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United States Nuclear Regulatory Commission
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Subject: Response to Request For Additional Information Regarding License Amendment Application to Change Design Requirements for Tornado Missile Protection (License Amendment Request No. 04-0024; TAC No. MC5661)

Ladies and Gentlemen:

On January 11, 2005, the FirstEnergy Nuclear Operating Company (FENOC) submitted an application (DBNPS Serial Number 3078) for an amendment to the Davis-Besse Nuclear Power Station, Unit Number 1, Operating License Number NPF-3. The proposed amendment which would allow certain structures, systems, and components that are not currently provided with physical protection from tornado-induced missiles to remain unprotected when the probability of a tornado-induced missile impact is demonstrated to be acceptably low using the Electrical Power Research Institute (EPRI) "Tornado Missile Risk Evaluation Methodology" (TORMIS).

By letter dated May 25, 2006, FENOC received a request for additional information regarding the license amendment application. Attachment 1 provides the response to this request.

Attachment 2 provides a list of regulatory commitments made in this submittal. If there are any questions or if additional information is required, please contact Mr. Gregory A. Dunn, Manager – FENOC Fleet Licensing, at (330) 315-7243.

The statements contained in this submittal, including its associated attachments, are true and correct to the best of my knowledge and belief. I am authorized by the FirstEnergy Nuclear Operating Company to make this submittal. I declare under penalty of perjury that the foregoing is true and correct.

A001

Executed on: July 24, 2006

By: [signature]
Mark B. Bezilla, Vice President - Nuclear

TSC/RNB

Attachments

cc: Regional Administrator, NRC Region III
NRC/NRR Project Manager
D. J. Shipley, Executive Director, Ohio Emergency Management Agency, State of Ohio (NRC Liaison)
NRC Senior Resident Inspector
Utility Radiological Safety Board

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

REGARDING

LICENSE AMENDMENT REQUEST (LAR) 04-0024

FOR

DAVIS-BESSE NUCLEAR POWER STATION UNIT NUMBER 1

The NRC staff has requested additional information related to Tornado Missile Protection (TAC No. MC5661) to complete their review. FENOC's response to this request is provided below:

Question #1 (a):

The October 26, 1983, TORMIS SE issued by the NRC specified that data on tornado characteristics should be employed for both broad regions and small areas around the site, and that the most conservative values should be used in the risk analysis.

With respect to tornado frequency, the Updated Safety Analysis Report (USAR) value of 6.3×10^{-4} per year is proposed as the more conservative value compared to the estimate for the broader region defined by WASH-1300, "Technical Basis for Interim Regional Tornado Criteria," (NRC Region 1).
The following additional information is required in order to demonstrate that the selected frequency estimate meets Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion 2, "Design bases for protection against natural phenomena," for SSCs important to safety is designed to withstand the effects of a natural phenomenon such as a tornado:

Explain how a tornado frequency of 4.25×10^{-4} per year was determined based upon the NRC Region 1 tornado data.

The TORMIS methodology defines four broad regions, A through D, and Davis-Besse is located on the border between Regions A and B. Regions A and B are a more discrete partitioning of Region 1. Determine the tornado frequency for Davis-Besse for both Region A and Region B, and explain how these values were calculated.

The response that was provided to Item 1 of the October 26, 1983, TORMIS SE regarding input parameters indicates that the annual probability of a tornado will be determined for the Fujita wind speeds using regional data available in TORMIS for NRC Tornado Region 1; and that the more conservative of these two values (the other value being the USAR tornado frequency) will be utilized in the Davis-Besse analysis.

Since Regions A and B are a discrete partitioning of a broad area, the analysis over a broader region (Region 1) could result in different strike probabilities. Explain how this analysis differs from the NRC Region 1 tornado frequency estimate and, to assure that the most conservative value is used, perform this analysis for TORMIS Regions A and B, and for the local site area described in the USAR. Provide the results of these analyses, including an explanation of how these values were calculated.

DBNPS Response:

The DBNPS TORMIS analysis was prepared based on the annual tornado occurrence rate of 6.3 x 10^{-4} as described in the DBNPS USAR. The annual tornado occurrence probabilities for the TORMIS methodology Regions A and B are 6.621 x 10^{-4} and 6.638 x 10^{-4} respectively. These annual occurrence rates were determined in the same manner as the information presented in Table 1 below. While the TORMIS Regions A and B have slightly higher annual occurrence rates than the DBNPS USAR value of 6.3 x 10^{-4}, these occurrence rates are not expected to appreciably impact the results of this probability analysis. Therefore, DBNPS has not at this time performed these additional analyses. In addition, the DBNPS TORMIS analysis remains acceptable and conservative based on the comparison with the recent tornado occurrence rates of NUREG/CR-4461. This comparison is discussed further in the response to Question #1(b).

