ABB
ASEA BROWN BOVERI

April 30, 1992
LD-92-059

Docket No. 52-002

Attn: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: System 80+™ Supplement to RAI Responses

Reference: ABB-CE Letter LD-92-038, Submittal Schedule, March 25, 1992

Dear Sirs:

Enclosed with this letter are slides presented at a meeting with NRC staff on March 19, 1992. Three of these slides are proprietary and are marked as such. The corresponding affidavit attesting to their proprietary status is included, along with a non-proprietary version of the slide package. These slides and the March 19 presentation provide additional information related to the response for RAIs 440.118 and 440.119. This corresponds to the commitment in the reference letter to provide "miscellaneous RAI responses" as they are completed.

If you have any questions, please call me or Mr. Stan Ritterbusch at (203) 285-5206.

Very truly yours,

COMBUSTION ENGINEERING, INC.

S. E. Ritterbusch for

C. B. Brinkman
Acting Director
Nuclear Systems Licensing

CBB/ser
cc: J. Trotter (EPRI)
T. Wambach (NRC)

LTR. Encl.
Change: NRC PDR 1 INP
NSIC 1 INP D037

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AFFIDAVIT PURSUANT

TO 10 CFR 2.790

Combustion Engineering, Inc.)
State of Connecticut)
County of Hartford) SS.:

I, C. B. Brinkman, depose and say that I am the Acting Director, Nuclear Systems Licensing, of Combustion Engineering, Inc., duly authorized to make this affidavit, and have reviewed or caused to have reviewed the information which is identified as proprietary and referenced in the paragraph immediately below. I am submitting this affidavit in conformance with the provisions of 10 CFR 2.790 of the Commission's regulations for withholding this information.

The information for which proprietary treatment is sought is contained in the following documents:

1) Figure of Reactor Coolant Pump Cross-section
2) Figure of Hydrodynamic Shaft Seal Assembly
3) Figure of Reactor Coolant Pump Seal (RCP) Single Stage

(These figures are attached to Combustion Engineering letter LD-92-059, dated April 30, 1992.)

These documents have been appropriately designated as proprietary.

I have personal knowledge of the criteria and procedures utilized by Combustion Engineering in designating information as a trade secret, privileged or as confidential commercial or financial information.

Pursuant to the provisions of paragraph (b) (4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure, included in the above referenced documents, should be withheld.

1. The information sought to be withheld from public disclosure, which is owned and has been held in confidence by Combustion Engineering, is the Reactor Coolant Pump internals configuration and the seal assembly arrangement.

2. The information consists of test data or other similar data concerning a process, method or component, the application of which results in substantial competitive advantage to Combustion Engineering.

3. The information is of a type customarily held in confidence by Combustion Engineering and not customarily disclosed to the public. Combustion Engineering has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The details of the aforementioned system were provided to the Nuclear Regulatory Commission via letter DP-537 from F. M. Stern to Frank Schroeder dated December 2, 1974. This system was applied in determining that the subject document

herein is proprietary.

4. The information is being transmitted to the Commission in confidence under the provisions of 10 CFR 2.790 with the understanding that it is to be received in confidence by the Commission.

5. The information, to the best of my knowledge and belief, is not available in public sources, and any disclosure to third parties has been made pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence.

6. Public disclosure of the information is likely to cause substantial harm to the competitive position of Combustion Engineering because:

   a. A similar product is manufactured and sold by major pressurized water reactor competitors of Combustion Engineering.

   b. Development of this program by Combustion Engineering which produced this information required tens of thousands of manhours and millions of dollars. To the best of my knowledge and belief, a competitor would have to undergo similar expense in generating equivalent information.

   c. In order to acquire such information, a competitor would also require considerable time and inconvenience.

d. The information required significant effort and expense to obtain the licensing approvals necessary for application of the information. Avoidance of this expense would decrease a competitor's cost in applying the information and marketing the product to which the information is applicable.

e. The information consists of the Reactor Coolant Pump internals configuration and the seal assembly arrangement, the application of which provides a competitive economic advantage. The availability of such information to competitors would enable them to modify their product to better compete with Combustion Engineering, take marketing or other actions to improve their product's position or impair the position of Combustion Engineering's product, and avoid developing similar data and analyses in support of their processes, methods or apparatus.

f. In pricing Combustion Engineering's products and services, significant research, development, engineering, analytical, manufacturing, licensing, quality assurance and other costs and expenses must be included. The ability of Combustion Engineering's competitors to utilize such information without a similar expenditure of resources may enable them to sell at prices reflecting significantly lower costs.

g. Use of the information by competitors in the international marketplace would increase their ability to market nuclear steam supply systems by reducing the costs associated with

their technology development. In addition, disclosure would have an adverse economic impact on Combustion Engineering's potential for obtaining or maintaining foreign licensees.

Further the deponent sayetn not.

