U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

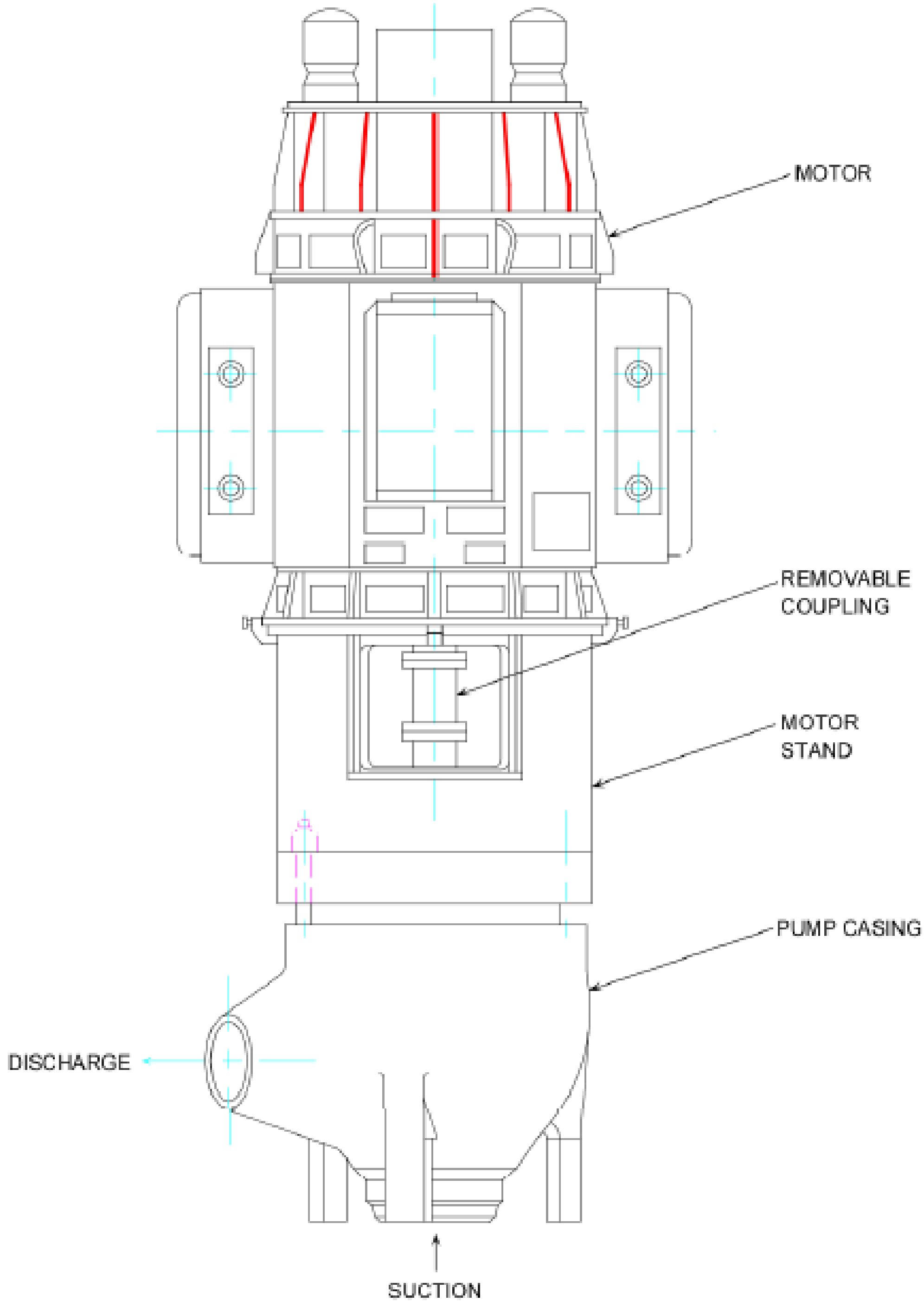
Reactor Coolant Pumps and Motors

Chapters 2.3
B&W Cross-training Course
R-326C

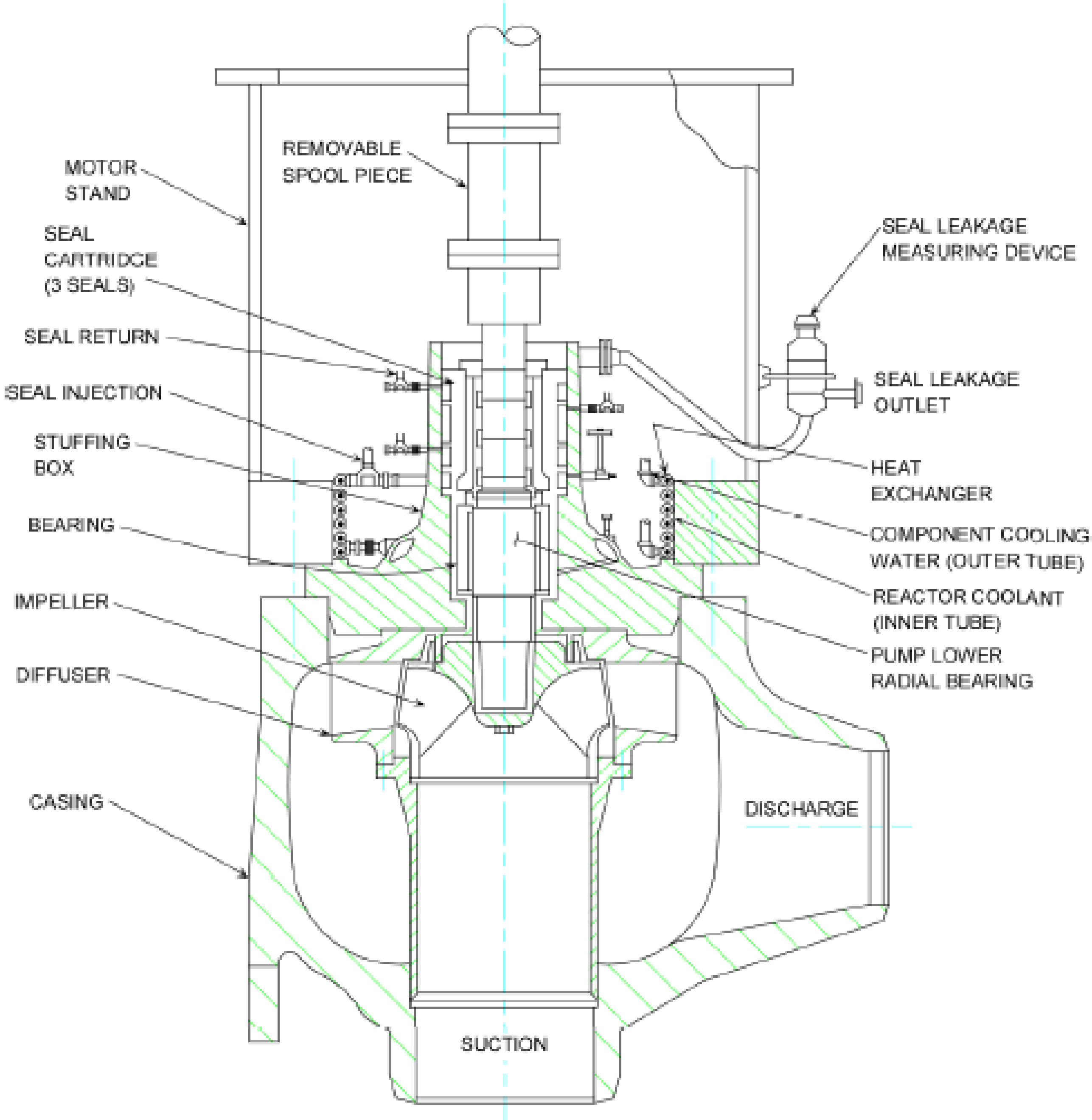
HRTD
Human Resources
Training & Development

