EMERGENCY CORE COOLING SYSTEM
&
NUCLEAR SERVICE WATER SYSTEM

Chapter 4.0
B&W Cross-Training Course
R-326C

OBJECTIVES

1. List the purposes of the following ECCS:
   a. DHR System
   b. HPI System
   c. Core Flooding Tank System
2. Describe how the DHR system is used to remove decay heat from the core during the later stages of a plant cooldown.
3. State the source of cooling water to the DHR heat exchangers, and explain how the cooldown rate of reactor coolant is controlled.

OBJECTIVES

4. Explain what cavitating venturis are and why they are used in the ECCS.
5. Explain the changes involved in converting the makeup and purification system into the high-pressure injection system.
6. List two accidents or malfunctions for which the high-pressure injection system is designed to provide core cooling.

OBJECTIVES

7. Define the following terms:
   a. LOCA
   b. Blowdown Phase
   c. Injection Phase
   d. Recirculation Phase
8. Explain the integrated operation of the ECCS for the conditions listed in Objective 7.
9. List the purposes of the Nuclear Service Water system (NSW) and the Shutdown Cooling Water system (SCW).

OBJECTIVES

10. Identify the changes that occur in the NSW and SCW systems on the receipt of an engineered safety features actuation signal or loss of offsite power signal.

PHASES OF A LOCA

LOCA – loss of coolant accident greater than makeup capability

The three phases of a loss of coolant accident are:

