ENCLOSURE 2

DESIGN DESCRIPTION

FOR THE

DEDICATED SAFE SHUTDOWN SYSTEM

SOUTHERN CALIFORNIA EDISON

SAN ONOFRE NUCLEAR GENERATING STATION,

UNIT 1

SEPTEMBER 30, 1985

DEDICATED SAFE SHUTDOWN SYSTEM

DESIGN DESCRIPTION

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DESIGN DESCRIPTION

1.0 DESIGN OBJECTIVE

The objective of the Dedicated Safe Shutdown System design is to provide, in conjunction with existing plant systems, the capability to achieve safe shutdown for any postulated fire in accordance with the safe shutdown requirements of 10CFR50 Appendix R.

The systems normally used for safe shutdown at SONGS 1 include reactor coolant, auxiliary feedwater, main steam, chemical and volume control, residual heat removal, component cooling water, and salt water cooling. Based on earlier fire hazards analyses, fires postulated to occur in any one of several of the plant's fire zones have the potential for making one or more of these systems unavailable as a result of fire damage to system components, associated electrical power circuits, instrument air supplies, system instrumentation, and controls.

SCE has evaluated the design of the existing systems required for safe shutdown and has identified the scope of modifications that would be necessary to furnish them the level of protection required by Appendix R.

2.0 DESIGN APPROACH

The approach taken in the design of the Dedicated Safe Shutdown System is based on the following concepts:

2.1 It should be possible to achieve and maintain cold shutdown by using the main steam generators for decay heat removal.

Normally, the steam generators are operated in conjunction with the auxiliary feedwater system and steam dump system to reject decay heat through the generation and controlled release of steam. When the reactor coolant system has been cooled to 350°F and 365 psia, operation of the residual heat removal system is initiated to bring the unit to cold shutdown. Previous calculations indicate that cooldown can be continued with the steam generators, and that cold shutdown (RCS temperature less than 200°F) can be achieved and maintained by operating the steam generators in a single-phase (liquid) heat transfer mode.

The advantage of using the steam generators to achieve and maintain cold shutdown is that this approach does not require the residual heat removal, component cooling, or salt water cooling systems to be operable following a fire. This, in turn, avoids a number of difficult and time consuming modifications that would have otherwise been necessary to meet Appendix R requirements for these systems.

2.2 Fires may be postulated having the potential for the following consequences:

- o Unavailability of the control room.
- o Nonoperability of existing safe shutdown equipment.
- o Failure of power, instrumentation, and control cables normally used to achieve and maintain safe shutdown.

By recognizing the potential consequences of all major fire scenarios, the design of the Dedicated Safe Shutdown System represents one unique combination of systems capable of being used in the event of any fire having the potential of making the existing normal safe shutdown systems unavailable.

Relative to a design approach which would allow separate systems to provide shutdown capability for different fire scenarios (see Paragraph III.G.3 of 10CFR50 Appendix R), this approach offers the advantage of using a single system and a single procedure for any fire which would cause the normal systems to be unavailable and for which no alternative systems exist. In order to provide this advantage, the Dedicated Safe Shutdown System incorporates:

- o Remote shutdown capability.
- o Independent onsite power source.
- o Independently powered instrumentation and controls.

2.3 Table 1 provides a listing of all new DSS structures, systems and components.

3.0 SYSTEM DESCRIPTION

3.1 Reactivity Control

3.1.1 Summary Description

Reactivity control will initially be provided by the reactor trip function, which is assumed not to be affected by any postulated fire. As the RCS is cooled-down, the required shutdown margin will be maintained by injecting borated water from the refueling water storage tank (RWST). This water will be supplied by the north centrifugal charging pump (G-8A) by way of the reactor coolant pump seals. The normal charging flow path will be available as an alternate. The system flow path and connection points are shown in Attachment 1.

3.1.2 Detailed Description

In order to achieve the required margin for cold shutdown following sustained operation at 100 percent power, approximately 6,200 gallons of boric acid solution must be added to the RCS from the RWST. This additional boron will bring the RCS concentration to 700 ppm which is sufficient to maintain K_{eff} less than 0.95.

The additional boron will be charged into the RCS using Charging Pump G-8A. The charging pump will be aligned to take suction from the RWST. The 6,200 gallons of borated water necessary to establish and maintain the required shutdown margin is based on the minimum RWST concentration required by Technical Specifications: 3750 ppm.

The equipment required for reactivity control includes the Charging Pump, RWST, and associated valves.

3.2 Primary Coolant Inventory Control

3.2.1 Summary Description

The primary coolant inventory will be controlled by limiting reactor coolant pump seal leakage while injecting a sufficient amount of water through the RCP seals and/or normal charging path to maintain pressurizer level and compensate for shrinkage during cooldown. With even only the minimum required concentration of boric acid in the RWST, the water injected for primary coolant inventory control exceeds that required to maintain an adequate shutdown margin for reactivity control. The system flow path and connection points are shown in Attachment 1.

3.2.2 Detailed Description

With the RCP seals intact, and RCS leakage less than 6 gpm (a Technical Specification limit assumed for the study), in order to prevent an unacceptable decrease in pressurizer level, CVCS system operation must be initiated within two hours of the reactor trip. As discussed above under functional requirements for reactivity control, Charging Pump (CHP) G-8A will be aligned to take suction from the RWST.

Water will be charged into the loops through the reactor coolant pump (RCP) seals. The flow path from pump G-8A to the RCP seals is through valves FCV-1115A, B and C.

In addition to the 7 gpm RCS leakage through the pump seals and unknown sources, there is also 5 gpm leakage from the known sources. Accordingly, the total RCS leakage rate is 12 gpm. This flow rate will be provided by the charging Pump G8-A.