OBJECTIVES

1. Explain how the plant operator can determine a seal failure using seal pressure indications.
2. Explain the purposes of the protection provided by the following reactor coolant pump start interlocks:
   a. Low oil pressure interlock.
   b. Minimum seal injection water & CCW flow interlock.
   c. Cold water interlock.
   d. Core lift interlock.



Reactor
Coolant Pump
and Motor
Assembly
Fig. 2.3-1



Reactor Coolant Pump Cross Section Fig. 2.3-2

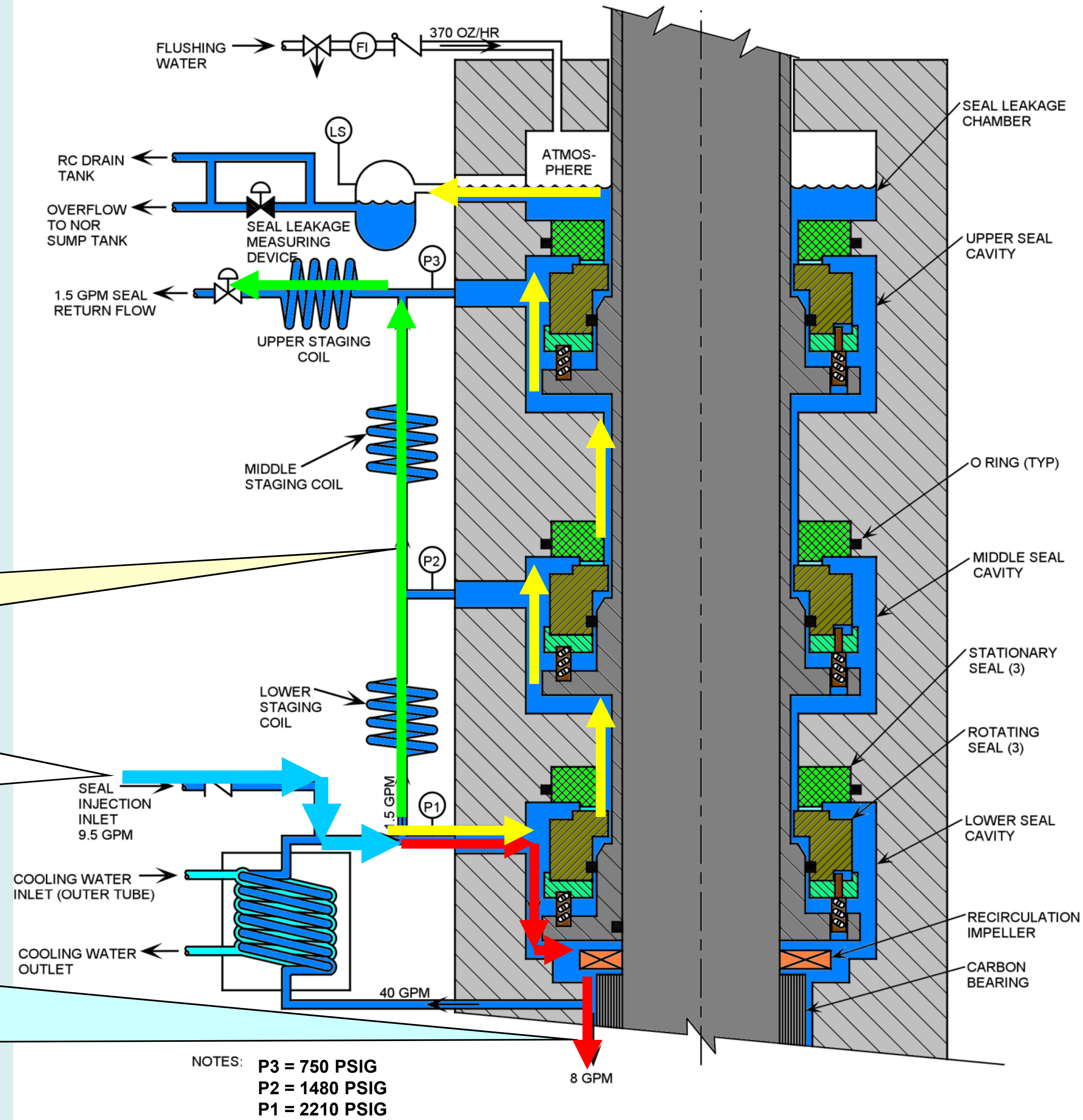
Shaft Seal Arrangement Fig. 2.3-3

Pressure is dropped by staging coils & clearances of the seals.

1.5 gpm passes through seal package.