1. Blowdown – break initiation to equalization of pressure with containment.

2. Injection – refilling of the core from the BWST using HPI and LPI pumps

3. Recirculation – period of long term cooling using containment recirc sump and DHR heat exchangers

Decay Heat Removal System Plant Cooldown Alignment

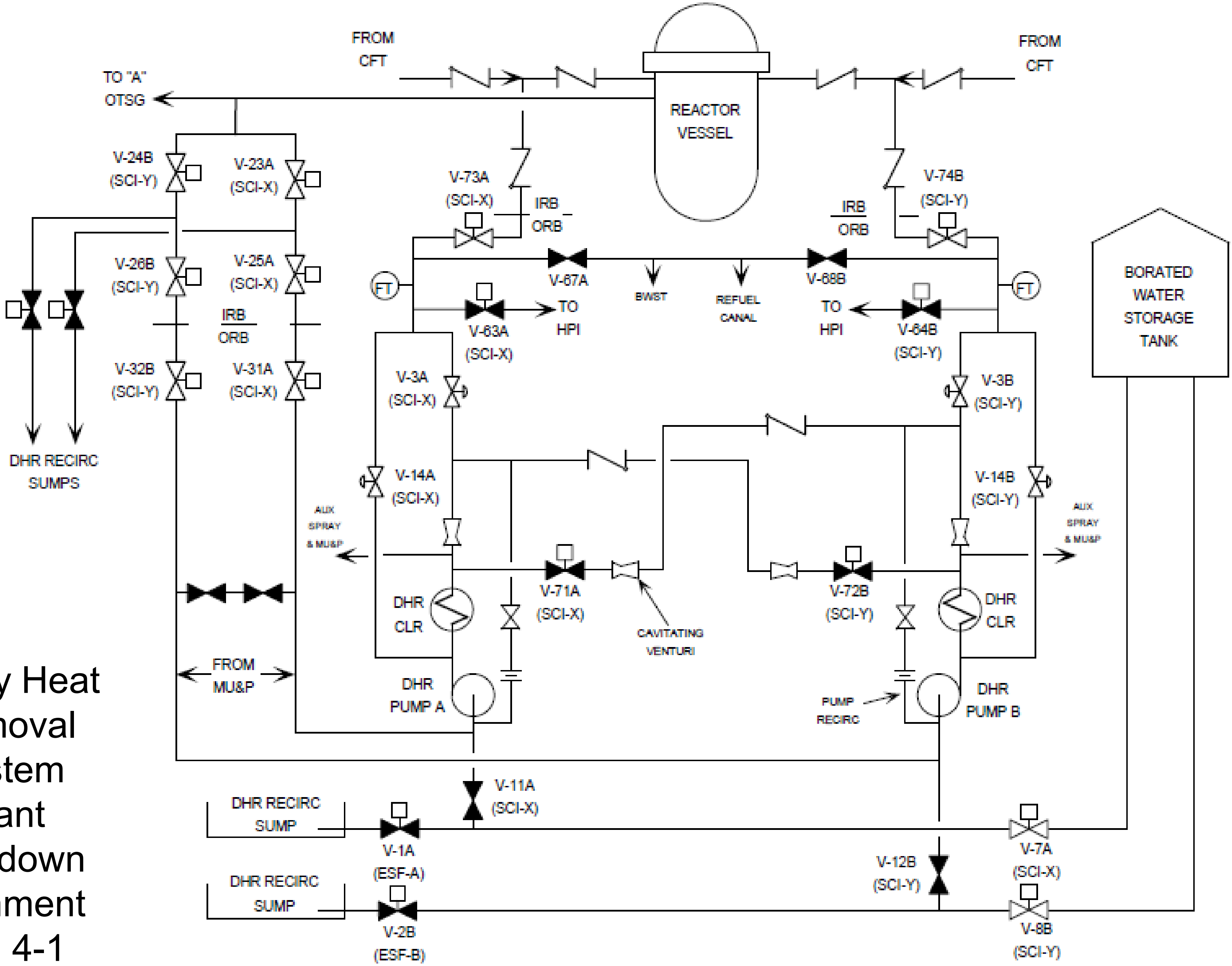
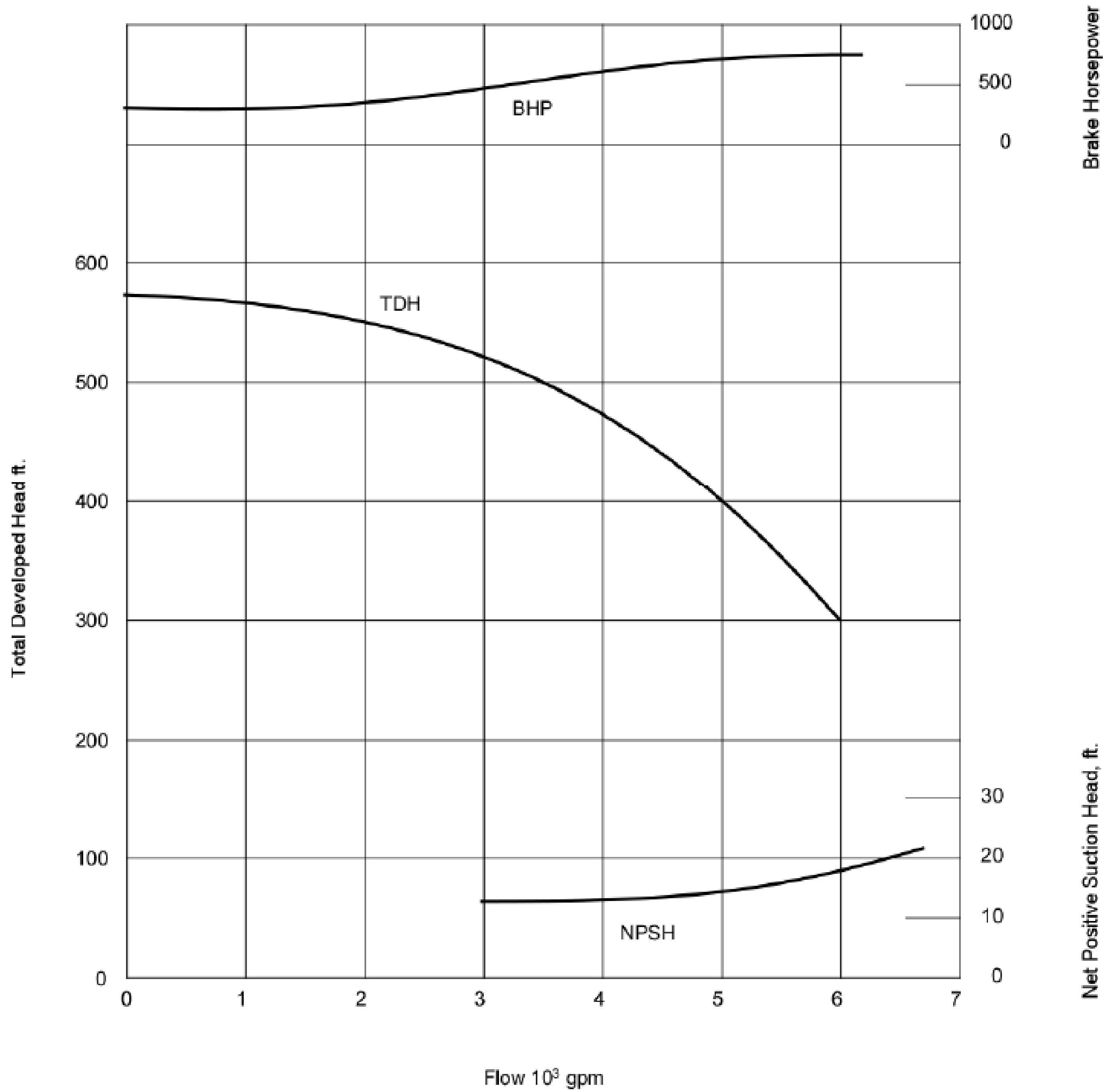
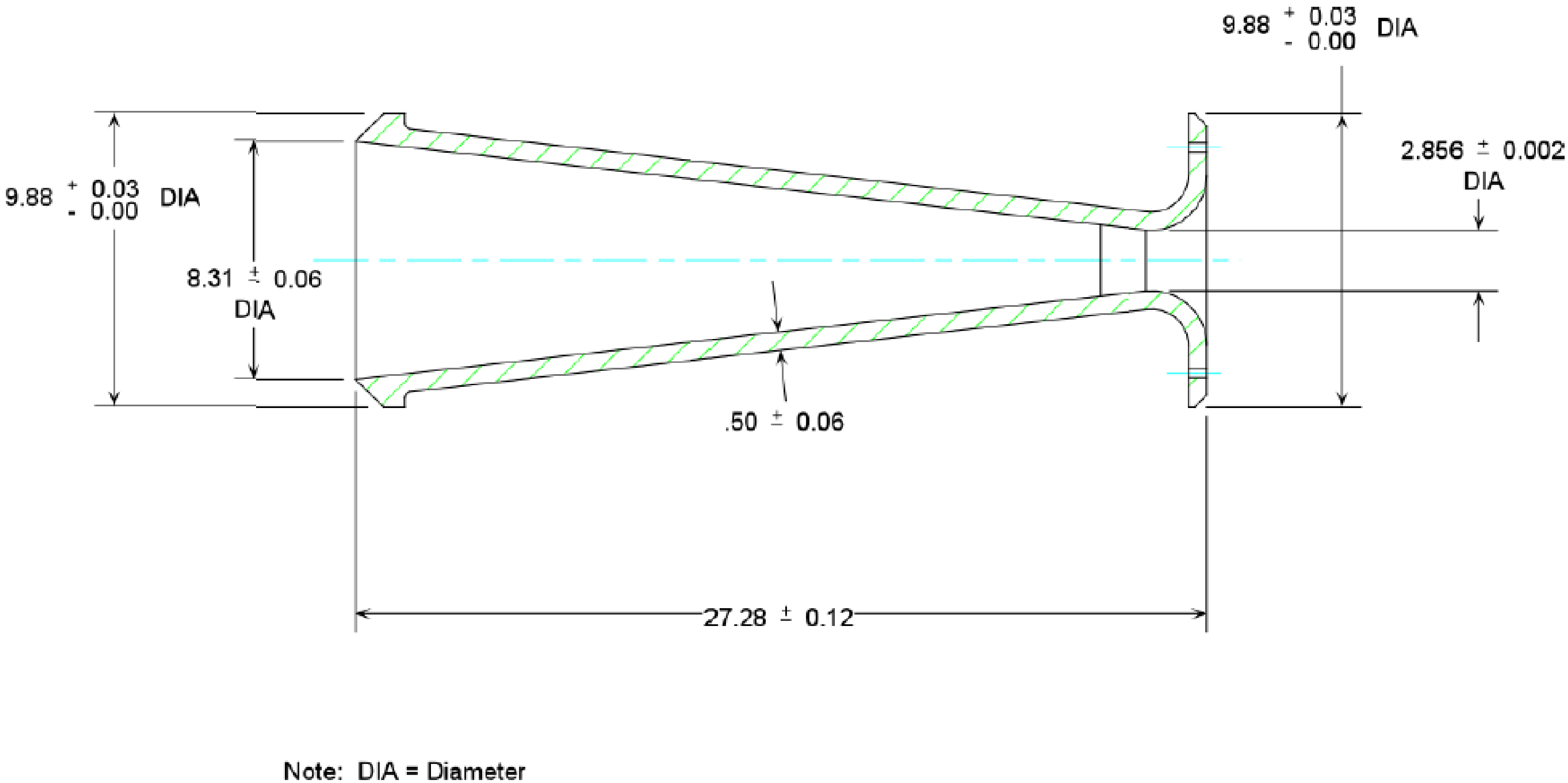


