**NORTHEAST UTILITIES**

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THE CONNECTICUT LIGHT AND POWER COMPANY
THE HARTFORD ELECTRIC LIGHT COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

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August 31, 1981

Docket No. 50-245
B10288



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. G. Eisenhut letter to All SEP Licensees, dated July 7, 1981.
(2) W. G. Counsil letter to D. G. Eisenhut, dated July 29, 1981.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 1
SEP Topic III-4.B, Turbine Missiles

Reference (1) requested the SEP licensees to commit additional resources devoted to completion of the SEP. In Reference (2), Northeast Nuclear Energy Company (NNECO) committed to develop Safety Assessment Reports (SARs) for certain SEP topics which could be submitted for Staff review. In accordance with this commitment, NNECO hereby provides the Safety Assessment Report for SEP Topic III-4.B, Turbine Missiles, which is included as Attachment 1.

We trust the Staff will appropriately use this information to develop a Safety Evaluation Report for this SEP topic.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

W. G. Counsil

W. G. Counsil
Senior Vice President

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Docket No. 50-245

Attachment 1

Safety Assessment Report

SEP Topic III-4.B, Turbine Missiles

August 1981

Millstone Nuclear Power Station, Unit No. 1
Safety Assessment Report

## Topic III-4.B, Turbine Missiles

## 1.0 INTRODUCTION

The purpose of this assessment is to assure that a destructive burst of one of the steam turbine rotors or of one of the discs shrunk on to the low pressure rotors will not occur. The assessment focuses on two areas: (1) normal operation, including overspeeds up to the design overspeed (120% of sychronous); and (2) a destructive condition, with overspeeds greater than 120% and up to maximum of 180% of synchronous.

As discussed in Standard Review Plan 3.5.1.3, an analysis to assess the probability of damage ($P_4$) to safety related entities in the plant can be described by:

$$P_4 = P_1 \cdot P_2 \cdot P_3$$

where:

$P_1$ = probability of a destructive burst which will eject missiles from the turbine

$P_2$ = probability that such missiles will impact a safety related area

$P_3$ = probability of damage to the struck component, system, or structure.

This review addresses only the probability of a destructive burst, which is part of the combined probability $P_4$.

## 2.0 CRITERIA

General Design Criterion 4 of Appendix A to 10 CFR Part 50 in part requires that components, systems, and structures important to safety be appropriately protected against the effects of missiles that might occur from the failure of equipment, such as, could occur from the bursting of the rotor/discs of the large steam turbine of the main turbine generator set. Regulatory Guide 1.115 states that:

> "Turbine orientation and placement, shielding, quality assurance in design and fabrication, inspection and testing programs, and overspeed protection systems are the principle means of safeguarding against turbine missiles."

and further clarifies the concerns discussed by this assessment with:

"Assurance of low failure rates (at speeds up to design overspeed) can be enhanced by an inservice inspection program...Significant reduction in the rate of destructive overspeed failures may be obtained by the application of improved overspeed protection systems, redundant turbine steam valving, and frequent valve testing."

## 3.0 DISCUSSION

### 3.1 Design Overspeed

In evaluating the possibility of brittle fracture during normal operation, the first step is to nondestructively inspect the rotors and discs to detect non-benign imperfections. The second step is to evaluate the rate of inservice growth of these flaws during the period of operation until the next inspection.

Since the initiation of operation in December 1970, the following ultrasonic rotor and disc inspections have been performed. These are in addition to the normal rotor surface examinations (i.e., visual, magnetic particle, and liquid penetrant) conducted at more frequent intervals.

| Year | Inspection | Results |
|---|---|---|
| 1974 | Discs on both LP rotors | No significant defects |
| 1978 | Discs on LP A rotor | No significant defects |
| 1980 | HP rotor | No significant defects |
| 1980 | Discs on LP B rotor | Water erosion grooves ("water cutting") noted in some LP disc keyways |

By maintaining a good inspection program, changes which could potentially affect the integrity of the turbines will be noted in a timely manner and appropriate corrective actions may be taken. The inspection results to date, however, have not warranted such actions. With regards to the grooves observed in the "B" low pressure turbine disc keyways, the turbine manufacturer, General Electric, has initially indicated that the grooving causal process is self-limiting. However, the final decision as to the future inspection interval awaits further understanding of this metal-loss mechanism.

The fact that no stress corrosion cracks were detected during these turbine inspections indicates that the full flow condensate demineralizers are maintaining the expected high purity feedwater. The chloride intrusion incident in 1972 is the only significant deviation from nominal feedwater chemistry. Results of the disc inspection in 1974 indicate no change in disc integrity due to this incident.

3.2 Destructive Overspeed

A depth of defense against an overspeed event is provided by two series valves on the HP turbine inlet, two series valves on the LP turbine inlet, and four independent overspeed control logic circuits for valves. Only seven out of 87 turbine trip events that have occurred at Millstone Unit No. 1 involved turbine overspeed, and none of these resulted in a peak rpm greater than 110% of synchronous. The most recent overspeed incident (1976) was a total electrical load rejection event due to switchyard flashover during a hurricane. The mechanical emergency trip logic, set to limit the overspeed peak to 120% synchronous, has never been required during operation. However, the ability to satisfactorily send the proper closure signal to the stop valves is periodically verified on-line. In addition, during the refueling outage the mechanical emergency trip system (set to activate at 110% of synchronous speed) and the backup mechanical emergency trip system (set to activate at 112% of synchronous speed) are tested during an actual overspeed test.

This periodic testing of the control systems to assure the sending of signals to close valves to limit overspeed has proven adequate to assure continued high reliability. The ability of the stop and control valves to successfully respond to these signals is checked by periodic stroke testing. These tests have never detected any valve sticking or other abnormal valve stroking condition. Additionally, there is a 50% valve inspection during each refueling outage. These inspections have determined the need for expected refurbishing and parts replacement, but no significant abnormal conditions which might affect operability have been detected with either the turbine stop valves or control valves.

4.0 CONCLUSIONS

Periodic inspections, in combination with the maintenance of high purity feedwater and the testing and inspection of the overspeed protection systems and the valves they control, assures a low probability of generating a turbine missile which could affect safety related equipment.

5.0 REFERENCES

1. 10CFR50 Appendix A, General Design Criterion 4.

2. Regulatory Guide 1.115.