C. B. Brinkman
Acting Director
Nuclear Systems Licensing

Sworn to before me
this 30th day of April, 1992

Laurie J. White
Notary Public

My commission expires: 3/31/94

SYSTEM 80+
REACTOR COOLANT PUMP
SEAL DESIGN
&
PERFORMANCE

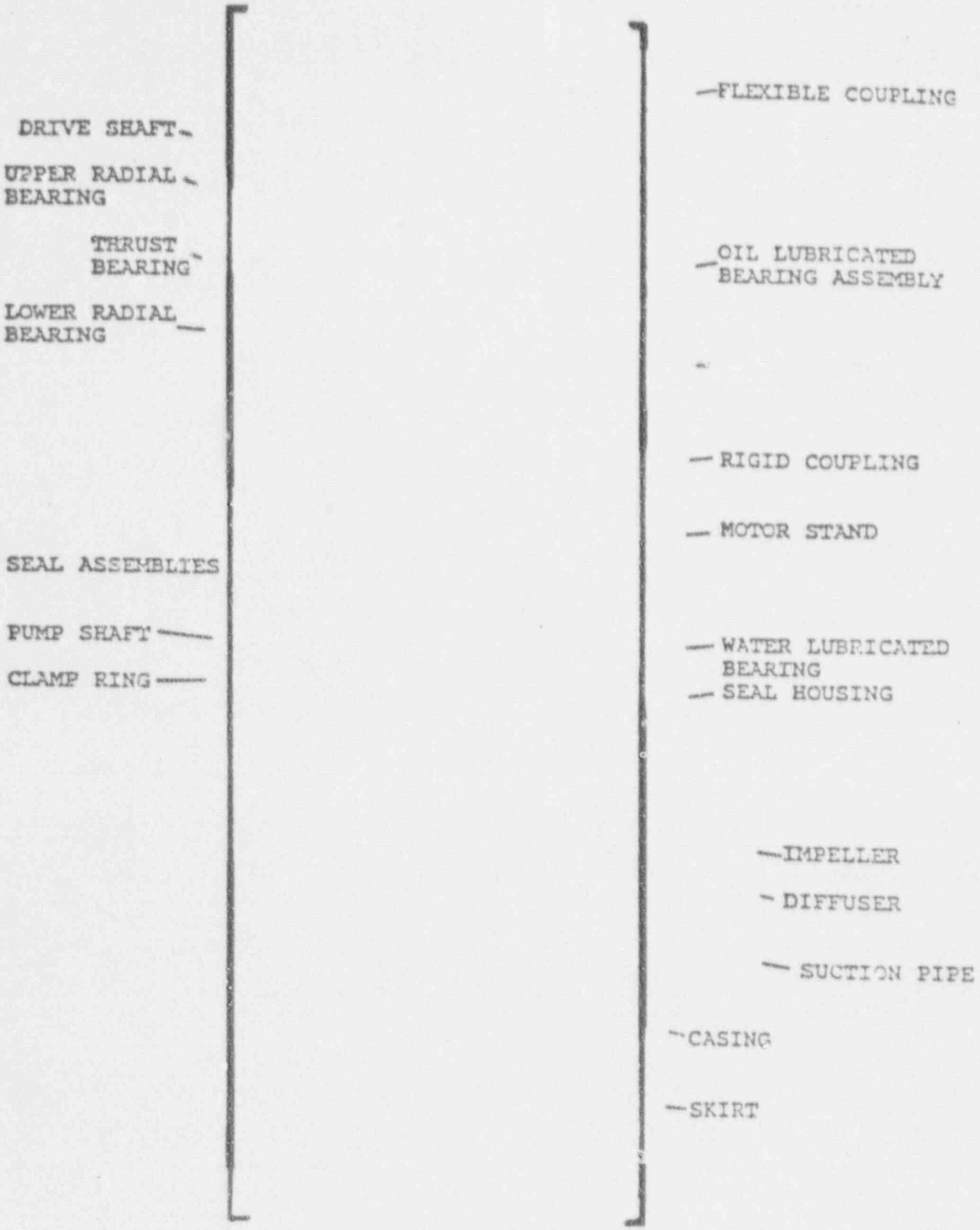
GSI-023

RCP SEAL FAILURES

CESSAR-DC POSITION (AMENDMENT F)

EXCESSIVE SEAL LEAKAGE IS PREVENTED FOR NORMAL OR OFF-NORMAL OPERATING CONDITIONS BY:

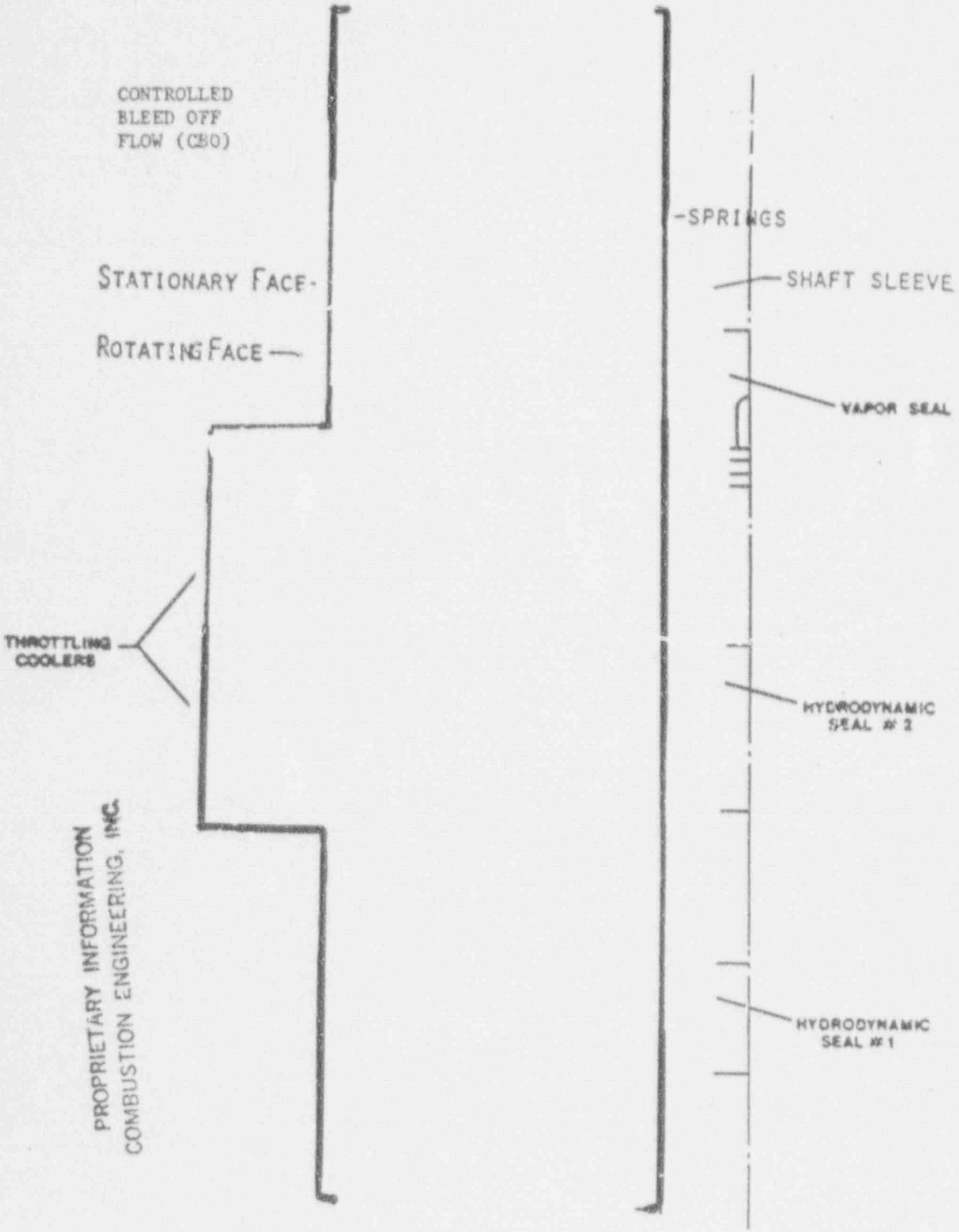
- USE OF PROVEN MULTI-STAGE SHAFT SEAL ARRANGEMENT
- REDUNDANT AND INDEPENDENT SEAL COOLING SYSTEMS (CCW & SI)
- ALTERNATE AC POWER SUPPLY TO CVCS CHARGING PUMPS TO PROVIDE SEAL INJECTION (SI) WATER FOR STATION BLACKOUT



REACTOR COOLANT PUMP

SYSTEM 80+
RCP SEAL DESCRIPTION CE-KSB

- SEAL SYSTEM CONSISTS OF THREE HYDRODYNAMIC SEAL STAGES ARRANGED IN SERIES
- EACH STAGE IS CAPABLE OF OPERATING AT FULL SYSTEM PRESSURE
- FIRST TWO STAGES BREAK DOWN APPROXIMATELY 84% OF SYSTEM PRESSURE (42% EACH)
- THIRD STAGE BREAKS DOWN REMAINING 16% OF SYSTEM PRESSURE AND ACTS AS A VAPOR SEAL

