Maine Yankee

RELIABLE ELECTRICITY FOR MAINE SINCE 1972

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February 11, 1991
MN-91-29 CDF-91-20
Proposed Change No. 160

UNITED STATES NUCLEAR REGULATORY COMMISSION
Attention: Document Control Desk
Washington, DC 20055

References:
(a) License No. DPR-36 (Docket No. 50-309)
(b) MYAPCo Letter MN-88-68 of November 22, 1988
(c) WCAP 11525, "Probabilistic Evaluation of Reduction in Turbine Valve Test Frequency"
(d) ABB Reports TB HTGE 52 103, 107 and 254

Subject: Proposed Technical Specification Change No. 160 - I.P Turbine Rotor Inspection Minimum Frequency for Equipment Tests

Gentlemen:

Maine Yankee hereby submits, pursuant to 10 CFR 50.90, this application to amend sections of the Maine Yankee Technical Specifications. This proposed change would delete the testing intervals of the low pressure turbine rotors. Maine Yankee's original low pressure turbine rotors were susceptible to, and had experienced, stress corrosion cracking. The rotors were replaced during the 1988 refueling outage with rotors of a different design, which significantly reduced the likelihood of stress corrosion cracking and the probability of turbine missile generation. Since rotor inspections are performed in conjunction with major turbine overhauls (at intervals of approximately 50,000 equivalent operating hours), there is no need for duplicate or supplemental Technical Specification surveillances.

The proposed amendment would modify Technical Specification 4.2, "Equipment and Sampling Tests" by deleting Item 10, L.P. Turbine Rotor Inspection and its associated test and frequency.

The new low pressure turbine rotors are of an improved design and have improved the reliability of the turbines. As described in Attachment A, this change does not increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated, create the possibility of an accident or malfunction of a different type than any evaluated previously in the safety analysis or reduce the margin of safety as defined in the basis for any Technical Specification. The change does not present an unreviewed safety question as defined in 10 CFR 50.59.

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Turbine valves are periodically tested to ensure they are operable and are designed to protect the turbine from excessive overspeed. Reference (b) requested an extension of this test interval and was based on an evaluation of turbine overspeed and missile generation probabilities considering the turbine valve test intervals that were presented in Reference (c). Reference (d) extends this analysis to the modified rotors and both reports form the basis for this proposed change. Staff action on Reference (b) is pending.

With regard to the matter of significant hazards considerations, we have evaluated this proposed change as required by 10 CFR 50.92. We concluded that no significant hazards consideration exists. Our analysis is attached to this letter as Attachment A.

Revised Technical Specification page 4.2-6 is included as Attachment B.

This proposed change has been reviewed and approved by the Plant Operation and Review Committee. The Nuclear Safety Audit and Review Committee has also reviewed this submittal. A representative of the State of Maine is being informed of this request by a copy of this letter.

We request that this proposed change be made effective within thirty days of issuance.

Very truly yours,

Charles D. Frizzle
President

WBD/sjj

Attachment

c: Mr. Thomas T. Martin
Mr. E. H. Trottier
Mr. Charles S. Marschall
Mr. Clough Toppan

STATE OF MAINE

Then personally appeared before me, Charles D. Frizzle, who being duly sworn did state that he is President of Maine Yankee Atomic Power Company, that he is duly authorized to execute and file the foregoing request in the name and on behalf of Maine Yankee Atomic Power Company, and that the statements therein are true to the best of his knowledge and belief.

Notary Public

BARBARA J. PADAVANA
NOTARY PUBLIC, MAINE
MY COMMISSION EXPIRES JUNE 20, 1996

Attachment A

Proposed Change (Table 4.2-2)

Delete Item 10, L.P. Turbine Rotor Inspection, its specified test of "Visual, Magnetic Particle or Liquid Penetrant" and its specified frequency of "One rotor each 4 years".

Reason for Change

The power industry has recognized the serious cracking problem in the rotors of low pressure turbines of the built-up design. These built-up rotors consist of a shaft with shrunk-on and keyed discs or wheels onto which the LP blading is attached. This design has proved to be susceptible to stress corrosion cracking (SCC). Due to their susceptibility, rotors of this design must be inspected frequently to identify cracks and determine crack growth rate. Thus, the SCC problem was lowering the availability and output of units and simultaneously increasing the probability of missile generation from an LP rotor disc failure.

