UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATING TO THE UPPER REACTOR BUILDING AND NON-SAFETY ARCHITECTURAL COMPONENTS SUBJECTED TO TORNADO-WIND LOADING

ITEMS 1 AND 11 OF SEP TOPIC III-2

GPU NUCLEAR CORPORATION

OYSTER CREEK NUCLEAR GENERATING STATION

DOCKET NO. 50-219

1.0 INTRODUCTION

In the Integrated Plant Safety Assessment (IPSA-Ref. 1), the staff indicated that the roof framing of the upper portion of the Reactor building is likely to be structurally unstable at tornado-wind velocities in excess of 164 km/h (102 mi/h). By NRC staff estimate (Fig. 1), this wind velocity corresponds to the annual probability of exceedance (PE) of $5x10^{-3}$. For the SEP plants, the staff has accepted the tornado-wind velocities corresponding to the PE lower than 10^{-5}. In the cover letter to the IPSA (Ref. 1), the staff requested the licensee to re-evaluate the structure and to assess if any modification to the structure would be needed to increase its capability.

With respect to tornado missile damage to non-safety architectural components (mechanical equipment access opening) staff members visiting the plant as part of the Systematic Evaluation Program (SEP) identified several components near the access door which could be vulnerable to tornado missiles and which could affect plant shutdown. As a result the licensee had agreed to evaluate the potential for and consequence of tornado missile impact on components in this area and provide protection if necessary.

This evaluation addresses the GPU Nuclear Corporation's (the licensee's) follow-up efforts.

2.0 EVALUATION

In its letter dated November 15, 1990 (Ref. 2), the licensee indicated that it had re-evaluated the steel frame of the Reactor Building, considering the staff concerns, and decided to upgrade the framing by adding 16 double angle cross braces to the bottom chord of the roof framing. The licensee claimed that the modification will enable the steel framing to withstand loads associated with wind speeds of up to 306 km/h (190 mi/h). From NRC staff estimated curve (Fig. 1), the PE for this wind speed corresponds to $5x10^{-6}$. In the letter, the licensee stated that under the loadings associated with the wind speed of 306 km/h, the maximum steel stresses in the upgraded structure will be less than 1.6 times the American Institute of Steel Construction (AISC) allowables. To confirm the adequacy of the general approach of

the analysis, the staff visited the licensee's office on February 12, 1991, and visited the site on February 13, 1992.

To analyze the modified structure, the licensee's consultant (Burns & Roe, Inc.) utilized a general purpose structural computer code; STAAD-III. The staff examined the structural model, the input properties, and the stress acceptance criteria. The structural model incorporated fixed end conditions at the column ends. This appeared questionable for normal construction practice. The examiantion of the as-built condition at the site indicated that the column ends should have been considered pinned. Except for this concern the analysis criteria were found adequate. By a letter dated October 3, 1991 (Ref. 3), the licensee agreed that the fixed end condition was not representative of the as-built condition, and reanalyzed the frame considering the pinned end conditions. The licensee confirmed that after the upgrades are complete, all frame members, including column baseplates and anchor bolts will have stresses within the allowables under the loadings generated by a tornado-wind having a velocity of 306 km/h. This is acceptable to the staff.

The steel framed structure is enclosed by metal siding and steel roof decking. The structure is not a leaktight structure. However, some differential pressure may develop during high winds. The catalogued (based on the vendor's laboratory tests) internal pressure capacity of the siding corresponds to the differential pressure of 3.83 kPa (0.56 psi) or 256 km/h (160 mi/h). Though the licensee has assumed all the wind loads (corresponding to 306 km/h) to be transmitted to the roof framing, some siding panels can get loose and act as missiles under high wind loading. During the plant audit, the staff expressed this concern to the licensee and requested the licensee to confirm that such a siding-missile would not cause safety problem for the spent fuel in the spent fuel pool. In response (Ref. 3), the licensee indicated that the impact loading that could be generated by such a missile on the fuel racks is bounded by the loading generated by the postulated drop of the fuel assembly, which has been previously analyzed and the results documented in Reference 4. The staff considers the explanation acceptable.

With respect to tornado missile damage to non-safety architectural components (mechanical equipment access opening) staff members visiting the plant as part of the SEP, identified several components near the equipment access door which could be vulnerable to tornado missiles and which could affect plant shutdown. In response to a staff request, the licensee determined that the probability of a missile striking the access door varied from 1.1 E-6 to 6.1 E-6. With the door closed, estimated to be 80% of the time, the probability became 2.2 E-7 to 1.2 E-6. These values were found to be unacceptable based upon the guidelines of Section 2.2.3 "Evaluation of Potential Accidents," of the Standard Review Plan which describes a value of 1 E-7 or lower for potential accident situations leading to the release of significant amounts of radioactive fission products, a distinct possibility in the event the plant was unable to shutdown properly.

The licensee reported that even in the unlikely failure of the mechanical components near the access door, a system consisting of the isolation

condenser (IC), torus and a core spray pump, was available both for shutting the plant down and for maintaining it in the shutdown mode. In this system, water from the torus is fed to the IC for the shutdown process. This system was found to be acceptable in safety evaluations dated February 28, 1990 and July 29, 1992. In the SE dated July 29, 1992, the staff concluded, that the licensee's plan for using the alternate system for shutdown in the event of a tornado to be acceptable.