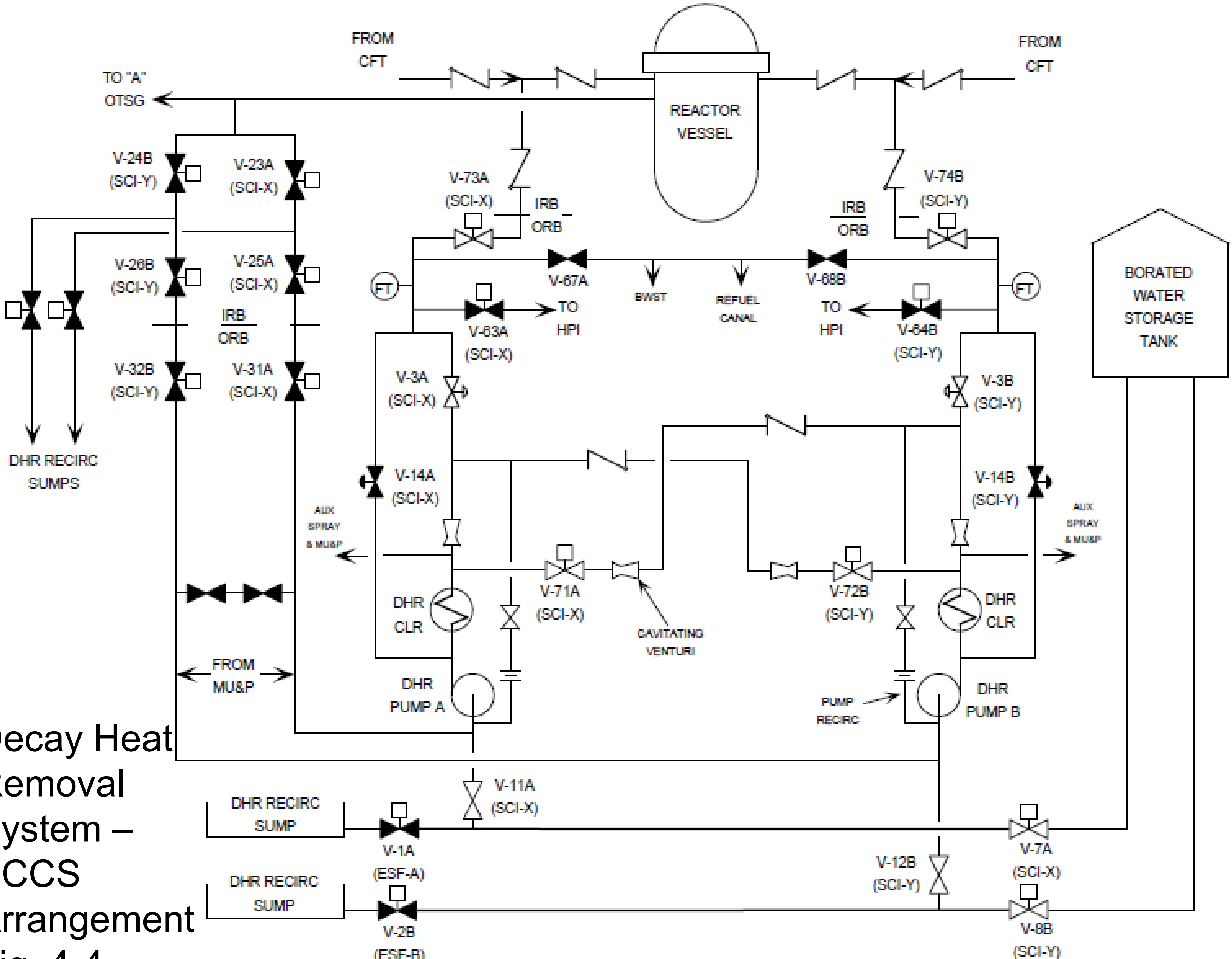
Fig. 4-1

Decay Heat Removal/Low Pressure Injection Pump Char. Fig. 4-2



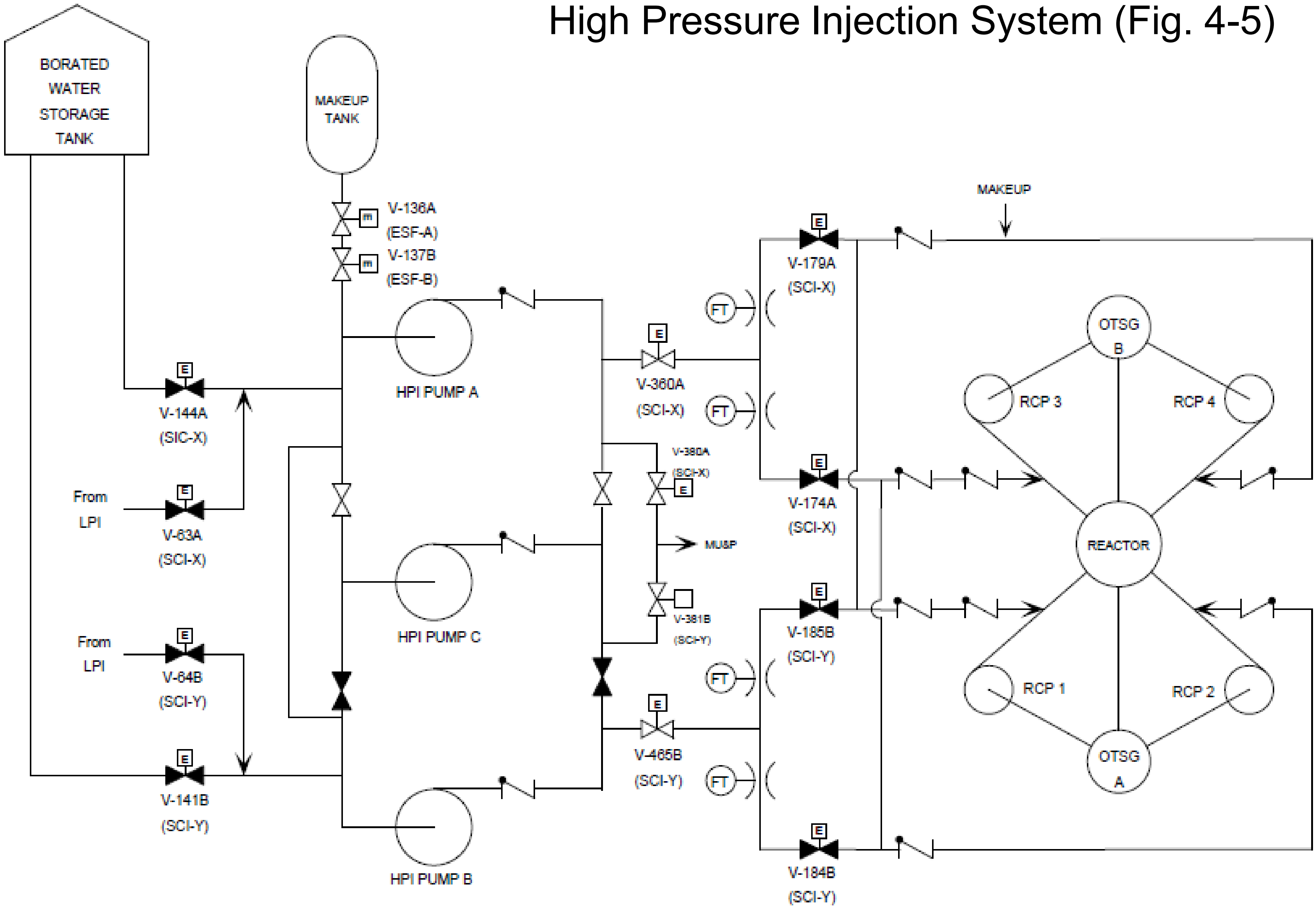


Cavitating Venturi (Fig. 4-3)

