

U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Reactor Coolant System, Piping, and Pressurizer

Chapter 2.2
B&W Cross-Training Course
R-326C

OBJECTIVES

1. Describe the arrangement of the RCS. List & state the purposes of the following RCS penetrations:
 - a. Hot Leg
 - 1) PZR surge line
 - 2) Decay heat removal suction line
 - 3) High point vent
 - 4) Flow sensing penetration

OBJECTIVES

1. Describe the arrangement of the RCS. List & state the purposes of the following RCS penetrations:

b. Cold Leg

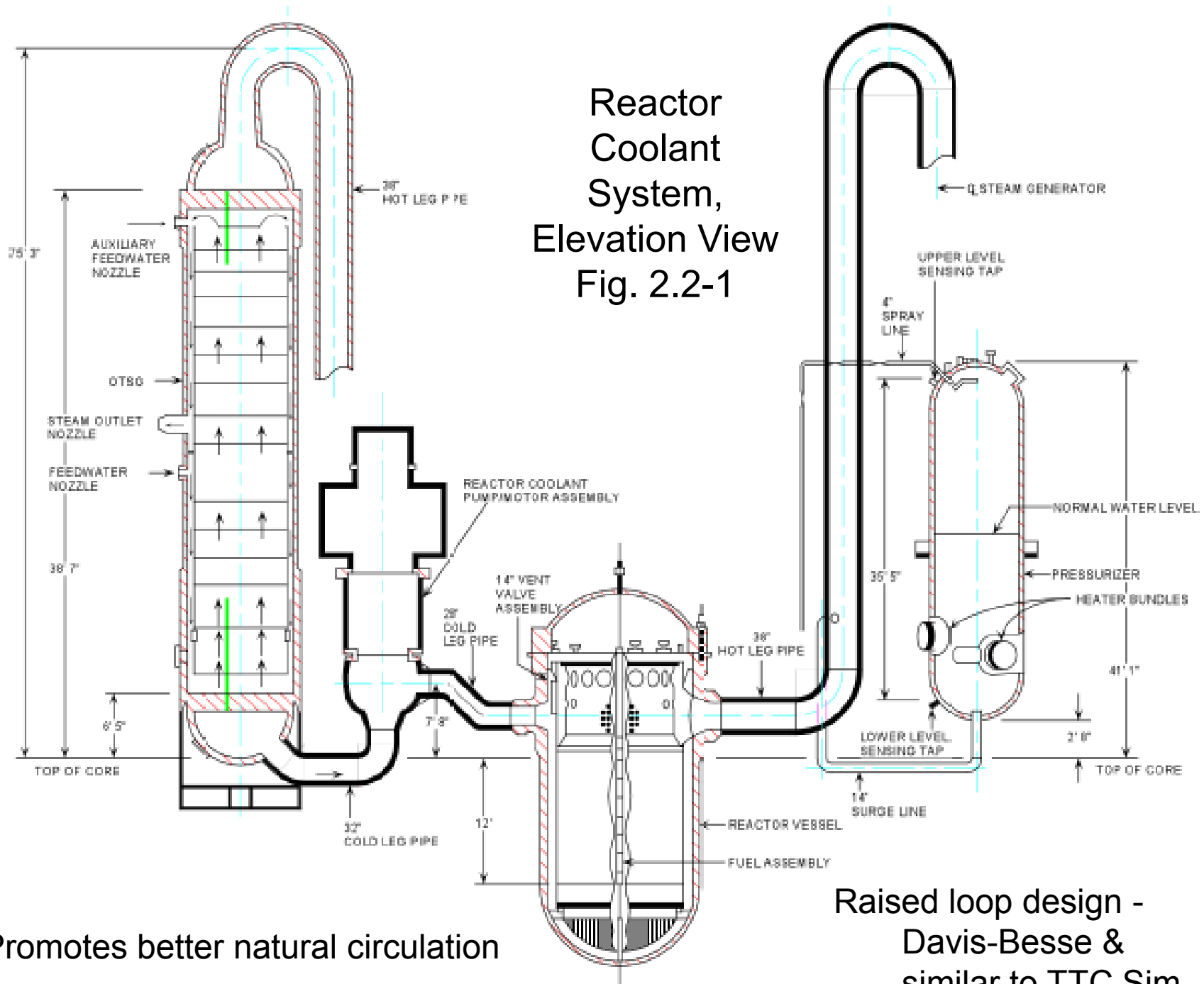
- 1) Makeup & purification letdown
- 2) Loop drain
- 3) PZR spray line
- 4) Normal makeup
- 5) High pressure injection