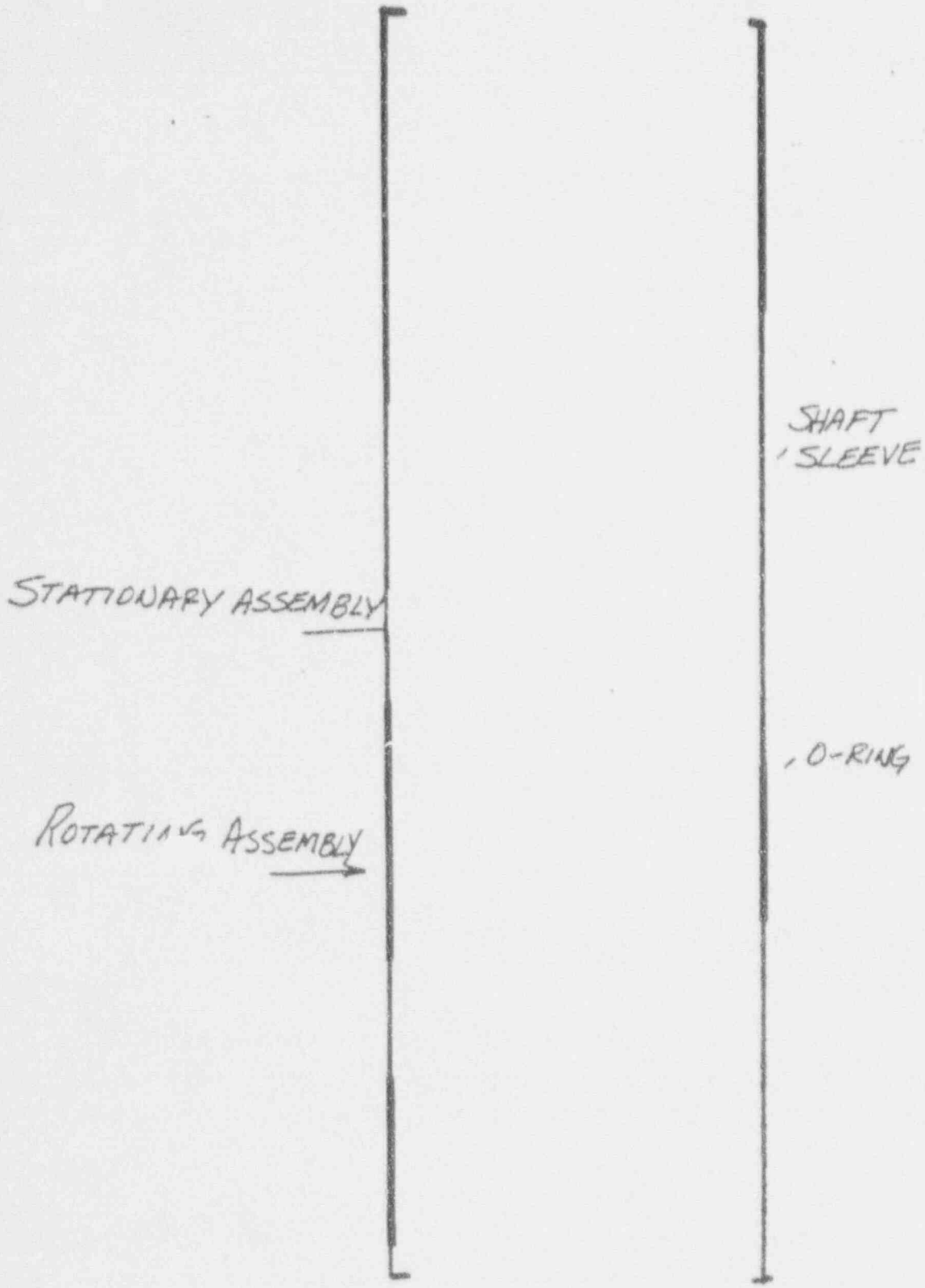


HYDRODYNAMIC SHAFT SEAL ASSEMBLY

FIGURE 1

CONTROLLED LEAKAGE

- ALSO CALLED CONTROLLED BLEEDOFF (CBO) FLOW
- CONTROLLED LEAKAGE COOLS AND LUBRICATES SEAL FACES
- CONTROLLED LEAKAGE FLOWS THROUGH THROTTLE SEAL COOLERS (TSC) MOUNTED PARALLEL TO EACH SEAL TO PROVIDE PRESSURE BREAKDOWN ACROSS EACH SEAL STAGE. TSC's ALSO PROVIDE SECONDARY SEAL COOLING
- CONTROLLED LEAKAGE NORMALLY 4.0 GPM AND COLLECTED IN VOLUME CONTROL TANK



SYSTEM 80+
RCP SEAL SINGLE STAGE

SEAL MATERIALS

ALL THREE SEAL STAGES USE SAME MATERIALS

- STATIONARY FACE - TUNGSTEN CARBIDE
- ROTATING FACE - CARBON GRAPHITE

SECONDARY STATIC SEALS (O-RINGS) - ACCOMMODATE AXIAL MOVEMENT OF ROTATING ASSEMBLIES

- O-RINGS - ETHYLENE PROPYLENE (EP)

SEAL COOLING

- o SEAL COOLING PROVIDED BY INDEPENDENT AND REDUNDANT COOLING SYSTEMS
  - SEAL INJECTION (SI) WATER (6.6 GPM EACH PUMP AT 120°F) INTRODUCED INTO SEAL COOLING CIRCUIT.
  - COMPONENT COOLING WATER (CCW) WHICH COOLS SEAL WATER BY HIGH PRESSURE SEAL COOLER (HPSC) AND THROTTLE SEAL COOLERS (TSC).
- o SEALS CAN OPERATE INDEFINITELY WITH:
  - LOSS OF SEAL INJECTION (SI) WATER WITH COMPONENT COOLING WATER AVAILABLE.
  - LOSS OF CCW WITH SI AVAILABLE.