Under the postulated conditions, however, the seal water return path will be isolated. Therefore, any leakage through the seal will pressurize the seal water return header, activate relief valve RV-2004 and be discharged to the RCS drain tank.

In case a high injection flow rate is required, the normal charging path through FCV-1112 and CV-304 will be available. To ensure operability during the cooldown phase, FCV-1112 has been upgraded to include backup nitrogen. CV-304, the charging line isolation valve inside containment, can be opened using Pump G-8A pressure differential.

Power to Charging Pump G-8A and auxiliary equipment must be routed in accordance with the requirements of Appendix R. The proposed electrical system is discussed in Section 3.5.

The proposed system does not require upgrading of the normal letdown flow path. If for some reason it became necessary to remove mass from the RCS, this would be accomplished through the power operated relief valve (CV-546) and block valve (CV-530).

Seal injection and seal cooling to the RCP's will be unavailable until seal injection is initiated from the DSS using Charging Pump G8-A. Westinghouse Electric Corporation (reference letter SCE-85598 titled "RCP Seal Integrity - Fire Protection," dated September 18, 1985) has evaluated the effect on RCS integrity of a postulated fire which would disable seal cooling for up to 30 minutes. This evaluation shows that, based on test results and actual station experience, the reactor coolant pump seals could be expected to survive for up to 2-1/2 hours without materially changing the leakage rate of the seals.

To provide defence-in-depth the existing DC Thermal Barrier Coolant Pump will be used, if available, to provide seal cooling until seal injection is initiated from the DSS. The Thermal Barrier Coolant Pump is powered from the station battery and can provide cooling water to the RCP thermal barriers for a period of at least 2 hours.

The equipment required for Reactor Coolant inventory control includes:

- RWST
- LCV-1100B and D
- Charging Pump (G-8A)
- FCV-1112
- CV-304
- FCV's 1115A, 1115B, and 1115C
- Thermal Barrier Pump (used as backup only)
- CV-530
- CV-546

3.3 Primary Coolant Pressure Control

3.3.1 Summary Description

Primary Coolant Pressure will be controlled by the use of pressurizer heaters. The heat loss from the pressurizer is sufficiently low that during the initial hours of RCS cooldown, pressurizer heaters are not necessary to maintain adequate system pressure. In case of overpressure, pressure must be relieved from the system so that the cooldown may proceed without exceeding RCS nil ductability transition temperature (NDTT) limits. This pressure relief will be accomplished by way of a pressurizer power-operated relief valve (PORV)/block valve combination.

Provisions will be made to restore one group of pressurizer heaters using power from the dedicated safe shutdown source. The heaters will be used to maintain pressure balance in the pressurizers.

The system flow path and connection points are shown in Attachment 1.

3.3.2 Detailed Description

Under the postulated accident conditions, the pressurizer spray line will be failed closed and pressurizer pressure will exceed NDTT limitations if no action is taken to relieve system pressure. With the proposed system, pressure will be relieved through the release of steam from the pressurizer. This will be accomplished through operation of the power operated relief valve CV-546 to maintain RCS pressure within allowable limits.

The pressurizer heater Group D power supply would require modification (i.e., the installation of a transfer switch, and cable rerouting) to be used for pressure control.

The equipment required to ensure Reactor Coolant Pressure Control is:

- The pressurizer
- Pressurizer heater Group D
- CV-530
- CV-546
- CV-953

3.4 Decay Heat Removal

3.4.1 Summary Description

Decay heat will be removed from the core by natural circulation. Heat (reactor decay and sensible) will be removed from the Reactor Coolant System (RCS) through one or more steam generators utilizing two different steam generator operating modes: a steaming mode and a single-phase heat transfer mode.

The steaming mode will commence immediately following reactor trip. Heat will be transfered to the feedwater in one or more steam generators. Steam will be generated and released under the control of the existing atmospheric dump valves (CV-76, CV-77, CV-78 and CV-79). Water will be supplied to the steam generator(s) by the third motor driven Auxiliary Feed Water (AFW) pump G-10W from the Auxiliary Feedwater Storage Tank (AFWST). After the steam generator bulk temperature reaches approximately 220°F, the steaming mode will be terminated and a transition made to the single-phase mode of operation.

The single-phase mode of operation involves heat transfer from the RCS to cooling water being supplied by the third AFW pump G-10W through the AFW supply headers. The steam generator will act as a once through, single-phase heat exchanger. Water will be discharged through a valve which will be "teed" into the turbine driven AFW pump turbine steam supply piping upstream of CV-113 and an existing manual isolation valve. This water will be "letdown" to an existing circulating water outfall point.

Using this method, cold shutdown can be achieved within 72 hours as required by Section III.G.1b and III.L.1 of Appendix R. The single-phase mode of operation will be continued until the normal residual heat removal system is restored to service.

At approximately t=55 hours, the decay plus sensible heat rate drops at which point the secondary subsystem may be transitioned to the single-phase mode of operation. The heat transfer capacity in the single-phase mode of operation is limited by the third AFW pump, which operates at the pump's design flow rate of 375 gpm to continue the cooldown. It is noted that additional cooling is provided by the 80°F charging flow into the RCS. However, relative to the heat transfer to the steam generators, the effect of the charging flow is minimal and has been conservatively ignored. The system flow path and connection points are shown in Attachment 1.

3.4.2 Detailed Description

The decay heat removal system is designed to remove decay heat from the reactor coolant system by way of the main steam generators. The secondary system includes the following components:

- The existing condensate storage tank (D-2)
- The existing auxiliary feedwater storage tank (D-2A)
- The motor driven third feedwater pump (G-10W) and associated suction and discharge piping and manual valves.
- The existing auxiliary feedwater system flow control valves (FCV-2300, -2301, -3301 and -3300) and associated piping to the steam generators.

