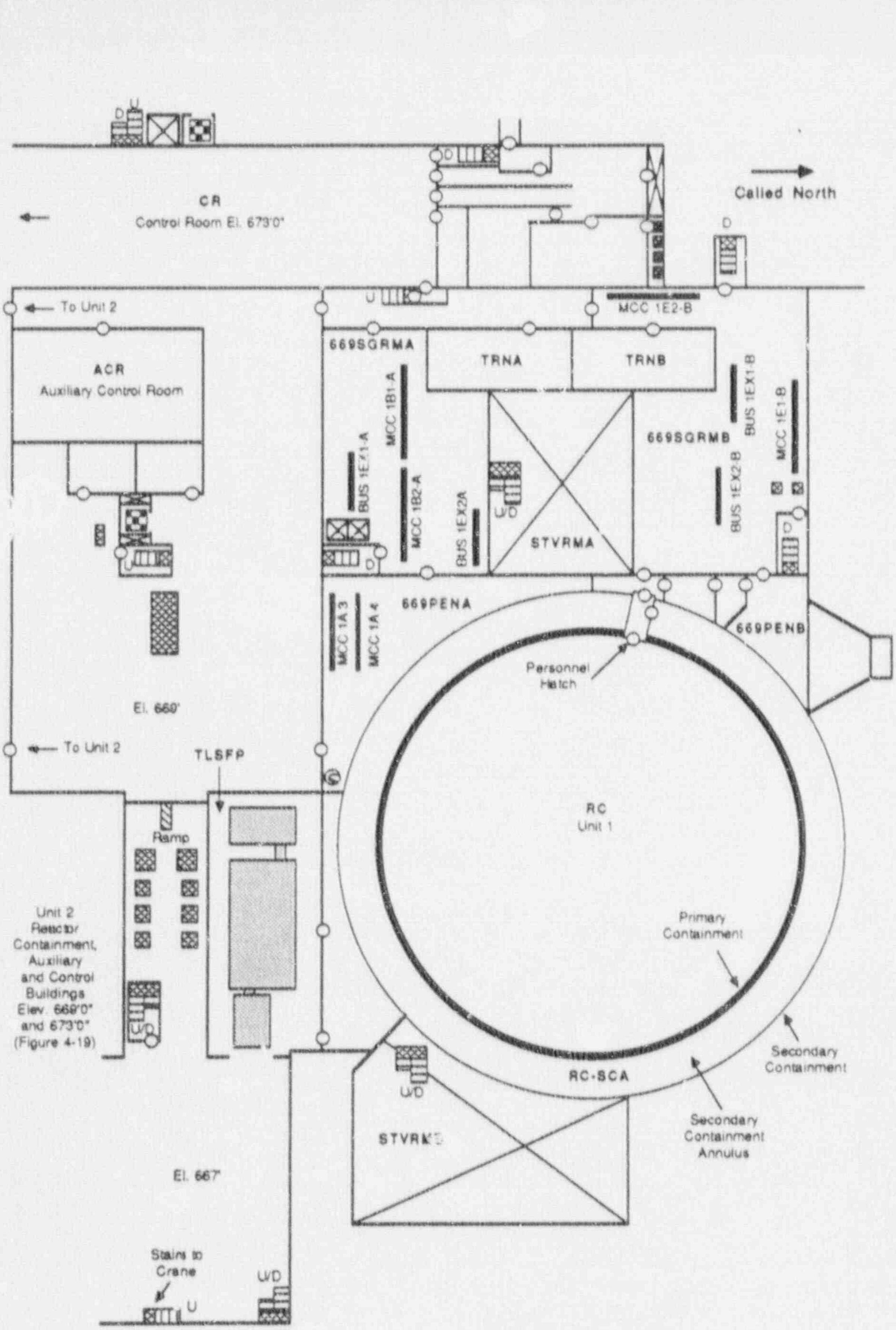



Figure 4-11. Bellefonte 1 Reactor Containment, Auxiliary and Control Buildings, Elevation 669'0" and 673'0"

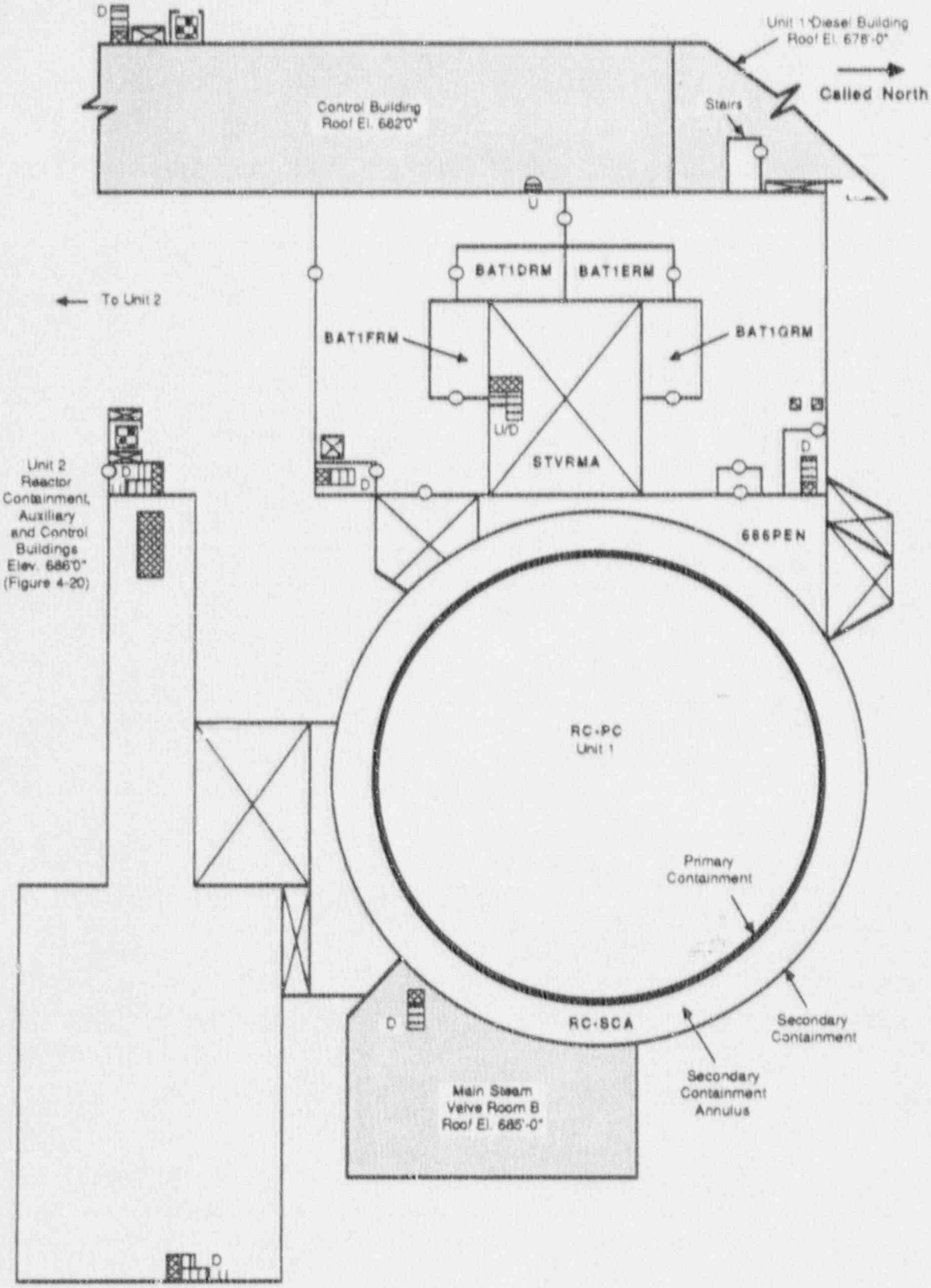



Figure 4-12. Bellefonte 1 Reactor Containment, Auxiliary and Control Buildings, Elevation 686'-0"

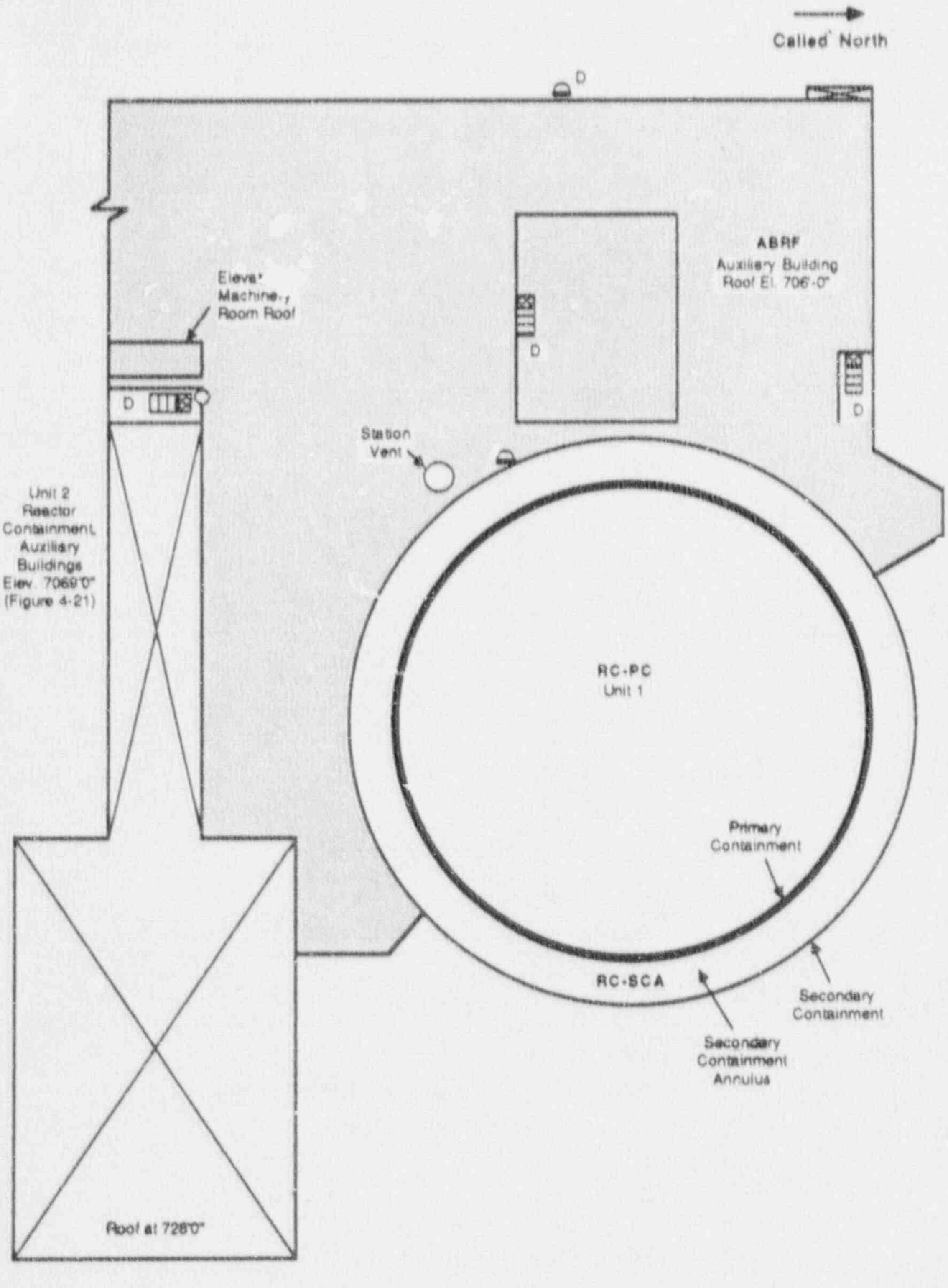



Figure 4-13. Bellefonte 1 Reactor Containment and Auxiliary Buildings, Elevation 706'-0"

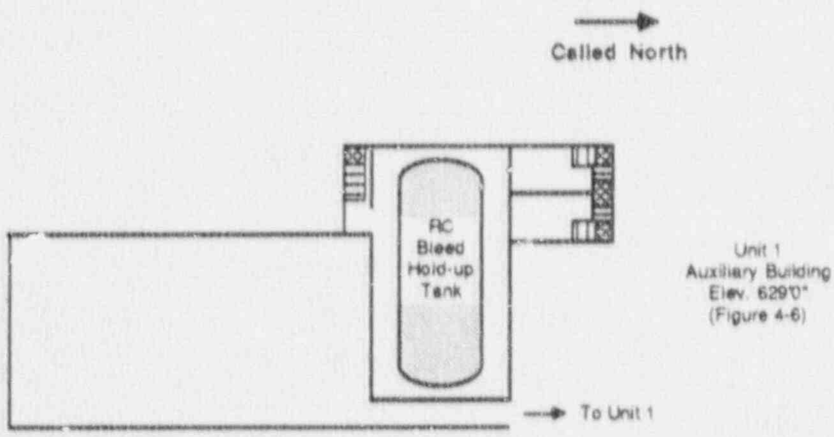



**Figure 4-14. Bellefonte 2 Auxiliary Building, Elevation 579'-0"**

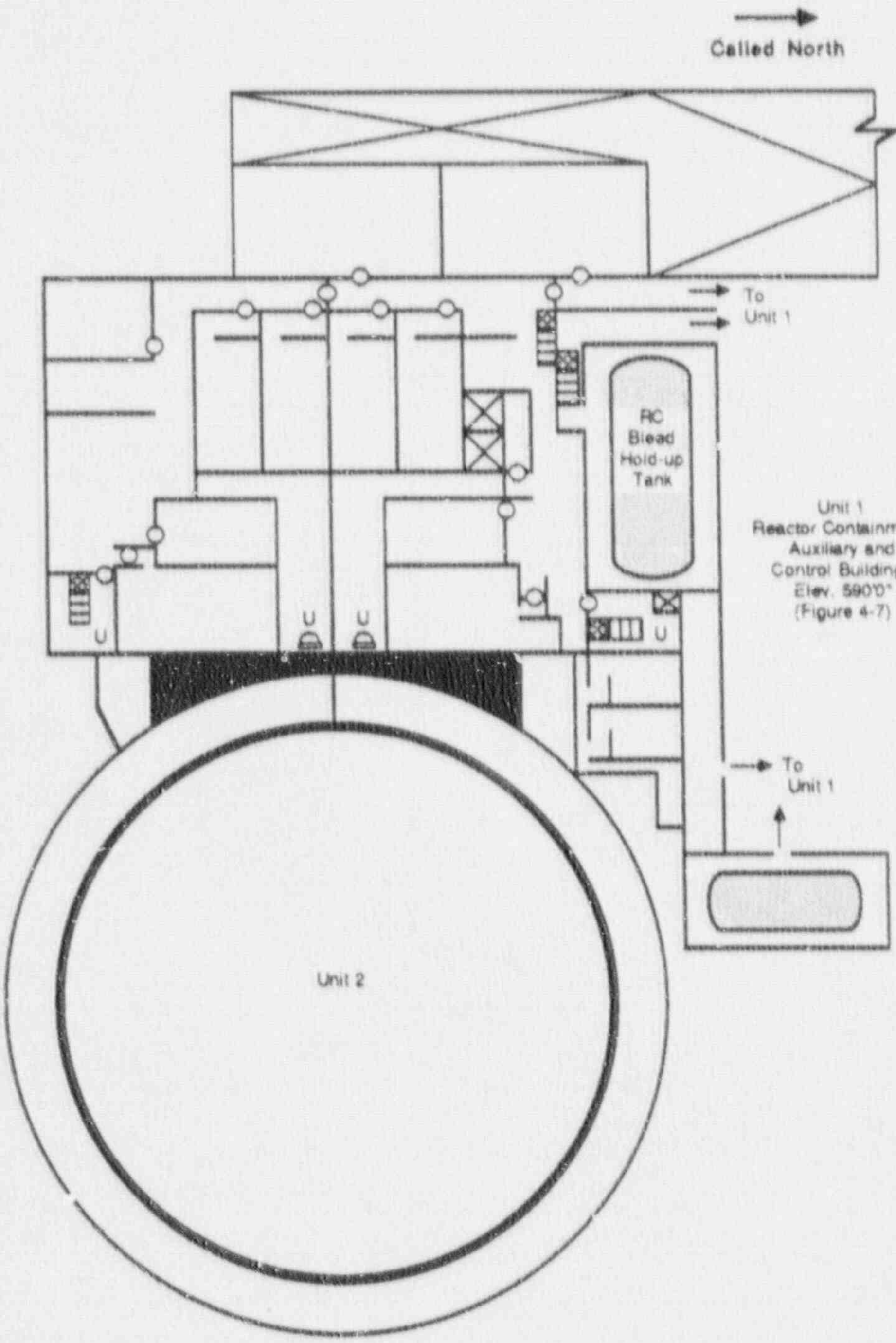



Figure 4-15. Bellefonte 2 Reactor Containment, Auxiliary and Control Buildings, Elevation 590'-0"