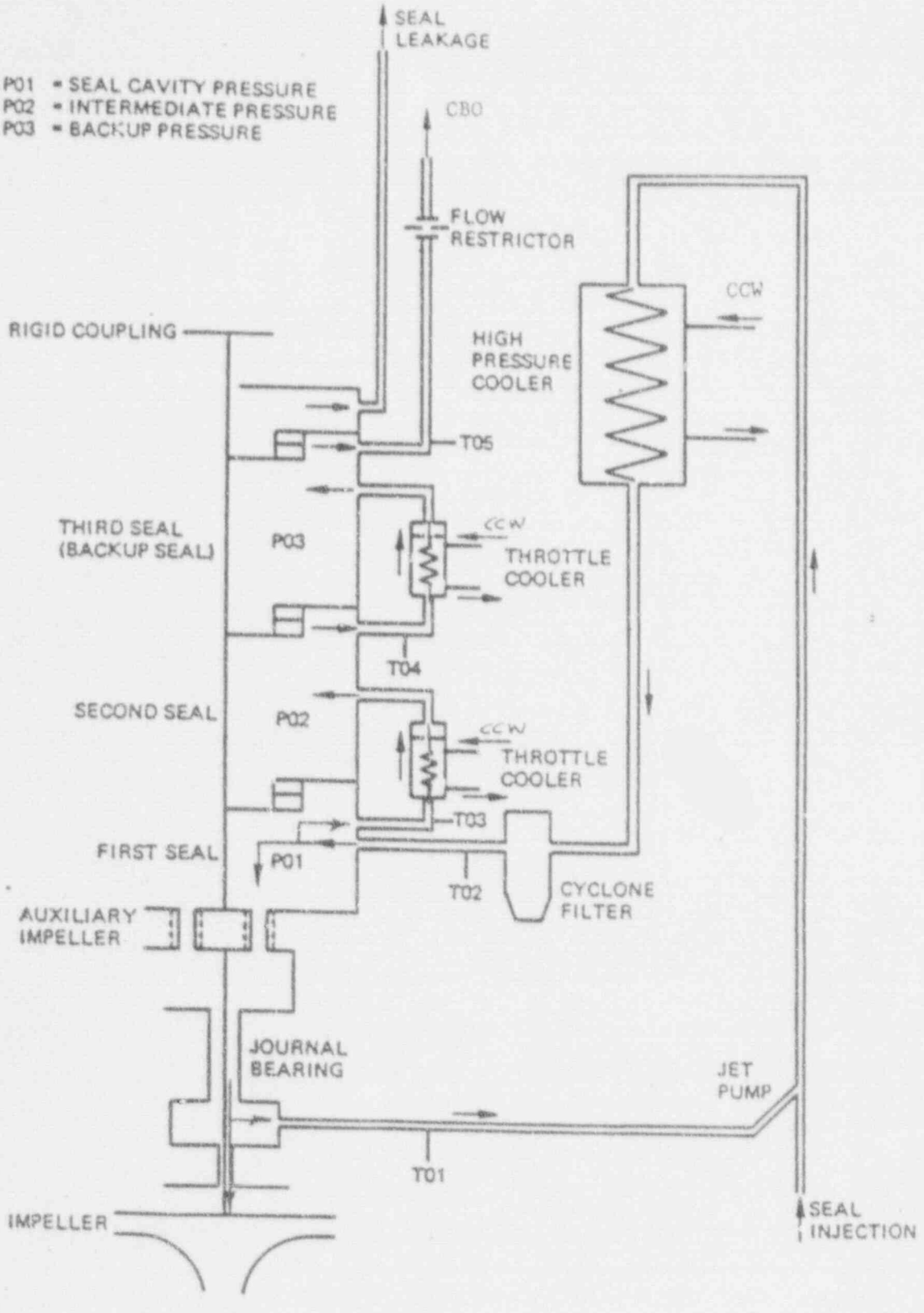


Figure 2 Flow Diagram for Hydrodynamic Shaft Seal System.
Normal Operation - with CCW & SI