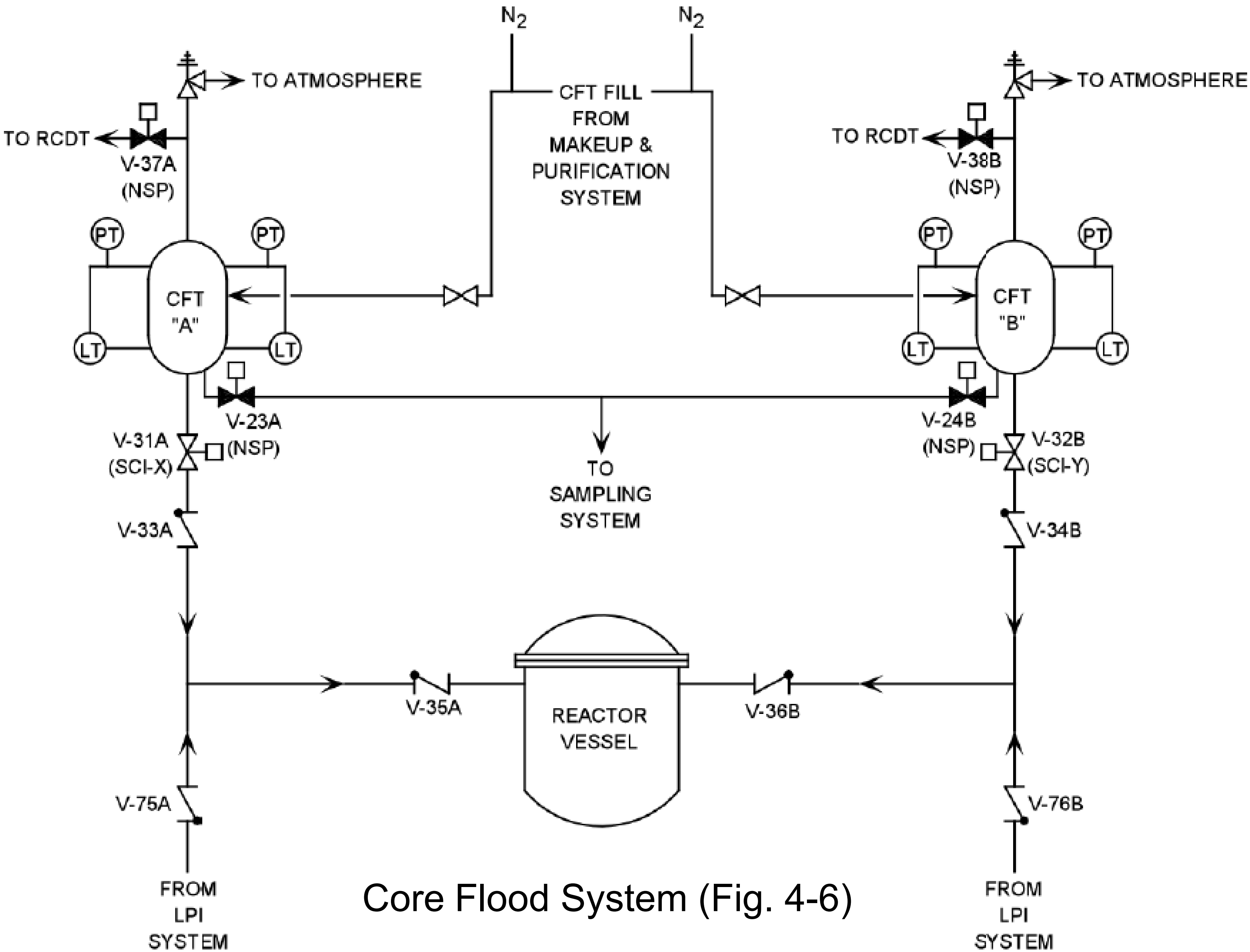


Decay Heat Removal System – ECCS Arrangement Fig. 4-4

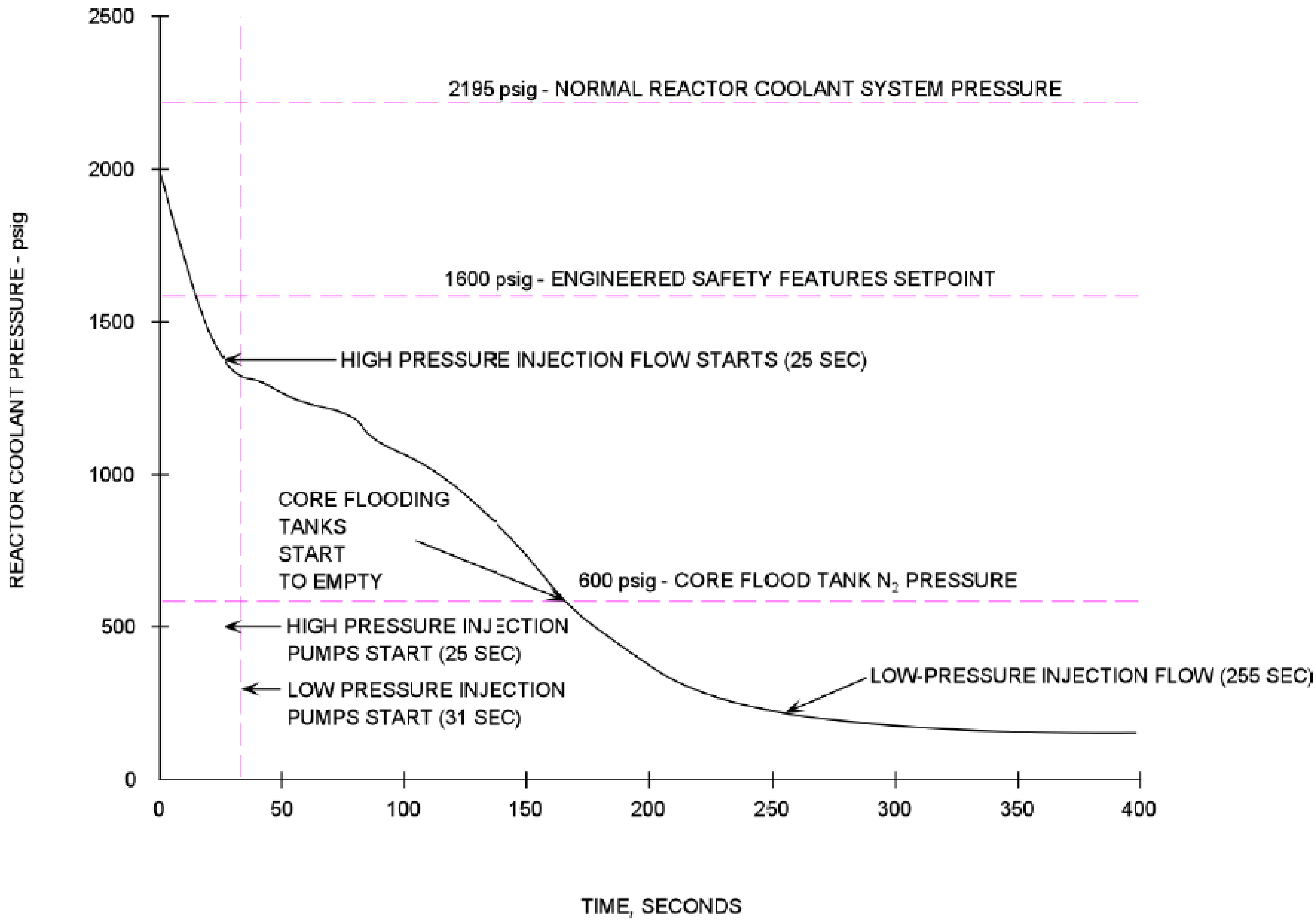
High Pressure Injection System (Fig. 4-5)