The information available in EPRI documents, reviewed by NRC for the TORMIS Safety Evaluation (References 1 and 2 below), for tornado occurrence rates and mean damage path areas in the EPRI speed ranges F'_0 through F'_6 were interpolated as described below to obtain the tornado occurrence rates and damage path area for Fujita speed ranges F_0 to F_6 (as defined in WASH-1300). After determining Fujita speed range occurrence rates and mean path areas, these quantities were multiplied for each speed range, and the products were summed to obtain the probability of a tornado occurrence in Region I. This probability is 4.25 x 10^{-4} per year. Since the DBNPS USAR states the probability of a tornado occurrence as 6.3 x 10^{-4} per year, in the TORMIS simulation studies performed for the Fujita speed ranges are used with the occurrence rates increased by the factor of 1.482, i.e. (6.3/4.25 = 1.482).

The above approach is detailed below for additional clarification.

Table 1 below lists the tornado wind speed range, occurrence rate and damage path area information as obtained from References 1 and 2.

Table 1 Tornado Information for EPRI Speed Ranges from References 1 and 2

EPRI Speed Range Designation	Speed Range (mph) (a)	Occurrence Rate (Per(year x sq. mile)) (b)	Mean Path Area (Sq. mile) (c)	Prob. of Occurrence (Per year) (Col. 3 x Col. 4)
F'_0	40 to73	2.543E-04	0.2	5.0860E-05
F'_1	73 to 103	1.364E-04	0.72	9.8208E-05
F'_2	103 to 135	8.502E-05	1.86	1.5814E-04
F'_3	135 to 168	2.954E-05	3.74	1.1048E-04
F'_4	168 to 209	6.232E-06	7.22	4.4995E-05
F'_5	209 to 277	8.476E-07	13.48	1.1426E-05
F'_6	277 to 300	6.242E-08	21.12	1.3183E-06

Sum = 4.7542E-04

Notes for Table 1

(a) From Table IV-5(b) of Reference 1. Values listed are for Region I
(b) From Table IV-5(a) of Reference 1. Values listed are for Region I.
(c) From Table I-24 of Reference 2. Values listed are for EPRI Region A. The corresponding values for Region B are somewhat smaller.

Table 2 below shows the Fujita wind speed ranges from WASH-1300, with extension for F_6 range to consider the NRC velocity of 360 mph.

Table 2 Tornado Wind Speed Ranges for Fujita

Fujita Speed Range Designation	Speed Range (mph) (a)
F_0	40 to 70
F_1	73 to 109
F_2	113 to 153
F_3	158 to 202
F_4	207 to 255
F_5	261 to 313
F_6	313 to 360

Notes for Table 2

(a) For F_0 to F_5 speed ranges are from WASH-1300. For F_6, the maximum range is set at NRC specified maximum speed of 360 mph.

In order to calculate the occurrence rate and path area for the Fujita wind speed ranges in Table 2, it is assumed each of these functions is constant in the speed range of interest. It is also assumed that total area under the function between limits of the speed range is the same as the area under the Table 1 information for the same speed range. Moreover, the occurrence rate and path area of F_o are taken to be equal to those of F'_o, and the values for F_6 are taken equal to F'_6. For other speed ranges an interpolation similar to F_2 is used as explained below.

$$\text{OccurF2} := \frac{\left[(135-113)\cdot 8.502\cdot 10^{-5} + (153-135)\cdot 2.954\cdot 10^{-5}\right]}{153-113} \qquad \text{per (year x mile}^2\text{)}$$

$$\text{OccurF2} = 6.005 \times 10^{-5} \qquad \text{per (year x mile}^2\text{)}$$

$$\text{PathareaF2} := \frac{[(135-113)\cdot 1.86 + (153-135)\cdot 3.74]}{153-113} \qquad \text{mile}^2$$

$$\text{PathareaF2} = 2.706 \qquad \text{mile}^2$$

Note from Table 2 that the speed range of F_2 is from 113 to 153. Therefore, from Table 1 information for F'_2 and F'_3 (with the lower limit lower than 113 and upper limit higher than 153) are used to calculate the F_2 data. Table 3 summarizes the calculated values of occurrence rate, mean path area, and probability of strike for Fujita speed ranges.

