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Docket No. 50-220

Mr. Donald P. Dise
Vice President - Engineering
c/o Miss Catherine R. Seibert
Niagara Mohawk Power Corporation
300 Erie Boulevard West
Syracuse, New York 13202

DEC 1 1982

Dear Mr. Dise:

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

Re: Nine Mile Point Nuclear Station, Unit No. 1

We have completed our review of your response regarding the above subject for the Nine Mile Point Nuclear Station, Unit No. 1. In essence, NUREG-0737 Item II.K.3.25 required that recirculation system pump seals be able to withstand a complete loss of normal power for at least two hours. By your letter of December 17, 1980, as supplemented by letter dated December 31, 1980 you indicated that the two cooling water systems which service pump seals are safety grade systems powered from an emergency power source.

Since cooling water will be provided to recirculation pump seals in the event of complete loss of normal off-site and on-site power sources, seal failure will not occur. Therefore, the present design of the Nine Mile Point facility is acceptable. Furthermore, based upon this, it is not necessary to demonstrate pump seal performance in the event that cooling water is lost.

In addition to reviewing the Nine Mile Point submittals, we have completed our review of the BWR Owners' Group response dated May 22, 1981, as supplemented by letters dated September 21, 1981 and September 2, 1982. The enclosed Safety Evaluation concludes that loss of seal cooling to recirculation pumps designed by either Byron Jackson or Bingham results in acceptably small seal leakage rates. Since the Byron Jackson design is installed at Nine Mile, this evaluation is forwarded for your information.

Based upon the foregoing, Item II.K.3.25 of NUREG-0737 is considered complete.

Sincerely,

Original signed by
D. B. Vassallo

Domenic B. Vassallo, Chief
Operating Reactors Branch #2
Division of Licensing

Enclosure:
Safety Evaluation

OFFICE	cc w/enclosure		DL:ORB#2	DL:ORB#2	DL:ORB#2		DL:ORB#2
SURNAME	See next	page	SNorris	JHegner:pobo	PPolk	DVassallo	
			11/12/82	11/23/82	11/22/82	12/1/82	
DATE							

Mr. Donald P. Dise
Niagara Mohawk Power Corporation

cc:

Troy B. Conner, Jr. Esq.
Conner & Wetterhahn
Suite 1050
1747 Pennsylvania Ave., NW
Washington, D.C. 20006

T. K. BeBoer, Director
Technological Development Programs
State of New York
Energy Office
Swan Street Building
CORE 1 - Second Floor
Empire State Plaza
Albany, New York 12223

Mr. Robert P. Jones, Supervisor
Town of Scriba
R. D. #4
Oswego, New York 13126

Niagara Mohawk Power Corporation
ATTN: Mr. Thomas Perkins
Plant Superintendent
Nine Mile Point Nuclear Station
P.O. Box 32
Lycoming, New York 13093

U.S. Environmental Protection Agency
Region II Office
Regional Radiation Representative
26 Federal Plaza
New York, New York 10007

Resident Inspector
c/o U.S. NRC
P. O. Box 126
Lycoming, New York 13093

John W. Keib, Esquire
Niagara Mohawk Power Corporation
300 Erie Boulevard West
Syracuse, New York 13202

Ronald C. Haynes
Regional Administrator, Region I
U.S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, PA 19406

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 (1) 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.

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(1) Yankee Rowe uses canned rotor type recirculation pumps which do not have pump seals

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 temperature which is limited by the temperature of the primary water system, was reached during the thirty minute test. Consequently, if any significant seal deterioration was to occur, it would have occurred during this thirty minute test period. The details of the testing 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: DEC 1 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.