Omaha Public Power District

1623 HARNEY • OMAHA, NEBRASKA 68102 • TELEPHONE 536-4000 AREA CODE 402

June 13, 1980

Mr. Robert A. Clark, Chief
U. S. Nuclear Regulatory Commission
Operating Reactors Branch No. 3
Division of Licensing
Washington, D. C. 20555

Reference: Docket No. 50-285

Dear Mr. Clark:

The Omaha Public Power District received a letter from the Commission, dated May 15, 1980, requesting that certain information be provided relative to turbine disc integrity at the Fort Calhoun Station. In response, the attached information is provided.

Sincerely,

W. C. Jones
Division Manager
Production Operations

WCJ/KJM/BJH:jmm

Attach.

cc: LeBoeuf, Lamb, Leiby & MacRae
1333 New Hampshire Avenue, N. W.
Washington, D. C. 20036

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Subscribed and sworn to before me

this 13th day of June, 1980.

Notary Public

ADD:	LTR	ENC
W. Ross	1	1
W. Hazelton	1	1
H. Walker	1	1

GENERAL NOTARY - State of Nebraska
J. T. GLEASON
My Comm. Exp. July 28, 1982

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SITE SPECIFIC GENERAL QUESTIONS

Question 1: Provide the following information for each LP turbine:

A. Turbine type.
B. Number of hours of operation for each LP turbine at time of last turbine inspection or if not inspected, postulated to turbine inspection.
C. Number of turbine trips and overspeeds.
D. For each disc:

1. Type of material including material specification.
2. Tensile properties data.
3. Toughness properties data including Fracture Appearance Transition Temperature and Charpy upper steel energy temperature.
4. Keyway temperatures.
5. Critical crack size and basis for the calculation.
6. Calculated bore and keyway stress at operating design overspeed.
7. Calculated K_{Ic} data.
8. Minimum yield strength specified for each disc.

Response 1: A. Turbine type: General Electric, 1800 rpm, tandem-compound, non-reheat unit with one high-pressure and two double-flow low-pressure cylinders and 38-inch last-stage buckets.
B. Number of hours: 44,375
C. Number of turbine trips: 60
Number of overspeeds: 7 (110%, tests only)
D. Answers to these questions involve data which are proprietary to the General Electric Company. Information was provided directly to the NRC during a meeting between General Electric and NRC representatives on April 21, 1980. General Electric has informed the District that this information was acceptable to the Commission as a reply to this question.

Question 2: Provide details of the results of any completed inservice inspection of LP turbine rotors, including areas examined, since issuance of an operating license. For each indication detected, provide details of the location of the indication, its orientation, size, and postulated cause.

Response 2: Magnetic particle inspections were performed on the LP turbine shrunk-on wheels during the 1975 and 1980 refueling outages. No crack-like indications were revealed.

During the 1980 outage, ultrasonic inspection, which was performed on the tangential entry dovetails on wheels 1 through 8 (governor and generator end shaft), revealed no indications. An ultrasonic technique is not presently available for inspecting wheels 9 and 10, which have a pinned finger type dovetail. In addition to the ultrasonic inspection of the tangential entry wheel dovetails, the wheel bore re-

gions of all LP wheels were inspected using an ultrasonic test developed to search for radial-axial cracks in the vicinity of wheel bore and keyway surfaces. Again, no crack-like indications were revealed.

Based upon the results of their inspection, General Electric have stated that the LP rotors are satisfactory for continued operation.

The results of the 1980 inspection were reported to the Commission in a letter dated April 23, 1980, W. C. Jones to Robert W. Reid of the Nuclear Regulatory Commission.

Question 3: Provide the nominal water chemistry conditions for each LP turbine and describe any condenser inleakages or other significant changes in water chemistry to this point in its operating life.

Response 3: CONDENSATE AND FEEDWATER SPECIFICATIONS

Conductivity Intensified Cation	<1.5 μmhos/cm
Dissolved Oxygen	<10 ppb
Hydrazine	10 - 50 ppb
Ammonia	<1 ppm
Silica	<20 ppb
Sodium	<10 ppb
Copper	<10 ppb
Iron	<25 ppb
pH a. With Copper-Alloy comp.	8.8 - 9.2

Fort Calhoun Station has a history of excellent chemistry control. Condenser leaks have been few and of very short duration, and as a result, chemistry parameters have seldom been out of specification.