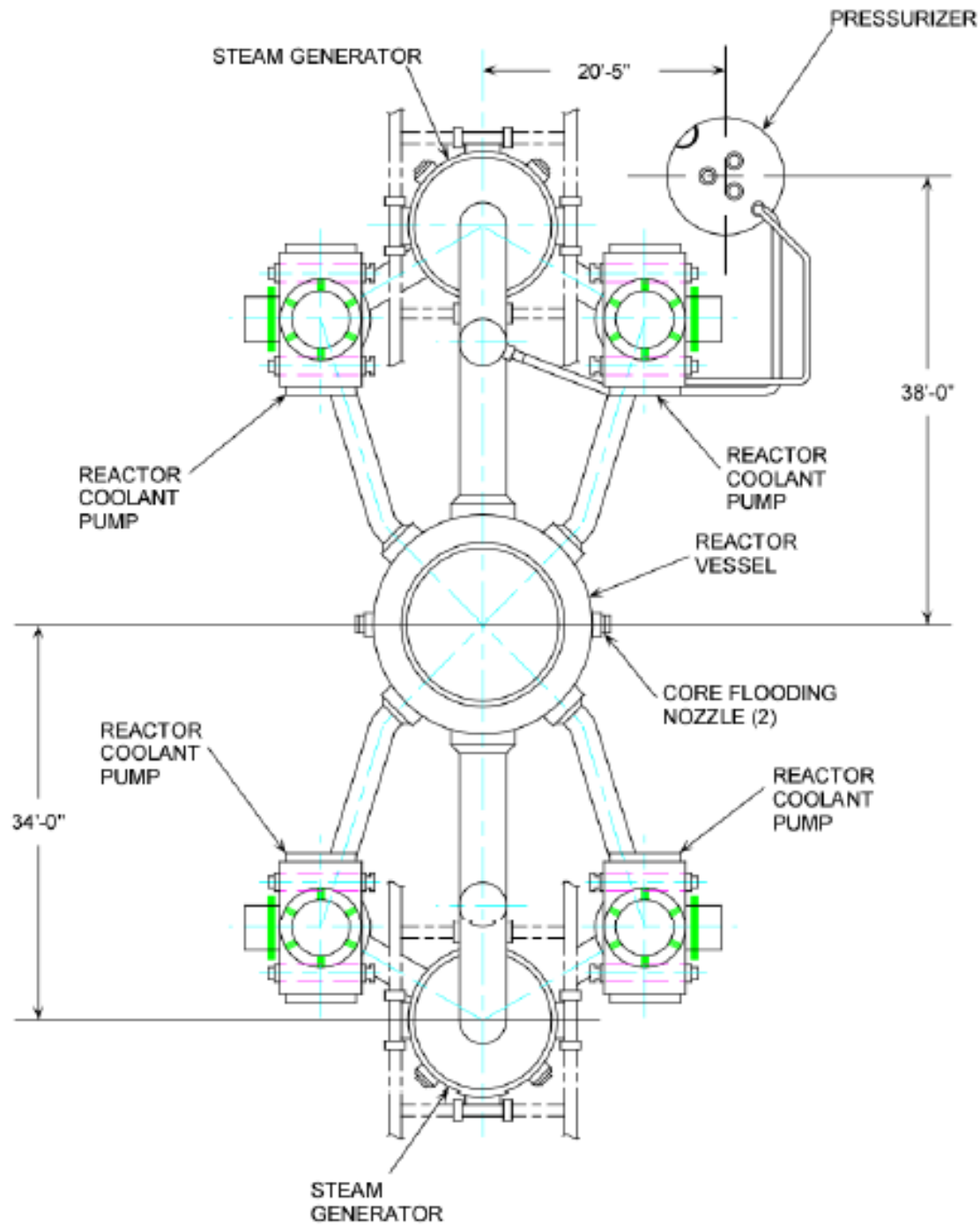
OBJECTIVES

2. State the purpose of the following:
 - a. Power Operated Relief Valve (PORV)
 - b. PZR spray block valve
 - c. Reactor Coolant Drain Tank (RCDT)
 - d. PZR auxiliary spray

