APPENDIX R EVALUATION - FORT ST. VRAIN NUCLEAR GENERATING STATION

REPORT NO. 1
SHUTDOWN MODEL

Submitted to:

Public Service of Colorado
P. O. Box 840
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1.0 OVERVIEW

1.1 Background

Since the Browns Ferry Fire of 1975, NRC criteria and guidance relative to fire protection have been evolving. These criteria are principally embodied in BTP 9.5-1, Appendix A and in Appendix R to 10CFR Part 50. Additional guidance is contained in various Generic Letters, I&E Notices, and Staff Positions. In response to these criteria Public Service of Colorado performed a fire hazards analysis, plant shutdown evaluation and comparison to Regulatory guidance in 1978. Modifications at that time included improved fire suppression capability as well as provision of an Alternate Cooling Method (ACM) to assure shutdown of the plant independent of power sources and cabling in the three room complex of Fort St. Vrain. The evaluations performed at that time were principally aimed at responding to Browns Ferry experience as well as NRC criteria in BTP 9.5-1, Appendix A.

The purpose of this evaluation is to determine the degree of compliance with the criteria of Appendix R, and in determining where additional modifications are required or exemption requests should be pursued if adequate protection is deemed available. This report contains results of evaluations that have been performed; results of further evaluations will be contained in subsequent reports.

1.2 Review Criteria

Section III.G of Appendix R provides criteria on separation and protection of plant shutdown components. Section III.L of Appendix R provides performance criteria for the safe shutdown systems. The criteria of III.L are generally aimed at water reactors (i.e., PWRs and BWRs), and are not completely applicable to a gas cooled reactor such as Fort St. Vrain. Accordingly, specialized performance criteria have been developed for Fort St. Vrain in order to provide an equivalent level of shutdown capability to that prescribed under Appendix R. In response to concerns identified in a letter from the NRC of July 18, 1984 (G-84257), Public Service of Colorado provided fire protection acceptance criteria applicable to

Fort St. Vrain for both congested cable areas as well as noncongested cable areas. These criteria are documented in a letter to the NRC of August 17, 1984 (P-84281). Congested cable areas were defined as the Control Room, 480 Volt Switchgear Room, Auxiliary Electric Equipment Room, and congested cable areas along the J and G walls. A copy of the August 17, 1984 letter to the NRC is attached as Appendix A to this report. These criteria essentially call for a forced circulation cooldown capability for a fire in noncongested cable areas, and shutdown with loss of forced circulation using PCRV liner cooldown for a fire in congested areas.

The review of Fort St. Vrain as described in this report has been consistent with these criteria. Additional criteria used in the evaluation are consistent with those contained in various NRC guidance documents, such as consideration of loss of offsite power, not allowing equipment repairs for equipment that may be required within a short time period following a reactor scram, consideration of spurious valve operation, consistency with shutdown methods relied on for other design basis events, process monitoring instrumentation and consideration of support functions necessary to assure continued decay heat removal for a 72 hour time period, as well as capability to provide decay heat removal well beyond 72 hours.

1.3 Review Methodology

The systems philosophy at Fort St. Vrain is somewhat different from that used in water reactors. Fort St. Vrain provides numerous diverse systems that are capable of performing individual shutdown functions, rather than a single system with redundant trains. The Fort St. Vrain systems themselves include significant redundancy of components, in addition to the diverse methods available to accomplish shutdown functions. Because of this design approach for Fort St. Vrain, it becomes extremely unlikely that a single fire can cause loss of all methods available to accomplish individual shutdown functions. Nonetheless, in order to assure that at least one method remains available and undamaged following a fire, and to demonstrate the degree of compliance with the separation and protection criteria of III.G of Appendix R, further evaluations have been performed.

Evaluations have been performed to identify the shutdown functions and system functions necessary in order to satisfy the performance criteria contained in Appendix A to this report. The evaluations also identify for each shutdown function a minimum of two redundant methods to accomplish that function. From these, two sets of systems were identified as Fire Protection Shutdown Train A and Fire Protection Shutdown Train B. The necessary components for performing shutdown functions were identified. The intent has been to identify the minimum set of components that are required in order to satisfy the review criteria described in Section 1.2 above.

1.4 Reporting

The Fort St. Vrain Appendix R evaluations have been subdivided into four major parts. Each portion will be documented in a separate report, and submitted in accordance with the following:

- o Report No. 1 - Shutdown Model, November 17, 1984.
- o Report No. 2 - Electrical Reviews, December 17, 1984.
- o Report No. 3 - Fire Protection, January 17, 1985.
- o Report No. 4 - Exemptions/Modifications, February 17, 1985.

1.5 Scope of Report No. 1

This first report describes the shutdown models that have been developed for Fort St. Vrain to demonstrate the capability to achieve safe shutdown under the criteria of Appendix R. The report identifies the minimum systems required, components, support functions, and process monitoring instrumentation. The result is a list of minimum required fire protection shutdown components using forced circulation (for noncongested cable area fires), and for shutdown using a PCRV liner cooldown (for congested cable area fires). This shutdown model provides a lead-in for subsequent evaluations to be addressed in later reports. Where subsequent evaluations identify additional or alternative components that may be required, the later reports will include page changes to revise and update this first report.

The scope of subsequent reports is described in Section 4.0.

2.0 FIRE PROTECTION SHUTDOWN EVALUATIONS

This section describes the various shutdown evaluations that were performed of Fort St. Vrain to identify the required shutdown systems and components that need to be considered in terms of the separation and protection requirements of 10CFR50, Appendix R, Section III.G.

2.1 Shutdown Models

Since at the NRC's request, the Public Service of Colorado letter dated August 17, 1984 to the NRC staff (Appendix A to this report) established separate safe shutdown performance requirements for congested cable areas and noncongested cable areas, it was necessary to establish two separate shutdown models for Fort St. Vrain. The intent of these shutdown models is to establish the safety subfunctions necessary to satisfy the performance goals of the August 17 letter, necessary systems to accomplish the safety subfunctions, and necessary components and support functions for systems to satisfy their performance requirements.

2.1.1 Forced Circulation Cooldown

Summary of Evaluation:

The August 17, 1984 letter (Appendix A to this report) established performance goals for safe reactor shutdown and cooldown for a fire in noncongested cable areas, including the reactivity control function, maintaining PCRV liner integrity and PCRV structural and pressure containment integrity, reactor heat removal (maintaining forced circulation decay heat removal), process monitoring and supporting functions. These performance goals were converted into a set of safety functions and subfunctions as outlined in Figure 2.1-1. Systems necessary to support the safety subfunctions of Figure 2.1-1 were identified as reflected in Figures 2.1-2 thru 2.1-7. Collectively these figures summarize the shutdown model that is proposed to be relied on for forced circulation cooldown (i.e., fires in noncongested cable areas).

The general method used in our fire protection shutdown model is water drive of a Helium circulator using either boosted fire water or a condensate pump, bearing water for circulator lubrication and cooling, steam generator cooling from a condensate pump or fire water, process monitoring to confirm that safety subfunctions are being accomplished and that systems are performing properly, and various support functions for accomplishing the above.

Accident Analysis 14.4.2.1 of the FSAR (Revision 1) justifies the adequacy of a condensate pump (12½%) for accomplishing water drive of a circulator, in addition to feeding a steam generator for steam generator cooling. Accident Analysis 14.4.2.2 of the FSAR (Revision 1) justifies the adequacy of boosted fire water for accomplishing water drive of a circulator. The FSAR accident analysis 14.4.2.1 also justifies ability of a firewater pump to cool a steam generator in addition to supplying water drive of a circulator. System description SD-21-2 defines required components for functioning of the bearing water system. Accident Analysis 14.4.2.1 of the FSAR (Revision 1) stipulates the need to preserve reactor coolant system (RCS) helium inventory.

The general methodology for performing the systems evaluations was to prepare marked-up flow diagrams for each of the identified systems in Figures 2.1-2 thru 2.1-7 that are relied on for fire protection shutdown, identify the components required in order for systems to satisfactorily function, including valves that must be repositioned for proper systems performance, and define necessary support functions. Figures 2.1-8 thru 2.1-11 provide simplified flow diagrams of the principal process flows for accomplishing the forced circulation cooldown safety functions. Tables 2.1-1 thru 2.1-7 were prepared to summarize the necessary fire protection shutdown components for each of these systems. Included are tables for necessary support functions. In addition other evaluations have been performed to address specific issues related to a shutdown model such as spurious valve operation, process monitoring, control rod evaluations, systems timing requirements, HVAC evaluations and primary system pressure boundary consideration. ,ther sections of this report summarize the related evaluations that we e performed. The end result of these shutdown evaluations is a listing of minimum required fire protection shutdown components as contained in Section 3.0 of this report.

Primary System Pressure Boundary:

For a forced circulation cooldown of Fort St. Vrain, primary system integrity is important to assure that a fire will not cause loss of sufficient helium inventory such that the core heat removal function would not be satisfactorily accomplished. The accident analysis relied on for Fort St. Vrain for shutdown under post fire conditions justifies a forced circulation cooldown following a 1-1/2 hour interruption of circulator operation; however, that accident analysis does not assume helium depressurization. Accordingly, an evaluation was performed to identify potential pathways for loss of helium from the PCRV, and to determine the potential for a fire to cause inadvertent loss of helium through any of these flow paths.

All penetrations through the primary system boundary were identified and tabulated. An evaluation was then made for each primary system penetration and a conclusion stated regarding whether each primary system boundary penetration could be compromised, given a fire, such that an inadvertent depressurization with a loss of He would result.

The following is a summary of the PCRV penetration evaluations:

A. Top Head Penetrations

a. Refueling/Control-37 individual penetrations

The primary and secondary refueling/control penetration enclosures are built onto or in the refueling/control penetration liner. Further, both enclosures are not vulnerable to any fire exposure possibilities because of their coverage by steel and concrete. Therefore, a fire would not jeopardize these metal barrier seals. The check valve in the helium purge line is also built into the penetration and there are no valves that could spuriously operate. The check valve prevents helium backflow. A fire would not cause a loss of helium from the 37 refueling/control penetrations

b. Helium purification system and the helium pump down line

The helium purification system penetration evaluation is identical to the evaluation of the 37 refueling/control penetrations.

One pathway that could lead to inadvertent helium depressurization is through the pump down line. When depressurization of the primary coolant system is required, the helium system pump down line (3"L2325-D32) is used to transfer helium coolant inventory to the helium storage system. This line is normally isolated from the primary system by motor actuated valves HV2311-2 and HV2312-2. These valves are on a header that converges onto a single line with a normally closed motor valve HV2401. The pump down line feeds into the helium transfer compressor. Therefore, in order to violate the primary system integrity with a flow of helium out of the PCRV, two separate and valved isolation points would have to spuriously operate in series and the transfer compressor would have to also spuriously operate. This sequence of events is not considered to be a credible event.

Two separate ventilation system lines are taken directly off the pump down line, but are isolated from this line by normally closed manual valves V23271 and V23272. Given these closed valves, and the closed valves (HV2311-2, HV2312-2, and

HV2401) prior to the ventilation system take off line location, it is not considered credible that the primary system integrity would be compromised through this path.

Based on the above, a fire would not cause a loss of helium from the two helium purification system penetrations, the helium purification pump down line, the ventilation system piping, or the storage system.

c. Access

Same as for refueling penetration closures. A fire would not cause a loss of helium from the top head access penetration.

B. Bottom Head Penetrations

a. Steam Generator (NOTE: primary closure is <u>within</u> PCRV liner boundary.)

Since the primary closure is built within the PCRV penetration and the secondary closure is a welded plate on the liner, then fire effects would not cause a loss of helium.

b. Helium Circulator Structure (NOTE: total of four penetrations).

Since there are no parts of these penetration assemblies that would be spuriously operated or degraded because of fire, no helium leaks would result. (NOTE: Helium circulator penetrations such as the buffer lines, static seal actuation system, "O" Ring, and the circulator brake system were evaluated and found not to be a potential primary system leakage path.)

C. Sidewall Penetrations

a. Instrumentation (NOTE: Total of 18 penetrations and all have primary and secondary closures that consists of welds, steel pipe, flanges and bolts, and are within the concrete of the PCRV.)

Since there are no leak paths through valves on the instrument lines or other penetrations, no leakage of helium would result because of a fire.

b. Safety Valves

Since a steel tank encloses safety valves and rupture discs, there are no external valves or combustible gasket materials that could degrade given a fire, and the primary boundary is steel (as is the secondary boundary), no loss of helium would result given a fire event. Additionally, the safety valves are not remotely operated.

2.1.2 Alternate Cooling Method

Public Service has provided an alternate cooling method based on a design basis accident addressed in the FSAR (Reference DBA-1, FSAR Appendix D). This alternate cooling method will be relied on for demonstrating capability to achieve shutdown given fires in congested cable areas. The August 17, 1984 letter to the NRC (Appendix A to this report) detailed performance goals for achieving shutdown for a fire in a congested cable area. These performance goals include the reactivity control function, helium depressurization, PCRV liner cooling, process monitoring, and support functions for the above.

The Fort St. Vrain alternate cooling method (ACM) has been described in various previous submittals to the NRC, and has been approved through NRC Safety Evaluation Reports. The following summarize the ACM submittals:

- Letter PSC to NRC; January 19, 1976 (P-76006); Fort St. Vrain, Alternate Cooling Method.
- Letter NRC to PSC; June 25, 1976 (G-76049); ACM and IACM Additional Information Request.
- Amendment No. 14, with SER, to Facility Operating License DPR-34 (G-76046).
- Amendment No. 18, with SER, to Facility Operating License DPR-34 (G-77076).
- Letter NRC to PSC, June 6, 1979 (G-79103); SER and License Amendment No. 21 (ACM approval).

- Amendment No. 22, with SER, to Facility Operating License DPR-34 (G-80139).

Figure 2.1-12 has been prepared to summarize the ACM shutdown model. Figure 2.1-13 illustrates the ACM interrelationships for the various plant systems that form a part of the ACM. Table 2.1-8 provides additional information pertaining to miscellaneous supplemental components required in order to support ACM operation. Equipment startup, operation, valve alignments, and performance monitoring are described in several Public Service Company procedures. Appendix B to this report contains portions of selected procedures related to the ACM illustrating the step by step controls available when operating under this system.

TABLE 2.1-1 (Sheet 1 of 2)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Bearing Water to Loop 1
Function: Circulator Bearing Lubrication and Cooling, D2.1

Ref P&ID's

1. PI 21-4
2. PI 21-5
3. PI 21-7
4. PI 21-6
5. PI 31-2
6.

Bearing Water PI-21-4 Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Bearing Water Surge Tank T-2104	A	NA	Fire Water Pump P-4501-S	NA	NA	NA	Control Room	Monitor LI 21135	1. (Start and stop emergency makeup pump P-2108 based on LI-21135).
Brg. Wtr. Pump P-2101	A	AC (See Table 2.1-5)	T-2104	NA	NA	HS 2131-2	1-02 control room	Start from	1. (Any 2 of 3 in series).
Brg. Wtr. Pump P-2106	A	AC (See Table 2.1-5)	T-2104	NA	See Section 2.6	HS 2131-2	1-02 Control Room		1. (Any 2 of 3 in Series)
Heat Exchanger E-2104	A	NA	T-2104	Service Water (Table 2.1-6)	NA	NA	NA	NA	2. (One of 2 Coolers)
High Pressure Separator 1A T-2106	A	NA	He Side of Bearing	NA	NA	NA	NA	NA	3.

TABLE 2.1-1 (Sheet 2 of 2)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Bearing Water to Loop 1
Function: Circulator Bearing Lubrication and Cooling, D2.1

Ref P&ID's

1. PI 21-4
2. PI 21-5
3. PI 21-7
4. PI 21-6
5. PI 31-2
6.

Bearing Water PI-21-4 Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Emergency Brg. Water Mk-Up Pump P-2108	A	AC (See Table 2.1-5)	T-3102	NA	NA	HS-21394	Control Room (1-02)	Control from HS-21394	1.
Valve V-211214	A	-	-	-	-	Manual	Local	Open valve locally.	1.
Condensate Storage Tank T-3102	A	-	-	-	-	-	-	-	5.
Low Pressure Separator T-2111	A + B	NA	T-2104 C-2101	NA	NA	NA	NA	NA	4.
Bearing Water Removal Pump P-2104	A	AC	T-2111	-	See Section 2.6	Start pump based on LI-21115. Use HS-21109.	Control room (1-02)	Start from HS-21109	4.

TABLE 2.1-2 (Sheet 1 of 2)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Bearing Water to Loop 2
Function: Circulator Bearing Lubrication & Cooling, D2.2

Ref P&ID's

1. PI 21-4
2. PI 21-5
3. PI 21-9
4. PI 21-6
5. PI 31-2
6.

Bearing Wtr. PI-21-4 Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Bearing Water Surge Tank T-2105	B	NA	Condensate T-3102	NA	NA	NA		Monitor LI-21136	1. (Start and stop makeup pump P-2105 based on LI-21136).
Brg. Wtr. Pump P-2102	B	AC (See Table 2.1-5)	T-2105	NA	See Section 2.6	HS-2130-1	Control Room (1-02)	Start from control room	1. (Any 2 of 3 in series).
Brg. Wtr. Pump P-2107	B	AC (See Table 2.1-5)	T-2105	NA	See Section 2.6	HS-2130-2	Control Room (1-02)	Start from control room	1. (Any 2 of 3 in series).
Heat Exchanger E-2105	B	NA	T-2105	Service Water (Table 2.1-6)	NA	NA	NA	NA	2. (One of 2 coolers).
High Pressure Separator IC T-2108	B	NA	He side of bearing	NA	NA	NA	NA		3.

TABLE 2.1-2 (Sheet 2 of 2)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Bearing Water to Loop 2
Function: Circulator Bearing Lubrication & Cooling, D2.2

Ref P&ID's
1. PI 21-4
2. PI 21-5
3. PI 21-9
4. PI 21-6
5. PI 31-2
6.

Bearing Wtr. PI-21-4 Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Condensate Storage Tank T-3102	B	NA	Condensate	NA	NA	NA	NA	NA	5.
Bearing Water Makeup Pump P-2105	B	AC (See Table 2.1-5)	T-3102 & T-2111	Service Water (Table 2.1-6)	NA	HS-21331-C	Control Room	Start pump from control room; HS-2131-C (I-02)	1.
Valve V-211309	B	Manual	-	-	-	-	Local	Close valve locally	1.
Low Pressure Separator T-2111	A + B	NA	T-2105 C-2103	NA	NA	NA	NA	NA	4.
Valve HV-21252-1	B	Electro Pneumatic	NA	NA	NA	NA	Open valve remotely, or locally if possible.	Open valve remotely, or locally if possible.	4. (Need to protect capability to open valve, or open locally).

TABLE 2.1-3 (Sheet 1 of 5)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Condensate Pumps
Function: D1.4 and J.3; Drive Pelton Wheel of Circulator C-2101 and feed S/G B-2201.

Ref P&ID's

1. PI 31-2
2. PI 31-5
3. PI 31-1
4. PI 21-6
5. PI 21-7
6. PI 22-1
7. PI 22-2
8. PI 32-1
9. PI 5[illegible]

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Pump P3106 (Pump IC)	A	AC (See Table 2.1-5)	Condensate Storage Tank or Decay heat removal exchanger E-4202	None (Gland Seal H_2O not required under abnormal conditions, ref. SD-31, Pg. 6 & 7.	See Section 2.6	NA	Cont. Room HS-3131	Start From Control Room	1.
Valve HV-3133-1	A	MOV	-	-	-	-	Local	De-energize and operate locally. (close valve)	1.
Valve HV-3133-2	A	MOV	-	-	-	-	Local	De-energize and operate locally. (open valve)	1.
Valve V-31131	A, B	Manual	-	-	-	-	Local	Close Valve	2(D,4); Note 1
Valve V-3166	A, B	Manual	-	-	-	-	Local	Close Valve	2 Note 1
Valve V-31408	A, B	Manual	-	-	-	-	Local	Close Valve	2 Note 1
Valve V-211658	A	Manual	-	-	-	-	Local	Close Valve	4 Note 1
Valve V-21867	A	Manual	-	-	-	-	Local	Close Valve	4 Note 1

TABLE 2.1-3 (Sheet 2 of 5)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Condensate Pumps
Function: D1.4 and J.3; Drive Pelton Wheel of Circulator C-2101 and feed S/G B-2201.

Ref P&ID's

1. PI 31-2
2. PI 31-5
3. PI 31-1
4. PI 21-6
5. PI 21-7
6. PI 22-1
7. PI 22-2
8. PI 32-1
9. PI 52

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Valve HV-2109-1	A	Normally Air	-	-	-	-	Local	Open Valve locally; de-energize	5.
Valve SV-2109	A	Electro-hydraulic	-	-	-	-	Local	Open Valve locally; de-energize	5.
Valve HV-2109-2	A	Normally Air	-	-	-	-	Local	Open Valve locally; de-energize	5.
Tank T-2110 (Turbine H_2O drain tank)	A, B	-	-	-	-	-	-	-	4.
Turbine H_2O Removal Pump (P-2103)	A	AC (See Table 2.1-5)	T-2110	-	See Section 2.6	-	Control Room	Start From Handswitch HS-2111	4.
Valve LV-21114	A, B	Inst. Air (See Table 2.1-7)	-	-	-	LC21114	Auto.	-	4.
Valve V-21729	A	Manual	-	-	-	-	Local	Operate Valve Locally (Close)	4, Note 2

TABLE 2.1-3 (Sheet 3 of 5)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Condensate Pumps
Function: D1.4 and J.3; Drive Pelton Wheel of Circulator C-2101 and feed S/G B-2201.

Ref P&ID's

1. PI 31-2
2. PI 31-5
3. PI 31-1
4. PI 21-6
5. PI 21-7
6. PI 22-1
7. PI 22-2
8. PI 32-1
9. PI 52

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Valve V-31904	A, B	Manual	NA	NA	NA	Manual	Local	Close Valve	N.O. Gate 1.
Valve V-31919	A, B	Manual	NA	NA	NA	Manual	Local	Open Valve	N.C. Gate 1.
Valve V-31921	A, B	Manual	NA	NA	NA	Manual	Local	Open Valve	N.C. Gate 1.
Valve V-32109	A	Manual	NA	NA	NA	Manual	Local	Open Valve	N.C. Gate 1.
Valve V-3102	A	Manual	NA	NA	NA	-	-	Close Valve	1. N.O. Butterfly
Valve V-32108	A	Manual	NA	NA	NA	Manual	Local	Open Valve	N.C. Gate 1.
Valve HV-2237	A	Normally AC (MOV)	NA	NA	NA	NA	Local - Manual	Remove Power and Open Valve Locally	N.C. Globe 6.
Valve FV-2205	A	Normally electro-hydraulic	NA	NA	NA	NA	1-49 Control Room	Control through HS-2205 in manual control position	6.
Valve V-75595	A	Manual	-	-	-	-	Local	Close Valve	7.
Valve HV-2223	A	Normally electro-pneumatic	P-3 6	NA	NA	NA	1-05 Control Room (if can't control locally)	Close Valve remove power or protect HS control from control room.	7.

TABLE 2.1-3 (Sheet 4 of 5)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Condensate Pumps
Function: D1.4 and J.3; Drive Pelton Wheel of Circulator C-2101 and feed S/G B-2201.

Ref P&ID's

1. PI 31-2
2. PI 31-5
3. PI 31-1
4. PI 21-6
5. PI 21-7
6. PI 22-1
7. PI 22-2
8. PI 32-1
9. PI 52

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Valve PV-2229	A	Normally electro-pneumatic	P-3106	NA	NA	NA	I-49 Control Room (if can't control locally)	Open Valve remove power or protect HS control from control room.	7.
Valve V-22345	A	Manual	-	-	-	-	Local	Close Valve	7. N.O. Gate
Valve V-5288	A	Manual	NA	NA	NA	NA	Local	Open Valve	9. N.C. Gate
Valve V-5287	A	Manual	NA	NA	NA	NA	Local	Close Valve	9. N.O. Gate
Valve V-5203	A	Manual	-	-	-	-	Local	Close Valve	9. N.O. Gate
Valve V-32308	A	Manual	NA	NA	NA	NA	Local	Close Valve	8.
Valve HV-3220-6	A	Electro-pneumatic	NA	NA	NA	NA	Local	Remove instr. air and open locally	8.
Decay Heat Exchanger E-4202	A, B	-	-	-	-	-	-	-	8.
Valve V-32234	A	Manual	NA	NA	NA	NA	Local	Close Valve	8.
Valve LV-3250-2	A	Normally AC (MOV)	NA	NA	NA	NA	Local	Remove power and throttle flow locally	8. N.C. Globe

* Components in flowpath required to function (operate) to achieve the above system function.

Note 1: Close these valves to prevent diverting flow to functions not required for F.P. shutdown.

Note 2: Close valve to prevent excessive condensate to low pressure separator T-2111.

TABLE 2.1-4 (Sheet 1 of 6)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Fire Water
Function: DI.1 and J.1; Boosted Firewater to drive Pelton Wheel and Firewater for Steam Generator Cooling

Ref P&ID's

1. PI 45
2. PI 31-2
3. PI 22-1
4. PI 21-9
5. PI 21-5
6. PI 21-6
7. PI 31-1
8. PI 22-6
9. PI 22-7
10. PI 52
11. PI 42-1
12. PI 32-1
13. PI 41-1
14. PI 75-2

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	Starting	PI's and Notes
Diesel Fire Pump P4501S	B	Fuel Oil (Engine F.O. Pump; no other components)	Main Cooling twr. basin; make-up pumps. Table 1.5-1.1	Engine and gear drive oil cooled from pump discharge; drain to basin.	See Section 2.6	No. Auto. required	Local Start from HS-4504-3	Local Start; monitor f[illegible]l level and replenish as necessary.	Battery	1. Fuel tank can be replenished from sources on site.
Fuel Oil Tank T-4503	B	-	-	-	-	-	-	-	-	1.
Valve V-4525	B	Manual	-	-	-	-	Local	Open Valve	-	1.
Emergency H_2O Booster Pump P-2110	B	AC (See Table 2.1-5)	-	-	See Section 2.6	-	Control Room HS-21536	Start from Control Room	-	3.
Valve V-211565	B	Manual	-	-	-	-	Local	Close Valve	-	3.
Valve V-211573	B	Manual	-	-	-	-	Local	Open Valve	-	3.
Valve V-211570	B	Manual	-	-	-	-	Local	Open Valve	-	3.
Valve HV-2110-1	B	Normally Air	-	-	-	-	Local	Open Valve Locally; de-energize	-	4.

TABLE 2.1-4 (Sheet 2 of 6)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Fire Water
Function: D1.1 and J.1; Boosted Firewater to drive Pelton Wheel and Firewater for Steam Generator Cooling

Ref P&ID's

1. PI 45
2. PI 31-2
3. PI 22-1
4. PI 21-9
5. PI 21-5
6. PI 21-6
7. PI 31-1
8. PI 22-6
9. PI 22-7
10. PI 52
11. PI 42-1
12. PI 32-1
13. PI 41-1
14. PI 75-2

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	Other	PI's and Notes
Valve SV-2110	B	Normally hydraulic	-	-	-	-	Local	Open Valve Locally; de-energize	-	4.
Valve HV-2110-2	B	Normally Air	-	-	-	-	Local	Open Valve Locally; de-energize	-	4.
Tank T-2110 (Turbine H_2O Drain Tank)	A + B	-	-	-	-	-	-	-	-	6.
Turbine H_2O Removal Pump (P-2103S)	B	AC (See Table 2.1-5)	T-2110	-	See Section 2.6	Operate as required based on Tank T-2110 level.	Hand Sw. Control Rm.	Start from Control Rm.	Gland Seal (Filter and manual valves; norm. open)	6.
Valve LV-21114	A, B	Inst. Air	-	-	-	LC-21114	Auto	-	-	6.
Valve V-31904	A, B	Manual	-	-	-	-	Local	Close Valve		2. N.O. Gate
Valve V-31919	A, B	Manual	-	-	-	-	Local	Open Valve		2. N.C. Gate
Valve V-31921	A, B	Manual	-	-	-	-	Local	Open Valve		2. N.C. Gate
Valve V-31101	A, B	Manual	-	-	-	-	Local	Open Valve		2. N.C. Gate

TABLE 2.1-4 (Sheet 3 of 6)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Fire Water
Function: DI.I and J.I; Boosted Firewater to drive Pelton Wheel and Firewater for Steam Generator Cooling

Ref P&ID's

1. PI 45
2. PI 31-2
3. PI 22-1
4. PI 21-9
5. PI 21-5
6. PI 21-6
7. PI 31-1
8. PI 22-6
9. PI 22-7
10. PI 52
11. PI 42-1
12. PI 32-1
13. PI 41-1
14. PI 75-2

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	Other	PI's and Notes
Condensate Storage Tank T-3101/T-3102 overflows and gravity drain to service water return sump.	B	-	-	-	-	-	-	No. Action req'd. (Overflow is aligned to service wtr return sump.)		14, 2
Service water return sump	-	-	-	-	-	-	-	-	-	Required components for sump operation, up to branch line to main cooling tower are covered by the service water evaluation table.
Valve HV-4221-1	B	Motorized	-	-	-	-	Local	Remove power and throttle at tower	-	13.
Valve HV-4138-1	B	Motorized	-	-	-	-	Local	Remove power and close locally	-	13.

TABLE 2.1-4 (Sheet 4 of 6)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Fire Water
Function: D1.1 and J.1; Boosted Firewater to drive Pelton Wheel and Firewater for Steam Generator Cooling

Ref P&ID's

1. PI 45
2. PI 31-2
3. PI 22-1
4. PI 21-9
5. PI 21-5
6. PI 21-6
7. PI 31-1
8. PI 22-6
9. PI 22-7
10. PI 52
11. PI 42-1
12. PI 32-1
13. PI 41-1
14. PI 75-2

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	Other	PI's and Notes
Valve HV-4138-2	B	Motorized	-	-	-	-	Local	Remove power and close locally	-	13.
Main Cooling Tower E-4103	B	Gravity (Fan Not Required)	-	-	-	-	-	-	-	13.
Valve HV-31122	B	Normally AC	-	-	-	-	Local	Remove power and manually open valve	-	N. C. Gate 7.
Valve HV-2238	B	Normally AC	-	NA	NA	-	Control Rm. (HS-2204)	Remove power and open valve locally	-	N. C. Globe 8.
Valve V-75610	B	Manual	-	-	-	-	Local	Close Valve	-	9.
Valve HV-2224	B	Electro pneumatic	-	NA	NA	NA	;-05 Control Room	Close Valve Remove power	-	9.
Valve PV-2230	B	Electro pneumatic	-	NA	NA	-	-	Open Valve locally if possible, or protect controls to HS-2230	-	9.

TABLE 2.1-4 (Sheet 5 of 6)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Fire Water
Function: D1.1 and J.1; Boosted Firewater to drive Felton Wheel and Firewater for Steam Generator Cooling

Ref P&ID's

1. PI 45
2. PI 31-2
3. PI 22-1
4. PI 21-9
5. PI 21-5
6. PI 21-6
7. PI 31-1
8. PI 22-6
9. PI 22-7
10. PI 52
11. PI 42-1
12. PI 32-1
13. PI 41-1
14. PI 75-2

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	Other	PI's and Notes
Valve V-22346	B	Manual	-	-	-	-	Local	Close Valve	-	9.
Valve V-5202	B	Manual	-	-	-	-	Local	Close Valve	-	
Valve V-5288	B	Manual	-	NA	NA	-	Local	Open Valve	-	10.
Valve V-5287	B	Manual	-	-	-	-	Local	Close Valve	-	10.
Valve V-32308	B	Manual	-	NA	NA	-	Local	Close Valve	-	12.
Valve HV-3220-6	B	Electro pneumatic	-	NA	NA	-	Local	Isolate instr. air and open valve locally	-	12.
Decay Heat Exchanger E-4202	A, B	NA	NA	NA	NA	NA	NA	NA	NA	12.
Valve V-32234	B	Manual	-	NA	NA	-	Local	Close Valve	-	12.
Valve LV-3250-2	B	Motorized	-	NA	NA	-	Local	Remove power and throttle valve	-	N.C. Globe
Valve V-32108	B	Manual	-	NA	NA	-	Local	Open Valve	-	2. N.C. Globe

(Sheet 6 of 6)

* Components in flowpath required to function (operate) to achieve the above system function.