Question 4: If your plant has not been inspected, describe your proposed schedule and approach to ensure that turbine cracking does not exist in your turbine.

Response 4: Not Applicable

Question 5: If your plant has been inspected and plans to return or has returned to power with cracks or other defects, provide your proposed schedule for the next turbine inspection and the basis for this inspection schedule, including postulated defect growth rate.

Response 5: Not Applicable

Question 6: Indicate whether an analysis and evaluation regarding turbine missiles have been performed for your plant and provided to the staff. If such an analysis and evaluation has been performed and reported, please provide appropriate references to the available documentation. In the event that such studies have not been made, consideration should be given to scheduling such an action.

Response 6: Such an analysis has been performed. The results are discussed in Subsection 5.8.2 and Section 14.8 of the Fort Calhoun FSAR.

GENERIC QUESTIONS

Question 1: Describe what quality control and inspection procedures are used for the disc bore and keyway areas.

Response 1: After the rough machined wheel/disc forging has been tempered, material is removed from surface locations to measure mechanical properties. The forging is then subjected to a 100% volumetric ultrasonic inspection. If the test results meet stringent acceptance standards, the forging is released for final machining. During final machining, attention is continually paid to the finish, contour and dimensions of every surface. For instance, the keyway depth, width, location, radii, and surface finish for every wheel are checked for conformance to drawings. Quality control personnel assure that tolerances are maintained. Any deviation from accepted tolerances are reported to engineering for disposition.

Only coolants and lubricants approved by engineering are used in the manufacturing and assembly process. These coolants and lubricants have undergone extensive laboratory corrosion testing to ensure their acceptability prior to their approval for use in manufacturing. Periodic sampling is done on all such fluids to verify that their chemistry is within acceptable limits.

Response 1: (Continued) After finish machining, each wheel is thoroughly cleaned and given a magnietic particle inspection of all surfaces. If acceptable, the buckets are assembled and the wheel is statiscally balanced. After assembly on the shaft, each wheel is inspected and measurements are made to assure its proper location. A high speed balance is performed on the assembled rotor which is then spun to 20% overspeed. Finally, after a magnetic particle inspection of the buckets, the rotor is cleaned to prepare for shipment.

Question 2: Provide details of the General Electric repair/replacement procedures for faulty discs.

Response 2: Stress corrosion cracks have not been observed to date in nuclear wheels manufactured by General Electric, and GE does not anticipate that removal or replacement of wheels will be required because of this phenomenon. The water erosion which has been observed in the keyways of wheels on several non-reheat machines is being studied intensively. General Electric currently believes that the erosion process is self-limiting and should not require the replacement of any wheels.

Question 3: What immediate and long term actions are being taken by General Electric to minimize future "water cutting" problems with turbine discs? What actions are being recommended to utilities to minimize "water cutting" of discs?

Response 3: No immediate actions are required to minimize water erosion because of the apparent self-limiting nature of the phenomenon. However, if future inspections show an unexpected progression of the water erosion, appropriate operating restrictions and/or modifications will be implemented.

Question 4: Describe fabrication and heat treatment sequence for discs, including thermal exposure during shrinking operations.

Response 4: The wheel/disc forgings are heat treated in the rough machined condition. The heat treatment consists of soaking at a temperature above the upper critical temperature with the time and temperature sufficient to ensure complete austenitization throughout the forging, followed by a quench in cold, vigorously circulated water for a sufficient time to ensure complete transformation throughout the section. The forgings are heated uniformly to a tempering temperature below the lower critical temperature and held for a sufficient time to soften to the desired tensile range. After tempering, the forgings are still-air cooled to room temperature.

Response 4: (Continued) After final machining, the wheels (discs) are uniformly heated in an electric furnace to a temperature below the embrittling range, but sufficiently high to increase the wheel diameter enough to assemble on the shaft with the required shrink fit.