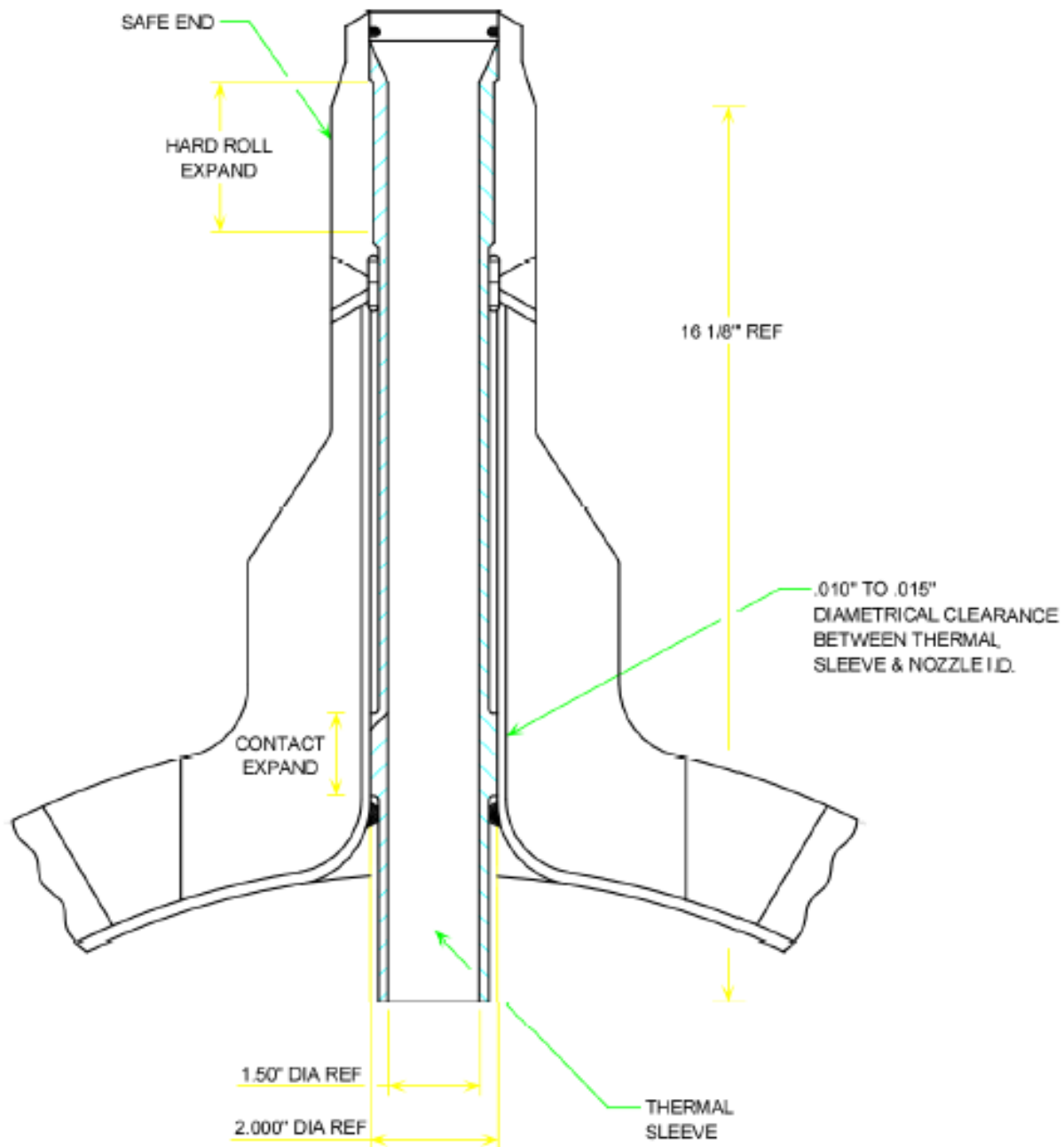
3. Describe the operation of the PZR & the pressure relief system, including methods of determining safety & relief valve leakage.

