October 22, 1982

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Docket No. 50-219
LS05-82-10-070

Mr. P. B. Fiedler
Vice President & Director
Oyster Creek Nuclear Generating Station
Post Office Box 388
Forked River, New Jersey 08731

Dear Mr. Fiedler:

SUBJECT: RESOLUTION OF NUREG-0737 ITEM II.K.3.25, EFFECT OF LOSS OF A-C POWER ON PUMP SEALS - OYSTER CREEK

We have completed our review of the BWR Owners' Group response dated May 22, 1981, as supplemented by the responses dated September 21, 1981 and September 2, 1982 for NUREG-0737 Item II.K.3.25, Effect of Loss of A-C Power on Pump Seals. You endorsed the BWR Owners' Group position as applicable to Oyster Creek in your letter dated February 23, 1982.

The seal leakage data provided by the BWR Owners' Group on the affected pumps demonstrated acceptable leakage rates following loss of cooling to the pump seals. The Owners' Group has also confirmed the applicability of the test data to the pumps currently in use at your facility. Therefore, we have concluded that no modifications to the seal cooling for the recirculation pumps are required.

Thus, based on your endorsement of the BWR Owners' Group position regarding this item, we find your response to be acceptable and consider this matter to be resolved.

A copy of our Safety Evaluation is enclosed.

Sincerely,

Original signed by

Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
Division of Licensing

Enclosure:
Safety Evaluation

cc w/enclosure:
See next page

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DATE	10/22/82	10/27/82					

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION OF BWR OWNERS' GROUP GENERIC RESPONSE TO ITEM II.K.3.25 OF NUREG-0737, EFFECT OF LOSS OF ALTERNATING - CURRENT POWER ON PUMP SEALS

I. Introduction

NUREG-0737 Item II.K.3.25 requires that licensees should determine, on a plant-specific basis, by analysis or experiment, the consequences of a loss of cooling water to the reactor recirculation pump seal coolers. The pump seals should be designed to withstand a complete loss of alternating current (AC) power for at least two hours. Loss of AC power for this case is assumed to be loss of offsite power. The intent of this position is to prevent excessive loss of reactor coolant system inventory following an anticipated operational transient. Adequacy of the seal design should be demonstrated.

II. Background

A BWR Owners' Group (OG) was formed to address this issue. The initial BWR OG response (Reference 1) attempted to quantify leakage from damaged seals through analytical methods. Our evaluation of the BWR OG response (Reference 2) found the response to be unacceptable on the basis that the analyzed leak rate exceeded normal make-up capability. As a result of subsequent discussions between the BWR OG and us, the Owners' Group submitted a supplemental response (Reference 3) which provided test data and supporting analyses of several BWR recirculation pump seal leakage tests. The BWR OG also submitted additional information (Reference 4) which confirmed the applicability of the tests to the various type pumps in use at operating BWR facilities, and addressed certain discrepancies identified by us during our review of the initial and supplemental responses.

III. Evaluation

Most BWRs use two different recirculation pump configurations, but the seal designs are essentially the same. The BWR recirculation pump design incorporates a dual mechanical shaft seal assembly to control leakage around the rotating shaft of the recirculation pump. Each individual seal in the cartridge is designed for full pump design pressure.

The recirculation pump seals require forced cooling due to the temperature of the primary reactor water and due to friction heat generated in the sealing surfaces. For most BWRs, two systems accomplish this forced cooling: the reactor building closed cooling water (RBCCW) system and the seal purge system. Cooling water provided by the RBCCW flow cools primary reactor water which flows to the lower seal cavity. The seal purge system injects clean, cool water from the control rod drive system into the seal cavity.

Three tests have been performed on pumps which are representative of BWR recirculation pumps in which all seal cooling water was lost. Although the pump seal cavity temperature exceeded normal operating conditions and pump seal leakage increased following loss of cooling, the observed leakage from the seals was acceptably low (within normal makeup capability).

The first test, which was of the Hanford 2 BWR recirculation pump, manufactured by the Bingham Pump Company, was performed at the pump vendor's test facility in July 1973. During the operability testing of that pump at rated temperature and pressure, plant power to the pump was inadvertently lost. Upon loss of plant power, the recirculation pump seal cavity was deprived of seal purge (direct injection), and the pump was unable to recirculate the seal coolant through the external heat exchanger. As a result, the seal cavity temperature exceeded 270°F. During this event the seal leakage recorder was inoperative; however, test personnel continued to visually monitor pump leakage and observed or recorded no leakages beyond the capability of the 1-inch seal drain lines (under 5 gpm). This is well within the makeup capacity of the RCIC system. These leakage observations continued for more than 5 hours after cooling was lost. These test results provide confirmation that loss of cooling to the tested Bingham pump seal for 5 hours does not lead to unacceptable seal leakage.