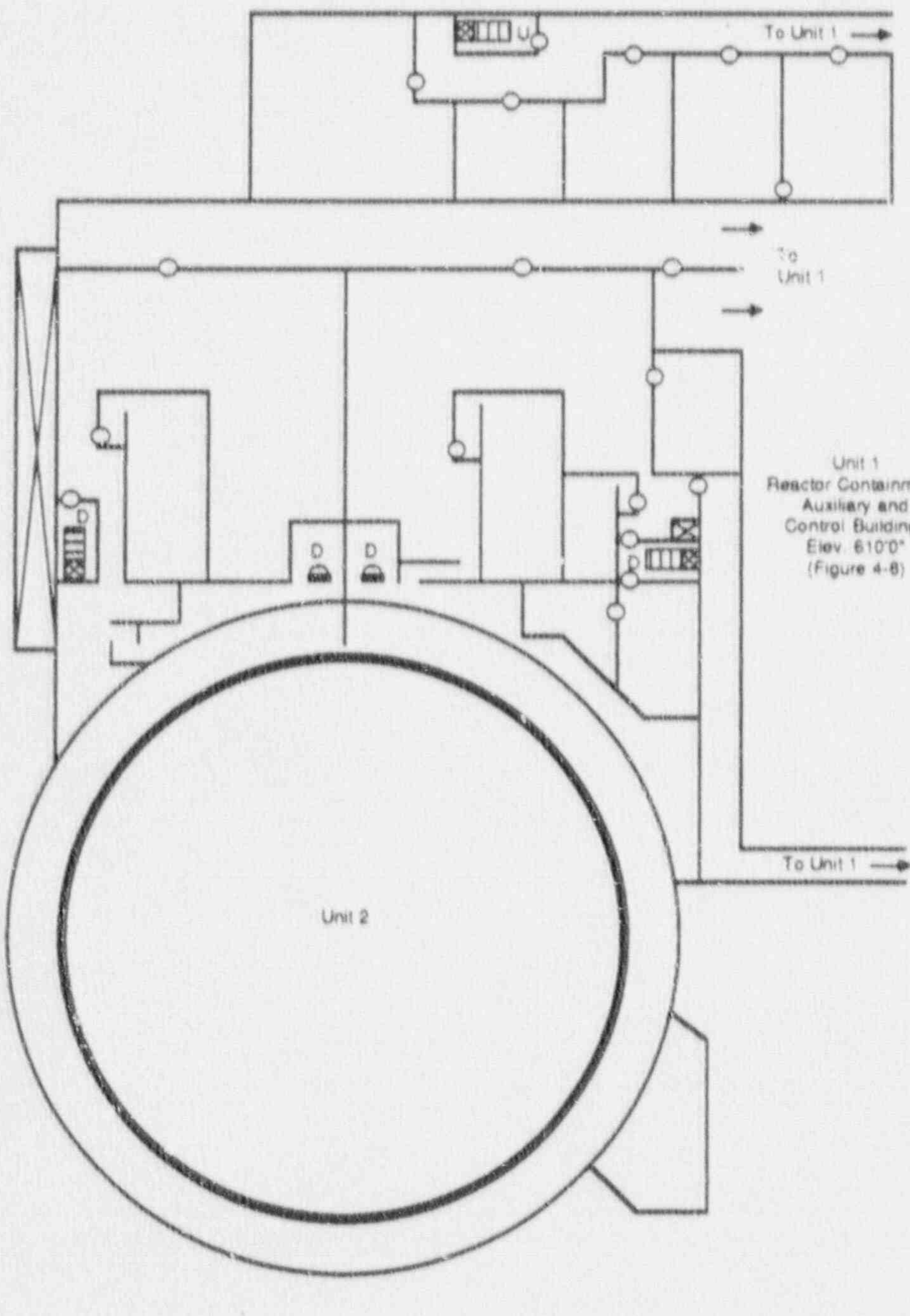



Figure 4-16. Bellefonte 2 Reactor Containment, Auxiliary and Control Buildings, Elevation 610'-0"

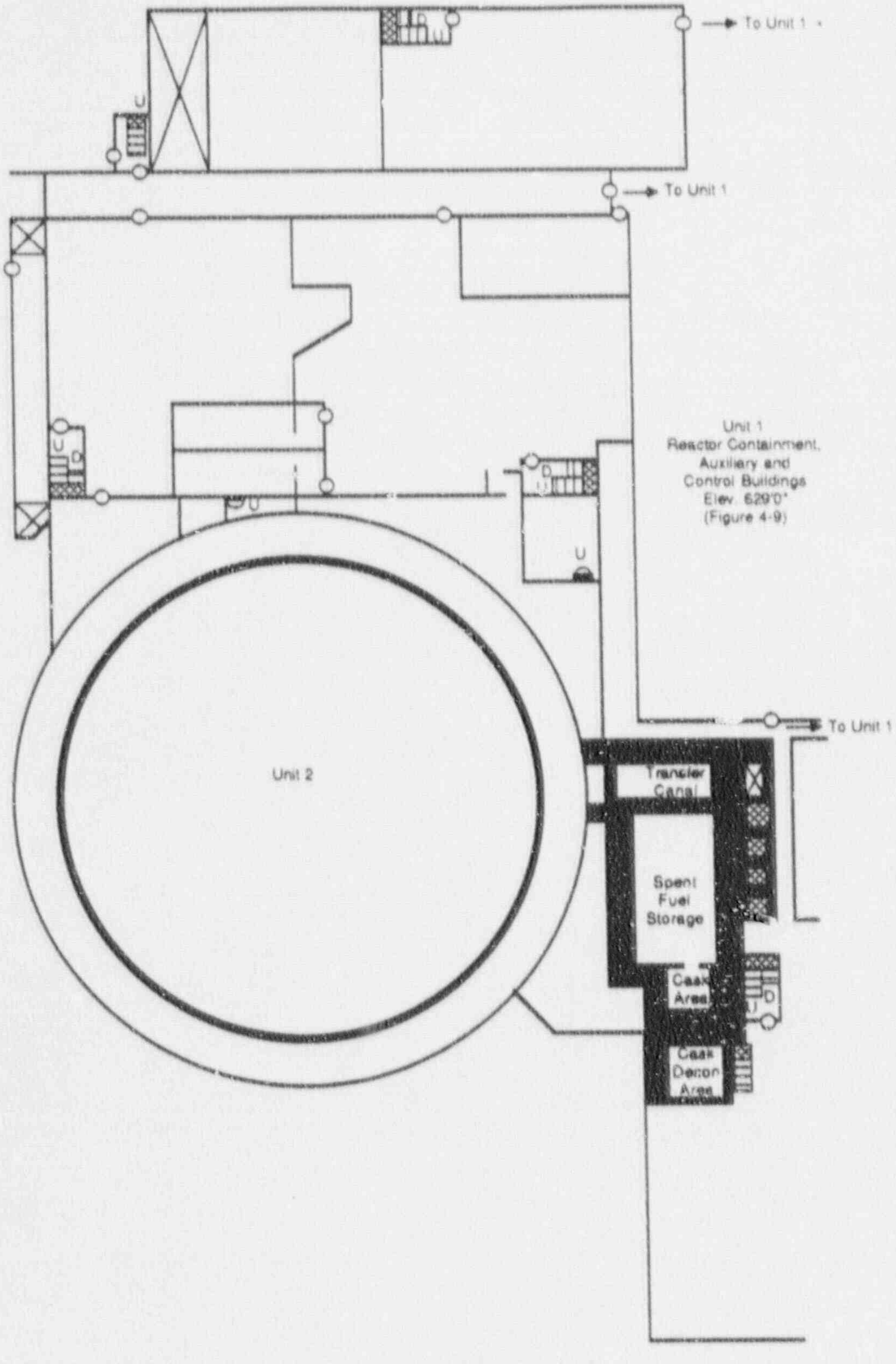



Figure 4-17. Bellefonte 2 Reactor Containment, Auxiliary and Control Buildings, Elevation 629'0"

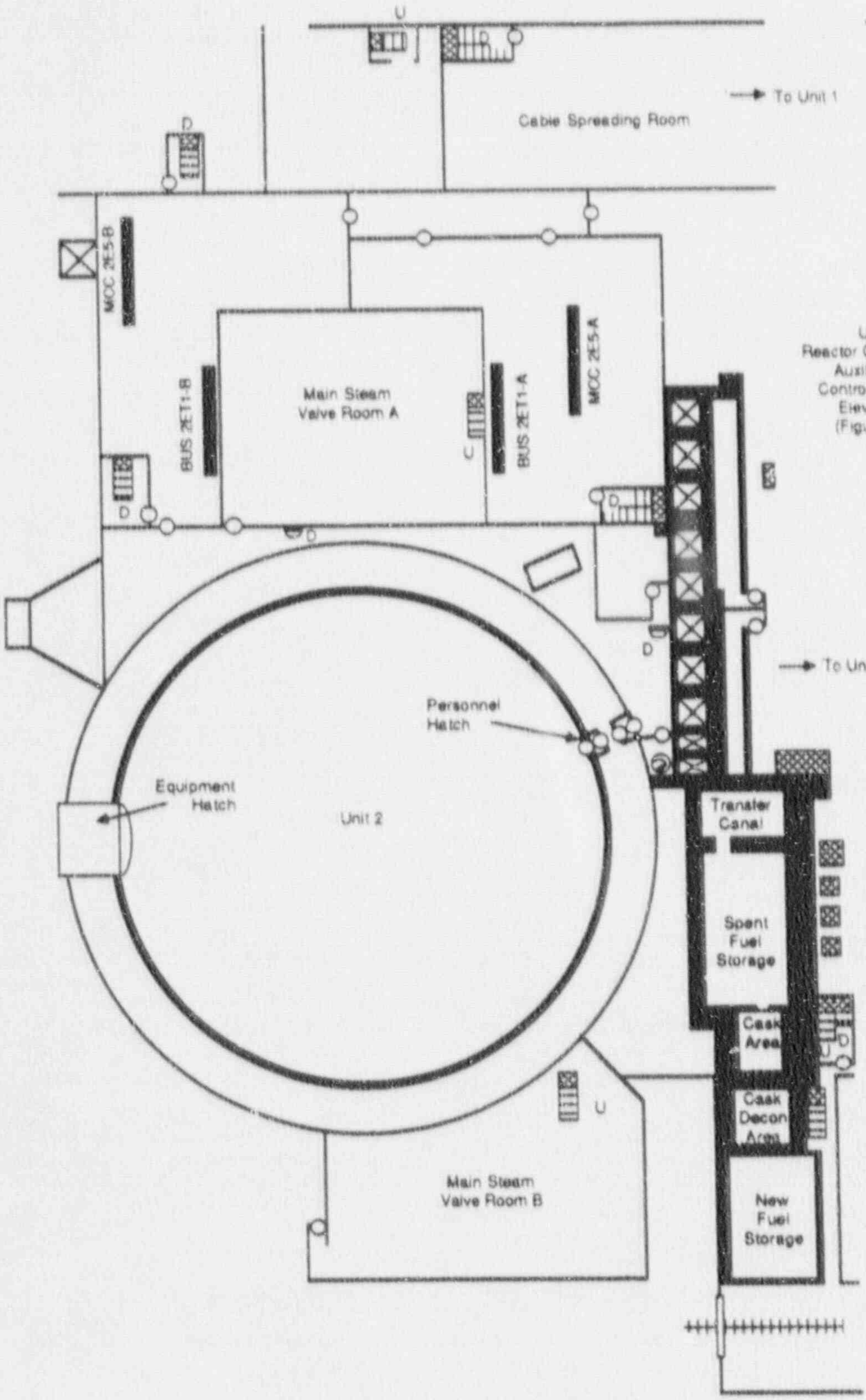



**Figure 4-18. Bellefonte 2 Reactor Containment, Auxiliary and Control Buildings, Elevation 649'0"**

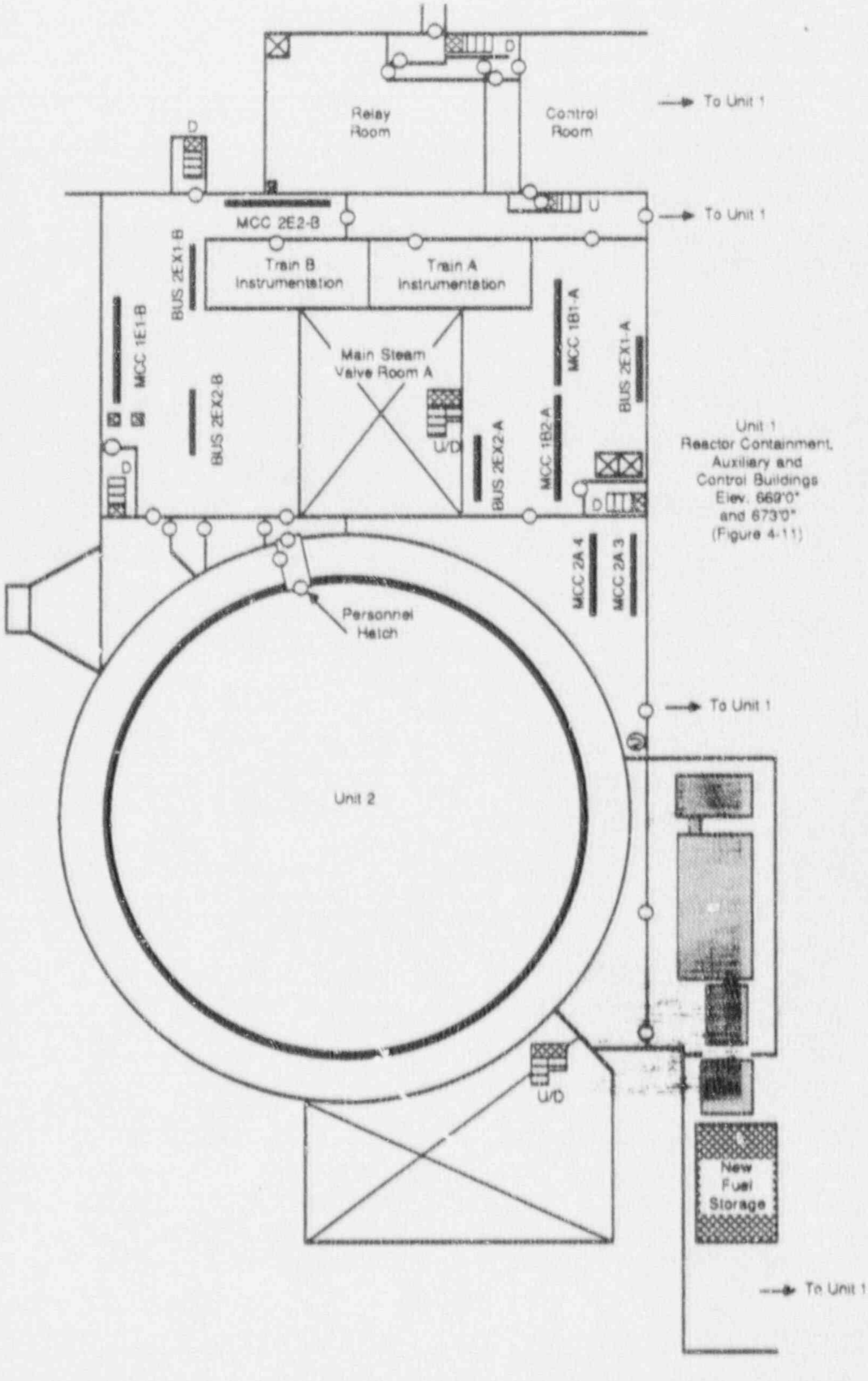



Figure 4-19. Bellefonte 2 Reactor Containment, Auxiliary and Control Buildings, Elevation 669'0" and 673'0"