Reactor Coolant System, Elevation View Fig. 2.2-1





Reactor
Coolant
System,
Plant View
Fig. 2.2-2



Makeup/High
- Pressure
Injection
Nozzle
Fig. 2.2-3

NOP: 2195 psig
Tave: 550-601°F
(0-15%); 601°F
(>15%)
Lpzc: 220" @ NOT

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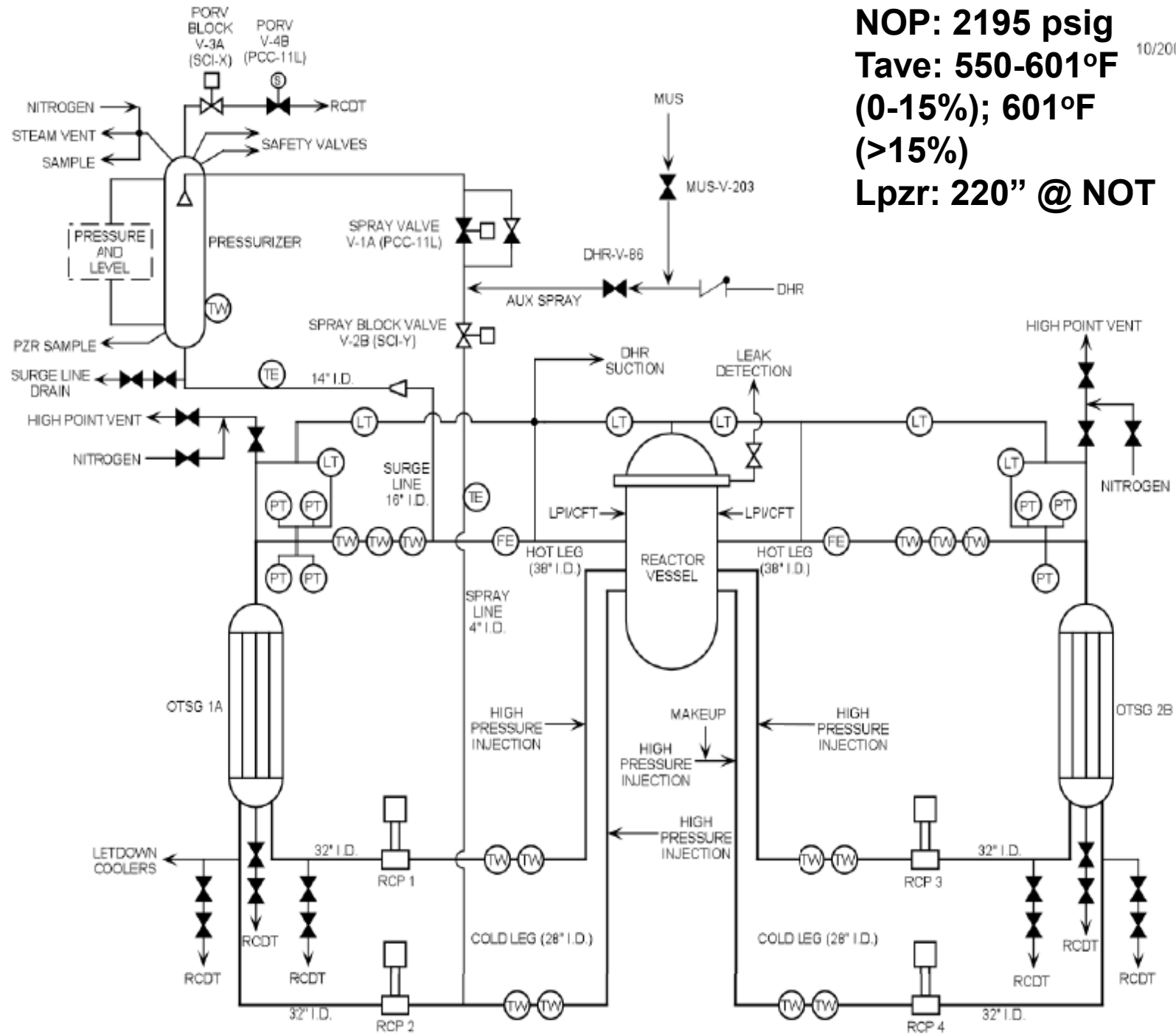


