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February 22, 1982



Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Dresden Station, Unit 2
SEP Topic III-2, Wind and Tornado Loadings

NRC Docket 50-237

Reference: (1) T.J. Rausch letter to D.G. Eisenhut dated August 14, 1981

Mr. Crutchfield:

Reference (1) committed Commonwealth Edison to devote additional resources to completion of SEP. CECo committed to develop several topic Safety Assessment Reports (SAR) which would be submitted for Staff review. In accordance with this committment, CECo hereby provides as Attachment 1, the SAR for SEP Topic III-2, Wind and Tornado Loadings.

Please address any questions you may have concerning this matter to this office.

One (1) signed original and thirty-nine (39) copies of this transmittal have been provided for your use.

Very truly yours,

T.J. Rausch

T.J. Rausch
Nuclear Licensing Administrator
Boiling Water Reactors

SPP/ji
1600D*
Attachment
cc: RIII Resident Inspector, Dresden

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Docket No. 50-237

ATTACHMENT 1

SEP TOPIC: III-2

WIND AND TORNADO LOADINGS

Dresden Nuclear Power Station - Unit 2

Commonwealth Edison Company

February 22, 1982

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## 1. INTRODUCTION

The objective of this safety review is to assure that Category 1 structures are adequately designed to resist wind, tornado, and tornado pressure drop loads, and that any damage to structures which are not designed for such loadings will not prevent safety-related structures, systems, or equipment from fulfilling their safety functions. In addition, the effects of tornados on emergency cooling ponds are reviewed to assure that tornado winds will not prevent the water in these cooling ponds from acting as a heat sink.

## 2. REVIEW CRITERIA

The currently accepted design criteria for wind and tornado loadings on structures are outlined in the Standard Review Plan (SRP), Sections 3.3.1 and 3.3.2, and in Regulatory Guides (RG) 1.76 and 1.117. The design basis tornado (DBT) wind load is specified in RG 1.76 as having a maximum wind speed of 360 mph with a pressure drop of 3 psi at a rate of 2 psi per second.

According to the information in Figure 1, which is based on Enclosure 2 of Ref. 2, the tornado hazard probability for a tornado wind speed of 337 mph is $1.0 \times 10^{-7}$/year for the Dresden site. In view of this probability level, the current NRC requirement of a DBT of 360 mph has been replaced by a 337 mph DBT for the purposes of this report.

## 3. REVIEW GUIDELINES

The pressures, load combinations, configurations, and design features which were used in the original construction of the plant as outlined in the FSAR and in other docket files are compared with the currently accepted criteria described in Section 2 of this report. When necessary, currently recommended pressure coefficients are employed and a new evaluation of the load effects is made.

## 4. EVALUATION

### 4.1 Buildings

The systems, structures, and components of the Dresden-2 Nuclear Power Plant which are required to be protected against tornado loading by RG 1.117 are located in the crib house, the off-gas filter building the reactor building, and the turbine building.

All these structures are designed to withstand the maximum potential loadings resulting from a wind velocity of 110 mph (Ref. 1). According to Enclosure 1 of Ref. 2, the design wind speed acceptable for the Dresden site region is 82 mph. Therefore, the buildings listed above do meet the current NRC requirements for design basis wind loading.

The safety-related components in the cribhouse, containment cooling service water (CCSW) suction header and diesel generator cooling water pump are located 8 ft. below ground level in an area surrounded by 3 ft. thick reinforced concrete walls and are protected from above by a 2 ft. thick reinforced concrete slab. The Regulatory Guide 1.76 tornado pressure drop of 3 psi results in an uplift force of 432 psf on the slab. Using the cribhouse design specification strength of 3500 psi for the concrete, calculations indicate an ultimate strength for this slab of approximately 1950 psf. Therefore, the slab is safe against the design basis tornado loading.

The systems located in the off-gas filter building are not required for the safe shutdown of the reactor. However, the radiation release in the event of an accident such as the DBT is evaluated to be below the limits of the 10 CFR 20 requirement for operating plants such as Dresden 2 (Ref. 3.).

The portion of the reactor building below the refueling floor (el. 613'0") meets and even exceeds the current NRC requirements for the design basis tornado loading. The reinforced concrete shear walls can accommodate tornado winds of up to 500 mph without exceeding normal stresses per Ref. 1.