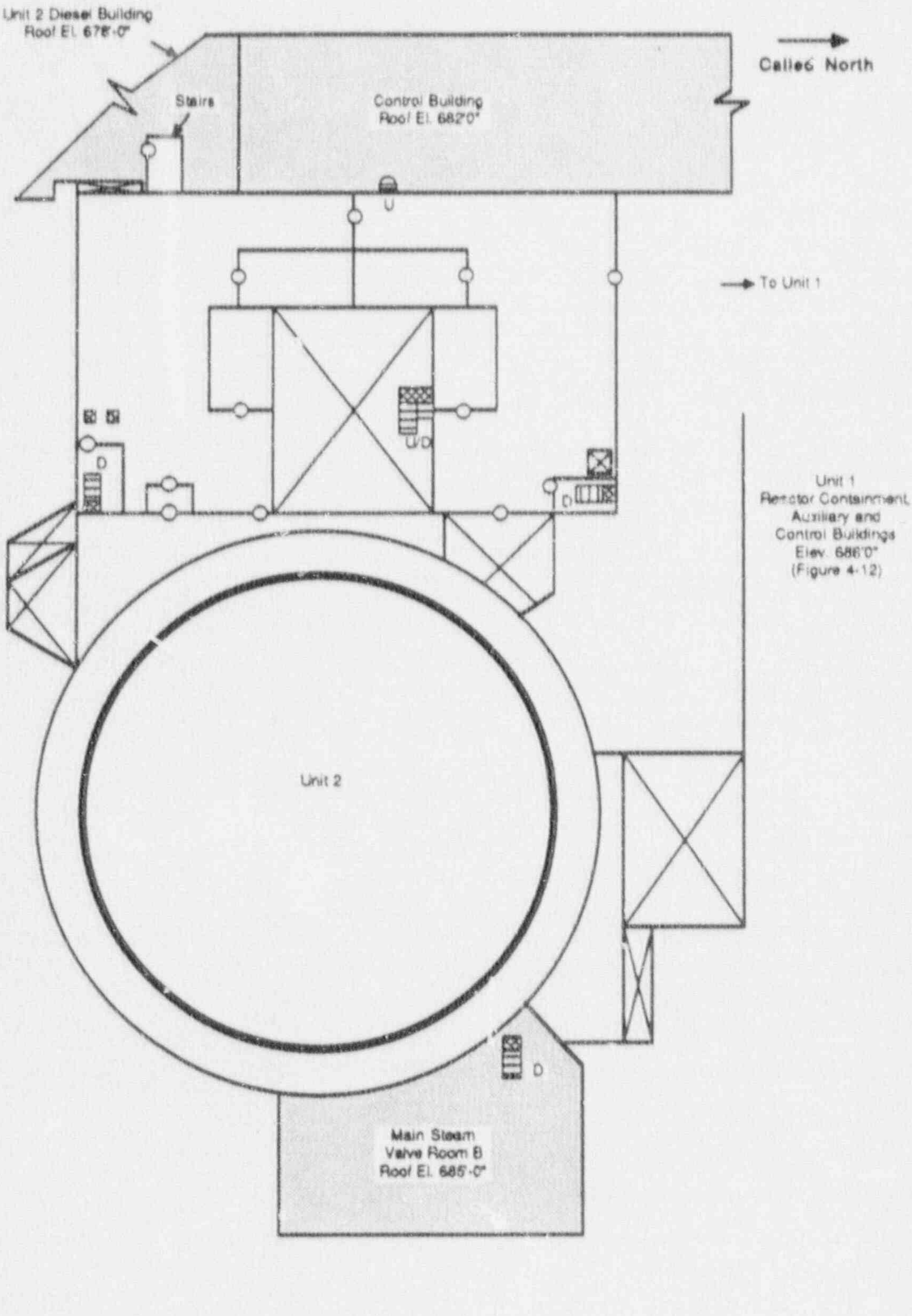



Figure 4-20. Bellefonte 2 Reactor Containment, Auxiliary and Control Buildings, Elevation 686'-0"

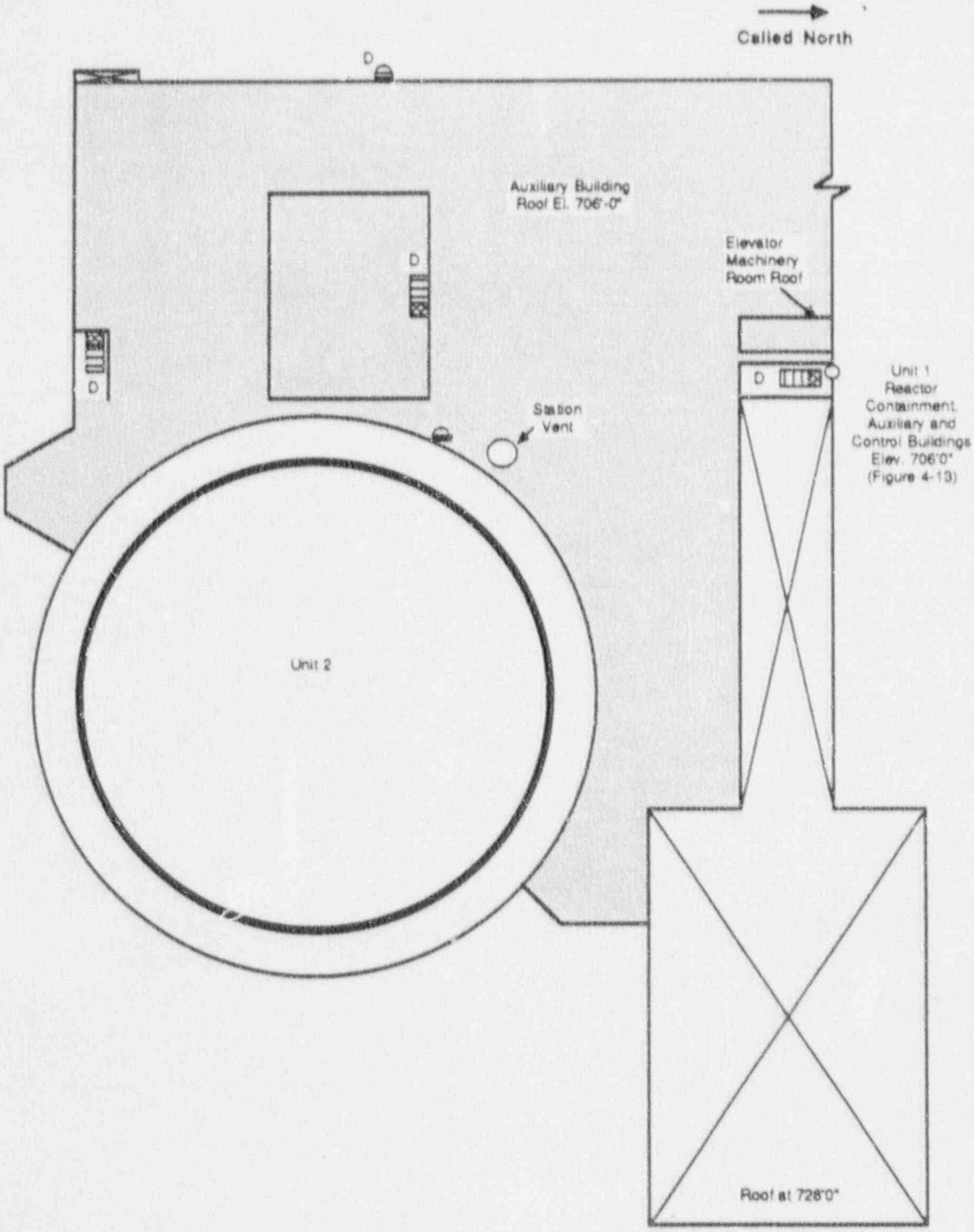



Figure 4-21. Bellefonte 2 Reactor Containment and Auxiliary Buildings, Elevation 706'-0"

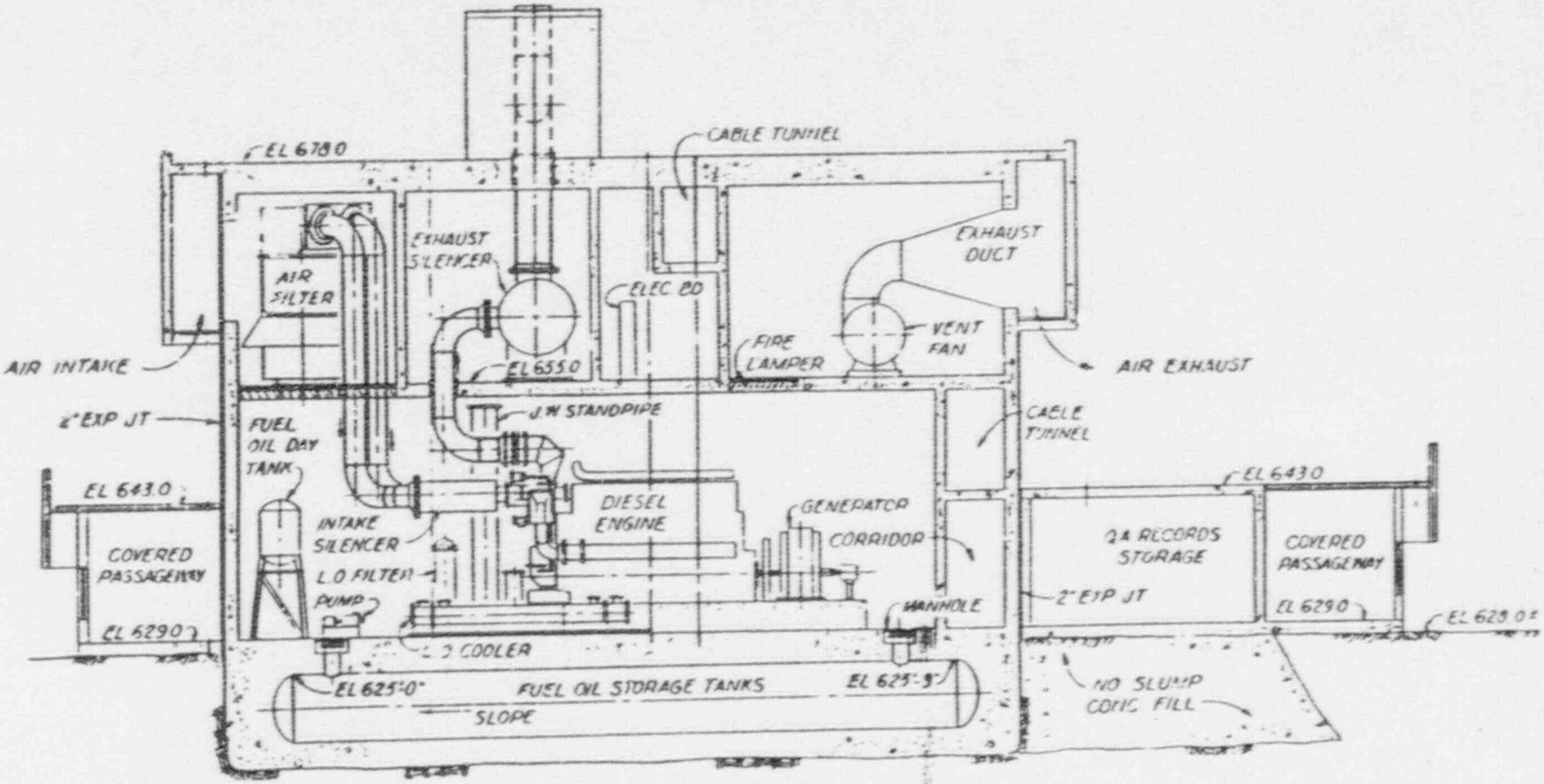



Figure 4-22. Elevation Views of the Bellefonte Diesel Generator Building (Sheet 1 of 2)

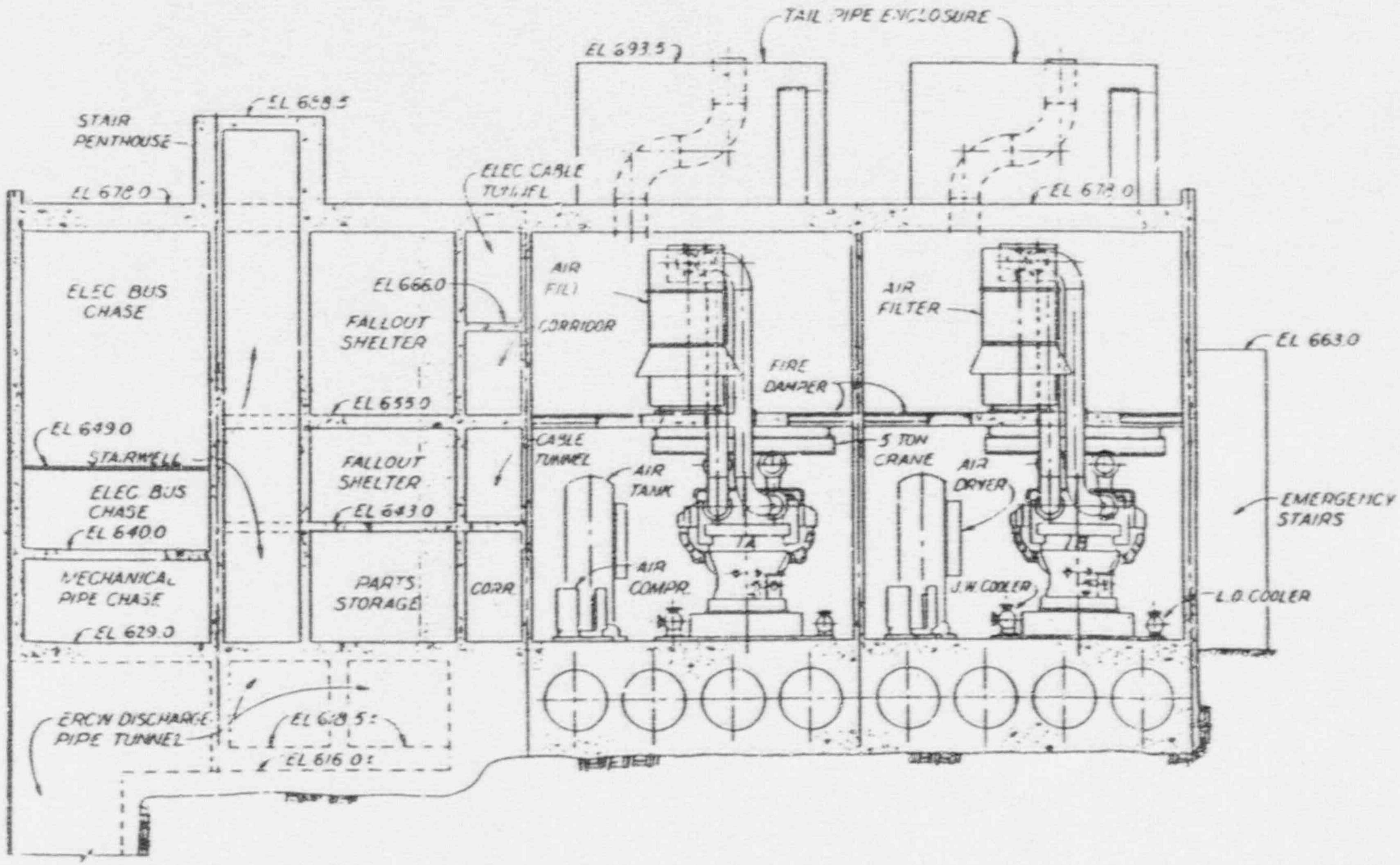



Figure 4-22. Elevation Views of the Bellefonte Diesel Generator Building (Sheet 2 of 2)