Figure 2.2-4 Reactor Coolant System Flow Diagram

Hot Leg Penetrations

- PZR Surge line (Loop-A). SS 16" & 14" I.D.
 - Hydraulically connects RCS to PZR
 - Thermal sleeve to minimize thermal stress.
- DHR Suction line (Loop-A) SS 14" I.D.
 - Connects RCS to DHR system for Normal plant cooldown (< 400# & 305°F)
 - Cold shutdown & refueling operations.
- Pressure transmitters (Loops A & B)
 - 4 RPS (1500 – 2500#)
 - 3 ESFAS (0 -2500#)
- RTD Thermowells (Loops A & B)
 - 3 thermowells per hot leg
 - Each thermowell contains a dual element RTD
 - 2 RPS, 2 Control & Indication, 2 spares.

Hot Leg Penetrations (continued)

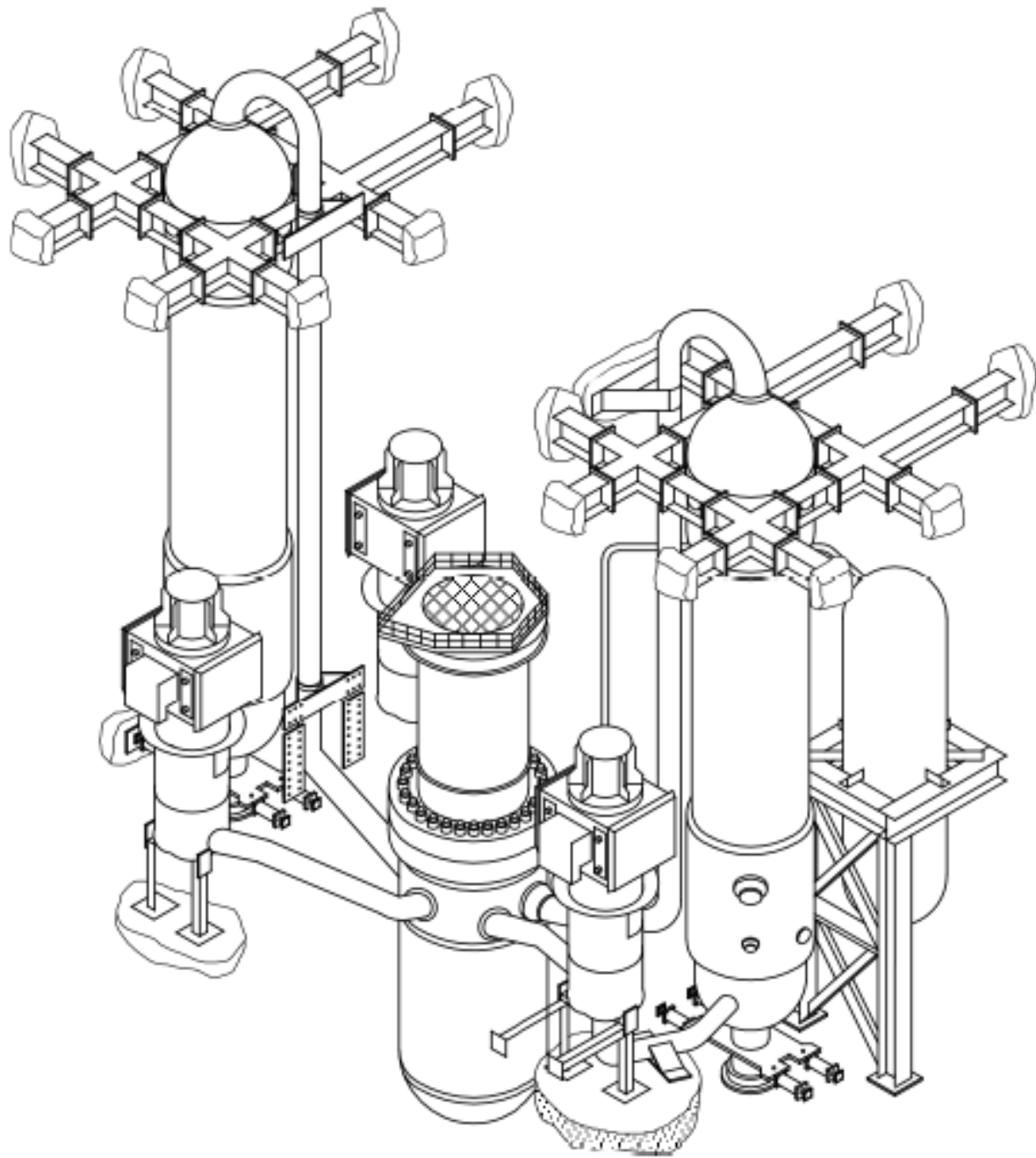
- High point vents (one per hot leg) 1”
 - Vent loops during startup
 - Vent non-condensable gases during accidents
 - Operated from control room
 - Discharge to RCDT (containment at some plants)
 - Connections for N₂ purge
 - Connections for hot leg level instrument upper taps
- Flow sensing penetrations (Loops A & B)
 - One flow element per hot leg
 - Six transmitters per element
 - 4 RPS and 2 Control & Indication