E = ESFAS Actuation



Core Flood System (Fig. 4-6)

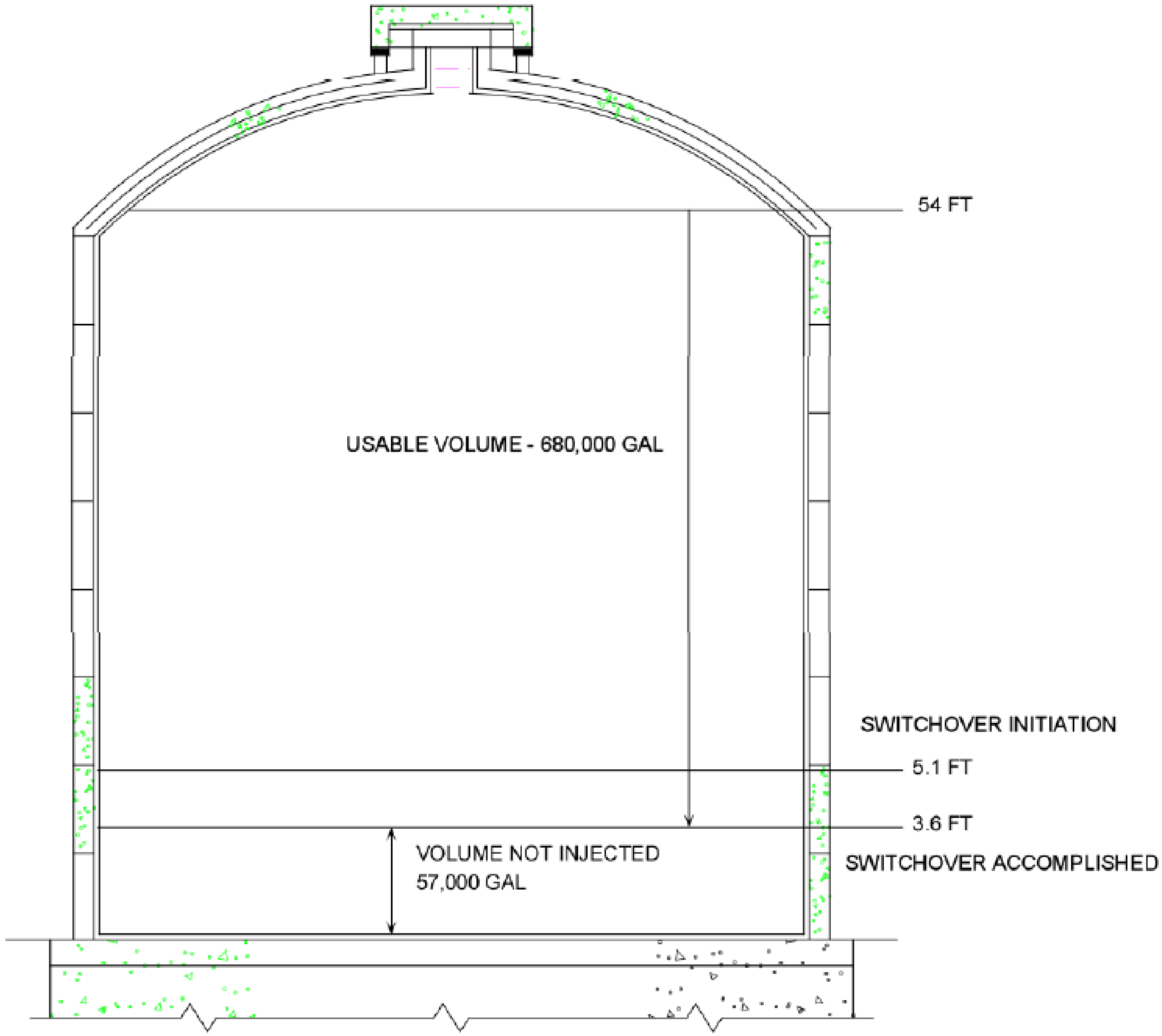


Emergency Core Cooling Actions (Fig. 4-7)

TABLE 4-1 EMERGENCY CORE COOLING SYSTEM FLOWS (ONE TRAIN)								
	HPI System Flow		LPI System Flow		CFT System Flow	ECCS Total Flow	
RCS pressure	Actual	Analysis	Actual	Analysis		Actual	Analysis
psig	gpm	gpm	gpm	gpm	gpm	gpm	gpm
1600	575	486	0	0	0	575	486
600	730	630	0	0	0	730	630
500	740	630	0	0	9016*	9756*	9646*
200	770	0	3600	2500	**	4370	2500+
100	778	0	5800	4500	**	6578	4500+
0	780	0	6500	4500	**	7280	4500+