The steel superstructure above the reactor building refueling floor at el. 613'0" has blow-off panels which are designed to mitigate the differential pressures. The panels are about 20 ft. wide and extend the full height of the siding. When a wind pressure differential of 70 psf is reached, these sections of the siding will blow off. For high velocity tornado winds, the roof is also assumed to blow off, allowing the entire tornado load to act on the exposed surfaces of the steel framing. The refueling floor at el. 613'0" is 18 inches thick reinforced concrete, and can withstand the tornado pressure drop of 3 psi in this event.

Using current day pressure coefficients applicable to exposed structures subjected to tornado winds it has been determined that the in-place structural steel part of the reactor building can withstand a tornado wind speed of 250 mph*. According to the information in Figure 1, the probability that actual tornado wind speeds at the Dresden site will exceed 250 mph is $1.7 \times 10^{-6}$ per year. While reaching a probability of exceedance of $1 \times 10^{-7}$ for a tornado wind speed is a goal, the marginal gain of going from a probability of exceedance of $1.7 \times 10^{-6}$ to $1 \times 10^{-7}$ provides a minimal addition safety margin increase. As a result of the minimal safety gain, no backfitting of the structures is required.

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* It should be noted that design of steel supertstructure was made for 300 mph as is stated in FSAR. However, the state of the art design did not consider the specific form of pressure coefficients for exposed structures as it has now been recommended for use by the standard review plan. When coefficients of Ref. 5 are used, the rating of in-place steel is determined to be 250 mph using the same standard criterion in the original design.

The tornado resistance of the turbine building is similar to that of the reactor building. The turbine building has reinforced concrete shear walls, which can easily withstand tornado winds of 500 mph or more without exceeding normal stress limits (Ref. 4). Therefore, the reinforced concrete structure meets the current NRC requirements for DBT loading. The steel superstructure above the main floor in the turbine building is adequate for tornado wind speed of 250 mph. The probability that actual tornado wind speeds will exceed 250 mph is $1.7 \times 10^{-6}$ per year. Based on the previous discussion of lack of substantial safety gain, no backfitting of this structure is required.

## 4.2 Emergency Cooling Ponds

The Dresden-2 ultimate heat sink (UHS) consists of the following sources of water for emergency cooling purposes: (1) Dresden cooling lake; (2) the Kankakee River, which is connected to the crib house through the intake canals; and (3) an additional source of impounded river water of approximately 9,000,000 gallons trapped within the circulating water canals and piping as a result of the topography of the system (Ref. 1, Amendment No. 9).

Because of the availability of water from these three sources, the DBT will not cause the loss of the ultimate heat sink safety function.

## 5. CONCLUSIONS

The following conclusions have been drawn from the evaluations made in this report:

a) The Dresden-2 plant structures meet current NRC requirements for desgn basis wind loading.

b) With the exception of steel superstructures in the reactor and turbine buildings, Dresden-2 plant structures meet the current NRC requirements for tornado loading. The in-place steel in the reactor and turbine buildings is adequate for a maximum tornado wind speed of 250 mph. The probability of this wind speed being exceeded at the Dresden site is $1.7 \times 10^{-6}$ per year which is considered adequate.

c) The availability of water in the cooling ponds at the Dresden-2 plant is such that tornado winds cannot prevent the water in these ponds from acting as an ultimate heat sink.

## 6. REFERENCES


1. Dresden-2 FSAR and Amendments 7 through 20.

2. Dresden 1 & 2, "SEP Topic II-2.A" Severe Weather Phenomena," December 15, 1980, Dockets No. 50-10 and 50-237. Enclosure No. 1, "NRC Staff Evaluation for Dresden Site" and Enclosure No. 2, "Tornado and Straight Wind Hazard Probability for the Dresden Site." Prepared by Texas Technical Univeristy Institute for Disaster Research.

3. Special Report No. 4A, "Supplementary Information for Dresden 2 & 3 for Modified Off-Gas System," Commonwealth Edison Company.

4. "Seismic Review of Dresden Nuclear Power Station - Unit 2 for the Systematic Evaluation Program," NUREG/CR-0891, April, 1980.