3.0 CONCLUSION

Based on the prior reviews by the staff (1983 to 1988), the subsequent responses to the staff requests for additional information, and audit of some of the licensee calculations, the staff concludes that the upper steel-framed portion of the Reactor Building will be able to withstand the tornado-wind loading generated by a total wind-speed (i.e., rotational plus translational) of up to 306 km/h (190 mi/h), when the planned modifications to the steel framing are completed. This is acceptable to the staff.

In Reference 5, the licensee has committed to complete the modification during cycle 14 (CY 1993-1994 time-frame).

As stated above, the staff concludes that in the unlikely failure of the mechanical components near the access door, a system consisting of the IC, torus, and a core spray pump is available both for shutting the plant down and for maintaining it in the shutdown mode and, therefore, acceptable.

Based on the above, the staff considers Items 1 and 11 of SEP Topic III-2 resolved and SEP Topic III-2 closed.

References:

1. Letter from J. A. Zwolinski (NRC) to P. R. Fiedler (GPUN), "Integrated Plant Safety Assessment Section 4.3, Wind and Tornado Loading," Dated March 8, 1986.

2. Letter from J. C. Devine (GPUN) to NRC Addressing IPSA Section 4.3, Dated November 15, 1990.

3. Letter from J. C. Devine (GPUN) to NRC Addressing SEP Topics III-2 and III-7B, Dated October 3, 1991.

4. Licensing Report on High Density Spent Fuel Racks for Oyster Creek, 1984.

5. Letter from R. L. Long (GPUN) to NRC, "Project List Semi-Annual Update," Dated June 5, 1992.

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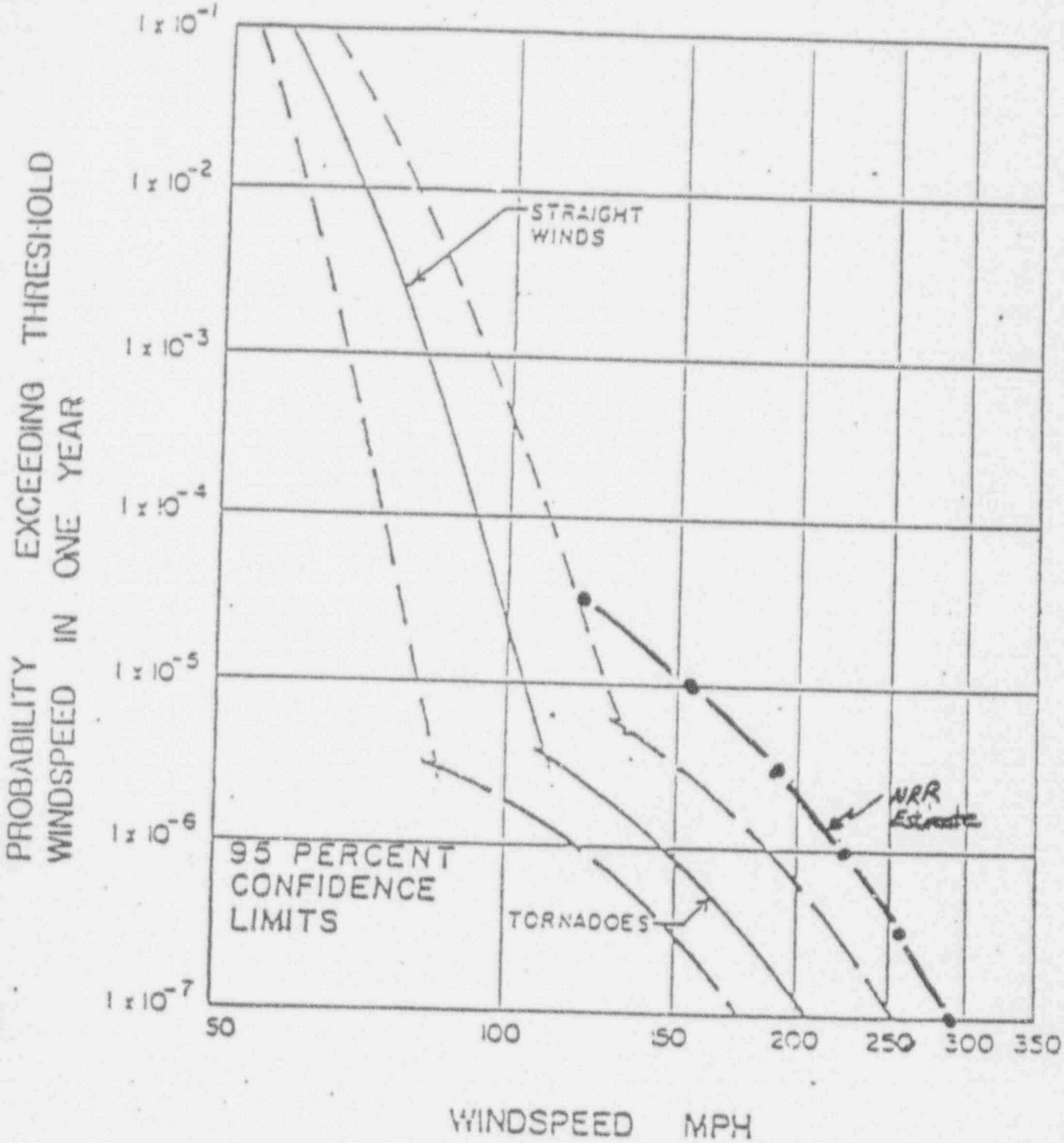
FIGURE 1



TORNADO AND STRAIGHT WIND HAZARD PROBABILITY MODEL FOR OYSTER CREEK POWER REACTOR SITE, NEW JERSEY