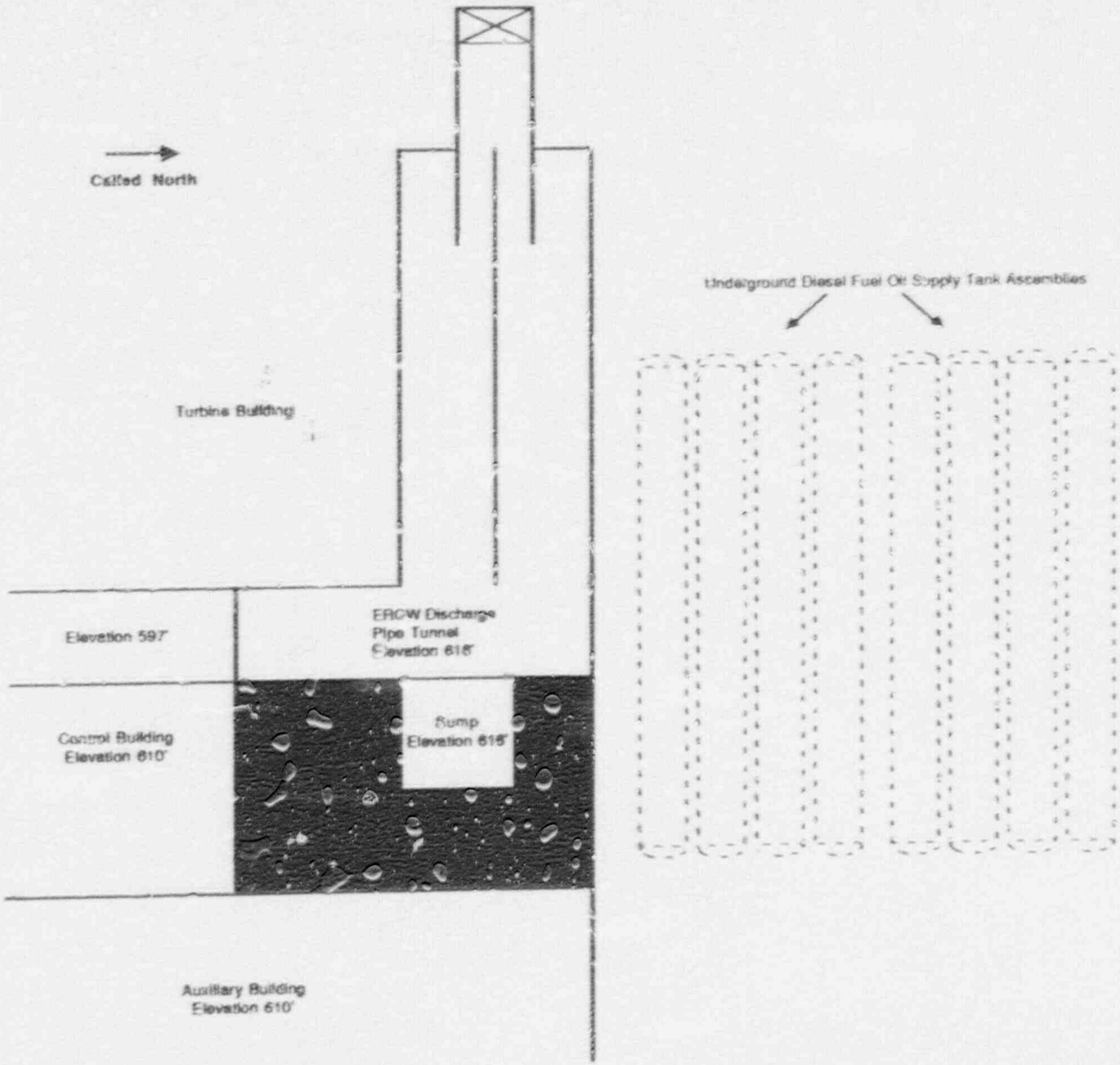



**Figure 4-23. Bellefonte 1 Diesel Generator Building, Elevation 623'0"**

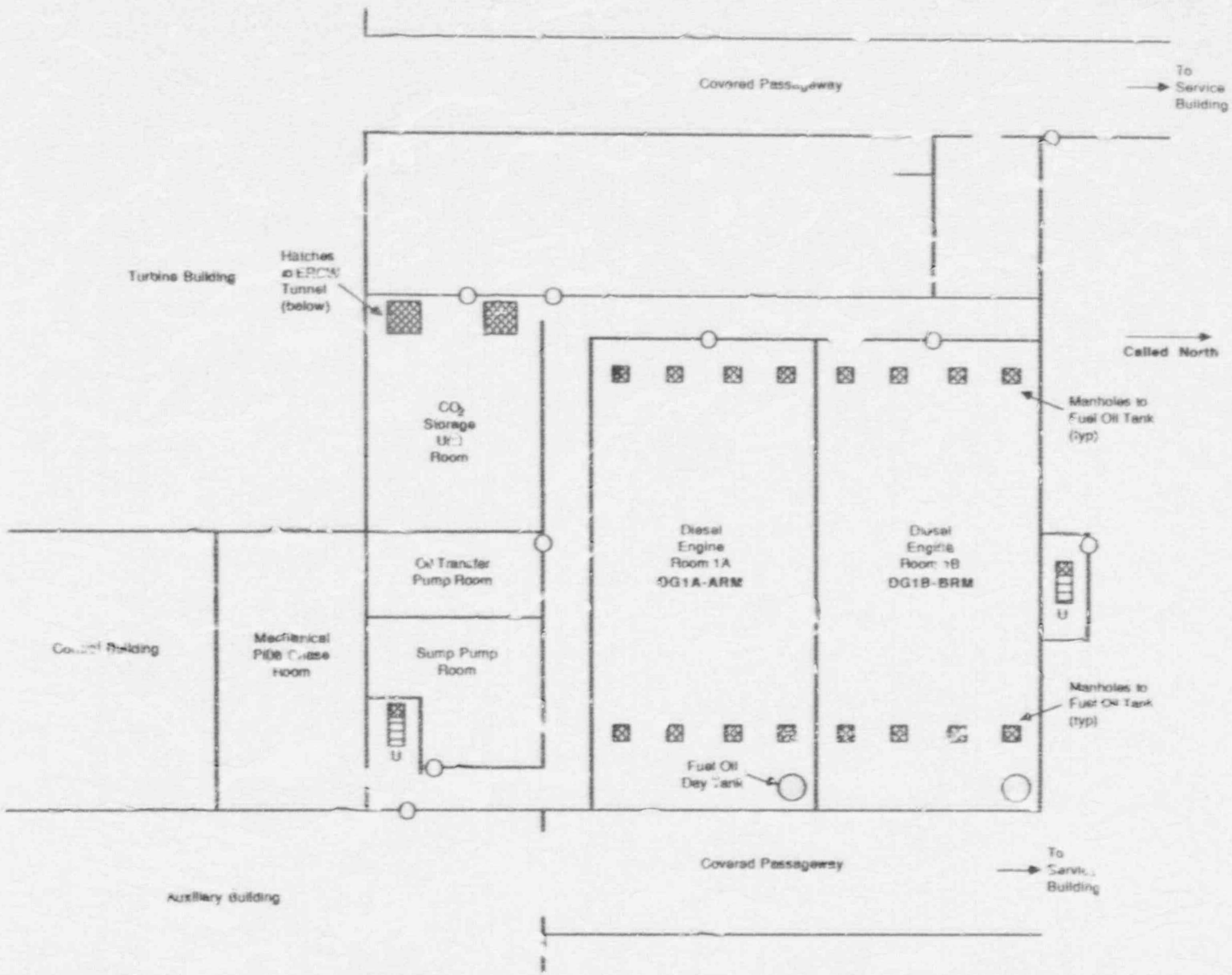



Figure 4-24. Bellefonte 1 Diesel Generator Building, Elevation 629'0"

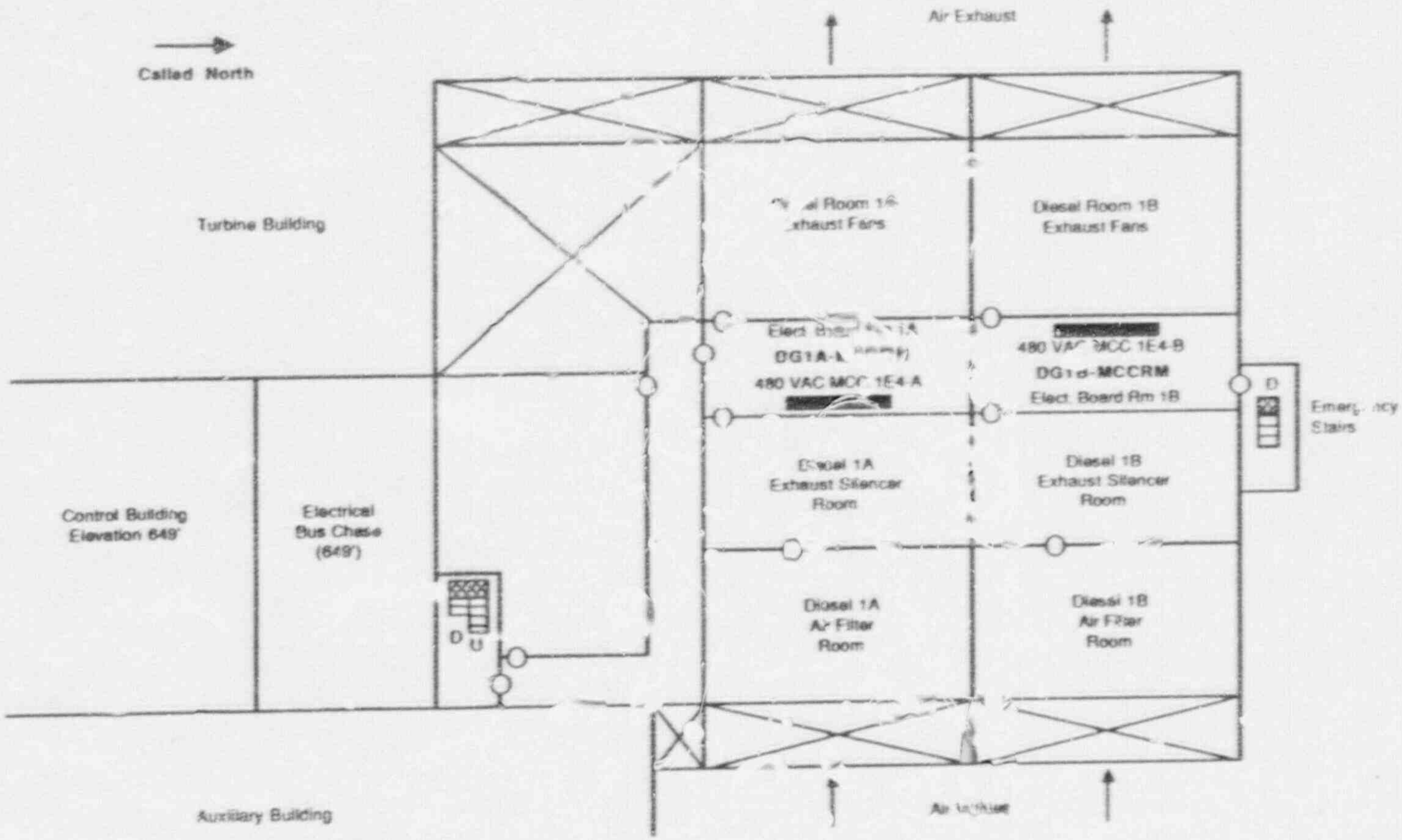



Figure 4-25. Bellefonte [illegible] Diesel Generator Building, Elevation 655'0"

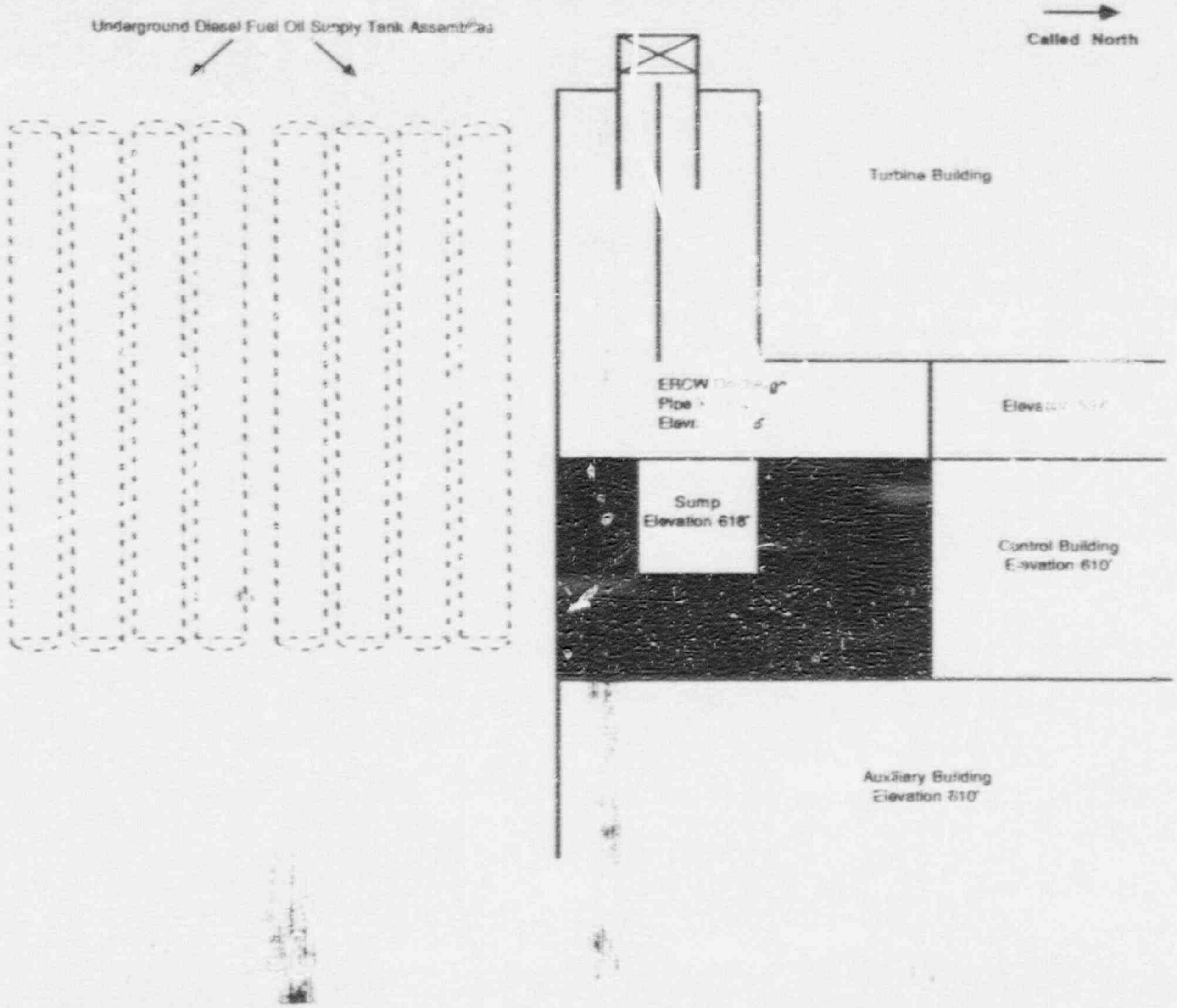



Figure 4-26. Bellefonte 2 Diesel Generator Building, Elevation 623'-0"