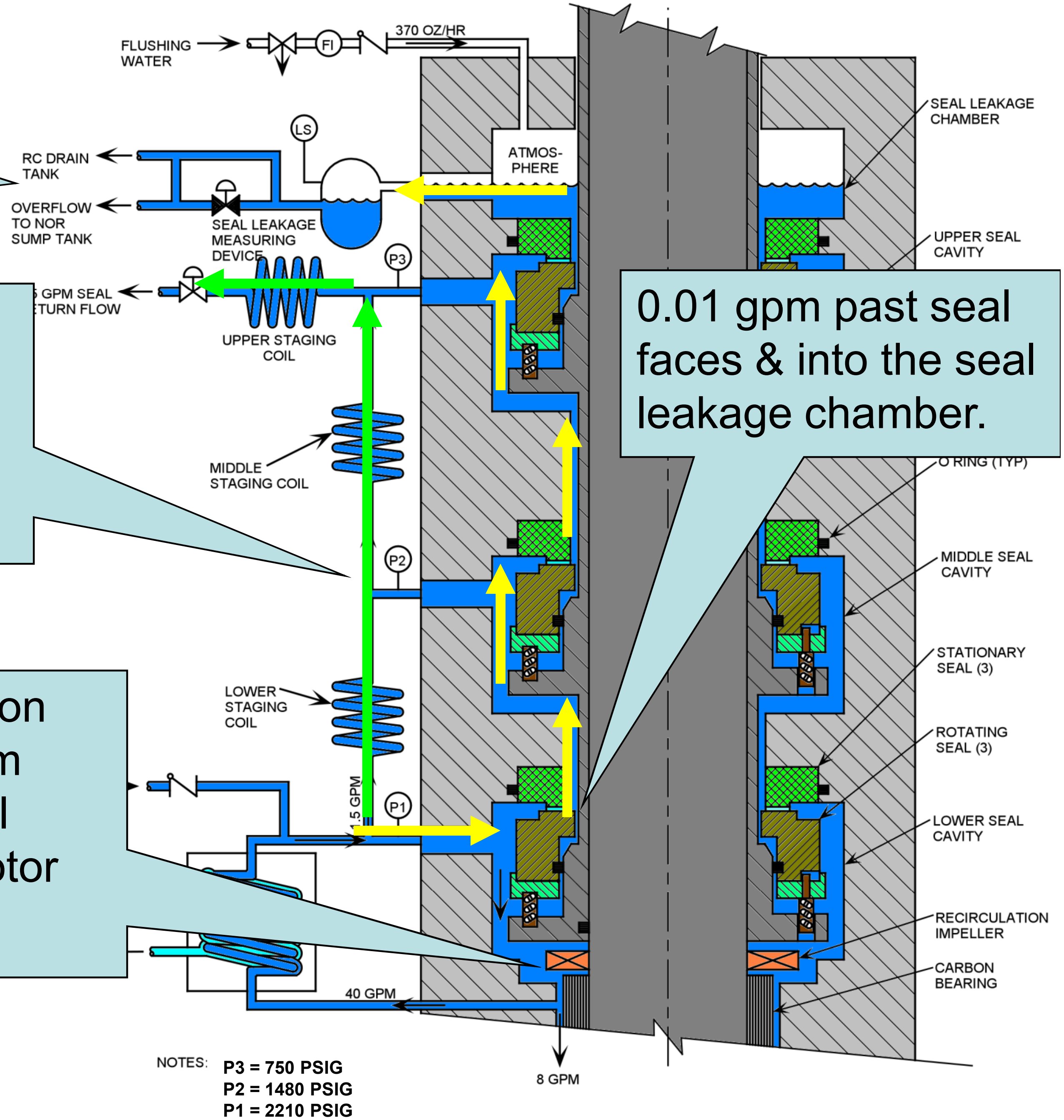
9.5 gpm per RCP supplied from M/U & Purification.

8 gpm into pump casing & down past radial bearing into RCS.



Seal leakage chamber alarmed & drains to RCDT.

Most of the 1.5 gpm flow passes through 3 staging coils and to Seal Return HX (to M/U & Purification system makeup tank).



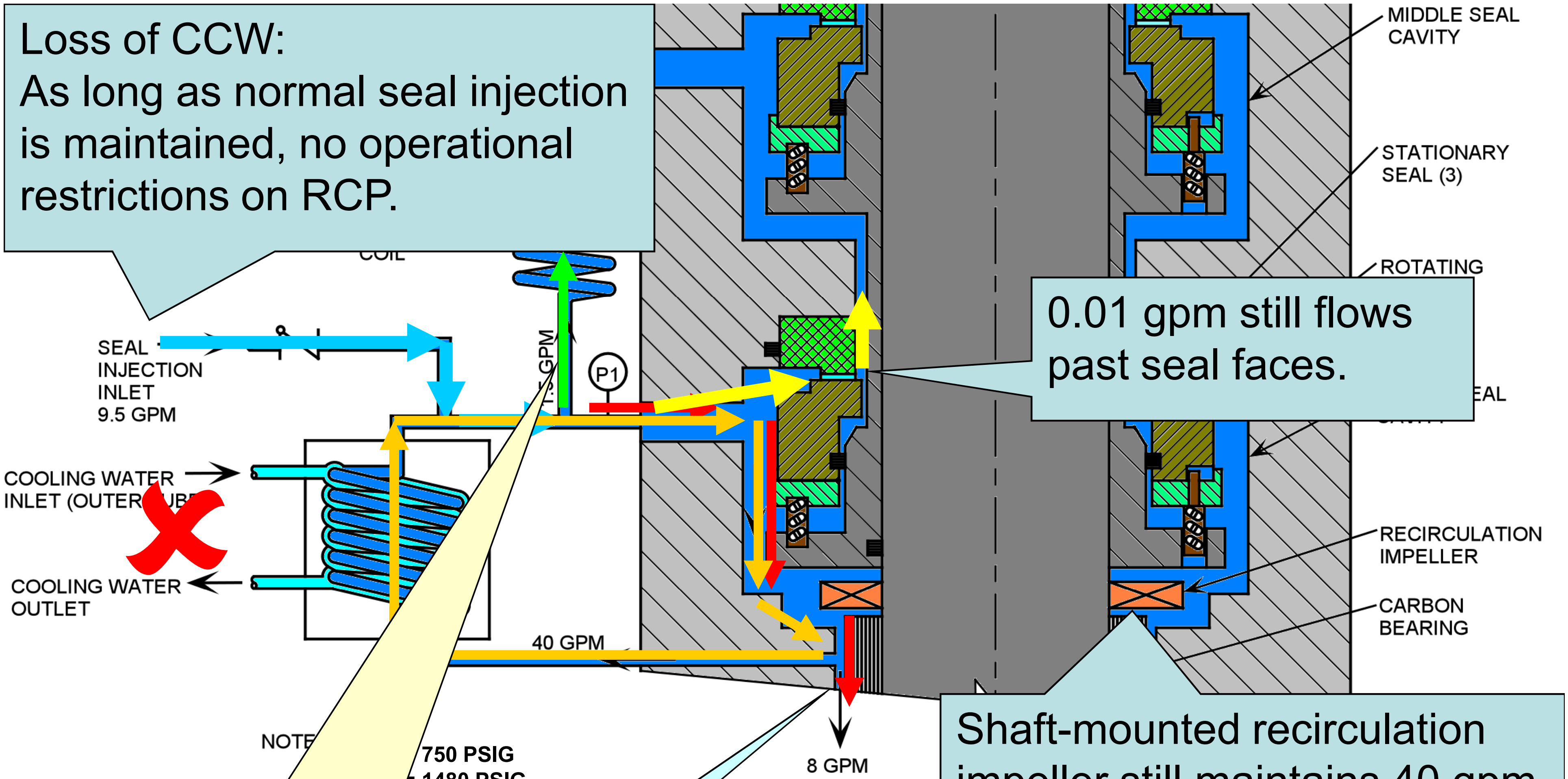
0.01 gpm past seal faces & into the seal leakage chamber.