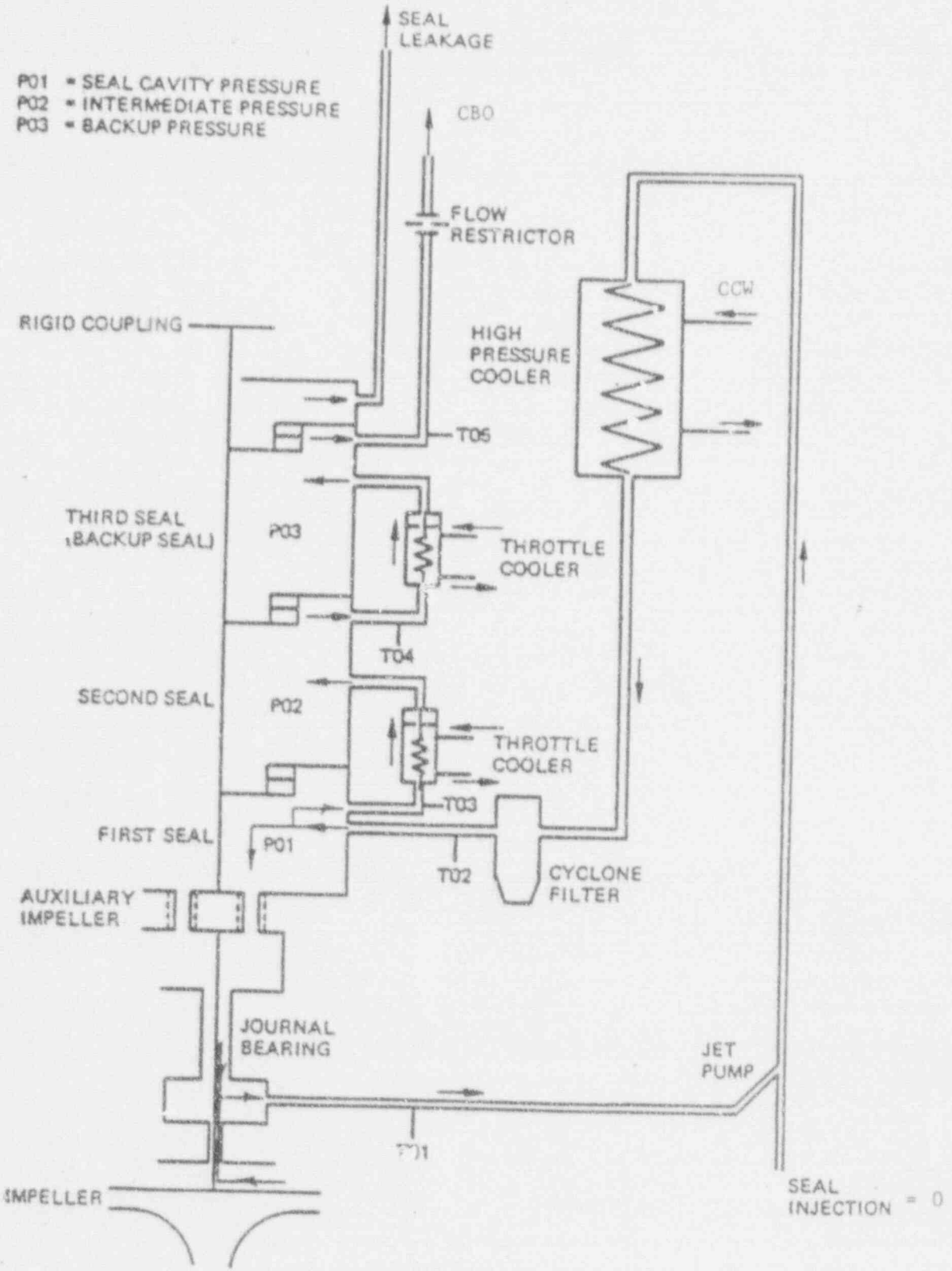


Figure 3 Flow Diagram for Hydrodynamic Shaft Seal System.
Operation without SI & with CCW

RCP SEAL INSTRUMENTATION

- CONTROLLED LEAKAGE (CBO) FLOW RATE MEASURED - ESTABLISHES SEAL MALFUNCTION IF CBO INCREASES BEYOND LIMITS

- SEAL CAVITY PRESSURES - SEAL NO. 2, SEAL NO 3, CBO — ALLOWS OPERATOR TO ANTICIPATE SEAL PROBLEMS

- SEAL WATER TEMPERATURES - SEAL INJECTION IN, HPSC/IN, HPSC/OUT, SEAL NO. 2, SEAL NO. 3 — ALLOWS OPERATOR TO ANTICIPATE SEAL PROBLEMS

- DISPLAYED AND ALARMED IN CONTROL ROOM TO WARN OPERATOR OF POSSIBLE SEALS PROBLEMS.

- PUMP EQUIPPED WITH VIBRATION MONITORING SYSTEM TO WARN OPERATOR OF ANY EXCESSIVE VIBRATION WHICH COULD CAUSE SEAL PROBLEMS.

SEAL FAILURE DEFINITIONS

SEAL FUNCTION MAINTAINED

- ONE OR TWO OF FULL PRESSURE SEALS FAILS, VAPOR SEAL FUNCTIONS AND DIRECTS CONTROLLED LEAKAGE TO VCT
- IF ONE FULL PRESSURE SEAL FAILS CONTINUOUS OPERATION ALLOWED
- IF TWO FULL PRESSURE SEALS FAIL VAPOR SEAL HOLDS FULL SYSTEM PRESSURE WITH PUMP IDLE; ALLOWS OPERATOR TO PERFORM ORDERLY PLANT SHUTDOWN
- NO GROSS SEAL FAILURE-LEAKAGE DIRECTED TO VCT-VAPOR SEAL FUNCTIONS

SEAL FAILURE DEFINITIONS

COMPLETE LOSS OF SEAL FUNCTION (GROSS SEAL LEAKAGE)

PREREQUISITES:

- o FAILURE OF TWO FULL PRESSURE SEALS
- o FAILURE OF VAPOR SEAL (HAS NOT HAPPENED IN ABB/CE PLANT)
- o FAILURE - INABILITY OF SEAL TO HOLD PRESSURE

CONSEQUENCES:

- o LEAKAGE PAST VAPOR SEAL IN EXCESS OF 25 GPM CRITERIA OF RG 1.155

RCP SEAL INJECTION/CVCS DESIGN (RAI 440.118)

SEAL INJECTION (SI) PROVIDED BY TWO INDEPENDENT & REDUNDANT CVCS DIVISIONS TO ASSURE RELIABILITY, REDUNANCY AND AVAILABLITY.

