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FYR 81-157

November 30, 1981

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Darrell G. Eisenhut, Director
Division of Licensing

References: (a) License No. DPR-3 (Docket No. 50-29)
(b) YAEC Letter to USNRC, dated July 6, 1981 (FYR 81-103)

Subject: Shielding

Dear Sir:

In Reference (b) we summarized the status of our shielding design review and indicated that we were proceeding on the design of an alternative to substantial shielding modifications. This alternative is the Post-Incident Cooling (PIC) System which allows for remote operation of all equipment required to maintain cold shutdown conditions for as long as necessary from the shielded areas of the plant such as the Control Room. A description of the PIC System is enclosed. Detailed design and equipment procurement is underway such that installation of modifications can be accomplished during the scheduled 1982 refueling outage.

Should you or your staff have any questions about the PIC System, we would be most pleased to discuss them with you.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

J. A. Kay

J. A. Kay
Senior Engineer - Licensing

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Enclosure

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System Description
Post-Incident Cooling System

The Post Incident Cooling (PIC) System is a system which permits the safe shutdown, cooldown and maintenance of cold shutdown conditions from within shielded areas of the Yankee Nuclear Power Station. Certain key areas within the plant have radiation shielding to allow personnel occupancy in the unlikely event a large source term is generated within the vapor container which restricts general access to the plant site.

The shielded areas include the following:

1. The main control room and technical support center located on the operating floor level of the turbine building.

2. The switchgear room located on the mezzanine floor of the turbine building below the control room.

3. The pump room area located on the ground floor of the turbine building.

If it becomes necessary to operate the plant with a high source term in the vapor container, the PIC system provides the required monitoring and control equipment to safely bring the plant to a cold shutdown condition and maintain it in that condition for as long as 2 or 3 months or until general access to the site is reestablished.

DESIGN BASES ASSUMPTIONS

The design bases for the PIC system are:

1. The source term specified in TID 14844 is released to the containment atmosphere.

2. The radiation dose rates generated in the site area from the TID 14844 source term limits general site access to only the shielded areas for a period of up to 3 months.

3. Monitoring and control of the equipment necessary for a normal cold shutdown is provided from within the shielded areas.

4. Monitoring and control of the equipment necessary for a cold shutdown and maintenance of containment integrity after a postulated loss of coolant accident (LOCA) is provided from within shielded areas.

5. Loss of the normal off-site power supply system is assumed during the restricted access period.

6. All equipment is operated within its design limitations.

FUNCTIONAL REQUIREMENTS OF THE PIC SYSTEM

There are 9 functions required to shutdown, cooldown and maintain cold shutdown conditions. The following is a listing of the functions required:

- Decay heat removal and cooldown
- Cooldown to cold shutdown
- Main coolant inventory, pressure and boration control
- Emergency core cooling
- Emergency power
- Post-accident hydrogen control
- Demineralized water replenishment
- Spent fuel pit make-up
- Personnel and logistical support

Each function is expanded below with a breakdown of its equipment, and associated instrumentation and controls. The schedule for modifications to the plant to insure that the functions are all available is also provided.

1. Decay Heat Removal and Cooldown

Purpose: To remove heat from the MCS by steaming the steam generators and providing make-up to the steam generators.

Components Required: (See Figure 1.) Steam will be released to the atmosphere via the atmospheric steam dumps. Steam generator pressure and main coolant loop temperature indications will be monitored to control dump valve position.

The motor driven emergency feedwater pumps and motor operated valves are used to control steam generator water inventory. Steam generator level indication and/or emergency feedwater flow indication are used to regulate steam flow rate.

Scheduled Modifications: Atmospheric steam dump valves remotely operable from the main control room will be added during the 1982 refueling outage. All other equipment controls and system indications required presently exist in the main control room.

2. Cooldown to Cold Shutdown

Purpose: To lower MCS temperature to less than 200°F with the shutdown cooling system, and to remove this heat through the component cooling and service water systems to Sherman Pond.

Components Required: (See Figure 2.) Shutdown cooling isolation valves are opened to align the system for operation. The shutdown cooling pump and its motor operated discharge valve are used to regulate cooling flow rate through the heat exchanger and back into the MCS. The operator controls the shutdown cooling flow rate by monitoring shutdown cooling heat exchanger discharge temperature and flow, main coolant loop termperature, and core exit thermocouples.