Maine Yankee's previously installed low pressure rotors had experienced stress corrosion cracking (SCC) problems which necessitated the removal of the blading from two reaction stages in each steam flow path of No. 2 turbine.

Both low pressure turbine shrunk-on disc type rotors were replaced with welded design rotors complete with blading, sleeved couplings, inner casings, and jack shafts. The contract for the manufacture and installation was awarded to ASEA Brown Boveri, Inc. (ABB) and the retrofit was completed during the 1988 refueling outage.

The ABB LP rotor design employs an entirely different approach which avoids the problems of SCC. The ABB rotor consists of solid forged discs circumferentially welded together at their periphery in the region of lowest stress. ABB's blade attachment design avoids all known generic and material deficiencies which have resulted in disc and steeple cracking (cracking in the blade attachment area) in the built-up rotor design. Inherent in the ABB welded rotor design are the following attributes:

1. Lower stress levels (2.5 times lower) at the blade attachment grooves.

2. Elimination of highly stressed areas such as keyways, blade roots and center bores.

3. Inspection and removal of the last stage blades without removal of the turbine outer casing.

4. Any SCC cracking (should it occur) will initiate at the outer surface of the rotor body.

5. A longer rotor overhaul (and inspection) interval. ABB recommends a major overhaul of the LP turbines every 50,000 equivalent operating hours. Equivalent operating hours are defined as actual operating hours plus the product of the number of starts and the operating hours charged for one start. Visual and/or ultrasonic inspections of the rotors are included in the scope of work performed during the major overhaul.

Missile generation analysis takes the turbine to reactor containment alignment and turbine disc fragment ejection probability into account, and along with other factors, determines the probability of an ejected turbine missile fragment penetrating the turbine casing, impacting a safety related component and causing failure of that component as a result of the impact damage. From this analysis, turbine inspection intervals are determined for each turbine rotor design. As a result of design improvements inherent in the ABB rotor and blade attachments, the total missile generation probability, as calculated using the methodology of Reference (c) and the conditional probabilities presented in Reference (d), is almost entirely dependent on the destructive overspeed event (see Table 1). Therefore, the total missile generation probability becomes essentially independent of the LP rotor inspection interval and depends primarily on valve test frequency. Based on Table 8.3-2 of Reference (c), for the worst case valve test interval of 12 months and at a rotor inspection interval of 4 years, the total missile generation probability decreased from the previous 9.21×10^{-6} yr^{-1} to 8.8×10^{-7} yr^{-1}. At the valve test interval of 3 months as requested by Reference (b), the total missile generation probability is 2.62×10^{-7} yr^{-1}. Thus, the welded rotor design greatly enhances the safety of the plant and significantly reduces maintenance requirements.

Safety Evaluation and Determination of Significant Hazards Considerations

The proposed change to the Technical Specifications has been evaluated to determine whether it constitutes a significant hazards consideration as required by 10 CFR Part 50, Section 50.91 using standards provided in Section 50.92. This analysis is provided below:

1. The proposed amendment will not involve a significant increase in the probability or consequences of an accident previously evaluated. Turbine missile analysis results reflect a decrease in missile generation probability; therefore, the safety of the plant is increased. All turbine trip parameters remain unchanged.

   The referenced analysis as reported in WCAP 11525 and ABB HTGE 52 provides an evaluation of the probability turbine missile ejection for the purpose of justifying a reducti the frequency of turbine rotor testing. In a letter to West ghouse Electri Corporation dated February 2, 1987 (C. E. Rossi, USNRC to J. A. Martin, Westinghouse), the Commission established acceptable criteria for the probability of generating a turbine missile from the unfavorably oriented turbine (acceptable probability of missile generation $< 1.0 \times 10^{-5}$ yr^{-1}). The Maine Yankee evaluation of the ABB rotor shows that the probability of a missile ejection incident versus turbine rotor service life never exceeds 1×10^{-6} yr^{-1} (see Table 1). Therefore, the change in the probability of generating a turbine missile with longer turbine rotor testing intervals does not represent an increase in the probability or consequences of an accident previously evaluated.

