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MEDFORD, M. O. Southern California Edison Co.
RECIP. NAME RECIPIENT AFFILIATION
KNIGHTON, G. W. PWR Project Directorate 7

SUBJECT: Informs that Bingham-Williamette mechanical shaft seals will be installed during refueling outage scheduled to begin on 860314 & Dec 1986 for Units 2 & 3, respectively. Results of seal testing at Alamitos Station encl.

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MAR 04 1986

Director, Office of Nuclear Reactor Regulation
Attention: Mr. George W. Knighton, Director
PWR Project Directorate No. 7
Division of PWR Licensing - B
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
Reactor Coolant Pump Seal Planned Modification
San Onofre Nuclear Generating Station
Units 2 and 3

By letter dated February 22, 1985, the NRC was informed that SCE was considering the installation of Bingham-Willamette mechanial shaft seals in the San Onofre Units 2 and 3 Reactor Coolant Pumps (RCP's). The final decision to install the Bingham-Willamette seals was to be made following completion of a development and testing program. The purpose of this letter is to inform you that SCE will be installing the Bingham-Willamette mechanical shaft seals in the San Onofre Units 2 and 3 RCP's during the upcoming refueling outages currently scheduled to begin on March 14, 1986 for Unit 2 and in December 1986 for Unit 3. The installation of Bingham-Willamette RCP seals is part of SCE's efforts to extend RCP seal life.

San Onofre Units 2 and 3 RCP shafts are currently equipped with Byron-Jackson type SU shaft seal cartridges. The Bingham-Willamette mechanical shaft seals that are replacing the Byron-Jackson seals are the Balanced Stator Model 950 design. This is the same Bingham-Willamette seal design that has been retrofitted at Oconee Units 2 and 3, Rancho Seco and WPPSS Unit 2, modified for installation at San Onofre Units 2 and 3.

Provided as an enclosure to this letter are the results of the Bingham-Willamette seal testing at the Alamitos Station. These results indicate that the Bingham-Willamette seals will perform within the current FSAR commitments.

If you have any questions, please contact me.

Very truly yours,

M. O. Medford/DRC

Enclosure

cc: Mr. H. Rood, Project Manager (To be opened by addressee only)
Mr. F. R. Huey, USNRC Senior Resident Inspector, Units 1, 2 and 3

A001
1/1

Enclosure

SOUTHERN CALIFORNIA EDISON COMPANY

REACTOR COOLANT PUMP SEAL RETROFIT
AT
SONGS 2 AND 3

The reactor coolant pumps at SONGS 2 and 3 are to be refitted with Bingham-Willamette (BW) seals replacing seals initially furnished by Byron-Jackson (BJ).

The design philosophy and general configuration of the original BJ and retrofit BW seals are very similar. Both Byron-Jackson and Bingham-Willamette employ three breakdown seals in series followed by a vapor seal. Each breakdown seal is bypassed by a pressure breakdown coil which permits controlled leakage bleed off to maintain an approximately equal pressure drop across each seal and to provide for seal cooling water. Pertinent design details of the two seals are compared in Table 1.

It can be seen from the comparison table that the Byron-Jackson original seal and the Bingham-Willamette retrofit are very similar in design philosophy and materials utilized.

There are differences in detail which impact the relative performance of the two seals. The Bingham-Willamette seal employs controlled bleed off around the seals both for cooling and to equalize the pressure drop across each seal as in the original Byron-Jackson design. Bingham-Willamette, as seen from Table 1 employees 1.5 $\pm$ .05 gpm bleed off flow compared to 1.0 gpm for the Byron-Jackson seal. This difference provides more effective cooling of the replacement seals during normal operation.

As in the originally designed BJ seals, the retrofit Bingham-Willamette seal cartridge is cooled by controlled leakage bleed off which in turn is cooled by the heat exchanger that is integral with the pump. It has been shown, by the test results that the retrofit seals can operate for thirty minutes without cooling water to the heat exchanger with no significant damage or increase in seal leakage. This was demonstrated by the test run on the Bingham-Willamette

TABLE 1

COMPARISON OF BINGHAM-WILLAMETTE REPLACEMENT SEAL WITH THE ORIGINAL BYRON-JACKSON SEAL PROVIDED FOR SONGS 2 AND 3 BYRON-JACKSON 36 X 36 X 38 DFSS REACTOR COOLANT PUMPS (SOUTHERN CALIFORNIA EDISON DRAWING SO23-922-50-05)