Shaft-mounted recirculation impeller maintains 40 gpm flow through integral seal water HX mounted on motor stand. Cooled by CCW.

Shaft Seal Arrangement Fig. 2.3-3

Loss of CCW:
As long as normal seal injection is maintained, no operational restrictions on RCP.

0.01 gpm still flows past seal faces.

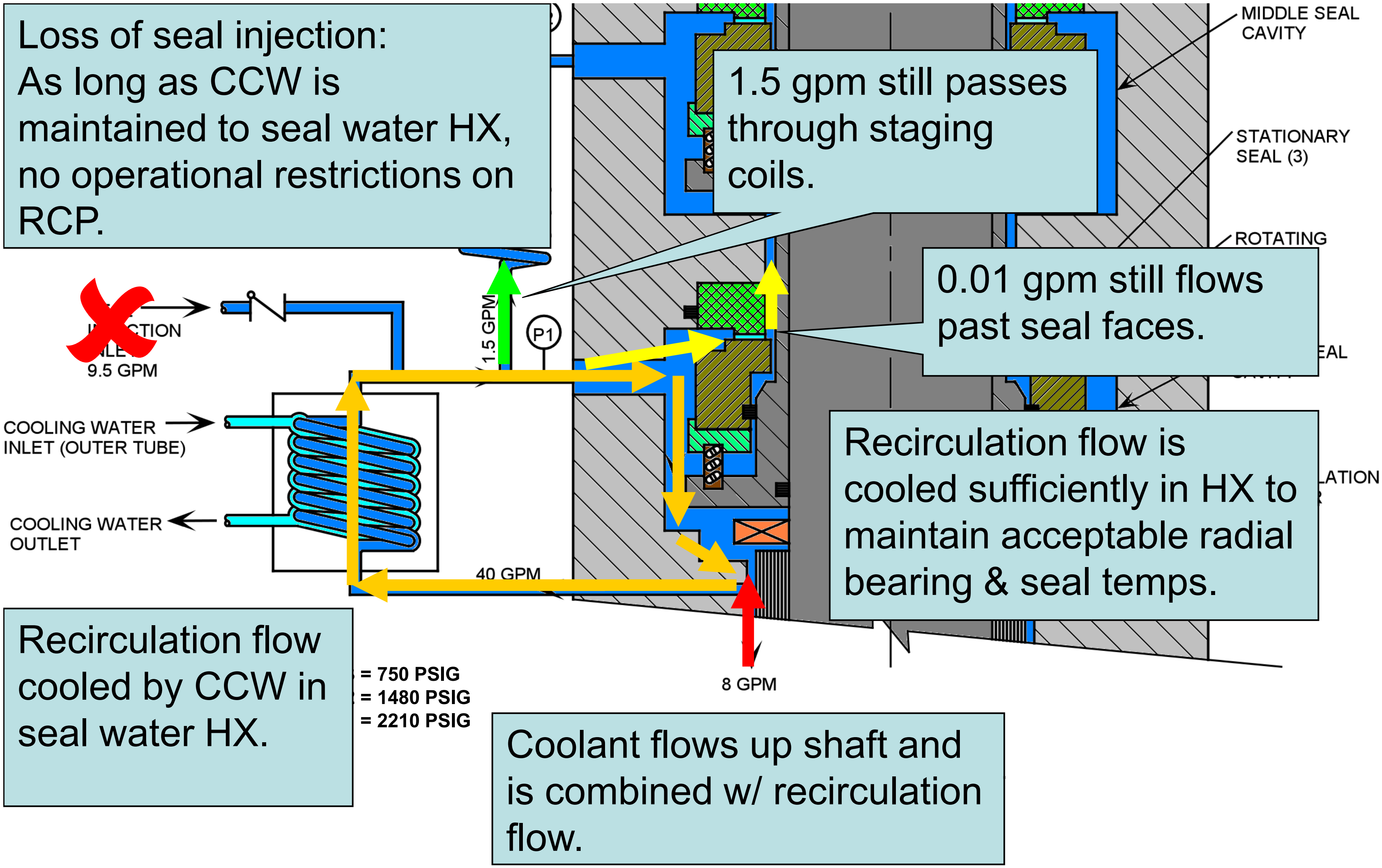


1.5 gpm passes through seal package.