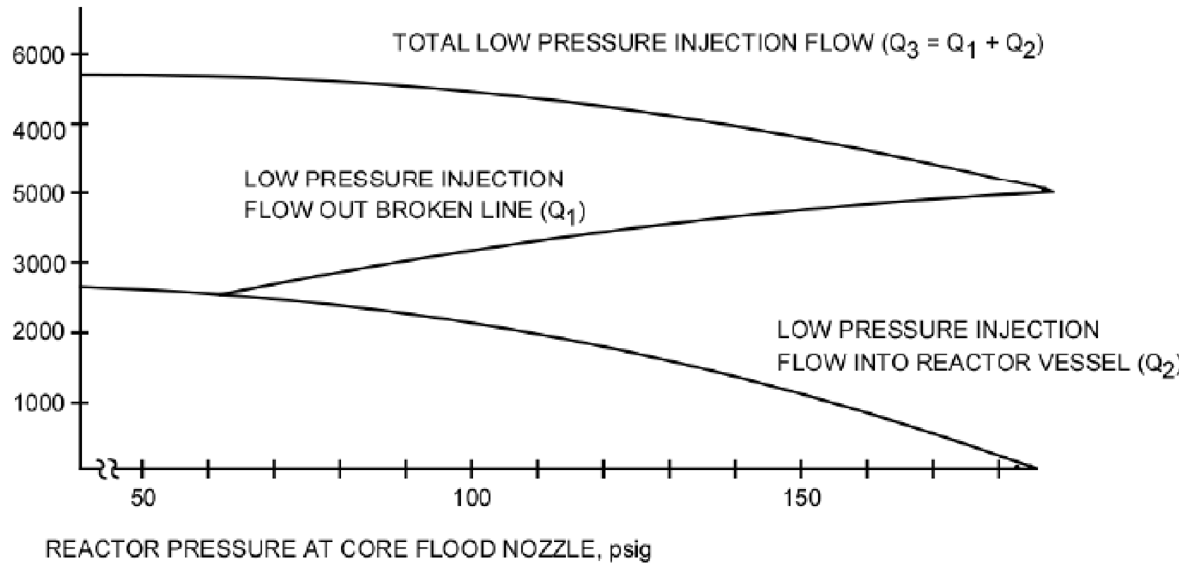
(*) Core flooding system flow when D/P (tank – RCS) = 50 psid.
(**) Core flooding system flow depends on break (time and pressure dependent).
+ Does not include core flooding system flow.

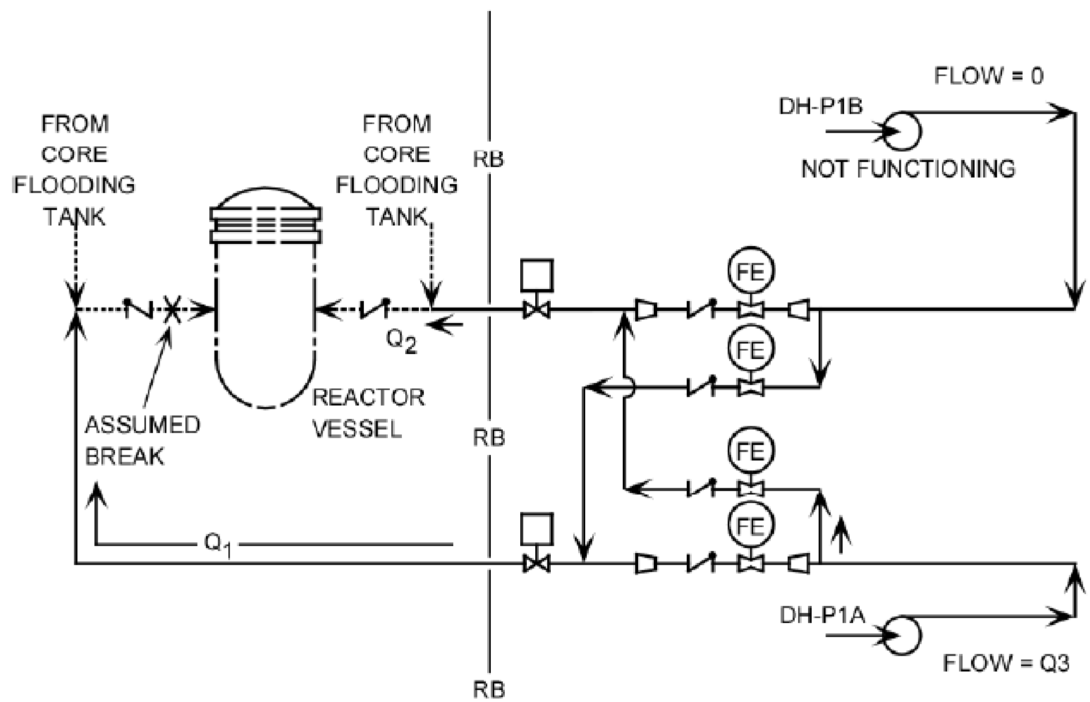
Borated Water Storage Tank Water Capacities Fig. 4-8