- The existing main steam generators (E-1A, -1B, and -1C).
- The existing main steam system piping from the steam generators to the manual isolation valves on the steam headers outside containment.
- The existing steam generator safety relief valves (RV-1 through RV-10).
- The existing steam generator atmospheric dump valves (CV-76, CV-77, CV-78 and CV-79) on the atmospheric steam dump headers.
- The existing steam supply piping to the turbine-driven auxiliary feedwater pump turbine up to and including the manual turbine isolation valve MSS-301.
- A manual flow control valve and flow discharge manifold to be added to turbine driven auxiliary feedwater pump turbine steam supply piping upstream of CV-113.

The decay heat removal system will be required to remove a sufficient amount of heat from the reactor coolant system to achieve and maintain cold shutdown. Water stored in the auxiliary feedwater and condensate storage tanks will be supplied to the steam generators by the motor-driven auxiliary feedwater pump. Flow to each steam generator will be controlled by the existing emergency auxiliary feedwater flow control valves.

For the few minutes following reactor/turbine trip that it will take to initiate operation of the auxiliary feedwater pump, RCS temperature will be controlled at 600°F by the heat removed through the production of steam from the initial inventory of water stored in the steam generators and escaping through the steam generator safety relief valves outside containment. After the auxiliary feedwater pump is started and flows are established to recover normal steam generator levels, the cooldown of the RCS is initiated through the operation of the power-operated atmospheric steam dump valves. The dump valves will be controlled to increase the flow of steam from the steam generators, resulting in a reduction in steam generator pressure to a point that will allow the safety relief valves to close. The steam flow through the dump valves is then adjusted to establish an RCS cooldown rate of 25°F/hr, while auxiliary feedwater flow is adjusted to maintain steam generator level.

The 25°F/hr cooldown rate is maintained until an RCS temperature of 350°F is reached, approximately 10 hours following reactor/turbine trip. The steam flow through the dump valves is reduced at this point to allow this temperature to be maintained for a period of approximately 20 hours. Following this 20 hour "soak" period, cooldown at the 25°F/hr rate is resumed.

When RCS temperature has been reduced to 220°F, approximately 55 hours following reactor/turbine trip, auxiliary feedwater flow is increased so that steam generators and main steam headers are flooded. Sometime prior to this, the manual isolation valves on the main steam headers outside containment should be closed to limit the extent of flow to the piping downstream.

As the headers are being flooded, the steam dump valves remain open to provide a means of venting the steam bubble trapped in the headers. As the headers approach a full condition, the valves are throttled closed and the manual flow control valve to be installed on the turbine driven auxiliary feedwater pump turbine steam supply piping is opened. The turbine is isolated from the supply generator feedwater "letdown" line, by closing the manual isolation valve MSS-301.

Water flow is now established by the manual flow control valve on the feedwater letdown line at a rate that will permit the RCS cooldown to continue at approximately 5°F/hr. In the single-phase mode of operation, the cooldown rate is limited to 5°F/hr by the capacity of the AFW pump. When RCS temperature has been reduced to less than 200°F, approximately 72 hours following reactor/turbine trip, cold shutdown is achieved and maintained by continuing the flow of auxiliary feedwater through the steam generators and out through the letdown flow control valve. RCS temperature will be maintained at 200°F using the AFW pump until normal RHR systems are restored. From 200°F, the ability of the system to further reduce RCS temperature is limited by AFW pump capacity and the decreasing steam generator terminal temperature difference.

Downstream of the new manual letdown flow control valve, a manifold will be attached which will allow several 2-1/2" fire hoses to be connected. Through these hoses, feedwater can be "letdown" to the circulating water outfall point.

The inventory of water onsite, including the 3,000,000 gallon service water reservoir, is sufficient to maintain cold shutdown conditions for a period of approximately 9 days. Offsite sources of water will allow the system to continue to maintain cold shutdown for an indefinite period. Within this period, however, it will be desirable to restore the systems normally used to maintain cold shutdown (residual heat removal, component cooling, and saltwater cooling) to normal operability, thereby allowing operation of the "dedicated" secondary system to be discontinued.

During the first 55 hours following reactor/turbine trip, functional requirements for the piping and valves which already exist as part of the auxiliary feedwater, main steam, and steam dump systems, will remain the same as required by the current system design. After 55 hours, the main steam system piping will be required to support water loads at or below 190°F and 600 psig and the steam header isolation valves will be required to isolate flow of water downstream of the valves. The auxiliary feedwater system flow control valves will be required to deliver a minimum of 375 gpm distributed equally between the three steam generators. The feedwater letdown line and manual flow control valve must be capable of withstanding the loads associated with passing a minimum of 375 gpm through the letdown line outlet manifold and fire hoses. Pressure downstream of the valve may not exceed the rated pressure of the hose. Upstream pressure will be nominally less than 600 psig but rated for full steam header pressure.

3.5 Electrical Systems

The electrical system, shown in Attachments 2 and 3, is designed to generate and supply the power necessary to operate the Dedicated Safe Shutdown System electrical loads. The electrical system includes the components described below.

The Quality Classification of the diesel generator set supplying power to the DSS System will be Non-Safety Related-Fire Protection (i.e. the Fire Protection QA Program will be applied to this equipment). All equipment to be supplied power by the DSS System through transfer switches receive normal power from Safety Related sources. The normal power supply for C-38 Panel Instrumentation and Control will also have its Safety Related source breaker controlled by a SIS/LOP permissive interlock in MCC-2A. Isolation devices will incorporate padlock fittings.