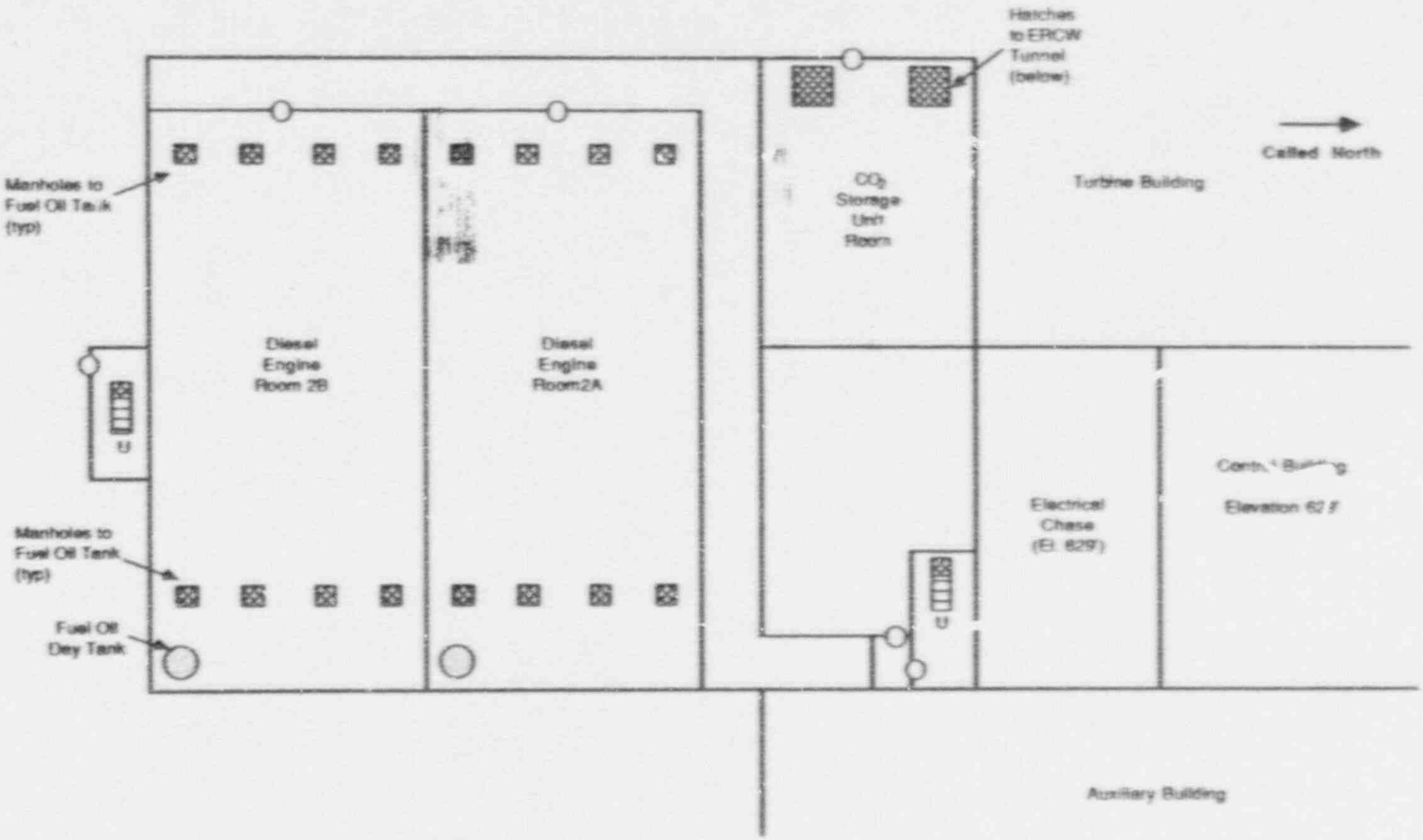



**Figure 4-27. Bellefonte 2 Diesel Generator Building, Elevation 643'-0"**

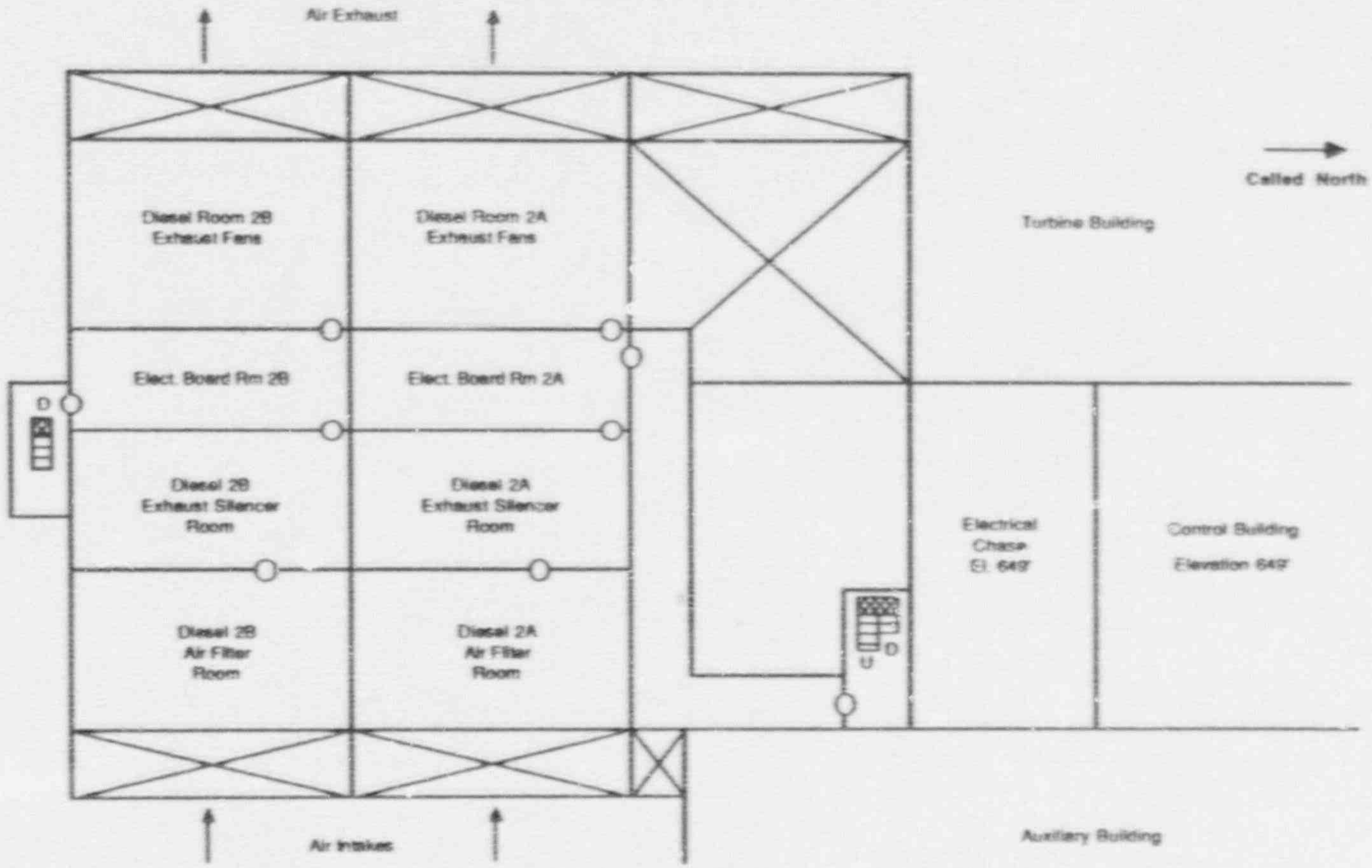



Figure 4-28. Bellefonte 2 Diesel Generator Building, Elevation 669'-0"

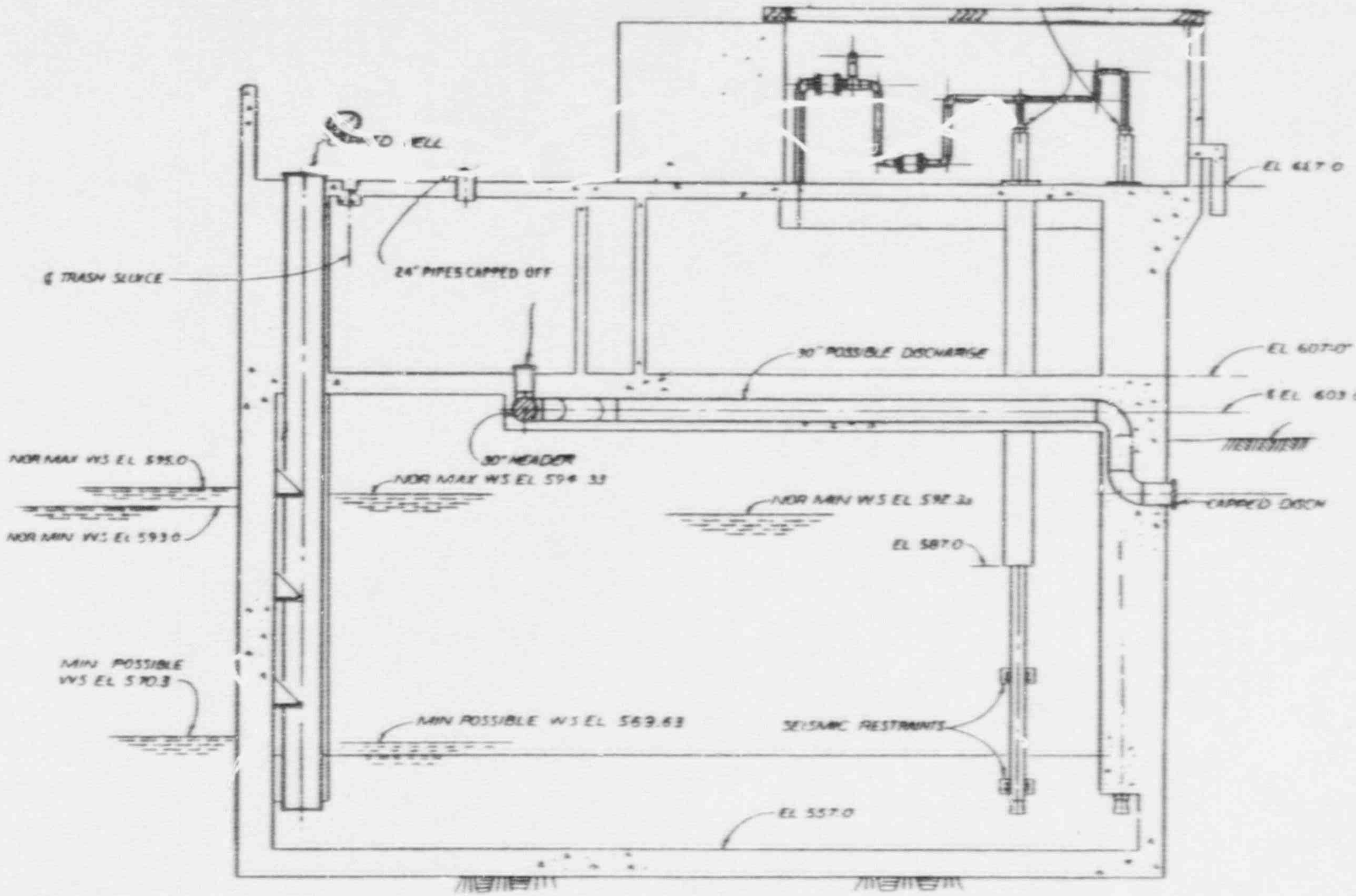



Figure 4-29. Elevation Views of the Bellefonte Intake Pumping Station (Sheet 1 of 2)

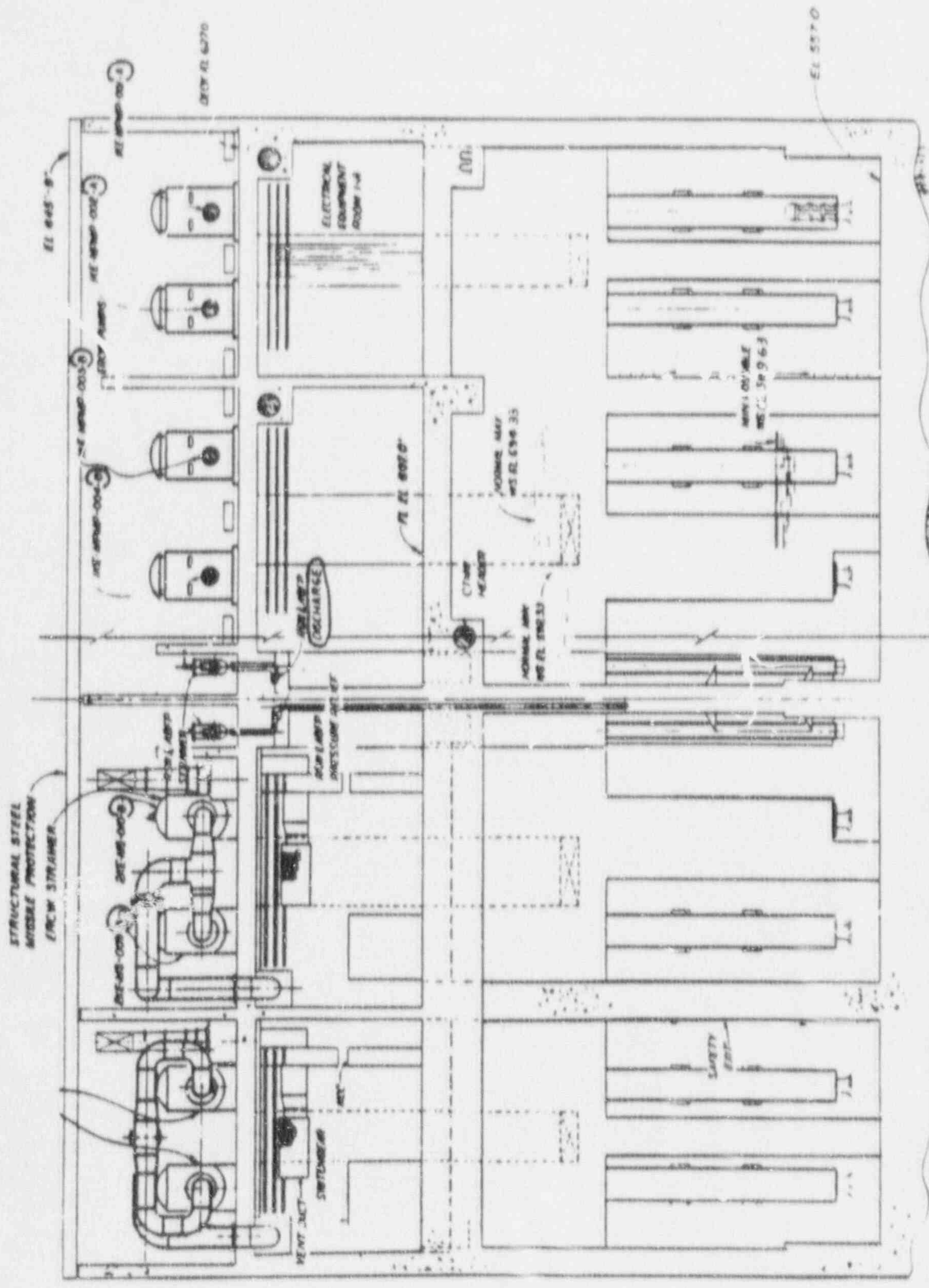


Figure 4-29. Elevation Views of the Bellefonte Intake Pumping Station (Sheet 2 of 2)

