October 26, 1983

MEMORANDUM FOR: Frank J. Miraglia, Assistant Director for Safety Assessment, Division of Licensing

FROM: L. S. Rubenstein, Assistant Director for Core and Plant Systems, Division of Systems Integration

SUBJECT: SAFETY EVALUATION REPORT - ELECTRIC POWER RESEARCH INSTITUTE (EPRI) TOPICAL REPORTS CONCERNING TORNADO MISSILE PROBABILISTIC RISK ASSESSMENT (PRA) METHODOLOGY

Enclosed is the Auxiliary Systems Branch Safety Evaluation Report regarding EPRI topical reports, "Tornado Missile Risk Analysis" (EPRI NP-768 and 769) and "Tornado Missile Risk Evaluation Methodology" (EPRI NP-2005).

Our SER incorporates the Technical Evaluation Reports (TERs) provided by two consultants, the National Bureau of Standards (NBS) and the University of Chicago. We have concluded that the EPRI methodology can be utilized when assessing the need for positive tornado missile protection for specific safety-related plant features in accordance with the criteria of SRP Section 3.5.1.4.

/s/
L. S. Rubenstein, Assistant Director
for Core and Plant Systems
Division of Systems Integration

Enclosures:
As Stated

cc w/enclosures:

C. Thomas I. Spickler
D. Moran E. Markee
B. K. Singh

cc w/o TERs:
R. Mattson
D. Eisenhut
T. Novak
G. Lainas
O. Parr
J. Wermiel
R. Lobel
C. Thomas
R. Martin
B. K. Singh

Contact:
B. K. Singh
X29466

8312070304 831026
CF SUBJ
ID&R-5FAC LIC CF

I.D.R. 5
Fac. Lic.
+RD-82
EPRI

SAFETY EVALUATION REPORT

ELECTRIC POWER RESEARCH INSTITUTE (EPRI) TOPICAL REPORTS

"TORNADO MISSILE RISK ANALYSIS" (EPRI NP-768 AND 769) AND

"TORNADO MISSILE RISK EVALUATION METHODOLOGY" (EPRI NP-2005)

AUXILIARY SYSTEMS BRANCH

I. INTRODUCTION

Nuclear power plants must be designed to withstand the effects of tornado and high wind generated missiles so as not to impact the health and safety of the public in accordance with the requirements of General Design Criteria 2 and 4. The current licensing criteria governing tornado missile protection are contained in Standard Review Plan (SRP) Section 3.5.1.4 and 3.5.2. These criteria generally specify that safety-related systems be provided positive tornado missile protection (barriers) from the maximum credible tornado threat. However, SRP Section 3.5.1.4 includes acceptance criteria permitting relaxation of the above deterministic guidance, if it can be demonstrated that the probability of damage to unprotected essential safety-related features is sufficiently small.

Certain operating license (OL) applicants and operating reactor licensees have chosen to demonstrate compliance with tornado missile protection criteria for certain portions of the

plant as part of their license application (OLs) and auxiliary feedwater system upgrade review (ORs - Item II.E.1.1 of NUREG-0737) by providing a probabilistic analysis which is intended to show a sufficiently low risk associated with tornado missiles. Some of these utilities have utilized the tornado missile probabilistic risk assessment (PRA) methodology developed by the Electric Power Research Institute (EPRI) in two topical reports, "Tornado Missile Risk Analysis and Appendices," EPRI NP-768 and 769 dated May 1978, and "Tornado Missile Risk Evaluation Methodology," EPRI NP-2005 Volumes I and II dated August 1981. The EPRI methodology employs Monte Carlo techniques in order to assess the probability of multiple missile strikes causing unacceptable damage to unprotected safety-related plant features.

Due to the specialized nature of the study, we utilized two consultants, the National Bureau of Standards (NBS) and the University of Chicago, to evaluate the EPRI methodology. The consultants were requested to prepare an evaluation and provide an assessment of the applicability of the EPRI model for use in assessing tornado missile effects at nuclear power plants. The consultants provided the following enclosed Technical Evaluation Reports (TERs):

1. "Tornado Missile Simulation and Design Methodology" (EPRI NP-2005) by Emil Simiu (NBS), April 1983, and
2. "Electric Power Research Institute, Tornado Missile Probabilistic Risk Assessment Methodology" by Timothy A. Rheinhold (Morrison, Hershfield Limited for the University of Chicago), April 22, 1983.

These TERs form a portion of this safety evaluation report.

II. EVALUATION

We have reviewed the TERs submitted by NBS and the University of Chicago. Based on this review, we conclude that the EPRI methodology is well conceived, well developed, versatile, and utilizes state of the art probabilistic Monte Carlo techniques. Thus, EPRI NP-768 and 769 or EPRI-2005 Volumes I and II can be utilized when assessing the need for positive tornado missile protection for specific safety-related plant features.

However, applicants and licensees using the EPRI approach must consider the following points and provide appropriate information:

1. Data on tornado characteristics should be employed for both broad regions and small areas around the site. The most conservative values should be used in the risk analysis or justification provided for those values selected.

2. The EPRI study proposes a modified tornado classification, F'-scale, for which the velocity ranges are lower by as much as 25% than the velocity ranges originally proposed in the Fujita, F-scale. Insufficient documentation was provided in the studies in support of the reduced F'-scale. The F-scale tornado classification should therefore be used in order to obtain conservative results.

3. Reductions in tornado wind speed near the ground due to surface friction effects are not sufficiently documented in the EPRI study. Such reductions were not consistently accounted for when estimating tornado wind speeds at 33 feet above grade on the basis of observed damage at lower elevations. Therefore, users should calculate the effect of assuming velocity profiles with ratios V_o (speed at ground level)/V_{33} (speed at 33 feet elevation) higher than that in the EPRI study. Discussion of sensitivity of the results to changes in the modeling of the tornado wind speed profile near the ground should be provided.

4. The assumptions concerning the locations and numbers of potential missiles presented at a specific site are not well established in the EPRI studies. However, the EPRI methodology allows site specific information on tornado missile availability to be incorporated in the risk calculation. Therefore, users should provide sufficient information to justify the assumed missile density based on site specific missile sources and dominant tornado paths of travel.

5. Once the EPRI methodology has been chosen, justification should be provided for any deviations from the calculational approach.

III. CONCLUSION

Based on our review of the EPRI tornado missile PRA methodology as contained in EPRI NP-768 and 769 (May 1978) and EPRI NP-2005, Volumes 1 and 2 (August 1981), we conclude that this is an acceptable probabilistic approach for demonstrating compliance with the requirements of General Design Criteria 2 and 3 regarding protection of safety-related plant features from the effects of tornado and high wind generated

missiles subject to the additional concerns related to input parameters identified above. Further, use of the EPRI PRAs or any tornado missile probabilistic study should be limited to the evaluation of specific plant features where additional costly tornado missile protective barriers or alternative systems are under consideration.