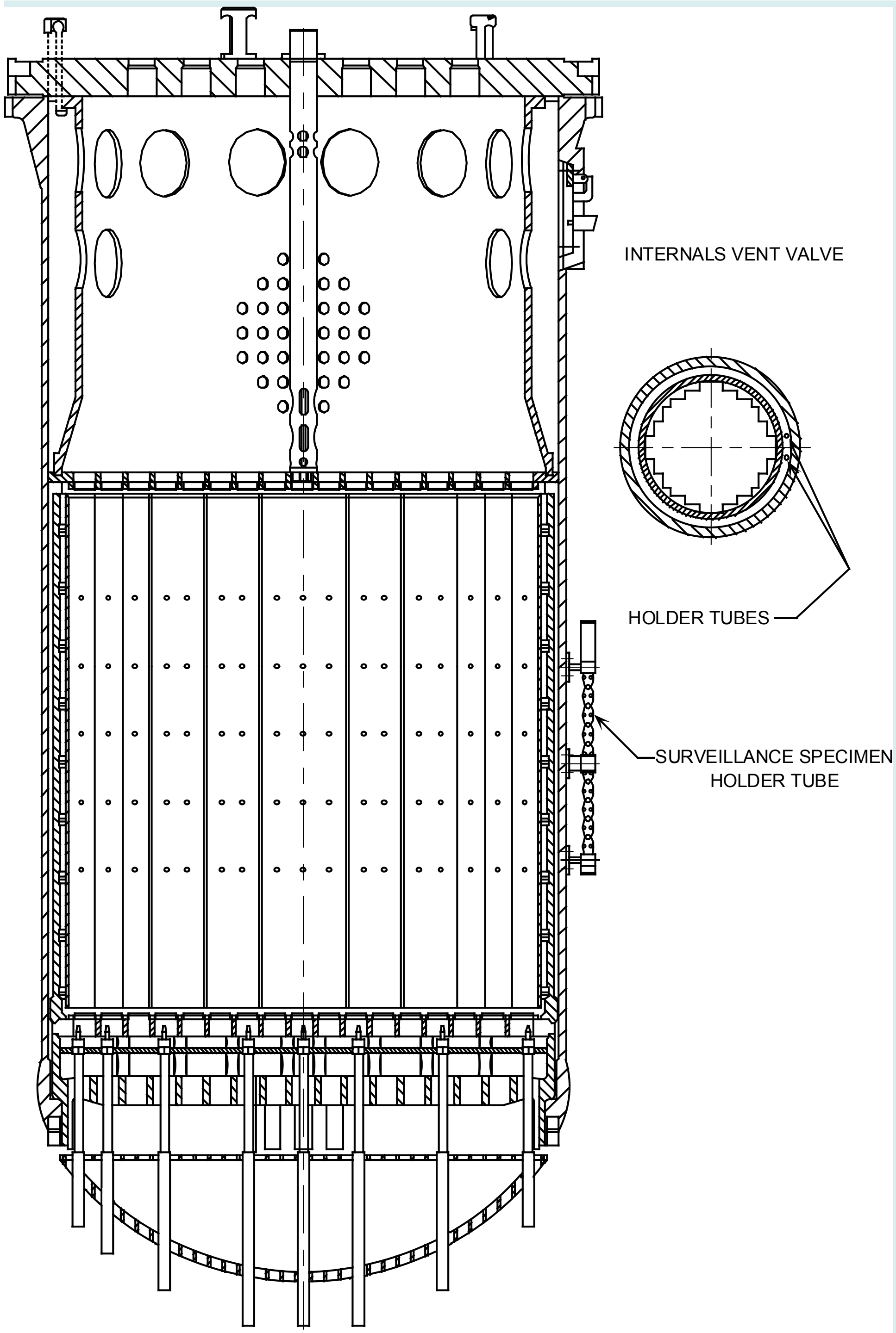


BWST NET CAPACITY - 807,000 GAL

Low Pressure Injection Flow for Core Flood Line Break Fig. 4-9



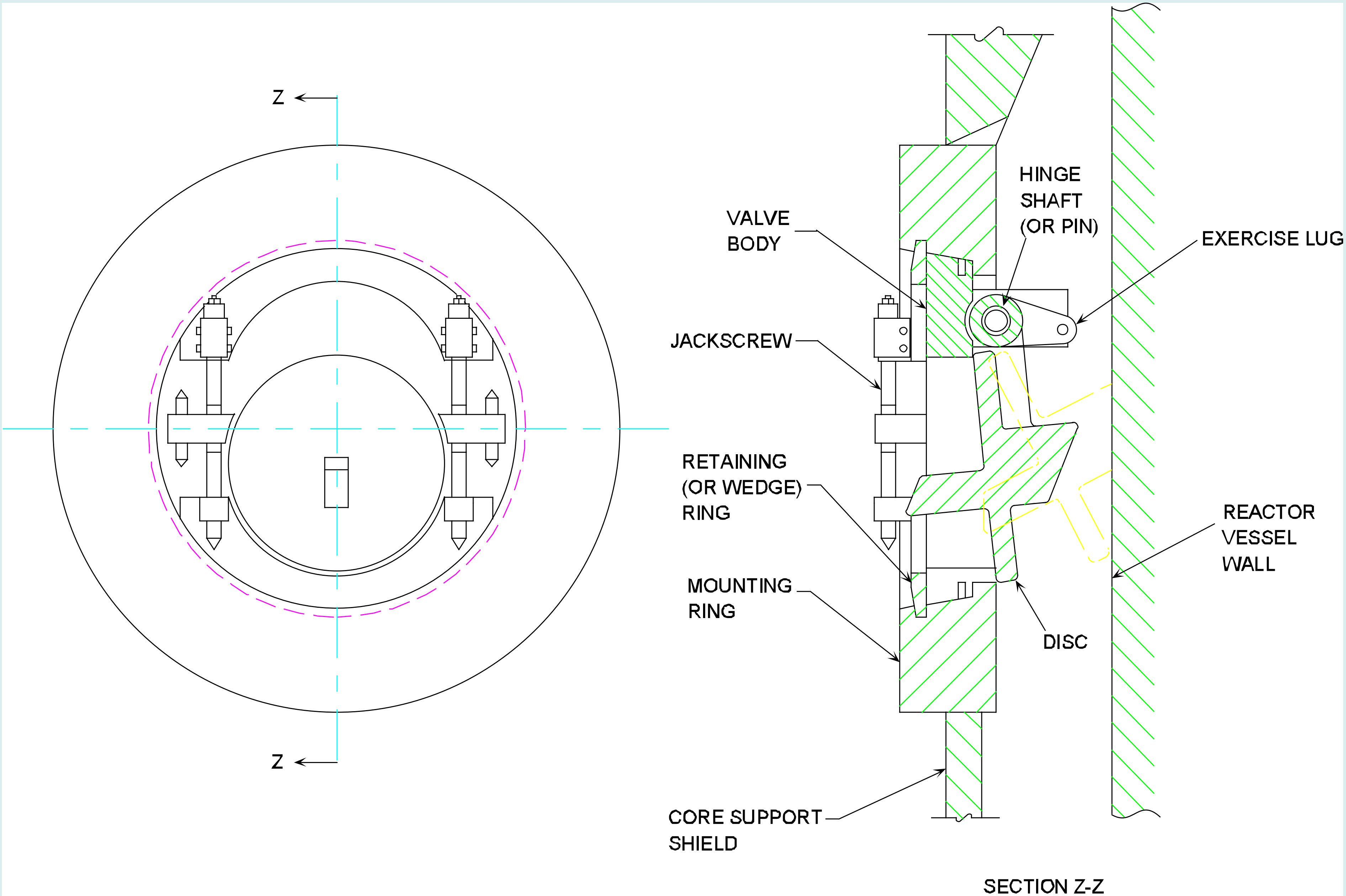




Reactor Internals Vent Valves

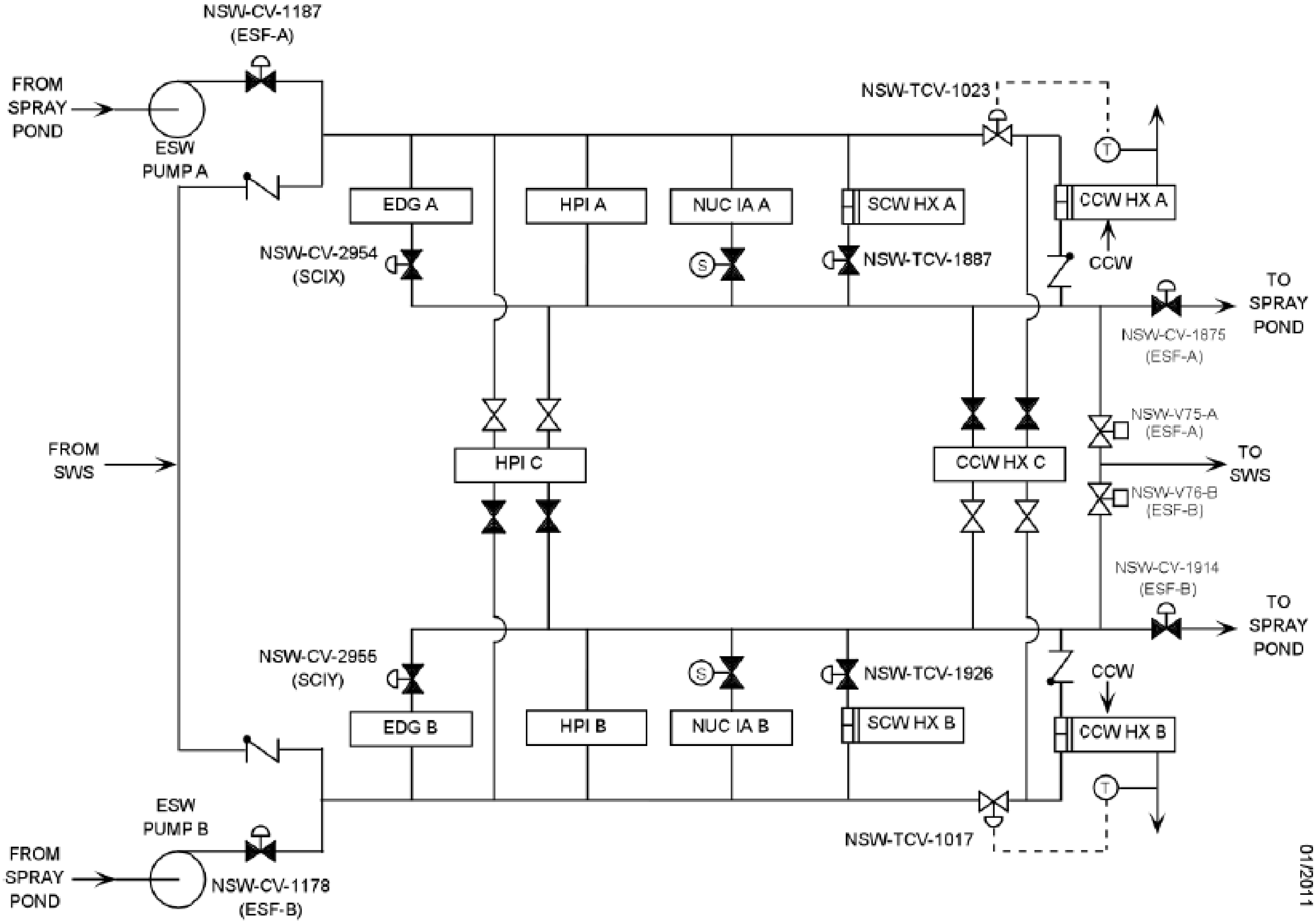
Provides a flow path from the region above the core directly to the cold leg break