The component cooling pumps and motor operated valves align and regulate cooling water flow from the component cooling heat exchangers to the shutdown cooling heat exchanger. Exit component cooling temperature indication from the shutdown cooling heat exchanger and temperature and flow indication from the component cooling heat exchanger are used to regulate component cooling flow to the shutdown cooling heat exchanger.

Service water pumps and motor operated valves supply cooling water to the component cooling heat exchangers and also regulate the flow to the heat exchangers. Exit component cooling water temperature indication is used to regulate service water flow to the component cooling heat exchangers.

Scheduled Modifications: During the 1982 refueling outage, the controls for the four shutdown cooling system isolation valves in the lines to main coolant loop 4 will be relocated from the primary auxiliary building to the main control room. The following manual valves will be motorized and their controls located in the main control room:

- shutdown cooling pump discharge valve
- component cooling pumps discharge valves
- shutdown cooling and low pressure surge tank cooling heat exchangers component cooling discharge valves and combined discharge valve
- one service water pump discharge valve
- combined service water discharge valve from the component cooling heat exchangers

Remote indication will be added in the main control room for shutdown cooling heat exchanger discharge flow and temperature, and component cooling water discharge temperature.

3. Main Coolant Inventory, Pressure and Boration Control

Purpose: To control MCS pressure above saturation temperature and to regulate system pressure as temperature is lowered with pressurizer heaters, charging pumps and the pressurizer relief valve. Also, to provide the capability to emergency borate the system, if required, with the charging pumps.

Components Required: (See Figure 3.) The pressurizer heaters can be cycled on and off as required for pressure control. The charging pumps and the various motor operated valves in the suction and discharge piping are operated to make-up to or borate the MCS. The pressurizer relief valve and block valve are also available for pressure control. They can also be used to bleed the system for emergency boration.

Pressurizer pressure indication, main coolant pressure indication, pressurizer level indication and charging flow indication are all used by the operator to control the pressurizer heaters, charging pumps and system valves. Source and intermediate range neutron detectors are utilized to determine the need for emergency boration. The various charging pump suction supplies have tank level indication available.

Scheduled Modifications: All of the controls and indications required are available in the main control room. No modifications are required.

4. Emergency Core Cooling

Purpose: To maintain MCS inventory and supply core cooling in the event of a LOCA.

Components Required: (See Figure 4.) The safety injection pumps, high and low pressure, are cycled on and off as necessary to meet system flow requirements. Various motor operated valves are operated to shift the system line-up from injection to recirculation, and to establish simultaneous hot and cold leg injection flows. Valves are also throttled to adjust flow rate. Indication of core exit thermocouple temperature, safety injection flows, safety injection pressure, vapor container pressure and safety injecton tank level are all used to vary operating pump combinations and to adjust flow rates.

Scheduled Modifications: All of the controls and indications required are available in the main control room. No modifications are required.

5. Emergency Power

Purpose: To supply the electrical power requirements of safe shutdown and cooldown equipment in the event of a loss of the normal off-site power supply system.

Components Required: Three emergency diesel generators are operated as required to supply emergency electrical power needs. Any diesel generator can supply power to any equipment load required by manual line-up of electrical system breakers. Indication of diesel generator frequency, amps, voltage, and load is used to determine power availability for additional loads.

The on-site fuel oil supply is adequate for seven days of operation. Furthermore, both of the normal off-site power supply circuits are supplied from hydroelectric generating stations wich would assure a quick response even if the units were not operating at the time of the loss. These units are the Harriman Station which is 2.5 miles away in a northerly direction, and the Cabot Station which is 24 miles away in an easterly direction. In the 20 year operating history of the plant a complete loss of off-site power has been experienced only once, with power being restored in less than 20 minutes.

All of the diesel generator controls and instrumentation are located in the main control room. The breaker controls are located in the main control room and the switchgear room.

Scheduled Modifications: All of the controls and indications required are available in the main control room. No modifications are required.

6. Post-Accident Hydrogen Control

Purpose: To vent any non-condensible gases from the MCS, and to monitor the hydrogen build-up inside containment.

Components Required: Reactor vessel head and pressurizer vents are operated to release gases from the MCS. Containment recirculation fans are run to evenly distribute the hydrogen gases inside containment. Containment hydrogen analyzers and sample valves are operated to monitor hydrogen concentration.

Controls for all of this equipment are located in the main control room with the exception of the redundant hydrogen analyzer controls located in the switchgear room.

Scheduled Modifications: A redundant hydrogen analyzer and the main control room control and indication panel are presently being installed. All other controls are presently available.

7. Demineralized Water Replenishment

Purpose: To replenish the on-site demineralized water supply.