When the DSS System is made operational due to a fire which would threaten the operability of normal safe shutdown systems, the dedicated diesel-generator unit would be started. This diesel-generator will be a self contained unit and is described below.

Diesel-Generator System (DGS)

Capacity:	2,000 kW, net
Electrical Characteristic:	4.16 kV, 60 Hertz, 3-phase
rpm:	900
Equipment Accessories:	Instrumentation and controls, output circuit breaker, starting air system, cooling, lube and fuel oils, engine air and exhaust, and generator excitation.
Equipment Configuration:	Skid mounted, outdoor type, fully enclosed, self-contained, radiator cooled, equipped with 275 gallons/day tank.
Diesel Fuel Oil Storage System:	2,500 gallons, Diesel No. 2, underground, fiberglass tank, equipped with 1/3 hp electric driven motorized transfer pump, and leak detection system per Cal-OSHA.
Full Load Fuel Supply:	17 hours approximately (additional 14 days supply is available from the

The Dedicated Power System will be designated as a new electrical Train J. Safety Related Quality Class equipment will be used to the extent practical; in any case, Non-Safety Related-Fire Protection equipment will be used as a minimum. Cable color coding of J-Train shall be blue.

Normal source power for DSS control, instrumentation (C-38 panel) and lighting will be supplied from a G-Train MCC-2A, 480 volt feeder isolated at MCC-2A by SIS/LOP control of a combination starter to provide isolation of J-Train during SIS/LOP conditions. A manual transfer switch in J-Train MCC-B30 will transfer this load to the DSS System during DSS diesel generator operation.

The DSS System will supply power to AFW Pump G-10W by a direct 4160 volt power feeder. Spare imbedded conduits and/or trenches will be installed in the switchgear foundation to provide for future configurations with the transfer switch installed in the switchgear building. Space will be reserved on the foundation layout for this future transfer switch installation.

3.5.1 Raceway and Cable Systems

All new cable installations shall be installed in rigid steel conduit systems. Conduit systems with the exception of lighting systems shall be Safety Related, Seismic Category A (Appendix R Emergency Lights will be classified as Non-Safety Related-Fire Protection). Conduit being installed for routing cable to various DSS apparatus will be mounted on their own independent supports where it is physically possible to do so. Installation of conduit will be reviewed against criteria to do so. Installation of conduit will be reviewed against criteria of 10CFR50, Appendix R, Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979. Underground duct banks will be installed from switchgear enclosure foundation cable trenches to Diesel Generator, Auxiliary Feedwater Pump, to a pull box at the edge of the Auxiliary Building for transition to aboveground routing and to below ground penetration of the reactor auxiliary building west wall. A cable raceway will be installed in the switchgear enclosure foundation underneath major equipment with embedded conduits to other equipment in the enclosure not covered by the trenches. Approximately 15 percent spare conduit will be run and stubbed up in space available for future equipment. All equipment in the switchgear enclosure will be free standing with bottom entry.

3.5.2 Lighting Systems

At equipment requiring emergency battery powered lights where emergency battery powered units presently exist, additional battery powered lights will not be necessary. New Emergency lights will be installed at all DSS operation areas where required. Fixtures will be similar to the present type of fixtures used throughout SONGS 1.

3.5.3 Switchgear and MCC

The 4160 volt switchgear will include a spare feeder cubicle for future use. All motor feeders from switchgear or MCC are manually controlled at the breaker or starter door panel. No automatic or remote control is provided for motors or pressurizer heaters. Operation of the generator will be locally controlled at the diesel generator control panel located on the generator skid.

3.6 Instrumentation and Controls

The instrumentation and controls identified to operate the proposed safe shutdown system have been selected to minimize required upgrades. Where possible, manual action has been identified to satisfy requirements.

Replacement of existing "Safety Related" devices will be with equivalent replacement in kind. New devices and instrumentation will meet the current requirements defined by this criteria. The quality class for each new device/instrument will be based on its safety function only. The individual specification data sheet will document when the device/instrument procured exceeds the safety function quality class requirements.

3.6.1 Control Panel

Auxiliary Control Panel C-38 shall be the primary control station for dedicated safe shutdown operations. Instrumentation and controls required for DSS are listed in Table 2.

a. C-38 shall be relocated from the Exciter Room to the DSS switchgear enclosure building.

b. All existing instrumentation and control features of C-38 except G-10S control shall be retained to permit use of the panel for other than DSS purposes. G-10S control shall be removed. Control of G-10S is available at the 480 volt switchgear.

c. Additional control system components shall be added to the panel to meet DSS requirements. New instruments shall be installed to meet Seismic Category A between the instrument and the support and between the support and the panel. However, no attempt will be made to seismically upgrade or alter existing panel configuration.

3.6.2 Control Panel Functions

Control Panel C-38 shall be adapted for DSS service.

3.6.3 Control Panel Indicators

Panel indicators shall be Sigma Model 9270 bar graph type instruments. Existing Foxboro Specification 200 indicators shall be replaced.

3.6.4 Solenoid Valves

a. Steam dump control transfer solenoid valve SV-175 shall be relocated from the lube oil area to the "breeze way" area. The solenoid valve and cables will be enclosed in a three (3) hour rated barrier within the breeze way area.

b. New DSS solenoid valves shall be added to the pneumatic control loops of PORV CV-546 and block valve CV-530 for pressurizer pressure control from C-38. (The design of the DSS may require use of PORV CV-545 and block valve CV-531 rather than CV-546 and CV-530 due to normal shutdown power train requirements.

