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UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

May 01, 1995

Mr. Robert E. Denton
Vice President - Nuclear Energy
Baltimore Gas and Electric Company
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
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SUBJECT: LICENSING BASIS CHARGE FOR EVALUATING THE NEED FOR TORNADO
GENERATED MISSILE BARRIERS - CALVERT CLIFFS NUCLEAR POWER PLANT,
UNIT NOS. 1 AND 2 (TAC NOS. M90621 AND M90622)

Dear Mr. Denton:

By letter dated October 13, 1994, Baltimore Gas and Electric Company requested to change the method of tornado missile protection for the emergency diesel generator (EDG) engines' intake air filters, exhaust piping, and mufflers. Specifically you requested NRC approval of eliminating the licensing requirement for tornado missile barriers based on associated low risk as shown by probabilistic risk assessment techniques consistent with the guidance provided in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." We have reviewed your request and approve the proposed licensing basis change. We have also determined that tornado missile barriers for the EDG equipment specified above need not be provided. The basis for our conclusions are provided in the enclosed Safety Evaluation.

This completes all actions related to TAC Nos. M90621 and M90622.

Sincerely,

Daniel G. McDonald, Senior Project Manager
Project Directorate I-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and
50-318

Enclosure: Safety Evaluation

cc w/encl: See next page



Robert E. Denton
Baltimore Gas & Electric Company

Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 and 2

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TORNADO MISSILE PROTECTION FOR EMERGENCY DIESEL GENERATORS

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2

DOCKET NOS. 50-317 AND 50-318

1.0 INTRODUCTION

By letter dated October 13, 1994, Baltimore Gas and Electric Company (BG&E or the licensee), requested NRC approval of a hazard analysis of a tornado generated missile impact on the emergency diesel generators (EDG) engines' intake air filters, exhaust piping, and mufflers for the Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2. Specifically, BG&E proposed a change to the methodology used to evaluate the need for tornado missile protection. The existing method is to provide tornado missile protection for all equipment required to operate following a tornado. This method would require structural missile barriers for the intake and exhaust systems for the EDGs. The proposed change would allow the use of Probabilistic Risk Assessment (PRA) techniques to evaluate the need for structural barriers to protect against tornado generated missiles. The proposed change is being requested because BG&E discovered that the existing EDGs engines' air intake filters, exhaust piping, and mufflers did not have specific structural barriers to protect them from tornado generated missile strikes.

The Calvert Cliffs site currently has three EDGs. Normally, No. 11 EDG is dedicated to Unit 1, No. 21 EDG is dedicated to Unit 2, and No. 12 EDG is able to swing to either unit. Each EDG is enclosed in a separate room in the Class I auxiliary building. The only components exposed to outside weather effects, including tornado missiles, are the intake air filters, exhaust piping, and mufflers. They extend through the roof of the auxiliary building. The top of the air intake filter is approximately 9 feet above the roof elevation, while the exhaust piping (includes muffler) extends to an elevation of approximately 26 feet above the roof elevation. Most of the intake air filter and a portion of the exhaust piping, including the entire muffler, is located behind a 7-1/2 foot high parapet wall along the west side of the roof; however, the parapet does not provide complete protection from all postulated tornado missiles.

BG&E performed a PRA to determine the risks associated with postulated tornado missile strikes on the exposed EDG components. In conjunction with the PRA, BG&E proposed to revise the licensing basis for tornado missiles to read: "Tornado-generated missile protection is not required for systems designed to meet the performance standards of draft GDC2 [General Design Criterion 2] if the resultant aggregate probability of exposures in excess of 10 CFR Part 100 guidelines is less than 10^{-6} per year." The 1967 draft GDC 2 is the existing

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licensing basis at Calvert Cliffs for protection against natural phenomena. Differences between the draft GDC 2 and the present GDC 2 are minimal and do not affect this safety evaluation. For purposes of this evaluation, compliance with draft GDC 2 would also mean compliance with the existing GDC 2 with respect to protection against tornado generated missiles. The criterion of 10^{-6} per year is based on the acceptance criteria of Standard Review Plan (SRP) Sections 2.2.3 "Evaluation of Potential Accidents," and 3.5.1.4 "Missiles Generated by Natural Phenomena."

Based on the results of the PRA and the revised licensing basis, BG&E proposes not to provide specific tornado missile barrier protection for the exposed components of the EDGs.

2.0 EVALUATION

In performing the PRA, BG&E calculated the increase in core damage frequency (CDF), due to the impact of a tornado generated missile on the exposed EDG components, as the product of the following five terms: (1) the tornado strike frequency, (2) the missile generation probability given that a tornado event occurs, (3) the probability that a missile will impact the exposed EDG components, (4) the component failure probability given missile impact, and (5) the conditional core damage probability given failure of all EDGs.

BG&E determined the tornado strike frequency based on the guidelines of NUREG-4461 (Tornado Climatology of the Contiguous United States) and on data from National Severe Storms Forecast Center. BG&E considered both the Point Strike and Area Strike frequencies and used the worst-case parameters. The missile generation probability was calculated using data from NUREG/CR-4710 (Shutdown Decay Heat Removal Analysis of a Combustion Engineering 2-Loop Pressurized Water Reactor). The missile impact probability was calculated using the methodology followed in NUREG/CR-4710 and NUREG/CR-4762 (Shutdown Decay Heat Removal Analysis of a Westinghouse 3-Loop Pressurized Water Reactor) for tornado strike event risk analysis. The component damage probability was conservatively assumed to be unity (certain failure). A conditional core damage probability of 0.02, given loss of all EDGs, was used based on the Calvert Cliffs individual plant examination of external events results.

BG&E, following a comparison of its findings with the results of similar analyses at other nuclear plants, concluded that the increase in CDF due to tornado generated missile strikes on the EDG engines' intake and exhaust system components is approximately 10^{-8} per reactor year. A sensitivity study, performed by BG&E, indicated that reasonable changes in data or assumptions (e.g., due to uncertainties) would not change this conclusion.

The NRC staff determined that BG&E's risk assessment is comprehensive, the methodology used is appropriate, and the supporting data are relevant. Based on this evaluation, the staff concludes that the increase in CDF due to tornado missile strikes on the exposed EDG components does not pose a significant threat to the safety of the plant.



The NRC staff also concludes that the PRA was conservative in nature because of several assumptions made by BG&E, of which the most significant is the failure probability of unity given a missile impact. Qualitative arguments could be made to provide a basis for assuming that not all missile impacts would result in system failures, and to give credence to operator actions (such as cutting the damaged portions away at roof level) that would restore the EDGs to an operable condition. Thus, SRP Section 2.2.3 acceptance criterion, that the realistic probability can be shown to be lower than 10^{-6} , when combined with reasonable qualitative arguments are met.

3.0 CONCLUSION

Based on its evaluation, the NRC staff concludes that the methodology used to justify not providing specific tornado missile barriers is appropriate and that tornado missile barriers do not have to be provided for the exposed components associated with the EDGs. Therefore, the staff further concludes that the aforementioned proposed change to the licensing basis to meet the requirements of draft GDC 2, with respect to protection against tornado generated missiles, is also acceptable.

Principal Contributor: W. LeFave

Date: May 01, 1995



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