5. ASCE Paper No. 3269, "Wind Forces on Structures," Transactions of the ASCE, Vol. 126, Part II, 1961.


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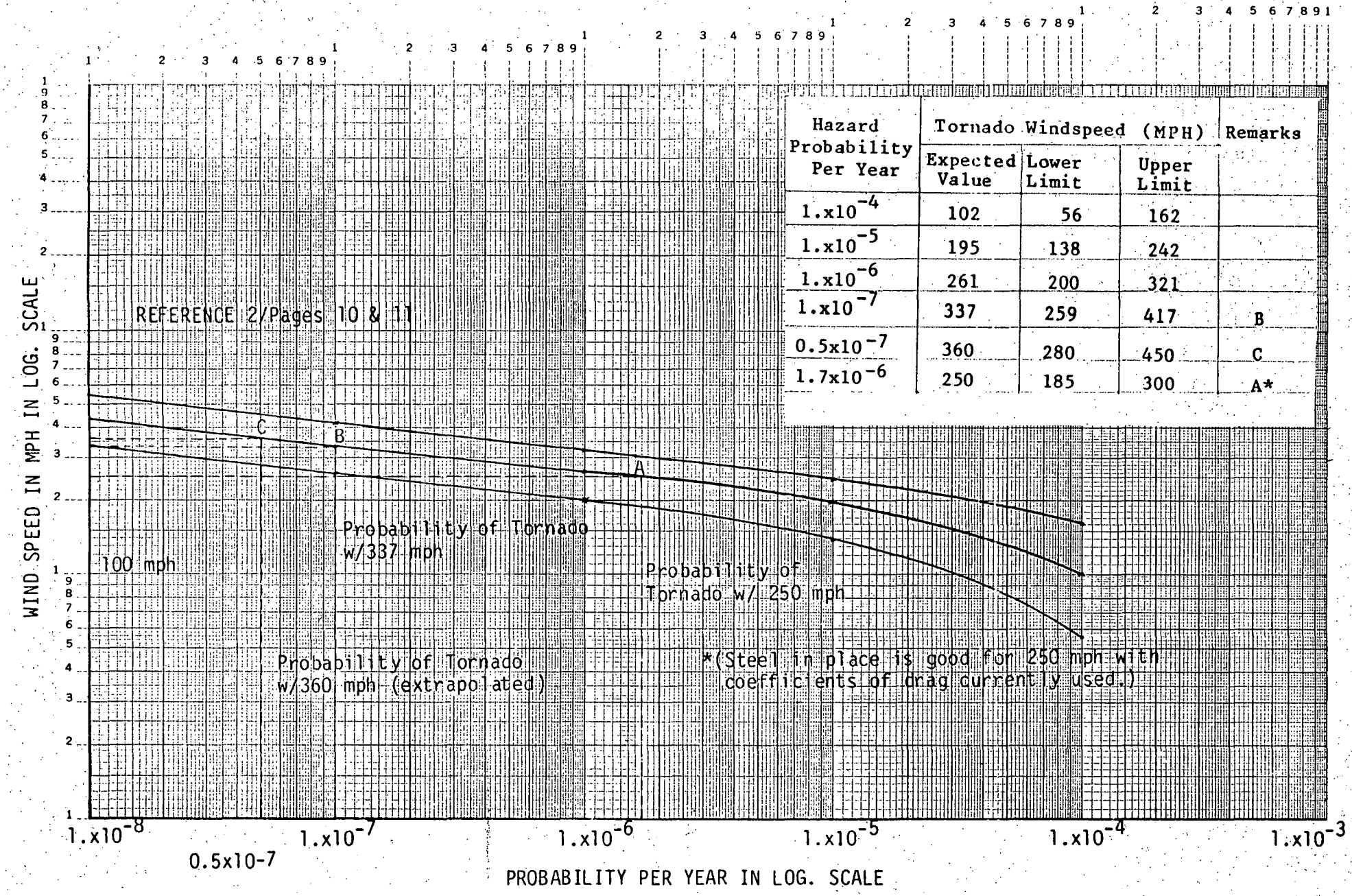


| Hazard Probability Per Year | Tornado Windspeed (MPH) | | | Remarks |
|---|---|---|---|---|
| | Expected Value | Lower Limit | Upper Limit | |
| $1.x10^{-4}$ | 102 | 56 | 162 | |
| $1.x10^{-5}$ | 195 | 138 | 242 | |
| $1.x10^{-6}$ | 261 | 200 | 321 | |
| $1.x10^{-7}$ | 337 | 259 | 417 | B |
| $0.5x10^{-7}$ | 360 | 280 | 450 | C |
| $1.7x10^{-6}$ | 250 | 185 | 300 | A* |

FIGURE 1 TORNADO HAZARD PROBABILITY MODEL FOR DRESDEN
(With 95% Confidence Limits)