3.6.5 Temperature Sensors

Existing installed spare RTD's TE-402A, TE-412A, and TE-422A, shall be used to implement the reactor hot-leg temperature indications.

3.6.6 Instrument Air Supply

Provision shall be made to connect panel C-38 to a portable air supply source for DSS operation.

3.6.7 Backup Nitrogen Supply

a. A supply of backup nitrogen for operation of FCV-1112 shall be provided.

b. The adequacy of the existing nitrogen supplies for PORV's CV-76, 77, 78 and 79; and PORV CV-546 and block valve CV-530 has been evaluated. The available supply of Nitrogen is sufficient for approximately 20 hours of operation. Approximately 12 hours are required to achieve hot shutdown. However, if additional compressed air or nitrogen is required for the operation of the instrument and their operated valves, then a portable air compressor or nitrogen bottles located on site may be used.

3.7 Civil-Structural

This section describes structures, foundation and structural supports for mechanical, electrical and control systems equipment, systems and components used for and associated with the Dedicated Safe Shutdown Systems.

3.7.1 Switchgear Enclosure, Superstructure

It will be a structure with metal siding on a steel frame, forced ventilated, equipped with personnel and equipment entries, and will be classified as a Non-Safety Related and Seismic Category C structure. The structure will have no connection to existing plant drainage system. The floor slab will be sloped to avoid ponding. The battery room section of the switchgear enclosure will be provided with portable eye wash.

3.7.2 Switchgear Enclosure, Foundation

The foundation will be classified and designed as Safety Related Seismic Category A to provide for future upgrading. The foundation will consist of a reinforced concrete slab on drilled caisson piers and wall.

3.7.3 Construction Materials

Concrete shall have a minimum compressive strength (28 days) of $f'_c = 3000$ psi or as specified in the construction drawings.

3.7.4 Diesel Generator Set Foundation

The foundation will be classified as NSR, Seismic Category C and consists of a reinforced concrete block on soil. The design will provide for a rotating equipment vibration analysis based on vendor supplied dynamic imbalance force/torque. The foundation will also provide support for a vendor supplied metal enclosure that will be bolted to the foundation to allow removal as required. The enclosure will provide access for servicing the equipment. Foundation rigidity limitations and differential settlement valves will be considered to meet equipment vendor requirements.

3.7.5 Pipe/Conduit Supports

Pipe supports and conduit supports will be in the civil engineering scope of responsibility. Before adding cables to any raceway, civil engineering shall evaluate the load capacity of the system. Whenever possible, supports will be mounted to existing Seismic Category A structures.

Pipe supports will be detailed on standard 8-1/2" x 11" pipe support assembly sheets and will reference civil calculations for loading information and piping isometrics for location. Loading data will be generated by piping and furnished to civil for the design of the pipe supports.

TABLE 1

LIST OF STRUCTURES, SYSTEMS AND COMPONENTS

FOR NEW DSS ITEM

MECHANICAL

Diesel-Generator Set

Diesel-Fuel Storage Tank

Diesel-Fuel Transfer Pump

Third Auxiliary Feedwater Pump

Third Auxiliary Feedwater Pump Piping and Valves

Charging Pump G8A Recirculation Line

Single Phase Cooling Letdown Piping

Charging Pump Room Fire Suppression System

CIVIL/STRUCTURAL

Switchgear Enclosure, Superstructure (Metal Siding on Steel Frame)

Switchgear Enclosure Superstructure (Concrete, Future)

Switchgear Enclosure Foundation

Diesel Generator Foundation

ELECTRICAL

4.16 kV Switchgear

Load Center (MCC and Transformer)

UPS with Solid State Inverter

Batteries

Battery Charger

DC Panelboard

Emergency Lighting

TABLE 1 (Continued)

Transfer Switches, 4.16 kV

Transfer Switches, 480 V

Fire Resistant Cable

CONTROL SYSTEMS

Remote Shutdown Panel

Steam Header Pressure Transmitter

Pressure Gauge

Solenoid Valves

New DSS Panel Switches

Pressurizer Pressure Indicator

Pressurizer Level Indicator

"A" Steam Generator Level Indicator

"B" Steam Generator Level Indicator

"C" Steam Generator Level Indicator

Loop "A" Reactor Coolant Temperature (Cold Leg) Indicator

Loop "B" Reactor Coolant Temperature (Cold Leg) Indicator

Loop "C" Reactor Coolant Temperature (Cold Leg) Indicator

Main Steam Header Pressure Indicator

Loop "A" Reactor Coolant Temperature (Hot Leg) Indicator

Loop "B" Reactor Coolant Temperature (Hot Leg) Indicator

Loop "C" Reactor Coolant Temperature (Hot Leg) Indicator

Current to Voltage Converter

Platinum Resistance Bulb Converter

Charging Flow Controller (FCV-1112)

TABLE 2

DSS INSTRUMENTATION AT RSP

INSTRUMENT

Pressurizer Pressure Indicator

Pressurizer Level Indicator

"A" Steam Generator Level Indicator

"B" Steam Generator Level Indicator

"C" Steam Generator Level Indicator

Loop "A" Reactor Coolant Temperature Indicator (Cold Leg)

Loop "B" Reactor Coolant Temperature Indicator (Cold Leg)

Loop "C" Reactor Coolant Temperature Indicator (Cold Leg)

Steam Dump Controller (CV-76-79)

Switch: Steam Dump Control Transfer

Main Steam Header Pressure Indicator

Loop "A" Reactor Coolant Temperature Indicator (Hot Leg)

Loop "B" Reactor Coolant Temperature Indicator (Hot Leg)