Table 3 Calculated Values of Tornado Data for Fujita Speed Ranges

Fujita Speed Range Designation	**Occurrence Rate (Per(year x sq. mile))**	**Mean Path Area (Sq. mile)**	**Prob. of Occurrence (Per year)** Col. 2 x Col. 3
F_0	2.543E-04	0.2	5.086E-05
F_1	1.278E-04	0.91	1.163E-04
F_2	6.005E-05	2.706	1.625E-04
F_3	1.153E-05	6.429	7.413E-05
F_4	1.072E-06	13.219	1.417E-05
F_5	3.040E-07	18.769	5.706E-05
F_6	6.242E-08	21.12	1.318E-06

Sum = 4.250E-04

References:

1. EPRI Report NP-2005-CCM, "Tornado Missile Simulation and Design Methodology—Computer Code Manual", August 1981.

2. EPRI Report NP-2005, "Tornado Missile Simulation and Design Methodology—Volume 2: Model Verification and Data Base Updates", August 1981.

3. NUREG/CR-4461, "Tornado Climatology of the Contiguous United States", Rev. 1, March 2005.

Question #1 (b):

Aside from the tornado frequency estimates discussed above, explain how the most conservative values will be determined for the tornado characteristics that are used in TORMIS based upon regional (WASH-1300 and TORMIS) and local tornado data, including a discussion of how more recent tornado data that is not reflected in TORMIS will be accounted for.
Note that the use of values for tornado characteristics that are not the most conservative based upon the available data must be identified and justification provided for NRC review and approval.

DBNPS Response:

The only tornado characteristic input used for the TORMIS Code is the occurrence rates for the specified speed ranges. All other characteristics used are contained in the tornado model internal to the NRC approved TORMIS code. Therefore, DBNPS can not evaluate these characteristics. For the DBNPS application, the approach described in the response to RAI 1(a) has been used to specify the occurrence rate parameters.
DBNPS has reviewed the recent tornado strike probability information detailed in NUREG/CR-4461, Rev. 1. The tornado strike probabilities for the 1°, 2°, and 4° box information from locations close to the DBNPS location of 41° 30' North and 83° 09' West were compared to the stated DBNPS USAR annual probability of 6.3E-04 per year. The NUREG/CR-4661 data confirms that the DBNPS USAR annual tornado probability of 6.3E-04 remains conservative.

Question # 2:

Describe how the exposed areas of unprotected SSCs will be determined to assure conservative results.

DBNPS Response:

The DBNPS plant TORMIS model consists of walls and roofs of safety-related buildings. Simulations are performed (1000 random tornado strikes in each tornado intensity, and 100 missile simulations per tornado strike) to determine missile strike probability on these surfaces. Actual DBNPS items are associated with the various plant surfaces and the part of surface area opening that exposes the item to missile strike. Ratio of vulnerable surface area to modeled large surface area is multiplied by the large surface area strike probability to calculate the plant item strike probability. For example, if an item inside a building has missile exposure potential due to a louver or a non-tornado missile barrier door, the probability reduction factor is calculated as louver or door area divided by the total wall area. Where the analysis evaluates specific SSC targets, the strike probability is based on dimensions obtained by field walkdown and/or drawings to determine the exposed area. In addition, when applicable, the strike probability has been modified by a "shielding factor". The shielding factors account for physical barriers that reduce the probability of a tornado missile strike. The shielding factors were derived based on field walkdowns and drawings.

Question # 3:

In the licensee's request dated January 11, 2005, the licensee referenced NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, Section 2.2.3, Revision 2. Section II, "Acceptance Criteria," states that the expected rate of exposures in excess of 10 CFR Part 100, "Reactor Site Criteria," guidelines of approximately 10^{-6} per year is acceptable if, when combined with reasonable quantitative arguments, the realistic probability can be shown to be lower. The proposed change indicates that a tornado missile strike on the limited portion of a system or component that is exposed is assumed to result in a radioactive release that exceeds the 10 CFR Part 100 guidelines, rather than performing specific evaluations as to whether the strike can actually cause damage and releases. Confirm that this logic will apply to all SSCs that are listed in proposed USAR Table 3.5-3, "TORMIS Analysis - Essential Safe Shutdown System Tornado Missile Targets," including (for example) the auxiliary building roll up and man doors, auxiliary building emergency diesel generator roof, auxiliary building roof penetrations, and auxiliary building roof drains. Also, revise the USAR to include this clarification.

DBNPS Response:

As stated in Insert A (previously submitted Serial Number 3078, dated January 11, 2005) of the "Proposed Mark-Up of Updated Safety Analysis Report Pages," it is assumed that a missile strike will result in damage sufficient to preclude it from performing its safety function and it would result in a radiological release in excess of 10 CFR 100 guidelines. This is applicable to all essential systems described in USAR Table 3.3-1 and the specific unprotected targets listed in the proposed USAR Table 3.5-3. The USAR will be changed to reflect this clarification within 90 days of the LAR approval.