	Bingham-Willamette Replacement Seal	Byron-Jackson Original Seal
Seal Type	Breakdown	Breakdown
Seal Construction	Cartridge	Cartridge
Number of Seals	4*	4*
(*Three breakdown seals in series with a final vapor seal)		
Nominal Operating Pressure	2250 psi	---
Normal Delta Pressure Stage 1 to Stage 2	733 psi	750 psi max
Normal Delta Pressure Stage 2 to Stage 3	733 psi	750 psi max
Normal Delta Pressure Stage 3 to Vapor Seal	733 psi	750 psi max
Vapor Seal Back Pressure	35-70 psia	25-250 psia
Design Pressure (Each Seal)	2,485 psig	2,500 psi
Controlled Leakage Bleed Off (Nominal)	1.5 $\pm$ .05 gpm	1.0 gpm
Seal Type	Face	Face
Seal Materials		
Rotor	Kennametal Gr. K801	Titanium Carbide
Stator	Morganite Grade CNFJ	Carbon or Graphite

(Note) Kennametal Gr K801 is a proprietary grade of Tungsten Carbide and Morganite Grade CNFJ is a proprietary grade of molded carbon.

boiler circulating pump conducted at the SCE Company Alamitos Station on November 1, 1985. The test pump employed a cartridge seal utilizing the improved elastomers and the same design factors as applied to the SONGS 2 and 3 reactor coolant pump retrofit. The test used a smaller pump seal (4 1/2" seal face diameter vs. a 9 1/2" seal diameter for SONGS 2 and 3). The seal was subjected to the same incoming controlled leakage bleed off flow temperature ramp that the replacement SONGS 2 and 3 seals will experience in a loss of cooling water incident. The temperature ramp had been calculated using data from the BJ heat exchanger analysis report (Reference 1). A further verification of the analysis is provided by an ASME Paper (Reference 2). The calculation of the temperature ramp of the primary water entering the SONGS 2 and 3 RCP's and used for this test is documented in O'Donnell and Associates report (Reference 3).

The SCE test results are documented in SCE Test Data #2PE-211-02 Rev. 0, (Reference 4) and the results of the seal evaluation following the test are published in Bingham-Willamette test report (Reference 5). The test demonstrates that the 4 1/2" diameter seal operated without definable performance degradation or increase in leakage for a full thirty minutes. This test followed an additional period of one and one half hours of operation without cooling water during which the pump seal came up on a slower ramp to an operating temperature in the 450^{0}F to 500^{0}F range. The ramps for each of the successive seal stages are calculated for the full size 9 1/2" diameter seal used for retrofit in SONGS 2 and 3 in Reference 6. The reduced time at temperature of the full size (9 1/2") seal provides significant conservatism in applying the 4 1/2" circulating pump seal test results to the larger RCP seal. Seal failure is associated with exposure of the elastomer O-rings to high temperature over a period of time and to increased rubbing engagement of the seal faces at the higher temperature as fluid viscosity is reduced.

Examination of the seal following a thirty minute loss of cooling test showed that it was in such good condition that it could have continued to operate without cooling water for an extended period of time (Reference 5).

To show that the BW replacement reactor coolant pump seal assemblies will not lose function during a two hour station blackout condition, tests have been performed with duplicate replacement seal elastomers which demonstrate that the elastomers applied in the BW replacement seal show no loss of function and essentially no change in characteristics after eight hours of operation under static test at 2250 psi and 550^{0}F. Further, there was minimal change in hardness and no leakage following an eight hour static test at 2250 psi and 600^{0}F.

Reference 1. Byron-Jackson Report TCF-1025-STR-Vol. 3, Rev. 0, Heat Exchanger Analyses for SCE

Reference 2. ASME Paper 80-C2/PVP-28, San Francisco California Conference, August 12-15, 1980, "Loss of Component Cooling Water Capability of a PWR Reactor Coolant Pump"

Reference 3. O'Donnel Report ODAI-1729-400-001, "RCP Pump Heat Exchanger Performance During Loss of Cooling Incident for Southern California Edison Company Reactor Coolant Pump Seal Replacement, San Onofre Nuclear Generating Station, Units 2 and 3"

Reference 4. SCE Test Data 2PE-211-02, Rev. 0, Retest No. 1, "Loss of Cooling Water to a Bingham Boiler Circulation Pump Mechanical Shaft Seal Demonstration Test at Alamitos Unit 3 (Pump Operating)," November 1, 1985

Reference 5. Bingham-Willamette Report E12.5.146, "Post Test Inspection for Loss of Cooling Test," performed on November 1, 1985

Reference 6. O'Donnell Report, ODAI-1729-400-002, "Southern California Edison Company SONGS 2 and 3 Reactor Coolant Pump Seal Retrofit Analysis"

Reference 7. Kalsi Engineering, Inc. Report, "O-Ring Static Seal Performance Evaluation Under Loss of Component Cooling Water to Reactor Coolant Pump at SONGS Units 2 and 3" dated January 9, 1986

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