TABLE 2.1-5 (Sheet 1 of 4)

Case: Fire in non-CCA arec (Forced Circulation Cooldown)
System: Diesel Generators 1A, 1B, 1C, & 1D
Function: Essential AC to Various Components

Ref P&ID's
1. PI 42-1
2. PI 92-2

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Diesel Fuel Oil Storage Tank T-9201	A + B	-	-	-	-	-	-	-	1.
Diesel Oil Transfer Pumps:									
P-9201X	A	AC (See Table 2.1-5)	-	-	See Section 2.6	HS-9299 LS-92206-1+2	1-06 Local	-	1. (Handswitches assumed positioned for auto start)
P-9201SX	B	AC (See Table 2.1-5)	-	-	See Section 2.6	HS-92100 LS-92207-1+2	1-06 Local	-	1. (Handswitches assumed positioned for auto start)
Day Tanks:									
T-9202X	A	-	-	-	-	-	-	-	1.
T-9203X	B	-	-	-	-	-	-	-	1.
Starting Air Receivers:									
T-9204X	A	-	-	-	-	-	-	-	2.
T-9206X	B	-	-	-	-	-	-	-	2.

TABLE 2.1-5 (Sheet 2 of 4)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Diesel Generators 1A, 1B, 1C, & 1D
Function: Essential AC to Various Components

Ref P&ID's
1. PI 42-1
2. PI 92-2

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Air Start Solenoids:									
HSV-92245	A	125VDC	-	-	-	Auto/Normal (See Notes)	Remote/ Local (See Notes)	Manual Control, as Required	2. (DG Control per E-1207 & E-1208)
HSV-92247	A	125VDC	-	-	-	Auto/Normal (See Notes)	Remote/ Local (See Notes)	Manual Control, as Required	2. (DG Control per E-1207 & E-1208)
HSV-92249	B	125VDC	-	-	-	Auto/Normal (See Notes)	Remote/ Local (See Notes)	Manual Control, as Required	2. (DG Control per E-1207 & E-1208)
HSV-92251	B	125VDC	-	-	-	Auto/Normal (See Notes)	Remote/ Local (See Notes)	Manual Control, as Required	2. (DG Control per E-1207 & E-1208)
Air Start Motors:									
M-92865	A	Air from receiver	-	-	-	HSV-92245	See Above	-	2 (See above)
M-92867	A	Air from receiver	-	-	-	HSV-92247	See Above	-	2 (See above)
M-92869	B	Air from receiver	-	-	-	HSV-92249	See Above	-	2 (See above)
M-92871	B	Air from receiver	-	-	-	HSV-92251	See Above	-	2 (See above)

TABLE 2.1-5 (Sheet 3 of 4)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Diesel Generators 1A, 1B, 1C, & 1D
Function: Essential AC to Various Components

Ref P&ID's
1. PI 42-1
2. PI 92-2

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Diesel Engines:									
1A (K-9203X)	A	Diesel engine	-	Service Water	See Section 2.6	See Notes	See Notes	Manual Control, as required	1. (See also E-1203 pgs 170 + 171) (See above)
1B (K-9204X)	A	Diesel engine	-	Service Water	See Section 2.6	See Notes	See Notes	Manual Control, as required	1. (See also E-1203 pgs 170 + 171) (See above)
1C (K-9205X)	B	Diesel engine	-	Service Water	See Section 2.6	See Notes	See Notes	Manual Control, as required	1. (See also E-1203 pgs 170 + 171) (See above)
1D (K-9206X)	B	Diesel engine	-	Service Water	See Section 2.6	See Notes	See Notes	Manual Control, as required	1. (See also E-1203 pgs 170 + 171) (See above)
Generators:									
1A (K-9201)	A	Diesel engine	-	-	See Section 2.6	See Notes	See Notes	Manual Control, as required	1 (See also E-1203 pgs 170 + 171)
1B (K-9202)	B	Diesel engine	-	-	See Section 2.6	See Notes	See Notes	Manual Control, as required	1 (See also E-1203 pgs 170 + 171)

* Components in flowpath required to function (operate) to achieve the above system function.

TABLE 2.1-6 (Sheet 1 of 12)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Service Water
Function: Component Cooling

Ref P&ID's

1. PI 42-1
2. PI 41-1
3. PI 42-2
4. PI 42-3
5. PI 75-3
6. PI 41-3
7. PI 46-2
8. PI 46-4
9. PI 46-10

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Service Water Pumps P-4201	A	AC (See Table 2.1-5)	Service Wtr. Cooling Twr. Basin, make-up from Circ. Wtr.	-	See Section 2.6	Remote Manual HS-4211-1	1-06	Start	1.
P-4202-S	B	AC (See Table 2.1-5)	Service Wtr. Cooling Twr. Basin, make-up from Circ. Wtr.	-	See Section 2.6	Remote Manual HS-4211-3	1-06	Start	1.
Circ. Water Make-up Pump P-4118-P	A	AC (See Table 2.1-5	Storage Ponds	-	See Section 2.6	HS-4102-1	1-09	Start	6. (Start and throttle flow at V-42131)
Valve V-41302 (from Circ. Water make-up pumps)	A	-	-	-	-	Manual	Local	Open	2.
Valve V-4121 (Circ. Water Make-up to Main Cooling Tower)	A	-	-	-	-	Manual	Local	Throttle	2. (To minimize potential flow to main cooling tower and ensure flow to S.W. pump pit.)
Valve V-41903P	A	-	-	-	-	Manual	Local	Close	2.
Valve V-42131 (Make-up to S.W. pumps)	A	-	-	-	-	Manual	Local	Open	1. Position to maintain S.W. pump pit level.

TABLE 2.1-6 (Sheet 2 of 12)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Service Water
Function: Component Cooling

Ref P&ID's

1. PI 42-1
2. PI 41-1
3. PI 42-2
4. PI 42-3
5. PI 75-3
6. PI 41-3
7. PI 46-2
8. PI 46-4
9. PI 46-10

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Valve V-42124 (LCV 4218-1 isolation)	A + B	-	-	-	-	Manual	Local	Close	1.
Valve V-42130 (LCV 4218-3 isolation)	A + B	-	-	-	-	Manual	Local	Close	1.
Valve V-4449 (Domestic water isolation)	A + B	-	-	-	-	Manual	Local	Close	1.
Strainer F-4201 (Dual element)	A + B	AC (See Table 2.1-5)	backwash via discharge	-	-	Manual strainer element selection & backwash HS-4226 PDIS-4226	Local	Backwash and strainer select	1. (See also SOP42 Section 3.5)
Valve HV-4257 (non-essential shut-off valve)	A + B	AC or Manual	-	-	-	Remote Manual HS-4257 Auto close on LOP & TT	1-06	De-energize and Close Manually	1. (Fails as is) N.O.
Valve HV-4225 (Decay heat removal exchanger shutoff)	A + B	AC or Manual	-	-	-	HS-4225	1-06	De-energize Close/Open manualy	1.

TABLE 2.1-6 (Sheet 3 of 12)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Service Water
Function: Component Cooling

Ref P&ID's

1. PI 42-1
2. PI 41-1
3. PI 42-2
4. PI 42-3
5. PI 75-3
6. PI 41-3
7. PI 46-2
8. PI 46-4
9. PI 46-10

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Service Water Return Pumps:									
P-4203	A	AC (See Table 2.1-5)	Service Wtr. Return Sumps in T.B.	-	See Section 2.6	HS-4201-1 Auto Start/ Stop LS-4208-1+2	1-06	Start	1.
P-4204S	B	AC (See Table 2.1-5)	Service Wtr. Return Sumps in T.B.	-	See Section 2.6	HS-4201-3 LS-4208-1 + 2	1-06	Start	1.
Valve LCV-4207 (for service water return)	A + B	Air (See Table 2.1-7)	-	-	-	Auto LC-4207	Auto/ Local (air)	-	1. (Fails open) (See also PI 82-10)
Valve HV-4221-1 (for service water return to main cooling tower)	A + B	AC or Manual	-	-	-	HS-4221 handwheel	1-06 Local	De-energize @ MCC Close for A Throttle flow for B	1. - Flow to be balanced to maintain level in S.W. pump pit.
Valve HV-4221-3 (for service water return to main cooling tower)	A + B	AC or Manual	-	-	-	HS-4221 handwheel	1-06 Local	De-energize @ MCC Open for A Throttle flow for B	1. - Flow to be balanced to maintain level in S.W. pump pit.
Valve V-4286 (S.W. Blowdown to Yard Drain)	A + B	-	-	-	-	Manual	Local	Close	1.

TABLE 2.1-6 (Sheet 4 of 12)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Service Water
Function: Component Cooling

Ref P&ID's

1. PI 42-1
2. PI 41-1
3. PI 42-2
4. PI 42-3
5. PI 75-3
6. PI 41-3
7. PI 46-2
8. PI 46-4
9. PI 46-10

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Service Water Cooling Tower Fans: C-4201X	A	AC (See Table 2.1-5)	-	-	-	Remote Manual HS-4231-1 Local Manual HS-4231-2 Auto Shut-off on High Vibration GS-4231	1-06 Local Local	Start	1.
C-4202X	B	AC (See Table 2.1-5)	-	-	-	HS-4232-1 HS-4232-2 GS-4231	1-06 Local Local	Start	1.
Valve TCV 4267 for (DG 1A Eng. Cooler)	A	Air (See Table 2.1-7) or manual	-	-	-	TIC-4267 TE-4267	Local	-	3, 4 (fails open) (See also PI 82-10 & E-1203 pages 170 + 171) (pneumatic controls are local only).
Valve TCV 4268	A	Similar to TCV 4267							
Valve TCV 4269	B	Similar to TCV 4267							
Valve TCV 4270	B	Similar to TCV 4267							

TABLE 2.1-6 (Sheet 5 of 12)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Service Water
Function: Component Cooling

Ref P&ID's

1. PI 42-1
2. PI 41-1
3. PI 42-2
4. PI 42-3
5. PI 75-3
6. PI 41-3
7. PI 46-2
8. PI 46-4
9. PI 46-10

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Standby Generator Engine Coolers:									
E-9201X	A	Diesel engine (for eng. side circulation)	Service Water	Service Water	-	See Notes	See Notes	-	3. (Assume S.W. supplied to all DG's) (See above also)
E-9202X	A	Diesel engine (for eng. side circulation)	Service Water	Service Water	-	See Notes	See Notes	-	3. (Assume S.W. supplied to all DG's) (See above also)
E-9203X	B	Diesel engine (for eng. side circulation)	Service Water	Service Water	-	See Notes	See Notes	-	3. (Assume S.W. supplied to all DG's) (See above also)
E-9204X	B	Diesel engine (for eng. side circulation)	Service Water	Service Water	-	See Notes	See Notes	-	3. (Assume S.W. supplied to all DG's) (See above also)

TABLE 2.1-6 (Sheet 6 of 12)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Service Water
Function: Component Cooling

Ref P&ID's

1. PI 42-1
2. PI 41-1
3. PI 42-2
4. PI 42-3
5. PI 75-3
6. PI 41-3
7. PI 46-2
8. PI 46-4
9. PI 46-10

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Standby Generator Air Handling Units:									
S-7539	A	AC for fans (See Table 2.1-5)	Service Water	Service Water	-	See Notes	See Notes	-	3. (See also E-1203 pgs 170+171 & PI 75-5) (Assume both operating) (see above)
S-7540	B	AC for fans (See Table 2.1-5)	Service Water	Service Water	-	See Notes	See Notes	-	3. (See also E-1203 pgs 170+171 & PI 75-5) (Assume both operating) (see above)
Valve V-4214 (for service air compressor) C-8202	A + B	-	-	-	-	Manual	Local	Close	4.
Valve V-4229 (for EHC Fluid Cooler E-5109X)	A + B	-	-	-	-	Manual	Local	Close	3.
Valve V-4236 (for EHC Fluid Cooler E-5109SX)	A + B	-	-	-	-	Manual	Local	Close	3.
Valve V-42390 (for heater drain pump P-3201)	A + B	-	-	-	-	Manual	Local	Close	4.

TABLE 2.1-6 (Sheet 7 of 12)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Service Water
Function: Component Cooling

Ref P&ID's

1. PI 42-1
2. PI 41-1
3. PI 42-2
4. PI 42-3
5. PI 75-3
6. PI 41-3
7. PI 46-2
8. PI 46-4
9. PI 46-10

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Valve V-4234 (for sample cooling system and E-3304X air ejector discharge heat exchanger)	A + B	-	-	-	-	Manual	Local	Close	4.
Valve V-42817 (for aux. boiler feed pumps)	A + B	-	-	-	-	Manual	Local	Close	3.
Valve V-4256 (for BFP lube oil coolers E-3109X and E-3109SX)	A + B	-	-	-	-	Manual	Local	Close	3.
Valve V-4239 (for BFP Lube oil cooler E-3108X)	A + B	-	-	-	-	Manual	Local	Close	3.
Valve V-4264 (for BFP Lube oil coolers E-3107X + E-3107SX)	A + B	-	-	-	-	Manual	Local	Close	3.
Valve V-42374 (for condensate pumps P-3104 and P-3105)	A + B	-	-	-	-	Manual	Local	Close	3.

TABLE 2.1-6 (Sheet 8 of 12)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Service Water
Function: Component Cooling

Ref P&ID's
1. PI 42-1
2. PI 41-1
3. PI 42-2
4. PI 42-3
5. PI 75-3
6. PI 41-3
7. PI 46-2
8. PI 46-4
9. PI 46-10

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Valve V-4221 (for Inst. Air Compressor C-8201)	A	-	-	-	-	Manual	Local	Open	4.
Valve TCV-4234 for C-8201)	A	Air (See Table 2.1-7)	-	-	-	TET-4234	Local	-	4.
Valve V-42394 (for Instr. Air Compressor C-8203)	B	-	-	-	-	Manual	Local	Open	4.
Valve TCV-4274 (for C-8203)	B	Air (See Table 2.1-7)	-	-	-	TET-4274	Local	-	4.
Valve V-42397 (for HVAC Sys)	A + B	-	-	-	-	Manual	Local	Close	1.
Valve V-75263 (for hot water heating system)	A + B	-	-	-	-	Manual	Local	Close	5.

TABLE 2.1-6 (Sheet 9 of 12)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Service Water
Function: Component Cooling

Ref P&ID's

1. PI 42-1
2. PI 41-1
3. PI 42-2
4. PI 42-3
5. PI 75-3
6. PI 41-3
7. PI 46-2
8. PI 46-4
9. PI 46-10

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Reactor Plant Cooling Water (Service Water Loop):									
Bearing Water Coolers:									
E-2104	A	-	Service Water	-	-	-	-	-	7, 8 (N. O. Manual Valves only)
E-2105	B	-	Service Water	-	-	-	-	-	7, 8 (N. O. Manual Valves only)
Valve V-46614 (for N_2 recondenser Chiller & Regen compressor containment tank)	A + B	-	-	-	-	Manual	Local	Close	7
Valve V-461516 (for backup bearing water coolers E-2101 & E-2106)	A + B	-	-	-	-	Manual	Local	Close	8.
Valve V-46297 (for Bearing Water cooler E-2104)	A + B	-	-	-	-	Manual	Local	Open for A Close for B	8. (Assure E-2104S valved out normally)
Valve V-46307 (for bearing water cooler E-2105)	A + B	-	-	-	-	Manual	Local	Close for A Open for B	7. (Assure E-2105S normally valved out)
Valve V-461536 (to HPU Oil Coolers)	A + B	-	-	-	-	Manual	Local	Close	8.

TABLE 2.1-6 (Sheet 10 of 12)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Service Water
Function: Component Cooling

Ref P&ID's

1. PI 42-1
2. PI 41-1
3. PI 42-2
4. PI 42-3
5. PI 75-3
6. PI 41-3
7. PI 46-2
8. PI 46-4
9. PI 46-10

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Valve V-461535 (to HPU Oil Coolers)	A + B	-	-	-	-	Manual	Local	Close	8.
Valve V-461619 (to purif. cool. water sys. HX's)	A + B	-	-	-	-	Manual	Local	Close	8.
Valve V-461744 (for seal water coolers)	A + B	-	-	-	-	Manual	Local	Close	7.
Valve V-46145 (cooling water Hx E-4601)	A + B	-	-	-	-	Manual	Local	Close	7.
Valve V-46147 (Hx E-4603)	A + B	-	-	-	-	Manual	Local	Close	7.
Valve V-46146 (Hx E-4602)	A + B	-	-	-	-	Manual	Local	Close	7.
Valve V-46148 (Hx E-4604)	A + B	-	-	-	-	Manual	Local	Close	7.
Valve V-46322 (for water chiller S-2109)	A + B	-	-	-	-	Manual	Local	Close	9.

TABLE 2.1-6 (Sheet 11 of 12)

Case: Fire in non-CCA area (Forced Circulation Cooldown)
System: Service Water
Function: Component Cooling

Ref P&ID's

1. PI 42-1
2. PI 41-1
3. PI 42-2
4. PI 42-3
5. PI 75-3
6. PI 41-3
7. PI 46-2
8. PI 46-4
9. PI 46-10

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Valve V-46483 (for water chiller S-2109S)	A + B	-	-	-	-	Manual	Local	Close	9.
Valve V-46326 (for water chiller S-2110)	A + B	-	-	-	-	Manual	Local	Close	9.
Valve V-46494 (for water chiller S-2110S)	A + B	-	-	-	-	Manual	Local	Close	9.
Valve V-461538 (for trap drain return pump P-7202)	A + B	-	-	-	-	Manual	Local	Close	9.
Valve V-46342 (for Helium Recovery Compressor C-2107)	A + B	-	-	-	-	Manual	Local	Close	9.
Valve V-46346 (for Helium Recovery Compressor C-2107S)	A + B	-	-	-	-	Manual	Local	Close	9.
Valve V-461643 (for Helium Dryer Unit S-2111)	A + B	-	-	-	-	Manual	Local	Close	9.

* Components in flowpath required to function (operate) to achieve the above system function.

TABLE 2.1-7 (Sheet 1 of 3)

Case: Fire in non-CCA area (Forced Circulation Cooldown) Ref P&ID's 1. PI 82-1
System: Instrument Air
Function: Supply Air to Instrument Headers** (Support to various F.P. Shutdown functions)

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Instrument Air Compressors:									
C-8201	A	AC (See Table 2.1-5)	-	Service Water See Table 2.1-6	-	HS-8211-2 TS's & PS's	1-06 Local	Start -	1.
C-8203	B	AC (See Table 2.1-5)	-	Service Water See Table 2.1-6	-	HS-8211-1 TS's & PS's	1-06 Local	Start	1.
Instrument Air Compressor After-coolers:									
E-8201X	A	-	-	Service Water See Table 2.1-6	-	-	-	-	1.
E-8203X	B	-	-	Service Water See Table 2.1-6	-	-	-	-	1.

TABLE 2.1-7 (Sheet 2 of 3)

Case: Fire in non-CCA area (Forced Circulation Cooldown)   Ref P&ID's   1. PI 82-1
System: Instrument Air
Function: Supply Air to Instrument Headers** (Support to various F.P. Shutdown functions)

Component*	F.P. Shutdown Train	Motive Power	Water Source	Equipment Cooling	HVAC	Actuation and Sensors	Control Location (Power)	Manual Operations	PI's and Notes
Instrument Air Receivers:									
T-8201	A	-	-	-	-	-	-	-	1.
T-8203	B	-	-	-	-	-	-	-	1.
Instrument Air Dryers:									
S-8201	A	NA	-	-	-	See Notes	Local	Bypass if inoperable	1. (Dryer controls not required)
S-8202	B	NA	-	-	-	See Notes	Local	Bypass if inoperable	1. (Dryer controls not required)

* Components in flowpath required to function (operate) to achieve the above system function.

** Note: Downstream of air supply, headers are open to components serviced.
Function of components serviced is analyzed in associated systems' tables.

TABLE 2.1-8

MISCELLANEOUS ACM SUPPORT COMPONENTS*

- Selected plant lighting powered by the ACM
- Breathing air compressor
- Battery for D/G startup and control functions
- Firewater pump house louvers and exhaust fans
- Firewater pump for fire fighting
- Power to motor operated valves (2)
- Diesel fuel oil supply pumps
- Circulating water makeup pump to makeup to service water
- Service water tower fan

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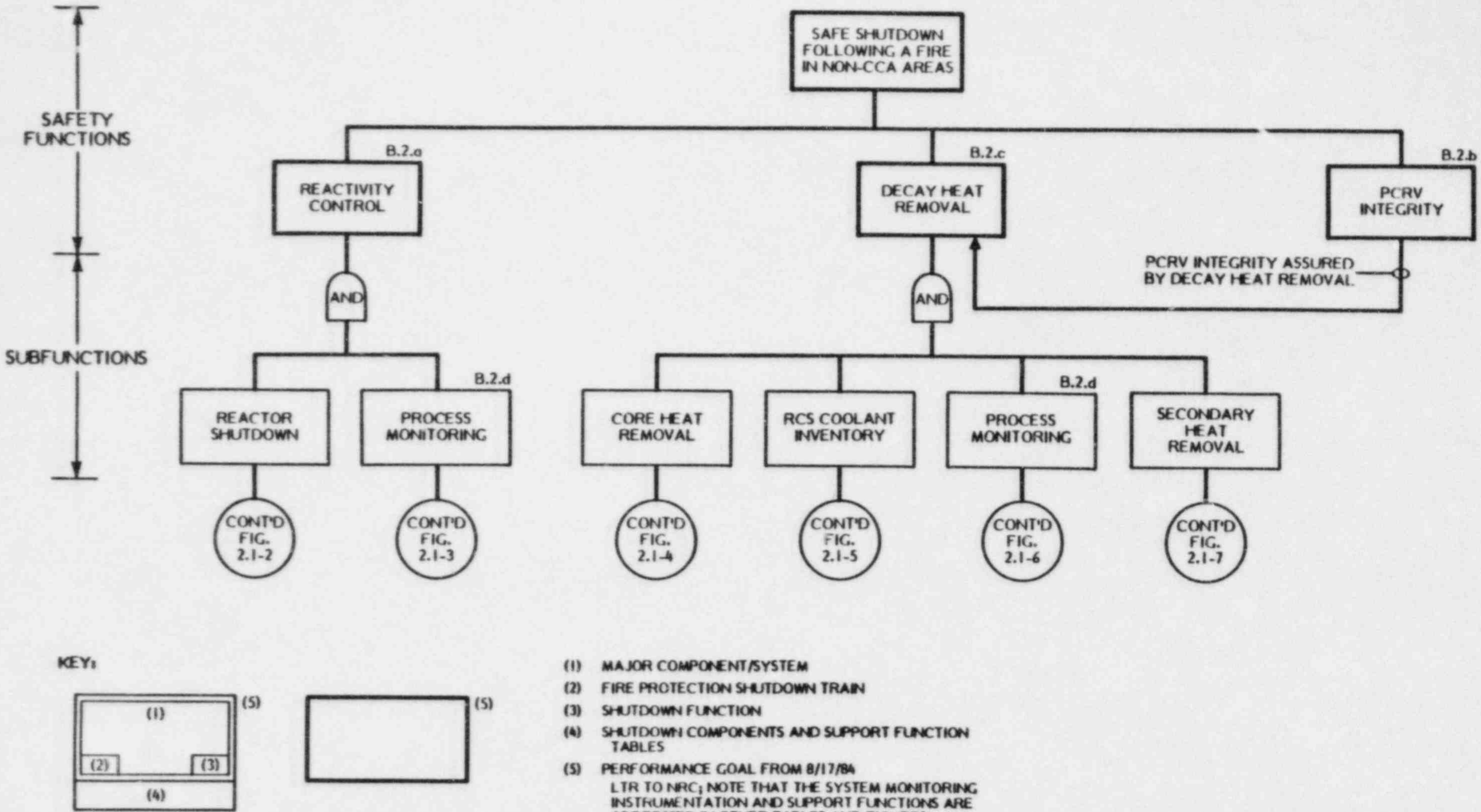
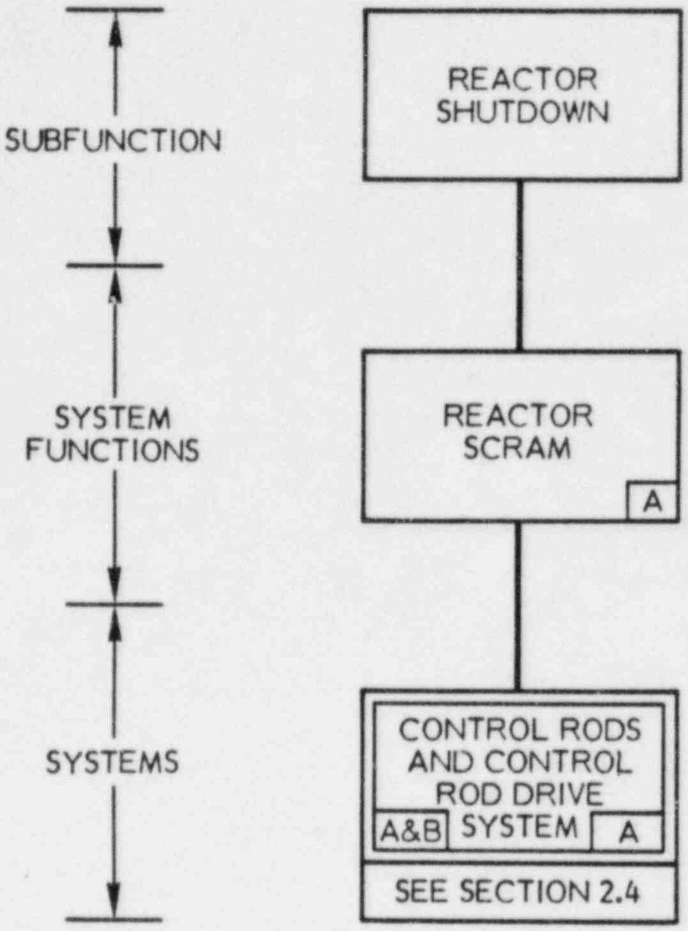
* Major components that are in addition to items listed on Figure 2.1-12



(1) MAJOR COMPONENT/SYSTEM
(2) FIRE PROTECTION SHUTDOWN TRAIN
(3) SHUTDOWN FUNCTION
(4) SHUTDOWN COMPONENTS AND SUPPORT FUNCTION TABLES
(5) PERFORMANCE GOAL FROM 8/17/84 LTR TO NRC; NOTE THAT THE SYSTEM MONITORING INSTRUMENTATION AND SUPPORT FUNCTIONS ARE ADDRESSED IN OTHER TABLES AND FIGURES

FIGURE 2.1-1

SHUTDOWN MODEL - NON-CONGESTED CABLE AREAS
FORCED CIRCULATION COOLDOWN



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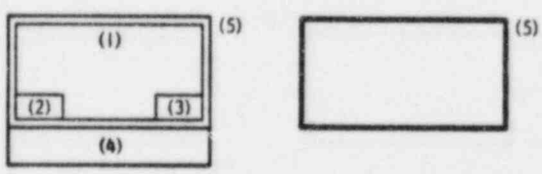


(1) MAJOR COMPONENT/SYSTEM

(2) FIRE PROTECTION SHUTDOWN TRAIN

(3) SHUTDOWN FUNCTION

(4) SHUTDOWN COMPONENTS AND SUPPORT FUNCTION TABLES

(5) PERFORMANCE GOAL FROM 8/17/84 LTR TO NRC; NOTE THAT THE SYSTEM MONITORING INSTRUMENTATION AND SUPPORT FUNCTIONS ARE ADDRESSED IN OTHER TABLES AND FIGURES