Cold Leg Penetrations

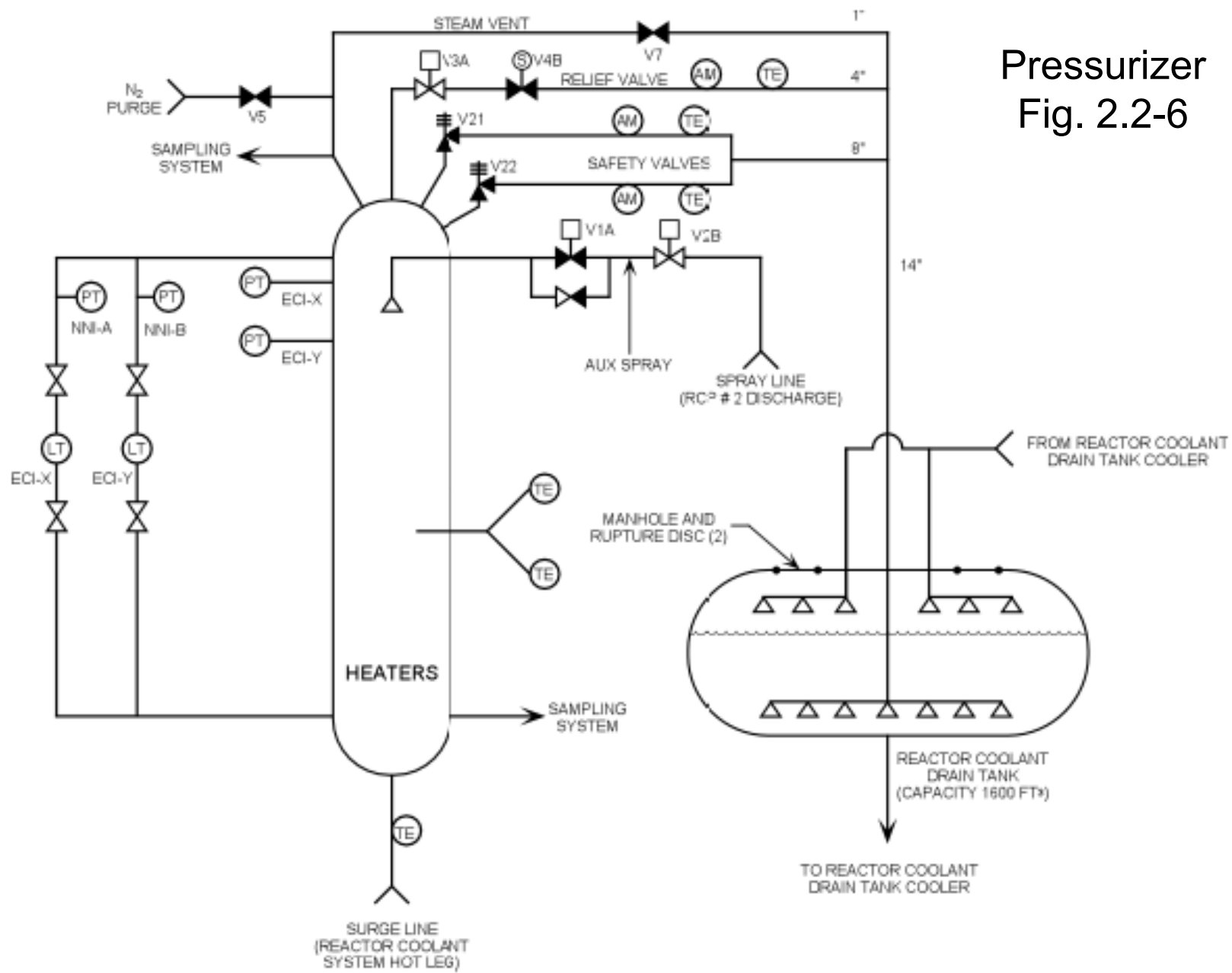
- High Pressure Injection (2.5")
 - One per cold leg.
 - ECCS high pressure supply to RCS.
 - Thermal sleeve to minimize thermal stress.
- Normal makeup (2.5")
 - Connected to HPI penetration to reduce the number of RCS penetrations.
 - Connects makeup & purification sys. to RCS.
- RTD Thermowells
 - Two thermowells per cold leg.
 - Each thermowell contains a dual element RTD.
 - 2 Control & Indication, 2 spares.