- CHARGING/SI PORTION OF CVCS ASME III - SAFETY CLASS 3 DESIGN
- TWO CENTRIFUGAL CHARGING PUMPS - SAFETY CLASS 3 DESIGN
- CHARGING PUMPS POWERED FROM NON-SAFETY RELATED BUSES
- EACH DIVISION CAN PROVIDE COMPLETE CHARGING FLOW RANGE (44-132 GPM)
- FOR STATION BLACKOUT (SBO) EVENT CHARGING PUMPS POWERED FROM ONSITE ALTERNATE AC (AAC) POWER SUPPLY.
- FOR SBO EVENT CONTINUED SEAL COOLING ASSURED BY SI AND AAC.
- CVCS/SI SYSTEM DESIGN MEETS DRAFT RG 1008 REQUIREMENTS FOR AN INDEPENDENT POWERED SYSTEM

RCP SEAL INTEGRITY ISSUES
(RAI 440.119)

GSI-23 SEAL FAILURES SCENARIO:

- o MECHANICAL OR MAINTENANCE INDUCED FAILURES:
  - OPERATING EXPERIENCE WITH RCP SEALS HAS IMPROVED SIGNIFICANTLY SINCE 1983.
  - PER CEOG REPORT ONLY 23 FAILURES REPORTED FOR 59 RCP'S OVER 8 YEAR TIME SPAN IN CE PLANTS
  - ONLY THREE OF THESE FAILURES INVOLVED LEAKAGE PAST LAST OR VAPOR SEAL. LEAKAGE WAS CONSIDERABLY BELOW 25 GPM CRITERIA OF RG 1.155
  - SYSTEM 80+ SEALS ARE SAME AS PALO VERDE SEALS AND THERE HAVE BEEN NO UNPLANNED PLANT SHUTDOWNS DUE TO SEAL PERFORMANCE ALONE
  - SEAL PERFORMANCE IS A RELIABILITY CONCERN AND NOT A SAFETY CONCERN

RCP SEAL INTEGRITY ISSUES
(RAI 440.119)

GSI-23 SEAL FAILURE SCENARIO:

- SEAL FAILURES RESULTING FROM LOSS OF SEAL COOLING
- SYSTEM 80+ RCP SEALS HAVE INDEPENDENT & REDUNDANT SEAL COOLING TO WITHSTAND:
  - FOR LOSS OF ALL AC POWER (I.E., SBO), AAC POWER SUPPLIED TO CHARGING PUMPS WHICH FURNISH SI FOR SEAL COOLING. AAC POWER ALSO FURNISHED TO CCW SYSTEM PUMPS & SW SYSTEM PUMPS TO ENSURE CCW TO CHARGING PUMPS.
  - FOR LOSS OF NON-ESSENTIAL CCW TO RCP'S INDEPENDENT OF SBO, SI WATER IS USED TO COOL SEALS. ESSENTIAL CCW SUPPLIED TO CHARGING PUMPS. ESSENTIAL CCW SYSTEM IS SAFETY GRADE AND FULLY REDUNDANT.
  - LOSS OF SERVICE WATER (SW) IS NOT CREDIBLE SINCE TWO SW DIVISIONS ARE SAFETY GRADE & FULLY REDUNDANT.
  - FOR LOSS OF OFF-SITE POWER (LOOP), CHARGING PUMPS/SI ARE POWERED FOR AAC. CCW PUMPS ARE SIMULTANEOUSLY POWERED FROM EMERGENCY DIESEL GENERATORS.

RCP SEAL INTEGRITY ISSUES (CONT'D)

- CCW AND SI TO RCP'S IS NOT TERMINATED DUE TO A SIAS OR CIAS.

- FOR LOSS OF AIR, SEAL COOLING IS MAINTAINED BECAUSE:
  - THERE ARE NOT PNEUMATICALLY OPERATED VALVES IN THE CCW FLOW PATH
  - PNEUMATIC VALVE IN SI FLOW PATH FAIL OPEN

DRAFT REGULATORY GUIDE DG1008
(RAI 440.119)

SYSTEM 80+ POSITION ON DG1008 RESOLUTIONS:

- SYSTEM 80+ RCP SEALS ALREADY DESIGNED AND MANUFACTURED TO MANY OF 10CFR50 APPENDIX B QA PROGRAM REQUIREMENTS. IN ADDITION, SEALS ARE MANUFACTURED IN CLEAN ROOM ENVIRONMENT; ARE HYDROSTATICALLY PRESSURE TESTED AND OPERATIONALLY TESTED IN SEAL TEST RIG.