Components Required: A manual cross-connect exists between the service water system and the water treatment system. The cross-connect uses manual valves, and a normally removed spool piece. Demineralized water and primary water storage tank level indication are used to determine when to fill and when to secure filling these tanks.

The manual valves and spool piece are located in the pump room area. The tank level indications are located in the main control room.

Scheduled Modificatons: The manual cross-connect piping and valves between the service water and water treatment systems will be installed during the 1982 refueling outage.

8. Spent Fuel Pit Makeup

Purpose: To replenish the spent fuel pit water losses due to evaporation and/or boiling.

Components Required: The spent fuel pit make-up line remotely operated fill valve is opened to add water to the spent fuel pit directly from the primary water storage tank. High and low level alarms in the main control room inform the operator when to open and close the fill valve, which is also operated from the main control room.

Scheduled Modifications: The make-up line and fill valve will be installed during the 1982 refueling outage. The existing high/low alarm windows for the spent fuel pit level will be split to individual high and low level alarm windows at the same time.

9. Personnel and Logistical Support

Purpose: To insure that operating personnel have adequate drinking water, food supplies, and other necessities available within the shielded areas.

Components Required: A means for staffing the technical support center and control room during the emergency has been developed that insures that the allowable personnel doses are not exceeded. A shift turnover and access plan have been developed to reduce unnecessary additional exposure. A supply of drinking water, food stuffs, and other necessities is stored in the shielded areas, and sleeping accommodations are available.

Scheduled Modifications: By the end of the 1982 refueling outage, all of the personnel staffing plans will be implemented, and logistical support items required will be available within the shielded areas.