Question # 4:

The response to the fourth item of the TORMIS SE states that the results of sensitivity study indicates that the probability values are not significantly adversely impacted by an increase in missile population. Discuss the results of this sensitivity analysis, including the basis for the conclusion that was reached.

DBNPS Response:

The TORMIS model consists of DBNPS buildings and missile zones. Detailed results were obtained for the configuration of the plant based on walk downs. This model is referred to as the "base case." For the base case, results are obtained for the estimate of mean probability of striking building surfaces. Upper and lower confidence bands are also available. For four building surfaces, with the highest mean strike probabilities, the ratio of confidence to mean estimate, herein called statistical variability, were compared to two cases in which the missile population was varied from the base case, as described below.

In the first sensitivity case, the missile count in the missile zones close to the plant structures was increased by 50% and in the other missile zones the increase was 25% over the base case.

In the second sensitivity case, the role of missile count increase was reversed compared to the first case. The missile zone close to the plant structures had an increase of 25% and the other zones have increases of 50%.

The ratio of mean strike probability of sensitivity cases to mean probability of the base case was found to be smaller than the statistical variability that was observed in the base case.

Considering that the base case has a missile population of 108000, compared to much smaller populations reviewed in EPRI documents; also considering that usually mean probability estimates are used to establish acceptability, it is concluded that reasonable variation in missile population does not affect the results. Therefore, there is no need to monitor missile population in the plant for usual outage related activities.

Question # 5 (a):

The Technical Analysis section of the proposed change indicates that upon NRC approval, existing plant conditions, as well as future changes to the facility, could be evaluated using TORMIS. However, the TORMIS SE stated that the use of TORMIS should be limited to the evaluation of specific plant features where additional costly tornado missile protective barriers or alternative systems are under consideration. Therefore, in order to assure that the use of TORMIS will be consistent with the position that was stated in the TORMIS SE, confirm that: a) TORMIS will not be used to temporarily or permanently eliminate existing barriers that are credited for providing tornado missile protection;

DBNPS Response:

As stated in the NRC SER for TORMIS, "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." Therefore, TORMIS will not be used to temporarily or permanently eliminate existing barriers. The USAR will be changed to reflect this clarification within 90 days of the LAR approval.

Question # 5 (b):

b) its use will be limited to demonstrating adequate protection for existing SSCs that were originally required to be protected from tornado missiles in accordance with the plant design basis but due to some oversight, are not adequately protected;

DBNPS Response:

TORMIS will only be used to evaluate adequate protection of existing SSCs that are currently not protected. The USAR will be changed to reflect this clarification within 90 days of the LAR approval.

Question # 5 (c):

c) identify the specific criteria that will be used for future applications of TORMIS in determining whether or not modifications that are required for protecting SSCs from tornado missiles are too costly such that the use of TORMIS is justified consistent with NRC approval of the TORMIS methodology. Also, revise the USAR to include this clarification.

DBNPS Response:

Page 8 of LAR 04-0024 (previously submitted Serial Number 3078, dated January 11, 2005) states "FENOC believes the cost to add new permanent barriers would be significant, and is not considered to be cost-justified based on the extremely low probability of tornado missile strike and damage to an essential SSC required for safe shutdown in the event of a tornado, and even lower probability of any resultant radiological release of sufficient quantity to compromise the health and safety of the public". DBNPS does not intend to perform unique cost justification studies for the future applications of TORMIS. DBNPS will use the TORMIS methodology to evaluate the tornado missile strike probability if additional currently unprotected SSCs are identified, in accordance with the 1×10^{-6} per year cumulative probability of a missile strike criteria. The USAR will be changed to reflect this clarification within 90 days of the LAR approval.

COMMITMENT LIST

THE FOLLOWING LIST IDENTIFIES THOSE ACTIONS COMMITTED TO BY THE DAVIS-BESSE NUCLEAR POWER STATION (DBNPS) IN THIS DOCUMENT. ANY OTHER ACTIONS DISCUSSED IN THE SUBMITTAL REPRESENT INTENDED OR PLANNED ACTIONS BY THE DBNPS. THEY ARE DESCRIBED ONLY FOR INFORMATION AND ARE NOT REGULATORY COMMITMENTS. IF THERE ARE ANY QUESTIONS OR IF ADDITIONAL INFORMATION IS REQUIRED, PLEASE CONTACT MR. GREGORY A. DUNN, MANAGER – FENOC FLEET LICENSING (330) 315-7243.

COMMITMENTS	DUE DATE
Modify the USAR as described in Attachment 1 to this letter.	Within 90 days after NRC approval of the amendment request by FENOC on January 11, 2005.