- SYSTEM 80+ DESIGN INCLUDES NECESSARY INSTRUMENTATION, INSTRUCTIONS AND OPERATING GUIDELINES TO DETECT INCIPIENT SEAL FAILURE AND PROTECT SEALS FOR NORMAL AND OFF-NORMAL PLANT CONDITIONS.

- SYSTEM 80+ DESIGN INCLUDES INDEPENDENT SEAL COOLING VIA AN ON-SITE AAC POWER SOURCE TO POWER THE CHARGING PUMPS WHICH PROVIDE SI TO COOL THE SEALS.

RCP SEAL OPERATING EXPERIENCE
(RAI 440.120)

SYSTEM 80+ SEAL INTEGRITY PROVEN BY OFF-NORMAL OPERATING EVENTS AT PALO VERDE:

- APRIL 1986 - UNIT NO. 2 RCP'S EXPERIENCED LOSS OF SI AND CCW FOR APPROXIMATELY 3 HOURS. COOLING RESTORED AND RCP'S OPERATED UNTIL JULY 1986 WHEN LEAKAGE FROM RCP 2B REACHED 2-3 GPM. UNIT SHUT DOWN FOR REFUELING AND SEALS REPLACED. TOTAL OPERATING TIME OF 14 MONTHS ON SEALS.

- JULY 1988 - UNIT NO. 1 RCP'S EXPERIENCED INTERMITTIN LOSS OF CCW AND SI FOR 8 HOURS. NO SEAL FAILURE OR LEAKAGE REPORTED.

- MARCH 1989 - UNIT NO. 3 RCP'S EXPERIENCED LOSS OF CCW AND SI FOR 90 MINUTES PRIOR TO REFUELING OUTAGE. AFTER RESTORATION OF SEAL COOLING PUMPS OPERATED AS PART OF PLANT COOLDOWN. RCP 1B LEAKAGE REACHED 1.25 GPM. NO LEAKAGE FROM OTHER PUMPS.

FOR ALL EVENTS LEAKAGE WAS LESS THAN 25 GPM CRITERIA.

RCP COOLER TUBE RUPTURE
(RAI 440.121 & 122)

- HIGH PRESSURE SEAL COOLER (HPSC) OR THROTTLE SEAL COOLER (TSC) TUBE RUPTURE ASSUMED
- OVERPRESSURIZATION OF CCW SYSTEM PREVENTED BY APPROPRIATELY SIZING CCWS HPSC RELIEF VALVE (THIS VALVE ALSO RELIEVES THE TSC CCW SYSTEM PIPING)
- HPSC RELIEF VALVE DISCHARGES INTO CONTAINMENT TO PREVENT RELEASE OF RADIOACTIVITY INTO ENVIRONMENT
- HPSC RELIEF VALVE DISCHARGES TO HOLD UP VOLUME WHICH SPILLS OVER TO IRWST. OPERATOR HAS SUFFICIENT VOLUME IN IRWST TO CONDUCT RCS COOLDOWN AND DEPRESSURIZATION
- LEAK INTO CCWS DUE TO A HPSC TUBE RUPTURE CAN BE DETECTED BY RADIATION DETECTORS IN CCWS OR BY A RISING CCWS SURGE TANK LEVEL
- LEAK CAN BE ISOLATED BY CLOSING THE HPSC TUBE SIDE ISOLATION VALVES OR THE CCWS ISOLATION VALVES

HPSC & TSC

DESIGN INTEGRITY (RAI 440.123)

- HPSC AND TSC DESIGNED PER ASME SECTION III SUBSECTION NB (CLASS 1) FOR PRIMARY SIDE AND SUBSECTION ND (CLASS 3) FOR COOLING WATER SIDE
- INTEGRITY OF SEAL COOLERS ASSURED BY PERFORMING AN ASME SECTION III DESIGN STRESS ANALYSIS FOR DESIGN, NORMAL, UPSET, FAULTED, TEST AND TRANSIENT LOADING CONDITIONS
- TRANSIENTS INCLUDE LOSS AND RESTORATION OF CCW AND SI WITH PUMP OPERATING AND ON HOT STANDBY
- ANALYSIS PERFORMED TO DEMONSTRATE THAT SEAL COOLER TUBE BUNDLES ARE RIGID AND NOT SUBJECT TO CYCLIC FATIGUE DUE TO VIBRATION

SUMMARY

- SYSTEM 80+ RCP'S UTILIZE PROVEN MULTIPLE STAGE SEALS BASED ON PALO VERDE DESIGN AND EXPERIENCE
- SEALS ARE FURNISHED WITH REDUNDANT AND INDEPENDENT SEAL COOLING VIA SI AND CCW SYSTEMS
- FOR OFF-NORMAL CONDITIONS (I.E. SBO), AAC POWER IS SUPPLIED TO CHARGING PUMPS TO PROVIDE SI TO SEALS
- FOR HPSC OR TSC TUBE RUPTURE, CCW SYSTEM IS FURNISHED WITH RELIEF VALVES TO PREVENT OVER PRESSURIZATION OF CCWS
- RELIEF VALVES DISCHARGE INTO CONTAINMENT TO PREVENT RADIOACTIVE RELEASE INTO ENVIRONMENT