FIGURE 2.1-2

SHUTDOWN MODEL - NON-CONGESTED CABLE AREAS
FORCED CIRCULATION COOLDOWN
REACTOR SHUTDOWN

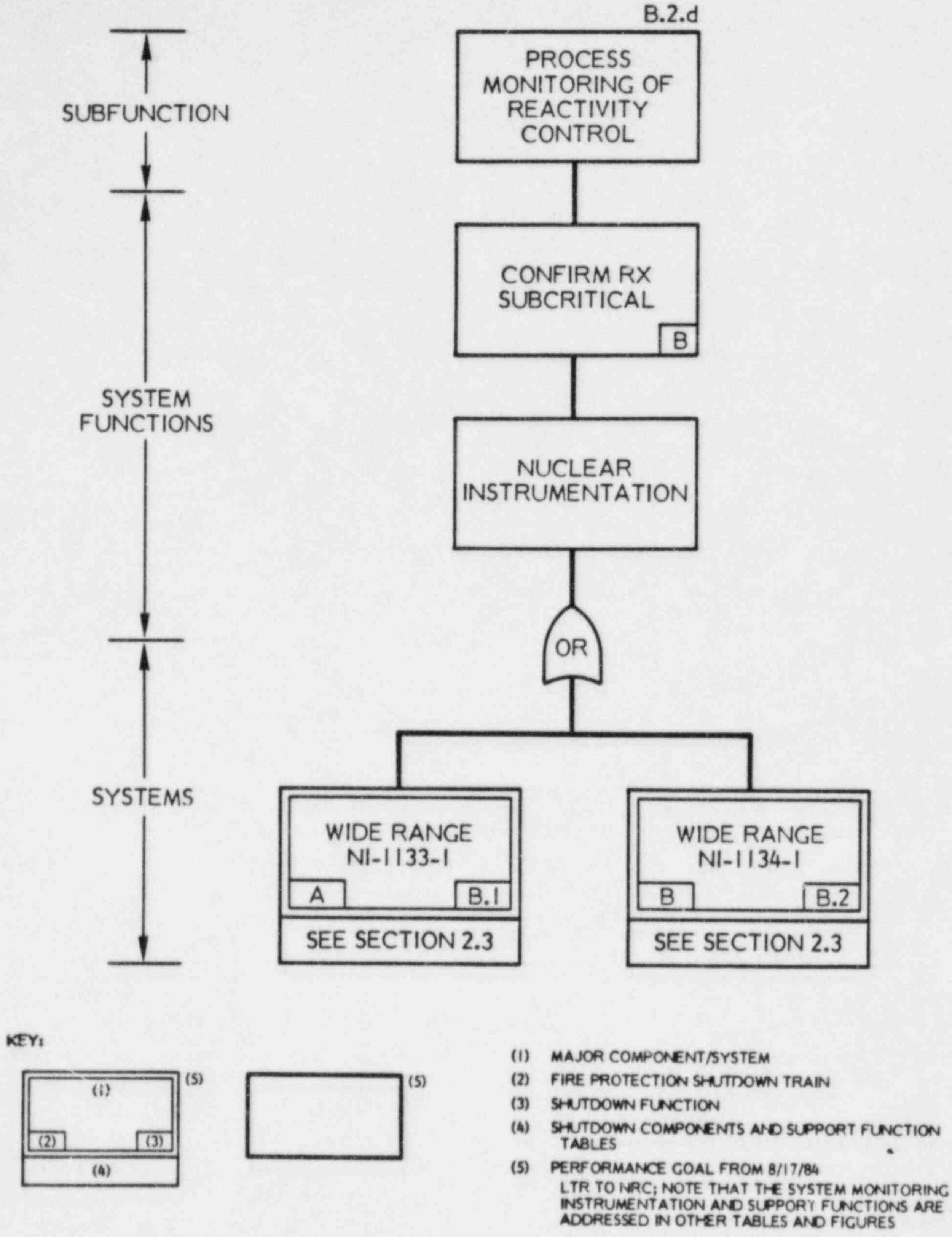


FIGURE 2.1-3

SHUTDOWN MODEL - NON-CONGESTED CABLE AREAS
FORCED CIRCULATION COOLDOWN
PROCESS MONITORING OF REACTIVITY CONTROL

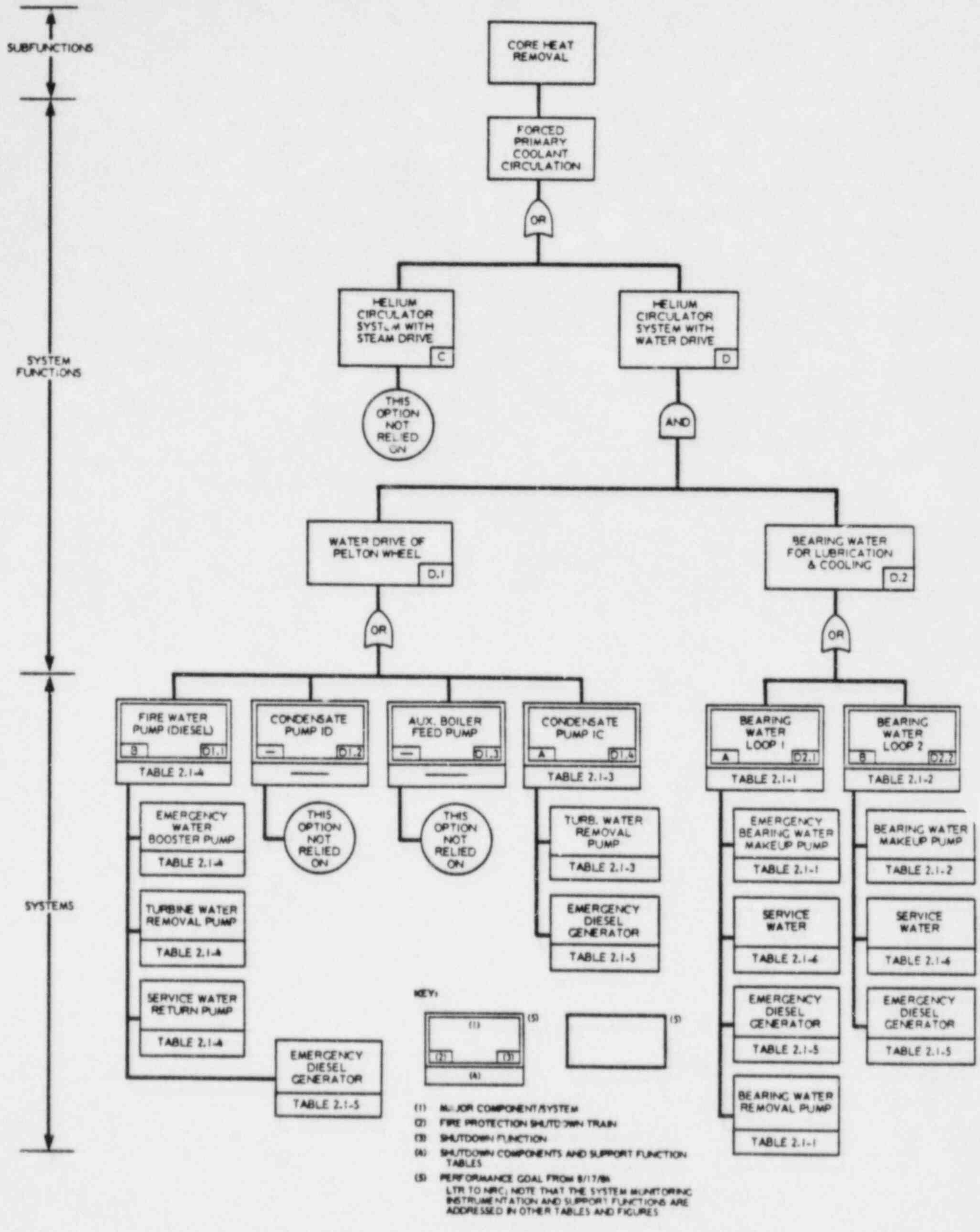
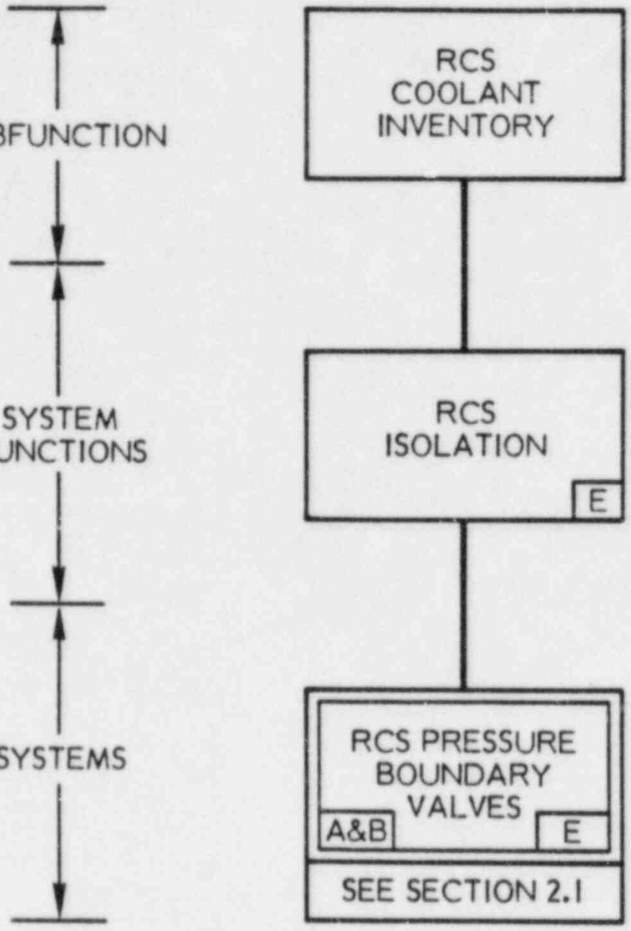
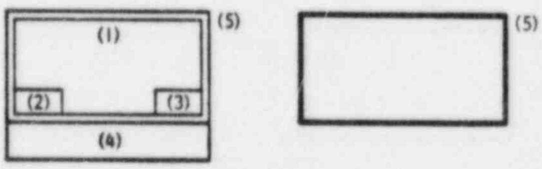


FIGURE 2.1-4

SHUTDOWN MODEL - NON-CONGESTED CABLE AREAS
FORCED CIRCULATION COOLDOWN
CORE HEAT REMOVAL



KEY:



(1) MAJOR COMPONENT/SYSTEM

(2) FIRE PROTECTION SHUTDOWN TRAIN

(3) SHUTDOWN FUNCTION

(4) SHUTDOWN COMPONENTS AND SUPPORT FUNCTION TABLES

(5) PERFORMANCE GOAL FROM 8/17/84 LTR TO NRC; NOTE THAT THE SYSTEM MONITORING INSTRUMENTATION AND SUPPORT FUNCTIONS ARE ADDRESSED IN OTHER TABLES AND FIGURES

FIGURE 2.1-5

SHUTDOWN MODEL - NON-CONGESTED CABLE AREAS
FORCED CIRCULATION COOLDOWN
RCS COOLANT INVENTORY

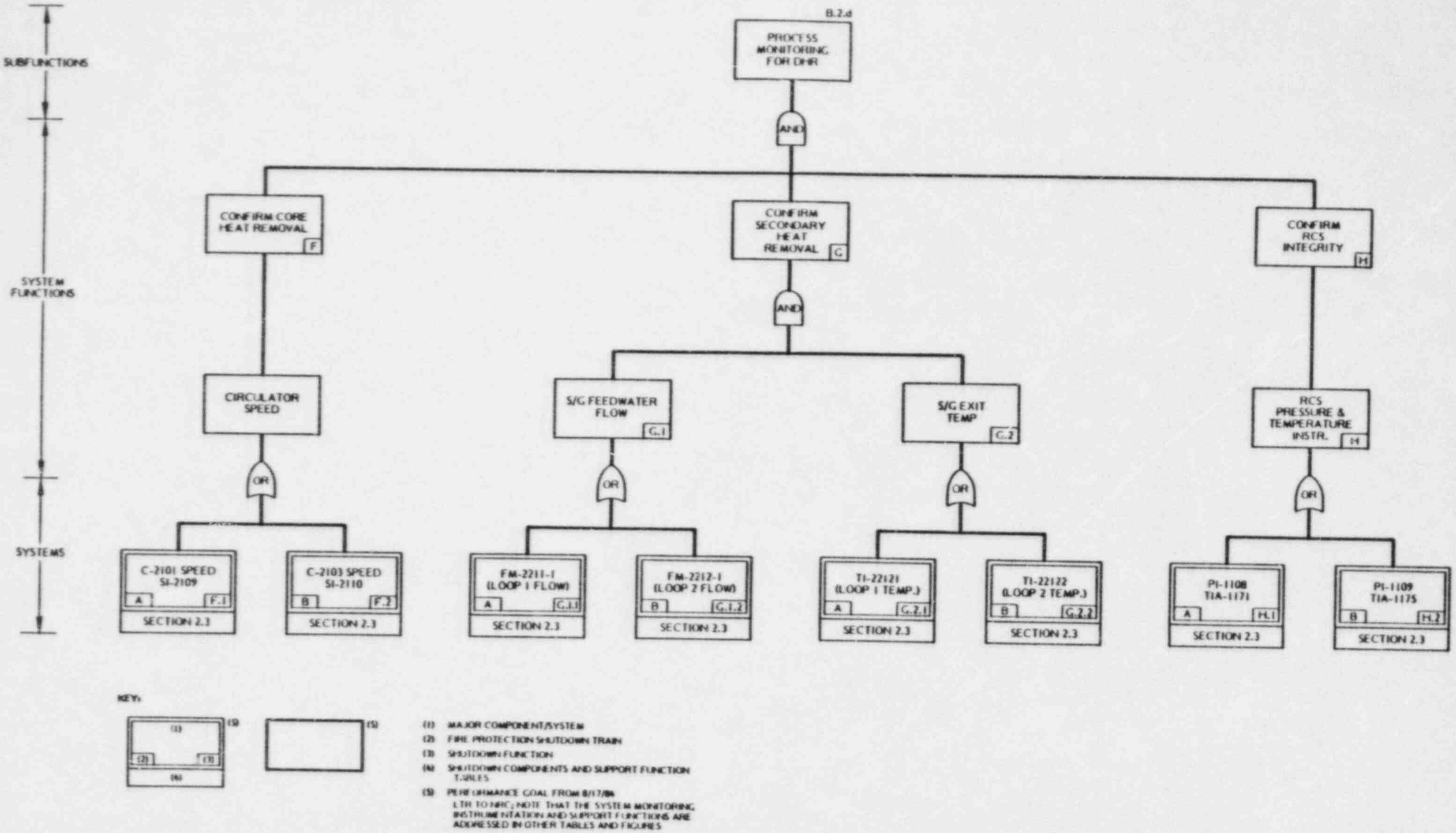


FIGURE 2.1-6

SHUTDOWN MODEL - NON-CONGESTED CABLE AREAS
FORCED CIRCULATION COOLDOWN
PROCESS MONITORING FOR DHR

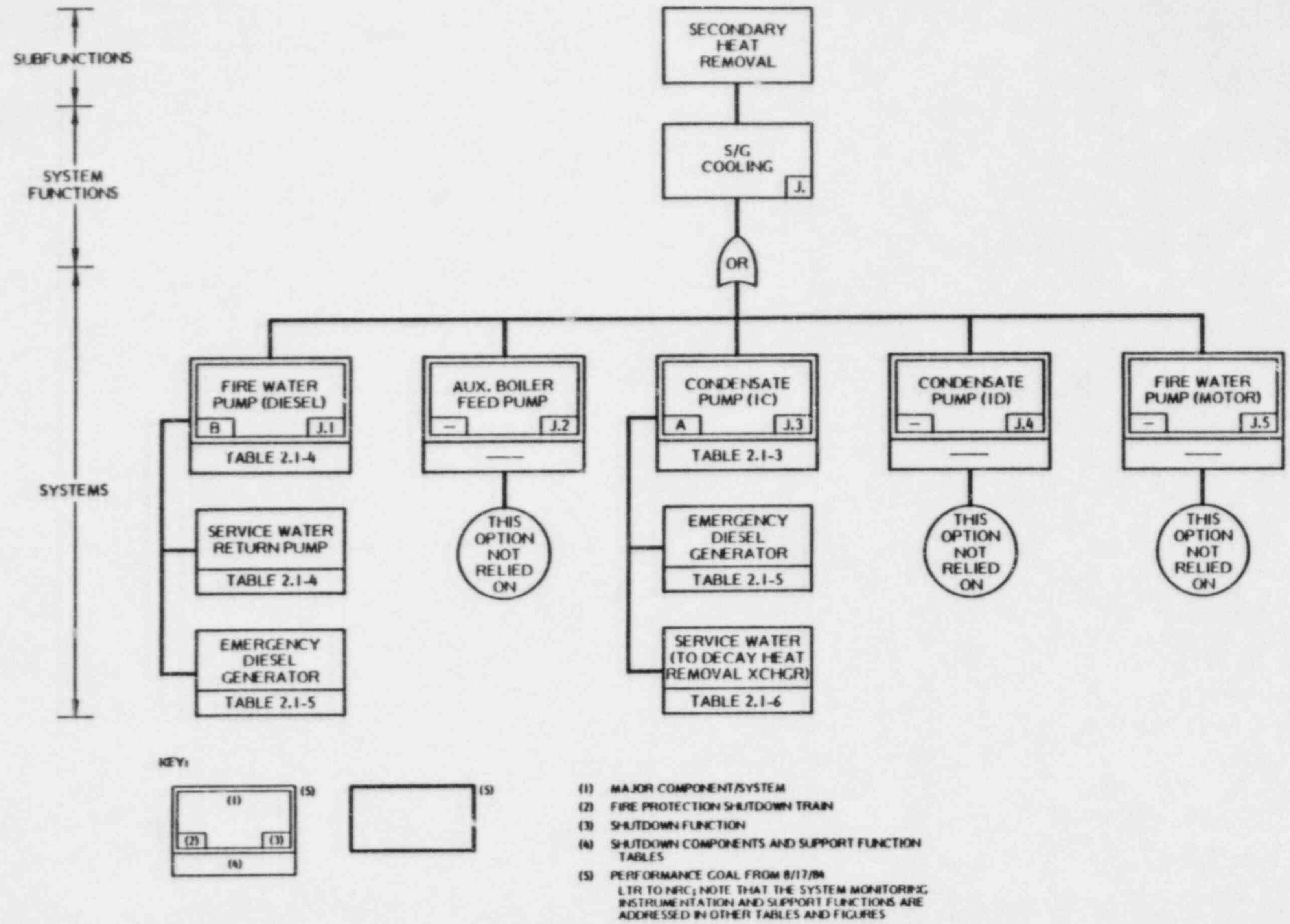


FIGURE 2.1-7

SHUTDOWN MODEL - NON-CONGESTED CABLE AREAS
FORCED CIRCULATION COOLDOWN
SECONDARY HEAT REMOVAL

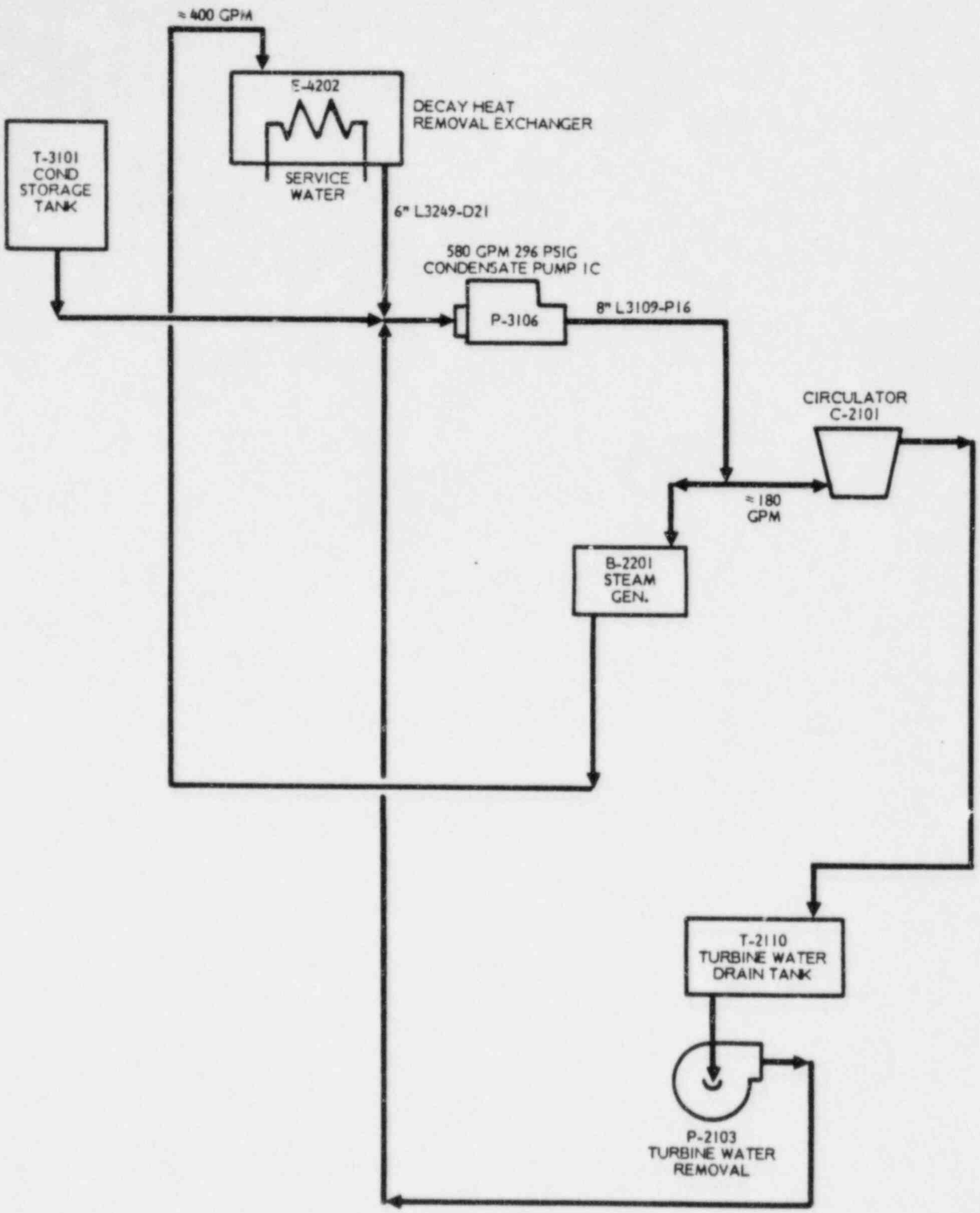


FIGURE 2.1-8

SIMPLIFIED FLOW DIAGRAM
CONDENSATE PUMP FOR CIRCULATOR DRIVE
& S/G COOLING - TRAIN A

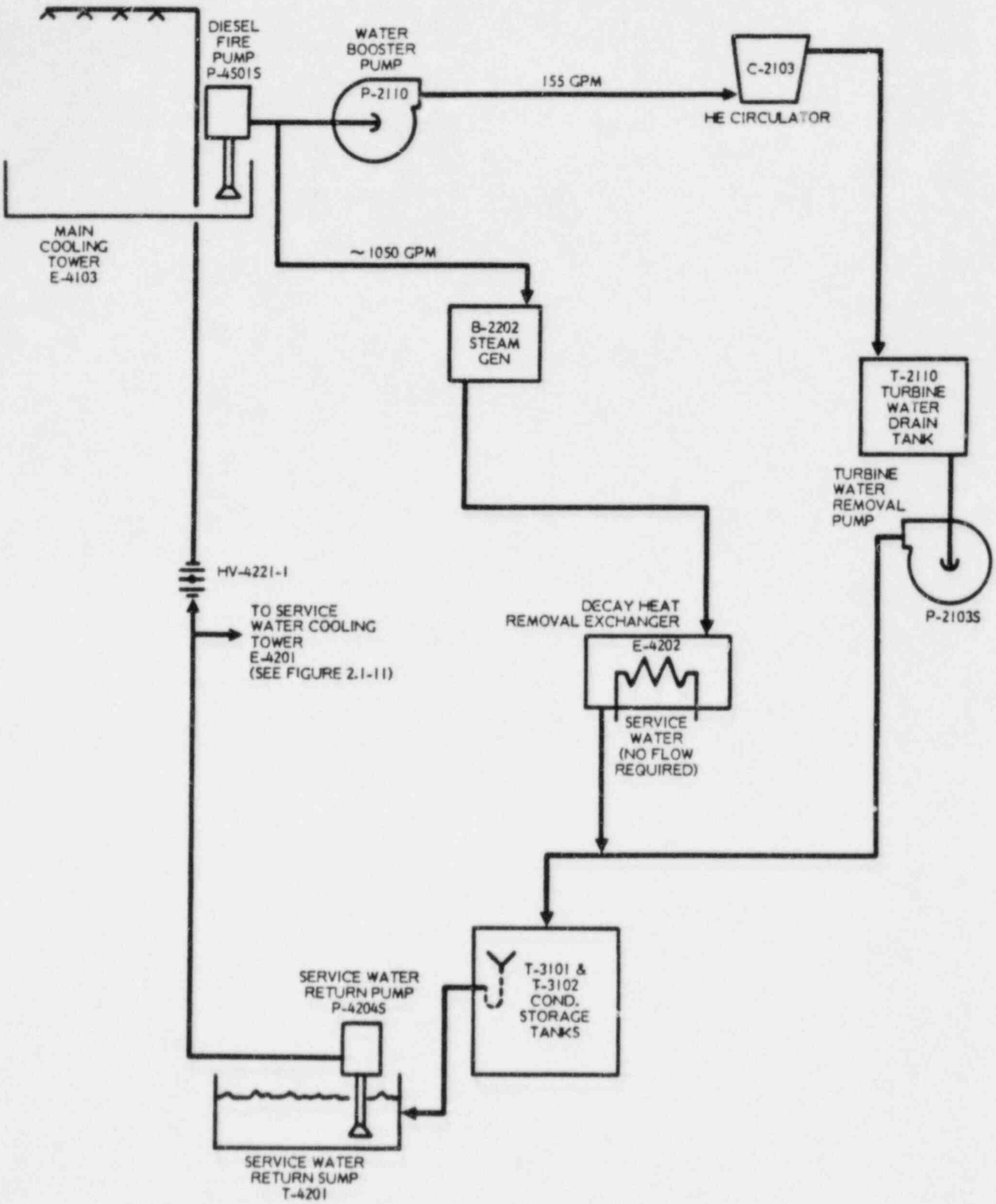


FIGURE 2.1-9

SIMPLIFIED FLOW DIAGRAM
FIRE WATER FOR CIRCULATOR DRIVE & S/G COOLING
TRAIN B

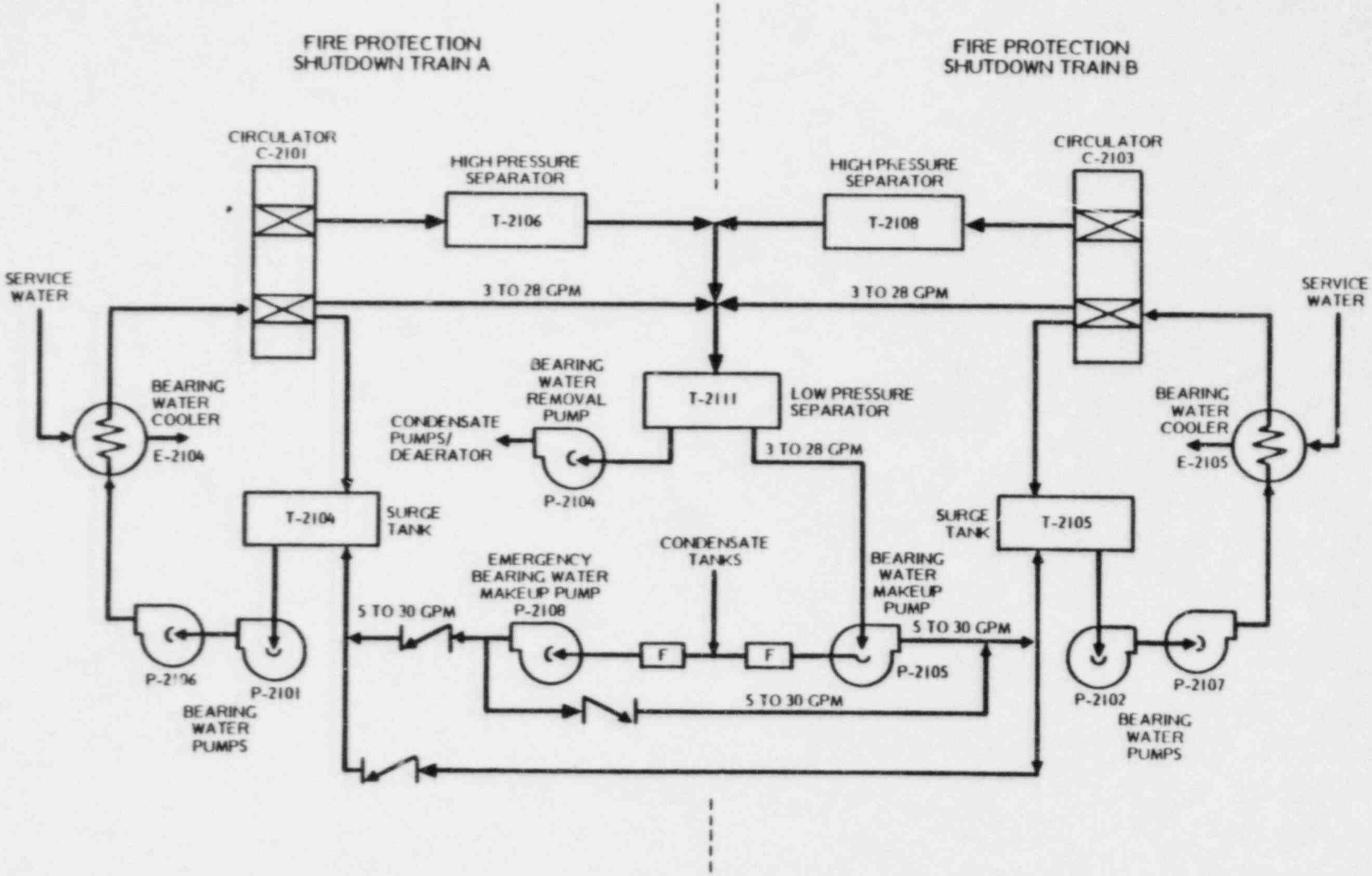


FIGURE 2.1-10

SIMPLIFIED FLOW DIAGRAM
BEARING WATER FOR CIRCULATORS

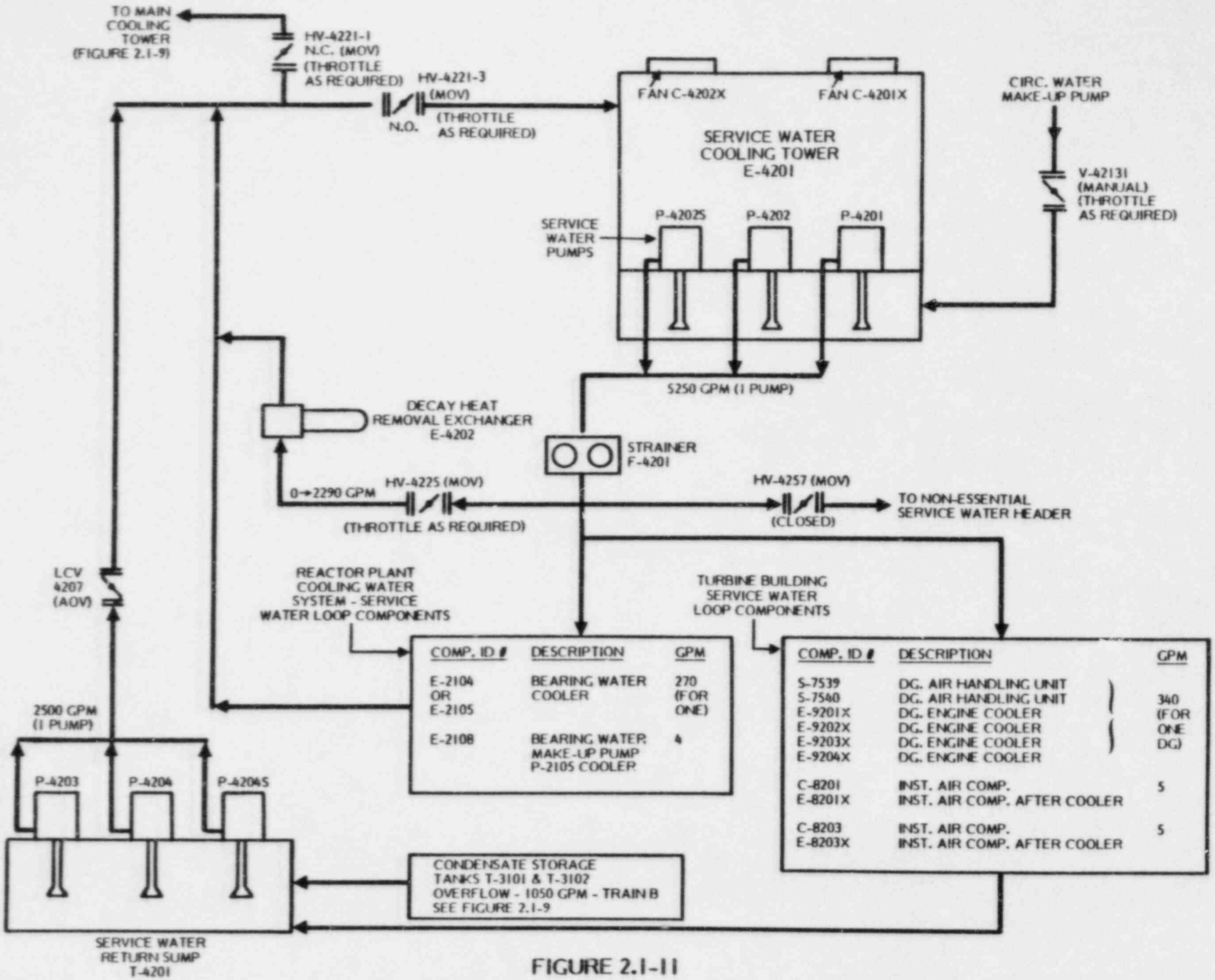
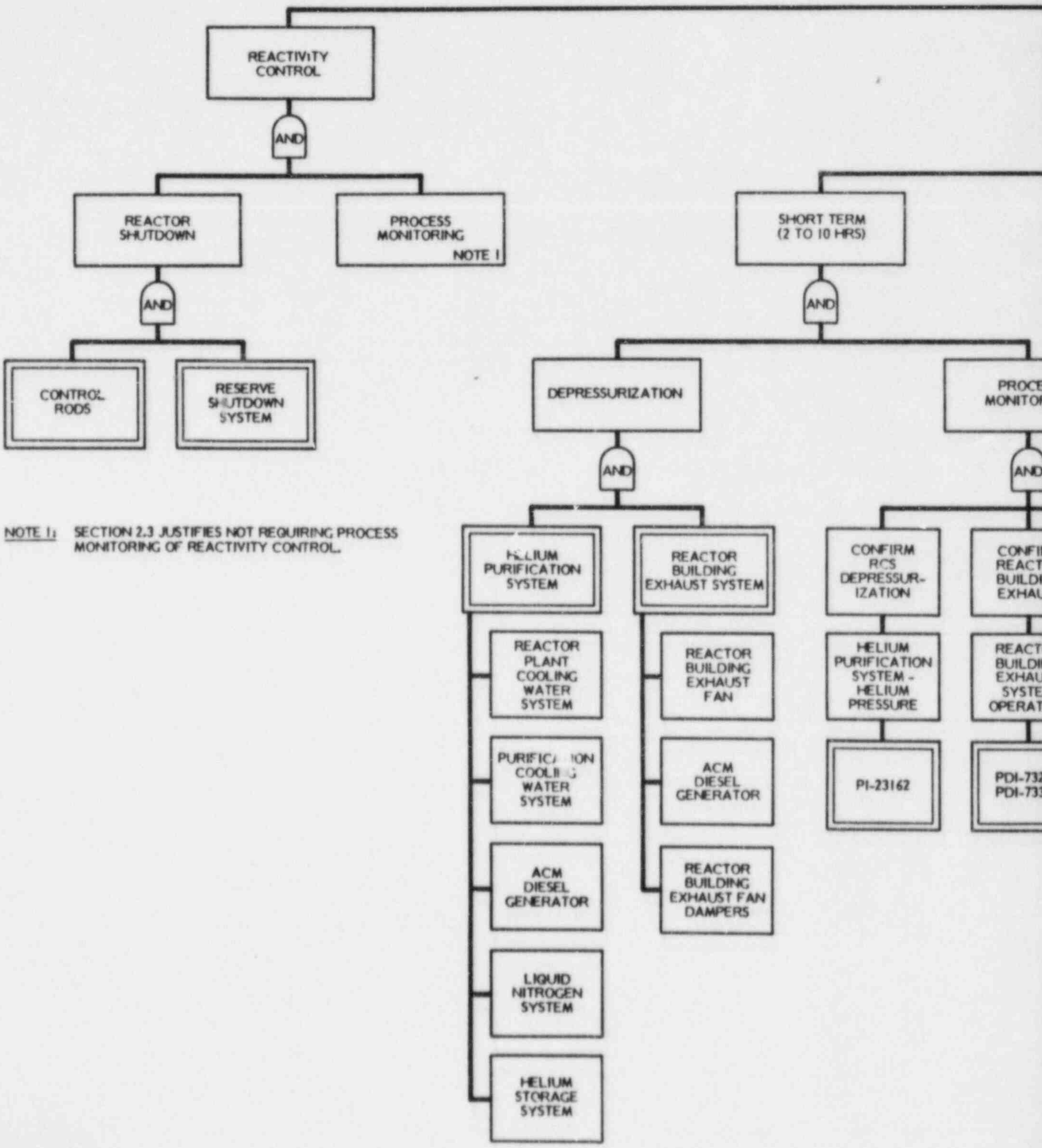


FIGURE 2.1-11

SIMPLIFIED FLOW DIAGRAM - SERVICE WATER SYSTEM



NOTE 1: SECTION 2.3 JUSTIFIES NOT REQUIRING PROCESS MONITORING OF REACTIVITY CONTROL.