Loop "C" Reactor Coolant Temperature Indicator (Hot Leg)

Charging Flow Controller (FCV-1112)

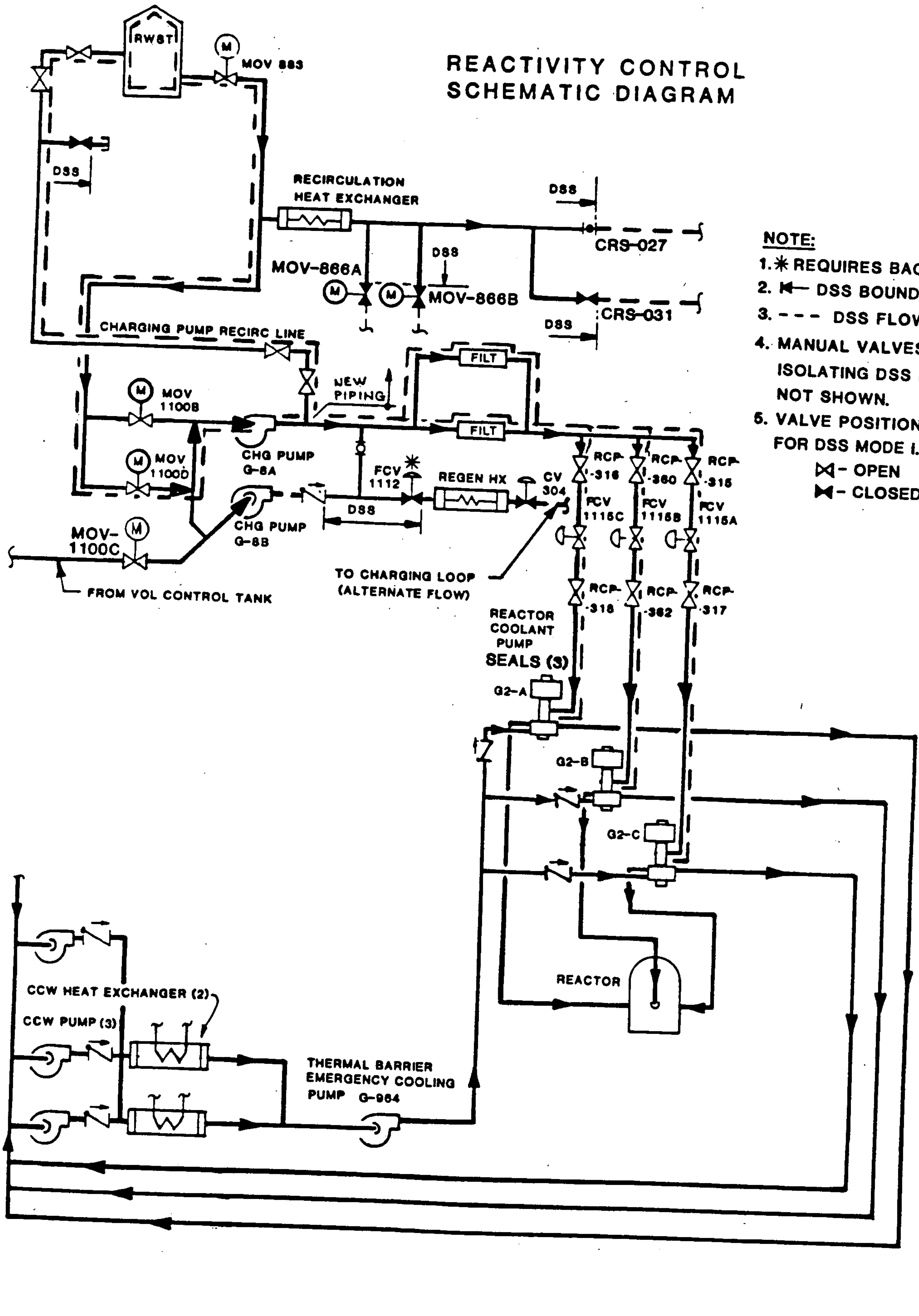
Switch: Pressurizer PORV Control (CV-530 and CV-546)