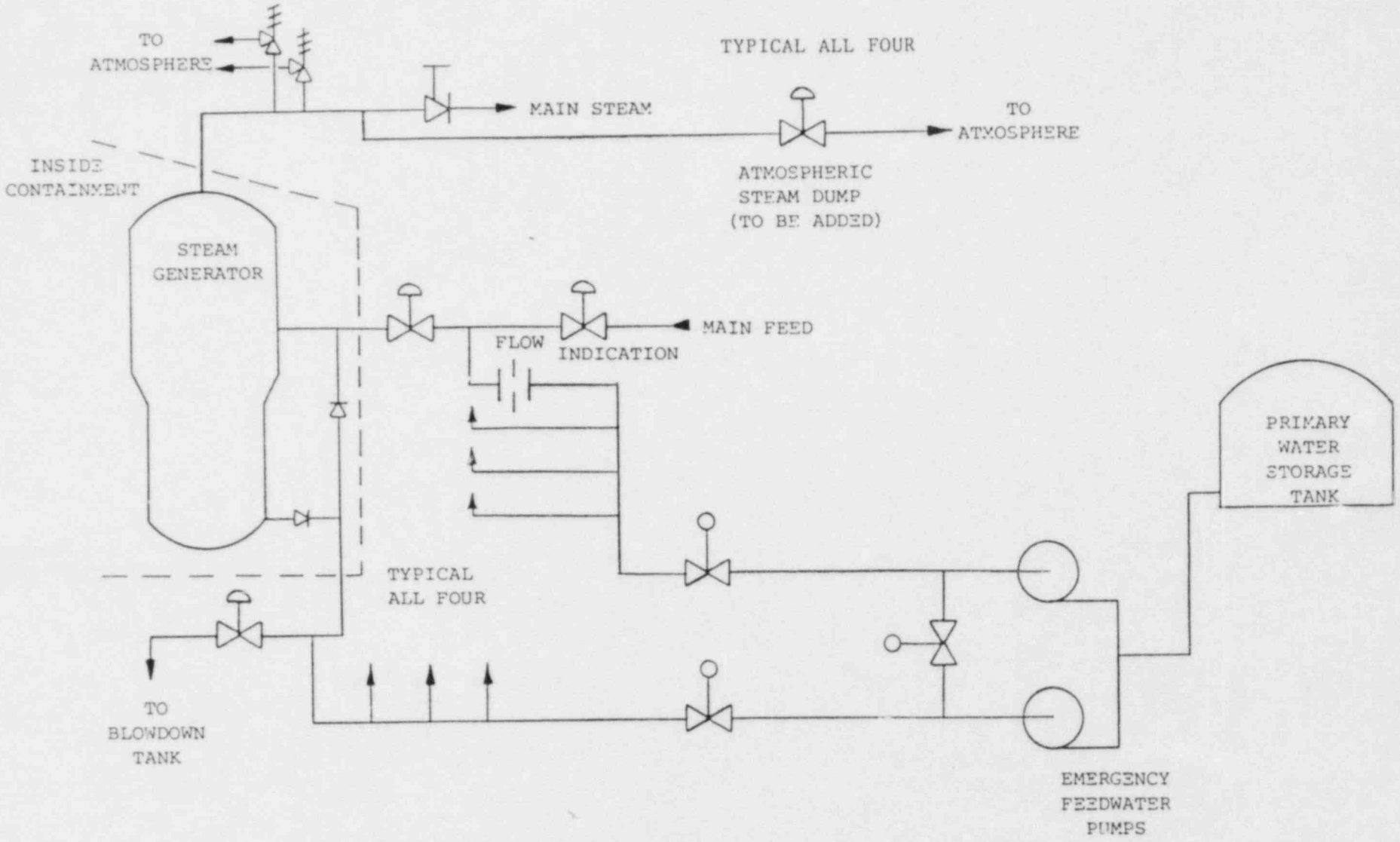

FIGURE 1: DECAY HEAT REMOVAL AND COOL DOWN FLOW DIAGRAM

NOTES

(1) VALVES TO BE MOTORIZED BY PICS
(2) VALVES WHOSE CONTROLS TO BE RELOCATED TO CONTROL ROOM BY PICS
(3) REMOTE TEMPERATURE AND FLOW INDICATIONS TO BE ADDED TO CONTROL ROOM BY PICS