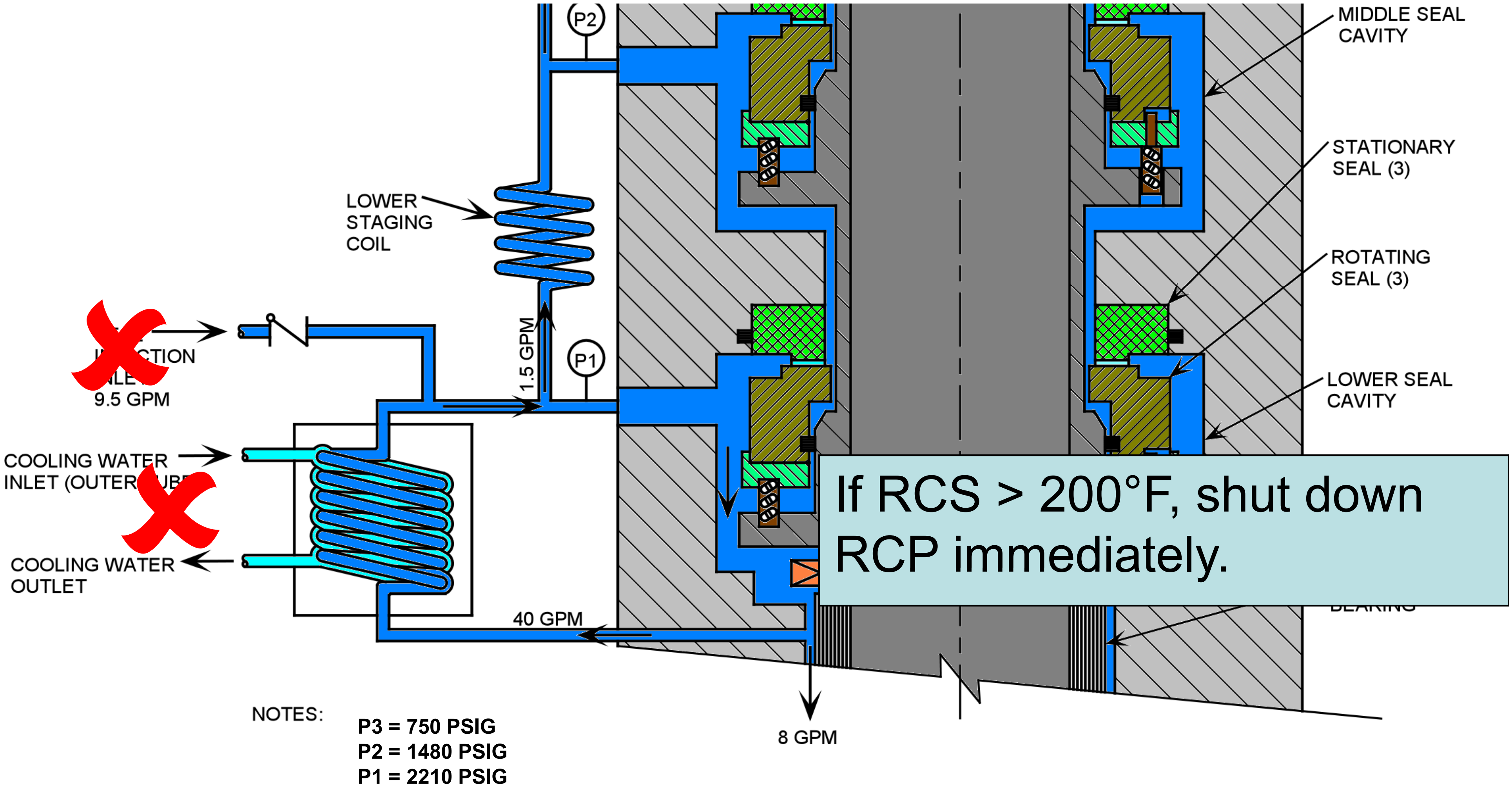
8 gpm into pump casing & down past radial bearing into RCS still occurs.

Shaft-mounted recirculation impeller still maintains 40 gpm flow through integral seal water HX mounted on motor stand.

Shaft Seal Arrangement (Fig. 2.3-3)



Shaft Seal Arrangement (Fig. 2.3-3)



