

**Florida
Power**
CORPORATION

W. P. STEWART, DIRECTOR
POWER PRODUCTION

August 31, 1978

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
Decay Heat Pump Failure

Dear Sir:

In your letter of August 3, 1978, you requested additional information regarding the Decay Heat Pump - 1A shaft failure. That information is enclosed so that you can continue your review.

If you need any further information, please contact this office.

Sincerely,

FLORIDA POWER CORPORATION

W. P. Stewart

W. P. Stewart

WPS/hew/

File: 3-B-15

R02 (8/31)

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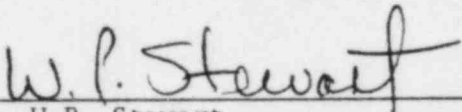
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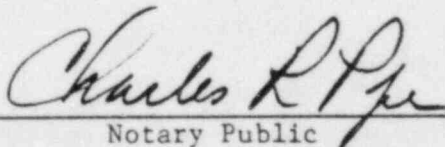
STATE OF FLORIDA

COUNTY OF PINELLAS

W.P. Stewart states that he is the Director, Power Production, 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.


W.P. Stewart

Subscribed and sworn to before me, a Notary Public in and for the State and County above named, this 31st day of August, 1978.


Notary Public

Notary Public, State of Florida at Large,
My Commission Expires: July 25, 1980

REQUEST FOR ADDITIONAL INFORMATION

CRYSTAL RIVER 3 DHP-1A SHAFT FAILURE

1. Additional assurance is needed that the corrective action proposed for DHP-1A will restore the ability of this pump to perform its intended function. Therefore, testing in the following areas is requested:

- (1) Verification that the minimum required flow and head characteristics are maintained.

Response:

The hydraulic characteristics of DHP-1A, following component inspection and reassembly, have been monitored by the performance of surveillance procedures. During the first 46 hours of continuous run-in, SP-340 "ECCS PUMP OPERABILITY" was run on a four hour interval. In all cases, the flow versus developed head characteristics were within the acceptable limits for this pump as specified by Section XI of the ASME codes. These surveillances are run with pump flow at rates required during accident conditions.

In addition, vibration data taken during this time as part of SP-340 indicate levels well within acceptable limits. Levels of .40 to .68 mils displacement and .10-.20 in/sec velocity were recorded and are considered to be indicative of a smooth running condition.

New baseline, alert and action levels, will be developed and the running of SP-340 will revert to its normal monthly cycle.

- (2) Verification that impeller rubbing has been eliminated and that excessive vibration levels do not exist at flow rates at which this pump may operate. This should be accomplished using accelerometer data taken from the bearing housing in the velocity mode, to ascertain peak values at various frequencies, and demodulated acceleration data taken for the pump casing, to ascertain the degree of pump rubbing or impact with the stationary wear rings or casing.

Response:

Enclosed is a copy of the vibration analysis for DH Pump 1A obtained using external accelerometers. Also enclosed is a copy of the DH Pumps 1A baseline external accelerometer report.

- (3) A thorough inspection of the pump at the conclusion of the testing.

Response:

The 1A Decay Heat Pump was removed from the DH Pit and inspected on August 16, 1978. The inspection of contact between the impeller and casing indicated that there was no contact between

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these parts. Also, there was no contact with either the casing or back cover wear rings and impeller wear rings. The unit was completely disassembled. During the disassembly, it was noted that the shaft sleeve would not easily come off the shaft. The shaft sleeve was pulled off by using the mechanical seal gland plate. This was the only way the sleeve could be removed without damage. This method of removal did, however, result in breaking the carbon ring in the mechanical seal. The shaft and sleeve were inspected and there appeared to be corrosion on the shaft. It is believed that this was responsible for the difficulty in removing the shaft sleeve. The shaft and bearings were removed from the bearing housing. The bearings appeared acceptable. The only abnormal item was that the oil slinger rings were both loose and riding against the thrust bearing. There were no other indications in the unit that could have caused the high vibration reading at approximately forty-five (45) times operating speed, as noted on the noise survey. Final inspection status of the pump showed that there was no contact between rotating and stationary parts in the pump and the bearings still appeared to be good.

In order to re-assemble the pump with new bearings and in order to Liquid Penetrant Inspect the shaft, the pump half coupling had to be pressed off the shaft. During this operation, the bearing cover on the outboard end of the pump was broken.

The shaft, after all bearings, slinger rings, and coupling halves had been removed, was Liquid Penetrant Inspected. This inspection showed no defects in the shaft in any location.

The following parts were ordered on Monday, August 14, 1978, from Worthington Pump Company:

- Two (2) sets of Radial Bearings
- Two (2) sets of Thrust Bearings - Total of four (4) Bearings
- Two (2) sets of Inboard Oil Seals
- Two Thrust Bearing Lock Nuts
- Two Thrust Bearing Lock Washers

These parts arrived on Thursday, August 17, 1978. On Wednesday, August 16, 1978, the following parts were ordered:

- Two (2) Carbon Rings for the Mechanical Seal
- One (1) Bearing Cover

These parts are still not on site as of this report.

The pump was re-assembled, less the bearing cover, on August 17, 1978. The corrosion indications on the shaft and matching marks on the sleeve were removed by using emory cloth. There was very little depth to the indications and these were removed from both pieces quite easily. The impeller was placed on the shaft and a rubbing/contact sound could be heard in the wear ring area. The impeller was removed, by using a pulley, on August 18, 1978, and the rubbing sound was determined to be caused by a small piece of trash between the wear rings on the impeller and back cover.