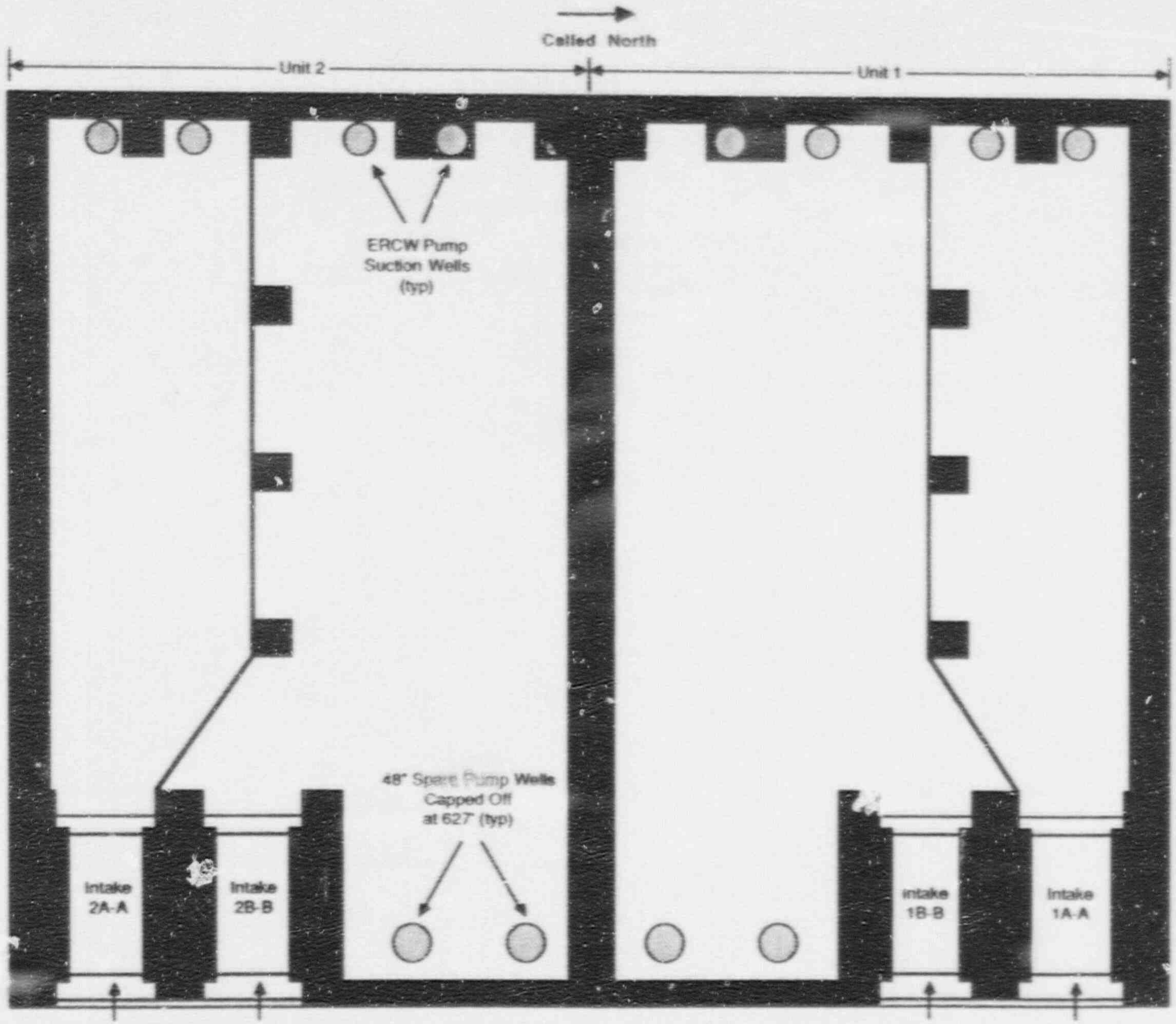



Figure 4-30. Bellefonte 1 and 2 Intake Pumping Station, Elevation 557'-0"

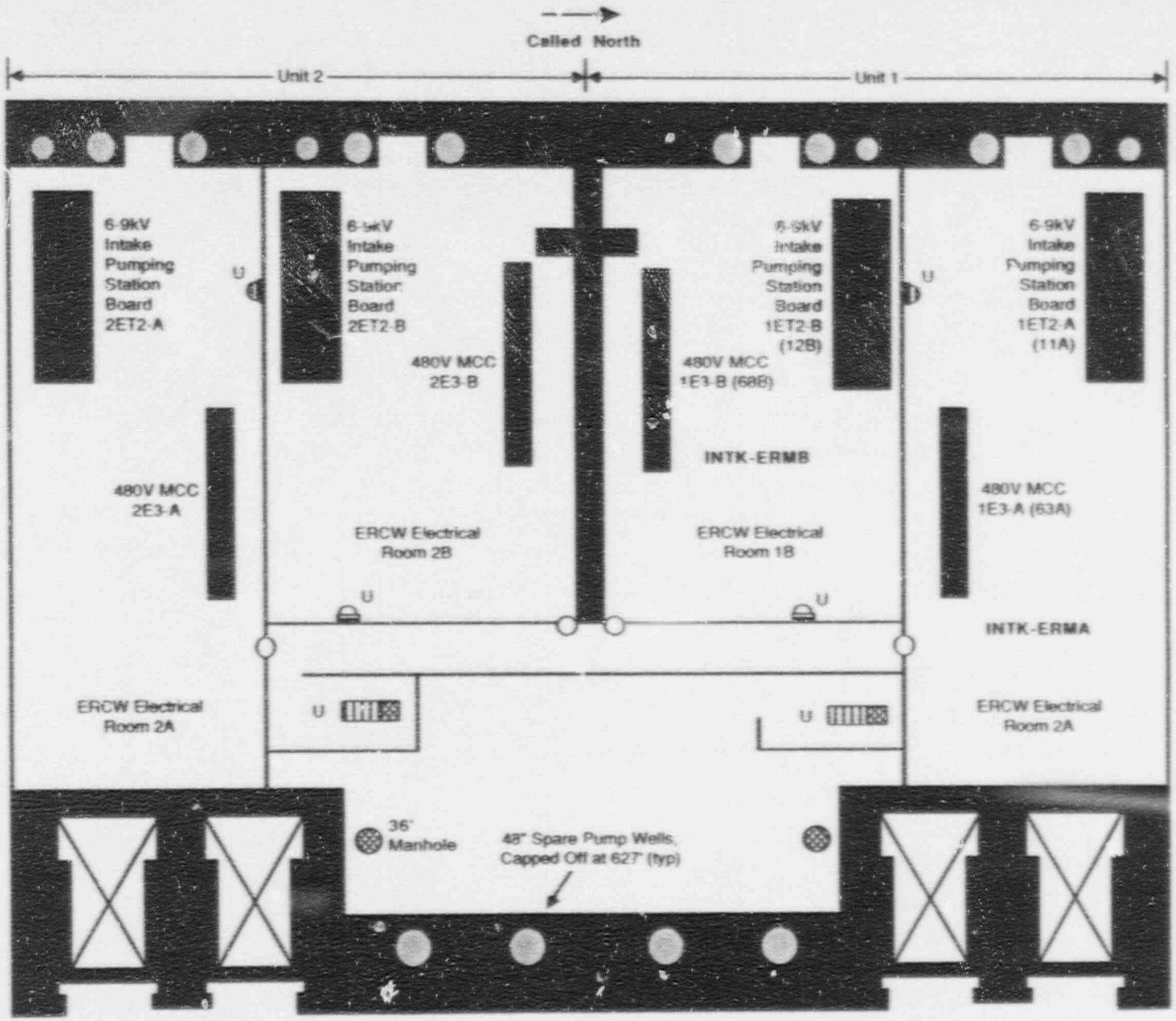



Figure 4-31. Bellefonte 1 and 2 Intake Pumping Station, Elevation 607'-0"

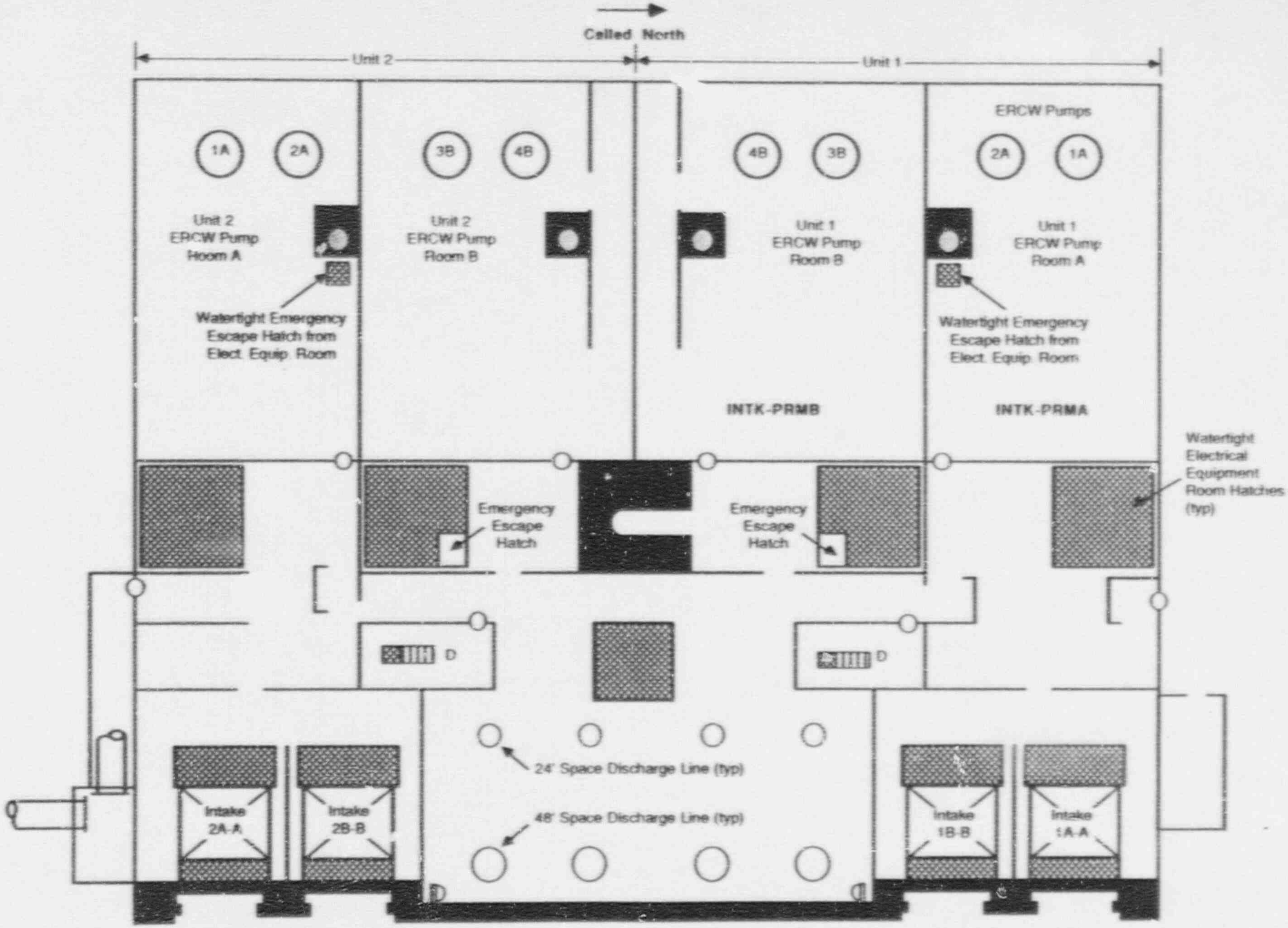



**Figure 4-32. Bellefonte 1 and 2 Intake Pumping Station, Elevation 627'-0"**

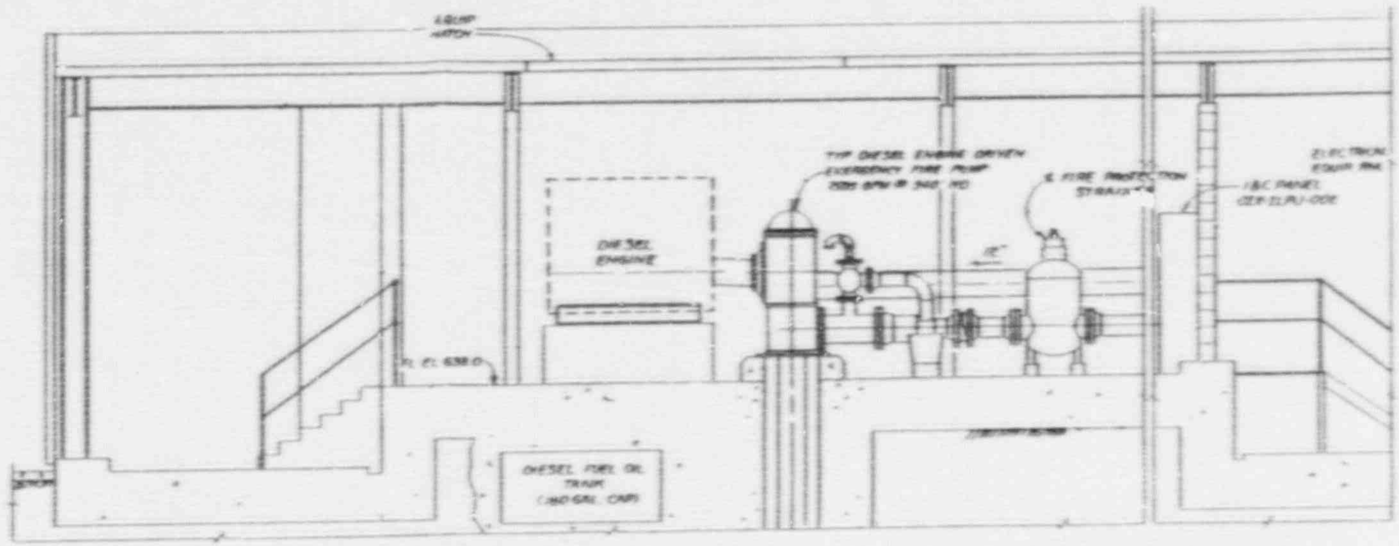



Figure 4-33. Elevation View of the Bellefonte Fire Water Pump Room

## Table 4-1. Definition of Bellefonte 1 Building and Location Codes

| Abbreviation | Description |
|---|---|
| 1. ABRF | Auxiliary Building Roof. |
| 2. ABYD | Yard area adjacent to the Auxiliary Building. |
| 3. ACR | Auxiliary Control Room located at level 669 of the Auxiliary Building. |
| 4. AFWTDPMRM | Room containing the turbine-driven auxiliary feedwater pump at level 590 of the Auxiliary Building. |
| 5. BAT1DRM | Room containing battery 1D located at level 686 of the Auxiliary Building. |
| 6. BAT1ERM | Room containing battery 1E located at level 686 of the Auxiliary Building. |
| 7. BAT1FRM | Room containing battery 1F located at level 686 of the Auxiliary Building. |
| 8. BAT1GRM | Room containing battery 1G located at level 686 of the Auxiliary Building. |
| 9. BWST | Borated Water Storage Tank located in the yard area north of containment. |
| 10. CCSA-UNK | Undetermined plant locations containing certain supply and return piping in CCS essential loop A (see Section 3.6). |
| 11. CCSB-UNK | Undetermined plant locations containing certain supply and return piping in CCS essential loop B (see Section 3.6). |
| 12. CCWPMRMA | "A" train component cooling water room at level 629 of the Auxiliary Building. |
| 13. CCWPMRMB | "B" train component cooling water room at level 629 of the Auxiliary Building. |
| 14. CR | Control Room located at level 673 of the Control Building. |
| 15. CRDPSRM | Control Rod Drive Power Supply Room located at level 590 of the Control Building. |
| 16. CSR | Cable Spreading Room located at level 659 of the Control Building. |
| 17. CST | Condensate Storage Tank located in the yard area north of turbine building. |

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

| Abbreviation | Description |
|---|---|
| 18. DG1A-ARM | Room containing emergency diesel generator 1A-A on level 629 of the Unit 1 Diesel Generator Building. |
| 19. DG1A-MCCRM | Room containing 480 VAC MCC 1E4-A on level 655 of the Unit 1 Diesel Generator Building. |
| 20. DG1B-BRM | Room containing emergency diesel generator 1B-B on level 629 of the Unit 1 Diesel Generator Building. |
| 21. DG1B-MCCRM | Room containing 480 VAC MCC 1E4-B on level 655 of the Unit 1 Diesel Generator Building. |
| 22. DHAPMRM | Room containing decay heat removal pump 1A-A located at level 590 of the Auxiliary Building. |
| 23. DHRACLRM | "A" train decay heat removal heat exchanger room located at level 610 of the Auxiliary Building. |
| 24. DHRBPMRM | Room containing decay heat removal pump 1B-B located at level 590 of the Auxiliary Building. |
| 25. DHRBCLRM | "B" train decay heat removal heat exchanger room located at level 610 of the Auxiliary Building. |
| 26. HPIA1RM | Room containing high pressure injection pump 1A-1 located at level 590 of the Auxiliary Building. |
| 27. HPIA2RM | Room containing high pressure injection pump 1A-2 located at level 590 of the Auxiliary Building. |
| 28. HPIB1RM | Room containing high pressure injection pump 1B-1 located at level 590 of the Auxiliary Building. |
| 29. HPI452RM | Undetermined plant location containing valve HPI-452 and associated piping between the makeup tank and the "A" train HPI pumps. |
| 30. INTK-ERMA | Unit 1 ERCW train A electrical room on level 607 of the Intake Pumping Structure. |
| 31. INTK-ERMB | Unit 1 ERCW train B electrical room on level 607 of the Intake Pumping Structure. |
| 32. INTK-PRMA | Unit 1 ERCW train A pump room on level 627 of the Intake Pumping Structure. |