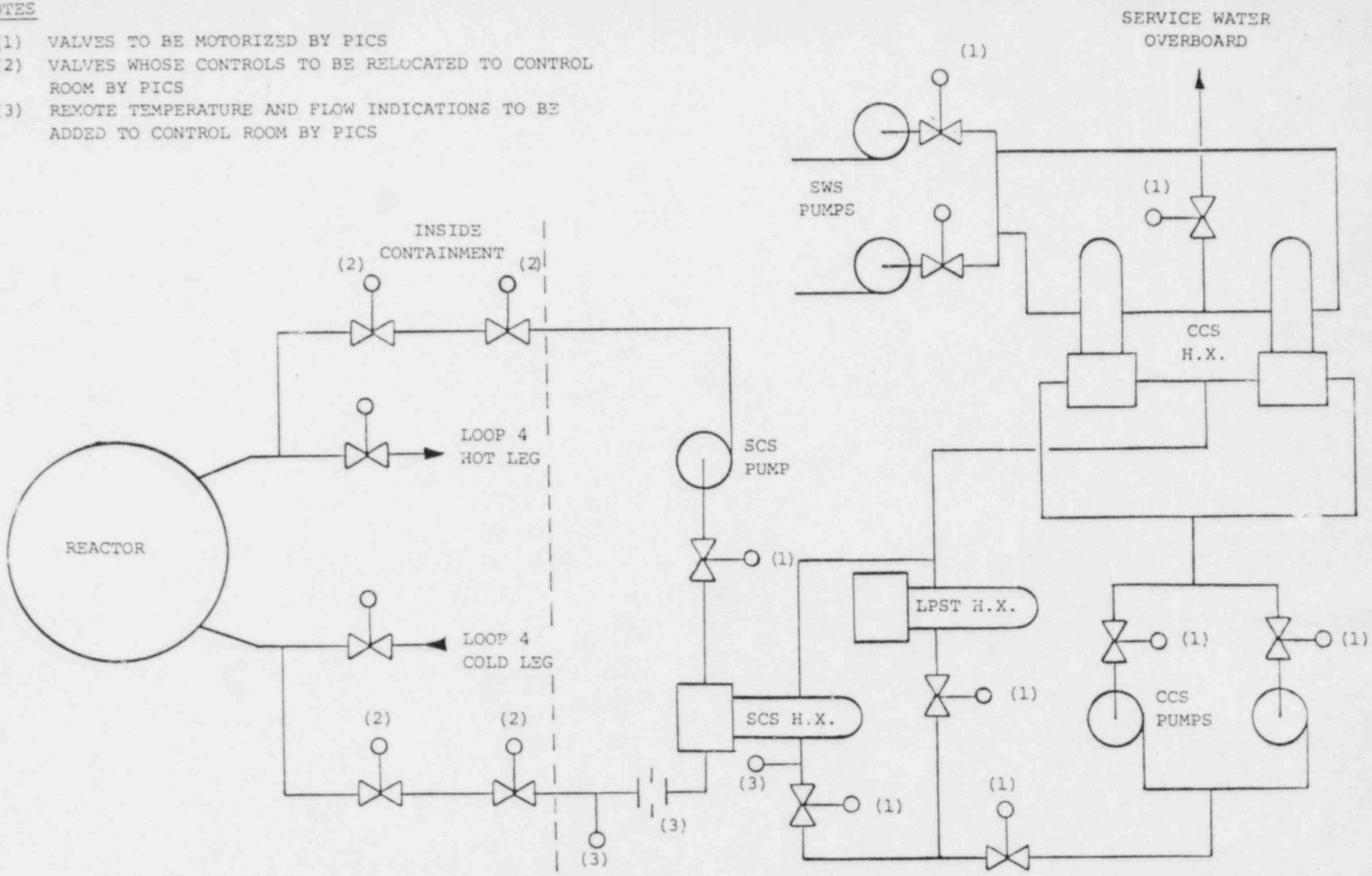

FIGURE 2: COOL DOWN TO CLOD SHUTDOWN FLOW DIAGRAM

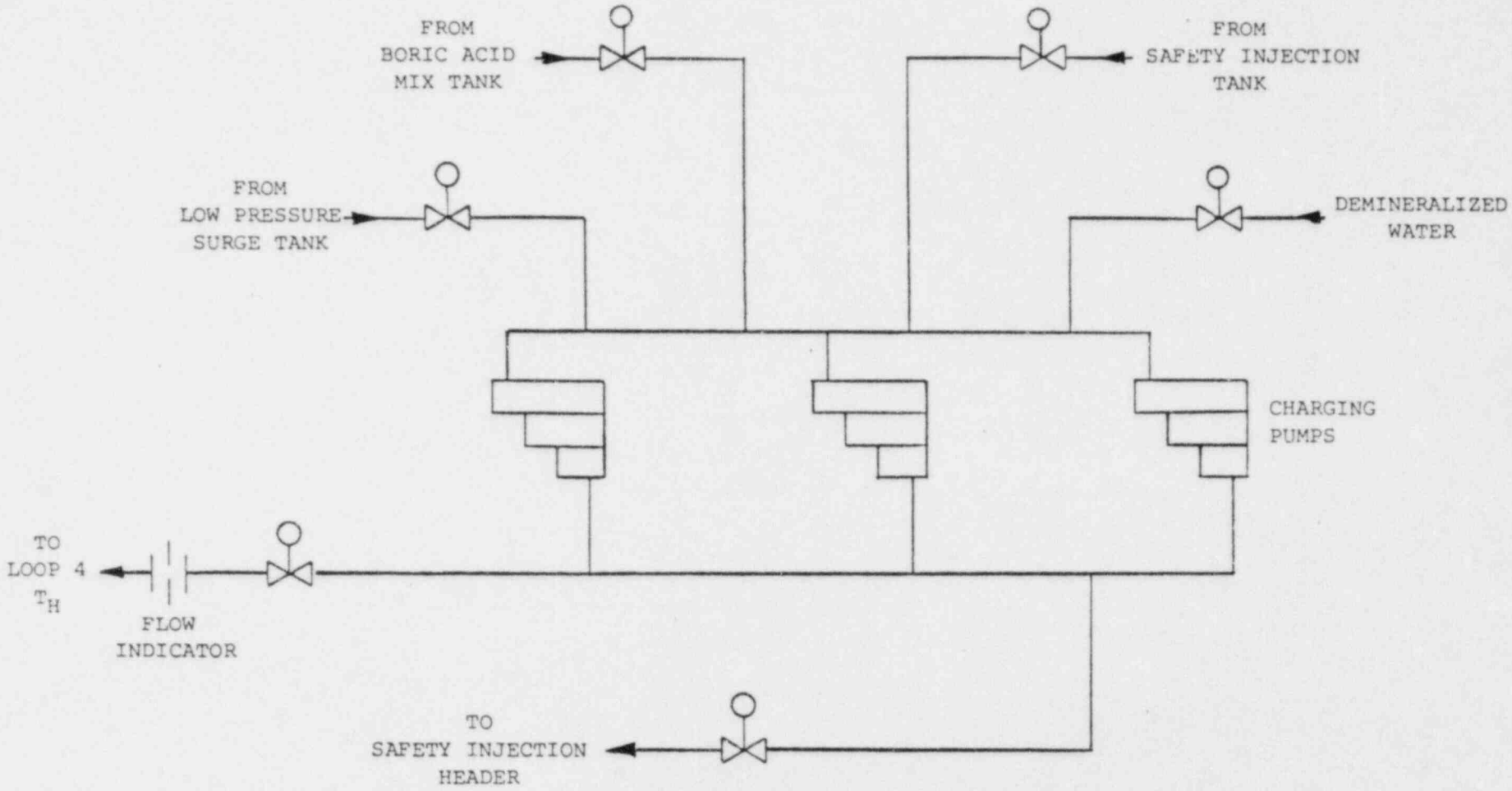