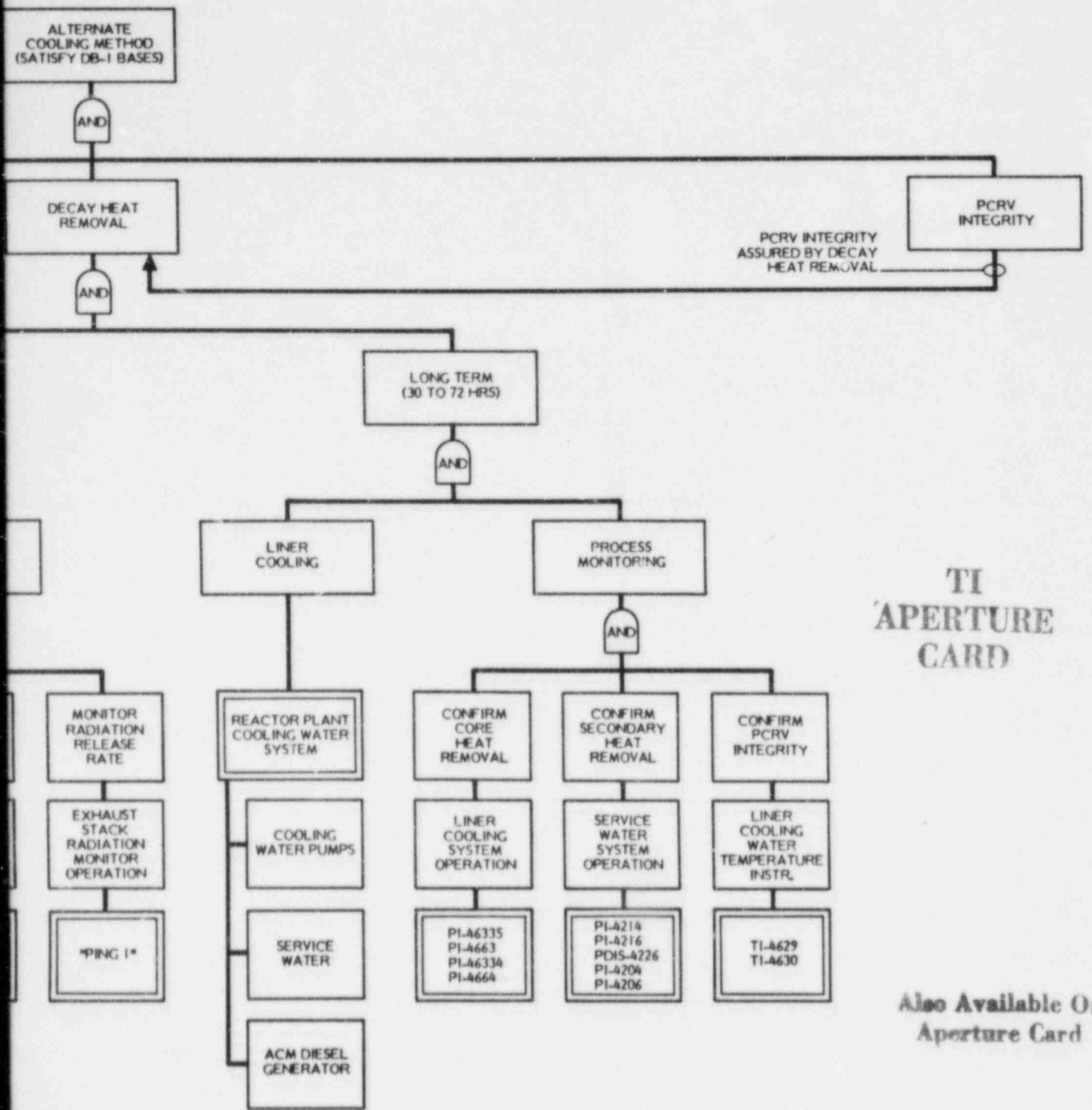


FIGURE 2.1-12

SHUTDOWN MODEL
CONGESTED CABLE AREAS
(LOSS OF FORCED CIRCULATION)

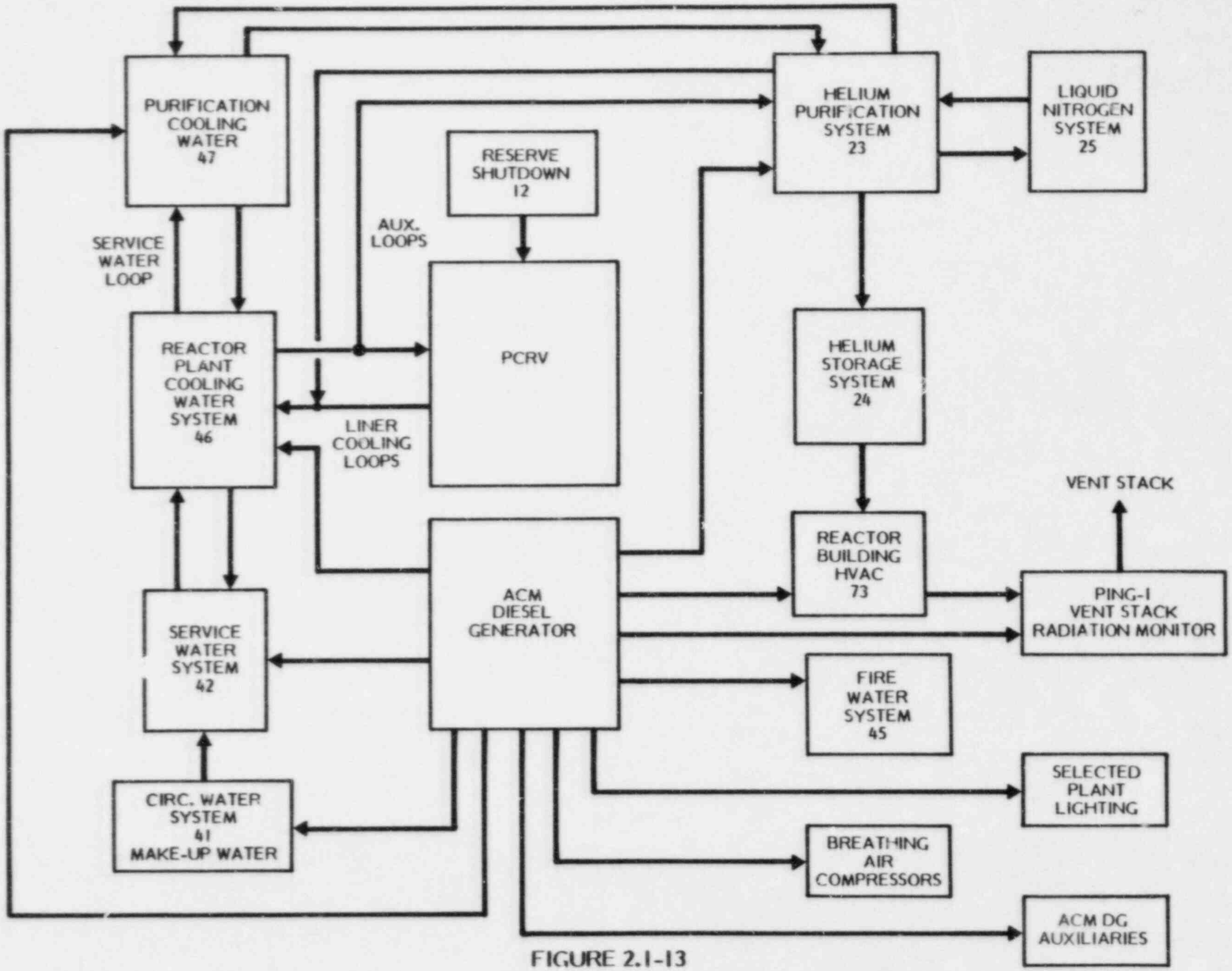


FIGURE 2.1-13

ACM SYSTEM INTERRELATIONSHIPS

2.2 Spurious Valve Operation

Evaluations of the forced circulation cooldown method were performed to identify potential spurious valves of concern. The evaluation identified valves in the designated flow path that are either normally closed or opened, and whose closure or continued closure could preclude accomplishing shutdown functions. The evaluation also identified valves in branch lines to the flow path whose spurious opening could result in significant diversion of flow required for fire protection shutdown functions. Potential effects on system operation were determined as a result of spurious changing of valve position. Valves normally closed in the flow path or normally opened in branch lines were identified as part of the shutdown model evaluation to define necessary components for accomplishing the shutdown function. Table 2.2-1 provides a summary of the spurious valve evaluation for forced circulation cooling. Potential spurious valves of concern with respect to the operation of the ACM will be addressed in Report No. 2.

The spurious valves identified in Table 2.2-1 are considered potential spurious valves of concern. Electrical reviews to be addressed in Report No. 2 may result in justification for excluding certain of these valves from requiring protection with respect to fires. In some cases corrective actions may be taken to overcome the spurious operation. The evaluation of these valves will be completed as part of the electrical reviews addressed in Report No. 2, including possible mitigating actions.

TABLE 2.2-1
Spurious Valve Operation
Forced Circulation Cooling

System/ Function	F.P. Shutdown Train	Potential Spurious Valve	Potential Effects
Helium Circulator/D	A	HV-21191-1, thru -4 and HV21203-1 thru -4 (PI-21-11)	Opening of either HV-21191-2 or -4 with HV-21191-1 or -3 would result in application of the He circulator static seal on C-2101. Similarly either HV-21203-2 or -4 opening with HV-21203-1 or -3 closing would apply the circulator brake to C-2101.
	B	HV-21192-1 thru -4 and HV-21204-1 thru -4. (PI-21-14)	Opening of either HV-21192-2 or -4 with closing of HV-21192-1 or -3 would result in application of the He circulator static seal on C-2103. Similarly opening of HV-21204-2 or -4 with closing of either HV-21204-1 or -3 would apply the He circulator brake for C-2103.
Condensate/D1.4 (Pelton Wheel)-A Boosted Fire-water/D1.1 (Pelton Wheel)-B	A	Valve HV31191 (MOV) (PI-31-1)	Terminate condensate water to drive circulator C-2101.
	A	Valves HV2110-1, SV-2110, and HV2110-2. (Exclude) (Similarly for HV-2116-1, SV-2116 and HV-2116-2, as well as HV-2115-1, SV-2115 and HV-2115-2)	Could divert condensate water to multiple circulators; instead of driving only circulator C-2101. (Exclude on basis of 3 spurious operations required for each set of valves associated with a single circulator).
	B	Valves HV-2116-1, SV-2116, and HV-2116-2 (Similarly for valves HV-2115-1, SV-2115, and HV-2115-2, as well as HV-2109-1, SV-2109 and HV-2109-2). (Exclude)	Could divert condensate water to multiple circulators, instead of driving only circulator C-2103. (Exclude on basis of 3 spurious operations required for each set of valves associated with a single circulator.)

TABLE 2.2-1
Spurious Valve Operation
Forced Circulation Cooling
(Continued)

System/ Function	F.P. Shutdown Train	Potential Spurious Valve	Potential Effects
	A	FV-2205	Spurious closure could isolate condensate flow to S/G EES (#2201).
	B	FV-2206	Spurious closure could isolate firewater flow to S/G EES (#2202).
	A	TV-2227-1 thru -6	Spurious closure could isolate condensate flow to S/G EES (#2201).
	B	TV-2228-1 thru -6	Spurious closure could isolate firewater flow to S/G EES (#2202).
	A, B	Valves FV-2239 and HV-2291 (MOV), PI-22-3; (Similarly for valves FV-2240 and HV-2290, (MOV), PI-22-8)	Bypass condensate/firewater to S/G reheater sect. in lieu of circulator water drive and S/G EES cooling. (Could isolate instrument air to AOV's and manually close).
	A	Valve HV-2238 (MOV) (PI-22-6)	Bypass condensate to S/G B-2202 EES sections in lieu of circulator C-2101 water drive. (De-energize MCC feeding MOV).
	B	Valve HV-2237 (MOV) PI-22-6	Could bypass firewater to S/G B-2101 EES sections in lieu of circulator C-2103 water drive (De-energize MCC feeding MOV).
	A + B	Valve PV-21244-1 (Exclude)	Could divert flow to He circulators C-2103 and C-2104, but requires three additional spurious valve operations to be a problem. Additionally valve opening could divert

TABLE 2.2-1
Spurious Valve Operation
Forced Circulation Cooling
(Continued)

System/ Function	F.P. Shutdown Train	Potential Spurious Valve	Potential Effects
			flow to emergency bearing water to helium circulator bearings; however, higher bearing water system pressure would not allow flow in this direction (PI-21-5 thru -10). Also, valve opening could attempt to divert flow to bearing water surge tanks PI-21-4 and -5); however, higher surge tank pressure would prevent flow in this direction. (Exclude)
	A + B	Valve PV-21243-1 (Exclude)	Same as for PV-21244-1 (Could divert flow through 1" line to He circulators C-2101 and C-2102). (Exclude)
	B	LCV-4501	Spurious opening could divert firewater flow to the firewater storage tank, and lead to overflow or overpressure of the firewater tank.
	B	Various firewater deluge valves (Exclude)	Spurious opening of these could result in diverting firewater flow. (Spurious opening of these could be terminated well before firewater demands for safe shutdown.)
	B	LCV-4207 (and other service water valves)	(Potential effects addressed under service water system elsewhere in this table.)
Condensate/J.3 (S/G Cooling)-A Firewater/J.1 (S/G Cooling)-B	A + B	HV-3220-4 (Exclude)	Could divert flow to main condenser, but would require two other spurious valve operations. (HV-3220-3 and LCV-3217-1). Therefore exclude.

TABLE 2.2-1
Spurious Valve Operation
Forced Circulation Cooling
(Continued)

System/ Function	F.P. Shutdown Train	Potential Spurious Valve	Potential Effects
	A + B	HV-3220-1	Could divert condensate to main condenser. (Isolate air supply and close locally).
	A + B	HV-3250 and LCV-3218	Spurious opening of both could divert condensate flow to the condenser. Opening of LCV-3218 could divert flow to pre-flash tanks. (Close valve V-32102)
Bearing Water/ D2.1 and D2.2	A B	Valve HV 21185 Valve HV 21186	Spurious closing of these could terminate bearing water flow to the associated circulator.
	A B	Valve HV 2187-1 Valve HV 2188-1	Spurious operation of these could terminate bearing water flow to the associated circulator.
	A B	Valves HV 2187-4, 5 6, & 7 Valves HV 2188-4, 5 6, & 7	Spurious closure of any one of these valves could terminate bearing water letdown from a circulator.
	A B	Valve LV 21303 Valve LV 21304	Spurious closure of either of these could isolate bearing water letdown from the associated high pressure separator. Note - lines from hp separators are now routed directly to surge tank gas space, thus affording equalization without need for keeping equalization line open. Valves LV-21303 and 21304 must be kept open.
	A B	Valve PDV-2175 Valve PDV-2176	Spurious closure of either of these valves could isolate bearing water letdown from the main drain of the associated circulator.

TABLE 2.2-1
Spurious Valve Operation
Forced Circulation Cooling
(Continued)

System/ Function	F.P. Shutdown Train	Potential Spurious Valve	Potential Effects
	A B	Valve PDV-2179 Valve PDV-2180	Spurious closure of either of these valves could isolate bearing water drains of the associated circulator.
	A B	Valve LV-2135-1 Valve LV-2136-1	Spurious closure of these would isolate bearing water makeup to surge tank T-2105.
	A	Valve LV-21115	Spurious closure could isolate removal of bearing water from separator T-2111.
	A B	Valve LV-2137 Valve LV-2138	These valves could isolate suction of bearing water pumps.
	A B	FV 21297 FV 21298	Spurious opening of these valves could divert bearing water back to pump suction.
	B	HV 21252-5	Spurious closure could isolate makeup source from the condensate storage tank for bearing water.
	A + B	LV 21119-1 (Exclude)	Spurious opening would open low pressure separator T-2111 floor drains. This is acceptable method of removing bearing water drain water.
Service Water/ Component Cooling	A + B	Strainer F-4201 element select (PI-42-1)	Terminate service water flow for fire at Service Water Pump House. (Could deenergize and manually operate valves.)

TABLE 2.2-1
Spurious Valve Operation
Forced Circulation Cooling
(Continued)

System/ Function	F.P. Shutdown Train	Potential Spurious Valve	Potential Effects
	A + B	Strainer inlet and outlet MOV's	Spurious closing of either could terminate service water flow.
	A + B	LCV-4207 (AOV) PI-42-1	Terminate service water return flow; however, unlikely since local pneumatic control only. (Manual bypass available).
	A + B	HV-4221-2 (MOV) PI-42-1	Assuming Circ. Water Pumps not running, could divert service water flow to Circ. Water System (Could deenergize MCC feeding and manually close).
	A + B	PCV-4266 (AOV) PI-42-2	Admit firewater to DG HX's, adding excessive inventory to service water system and diverting fire water flow. (Could manually isolate).
	A + B	TSV-4267, 68, 69, & 70, and TCV-4267, 68, 69, & 70.	Spurious operation of the TSV's is acceptable since it just bypasses the temperature controller (TIC-4267, 68, 69, & 70) and directly opens its associated TCV (which is fail open). Spurious operation of the TCV's is not a concern since its control is local pneumatic only, local to its associated diesel generator. A fire at a diesel would cause that particular diesel to be inoperable.
	A	TCV-4234 (AOV) PI-42-3	Terminate service water flow to Instrument Air Compressor C-8201. However, unlikely since local pneumatic control only. (Manual bypass available).

TABLE 2.2-1
Spurious Valve Operation
Forced Circulation Cooling
(Continued)

System/ Function	F.P. Shutdown Train	Potential Spurious Valve	Potential Effects
	B	TCV-4274 (AOV) PI-42-3	Terminate service water flow to Instr. Air Compr. C-8203. However, unlikely since local pneumatic control only. (Manual bypass available).
	A + B	FSV-8211-3 (SOL) PI-42-3	Divert service water flow thru Instr. Air Compr. C-8201S if TCV-4235 spuriously opens. (Not credible since 2 diverse spurious actions required - elec and air; also, if it occurred, small flow diversion involved, per SD-42).
	A + B	TCV-4235 (AOV) PI-42-3	Divert service water flow thru C-8201S if FSV-8211-3 spuriously opens. (See above).
Reactor Plant Cooling Water System - Service Water Loop/ Component Cooling	A + B	HV-21143 (MOV) and HV-21142-2 (MOV) or HV-21142-1 (MOV) PI-46-4	Admit firewater to Backup Bearing Water Coolers, diverting fire water flow, potentially adding excessive inventory to the service water system. (Could deenergize MOV's and manually close, or manually isolate upstream at V-461633-P).
	A + B	HV-21142-3 (MOV) and HV-21142-2 (MOV) PI-46-4	Admit Circ. Water to above. (Could manually isolate at V-46251.)
	A + B	HV-21142-2 (MOV) and HV-21142-1 (MOV) PI-46-4	Divert service water return flow to Circ. Water return header. (Could deenergize MOV's and manually close.)

TABLE 2.2-1
Spurious Valve Operation
Forced Circulation Cooling
(Continued)

System/ Function	F.P. Shutdown Train	Potential Spurious Valve	Potential Effects
DG's/Essential AC	A	HSV-92231 (SOL) PI-92-2	Actuate disconnect device for DG K-9203X. However, Spurious operation is not a concern since a fire causing the spurious operation would be local to the diesel, causing the diesel to be inoperable.
	A	HSV-92232 (SOL) PI-92-2	Actuate disconnect device for DG K-9204X. However, Spurious operation is not a concern since a fire causing the spurious operation would be local to the diesel, causing the diesel to be inoperable.
	B	HSV-92233 (SOL) PI-92-2	Actuate disconnect device for DG K-9205X. However, Spurious operation is not a concern since a fire causing the spurious operation would be local to the diesel, causing the diesel to be inoperable.
	B	HSV-92234 (SOL) PI-92-2	Actuate disconnect device for DG K-9206X. However, Spurious operation is not a concern since a fire causing the spurious operation would be local to the diesel, causing the diesel to be inoperable.
	A	HSV-92245 (SOL) PI-92-2	Spuriously crank DG, depleting air receiver or inhibit cranking. However, this is not a concern since a fire causing the spurious operation would be local

TABLE 2.2-1
Spurious Valve Operation
Forced Circulation Cooling
(Continued)

System/ Function	F.P. Shutdown Train	Potential Spurious Valve	Potential Effects
			to the diesel, causing the diesel to be inoperable. (Can manually isolate former and manually bypass the latter; also, redundant air start system provided.)
	A	HSV-92247 (SOL) PI-92-2	Spuriously crank DG, depleting air receiver or inhibit cranking. However, this is not a concern since a fire causing the spurious operation would be local to the diesel, causing the diesel to be inoperable. (Can manually isolate former and manually bypass the latter; also, redundant air start system provided.)
	B	HSV-92249 (SOL) PI-92-2	Spuriously crank DG, depleting air receiver or inhibit cranking. However, this is not a concern since a fire causing the spurious operation would be local to the diesel, causing the diesel to be inoperable. (Can manually isolate former and manually bypass the latter; also, redundant air start system provided.)
	B	HSV-92251 (SOL) PI-92-2	Spuriously crank DG, depleting air receiver or inhibit cranking. However, this is not a concern since a fire causing the spurious operation would be local to the diesel, causing the diesel to be inoperable. (Can manually isolate former and manually bypass the latter; also, redundant air start system provided.)

2.3 Process Monitoring Instrumentation

An evaluation was performed to address the minimum required instrumentation in order to accomplish required fire protection shutdown functions. This included two elements of process instrumentation:

- o Direct readings of process variables necessary to confirm satisfactory performance of safety functions, and
- o Instrumentation to perform, control and confirm operation of required systems. The process monitoring functions for forced circulation cooldown are reflected in Figures 2.1-3 and 2.1-6. The process monitoring functions for the ACM are reflected in Figure 2.1-12.

The intent of this evaluation was to identify existing process monitoring instrumentation that is provided on electrical safety busses. Table 2.3-1 identifies the process monitoring instrumentation required for forced circulation cooling to assure that safety functions are accomplished. Table 2.3-2 provides the system monitoring instrumentation for forced circulation cooling in order to confirm satisfactory operation of fire protection shutdown systems.

Process monitoring to confirm reactivity control under shutdown using the ACM is not believed to be required. The section 2.4, Control Rod Evaluation, of this report demonstrates that a fire cannot credibly prevent control rod insertion. Additionally, operation of the reserve shutdown system (neutron absorbing material) can be performed independent of the control room, without requiring use of electrical controls. The reserve shutdown system provides additional negative reactivity beyond the control rods to account for fuel and boron redistribution that may occur under DBA-1 (loss of forced circulation) conditions. FSAR Section 14.10.3.3 notes that with the reserve shutdown system under DBA-1 conditions, a final K-effective is achieved after all effects are included of 0.95, thus assuring core subcriticality at all times following scram of the control rods. Helium depressurization effects have been accounted for in the above evaluation. No fire induced mechanisms are available that could result in boron depletion. Accordingly, when instituting the ACM for shutdown independent of congested cable areas, necessary operator actions to assure insertion of the control rods and operation of the reserve shutdown system are taken to assure reactivity control. Additionally, the NRC Safety Evaluation Report supporting Amendment No. 21 to the license and transmitted by letter of June 6, 1979 (G-79103) concludes that the Alternate Cooling Method provides all necessary functions to assure safe plant shutdown and emergency cooling under degraded conditions. This includes, as noted in the SER a "reserve shutdown system to provide backup to the control rods, to assure the reactor remains subcritical." Accordingly, for shutdown using the ACM, process monitoring to confirm reactor subcriticality is not required.

Table 2.3-3 identifies the process and system monitoring instrumentation available to support loss of forced circulation cooldown (i.e., liner cooldown).

TABLE 2.3-1

PROCESS MONITORING INSTRUMENTATION

FORCED CIRCULATION COOLING

Function	Inst. No.	Range	Ref.	Power Supply
B.1 Nuclear Inst.			SD-93-11-1, FSAR Fig.	
Wide Range:	NI-1133-1	Approximately 10^{-6}-10^{3} % Rx Power	7.3-22.	Inst. Bus 1A
B.2 Nuclear Inst.			SD-93-11-1, FSAR Fig.	
Wide Range:	NI-1134-1	Approximately 10^{-6}-10^{-3} % Rx Power	7.3-22.	Inst. Bus 1B
F.1 Core Heat Removal				
Circulator 1A Speed	SI-2109		PI-21-7	Inst. Bus 1A
F.2 Core Heat Removal				
Circulator 1C Speed	SI-2110		PI-21-9	Inst. Bus 1B
G.1 S/G Feedwater Flow				
G.1.1 Loop 1 FW	FM-2211-1		PI-22-1	Inst. Bus 1A
G.1.2 Loop 2 FW	FM-2212-1		PI-22-6 and IB-93-8	Inst. Bus 1B
G.2 S/G Exit Temp				
G.2.1 Loop 1 Temp	TI-22121		PI-22-2	Inst. Bus 1A
G.2.2 Loop 2 Temp	TI-22122		PI-22-7	Inst. Bus 1B

TABLE 2.3-1

PROCESS MONITORING INSTRUMENTATION

FORCED CIRCULATION COOLING

(Continued)

Function	Inst. No.	Range	Ref.	Power Supply
H.1 RCS Integrity			SD-93-11-2	
Primary Coolant Press.	PI-1108	0-1000 psia		Inst. Bus 1A
Circ. Inlet Coolant Temp	TIA-1171	100-1000°F		Inst. Bus 1A
H.2 RCS Integrity			SD-93-11-2	
Primary Coolant Pres.	PI-1109	0-1000 psia		Inst. Bus 1B
Circ. Inlet Coolant Temp	TIA-1175	100-1000°F		Inst. Bus 1B

TABLE 2.3-2

SYSTEM INSTRUMENTATION

FORCED CIRCULATION COOLING

System	Variable	Instrument	Purpose/Method	Power Supply
Bearing Water to C-2101 (Loop 1)	Pump Operation (P-2101 and P-2106)	NA	Confirm pump start and operation of P-2101 and P-2106 through visit to pump room.	NA
		PI-21247	Local mechanical pressure indicator	NA
	Flow thru Circulator	PDIS-21173	Local mechanical pressure indicator	NA
	Surge Tank Level (T-2104)	LI-21135	To maintain inventory in bearing water system and need for starting/stopping makeup.	Instr. Bus 1C
	Pump Operation (P-2108)	NA	Confirm pump operation through level in Surge Tank using LI-21135.	NA
	Low Pressure Separator Level T-2111	LI-21119	Monitor tank level for starting/stopping bearing water removal pump P-2104.	Instr. Bus 1A
	Pump operation (P-2104)	NA	Confirm pump operation through L.P. Separator level LI-21119.	
Bearing Water to C-2103 (Loop 2)	Pump Operation (P-2102 and P-2107)	NA	Confirm pump start and operation of P-2102 and P-2107 through visit to pump room.	NA

TABLE 2.3-2
SYSTEM INSTRUMENTATION
FORCED C[illegible]CULATION COOLING
(Continued)

System	Variable	Instrument	Purpose/Method	Power Supply
		PI-21248	Local mechanical pressure indicator	NA
	Flow thru Circulator	PDIS-21174	Local mechanical pressure indicator	NA
	Surge Tank Level (T-2105)	LI-21136	To maintain inventory in bearing water system and need for starting/stopping makeup.	Instr. Bus IC
	Low Pressure Separator Level T-2111	LI-21115	To monitor tank level for aligning suction of P-2105 between T-2111 and Condensate Tank	Instr. Bus IB
	Pump Operation (P-2105)	NA	Confirm pump operation through level in Surge Tank using LI-21136.	NA
Instrument Air (Train A)	Compressor Operation (C-8201)	NA	Confirm compressor operation locally.	NA
	Receiver Pressure (T-8201)	PI-8209	Confirm air supply to header with local mechanical gauge.	NA
Instrument Air (Train B)	Compressor Operation (C-8203)	NA	Confirm compressor operation locally.	NA

TABLE 2.3-2
SYSTEM INSTRUMENTATION
FORCED CIRCULATION COOLING
(Continued)

System	Variable	Instrument	Purpose/Method	Power Supply
	Receiver Pressure (T-8203)	PI-8253	Confirm air supply to header with local mechanical gauge.	NA
Condensate for Circulator Water Drive & S.G. Cooling (Train A)	Condensate Pump Operation (P-3106)	PI-3134	Local Pressure indicator; confirm pump operation.	NA
	Turbine Water Removal Pump Operation (P-2103)	PI-21302	Local pressure indicator; confirm pump operation.	NA
Fire Water for Circulator Water Drive & S.G. Cooling (Train B)	Diesel Fire Water Pump Operation (P-4501S)	PI-4506	Local pressure indicator; confirm pump operation.	NA
	Emergency Water Booster Pump Operation (P-2110)	PI-21536-2	Local pressure indicator; confirm pump operation.	NA
	Turbine Water Removal Pump Operation (P-2103S)	PI-21302	Local pressure indicator; confirm pump operation.	NA
	CST Level to define opening time for Valve HV-4221-1	NA	Visually inspect tank level via access hatch.	NA
Service Water (F. P. Train A)	S.W. Pump Pit Water Level	NA	Confirm level through visual observation. Throttle valve V-42131 for water makeup.	NA

TABLE 2.3-2

SYSTEM INSTRUMENTATION

FORCED CIRCULATION COOLING

(Continued)

System	Variable	Instrument	Purpose/Method	Power Supply
	Service Water Pump Operation (P-4201)	PI-4214	Local mechanical pressure indicator.	NA
	Flow thru Strainer (F-4201) and necessity for backwash.	PDIS-4226	Local mechanical pressure indicator	NA
	Service Water Return Pump Operation (P-4203)	PI-4204	Local mechanical pressure indicator.	NA
	Service Water Cooling Tower Fan Operation (C-4201X)	NA	Visually observe fan operation.	NA
Service Water (F.P. Train B)	Service Water Pump Pit Water Level	NA	Balance flow returned to main cooling tower basin to maintain Service Water Pump Pit Water Level. (i.e., adjust valves HV-4221-1 and HV-4221-3 and observe water level at S.W. Pump Pit; could adjust for minimum overflow after time period in which HV-4221-1 must be opened).	NA
	Service Water Pump Operation (P-4202S)	PI-4216	Local mechanical pressure indicator.	NA
	Flow thru Strainer (F-4201) and necessity for backwash.	PDIS-4226	Local mechanical pressure indicator.	NA

TABLE 2.3-2
SYSTEM INSTRUMENTATION
FORCED CIRCULATION COOLING
(Continued)

System	Variable	Instrument	Purpose/Method	Power Supply
	Service Water Return Pump Operation (P-4204S)	PI-4206	Local mechanical pressure indicator.	NA
	Service Water Cooling Tower Fan Operation (C-4202X)	NA	Visually observe fan operation.	NA
Diesel Generator (Train A)	Voltage from Generator IA (K-9201)	Voltmeter	Local indicator.	Generator IA (K-9201)
Diesel Generator (Train B)	Voltage from Generator IB (K-9202)	Voltmeter	Local indicator.	Generator IB (K-9202)

TABLE 2.3-3
PROCESS AND SYSTEM MONITORING
INSTRUMENTATION - LINER COOLDOWN

FUNCTION	INSTRUMENT	POWER SUPPLY
He Purification System -		
He Pressure -	PI-23162	N/A (Observe Locally)
Reactor Building Exhaust System:		
Fan ΔP -	PDI-7323-1	N/A (Observe Locally)
	PDI-7339-1	N/A (Observe Locally)
Liner Cooling System Operations -	PI-46334	N/A (Observe Locally)
	PI-46335	N/A (Observe Locally)
	PI-4663	N/A (Observe Locally)
	PI-4664	N/A (Observe Locally)
Service Water System Operation:		
Service Water Pump Pit Level -	N/A	N/A (Observe Locally)
Pump Discharge Press -	PI-4214 or	N/A (Observe Locally)
	PI-4216	N/A (Observe Locally)
Flow Through Strainer -	PDIS-4226	N/A (Observe Locally)
Service Water Return Pump -	PI-4204 or	N/A (Observe Locally)
	PI-4206	N/A (Observe Locally)
Service Water Cooling Tower Fan -	N/A	N/A (Observe Locally)
PCRV Temperature (Reactor Plant Cooling Water Temp.) -	TI-4629	N/A (Observe Locally)
	TI-4630	N/A (Observe Locally)

2.4 Control Rod Evaluations

The Control Rod Drive (CRD) system was evaluated to determine if fire-caused electrical malfunctions could prevent the insertion of sufficient negative reactivity (i.e., a sufficient number of control rods) required to shutdown the reactor and maintain it in a shutdown condition. The cable interconnections for the CRD system are shown in Figure 2.4-1. A detailed Failure Modes and Effects (FMEA) analysis was conducted for the cables shown, evaluating the effects of potential grounds, open circuits, and hot shorts. The results of the analysis are summarized in Table 2.4-1.