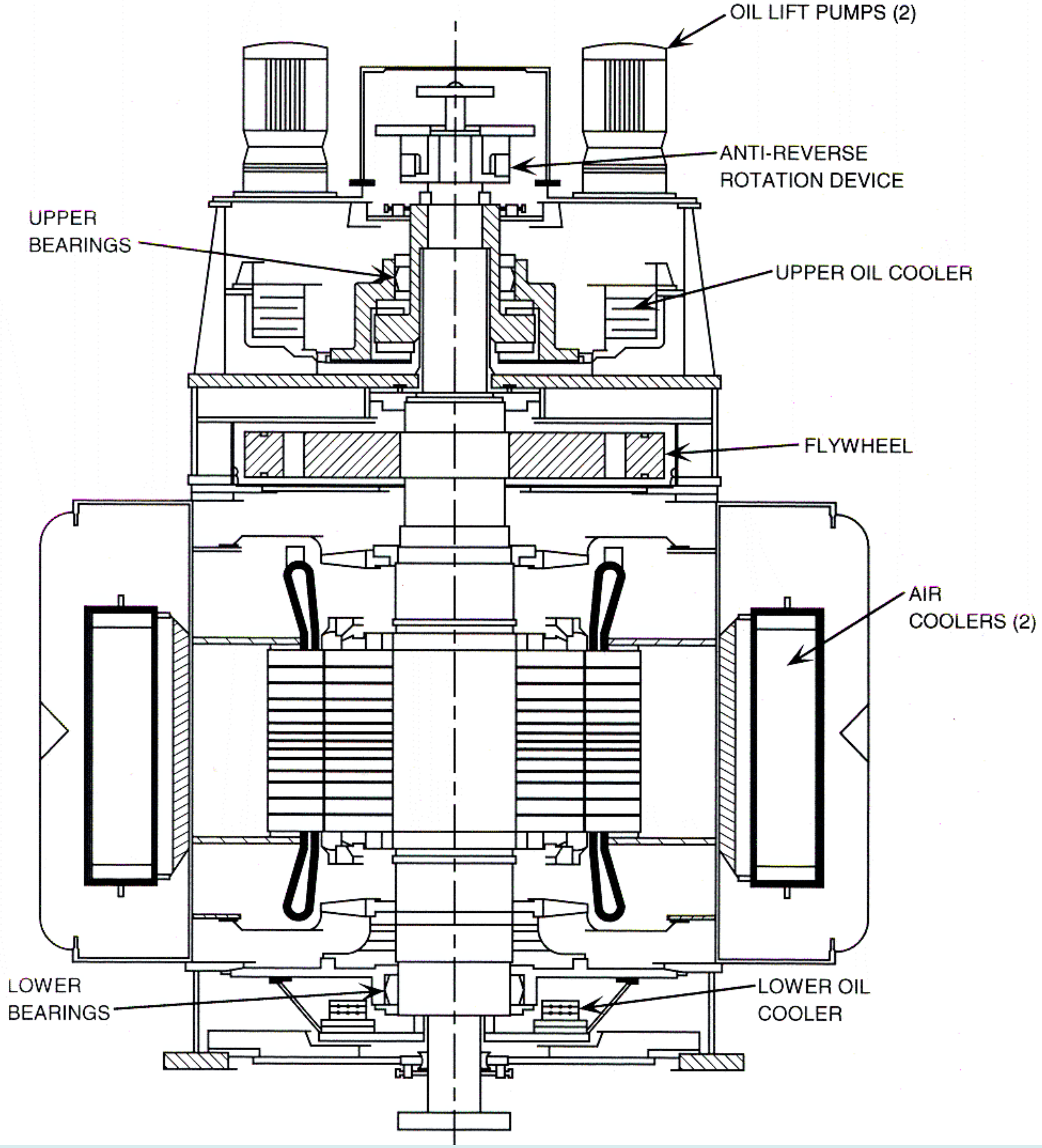
Loss of CCW and seal injection to RCP

Shaft Seal Arrangement (Fig. 2.3-3)

Table 2.3-1 lists the expected pressure for various seal failure conditions.

Table 2.3-1 - Seal Failure Indication Seal Failure			
	Seal #1	Seal #2	Seal #3
P3*	1115	1115	20
P2*	2210	1115	1115
P1*	2210	2210	2210
*Refer to Figure 2.3-3 for location of pressure detectors. P1 is always 2210 psig.			

Reactor Coolant Pump Motor Cross Section Fig. 2.3-4

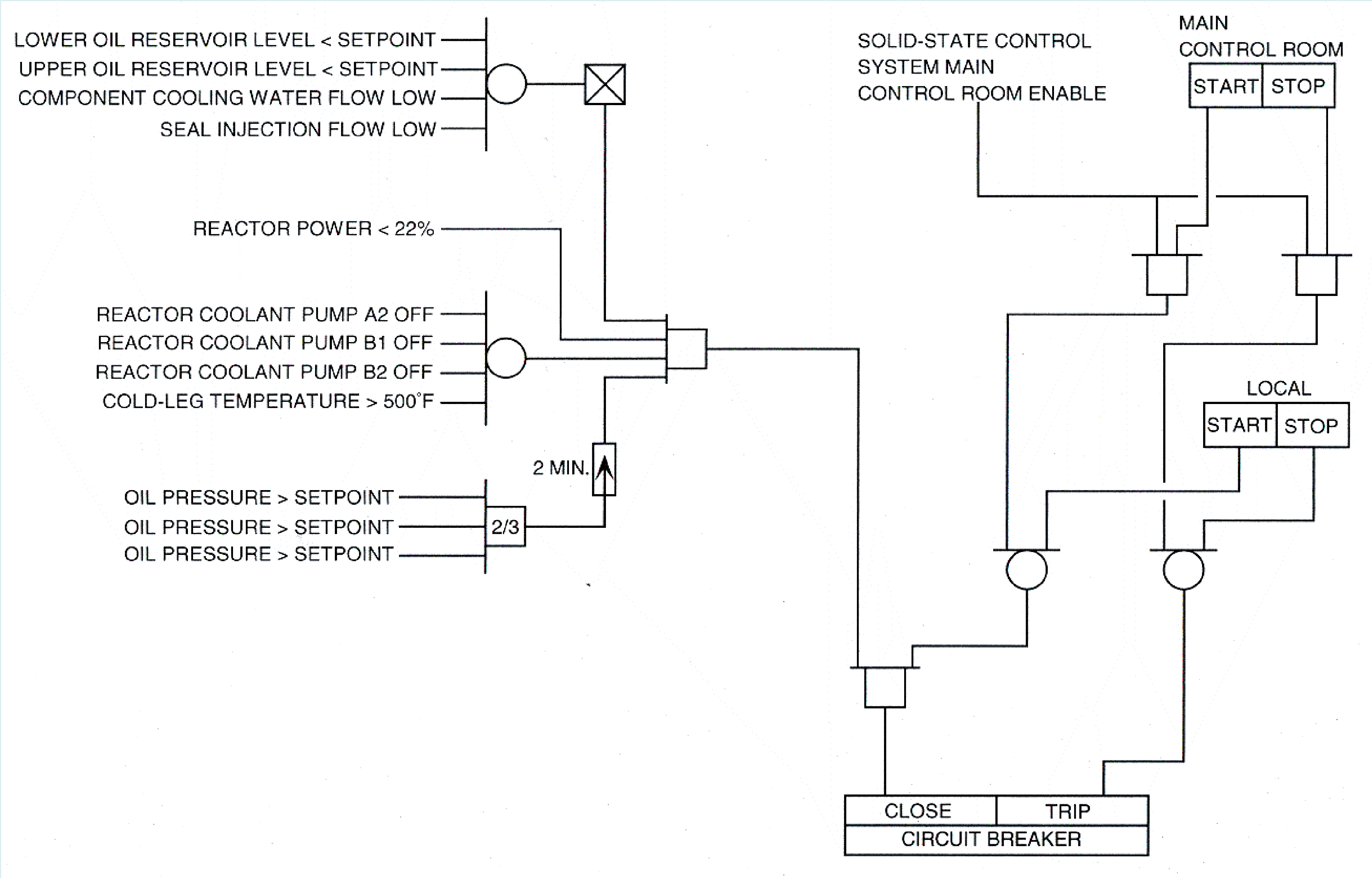


RCP Motor

- Anti-rotation device
  - Prevents reverse rotation to reduce starting current.
- Oil lift pumps
  - Provide oil pressure to thrust bearing before pump start to minimize starting torque.
  - As RCP speed increases, oil pump auto stops.
  - When RCP stopped, oil pump auto starts.
  - Thrust bearing oil pressure interlocked w/ RCP starting circuit.
- Flywheel
  - Provides coastdown flow following loss of power.
  - This allows Rx power reduction before flow through core is reduced.
  - Ensures localized boiling & DNB do not occur.

