Florida Power
CORPORATION

December 10, 1979

File: 3-0-3-a-3

Mr. Robert W. Reid
Chief
Operating Reactors Branch #4
Division of Operating Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Crystal River Unit 3
Docket No. 50-302
Operating License No. DPR-72

Dear Mr. Reid:

Enclosed is our response to Question 3 of your November 21, 1979 letter concerning small break loss of coolant accidents.

As indicated in our December 3, 1979 letter to you, our response to Question 1 will be submitted as soon as possible after January 18, 1980.

If you have any questions concerning the enclosed response, please do not hesitate to contact this office.

Very truly yours,

FLORIDA POWER CORPORATION

J. A. Hancock
Director, Nuclear Operations

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FPC RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

## Response to Question 3

### Normal Operation of RC Pump Seals

During normal RC pump operation, both seal injection water and Nuclear Services cooling water are supplied to each pump seal. These cooling systems are 100% redundant systems. Upon loss of offsite power, both of these systems remain operable as they are supplied from the Diesel Generator at CR-3. Therefore, loss of offsite power does not result in loss of RC pump seal cooling.

The seal injection flow is divided at the point of entry to the external circulation system. Water (9.0 gpm) flows over the face of the lower seal, downward across the recirculation impeller and pump bearing, and into the reactor coolant system. About 1 gpm passes to the upper seal chambers to set the interseal pressure. This flow is returned to the makeup system. During normal operation, then, 10 gpm of injection water is supplied to each pump.

The Nuclear Services cooling to the pump seals supplies 70 gpm to an internal heat exchanger which removes heat and thereby cools the RC pump seals.

### Operation with Complete Loss of RC Pump Seal Cooling

Even though a complete loss of seal cooling is very unlikely, as discussed above, an evaluation of the consequences has been performed using engineering judgment and the limited experience applicable. The evaluation shows that leakage would not increase appreciably for approximately 10 minutes and would not be severe for up to 60 minutes. In this evaluation, it was assumed at time 0 that the pumps are stopped when both seal injection and seal cooling are lost, the seal flow return flow valve is open and initial leakage is at a normal maximum of 2 gpm for mechanical face type seals. (Note that pumps with a first-stage film riding - hydrostatic seal may leak up to 5 gpm but due to the large internal heat sink of this type of seal, the projected times in this evaluation will be about the same.)

The seal cavity temperatures and seal leak rates for the first 4 to 5 minutes from time 0 will remain essentially stable due to the mass of the heat sink at the shaft, seal cartridge and pump heat exchanger. This time period could be extended by about 2 to 3 minutes if the seal return valve is closed within 90 seconds.

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With the seal return valve open, when the temperature in the seal cavity starts to rise, it will increase at a rapid rate. The seals will be passing steam in an additional 4 or 5 minutes. If seal injection can be gradually reinitiated or if the component cooling water flow is started within about 10 minutes, the temperature ramp will be turned around, and although some internal damage may have occurred, the seal system will gradually stabilize and return to approximately the initial leakage rate. Closure of the seal return valve within this time frame is most effective in slowing the rate of temperature rise on those pumps that had low seal leakage at time zero and have not reached the point of rapid temperature increase. Closure of the seal return valve shortly after time zero would have reduced the heatup rate by as much as 75% for low leaking seals or 50% for high leaking seals.

If cooling continues to remain unavailable, the seal cavity temperature will continue to increase and is predicted to reach at least 350°F in 20 minutes. At this time, the shaft directly above the seals will be about 300°F and the heat exchanger will be at full system temperature (~540°F).

The rapid restoration of cold seal injection water after the seals and pump parts are hot will shock all of the hot parts causing distortion and possible cracking of seal parts which could lead to an increased leak rate.. However, it is felt that this will not cause an appreciable increase in leakage on a static pump. It is preferred that component cooling water be the first source reinstated until the temperatures in the seal cavity have returned to normal and have stabilized. If the Nuclear Services cooling water cannot be reinstated then cold seal injection may be initiated, preferably at a gradual rate (approximately increasing the rate at one gal. per minute).

After steaming conditions are reached, significant seal degradation would not be expected up to a period of approximately one hour after time zero. The elastomers which make up a part of the seal assembly will start to soften at approximately 300°F and can start to extrude before reaching 500°F. The amount of extrusion is based upon time, temperature and annular clearances. Experience has shown that leakage of seals because of elastomer extrusion does not increase appreciably within the first 30 minutes. It is estimated that under the worst conditions, leakage on a static pump may reach 5 gpm in 30 minutes and 10 gpm in 60 minutes.



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After the pump expe[illegible]gh seal cavity temperatures, the following parts must [illegible]cted and replaced prior to operation:

a. Seal package - replace all elastomers and seal faces, inspect all structural parts including bolts for distortion, cracks, etc.

b. Water lubricated carbon bearings - inspect for cracking and steam cutting.

c. Perform pump-rotor alignment check.

d. Monitor shaft and frame vibration on pump start to determine if thermal shocking has produced a bow in the pump shaft.

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STATE OF FLORIDA

COUNTY OF PINELLAS

J. A. Hancock states that he is the Director, Nuclear Operations, of Florida Power Corporation; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information and belief.

J. A. Hancock

Subscribed and sworn to before me, a Notary Public in and for the State and County above named, this 10th day of December, 1979.

Catherine J. Cameron

Notary Public

Notary Public, State of Florida at Large,
My Commission Expires: August 8, 1983

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