FIGURE 3: MAIN COOLANT INVENTORY, PRESSURE AND BORATION CONTROL FLOW DIAGRAM

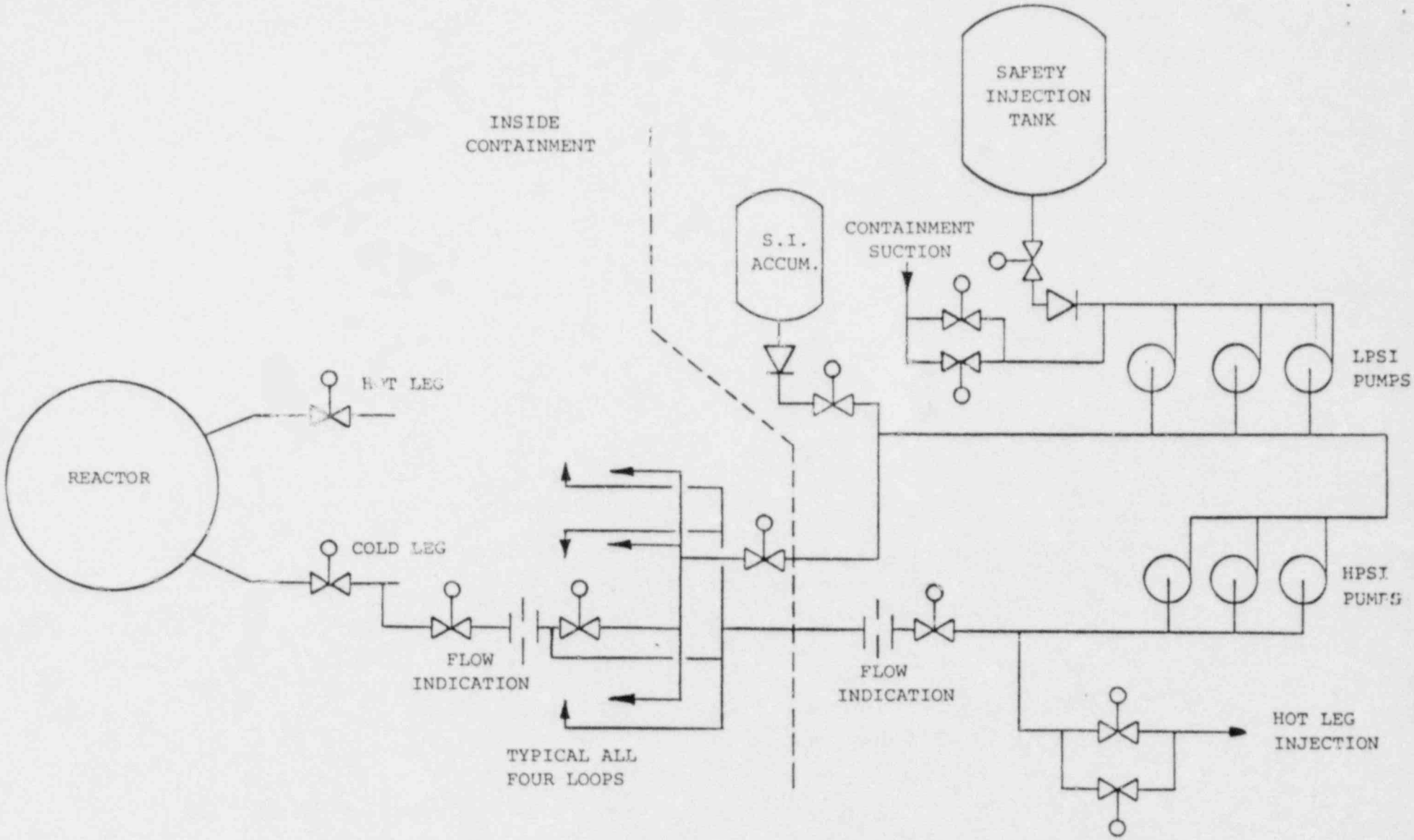

FIGURE 4: EMERGENCY CORE COOLING FLOW DIAGRAM