2. The proposed amendment will not create the possibility of a new or different kind of accident from any accident previously analyzed. The proposed amendment allows a change in the frequency at which low pressure turbine rotors are tested. Changing the frequency of testing does not result in a change in the failure modes of the rotors. Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. The proposed amendment will not involve a significant reduction in the margin of safety. As noted above, and as shown in WCAP 11525 and ABB HTGE 52, this change to the Maine Yankee Technical Specifications will not result in a reduction in the margin of safety for missile ejection. The probability of missile ejection has decreased, remains acceptably small and is within guidelines established by the NRC Staff.

The Commission has provided guidance (March 6, 1986 Federal Register) concerning the application of the standard in 10 CFR 50.92 for determining whether a significant hazards consideration exists by providing certain examples of amendments that will be found to involve no significant hazards considerations. The change to the Maine Yankee Technical Specifications proposed in this amendment request is similar to NRC example (vi). Example (vi) relates to a change which either may result in some increase to the probability or consequences of a previously analyzed accident or may reduce in some way a margin of safety, but where the results of the change are clearly within all transient analysis acceptance criteria and within the limits of 10 CFR Part 50.46 and Appendix K to Part 50. The Commission has established an acceptance criteria for the turbine missile ejection accident of 1.0×10^{-6} yr^{-1}. The probability of a turbine missile ejection incident presented in WCAP 11525 and ABB HTGE 52 is relatively independent of the turbine rotor inspection interval, and for the worst case valve test interval of 12 months and an LP rotor inspection interval of 10 years (see Table 1), is 9.8×10^{-7} yr^{-1}. This demonstrates that the probability of a turbine missile ejection accident for the Maine Yankee plant is well within accepted NRC criteria.

Based on this guidance and the reasons discussed above, we have concluded that the proposed change does not involve a significant hazards consideration.

TABLE 1

MEAN ANNUAL PROBABILITY OF TURBINE MISSILE EJECTION

LP ROTOR INSP.INT. (YEARS)	P(A)	P(M/A)	P(A)xP(M/A)	P(B)	P(M/B)	P(B)xP(M/B)	P(C)	P TOTAL
5	1.02E-03	1.50E-09	1.53E-12	2.11E-05	1.00E-08	2.11E-13	8.80E-07	8.80E-07
10	1.02E-03	2.00E-07	2.04E-10	2.11E-05	1.00E-06	2.11E-11	8.80E-07	8.80E-07
15	1.02E-03	2.00E-06	2.04E-09	2.11E-05	1.00E-05	2.11E-10	8.80E-07	8.82E-07
20	1.02E-03	1.00E-05	1.02E-08	2.11E-05	3.00E-05	6.33E-10	8.80E-07	8.91E-07
25	1.02E-03	3.00E-05	3.06E-08	2.11E-05	8.00E-05	1.69E-09	8.80E-07	9.12E-07
30	1.02E-03	5.00E-05	5.10E-08	2.11E-05	1.20E-04	2.53E-09	8.80E-07	9.34E-07
35	1.02E-03	9.00E-05	9.18E-08	2.11E-05	2.00E-04	4.22E-09	8.80E-07	9.76E-07
40	1.02E-03	1.00E-04	1.02E-07	2.11E-05	3.00E-04	6.33E-09	8.80E-07	9.88E-07

WHERE:

P TOTAL = P(A)xP(M/A)+P(B)xP(M/B)+P(C)
= ANNUAL PROBABILITY OF TURBINE MISSILE EJECTION

P(A) = ANNUAL PROBABILITY OF DESIGN OVERSPEED

P(B) = ANNUAL PROBABILITY OF INTERMEDIATE OVERSPEED

P(C) = ANNUAL PROBABILITY OF DESTRUCTIVE OVERSPEED

P(M/A)=CONDITIONAL PROBABILITY OF MISSILE EJECTION
AT DESIGN OVERSPEED

P(M/B)=CONDITIONAL PROBABILITY OF MISSILE EJECTION
AT INTERMEDIATE OVERSPEED

NOTES:

1. P(A), P(B), AND P(C) VALUES FROM REFERENCE (C) FOR 12 MONTH VALVE TEST INTERVAL

2. P(M/A) AND P(M/B) VALUES FROM REFERENCE (D), PART 3