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Mr. Robert Fell
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland 20014

Dear Mr. Fell:

Please find enclosed the safety assessment report concerning SEP Topic III-4-B "Turbine Missiles".

This information is being provided on an informal basis since it will be used as an input to the draft Safety Evaluation Report to be reviewed by JCP&L.

Please contact me in the event that any questions or comments arise.

Very truly yours,

Yoshito Nagai

Yoshito Nagai
Senior Licensing Engineer

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cc: J. Knubel
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Oyster Creek Nuclear Generating Station

Safety Assessment Report

Turbine Missiles

SEP Topic III-4.B

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I. Introduction

A number of non-nuclear plants and one nuclear plant have experienced turbine disk failures. The failure of turbine disks and rotors can result in high energy missiles which have the potential for resulting in plant releases in excess of 10 CFR 100 exposure guidelines.

The two main areas of concern are design overspeed failures and destructive overspeed failures. For design overspeed failures, the material quality of the disk and rotor, inservice inspection for flaws, and chemistry conditions leading to stress-corrosion cracking should be considered. For destructive overspeed failures, the reliability of the electrical overspeed protection system, reliability and testing program for stop and control valves, and inservice inspection of valves should be considered.

The focus of this review is on the turbine disk integrity and overspeed protection and includes the reliability of stop, intercept, and control valves. The objective is to assure that all the structures, systems, and components important to safety have adequate protection against potential turbine missiles either by structural barriers or a high degree of assurance that failures at design (120%) or destructive (180%) overspeed will not occur.

II. Basis of Evaluation

The following regulatory documents comprise the basis of this review:

A. Regulatory Guide 1.115

B. Regulatory Guide 1.117

C. Standard Review Plan 3.5.1.3

D. Standard Review Plan 10.2

E. Standard Review Plan 10.2.3

III. Evaluation

The following docketed information was utilized to perform this evaluation:

A. Oyster Creek Nuclear Generating Station FDSAR, Amendment 11.

B. Oyster Creek Nuclear Generating Station FDSAR, Amendment 22.

C. Oyster Creek Nuclear Generating Station FDSAR, Amendment 32.

Amendment 11 of the O.C.N.G.S. FDSAR provides an analysis which shows that massive failures in the turbine will not result in missiles which can damage vital safety features of the plant.

Amendment 22 of the O.C.N.G.S. FDSAR provides further information regarding the effects of turbine failure on the Control Room

Amendment 32 of the O.C.N.G.S. FDSAR contains an analysis and evaluation of the ability of the spent fuel pool to withstand the effects of missiles generated by turbine failure.

This docketed information provides a high degree of assurance that failures at design (120%) or destructive (180%) overspeed will not occur. In

addition, Table 3.5-15 of the Plant Description Manual contains the characteristics of the Steam Turbine. Included in the table are the tripping speeds of the overspeed emergency governor at between 110% and 111% and the backup overspeed trip at 112%. These values are below the design overspeed limit of 120% and, therefore, the overspeed protection is deemed adequate.

Also, an independent safety consultant performed a Probability Safety Analysis for Oyster Creek which addressed the Turbine Missile phenomenon. This study quantified the potential for damage from Turbine Missiles along with the uncertainties associated with the estimates. The uncertainties were expressed at the estimated 5% and 95% Bayesian confidence levels. Only events which could lead to core melt were considered in the evaluation.

The probability of missile strike was based on two independent factors as follows:

PMS = PfPs

PMS = probability of a missile strike (per yr.)

Pf = probability of turbine failure (per yr.)

Ps = the probability that, given a failure, the missile will strike a vital area of the plant

Calculations were made of the mean, variance, 5% and 95% confidence bounds. Both high energy (600 ft. per sec.) and low energy (300 ft. per sec.) missiles were considered. The data base was 70,000 turbine years of operation. The following table summarizes the calculated results.

Frequency of Distribution of External Events, Per Yr. Oyster Creek Plant

Turbine Missiles	Mean Frequency	Variance	95% Bound	5% Bound
a. High Energy (600 fps)	6.1×10^{-8}	9.39×10^{-12}	6.1×10^{-7}	6.1×10^{-11}
b. Low Energy (300 fps)	6.5×10^{-7}	1.07×10^{-9}	6.6×10^{-6}	6.6×10^{-10}

The conclusion reached by this study and analysis was that these external events have very little impact on the risk of the Oyster Creek plant.

The results of this study compare favorably with Reg. Guide 1.115 which cites an acceptable probability of missile strike of less than 10^{-3}.

The comparison of the Oyster Creek plant and the current regulatory criteria revealed a deviation from the current licensing requirements. This deviation consists of the fact that, at the present, the turbine is not covered by the In-Service Inspection (ISI) Program. The related, essential control valves are also not covered by the ISI Program.

However, The Oyster Creek preventive maintenance program covers the turbine and the related essential control valves. This preventive maintenance program meets the intent of the current regulatory criteria with respect to inspection of the turbine and valves.

IV. Conclusions

A review of the current regulatory criteria and the docketed information

for Oyster Creek reveals that the Oyster Creek design meets the intent of the regulatory criteria with respect to Turbine Missiles. The design of Oyster Creek consists of a favorable turbine orientation, missile barriers, separation, redundancy and independence of vital safety related systems, and redundant overspeed protection. Probabilistic evaluations have also proved to be acceptable per the current licensing requirements.

The only deviation from the current regulatory criteria which was found in the review was that the Turbine and its associated essential control valves are presently not covered by the In-Service Inspection (ISI) Program.

This deviation is not considered significant since a preventive maintenance program exists which covers the turbine and its associated essential control valves. This program, which is documented by plant procedures, fulfills the intent of the current regulatory requirements with respect to the inspection of the turbine and the related control valves.