The impeller wear rings and casing wear rings were cleaned up and the impeller re-installed. The unit rotated with no indication of contact or noise.

It was the recommendation of Engineering, B&W, Lynchburg, that the broken Bearing Cover, which had been brazed together by Florida Power personnel, be re-installed in the pump. The repaired bearing cover is equal to or better than a new bearing cover. Florida Power agreed and the repaired bearing cover was installed on the 1A Pump.

The unit was installed in the line and operated on August 19, 1978. The unit appears to operate smoothly.

2. What is the maximum time that the decay heat pumps must operate in the recirculation mode following a loss of coolant accident and approximately how long had DHP-1A operated in the recirculation mode prior to the most recent failure?

Response:

A decay heat system design review was performed by B&W Safety Analysis and Systems Engineering personnel. The review included decay heat system operational requirements with regard to the capability of the decay heat system to perform its intended function.

During LOCA, the decay heat pumps would be required to operate in the minimum recirculation flow mode (85-100 gpm) for a maximum time of fifteen (15) hours. This is the time required for a depletion of the BWST inventory during a small break LOCA. Subsequent to this maximum time, the decay heat pumps would be placed in the "piggy-back" mode of operation with the HPI System, thereby increasing the pump flow rate to approximately 550 gpm. Since the decay heat pumps have been determined to be suitable for at least 80 hours operation in the minimum recirculation mode, they would, in fact, perform their intended function during a LOCA.

From the time of the first failure of DHP-1A and its subsequent repair and the most recent failure, DHP-1A has not been operated at all in the recirculation mode (85-100 gpm).

3. Provide the information or data which supports the revised restrictions for operation at minimum or recirculation flow rates.

Response

Based on results of a design review meeting with Worthington (DH Pump manufacturer) and with Worthington's authorization, B&W has informed Florida Power Corporation that the low-flow recirculation restrictions have been modified. The new restrictions, which allow operation of the DHP's during the recirculation mode for fifteen (15) hours continuously and up to eighty (80) hours total within the life of the pump, were reported to you in our letter dated July 7, 1978. Attached is a copy of the B&W letter

to Florida Power Corporation revising these limits on the operation of the DH Pumps at CR #3.

4. In order to facilitate our review of DHP-1A and the corrective actions to be taken, please provide detailed engineering drawings of the DHP showing critical dimensions.

Response:

It is Worthington's Corporate Policy not to release engineering drawings of pumps. This is being pursued.

5. Because of a similar but less severe misalignment between impeller and casing on DHP-1B is not precluded by its operating history and because inspection of the previous DHP-1B shaft at the time of its replacement "revealed indications that could be interpreted as initiation of fatigue damage" (B&W Preliminary Significant Deficiency Report 5-77, May 3, 1977), you are requested to verify by inspection proper alignment between the DHP-1B impeller and casing and report the results of this inspection. Please inform us, in your seven day response to question 1, of your intent with respect to inspection of DHP-1B. You are also requested to provide the pump signature of DHP-1B which you refer to in your letter.

Response:

DHP-1B was removed from the line for disassembly and inspection on Friday, August 25, 1978. Initial observation indicated very minor contact between the impeller and casing.

The contact marks on the casing and impeller of the DHP-1B pump indicated that during some time in the pump's life the impeller had touched the casing. The marks on the impeller were approximately 3/8" wide and in three different areas on the impeller. (The marks are on the front shroud of the impeller at the maximum outside diameter of the wheel.) Each area (3 areas) is 3 to 5 inches long and approximately 60° to 90° apart for approximately 240° on the impeller. The single contact mark on the casing is opposite the discharge splitter vein next to the pump casing pedestal foot. This mark is approximately 1-1/2 inches long by 3/8 inch wide. The marks are dark in appearance compared to the machined areas on the pump casing and impeller. There is no evidence of metal removal from either the impeller or casing. The appearance of these contact areas would indicate the marks are old, possibly made during Worthington shop testing.

The scratch marks on the suction wear rings were irregular in location on the ring and did not propagate around the impeller wear ring area. Each mark had a start and stop point. This is typical of trash running through the rings.

Worthington is being contacted in regard to the thicker than normal Casing Gasket that was used in DHP-1B.

IMPELLER

Contact marks
3" to 5" long
by 3/8" wide

CASING

Contact mark
1-1/2" long
by 3/8" wide

It was B&W Lynchburg's recommendation to remove 1/8 inch from the back of the impeller hub thus increasing the clearance between impeller and casing. The remaining observation on the pump was that what appeared to be trash going through the wear rings on the impeller suction had scuffed up the suction wear rings on both the pump casing and impeller.

The unit was completely disassembled and the shaft dye checked on Friday night. There were no indications on the shaft.

The 1/8 inch of material was removed from the impeller hub and the unit reassembled with new bearings, oil seals, and mechanical seal on Saturday. The old shaft and impeller were returned to the DHP-1B pump.

The "B" pump shaft showed some corrosion marks under the shaft sleeve, similar to "A" pump shaft. These were removed with emory cloth. The completed unit, prior to reinstallation in the casing, was checked for impeller-to-casing clearance. Below are the readings taken:

Back Cover Flange to front Shroud at Impeller: 5-1/2".

Depth from Casing Flange to bottom of Casing Waterway:

- A - 5-5/8"
- B - 5-7/8"
- C - 5/15/16"
- D - 5-7/8"

Minimum clearance by measurement is 1/8".

The unit was installed in the system and operated on Sunday, August 27, 1978.

The pump signature of DHP-1B and a copy of the DH Pump 1B baseline external accelerometer reports are attached.