The control rods are housed in pairs, each pair in one of 37 control and orificing assemblies, one of which is shown in Figure 2.4-2. Normal control rod pair insertion and withdrawal is effected by energizing the CRD motor in the direction of motion desired and releasing the CRD brake. The motor is part of the CRD mechanism shown in Figure 2.4-3, and the brake is shown in detail in Figure 2.4-4. Normally, the CRD brake is energized from the 24Vdc scram brake power supplies to hold the control rod in the position selected. Also, the CRD motor is normally unpowered, and is only powered from 3-phase 105Vac when in or out motion is requested by the operator.

Scram is accomplished by interrupting the 24Vdc supply to the CRD brakes and to the scram contactor coils at the CRD Motor Control Centers (MCC's). Since the CRD motors are normally not powered, releasing the brake allows the control rod to fall by gravity into the core. De-energizing the scram contactors at the CRD MCC's ensures that power will not be inadvertently applied to any CRD motor. Based on the above operation, it is essential for the scram function that the CRD brake release and the CRD motors remain unpowered. In addition; it should be noted that the CRD motors act as dynamic brakes in an unpowered state, so that when the CRD brake releases, control rod insertion speed is controlled to limit the control rod deceleration force at end of travel. Therefore, the CRD motor must be allowed to turn freely during scram.

The electrical FMEA involved a detailed review of the schematic and wiring diagrams associated with the cables shown on Figure 2.4-1. Grounds, open circuits, and hot shorts were postulated to occur in these cable circuits, and the potential effects of these were determined and evaluated. Potential unacceptable effects were found in the areas corresponding to the essential actions which must occur to ensure scram:

1. Brake coil spurious energization - Since the brake coil is powered by a 24Vdc ungrounded system, it would take two conductor (hot and corresponding neutral) matchups with the brake coil conductors to spuriously energize the brake. Even if this did occur, only one control rod pair would be affected, which has been analyzed as acceptable. Multiple dual conductor matchups would have to occur to affect more than one CRD. Such an event due to a fire is not considered credible.

2. Brake coil damage and subsequent jamming - The highest voltage that could hot short to the brake conductors is 480Vac, 3-phase. However, the brake coil assemblies were Hi-Pot tested at 500Vac for one minute, and, in addition special retaining rings were added to the brake coil assembly to prevent the magnetic coil from interfering with the armature plate and jamming the brake in the event of coil encapsulation failure.

3. Spurious CRD motor energization - Since the CRD motors are 3-phase 105Vac, it would require a simultaneous 3-phase conductor matchup in the proper phase sequence and a brake release to cause spurious control rod withdrawal. This is considered incredible. In addition, there are no normally energized 3-phase power cables routed with the CRD motor power cables.

4. CRD Motor insulation damage and subsequent jamming -A high voltage (480Vac or greater) hot short on the motor windings could cause insulation failure and inhibit free motor operation. However, no high voltage cables are routed with the CRD motor cables, and the motor windings are insulated for its service rating.

Based on the Failure Modes and Effects analysis of the CRD cabling, it is concluded that a fire could not inhibit reactor shutdown via the CRD system.

As part of the Alternate Cooling Method, the Reserve Shutdown system is used with the control rod system for Design Basis Accident No. 1 (DBA-1) conditions, to ensure that sufficient negative reactivity is present in the core as DBA-1 progresses and core heat up occurs.

The Reserve Shutdown system is normally manually activated from the main control room via handswitches which energize solenoids to operate valves which admit high pressure helium to rupture discs, thus allowing the reserve shutdown material to enter the core. The material is refractory poison spheres containing boron, and is contained in a storage hopper in each refueling penetration (37 total). The Reserve Shutdown system has provisions for local manual operation of the valves which admit the high pressure helium to the rupture discs. This is accomplished by connecting quick-connect fittings from an installed nitrogen cylinder for each of 37 valves, and locally causing the pneumatically operated helium admission valves to open. Since this operation involves strictly manual actions, an electrical FMEA is not required. (Spurious electrical operation is acceptable.) Therefore, a fire in the congested cable area would not inhibit the operation of the Reserve Shutdown system.

TABLE 2.4-1

FAILURE MODES AND EFFECTS - CONTROL ROD SYSTEM

Cable*	To/From	Failure Mode	Effects	Effects Acceptable Y = Yes N = No	Evaluation
1. 5/C - Pos. Ind. Pot. (2 cables per CRD)	Control Room/ CRD MCC	Ground	Indication error	Y	Indication not required for SCRAM
		Open	Indication error	Y	Indication not required for SCRAM
		Hot Short	Indication error or damage	Y	Indication not required for SCRAM
2. 3/C or 7/C In/Out Control	Control Room/ CRD MCC	Ground: - to In or Out conductors	Loss of Control Power	Y	Normally deenergized; only selected CRD would have cable energized if operator commanded in or out motion, and only while operator held in or out command switch.
		- 3 outs in 7/C	Withdrawal of 3 CRDs when only 1 selected	Y	

* See Figure 2.4-1

TABLE 2.4-1

(continued)

Cable*	To/From	Failure Mode	Effects	Effects Acceptable Y = Yes N = No	Evaluation
2. 3/C or 7/C In/Out Control	Control Room/ CRD MCC	Open	Loss of in/out control	Y	Loss of control for in/out motion under power does not affect scram capability. Grounding of 3 outs in the 7/C cable is considered incredible, but its effect would stop when operator released "OUT" switch.
		Hot Short: - External Cable	None	Y	Ungrounded system; will not prevent SCRAM.
		- 3 outs in 7/C	Withdrawal of 3 CRDs	Y	See Ground above.
3. 2/C or 7/C CRD Brake	Control Room/ CRD MCC	Ground: - 1 conductor	None	Y	Ungrounded system; will not prevent SCRAM.
		2 or more cond.	Loss of control power	Y	CRD's SCRAM.

TABLE 2.4-1
(continued)

Cable*	To/From	Failure Mode	Effects	Effects Acceptable Y = Yes N = No	Evaluation
3. 2/C or 7/C Brake	Control Room/ CRD MCC	Open	Loss of control power	Y	CRD's SCRAM.
		Hot Short: - Low Voltage I/C	None	Y	Ungrounded system.
		I/C with appro priate neutral	Brake remains energized	N	Dual matchup of hot and neutral considered incredible. If it occurred, one control rod pair may not fully insert which has been analyzed as acceptable. Multiple occurrences considered incredible.
		- High Voltage (480 VAC or greater)	Coil insulation failure and/or coil damage, with result that brake jams on.	N	Brake coil retainer rings provided per FSAR (updated Rev. 1). Spring force causes brake mechanism to release after DC coil is deenergized. Also, Factory Test Procedure required 500Vac Hi-Pot

TABLE 2.4-1
(continued)

Cable*	To/From	Failure Mode	Effects	Effects Acceptable Y = Yes N = No	Evaluation
					test for one minute, applied brake coil terminal to housing. 480Vac is the highest possible hot short voltage.
4. 7/C - Pos. L/S'S and slack switch	Control Room/ CRD MCC	Ground	Indication error or loss of manual control	Y	Does not affect SCRAM.
		Open	Indication error or loss of manual control	Y	Does not affect SCRAM.
		Hot Short	Indication error or loss of manual control	Y	Does not affect SCRAM.
5. 3/C or 7/C Indication Lights	Control Room/ CRD MCC	Ground	Indication error	Y	Does not affect SCRAM.
		Open	Indication error	Y	Does not affect SCRAM.
		Hot Short	Indication error	Y	Does not affect SCRAM.

TABLE 2.4-1
(continued)

Cable*	To/From	Failure Mode	Effects	Effects Acceptable Y = Yes N = No	Evaluation
6. 2/C - SCRAM Contactors (2 cables per MCC)	Control Room/ CRD MCC	Same as #3 except high voltage could damage contactor coils			
7. 24/C - CRD Control	CRD MCC/ CRD	Same as #1, #4, and #5. Orifice Pos. Ind. same as #1.			
8. 24/C - CRD Power:	CRD MCC/ CRD				
- CRD Brake		Same as #3.			
- CRD Motor		Ground - 1/C	None	Y	Ungrounded system; will not prevent SCRAM.
		- 2 or more cond.	Trip CRD Breaker	Y	No effect on SCRAM capability; loss of manual control only.
		Open	Loss of 1 or more phases of motor power	Y	No effect on SCRAM capability; loss of manual control only.
		Hot Short: - Low Voltage-1/C	None	Y	Ungrounded system.

TABLE 2.4-1
(continued)

Cable*	To/From	Failure Mode	Effects	Effects Acceptable Y = Yes N = No	Evaluation
8. (continued)	CRD MCC/ CRD				
- CRD Motor		Hot Short: - 3-nhase	Motor operates	N	3-phase hot short considered incredible, so no inadvertent withdrawal. In addition, the brake would also have to be released at the same time. Also, there are no normally energized 3-phase cables routed with these.
		High Voltage	Insulation failure jams motor	N	There are no high voltage cables routed with these cables.

TABLE 2.4-1
(continued)

Cable*	To/From	Failure Mode	Effects	Effects Acceptable Y = Yes N = No	Evaluation
9. 2/C - Reserve Shutdown D.P. Switch (N.C. Contact)	CRD MCC/I-21 Local Panels	Ground - 1/C	None	Y	Does not affect SCRAM.
		- 2/C	Loss of PDS output	Y	Does not affect SCRAM.
		Open	False high DP alarm at local panel	Y	Does not affect SCRAM.
		Hot Short - 1/C	None	Y	Does not affect SCRAM (DC annunciator input).
		- 2/C	Loss of PDS output	Y	Does not affect SCRAM.
10. 7/C - Orifice Valve Motor	CRD MCC/ MCR	Ground - 1/C	None	Y	Does not affect SCRAM.

TABLE 2.4-1
(continued)

Cable*	To/From	Failure Mode	Effects	Effects Acceptable Y = Yes N = No	Evaluation
10. (continued)	CRD MCC/ Control Room	2/C or more	Prevent operation when selected by operator	Y	Does not affect SCRAM. Control not required for F.P. shutdown.
		Open	Prevent operatior. .en selected by operator	Y	Does not affect SCRAM. Control not required for F.P. shutdown.
		Hot Short - 1/C	None	Y	Does not affect SCRAM.
		2/C or more	Prevent operation when selected by operator	Y	Does not affect SCRAM. (Control not required for F.P. shutdown.)

TABLE 2.4-1
(continued)

Cable*	To/From	Failure Mode	Effects	Effects Acceptable Y = Yes N = No	Evaluation
10. (continued)	CRD MCC/ Control Room	1/C hot with appropriate neutral	Stepper motor operation	Y	Does not affect SCRAM. Also, one step movement of stepper motor results in very small flow change.
11. 5/C - Orifice Pos. Pot.	CRD MCC/ Control Room	Ground - 1/C	None	Y	Does not affect SCRAM.
		2/C or more	Loss of Pos. Ind.	Y	Does not affect SCRAM. (Pos. Ind. not required).
		Open	Loss of Pos. Ind.	Y	Does not affect SCRAM. (Pos. Ind. not required).
		Hot Short - 1/C	None	Y	Does not affect SCRAM. (DC system)
		2/C or more	Loss of Pos. Ind.	Y	Does not affect SCRAM. (Pos. Ind. not required).

TABLE 2.4-1
(continued)

Note: The remaining cables on Figure 2.4-1 involve power inputs, transfers, and test capability, and annunciation. The cables included in this group are as follows:

9/C - 1-03 from Bus 1 for K-61 and K-63 test capability
2/C - 1-70 annunciator for K-58 power monitor
2/C - 1-03 from C1 and C2 (control power)
2/C - 1-10 from 16 and 17 (K-51 odd rods scram)
2/C - 1-10 from 12 and 13 (K-50 even rods scram)
7/C - Bus 1 for K-61, K-62, K-63, and K-64 test capability
7/C - Bus 2 for K-61, K-62, K-63, and K-64 test capability
3/C - L1-1, L2-1, L3-1 120 VAC incoming to transfer switch
3/C - 5, 6, 7 120 VAC incoming to transfer swithc
2/C - C3 and C4 (control power)

Failures involving these cables can lead to loss of the CRD control, test, or annunciation function desired under normal operating conditions, but would not affect SCRAM capability since loss of control power is a fail-safe condition. The cable analysis above covers the potential failure modes that can affect a typical CRD assembly, which is the only way electrical failures would possibly affect SCRAM capability, by inhibiting control rod insertion via the CRD brake or motor.

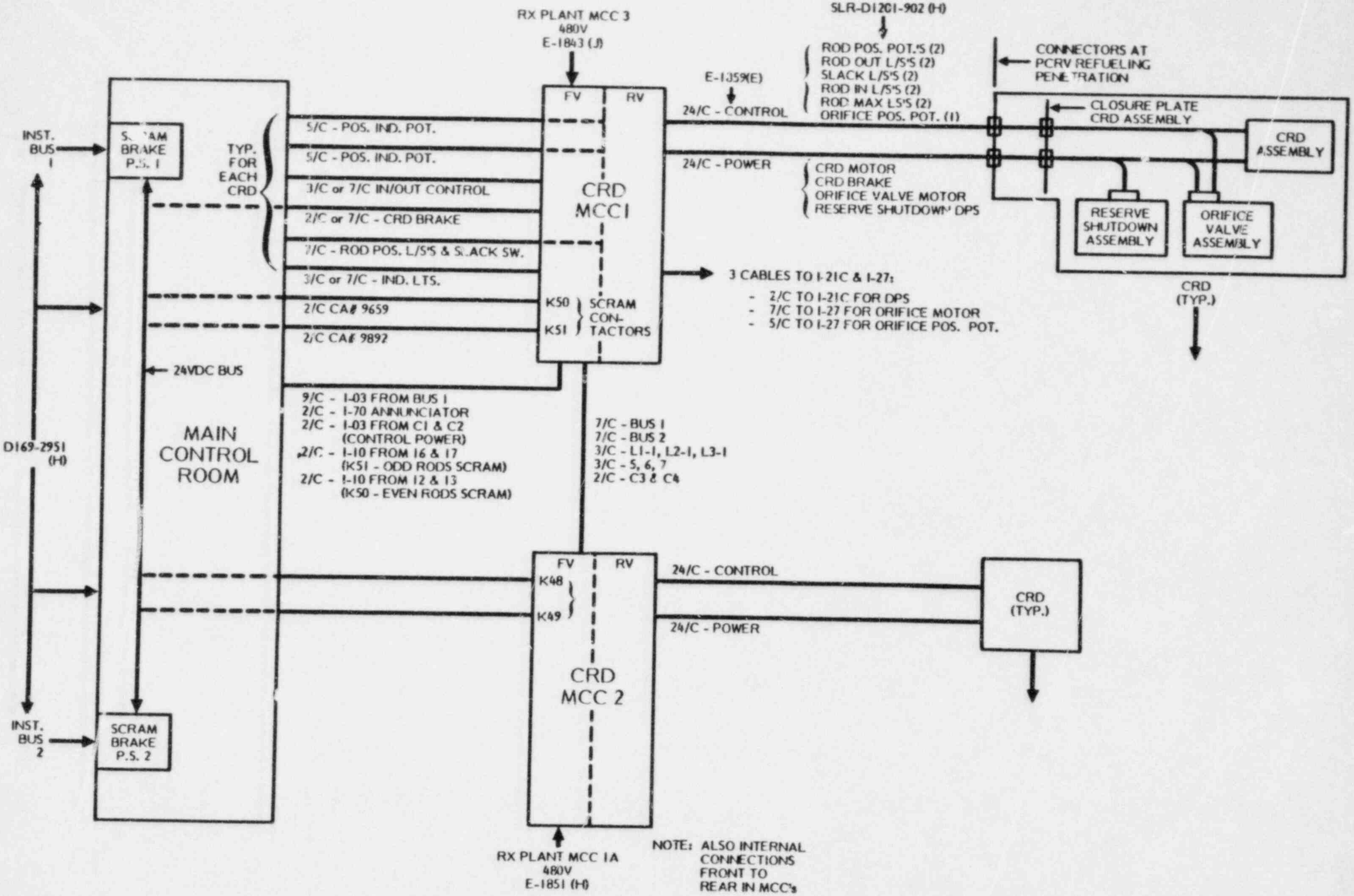


FIGURE 2.4-1

BLOCK DIAGRAM - CRD SYSTEM CABLES

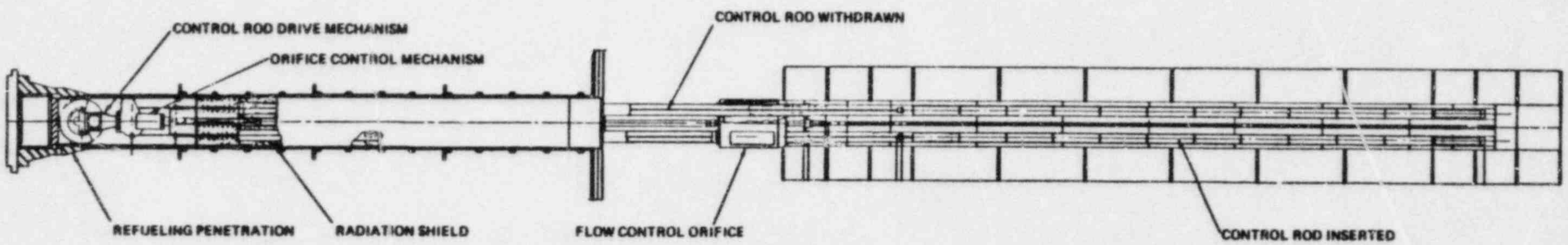


FIGURE 2.4-2

CONTROL AND ORIFICING ASSEMBLY

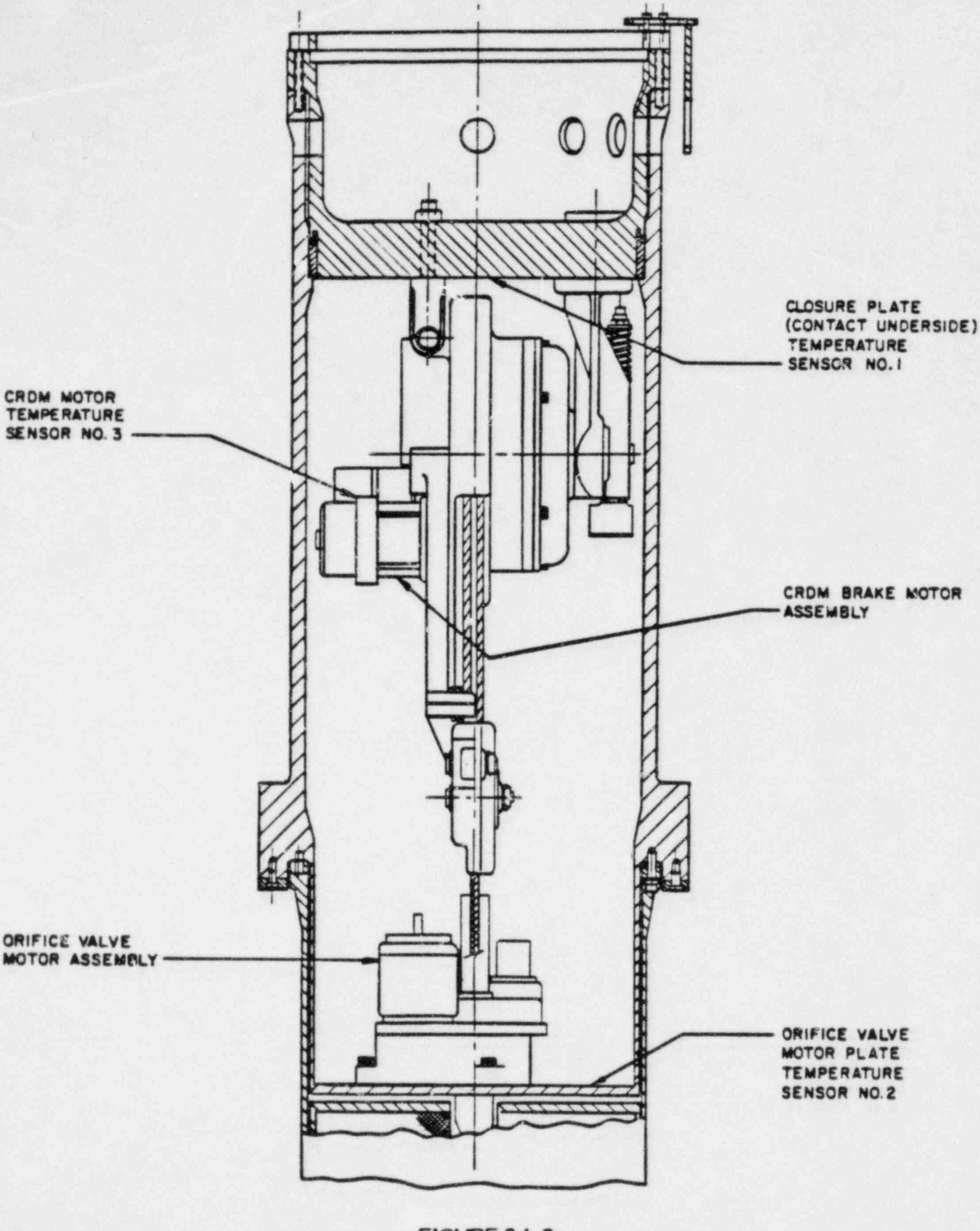


FIGURE 2.4-3
CONTROL ROD DRIVE MECHANISM

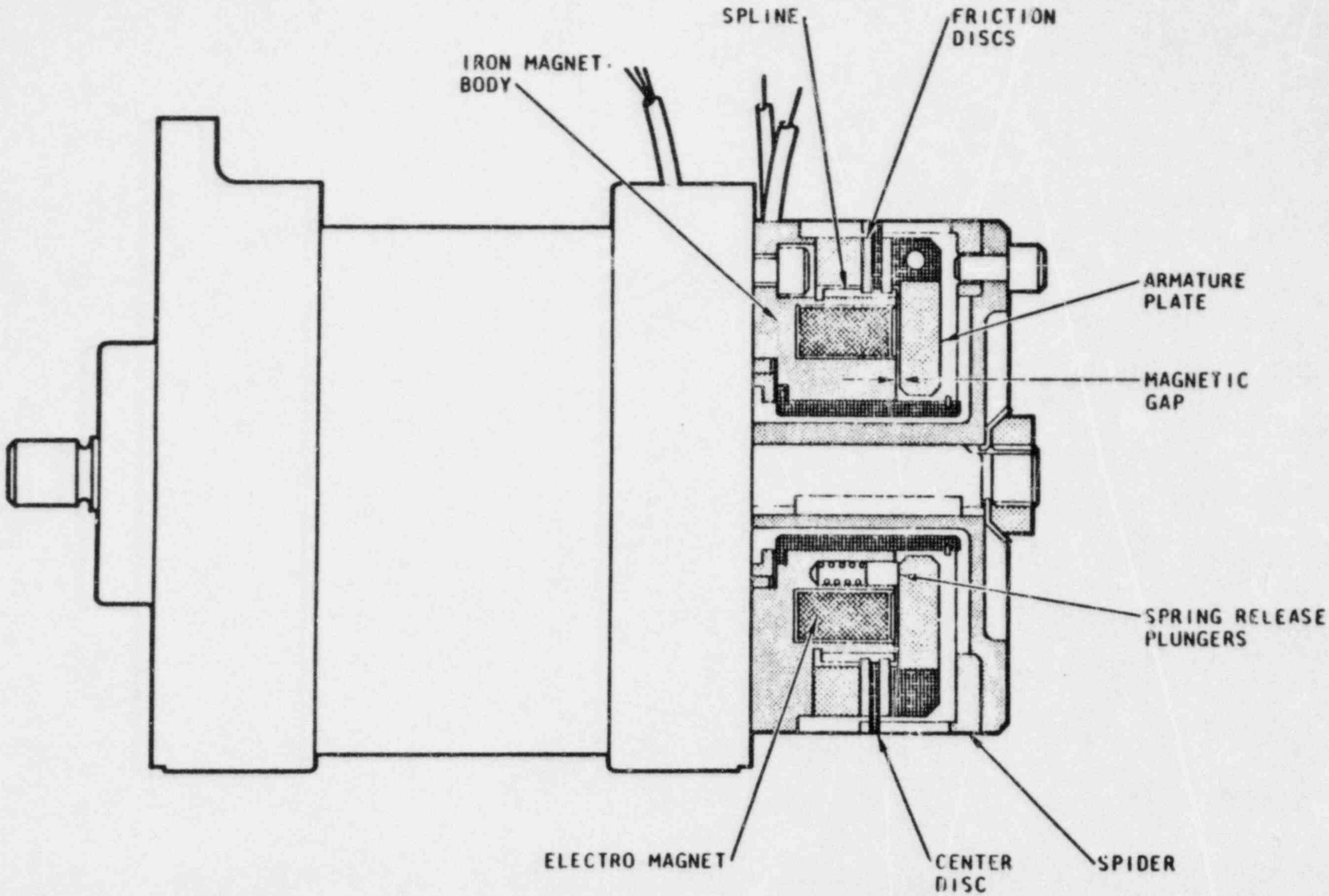


FIGURE 2.4-4

CONTROL ROD DRIVE BRAKE

2.5 System Timing Requirements

FSAR accident analysis 14.4.2 justifies a 1½ hour delay in starting a helium circulator following a reactor trip. This accident analysis demonstrates the adequacy of one helium circulator to provide adequate cooling to assure that fuel temperature limits are not reached. A turbine water removal pump would have to be started at essentially the same time as the pump used for water drive of the circulator. Similarly steam generator cooling need not be established until circulator operation is reestablished. Corresponding supporting functions of service water, circulator bearing water, diesel generator operation, and instrument air compressors need not be initiated until this time period also. The 1½ hour time period provides adequate allowance for fire fighting and fire suppression activities, as well as initial valve alignments and valve position checks that may be required.

Operation of the ACM requires that depressurization be started within 2 hours following reactor trip and completed by approximately 10 hours following reactor trip. This initial depressurization is required for short term decay heat removal. To preserve PCRV liner integrity, liner cooling must be initiated within 30 hours following reactor trip and operated continuously thereafter for continued cooldown; capability exists to operate well beyond the 72 hour time period. Support systems for depressurization would therefore have to be available within 2 hours following reactor trip. Systems that solely support liner cooling need not be available until nearly 30 hours following reactor trip. These time intervals allow sufficient time for fire suppression activities, valve alignments and valve position checks, and system startup.

2.6 HVAC Evaluation

An HVAC Evaluation was performed to assess the adequacy and necessity of plant HVAC systems, on a post-fire event basis, to support shutdown equipment or areas. The necessary HVAC system components required for shutdown (post-fire) are identified in Table 2.6-1. Each selected building/area evaluated is discussed below.

Reactor Building

The Reactor Building HVAC systems were reviewed with respect to cooling in operational support of the Bearing Water Pumps, Turbine Water Removal Pumps, and the Bearing Water Removal Pumps.

Although significant heat is generated in the piping cavity below the PCRV, this is not so when the reactor is shutdown or undergoing cooldown. Air from this area, however, is exhausted by the reactor plant exhaust fans. Therefore, the piping cavity fans are not required for shutdown post-fire event. Similarly the air handling units for PCRV cooling and the piping cavity are not required for post-fire shutdown.

The reactor building exhaust fans also draw from the instrument room with a fresh air supply. Hence, the instrument room booster fans are not required for post-fire shutdown. Similarly, the fuel storage facility air is exhausted by the reactor building exhaust fans and, therefore, the emergency booster fan is not required for post-fire shutdown.