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

| Abbreviation | Description |
|---|---|
| 33. INTK-PRMB | Unit 1 ERCW train B pump room on level 627 of the Intake Pumping Structure. |
| 34. PPCHSA | "A" train pipechase running from level 590 to level 629 of the Auxiliary Building. |
| 35. PPCHSB | "B" train pipechase running from level 590 to level 629 of the Auxiliary Building. |
| 36. RBSAPMRM | Room containing reactor building spray pump 1A-A located at level 590 of the Auxiliary Building. |
| 37. RBSBPMRM | Room containing reactor building spray pump 1B-B located at level 590 of the Auxiliary Building. |
| 38. RC-PC | Reactor primary containment. |
| 39. RC-SCA | Secondary containment annulus. |
| 40. STVRMA | "A" train steam valve room located at level 649 of the Auxiliary Building on the northwest side of the containment. |
| 41. STVRMB | "B" train steam valve room located at level 649 of the Auxiliary Building on the southeast side of the containment. |
| 42. TLSFP | Spent fuel pool operating floor at level 667 of the Auxiliary Building. |
| 43. TRNA | "A" train instrument room located at level 669 of the Auxiliary Building. |
| 44. TRNB | "B" train instrument room located at level 669 of the Auxiliary Building. |
| 45. VVPIT | DHR sump suction valve pit located at level 590 of the Auxiliary Building adjacent to the containment. |
| 46. 120 VACDF | Undetermined plant locations containing components in 120 VAC divisions D and F (see Section 3.6). |
| 47. 120 VACEG | Undetermined plant locations containing components in 120 VAC divisions E and G (see Section 3.6) |
| 48. 590ABCOR | Corridor along the northwest wall of the Auxiliary Building at level 590. |

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

| Abbreviation | Description |
|---|---|
| 49. 590ABTRNA | The area of the Auxiliary Building at level 590 containing Auxiliary Feedwater "A" train equipment. |
| 50. 590ABTRNB | The area of the Auxiliary Building at level 590 containing Auxiliary Feedwater "B" train equipment. |
| 51. 610ABCOR | Corridor along the northwest wall of the Auxiliary Building at level 610. |
| 52. 610ABTRNA | Undetermined area of the Auxiliary Building at level 610 containing "A" train HPI and DHR system components. |
| 53. 610ABTRNB | Undetermined area of the Auxiliary Building at level 610 containing "B" train HPI and DHR system components. |
| 54. 610PENA | "A" train containment penetration area at level 610 of the Auxiliary Building. |
| 55. 610PENB | "B" train containment penetration area at level 610 of the Auxiliary Building. |
| 56. 629ABCOR | Corridor along the northwest wall of the Auxiliary Building at level 629. |
| 57. 629ABTRNB | Undetermined area of the Auxiliary Building at level 629 containing "B" train HPI and RBS system components. |
| 58. 629PENA | "A" train containment penetration area at level 629 of the Auxiliary Building. |
| 59. 629PENB | "B" train containment penetration area at level 629 of the Auxiliary Building. |
| 60. 649PENA | "A" train containment penetration area at level 649 of the Auxiliary Building. |
| 61. 649PENB | "B" train containment penetration area at level 649 of the Auxiliary Building. |
| 62. 649SGRMA | "A" train switchgear room located at level 649 of the Auxiliary Building. |
| 63. 649SGRMB | "B" train switchgear room located at level 649 of the Auxiliary Building. |

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

| Abbreviation | Description |
|---|---|
| 64. 649TB | Level 649 of the Turbine Building. |
| 65. 669PENA | "A" train containment penetration area at level 669. |
| 66. 669PENB | "B" train containment penetration area at level 669. |
| 67. 669SGRMA | "A" train switchgear room located at level 669 of the Auxiliary Building. |
| 68. 669SGRMB | "B" train switchgear room located at level 669 of the Auxiliary Building. |
| 69. 686PEN | Containment penetration area at level 686 common to both "A" and "B" trains. |

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

| LOCATION | SYSTEM | COMPONENT ID | COMP TYPE |
|---|---|---|---|
| 120VACDF | EP | UPS-1D | UPS |
| 120VACDF | EP | UPS-1D | UPS |
| 120VACDF | EP | 120PNL-1D | BUS |
| 120VACDF | EP | 120PNL-1D | BUS |
| 120VACDF | EP | UPS-1F | UPS |
| 120VACDF | EP | UPS-1F | UPS |
| 120VACDF | EP | 120PNL-1F | BUS |
| 120VACDF | EP | 120PNL-1F | BUS |
| 120VACEG | EP | UPS-1E | UPS |
| 120VACEG | EP | UPS-1E | UPS |
| 120VACEG | EP | 120PNL-1E | BUS |
| 120VACEG | EP | 120PNL-1E | BUS |
| 120VACEG | EP | UPS-1G | UPS |
| 120VACEG | EP | UPS-1G | UPS |
| 120VACEG | EP | 120PNL-1G | BUS |
| 120VACEG | EP | 120PNL-1G | BUS |
| 590ABTRNA | AFW | AFW-29A | MOV |
| 590ABTRNA | AFW | AFW-30A | MOV |
| 590ABTRNA | AFW | AFW-87A | MOV |
| 590ABTRNA | AFW | AFW-P1A | MDP |
| 590ABTRNB | AFW | AFW-100B | MOV |
| 590ABTRNB | AFW | AFW-88B | MOV |
| 590ABTRNB | AFW | AFW-99B | MOV |
| 590ABTRNB | AFW | AFW-P1B | MDP |
| 610ABCOR | ERCW | ERCW-161A | MOV |
| 610ABCOR | ERCW | ERCW-59B | MOV |
| 610ABTRNA | ECCS | HPI-450A | MOV |
| 610ABTRNA | ECCS | DHR-10A | MOV |
| 610ABTRNA | PAHR | DHR-104A | MOV |
| 610ABTRNB | ECCS | HPI-419B | MOV |

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

| LOCATION | SYSTEM | COMPONENT ID | COMP TYPE |
|---|---|---|---|
| 610ABTRNB | ECCS | DHR-104B | MOV |
| 610ABTRNB | PAHR | DHR-104B | MOV |
| 649SGRMA | EP | EP-CB-C1A | CB |
| 649SGRMA | EP | BUS-1ET1A | BUS |
| 649SGRMA | EP | BUS-1ET1A | BUS |
| 649SGRMA | EP | BUS-1ET1A | BUS |
| 649SGRMA | EP | BUS-1ET1B | BUS |
| 649SGRMA | EP | MCC-1E5A | MCC |
| 649SGRMB | EP | EP-CB-C1B | CB |
| 649SGRMB | EP | BUS-1ET1B | BUS |
| 649SGRMB | EP | BUS-1ET1B | BUS |
| 649SGRMB | EP | MCC-1E5B | MCC |
| 669SGRMA | EP | BC-1D (50D) | BC |
| 669SGRMA | EP | BC-1F (52F) | BC |
| 669SGRMA | EP | DCBB-1F | BUS |
| 669SGRMA | EP | BUS 24A | BUS |
| 669SGRMA | EP | BUS 25A | BUS |
| 669SGRMA | EP | TRAN 1A | TRAN |
| 669SGRMA | EP | TRAN 2A | TRAN |
| 669SGRMA | EP | DCBB-1D | BUS |
| 669SGRMA | EP | DCBB-1F | BUS |
| 669SGRMA | EP | DCBB-1F | BUS |
| 669SGRMA | EP | PANEL-86A | BUS |
| 669SGRMA | EP | PANEL-88A | BUS |
| 669SGRMA | EP | MCC-1E1A | MCC |
| 669SGRMA | EP | MCC-1E2A | MCC |
| 669SGRMA | EP | DG-PNL-1A | BUS |
| 669SGRMA | EP | DG-PNL-1A | BUS |
| 669SGRMA | EP | DCBB-1D | BUS |
| 669SGRMA | EP | DCBB-1D | BUS |

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

| LOCATION | SYSTEM | COMPONENT ID | COMP TYPE |
|---|---|---|---|
| 669SGRMB | EP | BC-1E (51E) | BC |
| 669SGRMB | EP | BC-1G (53G) | BC |
| 669SGRMB | EP | DCBB-1G | BUS |
| 669SGRMB | EP | BUS 28B | BUS |
| 669SGRMB | EP | BUS 29B | BUS |
| 669SGRMB | EP | TRAN 1B | TRAN |
| 669SGRMB | EP | TRAN 2B | TRAN |
| 669SGRMB | EP | DCBB-1E | BUS |
| 669SGRMB | EP | DCBB-1E | BUS |
| 669SGRMB | EP | DCBB-1G | BUS |
| 669SGRMB | EP | DCBB-1G | BUS |
| 669SGRMB | EP | PANEL-87D | BUS |
| 669SGRMB | EP | PANEL-89D | BUS |
| 669SGRMB | EP | MCC-1E1B | MCC |
| 669SGRMB | EP | MCC-1E2B | MCC |
| 669SGRMB | EP | DG-PNP-1B | BUS |
| 669SGRMB | EP | DG-PNL-1B | BUS |
| 669SGRMB | EP | DCBB-1E | BUS |
| AFWTDPMRM | AFW | AFW-16A | MOV |
| AFWTDPMRM | AFW | AFW-17A | MOV |
| AFWTDPMRM | AFW | AFW-91B | MOV |
| AFWTDPMRM | AFW | AFW-92B | MOV |
| AFWTDPMRM | AFW | AFW-TDP1A | TDP |
| BAT1DRM | EP | BT 1D | BT |
| BAT1ERM | EP | BT 1E | BT |
| BAT1FRM | EP | BT 1F | BT |
| BAT1GRM | EP | BT 1G | BT |
| BWST | ECCS | BWST | TK |
| BWST | PAHR | BWST | TK |
| CCWPMRMA | CCS | CCS-HX6A | HX |

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

| LOCATION | SYSTEM | COMPONENT ID | COMP TYPE |
|---|---|---|---|
| CCWPMRMA | CCS | CCS-P1A | MDP |
| CCWPMRMA | CCS | CCS-313A | MOV |
| CCWPMRMA | CCS | CCS-P3A | MDP |
| CCWPMRMA | CCS | CCS-136 | MOV |
| CCWPMRMA | CCS | CCS-137 | MOV |
| CCWPMRMA | CCS | CCS-375 | MOV |
| CCWPMRMA | CCS | CCS-376 | MOV |
| CCWPMRMA | ERCW | ERCW-BP13A | MDP |
| CCWPMRMB | CCS | CCS-316B | MOV |
| CCWPMRMB | CCS | CCS-HX7B | HX |
| CCWPMRMB | CCS | CCS-P2B | MDP |
| CCWPMRMB | ERCW | ERCW-BP11B | MDP |
| CCWPMRMB | ERCW | ERCW-BP12B | MDP |
| CCWPMRMB | ERCW | ERCW-279B | MOV |
| CST | AFW | CST | TK |
| DG1A-ARM | EP | DG-1A-A | DG |
| DG1A-ARM | ERCW | ERCW-295A | MOV |
| DG1A-MCCRM | EP | MCC-1E4A | MCC |
| DG1B-BRM | EP | DG-1B-B | DG |
| DG1B-BRM | ERCW | ERCW-296B | MOV |
| DG1B-MCCRM | EP | MCC-1E4B | MCC |
| DHAPMRM | ECCS | DHR-68A | MOV |
| DHAPMRM | ECCS | DHR-P1A | MDP |
| DHBPMRM | ECCS | DHR-162B | MOV |
| DHBPMRM | ECCS | DHR-P2B | MDP |
| DHRACLRM | ECCS | DHR-HX1A | HX |
| DHRACLRM | ECCS | DHR-48A | MOV |
| DHRBCLRM | ECCS | DHR-HX1B | HX |
| DHRBCLRM | ECCS | DHR-142B | MOV |
| HPIA1RM | ECCS | HPI-P1A | MDP |

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

| LOCATION | SYSTEM | COMPONENT ID | COMP TYPE |
|---|---|---|---|
| HPIA1RM | ECCS | HPI-366A | XV |
| HPIA2RM | ECCS | HPI-P2A | MDP |
| HPIA2RM | ECCS | HPI-219A | XV |
| HPIB1RM | ECCS | HPI-P3B | MDP |
| INTK-ERMA | EP | BUS-1ET2A | BUS |
| INTK-ERMA | EP | MCC-1E3A | MCC |
| INTK-ERMA | EP | TRAN-3A | TRAN |
| INTK-ERMB | EP | BUS-1ET2B | BUS |
| INTK-ERMB | EP | MCC-1E3B | MCC |
| INTK-ERMB | EP | TRAN-3B | TRAN |
| INTK-PRMA | ERCW | ERCW-P1A | MDP |
| INTK-PRMA | ERCW | ERCW-P2A | MDP |
| INTK-PRMB | ERCW | ERCW-P3B | MDP |
| INTK-PRMB | ERCW | ERCW-P4B | MDP |
| RBSAPMRM | PAHR | RBS-P1A | MDP |
| RBSBPMRM | PAHR | RBS-P1B | MDP |
| RC-PC | ECCS | DHR-85A | MOV |
| RC-PC | ECCS | DHR-91A | MOV |
| RC-PC | ECCS | DHR-179B | MOV |
| RC-PC | ECCS | DHR-185A | MOV |
| RC-PC | ECCS | SUMP-1A | TK |
| RC-PC | ECCS | SUMP-1B | TK |
| RC-PC | PAHR | RBC-FAN-1A | FAN |
| RC-PC | PAHR | RBC-FAN-1B | FAN |
| RC-PC | PAHR | RBC-FAN-2B | FAN |
| RC-PC | PAHR | SUMP-1A | TK |
| RC-PC | PAHR | SUMP-1B | TK |
| RC-PC | RCS | RCS-57A | MOV |
| RC-PC | RCS | RCS-58B | NV |
| RC-PC | RCS | MU-21A | MOV |

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

| LOCATION | SYSTEM | COMPONENT ID | COMP TYPE |
|---|---|---|---|
| RC-PC | RCS | MU-22B | MOV |
| RC-PC | RCS | MU-26A | MOV |
| RC-PC | RCS | MU-20B | MOV |
| RC-PC | RCS | RCS-235A | MOV |
| RC-PC | RCS | RCS-237B | MOV |
| RC-SCA | AFW | AFW-37A | MOV |
| RC-SCA | AFW | AFW-54B | MOV |
| RC-SCA | AFW | AFW-64B | MOV |
| RC-SCA | AFW | AFW-71A | MOV |
| RC-SCA | ECCS | HPI-213B | MOV |
| RC-SCA | ECCS | DHR-174B | MOV |
| RC-SCA | ECCS | DHR-80A | MOV |
| RC-SCA | ECCS | HPI-225B | MOV |
| RC-SCA | ECCS | HPI-113A | MOV |
| RC-SCA | ECCS | HPI-101A | MOV |
| RC-SCA | ERCW | ERCW-268A | MOV |
| RC-SCA | ERCW | ERCW-275A | MOV |
| RC-SCA | ERCW | ERCW-310B | MOV |
| RC-SCA | ERCW | ERCW-316B | MOV |
| RC-SCA | ERCW | ERCW-323B | MOV |
| RC-SCA | ERCW | ERCW-330B | MOV |
| RC-SCA | PAHR | RBS-31A | MOV |
| RC-SCA | PAHR | RBS-64B | MOV |
| STVRMA | AFW | AFW-868B | MOV |
| STVRMB | AFW | AFW-869A | MOV |
| VVPIT | ECCS | DHR-96A | MOV |
| VVPIT | ECCS | DHR-192B | MOV |

## 5. BIBLIOGRAPHY FOR BELLEFONTE 1 & 2


1. NUREG/CR-3724, "Ultimate Strength Analysis of the Watts Bar, Maine Yankee, and Bellefonte Containments," Sandia National Laboratories, July 1984.

2. NUREG/CR-4563, "Analysis of Station Blackout Accidents for the Bellefonte Pressurized Water Reactor," Sandia National Laboratories, September 1986.

3. NUREG/CR-4741, "Feedwater Transient and Small Break Loss of Coolant Accident Analyses for the Bellefonte Nuclear Plant," EG&G Idaho, Inc., March 1987.