Cold Leg Penetrations (continued)

- PZR spray line (4") (RCP-2 discharge)
 - ΔP across vessel provides PZR spray driving force (no scoops)
 - Provides relatively cool RCS water to PZR for automatic or manual pressure control
- Makeup & purification letdown (3")
 - Intermediate leg (RCP-2 suction)
 - Connects RCS to makeup & purification sys.
- Loop drains (1.5")
 - Used to drain RCS for maintenance.



Reactor
Coolant
System
Supports and
Restraints
Fig. 2.2-5



Pressurizer
Fig. 2.2-6

Pressurizer

- Purposes:
 - Maintains RCS subcooled.
 - Provides for pressure control & overpressure protection.
 - Accommodates RCS volume changes.

Pressurizer

- PZR Heaters
 - 72 heaters (4 banks – 10 groups) - 1742 KW
 - Raise pressure to NOP during startup
 - Restore RCS pressure following transients
 - Auto off < 120" PZR level (auto on > 120")
- Spray Block Valve
 - MOV upstream of spray valve
 - Isolates spray line if spray valve fails to close
- Spray Valve
 - Opens 2245#; closes 2195# (NOP 2195#)
 - In auto control, MOV either 40% open or closed
 - In manual control, MOV can be throttled (jogged). Can be opened to 100%.
 - ΔP across vessel provides driving force (no scoops)
 - Normal spray flow ~ 275 gpm w/ 4 RCPs

Pressurizer (continued)

- **PZR Auxiliary Spray (2")**
 - Connects between block & spray valve.
 - Used for RCS depressurization when DHR in service & RCPs stopped.
 - Supplied from DHR.
 - Another supply from HPI.
 - Used for RCS depressurization during emergencies.
 - Not all B&W plants have feature.
- **Code Safety Valves (8") (setpoint: 2500#)**
 - Two spring-loaded, self-actuated safety valves.
 - Protects RCS from overpressure.
- **Power-Operated Relief Valve (PORV) (4")**
 - Solenoid-actuated pilot valve.
 - Limits pressure transients during step load changes to prevent lifting safeties.
 - Setpoint: Open 2400 psig; Close 2375 psig

Pressurizer (continued)

- PORV Block Valve – Isolates failed or leaking PORV.
- Temperature element & acoustic monitor on each downstream tailpipe.