Per the FSAR Section 6.2.3.2.3, only the reactor building exhaust fans and filters are required for plant shutdown cooling.

Diesel Generator, Fire Pumps, Service Water Pumps, and Circulating Water Make-up Pump Building

An analysis was made of the heat gain potential of the compartments housing the Emergency Diesel Generators, Diesel Fire Pump, Service Water Pumps, and the Circulating Make-up Pump Building. The calculated heat gain was based on the loss of HVAC system operability. With the exception of the Service Water Pump Building all compartments were found to be in need of the HVAC system ventilation capability.

Three Room Complex: Control Room, Auxiliary Electrical Equipment Room, and 480V Switchgear Room

The 480V Switchgear Room is independently ventilated but interconnected to the Turbine Building Ventilation System. Room ambient is maintained normally by supplying cooling air from the Turbine Building ventilation system. Normally, both 480V Switchgear Room Vent Booster and Exhaust Fans operate continuously. On loss of offsite power, and without relying on the Turbine Building ventilation system, the 480V Switchgear Room may be ventilated through operation of either an exhaust fan or vent booster fan.

The Control Room HVAC System serves the control room, reactor engineer's office and the auxiliary electrical equipment room. The Control Room HVAC System can be aligned to 100% outside air by using either a supply or exhaust fan. This assures adequate ventilation for equipment and habitability considerations.

TABLE 2.6-1

REQUIRED HVAC COMPONENTS -
FORCED CIRCULATION COOLDOWN

Building/Area	Component	Component Number Train A	Component Number Train B
Reactor Building	Exhaust Fans	C-7301	C-7302S
Emergency Diesel Generator Compartments	Vent Fans Air Handling	C-7528X S-7539	C-7529X S-7540
Fire Pump Room (Diesel)	Louvers Fan	--- ---	DV-75321 C-7522
Circ. Water Makeup Pump Room	Exhaust Fan	Fan A	---
Turbine Building:			
o Control Room and Aux. Electrical Equipment Room	Supply Fan Return Fan	C-7504X	 C-7505
o Switchgear Room	Vent Booster Fan Exhaust Fan	 C-7539	C-7534
o Miscellaneous dampers and louvers that could spuriously close		Dampers	

3.0 MINIMUM REQUIRED FIRE PROTECTION SHUTDOWN COMPONENTS

This section summarizes in table form the mininum components that have been identified through the evaluations described in Section 2.0.

3.1 Forced Circulation Cooldown

Table 3.1 provides a listing of mininum components required for a forced circulation cooldown. This list of components is an initial list based on a systems review and does not yet incorporate results of electrical or fire protection reviews. These reviews will likely identify additional components that require protection, as well as resulting in justification for deleting certain of the components in Table 3.1. Subsequent reports will provide page changes as appropriate for Table 3.1.

3.2 Alternate Cooling Method

The ACM is relied on for accomplishing fire protection shutdown for postulated fires in congested cable areas. Since the ACM has been extensively documented and reviewed in previous evaluations, the intent of this review is to summarize and confirm system components required to function in order for ACM to accomplish its shutdown functions. These are reflected in Table 3.2.

Valve alignments required for ACM are reflected in ACM procedures (reference Appendix B to this report). Potential spurious valves of concern for ACM operation will be addressed in Report No. 2. Additionally further reviews are being performed to identify instrumentation available and independent of congested cable areas for performing the process monitoring described in Figure 2.1-12.

TABLE 3.1

MINIMUM REQUIRED FIRE PROTECTION COMPONENTS -
FORCED CIRCULATION COOLDOWN

F.P. Shutdown Train A		F.P. Shutdown Train B	
Reactivity Control Components:		Reactivity Control Components:	
Control Rods		Control Rods	
Circulator:		Circulator:	
Circulator C-2101		Circulator C-2103	
Steam Generator:		Steam Generator:	
Loop 1 S/G, EES S/G B-2201		Loop 2 S/G, EES S/G B-2202	
Emergency Diesel Generator:		Emergency Diesel Generator:	
K-9201, 1A		K-9202, 1B	
Pumps:		Pumps:	
Bearing Water	P-2101	Bearing Water	P-2102
Bearing Water	P-2106	Bearing Water	P-2107

TABLE 3.1
(continued)

F.P. Shutdown Train A		F.P. Shutdown Train B	
Pumps (continued):		Pumps (continued):	
Emergency Bearing Water Makeup Pump	P-2108	Bearing Water Makeup Pump	P-2105
Bearing Water Removal Pump	P-2104	Diesel Fire Pump	P-4501S
Condensate Pump 1C (12½%)	P-3106	Emergency Water Booster Pump	P-2110
Turbine Water Removal Pump	P-2103	Turbine Water Removal Pump	P-2103S
Service Water Pump	P-4201	Service Water Pump	P-4202S
Circ. Water Makeup Pump	P-4118S	Service Water Return Pump	P-4204S
Service Water Return Pump	P-4203	Instrument Air Compressor	C-8203
Instrument Air Compressor	C-8201	Diesel Oil Transfer Pump	P-9201SX
Diesel Oil Transfer Pump	P-9201X		

TABLE 3.1
(continued)

F.P. Shutdown Train A

Tanks:

Bearing Water Surge Tank	T-2104
High Pressure Separator 1-A	T-2106
Condensate Storage Tank	T-3102
Low Pressure Separator	T-2111
Turbine Water Drain Tank	T-2110
Instrument Air Receiver	T-8201
Instrument Air Dryer	S-8201
Diesel Fuel Oil Storage Tank	T-9201
Diesel Fuel Oil Day Tank	T-9202X
Starting Air Receiver	T-9204X

F.P. Shutdown Train B

Tanks:

Bearing Water Surge Tank	T-2104
High Pressure Separator 1-C	T-2108
Condensate Storage Tank	T-3102
Low Pressure Separator	T-2111
Fuel Oil Tank	T-4503
Turbine Water Drain Tank	T-2110
Instrument Air Receiver	T-8203
Instrument Air Dryer	S-8202
Diesel Fuel Oil Storage Tank	T-9201
Diesel Fuel Oil Day Tank	T-9203X
Starting Air Receiver	T-9206X

TABLE 3.1
(continued)

F.P. Shutdown Train A		F.P. Shutdown Train B	
HVAC Fans/Dampers:		**HVAC Fans/Dampers:**	
Service Water Cooling Tower Fan	C-4201X	Service Water Cooling Tower Fan	C-4202X
Reactor Building Exhaust Fan	C-7301	Reactor Building Exhaust Fan	C-7302S
Control Room - Supply Fan	C-7504X	Control Room - Return Fan	C-7505
Switchgear Room - Exhaust Fan	C-7539	Switchgear Room - Vent Booster Fan	C-7534
Diesel Generator Compartment - Vent Fan	C-7528X	Diesel Generator Compartment - Vent Fan	C-7529X
Air Handling Unit	S-7539	Air Handling Unit	S-7540
Circulating Water Makeup Pump Room	Exhaust Fan "A"	Fire Pump (Diesel) Room - Vent Fan	C-7522
		Louvers	DV-75321
Heat Exchangers:		**Heat Exchangers:**	
Bearing Water	E-2104	Bearing Water	E-2105
Decay Heat Exchanger	E-4202	Main Cooling Tower	E-4103
		Decay Heat Exchanger	E-4202

TABLE 3.1
(continued)

F.P. Shutdown Train A

Emergency Diesel Generator:

Air Handling Unit	S-7539
Engine Coolers	E-9201X
Engine Coolers	E-9202X
Instrument Air Comp. After cooler	E-8201X
Bearing Water Cooler	E-2104

<u>Auto. Actuation and Control:</u>

2.1-5	Sht. 1	Auto Control of P-9201X
2.1-5	Sht. 2	D.G. Control/Start

<u>Valves - Spurious:</u>

He Circulator	HV-21191-1 HV-21191-2 HV-21191-3 HV-21191-4

F.P. Shutdown Train B

Emergency Diesel Generator:

Air Handling Unit	S-7540
Engine Coolers	E-9203X
Engine Coolers	E-9204X
Instrument Air Comp. Aftercooler	E-8203X
Bearing Water Cooler	E-2105

<u>Auto. Actuation and Control:</u>

2.1-5	Sht. 1	Auto Control of P-9201SX
2.1-5	Sht 2	D.G. Control/Start

<u>Valves - Spurious:</u>

He Circulator	HV-21192-1 HV-21192-2 HV-21192-3 HV-21192-4

TABLE 3.1
(continued)

F.P. Shutdown Train A			F.P. Shutdown Train B		
Valves - Spurious:			Valves - Spurious:		
Condensate and Firewater/Pelton Wheel			Boosted Firewater/Pelton Wheel		
		HV-21203-1			HV-21204-1
		HV-21203-2			HV-21204-2
		HV-21203-3			HV-21204-3
		HV-21203-4			HV-21204-4
		HV-31191			FV-2206
		FV-2205			TV-2228-1
		TV-2227-1			TV-2228-2
		TV-2227-2			TV-2228-3
		TV-2227-3			TV-2228-4
		TV-2227-4			TV-2228-5
		TV-2227-5			TV-2228-6
		TV-2227-6			FV-2239
		FV-2239		PI-22-3	HV-2291
	PI-22-3	HV-2291			FV-2240
		FV-2240		PI-22-8	HV-2290
	PI-22-8	HV-2290		PI-22-6	HV-2237
	Pi-22-6	HV-2238			

TABLE 3.1
(continued)

F.P. Shutdown Train A		F.P. Shutdown Train B	
Valves - Spurious:		Valves - Spurious:	
			LCV-4501
			LCV-4207
Condensate and Firewater for Steam Generator Cooling		Firewater for Steam Generator Cooling	
	HV-3220-1		HV-3220-1
	HV-3250		HV-3250
	LCV-3218		LCV-3218
Bearing Water		Bearing Water	
	HV-21185		HV-21186
	HV-2187-1		HV-2188-1
	HV-2187-4		HV-2188-4
	HV-2187-5		HV-2188-5
	HV-2187-6		HV-2188-6
	HV-2187-7		HV-2188-7
	LV-21303		LV-21304
	PDV-2175		PDV-2176
	PDV-2179		PDV-2180
	LV-2135-1		LV-2136-1
	LV-21115		LV-2138
	LV-2137		FV-21298
	FV-21297		HV-21252-5

TABLE 3.1
(continued)

F.P. Shutdown Train A			F.P. Shutdown Train B		
Valves - Spurious:			**Valves - Spurious:**		
Service Water Component Cooling			Service Water Component Cooling		
PI-42-1	Strainer	F-4201	PI-42-1	Strainer	F-4201
PI-42-1		LCV-4207	PI-42-1		LCV-4207
PI-42-1		HV-4221-2	PI-42-1		HV-4221-2
PI-42-2		PCV-4266	PI-42-2		PCV-4266
		TSV-4267			TSV-4267
		TSV-4268			TSV-4268
		TSV-4269			TSV-4269
		TSV-4270			TSV-4270
		TCV-4267			TCV-4267
		TCV-4268			TCV-4268
		TCV-4269			TCV-4269
		TCV-4270			TCV-4270
PI-42-3		TCV-4234	PI-42-3		TCV-4274
PI-42-3		FSV-8211-3	PI-42-3		FSV-8211-3
PI-42-3		TCV-4235	PI-42-3		TCV-4235
Reactor Plant Cooling Water System Water Loop/Component Cooling			Reactor Plant Cooling Water System Water Loop/Component Cooling		
PI-46-4		HV-21143	PI-46-4		HV-21143
PI-46-4		HV-21142-3	PI-46-4		HV-21142-3

TABLE 3.1
(continued)

F.P. Shutdown Train A				F.P. Shutdown Train B			
Valves - Spurious:				**Valves - Spurious:**			
Diesel Generator/Essential A.C.				Diesel Generator/Essential A.C.			
	PI-92-2		HSV-92231		PI-92-2		HSV-92233
	P!-92-2		HSV-92232		PI-92-2		HSV-92234
	PI-92-2		HSV-92245		PI-92-2		HSV-92249
	PI-92-2		HSV-92247		PI-92-2		HSV-92251
Valves - Control Protected:				**Valves - Control Protected:**			
	Table 2.1-3 Sht-3	Valve	FV-2205		2.1-2 Sht. 2	Valve	HV-21252-1
	2.1-3 Sht. 3	Valve	HV-2223		2.1-4 Sht. 5	Valve	PV-2230
	2.1-3 Sht. 4	Valve	PV-2229		2.1-5 Sht. 2	Valve	HSV-92249
	2.1-5 Sht. 2	Valve	HSV-92245		2.1-5 Sht. 2	Valve	HSV-92251
	2.1-5 Sht. 2	Valve	HSV-92247		2.1-3 Sht. 3	Valve	LV-21114
	2.1-3 Sht. 2	Valve	LV 21114		2.1-6 Sht. 3	Valve	LCV-4207
	2.1-6 Sht. 3	Valve	LCV 4207		2.1-6 Sht. 4	Valve	TCV 4269
	2.1-6 Sht. 4	Valve	TCV 4267		2.1-6 Sht. 8	Valve	TCV 4274
	2.1-6 Sht. 4	Valve	TCV 4268				
	2.1-6 Sht. 8	Valve	TCV 4234				

TABLE 3.1
(continued)

F.P. Shutdown Train A				F.P. Shutdown Train B		
Valves - Operated Locally:*				**Valves - Operated Locally:***		
Table	2.1-3 Sht-1	Valve	HV-3133-1	2.1-4 Sht-1	Valve	HV-2110-1
	2.1-3 Sht-1	Valve	HV-3133-2	2.1-4 Sht-2	Valve	SV-2110
	2.1-3 Sht-2	Valve	HV-2109-1	2.1-4 Sht-2	Valve	HV-2110-2
	2.1-3 Sht-2	Valve	SV-2109	2.1-4 Sht-3	Valve	HV-4221-1
	2.1-3 Sht-2	Valve	HV-2109-2	2.1-4 Sht-4	Valve	HV-4138-1
	2.1-3 Sht-3	Valve	HV-2237	2.1-4 Sht-4	Valve	HV-4138-2
	2.1-3 Sht-3	Valve	HV-3220-6	2.1-4 Sht-4	Valve	HV-31122
	2.1-3 Sht-4	Valve	LV-3250-2	2.1-4 Sht-4	Valve	HV-2238
				2.1-4 Sht-4	Valve	HV-2224
	2.1-6 Sht-2	Valve	HV-4257	2.1-4 Sht-5	Valve	HV-3220-6
	2.1-6 Sht-2	Valve	HV-4225	2.1-4 Sht-5	Valve	LV-3250-2
	2.1-6 Sht-3	Valve	HV-4221-1	2.1-6 Sht-2	Valve	HV-4257
	2.1-6 Sht-3	Valve	HV-4221-3	2.1-6 Sht-2	Valve	HV-4225
				2.1-6 Sht-3	Valve	LCV-4207
				2.1-6 Sht-3	Valve	HV-4221-1
				2.1-6 Sht-3	Valve	HV-4221-3

* Normally operated remotely (HCVs, MOVs, etc.)

TABLE 3.1

(continued)

F.P. Shutdown Train A

Valves - Manual Only:

Table	Valve
	V-21754
2.1-1 Sht 2	V-211214
2.1-3 Sht 1	V-31131
	V-3166
	V-31408
	V-211658
2.1-3 Sht 1	V-21867
2.1-3 Sht 2	V-21729
2.1-3 Sht 3	V-31904
	V-31919
	V-31921
	V-32109
	v-3102
2.1-3 Sht 3	V-32108
2.1-3 Sht 4	V-22345
	V-5288
	V-5287
	V-5203
	V-32308
2.1-3 Sht 4	V-32234
2.1-6 Sht 1	V-41302
	V-4121
	V-41903
2.1-6 Sht 1	V-42131
2.1-6 Sht 2	V-42124
2.1-6 Sht 2	V-42130
2.1-6 Sht 2	V-4449
2.1-6 Sht 3	V-4286
2.1-6 Sht 6	V-4214

F.P. Shutdown Train B

Valves - Manual Only:

Table	Valve
2.1-2 Sht 2	V-211309
2.1-4 Sht 1	V-4525
	V-211565
2.1-4 Sht 1	V-211573
	V-211570
2.1-4 Sht 2	V-31904
2.1-4 Sht 2	V-31919
2.1-4 Sht 2	V-31921
2.1-4 Sht 3	V-31101
2.1-4 Sht 4	V-75610
2.1-4 Sht 5	V-22346
	V-5202
	V-5288
	V-5287
	V-32308
	V-32234
2.1-4 Sht 5	V-32108
2.1-6 Sht 2	V-42124
2.1-6 Sht 2	V-42130
2.1-6 Sht 2	V-4449
2.1-6 Sht 3	V-4286
2.1-6 Sht 6	V-4214
	V-4229
	V-4236
2.1-6 Sht 6	V-42390
2.1-6 Sht 7	V-4234
	V-42817
	V-4256
	V-4239
	V-4264

TABLE 3.1
(continued)

F.P. Shutdown Train A		F.P. Shutdown Train B	
Valves - Manual Only (Continued):		**Valves - Manual Only (Continued):**	
Table 2.1-6 Sht 6	V-4229	Table 2.1-6 Sht 7	V-42374
	V-4236	2.1-6 Sht 8	V-42394
2.1-6 Sht 6	V-42390	2.1-6 Sht 8	V-42397
2.1-6 Sht 7	V-4234	2.1-6 Sht 8	V-75263
	V-42817	2.1-6 Sht 9	V-46614
	V-4256	2.1-6 Sht 9	V-461516
	V-4239		V-46297
	V-4264		V-46307
2.1-6 Sht 7	V-42374	2.1-6 Sht 9	V-461536
2.1-6 Sht 8	V-4221	2.1-6 Sht 10	V-461535
2.1-6 Sht 8	V-42397		V-461619
2.1-6 Sht 8	V-75263		V-461744
2.1-6 Sht 9	V-46614		V-46145
2.1-6 Sht 9	V-461516		V-46147
2.1-6 Sht 9	V-46927		V-46146
2.1-6 Sht 9	V-46307		V-46148
2.1-6 Sht 9	V-461536	2.1-6 Sht 10	V-46322
2.1-6 Sht 10	V-461535	2.1-6 Sht 11	V-46483
	V-461619		V-46326
	V-461744		V-46494
	V-46145		V-461538
	V-46147		V-46342
	V-46146		V-46346
	V-46148	2.1-6 Sht 11	V-461643
2.1-6 Sht 10	V-46322		
2.1-6 Sht 11	V-46483		
	V-46326		
	V-46494		

TABLE 3.1
(continued)

F.P. Shutdown Train A	F.P. Shutdown Train B

Valves - Manual Only (Continued):

TAble 2.1-6 Sht 11	V-461538
	V-46342
	V-46346
2.1-6 Sht 11	V-461643

F.P. Shutdown Train A	F.P. Shutdown Train B
Instrumentation:	**Instrumentation:**
Process Monitoring	Process Monitoring
NI-1133-1	NI-1134-1
SI-2109	SI-2110
FM-2211-1	FM-2212-1
TI-22121	TI-22122
PI-1108	PI-1109
TIA-1171	TIA-1175
System Instrumentation	System Instrumentation
PI-21247	PI-21248
PDIS-21173	PDIS-21174
LI-21135	LI-21136
LI-21119	LI-21115
PI-8209	PI-8253
PI-3134	PI-4506
PI-21302	PI-21536-2

TABLE 3.1
(continued)

F.P. Shutdown Train A	F.P. Shutdown Train B
System Instrumentation (Continued)	System Instrumentation (Continued)
PI-4214	PI-21302
PDIS-4226	PI-4216
P-4204	PDIS-4226
1A, (K9201) Voltmeter	PI-4206
	1B, (K9202) Voltmeter
<u>Diesel Generators & Accessories:</u>	<u>Diesel Generators & Accessories:</u>
Air Start Motors	Air Start Motors
M-92865	M-92869
M-92867	M-92871
Diesel Engines	Diesel Engines
1A (K-9203X)	1C (K-9205X)
1B (K-9204X)	1D (K-9206X)
Diesel Generators	Diesel Generators
1A (K-9201)	1B (K-9202)

TABLE 3.2
REQUIRED ACM FIRE PROTECTION
SHUTDOWN COMPONENTS

Diesel-Driven Generator (2500 kW)
Plant Lighting Auto-Transfer Switches
Electrical Equipment Transfer Switches
4160v to 480v Transformer
Stack Effluent Radiation Monitor (PING-1)

Firewater Pump (Motor Driven)
Service Water Pump
Service Water Tower Fan
Service Water Return Pump
PCRV Liner Cooling Water Pumps (2)
Circulating Water Makeup Pump
Reactor Plant Exhaust Fan
Diesel Oil Transfer Pump
Helium Purification Cooling Water Pump
Selected Plant Lighting
Firewater Pump House Vent Fans and Louvers
Motor Operated Valves (2)
Reserve Shutdown System
Breathing Air Compressors (2)
Startup Battery for Diese Generator and D.C. Control

Liner Cooling Water Temperature Indicators
TI-4629 and TI-4630

Helium Purification System, Hel Pressure Indicator
PI-23162

Reactor Building Exhaust Fan ΔP -
PDI-7323-1 and PDI-7339-1

Liner Cooling Pump Discharg . essure
PI-46334, PI-46335, PI- [illegible], and PI-4664.

Service Water Instruments - PI-4214, PI-4216, PDIS-4226,
PI-4204 and PI-4206.

4.0 SUBSEQUENT REPORTS

Subsequent reports will address the electrical reviews, fire protection reviews, proposed modifications and exemption requests related to the Appendix R evaluation of Fort St. Vrain. The following summarize the topics to be addressed in each of those reports:

Report No. 2 - Electrical Reviews

- Breaker Coordination Study
- Hot Shorts Evaluations
- Common Enclosure Evaluations
- Cable Isolation and Separation
- ACM Spurious Valve Operation

Report No. 3 - Fire Protection

- Equipment/Component Location
- Fire Areas
- Structural Steel and Debris Damage
- Fire Barriers and Penetrations
- Electrical Penetration Seals
- Component Separation/Protection
- Fire Detection Systems
- Fire Suppression Systems
- Combustible Gases/Fluids
- Component/Equipment Accessibility (Felix/Fred to handle manual valves)
- Emergency Lighting
- Personnel Requirements

Report No. 4 - Exemptions/Modifications

- o Fire Hazards Analysis Data Review
- o Operating Procedure Data
- o ACM Procedure Evaluation
- o Other Procedures
- o Communications
- o Exemption Requests
- o Proposed Modifications

These reports will be submitted consistent wth the schedules described in Section 1.5.

APPENDIX A

PSC LETTER TO NRC
DATED AUGUST 17, 1984
(P-84281)

SUBJECT:

10CFR50, APPENDIX R
FIRE PROTECTION REGULATORY GUIDANCE

(Fire Protection Acceptance Criteria)

PUBLIC SERVICE COMPANY OF COLORADO
P. O. BOX 840 DENVER, COLORADO 80201

OSCAR R. LEE
VICE PRESIDENT

August 17,1984
Fort St. Vrain
Unit No. 1
P-84281

Mr. Eric H. Johnson, Chief
Reactor Project Branch 1
Region IV
Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

DOCKET NO. 50-267

SUBJECT: 10CFR50, Appendix R Fire Protection Regulatory Guidance

REFERENCES:
1) NRC Letter, Wagner to Lee, dated June 4, 1984 (G-84176)
2) PSC Letter, Lee to Johnson, dated June 22, 1984 (P-84183)
3) NRC Letter, Johnson to Lee, dated July 18, 1984 (G-84257)

Dear Mr. Johnson:

This letter responds to your July 18, 1984 letter (reference 3) which transmitted NRC concerns/comments on the Fire Protection Regulatory Guidance submitted via reference 2.

Attachment 1 to this letter is the revised schedule for completion of our fire protection review and the modification requested in reference 3. Attachment 2 includes the revised "Fire Protection Safe Reactor Shutdown/Cooldown Capability for the Fort St. Vrain Nuclear Generating Station" which incorporates your concerns/comments. This regulatory guidance will be used for ensuring compliance with Section III.G of 10CFR50, Appendix R. In response to your comment 1 of reference 3, we have deleted the sentence as requested in order to expedite this document and because it did not affect this fire protection review. Deletion of that sentence does not imply that PSC concurs that the sentence is incorrect.

Your early review and concurrence with the proposed regulatory guidance in Attachment 2 is requested. If you have any questions or wish to discuss the proposed guidance in Attachment 2, please contact Mr. M. H. Holmes at (303) 571-8409.

Very truly yours,

ORLee

O. R. Lee, Vice President
Electric Production

ORL/FWT:pa

Attachment

FSV
Schedule for Appendix R Review and Submittals
and Plant Modifications

Commitment Date	Commitment
August 17, 1984	PSC will submit revised schedule and Fire Protection Regulatory Guidance
November 17, 1984	PSC will submit first portion of Fire Protection Review
December 17, 1984	PSC will submit second portion of Fire Protection Review
January 17, 1985	PSC will submit third portion of Fire Protection Review
February 17, 1985	PSC will submit final portion of Fire Protection Review
3 weeks following written NRC approval (SER) of entire Review	PSC will submit schedule for any proposed modifications not complete at that time
May 17, 1985	PSC will complete modification to automate J and G wall fixed water spray system

Fire Protection Safe Reactor Shutdown/Cooldown Capability for the Fort St. Vrain Nuclear Generating Station

I. Applicability

The following regulatory guidance for compliance with the fire protection provisions of Section III.G of 10CFR50, Appendix R are applicable to the Fort St. Vrain Nuclear Generating Station.

II. Appendix R Fire Protection Acceptance Criteria at Fort St. Vrain

A. Congested Cable Areas

1. Congested cable areas shall be defined as the Control Room, 480 Volt Switchgear Room, the Auxiliary Electric Room, and the congested cable areas along the J and G walls currently protected with a coating of Flamemastic and spray systems.

2. Limiting consequences of a fire in a congested cable area:

   For any single fire in a congested cable area means shall be available to shut down and cool down the reactor in a manner such that the consequences of DBA-1, as defined in FSAR Appendix D (Rev. 1), are not exceeded.

3. Performance goals for safe reactor shutdown/cooldown functions for a fire in a congested cable area shall be:

   a. The reactivity control function shall be capable of achieving and maintaining a subcritical reactivity condition.

   b. The pressure control function shall be capable of achieving depressurization (if required) through the helium purification system.

   c. The PCRV liner cooling function shall be capable of maintaining the PCRV integrity, and shall be capable of achieving and maintaining decay heat removal.

   d. The process monitoring function shall be capable of providing direct readings (local or remote) of the process variables necessary to perform and control the above functions.

e. The supporting functions shall be capable of providing the process cooling, lubrication, etc. necessary to permit operation of the equipment used for safe reactor shutdown/cooldown functions A.3.a through A.3.c above.

B. <u>Non-Congested Cable Areas</u>

1. Limiting consequences of a fire in non-congested cable areas:

   For any single fire in a non-congested cable area means shall be available to shut down and cool down the reactor in a manner such that no fuel damage occurs (i.e. maximum fuel particle temperature does not exceed 2900 degrees F). There shall be no simultaneous rupture of both a primary coolant boundary and the associated secondary containment boundary such that no unmonitored radiological releases of primary coolant occur.

2. Performance goals for safe reactor shutdown/cooldown functions for a fire in non-congested cable areas shall be:

   a. The reactivity control function shall be capable of achieving and maintaining subcritical reactivity conditions.

   b. Maintain the PCRV liner integrity and PCRV structural and pressure containment integrity.

   c. The reactor heat removal function shall be capable of achieving and maintaining forced circulation decay heat removal.

   d. The process monitoring function shall be capable of providing direct readings (local or remote) of the process variables necessary to perform and control the above functions.

   e. The supporting functions shall be capable of providing the process cooling, lubrication, etc. necessary to permit operation of the equipment used for safe reactor shutdown/cooldown functions B.2.a through B.2.c above.

III. Specific Criteria

A. The congested cable areas at the G and J walls shall be protected with automatic sprinkler or spray systems which comply with either NFPA Standard No. 13 or with NFPA Standard No. 15.

B. The safe reactor shutdown/cooldown capability for specific fire locations may be unique for each such area, room or zone, or it may be one unique combination of systems for all such locations. In either case the redundant or alternate safe reactor shutdown/cooldown capability shall be physically and electrically independent of the specific fire location.

C. The redundant or alternate safe reactor shutdown/cooldown capability shall accommodate post fire conditions where offsite power is available and where offsite power is not available for 72 hours.

D. Redundant and alternate equipment and systems performing safe reactor shutdown/cooldown functions shall, prior to considering any postulated fire damage, be capable of being powered either by both an off-site and an on-site power source, or by two independent on-site power sources.

E. Procedures shall be in effect to implement the capability to safely shut down and cool down the reactor in the event of any single fire.

F. The number of operating shift personnel, exclusive of fire brigade members, required to operate the safe reactor shutdown/cooldown equipment and systems shall be onsite at all times the reactor is not shutdown. All other personnel required for any resulting emergency shall respond within required time limits.

G. Systems used to ensure the post fire safe reactor shutdown/cooldown capability need not be designed to meet seismic Category I criteria, single failure criteria, or other design basis accident criteria, except where required for other reasons, e.g., because of interface with or impact on existing safety systems, or because of adverse valve actions due to fire damage.

H. The safe reactor shutdown/cooldown equipment and systems for each location shall be known to be isolated from associated circuits in that location so that hot shorts, open circuits, or shorts to ground in the associated circuits will not prevent operation of the safe reactor shutdown/cooldown equipment.

I. Water-filled mechanical components, such as piping and valves, necessary for safe reactor shutdown/cooldown which are within the area, room or zone encompassed by a single postulated fire shall not be considered damaged by the fire. Water-filled valves and mechanical components with manual operators in the fire area, room, or zone shall be considered to be manually operable within one hour after the start of the fire.

IV. Basis

Section III.L of Appendix R to 10CFR50 provides the performance criteria for Alternative and Dedicated Shutdown Capability for light water reactors. Because of the unique design features of Fort St. Vrain, a gas cooled reactor, all criteria of Section III.L are not applicable and revised acceptance criteria have been developed. The Acceptance Criteria in Part II of this document provide limiting consequences for single fires in congested cable areas and in non-congested cable areas for determination of acceptable safe reactor shutdown/cooldown systems and equipment under either Section III.G.2 or Section III.G.3 of 10CFR50 Appendix R. These limiting consequences ensure that public health and safety will not be threatened for any single fire in the FSV Nuclear Generating Station.

FSV has two primary means of achieving and maintaining safe reactor shutdown/cooldown. For either means the control rods and/or the reserve shutdown system is utilized to shutdown the reactor and maintain a subcritical reactivity condition. The decay heat removal function can be performed by 1) forced circulation cooling or by 2) PCRV liner cooling. There exists multiple redundant and/or alternate means for achieving and maintaining either of these two cooldown modes. The consequences of both of these cooldown modes have been analyzed, reviewed by the NRC Staff, and found acceptable.

The limiting event involving forced circulation cooldown occurs when an interruption of forced circulation (IOFC) takes place followed by a firewater cooldown as analyzed in FSAR Section 14.4.2.2. Following the IOFC forced circulation is resumed when firewater is supplied to either the reheater or the economizer/evaporator/superheater section of one steam generator and boosted firewater is supplied to the water turbine drive of one helium circulator. Fuel temperatures remain below 2900 degrees F as shown in FSAR Figure 14.4-6 and no fuel damage is predicted to occur.

