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HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

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July 24, 1980

Docket No. 50-245
A01087

Director of Nuclear Reactor Regulation
Attn: Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

References: (1) D. M. Crutchfield letter to W. G. Counsil dated June 11, 1980.
(2) D. C. Switzer letter to D. J. Skovholt (AEC) dated December 19, 1972.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 1
Low Pressure Turbine Disc Integrity

This letter responds to your request (Reference (1)) for information related to the turbine disc in use at Millstone Unit No. 1. Attachments 1 and 2 are the plant-specific and generic questions, respectively, along with Northeast Nuclear Energy Company's (NNECO) replies which we believe are fully responsive to your concerns.

Should you have any questions, please contact us.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

W. G. Counsil

W. G. Counsil
Senior Vice President

Attachments

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ATTACHMENT 1

MILLSTONE NUCLEAR POWER STATION, UNIT NO. 1

PLANT-SPECIFIC INFORMATION

JULY, 1980

Plant-Specific Question I.

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 of if not inspected, postulated to turbine inspection.

C. Number of turbine trips and overspeeds.

D. For each disc:

1. Type of material including material specifications.

2. Tensile properties data

3. Toughness properties data including Fracture Appearance Transition Temperature and Charpy upper steel energy and 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

A. The Millstone Unit No. 1 turbine is a tandem compound four flow, three casing, non-reheat condensing, 1800 RPM steam turbine utilizing 43-inch last row blades in the low pressure elements.

B. The Millstone Unit No. 1 low pressure (LP) turbine rotors were ultrasonically tested for disc defects in September, 1974. The LP turbines had accumulated 21,188 hours of operation prior to this inspection.

C. The Millstone Unit No. 1 turbine has experienced a total of 87 turbine trips and overspeeds. Of these trips, only seven have resulted in turbine overspeeds. In all cases, the turbine overspeeds were limited to less than 10 percent of the rated speed. In addition, a turbine overspeed trip test is conducted during each refueling outage, which involves raising the turbine speed to approximately 110 percent of rated speed under a no-load condition.

D. The disc information requested involves data proprietary to the General Electric Company and is not presently available to NNECO. This information was provided to the NRC Staff by representatives of the General Electric Company at a meeting with the Staff on April 21, 1980. NNECO has been informed by General Electric that the NRC Staff has accepted the information presented at the April 21, 1980 meeting as an acceptable response to this question. As such, a response to this question is not required by NNECO.

Plant-Specific Question II.

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

The Millstone Unit No. 1 LP rotors were both ultrasonically tested for disc bore and keyway defects in September, 1974. No significant defects were found, although low-level indications were detected on an L-0 and L-2 disc of the "A" LP rotor. These indications were dispositioned as probably bore scratches which occurred during the rotor assembly at the factory. In March, 1978, these discs were ultrasonically reinspected, and no changes were detected. Therefore, it was concluded that these low-level indications on these discs are most probably bore scratches from the original rotor assembly and are not of concern from a disc integrity standpoint. NNECO presently intends to reinspect the "B" LP turbine rotor during the refueling outage scheduled to commence in September, 1980. At that time, the "B" LP rotor will have accumulated an estimated 64,121 hours of operation, based on an October 4, 1980 shutdown date for refueling.

Plant-Specific Question III.

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

Millstone Unit No. 1 operates with full flow condensate demineralizers to maintain high water purity in the primary coolant. The only significant excursion in feedwater chemistry control was the September, 1972 chloride intrusion incident caused by condenser inleakage. This incident and the follow-up inspections are thoroughly documented in the Chloride Intrusion Report (Reference (2)). The main condenser was retubed during the September - December, 1972 refueling outage. Since that time, feedwater chemistry has not been significantly perturbed by condenser inleakages.

The ultrasonic disc inspections conducted on both LP rotors in September of 1974 indicate that the chloride intrusion incident had not degraded disc integrity.

Nominal feedwater chemistry is as follows:

pH	6.8
Conductivity, mhos/cm	.06
Oxygen, ppb	20 - 30
SiO_2, ppb	0.0
Cl, ppb	< 20
Total Metals, ppb	5 - 8 (90% Fe, Balance Cu, Ni, and Cr)

Plant-Specific Question IV.

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

The Millstone Unit No. 1 LP turbine rotors were both ultrasonically inspected for disc defects in 1974. LP "A" was reinspected in 1978, and LP "B" is scheduled for reinspection in the upcoming October, 1980 refueling outage. Thusfar, no disc defects (i.e., stress corrosion cracking, water erosion, etc.) have been found.

Plant-Specific Question V.

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

Not applicable since no disc defects have been found in the Millstone Unit No. 1 LP rotors.

Plant-Specific Question VI.

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 have 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

FSAR Amendment 17, Response to Question B.6, provided a summary description of the provisions incorporated in Millstone Unit No. 1 for protection against a complete spectrum of potential missiles, including potential missiles from a failure of the main turbine. The response referenced the GE Report TR-675L211, "Analysis of Turbine Missiles Resulting from Last Stage Wheel Failure". It was concluded that the worst-case turbine generator missile would not penetrate the reactor building walls to an extent that would preclude the safe shutdown of the plant.

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ATTACHMENT 2

MILLSTONE NUCLEAR POWER STATION, UNIT NO. 1

GENERIC INFORMATION

JULY, 1980

Generic Question I.

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

Response

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 is checked for conformance to drawings. Quality control personnel assure that tolerances are maintained. Any deviation from accepted tolerances is reported to engineering for disposition.

Only coolants and lubricants approved by engineering are used in the manufacturing and assembly process. These coolant 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.

Generic Question II.

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

Response

Stress corrosion cracks have not been observed to date in nuclear wheels manufactured by General Electric Company. General Electric does not anticipate that removal or replacement of wheels will be required as a result of this phenomenon. The water erosion which has been observed in the keyways of wheels on several non-reheat machines is being studied intensively.

Current information indicates that the erosion process is self-limiting and that replacement of any wheels will not be required.

Generic Question III.

What immediate 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

As a result of the self-limiting nature of the "water-cutting" phenomenon, no immediate actions are required to minimize water erosion. Should future inspections indicate an unexpected progression of water erosion, appropriate corrective actions will be taken.

Generic Question IV.

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

Response

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 under conditions sufficient to ensure complete austenitization through the forging. This is followed by a quench in cold, vigorously circulated water for a sufficient time to ensure complete transformation throughout the section. The forgings are then 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.