4. NUREG/CR-4803, "The Possibility of Local Detonations During Degraded-Core Accidents in the Bellefonte Nuclear Power Plant," Sandia National Laboratories, January 1987.

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

## A1. SYSTEM DRAWINGS

### A1.1 Fluid System Drawings

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

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

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

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

### A1.2 Electrical System Drawings

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

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

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

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

## A2. SITE AND LAYOUT DRAWINGS

### A2.1 Site Drawings

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

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

### A2.2 Layout Drawings

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

Symbols used in the simplified layout drawings are defined in Figure A-3. Major rooms, stairways, elevators, and doorways are shown in the simplified layout drawings however, many interior walls have been omitted for clarity. The building layout

drawings, are approximately to scale, should not be used to estimate room size or distances. As-built scale drawings for should be consulted his purpose.

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

## A3. APPENDIX A REFERENCES

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

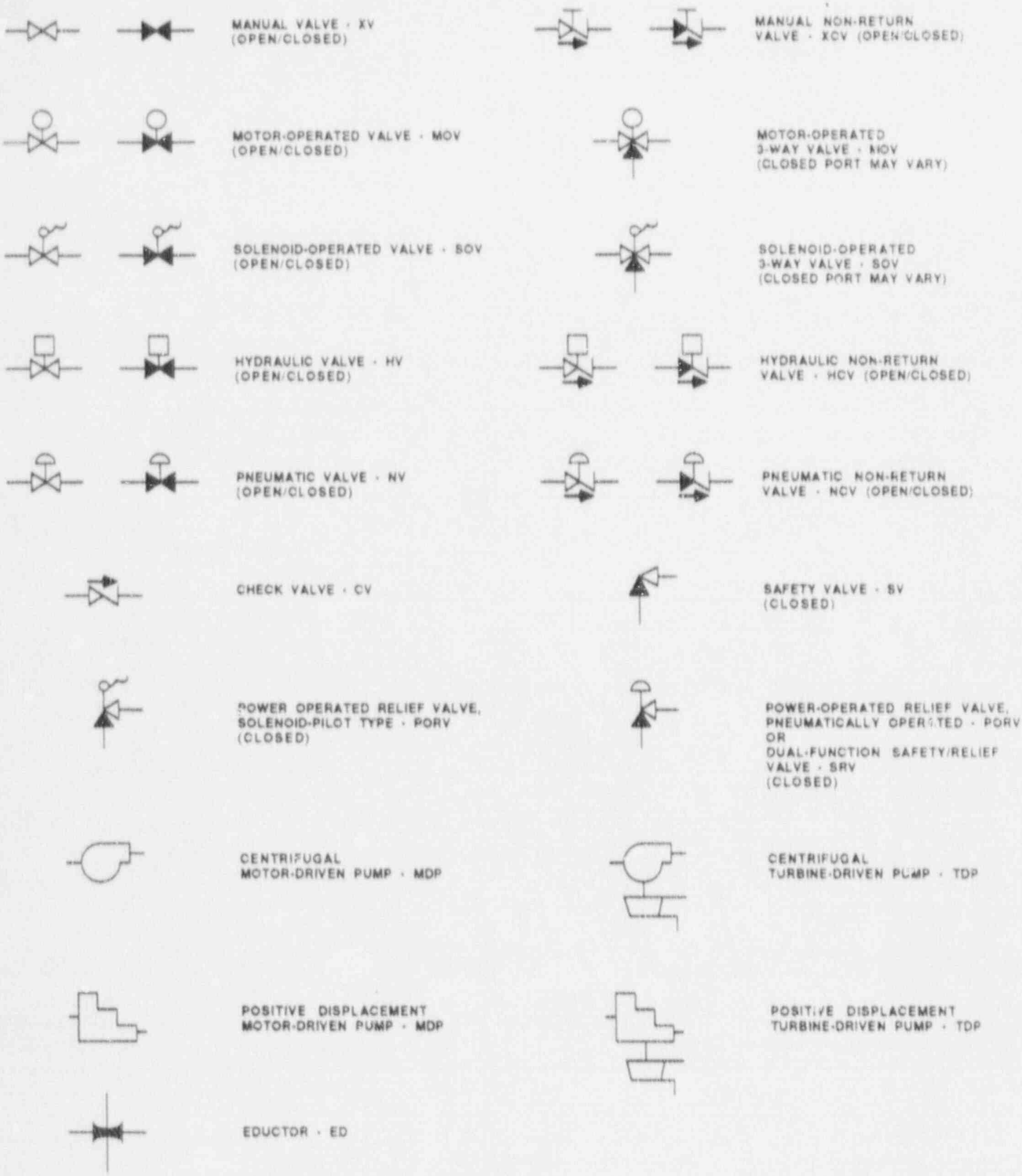



Figure A-1. Key To Symbols In Fluid System Drawings

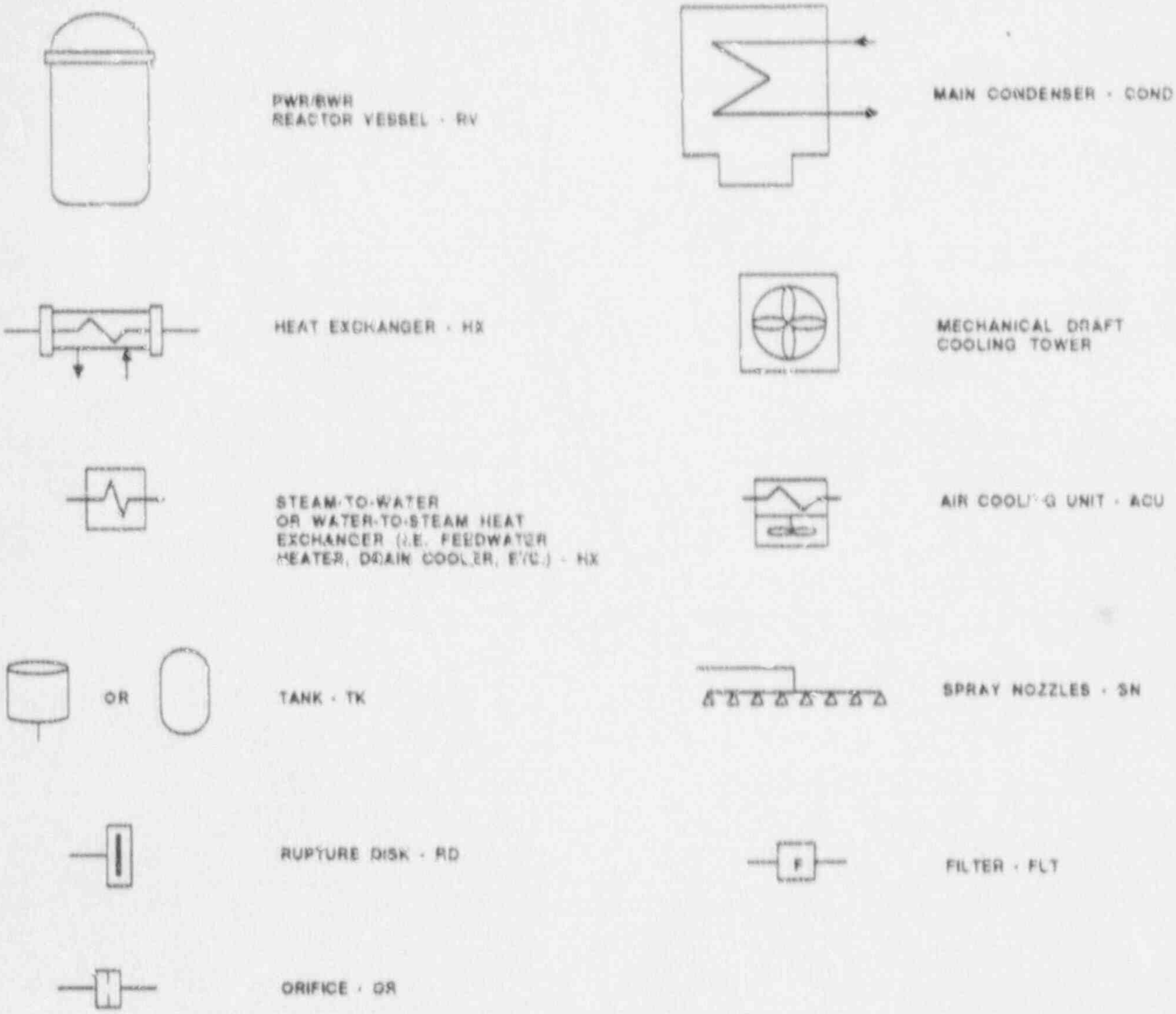



Figure A-1. Key To Symbols In Fluid System Drawings
(Continued)

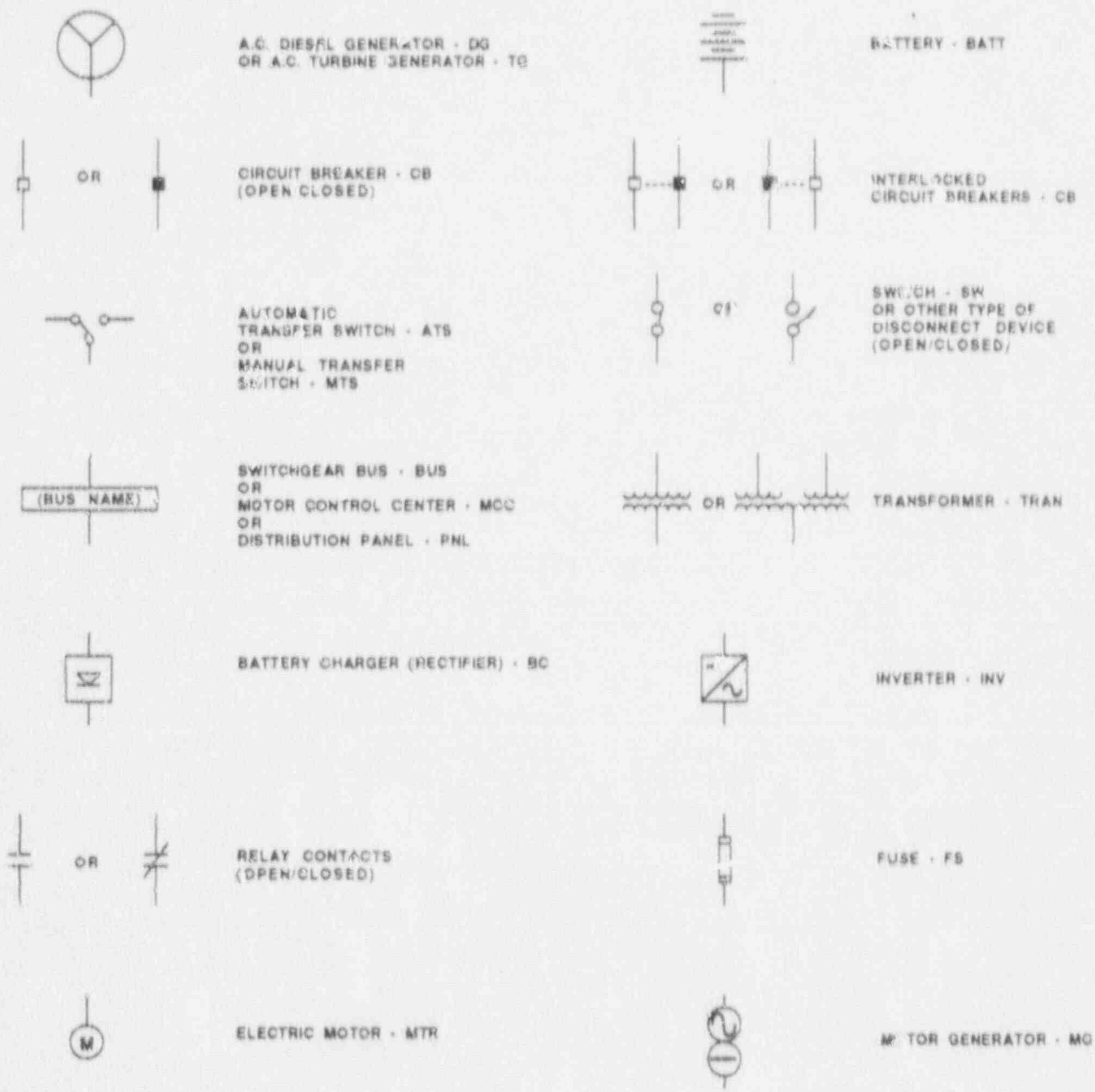



Figure A-2. Key To Symbols In Electrical System Drawings

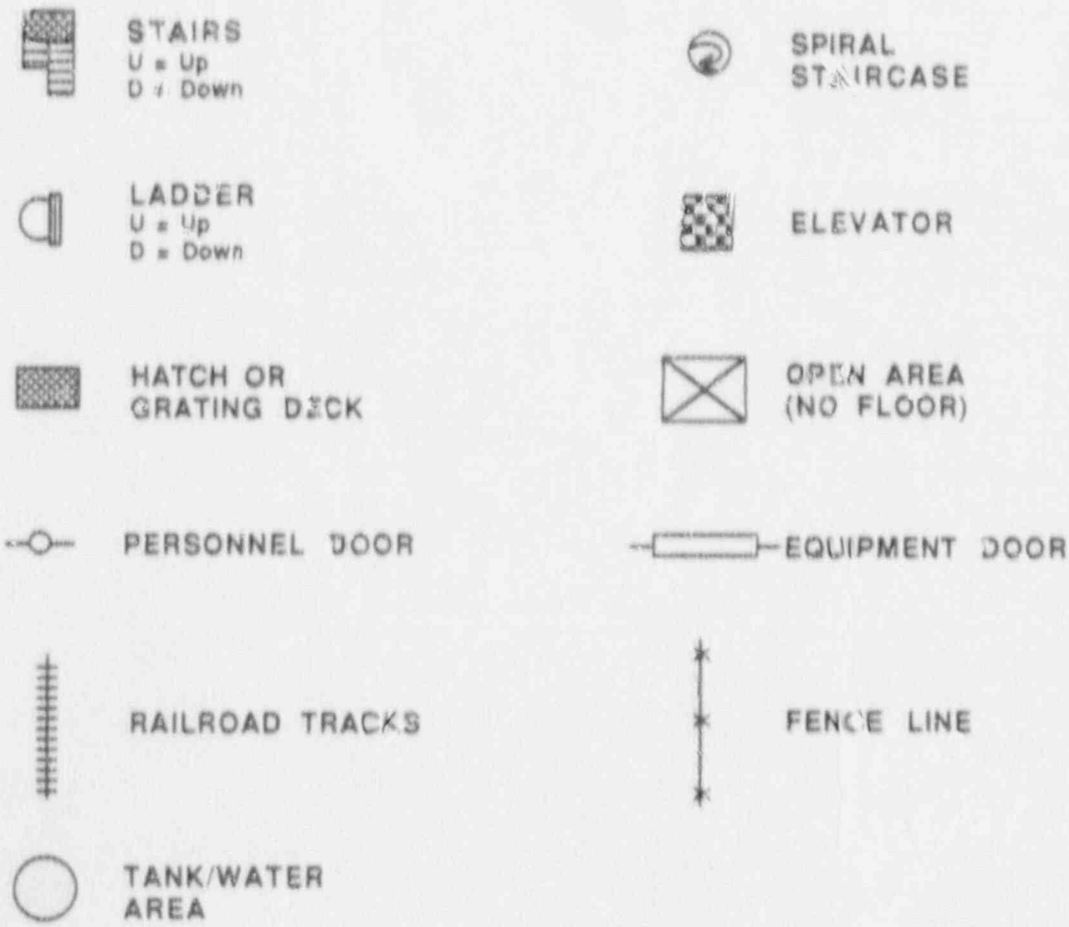



Figure A-3. Key To Symbols In Facility Layout Drawings

# APPENDIX B
# DEFINITION OF TERMS USED IN THE DATA TABLES

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

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

| Code | Definition |
|---|---|
| RCS | Reactor Coolant System |
| AFW | Auxiliary Feedwater System |
| ECCS | Emergency Core Cooling System (including HPI and LPI) |
| PAHR | Containment Heat Removal Systems (including Reactor Building Spray and Reactor Building Coolers) |
| EP | Electric Power System |
| CCS | Component Cooling System |
| ERCW | Essential Raw Cooling 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 (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 |