Fuel damage will not occur so long as fuel temperatures do not exceed 2900 degrees F. At fuel temperatures in excess of 2900 degrees F the fuel failure mode has been determined to be fuel kernel migration through the fuel coating layers. As stated in the basis for Technical Specification SL 3.1, the Core Safety Limit has been established to assure that a fuel kernel migrating at the highest rate in the core will penetrate a distance less that the combined thickness of the buffer coating plus inner isotropic coating on the particle. It is further noted in the basis for SL 3.1 that the maximum fuel kernel migration expected for the fuel with the most damaging temperature history is less than 20 microns. Thus, out of a total inner coating thickness of 70 microns, only 50 microns is assumed to be available in establishing the limits in SL 3.1. Actual testing of TRISO coated fuel particles has shown that at 2900 degrees F fuel kernels will not migrate through the buffer and inner isotropic coatings for several hundred hours. Therefore, 2900 degrees F was chosen as a fuel safety limit (FSAR Section 3.2.3.3).

The FSV fuel testing program is described in FSAR Appendix A.1. Table A.1.9 shows that five of six samples of TRISO fuel particles had no evidence of fuel kernel migration after 250 hours at 1600 degrees C (2912 degrees F) while the sixth sample had only 5 microns of fuel kernel migration. These are all well below the 50 micron fuel kernel migration at which fuel particle damage is judged to occur. FSAR Figure 3.6-8 predicts that it would take approximately 300 hours at 2900 degrees F before the fuel kernel would migrate through the buffer and inner isotropic coating layers. This is consistent with the statement in FSAR Section 14.2.2.7 that "Data for the impact of time and temperature on fuel particle integrity indicate that failure could be expected for any fuel reaching 2500 degrees C, maintained above 2000 degrees C for almost an hour, or at 1600 degrees C for times up to several hundred hours." The 2900 degrees F limit to ensure no fuel damage in II. B of the Appendix R Fire Protection Acceptance Criteria at Fort St. Vrain is conservative since forced circulation decay heat removal results in a relatively fast cooldown such that fuel temperatures will not remain high for long periods of time, and only very limited, if any, fuel kernel migration will occur.

The limiting event involving PCRV liner cooldown occurs when forced circulation is lost and cannot be restored. This permanent loss of forced circulation is referred to as Design Basis Accident No. 1 and is analyzed in Appendix D of the FSAR. In this accident reactivity is maintained subcritical by insertion of the control rods, followed by insertion of the reserve shutdown system's boron carbide balls within 5 hours. PCRV liner cooling is established utilizing any one of the four PCRV liner cooling water pumps or by utilizing one of the firewater pumps to supply either one of the two PCRV liner cooling loops. The radiological consequences of Design Basis Accident No. 1 are only a small fraction of the guidelines established in 10CFR100. The NRC SER dated June 21, 1969 concludes that the doses resulting from Design Basis Accident No. 1 are insignificant and acceptable.

The Alternate Cooling Method (ACM) provides an independent source of power to specific safe reactor shutdown/cooldown equipment using the PCRV liner cooling method. PCRV liner cooling can be achieved and maintained using the ACM power source for a postulated fire in a congested cable area which causes a LOFC accident and/or disables the normal power supply cables to the equipment items necessary for PCRV liner cooling. In the SER to Amendment No. 21 to FSV's operating license, dated June 6, 1979, the NRC Staff concluded: "this alternative cooling method (ACM) will ensure that conditions and public health and safety consequences, analyzed and presented in Design Basis Accident number 1 in the FSAR, are not exceeded in the case of such disruptive faults or events (these include a major fire) in congested cable areas." The ACM thus provides an acceptable source of power to the equipment necessary to achieve and maintain PCRV liner cooling.

The Acceptance Criteria specified in Part II of this document apply to either III.G.2 or III.G.3, whichever the Licensee chooses to comply with for a postulated single fire in a specific area, room or zone of FSV. The Staff has imposed more stringent acceptance criteria for fires in non-congested cable areas than for fires in congested cables areas. The Acceptance Criteria for both areas are in accordance with 10CFR50 Appendix A General Design Criterion 3, which states "Structures, systems and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires..."

Based on the consequences of DBA-1, the staff concludes that for a postulated fire in the three room control complex or in congested cable areas at the G and J walls, the substitution of acceptance criteria of DBA-1 in place of the criteria in III.L relating to cold shutdown and limits on reactor coolant system process variables is acceptable, provided that the fire protection features in these areas are enhanced over the minimum requirements of Section III.G.3 of Appendix R as required by Specific Criterion A in Part III of this document.

The acceptance criteria for a postulated fire in a non-congested cable area are: no fuel damage shall occur, there shall be no simultaneous rupture of both a primary coolant boundary and the associated secondary containment boundary such that no unmonitored radiological releases of primary coolant occur. At FSV the primary coolant boundary includes the PCRV liner, the PCRV penetration primary closures, the steam generator tubes inside the PCRV, the PCRV rupture discs, and piping which contains primary coolant. The secondary containment boundary includes the PCRV itself; the PCRV penetration secondary closures; feedwater piping, main steam piping, and reheat steam piping up to the first isolation valves; the PCRV liner cooling water tubes; lines open to a PCRV penetration interspace; the PCRV safety relief valves dowstream of the rupture discs; and the PCRV safety relief valve tank.

These criteria ensure that the PCRV helium coolant inventory will be maintained and no significant release of primary coolant will occur. The performance goals for a fire in a non-congested cable area specify that forced circulation shall be achieved and maintained for the reactor heat removal function. This requirement is based on the fact that the establishment of forced circulation cooling, within a time dependent on reactor power history, is necessary to prevent fuel damage.

The criteria in III.L relating to cold shutdown and limits on reactor coolant process variables such that there is no fuel clad damage nor rupture of any primary coolant or containment boundary, apply to light water reactors and are not directly applicable to the Fort St. Vrain HTGR. The FSV Acceptance Criteria for a fire in non-congested cable areas, which require no fuel damage and no simultaneous rupture of both a primary coolant boundary and the associated secondary containment boundary, are considered to be as effective as the III.L light water reactor criteria for ensuring the public health and safety is protected.

The Specific Criteria B through H, in Part III of this document, parallel the criteria for light water reactors contained in III.L. Specific Criterion C requires that the redundant or alternate safe reactor shutdown/cooldown capability accommodate post fire conditions where offsite power is not available for 72 hours. FSV is required by the Technical Specifications to have sufficient diesel fuel on - site to permit operation of both standby generators under required loading conditions for at least seven days (LCO 4.6.1) and operation of the ACM diesel generator for 108 hours with full ACM load (LCO 4.2.17). Specific Criterion I of Part III is based on the Staff's consideration that manually operable mechanical components containing water would not be damaged by a postulated fire.

APPENDIX B

ACM PROCEDURES

TITLE: ALTERNATE COOLING METHOD

ISSUANCE AUTHORIZED BY	Milt McBride		
PORC REVIEW	PORC 555 FEB 9- 1984	EFFECTIVE DATE	2-16-84

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SECTION I

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SECTION II
SHIFT SUPERVISOR CHECKLIST OF ACM EQUIPMENT OPERATION

| 1.0 SYSTEM PRECAUTIONS AND LIMITATIONS

1.1 Technical Specifications

The operator should be familiar with the following Technical Specifications which are pertinent to the operation of System 48-01. Refer to Fort St. Vrain Nuclear Generating Station Technical Specifications.

| 1.1.1 LCO 4.2.17 - Diesel Driven Generator for ACM, Limiting Condition for Operation.

| 1.1.2 LCO 4.2.18 - Primary Coolant Depressurization, Limiting Condition for Operation.

1.2 System Purpose

| 1.2.1 System 48-01, the alternate cooling method (ACM), provides an alternate means of cooling the reactor in the event of the occurrence of disruptive faults or events, such as a major fire, in congested cable areas. This method is provided to ensure that conditions and public health and safety consequences, analyzed and presented in the Design Basis Accident Number 1 (Permanent Loss of Forced Circulation) in the Final Safety Analysis Report, are not exceeded.

1.3 System Description

| 1.3.1 The ACM system is designed to provide sufficient electric power to operate the following equipment items: (see ACM one line diagram, Figure 1)

a. Fire Water Pump, P-4501

b. Service Water Pump, P-4201 or P-4202

c. Service Water Tower Fan, C-4201X or C-4202X

d. Service Water Return Pump, P-4203 or C-4204

e. PCRV Liner Cooling System Pumps (2), P-4601 or P-4601S/P-4602 or P-4602S

f. Circulating Water Makeup Pump, CWMUP-1A or CWMUP-1B

g. Reactor Plant Exhaust Fan, C-7301 or C-7302

h. Diesel Oil Transfer Pumps (2), P-4803 and P-4804

i. Helium Purification Cooling Water Pump, P-4701 or P-4702

j. Firewater Pump House Vent Fans (2), C-7521 and C-7522

k. Motor Operated Valves, HV-2301 or HV-2302

l. Stack Effluent Gas Radiation Monitor, PING-1

m. Fire Pump House Louvers (2)

n. Selected Plant Lighting

o. Breathing Air Compressors (2), C-4501 and C-4502

p. Startup Battery for Diesel Generator and D.C. Control

| 1.3.2 These items represent slightly less than a 700 KW design load. Electric power to meet these design requirements is supplied b, a separate, dedicated, manually started, diesel engine driven generator unit, the ACM Diesel Generator, K-4804, which is independent of both plant normal and emergency electrical power sources and is rated at 2,750 KW.

| 1.3.3 Existing plant equipment has been used to the maximum extent possible. The ACM system has been designed to ensure that it does not compromise the previously established design or operating limits of such equipment.

| 1.3.4 Under normal plant operating conditions, the ACM diesel generator is shutdown and maintained in a standby mode with the ACM 4160 volt bus de-energized, and the ACM 480 volt load center bus fed from the 480 volt Turbine Plant HVAC load center.

NOTE: Under these conditions, the ACM 480V 1040 Center Bus is capable of supplying only ACM Generator Auxiliary Power. DO NOT allow use of the backup circuits to the Security System and/or the Technical Support Center without putting the ACM Generator in service FIRST.

1.3.5 The ACM 480 volt motor control center is fed from the ACM load center bus and provides power to the ACM diesel generator auxiliaries and the ACM diesel battery charger to maintain the ACM diesel ready for operation.

1.3.6 Electric power is available to ACM loads from the energized ACM load center and motor control center busses, but remains isolated by the manual transfer switches which are selected for normal plant electric power sources.

1.3.7 System 48-01 is a backup system which is not used for normal operation of the plant. The conditions and sequence under which it is required to be placed in service are specified in the <u>Safe Shutdown and Cooling with Highly Degraded Conditions</u> procedure.

1.3.8 In the event of a loss of all normal and standby 480 volt essential power, the ACM system is placed in service as a single operation per Section II of this procedure.

1.3.9 In the event of a Loss of Forced Circulation Situation, installation of the HTFA cooling spool pieces shall be started one half hour after the loss and depressurization of the PCRV shall be started at the time determined from the curves of Emergency Procedure G.

1.3.10 The startup, shutdown, and operating procedures for each individual part of System 48-01 are provided in appropriate sections of this procedure. Section II provides the procedure to be followed in the case where the entire system is placed in service at one time.

1.3.11 System 48-01 is designed for manual operation and requires operator action to place it in service. In order to control the implementation of the ACM, the Shift Supervisor shall establish a means of communications with the person or persons performing the required manual operations.

1.4 <u>Major Electrical Equipment</u>

1.4.1 ACM Diesel Generator (K-4804) is a self-contained unit designed to provide 4160 volt AC, 3/, 60 Hz power at up to 2,750 KW.

1.4.2 ACM 4160 Volt Switch Gear (N-4866)

1.4.2.1 One breaker which feeds 4160/480 volt AC ACM transformer.

1.4.2.2 One breaker which feeds ACM diesel exercise breaker.

1.4.3 ACM Diesel Exercise Breaker (N-4869) connects ACM diesel generator to the reserve auxiliary transformer in order to load test the ACM diesel generator.

1.4.4 ACM 480 volt Load Center (N-4868) feeds ACM 480 volt MCC and other ACM loads and is back fed from the HVAC LC.

1.4.5 ACM 480 volt Motor Control Center (N-4870).

1.4.6 ACM Diesel Oil Transfer Pumps (P-4803, P-4804) supply makeup fuel oil to the ACM diesel fuel oil day tank from T-8401 or T-8402. They are fed from the ACM 480 volt MCC.

1.4.7 ACM diesel battery charger is fed from the ACM 480 volt MCC.

1.4.8 Electrical equipment provided with ACM is listed with normal and ACM power source in Table 1.

1.4.9 A simple one line diagram of the ACM power distribution is shown in Figure 1.

TABLE 1

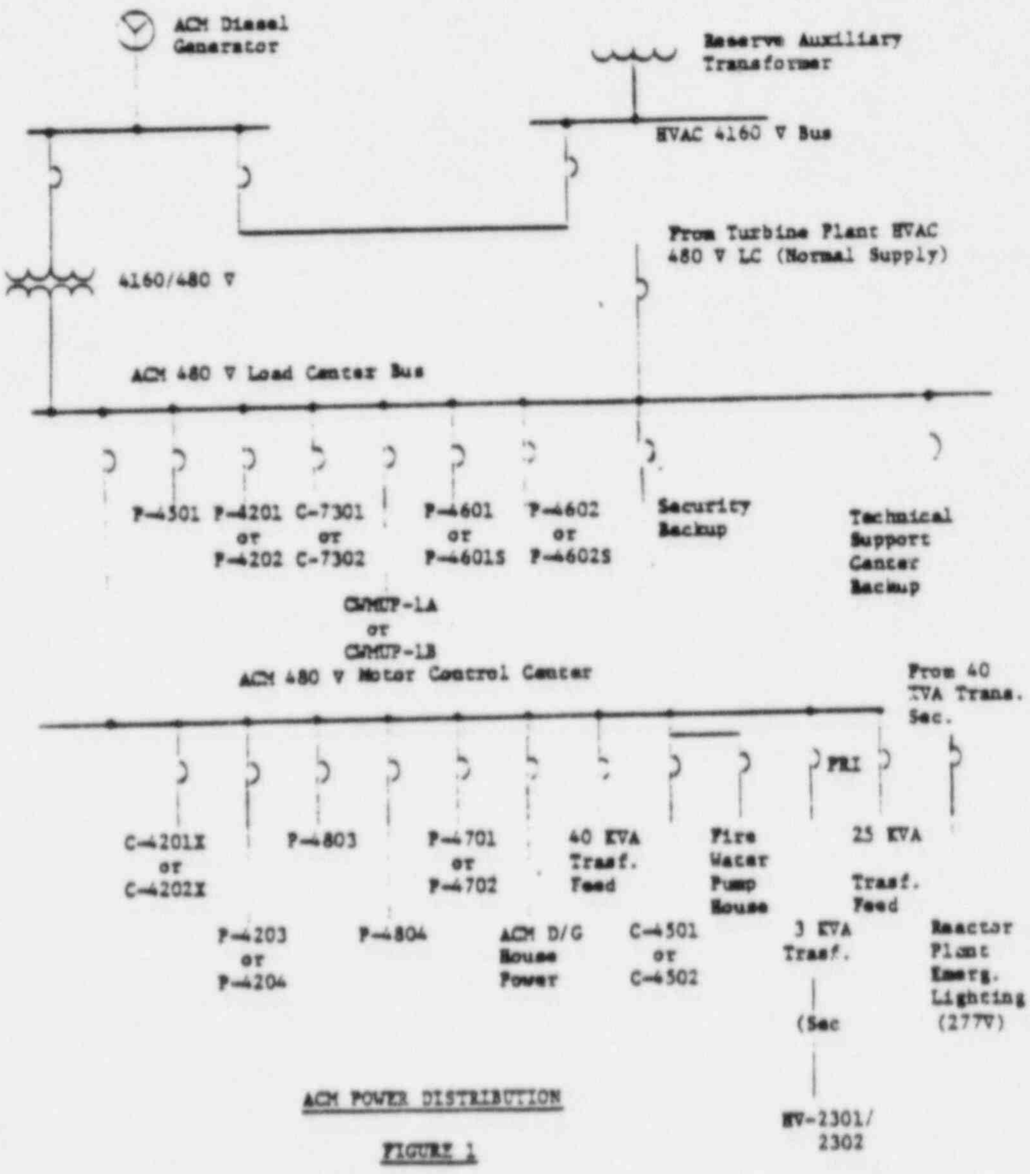
EQUIPMENT CROSS REFERENCE

EQUIPMENT NUMBER	NORMAL HS	NORMAL FEED	TRANSFER SWITCH	ACM FEED
P-4501	HS-4504-2	480V Bus 1	N-4876	ACM 480V LC
P-4201	HS-4211-1	480V Bus 1	N-4874	ACM 480V LC
P-4202	HS-4211-2	480V Bus 2	N-4875	ACM 480V LC
P-4203	HS-4201-1	TB MCC 1	N-4881	ACM MCC
P-4204	HS-4201-2	TB MCC 2	N-4882	ACM MCC
C-4201X	HS-4231-1	TB MCC 1	N-4871	ACM MCC
C-4202X	HS-4232-1	TB MCC 3	N-4872	ACM MCC
P-4601	HS-4601	480V Bus 1	N-4877	ACM 480V LC
P-4601S	HS-4603	480V Bus 2	N-4878	ACM 480V LC
P-4602	HS-4602	480V Bus 3	N-4879	ACM 480V LC
P-4602S	HS-4604	480V Bus 2	N-4880	ACM 480V LC
P-4701	HS-4701	Rx MCC 1A	N-4845	ACM MCC
P-4702	HS-4702	Rx MCC 3	N-4846	ACM MCC
CWMUP-1A	HS-4102	480V Bus 3	N-4847	ACM 480V LC
CWMUP-1B	HS-4103	480V Bus 1	N-4848	ACM 480V LC
C-7301	HS-7323	Rx MCC 1A	N-4843	ACM 480V LC
C-7302	HS-7358	Rx MCC 2	N-4844	ACM 480V LC
C-7521	TIC-75104	TB MCC 1	N-4855	ACM MCC
C-7522	TIC-75108	TB MCC 3	N-4856	ACM MCC
P-4803	-----------	------------	----------	480V MCC
P-4804	-----------	------------	----------	480V MCC
HV-2301	HS-2301	Rx MCC 2	N-4842	480V MCC

TABLE 1

EQUIPMENT CROSS REFERENCE

EQUIPMENT NUMBER	NORMAL HS	NORMAL FEED	TRANSFER SWITCH	ACM FEED
HV-2302	HS-2302	Rx MCC 3	N-4841	480V MCC
C-4501 C-4502	HS-4598 HS-45100	Rx Plant HVAC MCC	N-4501	480V MCC



ACM POWER DISTRIBUTION

FIGURE 1

| 2.0 SYSTEM STARTUP

| 2.1 Prerequisites to Operation

| 2.1.1 ACM Electrical Distribution Preoperational System Lineup

| 2.1.1.1 4160 Volt Breakers

| (a) ACM Exercise Breaker (ACM Bus) - Open

| (b) ACM Exercise Breaker (HVAC Bus) - Closed

| (c) ACM Feed Breaker (ACM Transformer) - Open

| 2.1.1.2 ACM 480 Volt Load Center

| (a) Circulating Water Makeup Pumps Breaker - Open

| (b) Fire Water Pump Breaker - Open

| (c) Service Water Supply Pump Breaker - Open

| (d) Reactor Plant Exhaust Fan Breaker - Open

| (e) Loop 1 Reactor Plant Cooling Water Pump Breaker - Open

| (f) Loop 2 Reactor Plant Cooling Water Pump Breaker - Open

| (g) ACM 480 Volt MCC Breaker - Closed

| (h) HVAC LC Breaker (normal source) - Closed

| (i) Security System Backup Breaker - Closed*

| (j) Technical Support Center Backup Breaker - Open

* Security backup feed transfer switch open to ACM feed at the Security Building.

2.1.1.3 ACM 480 Volt Motor Control Center

(a) 277 Volt Lighting Breaker - Open

(b) ACM Diesel Generator Battery Charger Breaker - Closed

(c) Breathing Air Compressor Breaker - Open

(d) 25 KVA Transformer Primary Breaker - Closed

(e) 45 KVA Transformer Primary Breaker - Closed

(f) 3 KVA Transformer Primary Breaker - Closed

(g) 3 KVA Transformer Secondary Breaker - Open

(h) Firewater Pump House Breaker - Open

(i) Service Water Return Pump Breaker - Open

(j) Purification Cooling Water Pump Breaker - Open

(k) 1A ACM Diesel Generator Fuel Oil Pump Breaker - Closed

(l) 1B ACM Diesel Generator Fuel Oil Pump Breaker - Closed

(m) Service Water Tower Fan Breaker - Open

(n) Power Distribution Panel - 277 Volt - All Switches Closed

2.1.2 ACM Diesel Generator (K-4804)

2.1.2.1 ACM Diesel Generator to ACM Loads (No Power on ACM 480 Volt LC)

(a) At the ACM diesel Generator activate the READY push button.

(b) Place the manual selector switch (MS) in the ACM (independent) position.

(c) Place Engine "Start/Stop" switch to start for about 5 seconds.

NOTE: Engine will start and idle for approximately 90 seconds. Then increase to approximately 900 rpm. Generator will self excite after approximately 14 seconds and "Bus" voltage will start to build up. ACM Back Feed ACB Breaker will trip.

(d) Close the ACM feed breaker.

NOTE: ACM feed breaker must be closed within 60 seconds of generator voltage buildup.

(e) Bus voltage should be approximately 4160 volts and frequency should be approximately 60.9 hertz.

2.1.2.2 ACM Diesel Generator "Exercise" or Load (RAT Backfeed)

(a) Verify the 4160 ACM breaker open.

(b) Verify the 4160 ACM Load Test Breaker Open.

(c) Verify closed the 4160 ACM HVAC Load Test Breaker.

(d) Verify the battery switch (knife switch) in the generator control cabinet is closed.

(e) Activate READY push button.

(f) Set MS to IDLE.

(g) Press START push button on engine control panel. Engine should start.

(h) After engine has run at IDLE speed (200 rpm) for 2 minutes, set MS to RUN. Engine should increase speed to 900 rpm.

(i) Use voltage control switch to match diesel generator voltage with system voltage.

(j) Use governor control switch and synchronizer to synchronize frequency of diesel generator with system frequency.

(k) Close ACM load test breaker at proper instant per the synchronizer.

(l) Use governor control switch to adjust load to desired load.

2.1.3 ACM Diesel Fuel Oil System

2.1.3.1 Valve Lineup

(a) Complete System 48-01 valve lineup per Appendix 1.

(b) Close or verify closed P-4803 and P-4804 breakers at ACM MCC.

(c) Set HS-48506 at the ACM MCC to the desired pump.

(d) Set HS-48500 at the ACM MCC to AUTO.

(e) Set HS-48501 at the ACM MCC to AUTO.

2.2 <u>Placing the ACM System in Operation</u>

If the entire ACM system is to be placed in operation because of a disruptive event in the congested cable area use the procedure of Section II of this SOP.

If the only use of the ACM system is to provide power to equipment which has lost its normal power source use the appropriate steps of Section 2.2.1 and 2.2.2 of this SOP.

If a LOFC incident has occurred in conjunction with some loss of electrical power use Section II of this SOP.

2.2.1 Placing ACM Equipment in Service

2.2.1.1 Open the feed breaker to the ACM 480 Volt load center from the HVAC LC. Compartment A1 at the ACM 480 Volt load center.

2.2.1.2 Place the ACM diesel generator on line per Step 2.1.2 of this SOP.

2.2.1.3 Verify the ACM diesel generator fuel oil pumps are operable per Step 2.1.3 of this SOP.

2.2.2 Individual ACM Powered Equipment Items

2.2.2.1 Placing the fire water pump house fans and fire water pump P-4501 in operation on ACM power.

(a) Open the normal feed breaker for C-7521 at turbine building MCC 1.

(b) Open the normal feed breaker for C-7522 at turbine building MCC 3.

(c) At the C-7521 transfer box place the toggle and knife switches in the ACM position.

(d) At the C-7522 transfer box place the toggle and knife switches in the ACM postion.

(e) Verify all breakers in the ACM distribution panel N-4854 are closed.

(f) At the ACM 480 Volt MCC close the fire pump house feed breaker.

(g) Place HS-4504-2 in the pull to lock position.

(h) Open the normal feed breaker at 480 Volt Bus 2.

(i) Place transfer switch N-4876 in the ACM position.

(j) Close the ACM feed breaker at the ACM 480 Volt load center.

2.2.2.2 Placing service water supply pump P-4201 in operation on ACM power.

(a) Place HS-4211-1 in the pull to lock position.

(b) Open the normal feed breaker at 480 Volt Bus 1.

(c) Place transfer switch N-4874 in the ACM position.

(d) Close the ACM feed breaker at the ACM 480 Volt load center.

2.2.2.3 Placing service water supply pump P-4202 in operation on ACM power.

(a) Place HS-4211-2 in the pull to lock position.

(b) Open the normal feed breaker at 480 Volt Bus 2.

(c) Place transfer switch N-4875 in the ACM position.

(d) Close the ACM feed breaker at the ACM 480 Volt load center.

2.2.2.4 Placing service water return pump P-4203 in operation on ACM power.

(a) Place HS-4201-1 in the pull to lock position.

(b) Open the normal feed breaker at turbine building MCC 1.

(c) Place transfer switch N-4881 in the ACM position.

(d) Close the ACM feed breaker at the ACM MCC.

(e) Depress the START switch on the ACM MCC.

2.2.2.5 Placing service water return pump P-4204 in operation on ACM power.

(a) Place HS-4201-2 in the pull to lock position.

(b) Open the normal feed breaker at turbine building MCC 2.

(c) Place transfer switch N-4881 in the ACM position.

(d) Close the ACM feed breaker at the ACM MCC.

(e) Depress the START switch on the ACM MCC.

2.2.2.6 Placing service water tower fan C-4201X in operation on ACM power.

(a) Place HS-4231-1 in the pull to lock position.

(b) Open the normal feed breaker at turbine building MCC 3.

(c) Place transfer switch N-4871 in the ACM position.

(d) Close the ACM feed breaker at the ACM MCC.

(e) Depress the START switch on the ACM MCC.

2.2.2.7 Placing service water tower fan C-4202X in operation on ACM power.

(a) Place HS-4232-1 in the pull to lock position.

(b) Open the normal feed breaker at turbine building MCC 3.

(c) Place transfer switch N-4872 in the ACM position.

(d) Close the ACM feed breaker at the ACM MCC.

(e) Depress the START switch on the ACM MCC.

2.2.2.8 Placing PCRV cooling water pump P-4601 in operation on ACM power.

(a) Place HS-4601 in the pull to lock position.

(b) Open the normal feed breaker at 480 Volt Bus 1.

(c) Place transfer switch N-4877 in the ACM position.

(d) Close the ACM feed breaker at the ACM 480 Volt load center.

2.2.2.9 Placing PCRV cooling water pump P-4601S in operation on ACM power.

(a) Place HS-4603 in the pull to lock position.

(b) Open the normal feed breaker at 480 Volt Bus 2.

(c) Place transfer switch N-4878 in the ACM position.

(d) Close the ACM feed breaker at the ACM 480 Volt load center.

2.2.2.10 Placing PCRV cooling water pump P-4602 in operation on ACM power.

(a) Place HS-4602 in the pull to lock position.

(b) Open the normal feed breaker at 480 Volt Bus 3.

(c) Place transfer switch N-4879 in the ACM position.

(d) Close the ACM feed breaker at the ACM 480 Volt load center.

2.2.2.11 Placing PCRV cooling water pump P-4602S in operation on ACM power.

(a) Place HS-4604 in the pull to lock position.

(b) Open the normal feed breaker at 480 Volt Bus 2.

(c) Place transfer switch N-4880 in the ACM position.

(d) Close the ACM feed breaker at the ACM 480 Volt load center.

2.2.2.12 Placing purification cooling water pump P-4701 in operation on ACM power.

(a) Place HS-4701 in the pull to lock position.

(b) Open the normal feed breaker at reactor plant MCC 1A.

(c) Place transfer switch N-4845 in the ACM position.

(d) Close the ACM feed breaker at the ACM MCC.

(e) Depress the START switch on the ACM MCC.

2.2.2.13 Placing purification cooling water pump P-4702 in operation on ACM power.

(a) Place HS-4702 in the pull to lock position.

(b) Open the normal feed breaker at reactor plant MCC 3.

(c) Place transfer switch N-4846 in the ACM position.

(d) Close the ACM feed breaker at the ACM MCC.

(e) Depress the START switch on the ACM MCC.

2.2.2.14 Placing circulating water makeup pump CWMUP-1A in operation on ACM power.

(a) Place HS-4102 in the pull to lock position.

(b) Open the normal feed breaker at 480 Volt Bus 3.

(c) Place transfer switch N-4847 in the ACM position.

(d) Close the ACM feed breaker at the ACM 480 Volt load center.

2.2.2.15 Placing circulating water makeup pump CWMUP-1B in operation on ACM power.

(a) Place HS-4103 in the pull to lock position.

(b) Open the normal feed breaker at 480 Volt Bus 1.

(c) Place transfer switch N-4848 in the ACM position.

(d) Close the ACM feed breaker at the ACM 480 Volt load center.

2.2.2.16 Placing reactor plant exhaust fan C-7301 in operation on ACM power.

(a) Place HS-7323 in the pull to lock position.

(b) Open the normal feed breaker at reactor plant MCC 1A.

(c) Place transfer switch N-4871 in the ACM position.

(d) At the ACM exhaust fan damper operating panel close V-73848.

(e) At the ACM exhaust fan damper operating panel connect the nitrogen bottle to the DV-73453 and DV-73456 air supply line.

(f) Adjust the nitrogen bottle pressure to 50 psig and verify DV-73453 and DV-73456 are open.

(g) At the ACM MCC close the reactor plant exhaust fans feed breaker.

2.2.2.17 Placing reactor plant exhaust fan C-7302 in operation on ACM power.

(a) Place HS-7358 in the pull to lock position.

(b) Open the normal feed breaker at reactor plant MCC 2.

(c) Place transfer switch N-4872 in the ACM position.

(d) At the ACM exhaust fan damper operating panel close V-73849.

(e) At the ACM exhaust fan damper operating panel connect the nitrogen bottle to the DV-73454 and DV-73457 air supply line.

(f) Adjust the nitrogen bottle pressure to 50 psig and verify DV-73454 and DV-73457 are open.

(g) At the ACM MCC close the reactor plant exhaust fans feed breaker.

| 3.0 SYSTEM OPERATION

| 3.1 General Equipment Operation

| 3.1.1 The majority of the equipment supplied by the ACM power system are contained within other System Operating Procedures. Specific operations not contained within this section are covered in Section 2.0 or the appropriate SOP.

| 3.2 Purification System Valves HV-2301 and HV-2302

CAUTION: The ACM system is designed to provide power to only one of the two valves covered by this section of the procedure. Do not attempt to operate both at the same time.

| 3.2.1 Train A Inlet Valve HV-2301 IACM Power

| 3.2.1.1 Verify de-energized or de-energize normal power to HV-2301 at Reactor Plant MCC-2.

| 3.2.1.2 Place transfer switch N-4842 in the ACM postion.

| 3.2.1.3 Inside N-4840, place S-48401 and S-48402 in the ACM position.

| 3.2.1.4 Inside N-4840, place the circuit breaker in the "ON" position.

| 3.2.1.5 At the ACM MCC close the HV-2301/2302 feed switch.

| 3.2.1.6 At N-4840 position the valve as desired.

| 3.2.2 Train B Inlet Valve HV-2302 IACM Power

| 3.2.2.1 Verify de-energized or de-energize normal power to HV-2302 at Reactor Plant MCC 3.

| 3.2.2.2 Place transfer switch N-4841 in the ACM position.

| 3.2.2.3 Inside N-4839 place S-48391 and S-48392 in the ACM position.

| 3.2.2.4 Inside N-4839, place the circuit breaker in the "ON" position.

| 3.2.2.5 At the ACM MCC, close the HV-2301/2302 feed switch.

