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IPPOLTIO,T.A. Operating Reactors Branch 2

SUBJECT: Forwards response to NRC 800516 ltr re turbine disc cracking at site.Response includes site-specific technical & background info,chemistry & insp data & general info.No cracks detected in turbine discs.

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JUN 24 1980

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Iowa Electric Light and Power Company

June 6, 1980
LDR-80-158

LARRY D. ROOT
ASSISTANT VICE PRESIDENT
NUCLEAR GENERATION

Mr. Thomas A. Ippolito
Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, MD 20034

Dear Mr. Ippolito:

This letter is in response to your letter of May 16, 1980 requesting information related to the turbine disks at Duane Arnold Energy Center.

Attached is an item-by-item response to the questions listed in enclosure 3 to your letter. The response to the generic questions concerning GE turbines was provided to us by General Electric.

Very truly yours,

Larry D. Root

Larry D. Root
Assistant Vice President
Nuclear Generation

LDR/ED/rs

Attachments: 1) Written Responses
2) Normal Water Chemistry

cc: R. Salmon
D. Arnold
L. Liu
S. Tuthill
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T. Kevern (NRC)
File: A-107a, LC800328

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Information requested by NRC letter of 5-16-80, (Ippolito to Arnold)

Site Specific General Questions

I. A. The DAEC turbine is a General Electric M6R, tandem compound, 4 flow machine, with 38" last stage buckets, and 2 stage reheat.

B. The low pressure turbines were inspected as described in item II below. The "A" turbine was inspected during 1976 outage after a total of 11,956 hours of operation. The "B" portion was inspected during the 1977 outage after 14,855 hours of operation.

It is anticipated that the ultrasonic examination described in IV below will be performed on one low pressure turbine during the 1981 outage and on the other during the 1982 outage. At those times the machine will have a total of approximately 38,000 and 46,000 hours of operation respectively.

C. There have been 71 turbine trips since the plant went into operation. This includes normal shutdowns. None of these trips have been caused by inadvertent turbine overspeeds. In addition, please note that a turbine overspeed trip test is usually conducted in conjunction with turbine maintenance.

D. The requested detailed information concerning the LP turbine rotor disks is included in the proprietary information presented by General Electric during their April 21, 1980 meeting with the NRC. This information is applicable to the DAEC turbine.

II. One low pressure turbine was inspected during the 1976 outage and one during the 1977 outage. A magnetic particle examination (MT) was performed on the low pressure rotor consisting of seven stages (14 rows double flow) of wheels buckets, bucket covers and exposed areas of the shaft, journals, couplings, and tie or lashing wires. No indications were reported.

During the 1976 outage a dye penetrant examination (PT) was performed on the 14th stage erosion shields of the "A" turbine with no evidence of cracks being reported.

III. The normal water chemistry conditions experienced by the turbine are indicated by the reactor and hotwell water chemistry. These water chemistry conditions are tabulated in Attachment 2. No water chemistry tests are made on steam extracted from the turbine. There have been no water chemistry transients which would have had a significant impact on steam water quality. There has been no chemical cleaning of the low pressure rotors.

IV. A full ultrasonic examination (UT) of one low pressure turbine rotor will be performed during the next refueling outage scheduled to begin in early 1981.

The other LP turbine rotor will be inspected during the 1982 refueling outage.

It is intended that the examination techniques described by G.E. during their February 21, 1980 meeting with the NRC will be used.

V. No cracks or other defects have been found in the low pressure turbine rotors.

VI. A turbine missile analysis has been performed, and the results are documented in Appendix N, question N.11.2 of the DAEC FSAR.

Generic Questions

I. After the rough machined wheel/disk forging has been tempered, material is removed from the 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 is 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. If required, corrective actions are taken to maintain the chemistry within limits.

After finish machining, each wheel is thoroughly cleaned and given a magnetic particle inspection of all surfaces. If acceptable, the buckets are assembled and the wheel is static balanced. After assembly on the shaft, each wheel is inspected and measurements are made to assure its proper location. The assembled rotor is then spun to 20% overspeed following a high speed balance. Finally, after a magnetic particle inspection of the buckets, the rotor is cleaned to prepare for shipment.

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

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

IV. The wheel/disk 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 through 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.

After final machining the wheels (disks) 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.

NORMAL WATER CHEMISTRY CONDITIONS

	Reactor Water	Hotwell Water
Conductivity	0.1 umho/cm	0.09 umho/cm
pH	6.2	----------
Chloride	<0.03 ppm	<0.03 ppm
Silicates	<80 ppb	----------
Boron	<10 ppb	----------
Dissolved Oxygen	50 ppb	50 ppb
Total Dissolved Solids	<10 ppb	<10 ppb
Total Solids	<10 ppb	<10 ppb