Switch: FCV-1112 Control Capture

Switch: SV-176 Control Separation

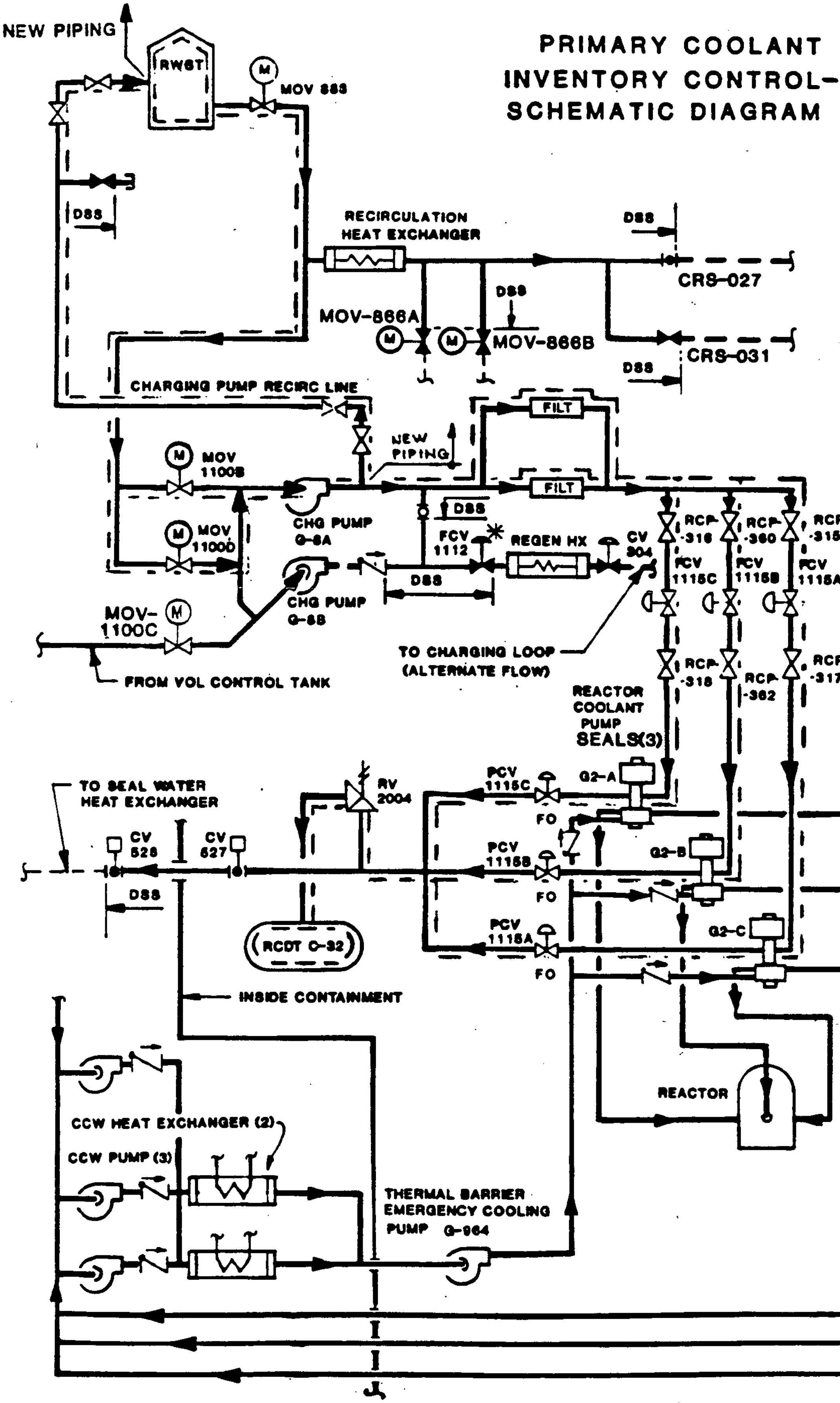
RSP - Remote Shutdown Panel (C-38)

REACTIVITY CONTROL SCHEMATIC DIAGRAM



NOTE:
1. ✳ REQUIRES BACK-UP N2
2. ⊣← DSS BOUNDARY
3. - - - DSS FLOW PATH
4. MANUAL VALVES USED FO ISOLATING DSS BOUNDAR NOT SHOWN.
5. VALVE POSITION SHOWN I FOR DSS MODE i.e.,
   ⋈ - OPEN
   ⧓ - CLOSED

PRIMARY COOLANT INVENTORY CONTROL-SCHEMATIC DIAGRAM



NOTE:

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4. MANUAL VALVES USED FO[R] ISOLATING DSS BOUNDARY NOT SHOWN.
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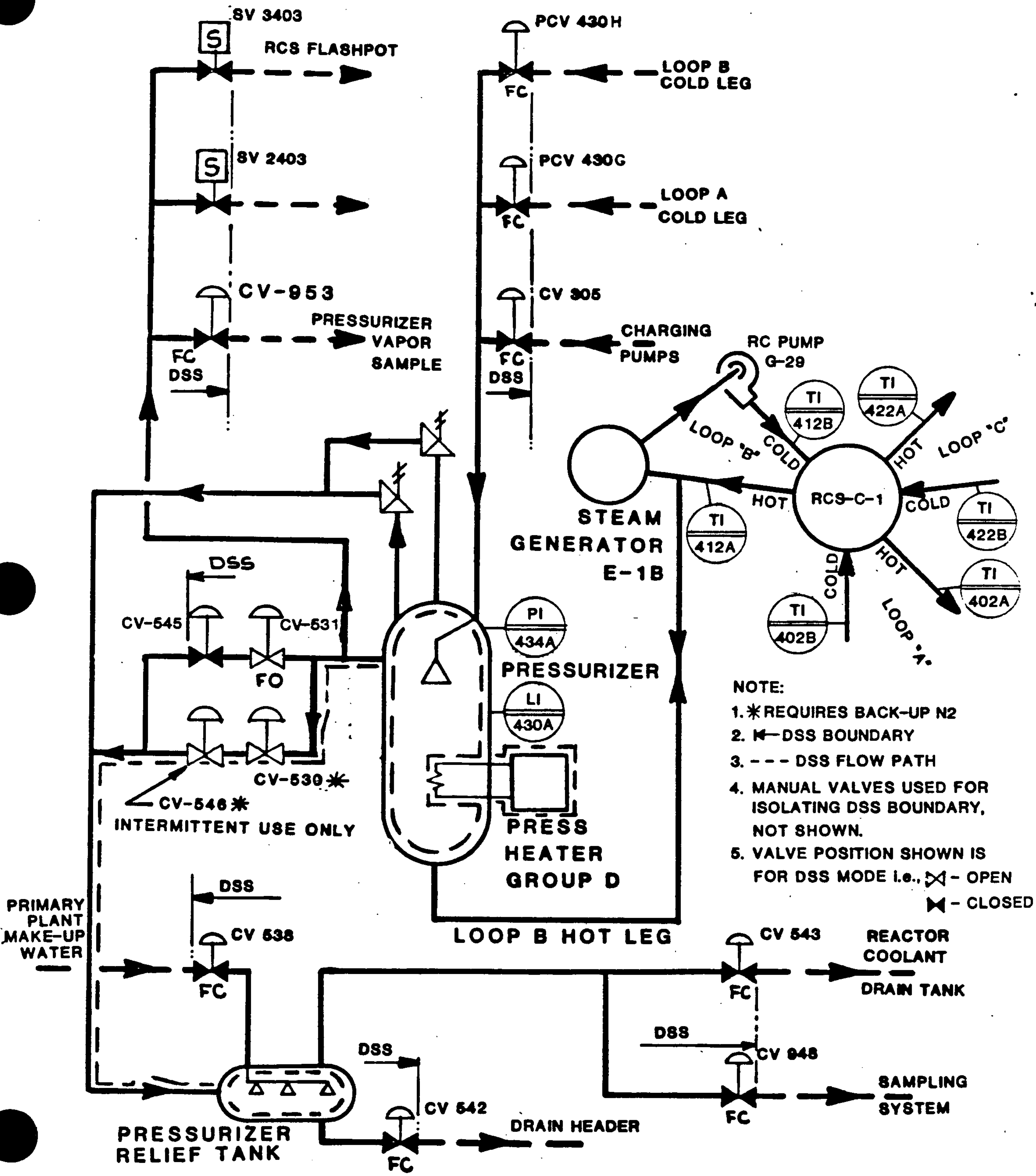
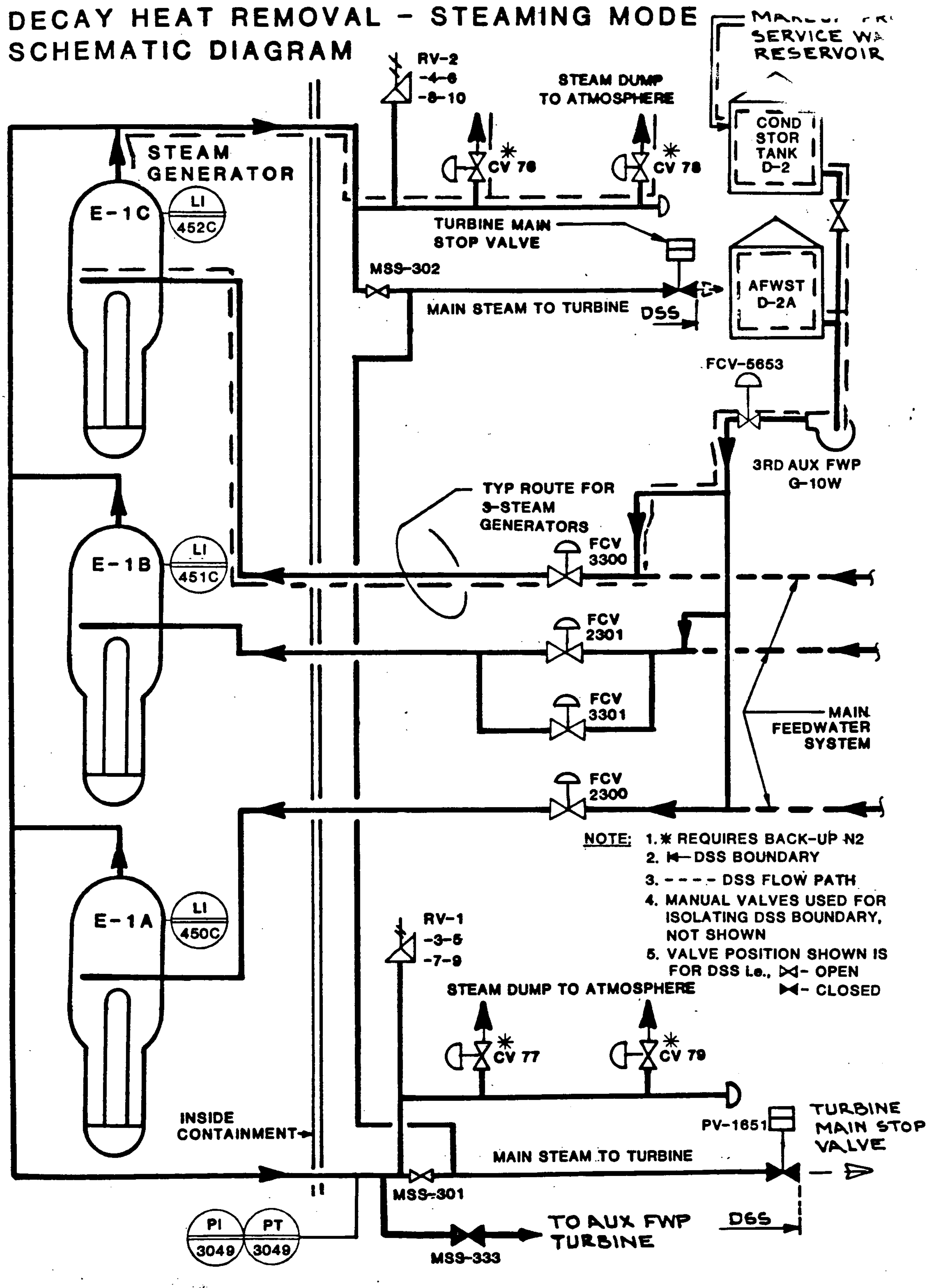
   ⋈ - OPEN
   ⧓ - CLOSED

PRIMARY COOLANT PRESSURE CONTROL SCHEMATIC DIAGRAM



DECAY HEAT REMOVAL - STEAMING MODE SCHEMATIC DIAGRAM



DECAY HEAT REMOVAL
-SINGLE PHASE COOLING MODE SCHEMATIC DIAGRAM