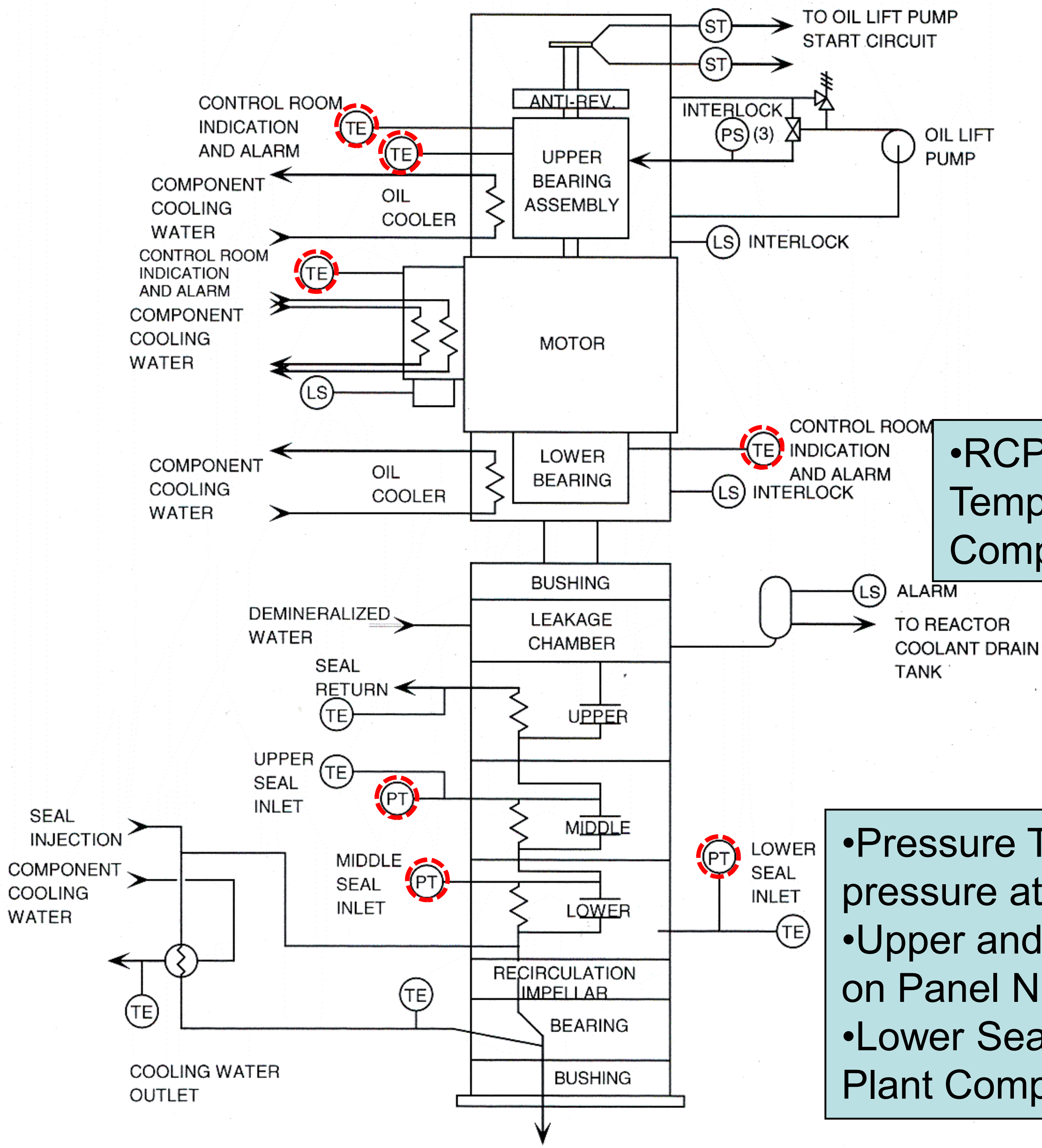
RCP Start Logic

- Cold Water Interlock
  - Must be < 22% power to start RCP.
  - Starting an idle pump will increase core flow & decrease average moderator temperature.
  - Positive reactivity added by pump start.
  - Ensures high pressure trip setpoint (2370#) will NOT be reached before power equilibrium is restored after RCP start.
- Core lift interlock
  - When starting 4th RCP:
    - Cold leg temp. must be > 500°F.
    - Prevents high density coolant from lifting fuel assemblies.
    - Prevents spacer grids from rubbing fuel rod cladding.



Reactor Coolant Pump Start Logic (Fig. 2.3-5)

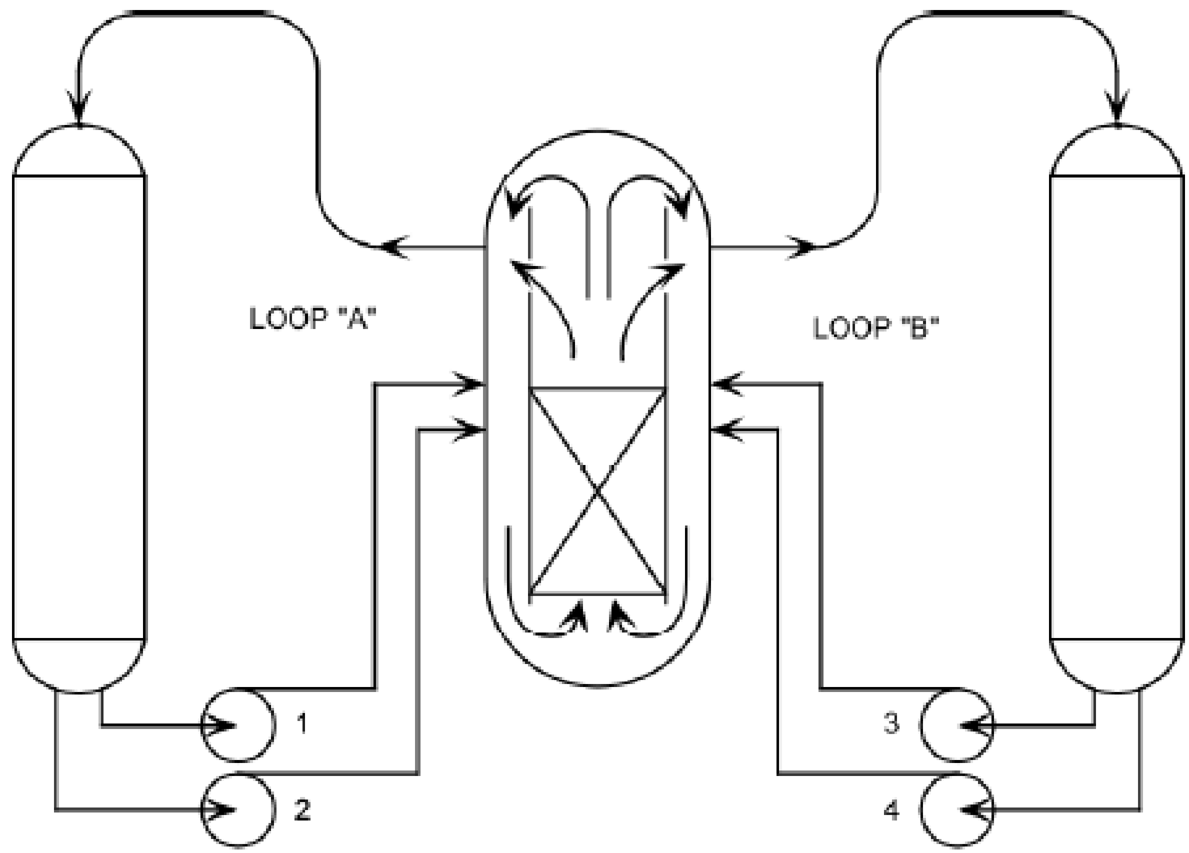
Reactor Coolant Pump Instrumentation Fig. 2.3-8