side in order to maximize injection flow. Hot leg arrangement may not allow for sufficient venting of the steam on cold leg break at lower pressures.

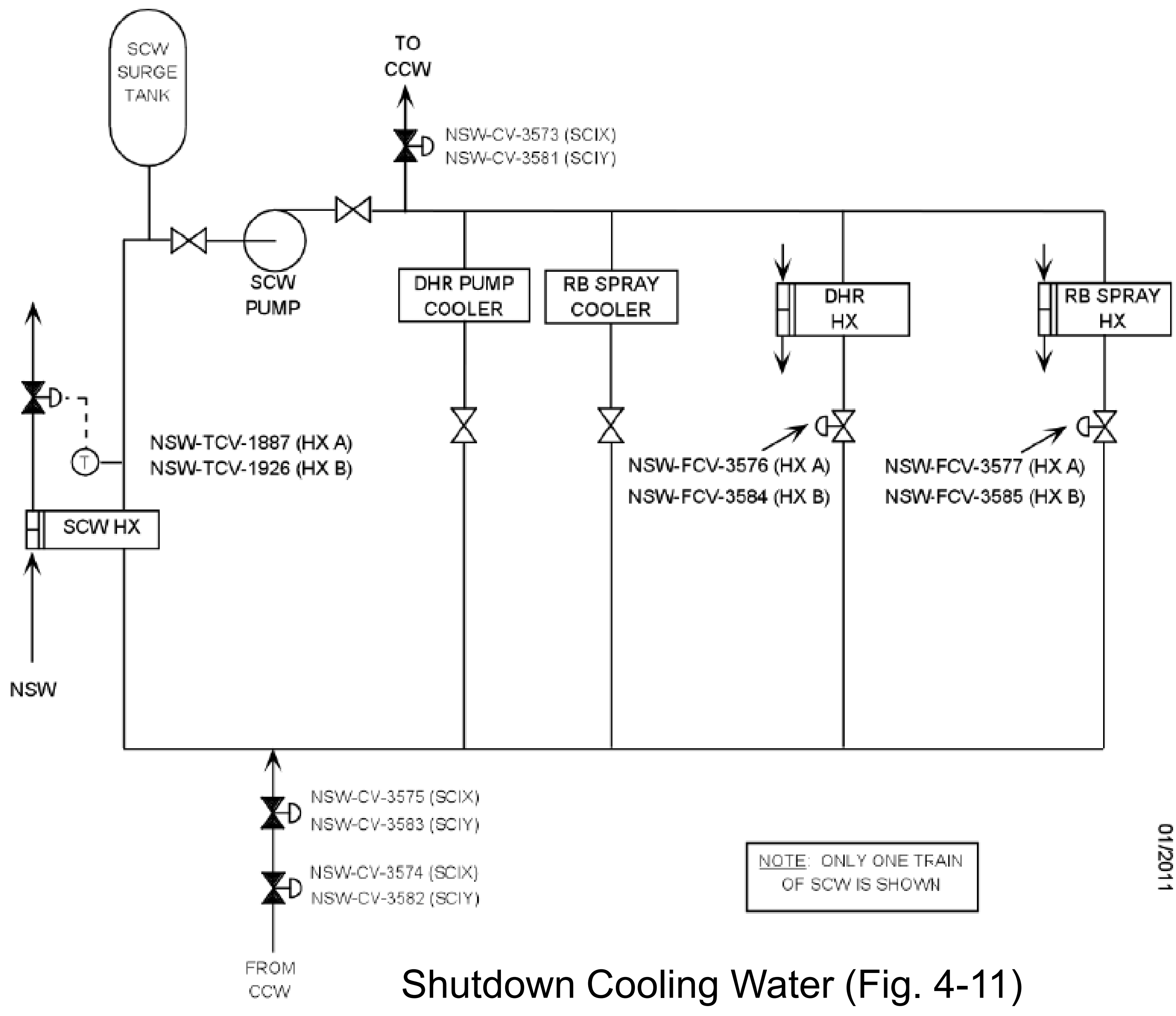
Core Support Cylinder (Fig. 2.1-16)



Vent Valve Arrangement (Fig. 2.1-5)

Nuclear Service Water (Fig. 4-10)





Shutdown Cooling Water (Fig. 4-11)