3.2.2.6 At N-4839 position the valve as desired.

3.3 Returning ACM Powered Equipment to Normal Power Source

When power has been restored to the normal source for any equipment being operated on ACM power the equipment may be returned to its normal power source in accordance with the appropriate step of Section 3.3.1 of this SOP.

3.3.1 Individual ACM Equipment

3.3.1.1 Returning fire water pump P-4501 to normal power.

(a) Open the ACM feed breaker at ACM 480 Volt load center.

(b) Place transfer switch N-4876 in the normal position.

(c) Close the normal feed breaker at 480 Volt Bus 2.

(d) If required P-4501 may be started with HS-4504-2.

3.3.1.2 Returning fire water pump house to normal power.

(a) Open the ACM feed breaker to the fire water pump house.

(b) At the C-7522 transfer box place the toggle switch and knife switch in the normal position.

(c) At the C-7521 transfer box place the toggle switch and knife switch in the normal position.

(d) Close the C-7522 normal feed breaker at turbine building MCC 3.

(e) Close the C-7521 normal feed breaker at turbine building MCC 1.

3.3.1.3 Returning service water supply pump P-4201 to normal power.

(a) Open the ACM feed breaker at ACM 480 Volt load center.

(b) Place transfer switch N-4874 in the normal position.

(c) Close the normal feed breaker at 480 Volt Bus 1.

(d) If required P-4201 may be started with HS-4211-1.

3.3.1.4 Returning service water supply pump P-4202 to normal power.

(a) Open the ACM feed breaker at ACM 480 Volt load center.

(b) Place transfer switch N-4875 in the normal position.

(c) Close the normal feed breaker at 480 Volt Bus 2.

(d) If required P-4202 may be started with HS-4211-2.

3.3.1.5 Returning service water return pump P-4203 to normal power.

(a) Depress the STOP switch at the feed breaker on ACM 480 Volt MCC.

(b) Open the ACM feed breaker at ACM 480 Volt MCC.

(c) Place transfer switch N-4881 in the normal position.

(d) Close the normal feed breaker at turbine building MCC 1.

(e) If required P-4203 may be started with HS-4201-1.

3.3.1.6 Returning service water return pump P-4204 to normal power.

(a) Depress the STOP switch at the feed breaker on ACM 480 Volt MCC.

(b) Open the ACM feed breaker at ACM 480 Volt MCC.

(c) Place transfer switch N-4881 in the normal position.

(d) Close the normal feed breaker at turbine building MCC 2.

(e) If required P-4204 may be started with HS-4201-2.

3.3.1.7 Returning service water tower fanC-4201X to normal power.

(a) Depress the STOP switch at the feed breaker on ACM 480 Volt MCC.

(b) Open the ACM feed breaker at ACM 480 Volt MCC.

(c) Place transfer switch N-4871 in the normal position.

(d) Close the normal feed breaker at turbine building MCC 3.

(e) If required C-4201X may be started with HS-4231-1.

3.3.1.8 Returning service water tower fan C-4202X to normal power.

(a) Depress the STOP switch at the feed breaker on ACM 480 Volt MCC.

(b) Open the ACM feed breaker at ACM 480 Volt MCC.

(c) Place transfer switch N-4872 in the normal position.

(d) Close the normal feed breaker at turbine building MCC 3.

(e) If required C-4202X may be started with HS-4232-1.

3.3.1.9 Returning PCRV cooling water pump P-4601 to normal power.

(a) Open the ACM feed breaker at ACM 480 Volt load center.

(b) Place transfer switch N-4877 in the normal position.

(c) Close the normal feed breaker at 480 Volt Bus 1.

(d) If required P-4601 may be started with HS-4601.

3.3.1.10 Returning PCRV cooling water pump P-4601S to normal power.

(a) Open the ACM feed breaker at ACM 480 Volt load center.

(b) Place transfer switch N-4878 in the normal position.

(c) Close the normal feed breaker at 480 Volt Bus 2.

(d) If required P-4601S may be started with HS-4603.

3.3.1.11 Returning PCRV cooling water pump P-4602 to normal power.

(a) Open the ACM feed breaker at ACM 480 Volt load center.

(b) Place transfer switch N-4879 in the normal position.

(c) Close the normal feed breaker at 480 Volt Bus 3.

(d) If required P-4602 may be started with HS-4602.

3.3.1.12 Returning PCRV cooling water pump P-4602S to normal power.

(a) Open the ACM feed breaker at ACM 480 Volt load center.

(b) Place transfer switch N-4880 in the normal position.

(c) Close the normal feed breaker at 480 Volt Bus 2.

(d) If required P-4602S may be started with HS-4604.

3.3.1.13 Returning purification cooling water pump P-4701 to normal power.

(a) Depress the STOP switch at the feed breaker on ACM 480 Volt MCC.

(b) Open the ACM feed breaker at ACM 480 Volt MCC.

(c) Place transfer switch N-4845 in the normal position.

(d) Close the normal feed breaker at reactor plant MCC 1A.

(e) If required P-4701 may be started with HS-4701.

3.3.1.14 Returning PCRV cooling water pump P-4702 to normal power.

(a) Depress the STOP switch at the feed breaker on ACM 480 Volt MCC.

(b) Open the ACM feed breaker at ACM 480 Volt MCC.

(c) Place transfer switch N-4846 in the normal position.

(d) Close the normal feed breaker at reactor plant MCC 3.

(e) If required P-4702 may be started with HS-4702.

3.3.1.15 Returning circulating water makeup pump CWMUP-1A to normal power.

(a) Open the ACM feed breaker at ACM 480 Volt load center.

(b) Place transfer switch N-4847 in the normal position.

(c) Close the normal feed breaker at 480 Volt Bus 3.

(d) If required CWMUP-1A may be started with HS-4102.

3.3.1.16 Returning circulating water makeup pump CWMUP-1B to normal power.

(a) Open the ACM feed breaker at ACM 480 Volt load center.

(b) Place transfer switch N-4848 in the normal position.

(c) Close the normal feed breaker at 480 Volt Bus 1.

(d) If required CWMUP-1B may be started with HS-4103.

3.3.1.17 Returning reactor plant exhaust fan C-7301 to normal power.

(a) Open the ACM feed breaker at ACM 480 Volt load center.

(b) Place transfer switch N-4871 in the normal position.

(c) At the ACM nitrogen bottle close the bottle valve and disconnect the damper operating nitrogen supply line.

(d) Open V-48848.

(e) Close the normal feed breaker at reactor plant MCC 1A.

(f) If required C-7301 may be started with HS-7323.

3.3.1.18 Returning reactor plant exhaust fan C-7302 to normal power.

(a) Open the ACM feed breaker at ACM 480 Volt load center.

(b) Place transfer switch N-4872 in the normal position.

(c) At the ACM damper nitrogen bottle close the bottle valve and disconnect the damper operating nitrogen supply line.

(d) Open V-48849.

(e) Close the normal feed breaker at reactor plant MCC 2.

(f) If required C-7302 may be started with HS-7358.

3.3.1.19 Restoration of HV-2301 and HV-2302 to normal power.

(a) Restoration of Train A inlet valve HV-2301 to normal power.

1. At the ACM MCC open the HV-2301/2302 feed switch.
2. At N-4840 place S-48401 and S-48402 in the normal position.
3. At reactor plant MCC 2 open or verify open the feed breaker to HV-2301.
4. Place transfer switch N-4842 in the normal position.
5. At reactor plant MCC 2 close the feed breaker to HV-2301.

(b) Restoration of Train B inlet valve HV-2302 to normal power.

1. At the ACM MCC open the HV-2301/2302 feed switch.
2. At N-4839 place S-48391 and S-48392 in the normal position.
3. At reactor plant MCC 3 open or verify open the feed breaker to HV-2302.
4. Place transfer switch N-4841 in the normal position.
5. At reactor plant MCC 3 close HV-2302 feed breaker.

3.4 Ventilation of ACM Batteries

3.4.1 Normal ventilation of the ACM battery off-gas is provided by the Turbine Building Evaporator Cooler Building (T.B.E.C.B.) Bahnson Building ventilation.

3.4.2 During extended periods of no Bahnson Building ventilation or during periods of placing the ACM batteries on overcharge, the north and south doors must be opened to provide natural ventilation.

| 4.0 SYSTEM SHUTDOWN

| 4.1 Shutdown of ACM Diesel Generator From Supplying ACM Loads

| 4.1.1 Verify electrical system lineup is per Section 2.1 except that the ACM circuit breaker should be closed and the HVAC feed to the ACM LC should be open.

| 4.1.2 Open the ACM circuit breaker.

| 4.1.3 Close the HVAC feed to the ACM LC.

| 4.1.4 Place the MS switch in the OFF position. Engine will run for approximately 10 minutes at idle speed for cooldown then shutdown.

| 4.2 Shutdown of ACM Diesel Generator from Exercise or Load Test

| 4.2.1 Using governor control switch reduce unit load to approximately 500 KW.

| 4.2.2 Open the ACM bus exercise breaker.

| 4.2.3 Place the MS switch in the OFF position. The engine will run for approximately 10 minutes at idle speed then shutdown.

| 4.2.4 Open the RAT to ACM exercise breaker.

| 5.0 ABNORMAL OPERATIONS

| NOTE: The operation of the entire ACM system would be considered
| an abnormal operation, with the exception of testing.
| Therefore, it is considered that Section 5.0 does not
| apply to this System Operating Procedure.

SECTION II

SHIFT SUPERVISOR CHECK LIST OF ACM EQUIPMENT OPTIONS

When the Shift Supervisor determines that the ACM is to be placed in service, he shall identify the selected equipment items on the following check-list by circling the equipment number.

When the Shift Supervisor is notified that a particular equipment item is operating he shall initial the appropriate blank provided.

1.0 ACM Generator ________________

2.0 Fire Water Pump

P-4501 ________________

3.0 Service Water System

P-4201 ________________ or P-4202 ________________

C-4201X ________________ or C-4202X ________________

P-4203 ________________ or P-4204 ________________

4.0 Circulating Water Makeup

P-1A ________________ or P-1B ________________

5.0 System 46

P-4601 ________________ or P-4601S ________________

P-4602 ________________ or P-4602S ________________

6.0 Helium Purification System

Train A ________________

HV-2301 ________ and E-2301 ________ and A-2305 ________

P-4701 ________ or P-4702 ________

E-4701 ________ or E-4702 ________

Train B ____________

HV-2302 ________ and E-2302 ________ and A-2306 ________

P-4701 ________ or P-4702 ________

E-4701 ________ or E-4702 ________

HTFA Cooling

A-2301 ________ or A-2302 ________

7.0 Reactor Building Exhaust Fans

C-7301 ____________ or C-7302 ____________

8.0 Depressurization

Train A ____________ lineup complete.

Train B ____________ lineup complete.

Auxiliary stack monitor operable. ____________

Vent to atmosphere lineup complete. ____________

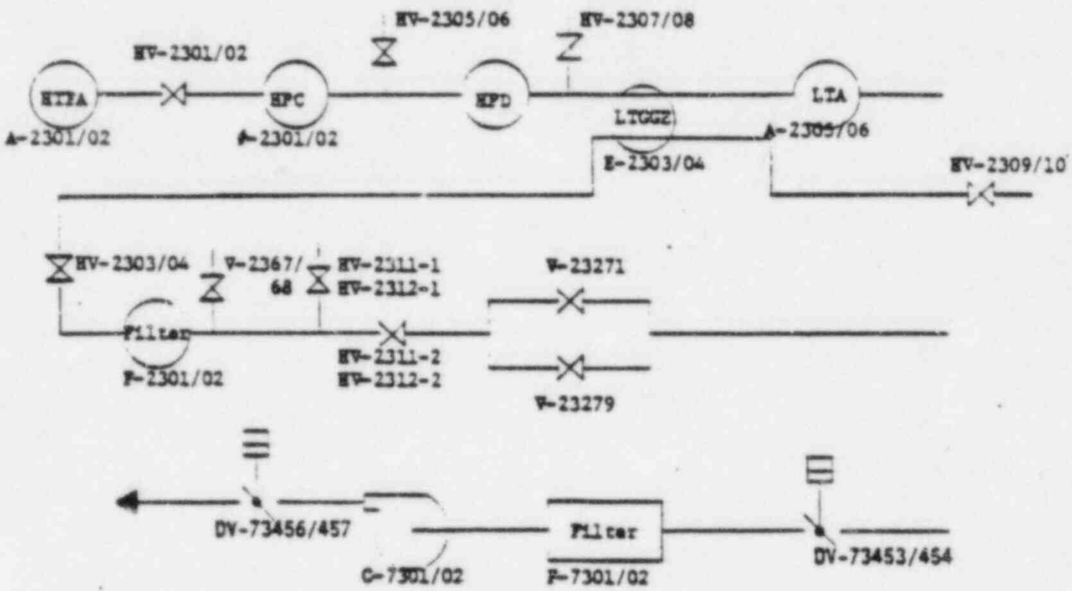
PCRV depressurization complete. ____________

9.0 Insertion of Reserve Shutdown Material

Insertion of RSD complete except for ________ regions.

10.0 System 46 shifted to redistribute mode. ________

11.0 System 46 surge tank pressurization complete. ________



PRIMARY COOLANT DEPRESSURIZATION FLOW PATH

ACM SYSTEM STARTUP

1.0 ACM GENERATOR

NOTE: Generator will supply ACM lighting, auxiliary stack radiation monitor, and the plant radio at this time. The radio hand set at the ACM MCC will be operable if instrument power bus 1A is de-energized or if the ACM switch at the radio selection panel is placed on the "ON" position.

| 1.1 Verify electrical lineup is as specified in Section I of this SOP.

1.2 At the 480 Volt ACM MCC open the feed breaker from the HVAC LC.

| 1.3 Start the ACM diesel generator per Section I of this SOP.

2.0 FIREWATER PUMP HOUSE FANS AND FIREWATER PUMP

2.1 Start fire water pump house fans and fire water pump
| P-4501 per Section I of this SOP.

3.0 SERVICE WATER SYSTEM

| 3.1 Start the selected service water supply pump per Section I of this SOP.

| 3.2 Start the selected service water return pump per Section I of this SOP.

3.3 If required, start the selected service water tower fan
| per Section I of this SOP.

3.4 If required the following components may be isolated from service water to increase flow to E-4701/02, E-4601/03, and E-4602/04.

CAUTION: Do not allow the service water return pump to run without sufficient water input to the service water return sump.

Component	Isolation Valve
Reactor Plant HVAC	V-42397
Main Turbine Lube Oil Coolers	V-4267, V-4271
EHC Fluid Coolers	V-4227, V-4231
Condensate Pumps 1A and 1B	V-42375, V-42376
BFP Lube Oil Coolers	V-4256, V-4260, V-42114, V-4239, V-4264, V-4266
Standby Generator Air Handlers	V-42809, V-42810, V-42811, V-42812
Standby Generator Engine Coolers	V-42386, V-42387, V-42388, V-42389
Sample Cooling	V-4234
Heater 5 Drain Pump	V-42390
Main Generator	V-4242, V-4248
Generator Bus Duct Cooling	V-4254, V-4255
Air Compressors	V-4214, V-4216, V-4217, V-4221, V-4218, V-4222, V-42392, V-42394
Rix Compressor Coolers	V-461744
Service Water Booster Pumps 1A and 1B	V-46614
Backup Bearing Water Coolers	V-461516
Hydraulic Oil Coolers	V-461536, V-461535
Bearing Water Coolers	V-46255, V-46258, V-46261, V-46264

4.0 CIRCULATING WATER MAKEUP

4.1 If required for makeup to the fire water pump pit or to the service water tower basin, start the selected circulating water makeup pump per Section I of this SOP.

4.2 Makeup to the service water tower basin is controlled via V-41302 and V-42128.

5.0 SYSTEM 46

5.1 Start the selected PCRV cooling water pump in Loop 1 per Section I of this SOP.

5.2 Start the selected PCRV cooling water pump in Loop 2 per Section I of this SOP.

6.0 HELIUM PURIFICATION SYSTEM

6.1 Start the selected purification cooling water pump per Section I of this SOP.

6.2 Install the HTFA cooler spool pieces for the HTFA in the purification train selected for cooldown.

6.3 Place in service the HTFA cooler as follows:

6.3.1 For Train A HTFA open:

V-23104, V-46606, V-23105, V-46602

6.3.2 For Train B, HTFA open:

V-23106, V-46601, V-23107, V-46605

6.4 Lineup the purification train selected for depressurization as follows:

6.4.1 Train A Selected for Depressurization

6.4.1.1 Train A Inlet Valve HV-2301 ACM Power.

a. Verify de-energized or de-energize normal power to HV-2301 at reactor plant MCC 2. Rackout valve breaker if required.

b. Place transfer switch N-4842 in the ACM position (Level 10).

c. Inside N-4840, place S-48401 and S-48402 in the ACM position (Level 10).

d. Inside N-4840, place the circuit breaker in the "ON" position.

e. At the ACM MCC close the HV-2301/2302 feed switch.

f. At N-4840 open HV-2301 by depressing the open pushbutton.

g. Notify the Shift Supervisor that HV-2301 is open.

6.4.1.2 Lineup for E-2301 and P-4701 and E-4701

a.	HV-4704-1	Open	Level 10
b.	HV-4704-2	Open	Level 10
c.	HV-4705-1	Closed	Level 10
d.	V-46657	Open	Level 2
e.	V-46658	Closed	Level 2
f.	V-46661	Closed	Level 2
g.	V-46663	Open	Level 2
h.	V-46348	Closed	Level 2
i.	V-46348	Open	Level 2
j.	V-4706	Open	Level 1
k.	V-4704	Open	Level 1
l.	V-4775	Closed	Level 1
m.	V-4776	Closed	Level 1

n. Notify Shift Supervisor E-2301 cooling water supply is operating.

6.4.1.3 Lineup for E-2301 and P-4702 and E-4702

a.	HV-4704-3	Open	Level 10
b.	HV-4704-4	Open	Level 10
c.	HV-4705-3	Closed	Level 10
d.	V-46659	Open	Level 2
e.	V-46660	Closed	Level 2
f.	V-46662	Closed	Level 2

g. V-46665 Open Level 2

h. V-46348 Open Level 2

i. V-4707 Open Level 1

j. V-4703 Closed Level 1

k. V-4705 Open Level 1

l. V-4711 Closed Level 1

m. Notify the Shift Supervisor E-2301 cooling water supply is operating.

6.4.1.4 The combinations P-4701 and E-4702; or P-4702 and E-4701, are available if required at the Shift Supervisor's direction.

6.4.1.5 Liquid Nitrogen Lineup for A-2305

a. HV-2505 Open Level 11

b. HV-2501 Open Level 11

c. HV-2502-1 Open Level 11

d. HV-2503 Closed Level 11

e. V-25203 Open Level 11

f. HV-2506 Closed Level 11

g. HV-2507 Open Level 11

h. HV-2534 Closed Level 11

i. V-25204 Open Level 11

j. HV-2535 Closed Level 11

k. HV-2510 Open Level 11

l. PV-2521 Fail Open Level 11

m. V-25205 Open Level 11

n. Notify Shift Supervisor liquid nitrogen is cooling A-2305.

6.4.2 Train B Selected for Depressurization

6.4.2.1 Train B Inlet Valve HV-2302 IACM Power

a. Verify de-energized or de-energize normal power to HV-2302 at reactor plant MCC 3. Rackout valve breaker if required.

b. Place transfer switch N-4841 in the ACM position (Level 10).

c. Inside N-4839, place S-48391 and S-48392 in the ACM position (Level 10).

d. Inside N-4839, place the circuit breaker in the "ON" position.

e. At the ACM MCC close the HV-2301/2302 feed switch.

f. At N-4839, open HV-2302 by depressing the open pushbutton.

g. Notify the Shift Supervisor that HV-2302 is open.

6.4.2.2 Lineup for E-2302 and P-4701 and E-4701

a.	HV-4705-1	Open	Level 10
b.	HV-4705-3	Closed	Level 10
c.	HV-4704-1	Closed	Level 10
d.	HV-4705-2	Open	Level 10
e.	V-46657	Open	Level 2
f.	V-46658	Closed	Level 2
g.	V-46661	Closed	Level 2
h.	V-46663	Open	Level 2
i.	V-46348	Open	Level 2
j.	V-4706	Open	Level 1
k.	V-4704	Open	Level 1

l. V-4775 Closed Level 1

m. V-4776 Closed Level 1

6.4.2.3 Lineup for E-2302 and P-4701 and E-4701

a. HV-4705-1 Open Level 10

b. HV-4705-3 Closed Level 10

c. HV-4704-1 Closed Level 10

d. HV-4704-3 Closed Level 10

e. HV 705-2 Open Level 10

f. V-46657 Open Level 2

g. V-46658 Closed Level 2

h. V-46661 Closed Level 2

i. V-46663 Open Level 2

j. V-46348 Open Level 2

k. V-4706 Open Level 1

l. V-4704 Open Level 1

m. V-4775 Closed Level 1

n. V-4776 Closed Level 1

6.4.2.4 The combinations P-4701 and E-4702; or P-4702 and E-4701, are available if required at the Shift Supervisor's discretion.

6.4.2.5 Liquid Nitrogen Lineup for A-2306

a. HV-2506 Open Level 11

b. HV-2503 Open Level 11

c. HV-2504-1 Open Level 11

d. V-25203 Open Level 11

e. HV-2507 Open Level 11

f. V-25204 Open Level 11

g. HV-2501 Closed Level 11

h. HV-2510 Open Level 11

i. HV-2505 Closed Level 11

j. PV-2521 Fail Open Level 11

k. HV-2534 Closed Level 11

l. V-25205 Open Level 11

m. HV-2535 Closed Level 11

n. Notify Shift Supervisor liquid nitrogen is cooling A-2306.

7.0 <u>REACTOR BUILDING EXHAUST FANS</u>

| 7.1 Start the selected reactor plant exhaust fan per Section I of this SOP.

8.0 <u>PCRV DEPRESSURIZATION</u>

8.1 Lineup for Train A Selected

8.1.1	V-23204	Closed	Level 10
8.1.2	V-23209	Closed	Level 10
8.1.3	V-23206	Closed	Level 10
8.1.4	V-23202	Closed	Level 10
8.1.5	V-23271	Closed	Level 7
8.1.6	V-23279	Closed	Level 7
8.1.7	HV-2303	Open	Level 8
8.1.8	HV-2311-2	Open	Level 8
8.1.9	HV-2311-1	Closed	Level 8
8.1.10	HV-2312-2	Closed	Level 8
8.1.11	HV-2312-1	Closed	Level 8

8.1.12 HV-11251 Open Level 6

8.1.13 HV-2401 Closed Level 4

8.1.14 Notify Shift Supervisor lineup is completed for Train A.

8.2 Lineup for Train B Selected

8.2.1 V-23205 Closed Level 10

8.2.2 V-23203 Closed Level 10

8.2.3 V-23207 Closed Level 10

8.2.4 V-23208 Closed Level 10

8.2.5 V-23271 Closed Level 7

8.2.6 HV-2304 Open Level 8

8.2.7 HV-2312-2 Open Level 8

8.2.8 HV-2312-1 Closed Level 8

8.2.9 HV-2311-1 Closed Level 8

8.2.10 HV-2311-2 Closed Level 8

8.2.11 HV-11251 Open Level 6

8.2.12 HV-2401 Open Level 1

8.2.13 Notify Shift Supervisor lineup is complete for Train B.

8.3 Auxiliary Stack Monitor Operability Check (Level 11 Turbine Building).

8.3.1 Verify the PING-1 stack monitor is energized.

8.3.2 Verify the PING-1 sample pump is running.

8.3.3 Depress the three check source switches and verify all three detector channels read upscale.

8.3.4 Release the three check source switches and verify all three detector channels are returning to normal.

8.3.5 Repeat Steps 8.3.1, 8.3.2, 8.3.3, and 8.3.4 above once each hour during depressurization to atmosphere.

8.4 Depressurize the primary coolant to atmosphere as follows:

8.4.1 Open V-23279.

8.4.2 Log the time V-23279 is opened. Time: __________

8.4.3 One and a half hours after V-23279 is opened, open V-23271.

8.4.4 Log the time V-23271 is opened. Time: __________

8.4.5 Open V-23272, V-23273, and V-23275.

8.4.6 When the primary coolant has depressurized for 7 hours the time logged in Step 8.4.2, close V-23271 and V-23279.

8.4.7 Notify Shift Supervisor depressurization is complete.

8.4.8 At the 480 Volt ACM MCC stop the purification cooling water pump.

8.4.9 If purification cooling water heat exchanger E-4701 was being used close V-46657.

8.4.10 If purification cooling water heat exchanger E-4702 was being used close V-46659.

9.0 • <u>INSERTION OF RESERVE SHUTDOWN MATERIAL</u>

9.1 Insert reserve shutdown material as follows:

9.1.1 Insertion of Reserve Shutdown Material at I-21A (Level 10).

9.1.1.1 At I-21A, close V-187C to isolate normal air supply.

9.1.1.2 At I-21A, connect the nitrogen supply hose quick disconnect to the left hand fitting which connects to the normal air supply line.

9.1.1.3 At I-21A, open V-82887 to normal air supply line.

9.1.1.4 At the nitrogen supply bottle for I-21A, open the bottle valve to pressurize the normal air supply line.

9.1.1.5 Adjust the nitrogen regulator to 60 psig.

9.1.1.6 When nitrogen from the bottle stops pressurizing the air lines, all reserve shutdown dump valves whose solenoids are energized have been opened. Note which region's valves are open on the back of this page. Disconnect the quick disconnect.

9.1.1.7 Verify vent valve, V-821440 is closed.

9.1.1.8 Reconnect the quick disconnect to the right hand fitting. This will open all reserve shutdown dump valves whose solenoids were not energized. Note all regions whose dump valves are open on the back of this page.

9.1.1.9 Insertion of reserve shutdown at I-21A complete.

9.1.2 Insertion of Reserve Shutdown Material at I-21B (Level 10).

9.1.2.1 At I-21B, close V-187A to isolate normal air supply.

9.1.2.2 At I-21B, connect the nitrogen supply hose quick disconnect to the left hand fitting which connects to the normal air supply.

9.1.2.3 At I-21B, open V-82888 to normal air supply line.

9.1.2.4 At the nitrogen supply bottle for I-21B, open the bottle valve to pressurize the normal air supply line.

9.1.2.5 Adjust the nitrogen regulator to 60 psig.

9.1.2.6 When nitrogen from the bottle stops pressurizing the air lines, all reserve shutdown dump valves whose solenoids are energized have been opened. Note which region's valves are open on the back of this page. Disconnect the quick disconnect.

9.1.2.7 Verify vent valve, V-821441 is closed.

9.1.2.8 Reconnect the quick disconnect to the right hand fitting. This will open all reserve shutdown dump valves whose solenoids were not energized. Note all regions whose dump valves are open on the back of this page.

9.1.2.9 Insertion of reserve shutdown at I-21B completed.

9.1.3 Insertion of Reserve Shutdown Material at I-21C (Level 10).

9.1.3.1 At I-21C, close V-193B to isolate normal air supply.

9.1.3.2 At I-21C, connect the nitrogen supply hose quick disconnect to the left hand fitting which connects to the normal air supply.

9.1.3.3 At I-21C, open V-82889 to normal air supply line.

9.1.3.4 At the nitrogen supply bottle for I-21C, open the bottle valve to pressurize the normal air supply line.

9.1.3.5 Adjust the nitrogen regulator to 60 psig.

9.1.3.6 When nitrogen from the bottle stops pressurizing the air lines, all reserve shutdown dump valves whose solenoids are energized have been opened. Note which region's valves are open on the back of this page. Disconnect the quick disconnect.

9.1.3.7 Verify vent valve, V-821442 is closed.

9.1.3.8 Reconnect the quick disconnect to the right hand fitting. This will open all reserve shutdown dump valves whose solenoids were not energized. Note all regions whose dump valves are open on the back of this page.

9.1.3.9 Insertion of reserve shutdown at I-21C completed.

9.1.4 Insertion of Reserve Shutdown Material at I-21D (Level 10).

9.1.4.1 At I-21D, close V-195E to isolate normal air supply.

9.1.4.2 At I-21D, connect the nitrogen supply hose quick disconnect to the left hand fitting which connects to the normal air supply.

9.1.4.3 At I-21D, open V-82890 to normal air supply line.

9.1.4.4 At the nitrogen supply bottle for I-21D, open the bottle valve to pressurize the normal air supply line.

9.1.4.5 Adjust the nitrogen regulator to 60 psig.

9.1.4.6 When nitrogen from the bottle stops pressurizing the air lines, all reserve shutdown dump valves whose solenoids are energized have been opened. Note which region's valves are open on the back of this page. Disconnect the quick disconnect.

9.1.4.7 Verify vent valve, V-821443 is closed.

9.1.4.8 Reconnect the quick disconnect to the right hand fitting. This will open all reserve shutdown dump valves whose solenoids were not energized. Note all regions whose dump valves are open on the back of this page.

9.1.4.9 Insertion of reserve shutdown at I-21D completed.

9.1.5 Verification of Reserve Shutdown Material Insertion.

Check that all 37 regions' dump valves have been opened and have been noted. Notify Shift Supervisor when all reserve shutdown material has been inserted. If any regions have not been dumped, notify the Shift Supervisor of the region numbers.

10.0 REDISTRIBUTE SYSTEM 46 FLOW

10.1 Line up System 46 in the redistribute mode as follows:

10.1.1 Set HV-46229 to the red line on the position indicator dial. Level 5 1/2.

10.1.2 Set HV-46228 to the red line on the position indicator dial. Level 5 1/2.

10.1.3 Set HV-46231 to the red line on the position indicator dial. Level 5 1/2.

10.1.4 Set HV-46227 to the red line on the position indicator dial. Level 5.

10.1.5 Set HV-46230 to the red line on the position indicator dial. Level 5 1/2.

10.1.6 Set HV-46232 to the red line on the position indicator dial. Level 5 1/2.

10.1.7 Set HV-46234 to the red line on the position indicator dial. Level 5.

10.1.8 Set HV-46233 to the red line on the position indicator dial. Level 5.

10.1.9 Notify Shift Supervisor System 46 is lined up in the redistribute mode.

11.0 SYSTEM 46 SURGE TANK PRESSURIZATION

11.1 Pressurize the System 46 Loop 1 surge tank to 30 PSIG as follows:

11.1.1 Open or verify open HV-4669. (Valve fails open on loss of air.)

11.1.2 Open or verify open the helium supply bottle valve.

11.2 Pressurize the System 46 Loop 2 surge tank to 30 PSIG as follows:

11.2.1 Open or verify open HV-4670. (Valve fails open on loss of air.)

11.2.2 Open or verify open the helium supply bottle valve.

11.3 Notify the Shift Supervisor that the System 46 surge tanks have been pressurized.

APPENDIX I

ACM VALVE LIST

VALVE NO.	P&I DWG.	P&I COORD	LOCATION OR SERVICE	PRE-OP VALVE POSITION	CHECKED
V-48502	48-1	C,6	ACM Fuel Oil Pumps Suction - TKB	Open	
V-48503	48-1	D,6	ACM Fuel Oil Pumps Suction - TKA	Open	
V-48504	48-1	D,6	P-4804 Suction Isolation	Open	
V-48505	48-1	C,6	P-4803 Suction Isolation	Open	
V-48506	48-1	F,5	PSL-48506 Isolation	Open	
V-48507	48-1	D,5	PSL-48507 Isolation	Open	
V-48508	48-1	F,4	PSH-48502 Isolation	Open	
V-48509	48-1	D,4	PSH-48503 Isolation	Open	
V-48512	48-1	F,3	P-4804 Discharge Isolation	Open	
V-48513	48-1	D,3	P-4803 Discharge Isolation	Open	
V-48514	48-1	D,3	Discharge Header Drain	Closed	

Checked By______________________________ Date__________