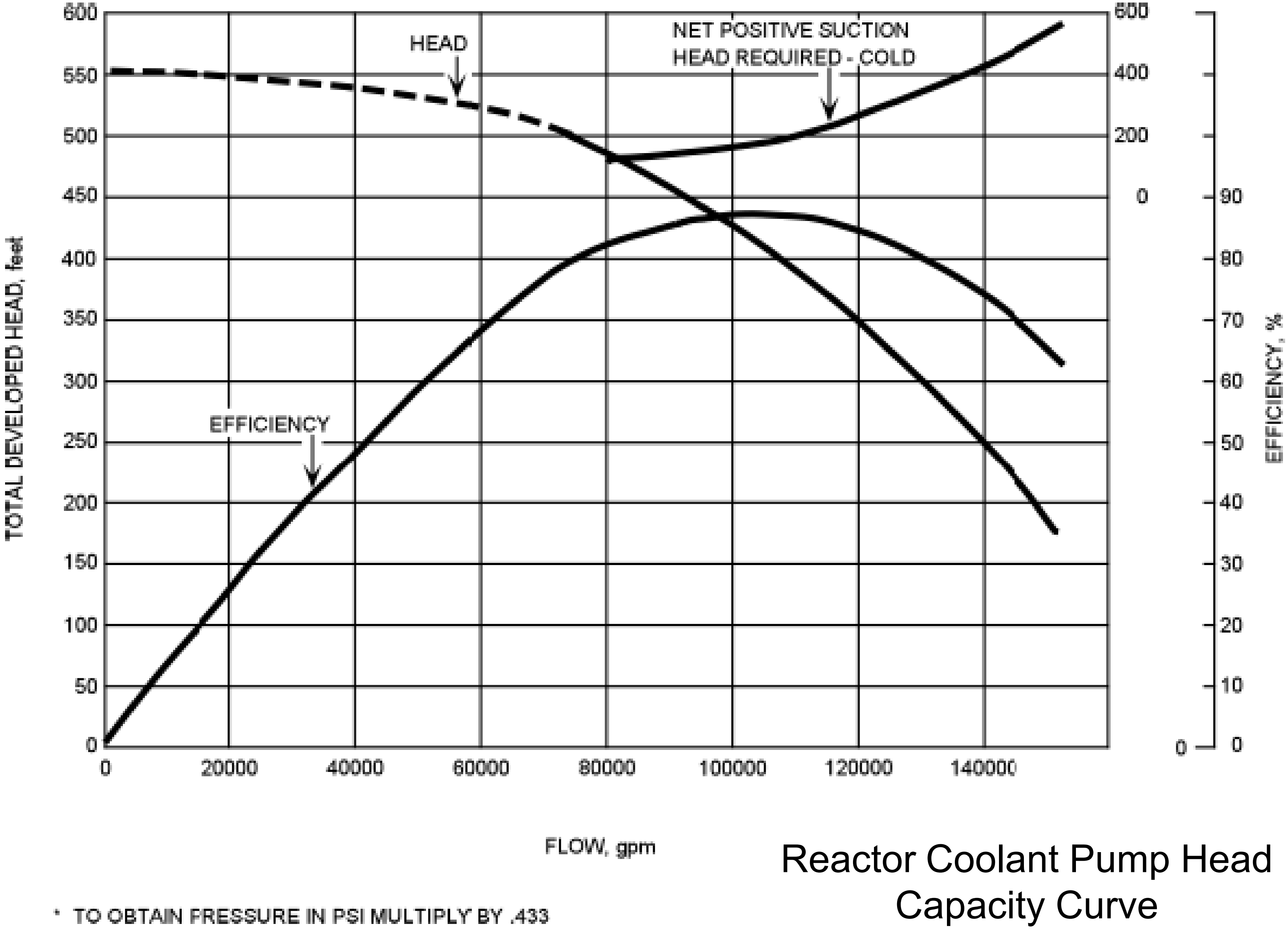
- RCP Motor Stator and Bearing Temperatures indicated on Plant Computer.

- Pressure Transmitters provide seal pressure at each stage
- Upper and Middle Seal Pressures on Panel NSP
- Lower Seal Pressure Read on Plant Comp.

Reactor Coolant Flow vs. Number of Pumps Operating
Fig. 2.3-6



PUMPS RUNNING	FLOW PER PUMP, %				CORE FLOW, %
	1	2	3	4	
1,2,3,4	25	25	25	25	100
1,2,3	26	26	32	-10	74
1,2	27	27	-4	-4	46
1,3	32	-9	32	-9	46
1	33	-6	-2	-2	23



Reactor Coolant Pump Head Capacity Curve
Fig. 2.3-7