The second test was performed on a Byron Jackson (BJ) pump. a description of the test procedure and results is given in Reference 5. The test was conducted at Byron Jackson Pump Division, Borg-Warner Corp., in Los Angeles in August 1980. Water at 550°F and 2300 psig was piped from the discharge leg of a test loop through a test fixture that closely simulated a typical BJ seal cavity and heat exchanger arrangement and back to the suction leg of the test loop. When the test loop water reached this temperature and pressure the cooling water to the test fixture was discontinued and the test commenced. The test results showed that the seal leakage remained steady and low (.008 gpm) for the first 4 hours of the test. The test continued for 56 hours and leakage did not increase appreciably. As with the previous Byron Jackson test, this test showed that loss of seal cooling to that pump does not lead to unacceptable seal leakage i.e., leakage beyond the makeup capacity of the RCIC system.

The third test was performed on a Byron Jackson pump in December, 1978 by exposing the seal to 530°F water and observing and recording seal leakage following a loss of seal cooling water for 30 minutes. Although this test duration does not exceed the 2-hour criterion, the peak seal

and associated hardware are described in ASME Paper No. 80-C2-PVP-28. The test results showed a measured seal leak rate of 2.39 gpm which is well within the makeup capacity of the RCIC system.

Consequently, this test shows that loss of seal cooling for the tested Byron Jackson pump does not lead to unacceptable seal leakage.

The above test results are representative or bounding for BWR recirculation pumps as described below.

(1) Bingham Pumps

The seal design for the tested pump is the same design and the largest size used in BWR recirculation pump applications. In addition, the test conditions for the tested pump are applicable to BWR recirculation pumps. The test results are therefore applicable to the Bingham pumps used in BWR facilities.

(2) Byron Jackson Pumps

The test results for the tested Byron Jackson pumps are bounding for the Byron Jackson pumps used for BWR recirculation systems because:

a. The tested BJ pumps had a three-stage seal assembly with a fourth vapor seal. The BJ recirculation pumps in operating BWR facilities utilize two-stage seals. However, since the seal leak rates were small, the impact of the number of stages on the leak rate is also small. For the BJ pumps in BWR applications the differential pressure per stage across the seal is approximately 190 psi lower (525 psi vs 716 psi) than for the BJ pump seals tested. Consequently, the leak rate through the tested pump seal would be higher than that for the BJ recirculation pump seal in operating BWR facilities.

b. The BJ test seal is a larger size seal than that used in a BWR recirculation pump and the expected leakage from that seal would be higher than for a BWR pump.

c. Other than the differences identified in a. and b., the seal design of the BJ test seal is similar to a typical BJ seal used in BWR recirculation pump applications.

IV. Conclusion

Seal leakage data on Bingham and Byron Jackson pumps show the leakage rates to be acceptable following loss of cooling to the pump seals. The test pumps were typical of recirculation pumps used in BWRs (see Table 1 for plant/pump information). Therefore, no modifications to the seal cooling for recirculation pumps are required.

Date: OCT 8 - 1982
Principal Contributor: W. Hodges

TABLE 1

PLANT NAME	PUMP MANUFACTURER	
	BYRON JACKSON	BINGHAM
Pilgrim 1	X	
Brunswick 1 & 2		X
LaSalle 1 & 2		X
Dresden 1-3	X	
Quad Cities 1 & 2	X	
Hatch 1 & 2	X	
Duane Arnold	X	
Oyster Creek	X	
Nine Mile Point 1	X	
Nine Mile Point 2		X
Cooper	X	
Millstone 1	X	
Monticello		X
Peach Bottom 2 & 3	X	
Limerick 1 & 2	X	
FitzPatrick	X	
Browns Ferry 1-3	X	
Vermont Yankee	X	
Enrico Fermi 2	X	
Shoreham	X	
Grand Gulf 1 & 2	X	
Susquehanna 1 & 2	X	
Hanford 2		X
Perry 1 & 2	X	
River Bend 1 & 2		X
Allens Creek	X	
Clinton Station 1 & 2		X
Black Fox 1 & 2		X
Skagit 1 & 2	X	
Hope Creek 1 & 2	X	

REFERENCES

1. May 22, 1981 letter; D.B. Waters, BWR OG, to D. G. Eisenhut, NRC; Subject: BWR Owners' Group Evaluation of NUREG-0737 Requirement II.K.3.25.

2. August 14, 1981 memorandum; P. Check, NRC, to G. Lainas, NRC; Subject: Evaluation of BWR Owners' Group Generic Response to Item II.K.3.25 of NUREG-0737, "Effect of Loss of Alternating-Current Power on Pump Seals."

3. September 21, 1981 letter; T. J. Dente , BWR OG, to D.G. Eisenhut, NRC, Subject: Supplement to BWR Owners Group Evaluation of NUREG-0737, Requirement II.K.3.25.

4. September 2, 1981 letter; T. J. Dente , BWR OG,to D. B. Vassallo, NRC; Subject: Response to NRC Request for Information on NUREG-0737, Item II.K.3.25.

5. September 19, 1980 memorandum; J.J. Zudans, NRC, to Z.R. Rosztoczy, NRC; Subject: St. Lucie; Reactor Coolant Pump Seal Hot Standby Test.