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July 15, 1983

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Limerick Generating Station, Units 1&2 Tornado Depressurization Information for Meteorology and Effluent Treatment and Structural and Geotechnical Engineering Branches

Reference: Telephone Conversation among Meteorology and Effluent Treatment Branch, Structural and Geotechnical Engineering Branch and Philadelphia Electric Company on June 24, 1983

File: GOVT 1-1 (NRC)

Dear Mr. Schwencer:

The attached document is a draft revision to the response to FSAR Question 220.2 prepared as a result of the referenced telephone conversation.

The information contained in this draft FSAR change will be incorporated into the FSAR, exactly as it appears on the attachment, in the revision scheduled for August, 1983.

Sincerely,

Eugene J. Bradley

JTR/gra/25

Attachment

Copy to: See Attached Service List

B001
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cc: Judge Lawrence Brenner	(w/o enclosure)
Judge Richard F. Cole	(w/o enclosure)
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Docket and Service Section	(w/o enclosure)

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QUESTION 220.2 (Section 3.3.2.1)

Section 3.3.2.1 of the LGS-FSAR states that the pressure transient caused by the design basis tornado is a 3 psi pressure drop at the rate of 1 psi/sec. However, NRC R.G. 1.76, "Design Basis Tornado for Nuclear Power Plants" calls for a pressure drop of 3 psi at the rate of 2 psi/sec. Discuss the effect on structures required to be tornado resistant of the faster rate of pressure drop.

RESPONSE

The increased depressurization rate of 2 psi/sec in Regulatory Guide 1.76 would have no effect on the external structural elements of tornado-resistant structures. These structures are designed for the maximum pressure differential due to a tornado of 3 psi regardless of the rate of depressurization.

The increased depressurization rate would increase the maximum differential pressure for internal structural elements. These elements were checked for the maximum differential pressure caused by the following design basis tornado pressurization profile: a 1 psi/sec pressure decrease for 3 seconds; a 2 second calm; a 1 psi/sec pressure increase for 3 seconds. An analysis to determine the effects of the increased maximum differential pressures on the internal structural elements has not been performed because the 1 psi/sec depressurization rate is considered to be conservative. The design basis tornado pressurization profile used was committed to in the LGS PSAR, Appendix C, Section C.2.4, prior to the issuance of R.G. 1.76. This pressurization profile was based on the technical paper "Nuclear Power Plant Tornado Design Considerations" by J.A. Dunlop and K. Wiedner in the Journal of the Power Division, Proceedings of the American Society of Civil Engineers, March 1971. Previous documents used as the design basis for tornado effects were Bechtel Power Corporation's topical report "Design Criteria for Nuclear Power Plants Against Tornadoes", B-TOP-3, dated March 12, 1970, and Bechtel Power Corporation's July 1969 report "Tornado Criteria for Nuclear Plants." Actual tornado parameters were developed by studies of the tornado damage, eyewitness accounts of the maximum tornado depressurization on barometric instruments, and analysis of films of actual tornadoes. The depressurization effects defined in the ASCE paper and the Bechtel reports substantiate the conservatism of the 1 psi/sec depressurization rate because they exceed the observed effects of actual tornadoes.

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Insert A

To further demonstrate the conservatism of the 1 psi/sec depressurization rate, site specific tornado parameters have been determined for Limerick using the methodology of WASH-1300 "Technical Basis for Interim Regional Tornado Criteria", U.S. AEC, May, 1974. WASH-1300 is the basis document for R.G. 1.76.

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For the following analysis,

Per R.G. 1.76,

Limerick is in zone I, a region which encompasses a wide variation of tornado risks; from high tornado risk areas such as the Midwest, to low risk areas such as New England. a site-specific tornado risk data base is used to determine the Design Basis Tornado (DBT) parameters.

Tornado data was obtained from the National Severe Storms Forecast Center for the years 1950 through 1981 inclusive for an area 125 nautical miles (nm) in radius centered on Pottstown, PA. During this time period there were 322 tornadoes, or 10.1 tornadoes per year.

The probability that a tornado will strike a particular area is given by WASH-1300 as:

$$P_s = \overline{n}\ (a/A)$$

where P_s is the tornado strike probability, $\overline{n}$ is the average number of tornadoes per year, a is the average individual tornado area, and A is the land area within 125 nm of Pottstown.

From the tornado data, tornado areas were calculated for 307 tornadoes (data was not available for 15 tornadoes). The average area was 0.24 square miles. The land area within 125 nm of Pottstown is approximately 53,500 square miles. Therefore, the average probability of a tornado strike is:

$$P_s = \frac{10.1 \times 0.24}{53,500} = 4.6 \times 10^{-5}/\text{year}$$

In accordance with WASH-1300, the probability of occurrence of a tornado that exceeds the DBT should be on the order of 10^{-7} per year to adequately protect public health and safety. Therefore:

$$P_s \cdot P_i \leq 10^{-7}$$

where P_i is the acceptable intensity probability. Thus,

$$P_i = 10^{-7}/4.6 \times 10^{-5} = 2.2 \times 10^{-3} \text{ per year} = .22\%$$

Each tornado in the tornado data base has been classified according to a windspeed scale (the Fujita parameters). The distribution of tornadoes with respect to windspeed is given in Table Q 220.2-1. The cumulative distribution from Table Q 220.2-1 is plotted in Figure Q 220.2-1. Using Figure 1, the maximum windspeed corresponding to a probability P_i of 0.22% is 280 mph.

To determine the rotational and translational components of the maximum windspeed, the values obtained from Table 4 of WASH-1300 are used for interpolation. The values thus obtained are: translational windspeed of 56.5 mph and rotational windspeed of 223.5 mph.

The depressurization rate is calculated by WASH-1300 as follows:

$$\frac{dp}{dt} = \frac{T}{r_m} \rho V_m^2$$

where

p is the pressure
t is time
T is the translational windspeed
V_m is the rotational windspeed
ρ is the density of air
r_m is the radius of maximum rotational windspeed

From Table 4 and Table 5 of WASH-1300, the parameters for a Region I DBT are:

$$T = 70 \text{ mph}$$
$$V_m = 290 \text{ mph}$$
$$\frac{dp}{dt} = 2 \text{ psi/sec}$$

Therefore, by ratio

$$\frac{dp_2}{dt} = \frac{dp_1}{dt} \frac{T_2 V_{m_2}^2}{T_1 V_{m_1}^2} = 2.0 \times \frac{56.5 \times (223.5)^2}{70 \times (290)^2}$$

$$= 0.96 \text{ psi/sec}$$

These site specific tornado parameters are less limiting than the values used for the DBT in FSAR Section 2.3.1.

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Table Q 220.2 -1

Windspeed and Cumulative Windspeed Distribution for Tornadoes within 125 nm of Pottstown, PA

Windspeed Classification	No of Tornadoes	Percent of Total	Cumulative Percentage
F5 (261 - 308 mph)	0	0.0	0.0
F4 (207 - 260 mph)	0	0.0	0.0
F3 (158 - 206 mph)	15	4.9	4.9
F2 (113 - 157 mph)	93	30.2	35.2
F1 (73 - 112 mph)	154	50.2	85.3
F0 (40 - 72 mph)	43	14.0	99.3
F-1 (<40 mph)	2	0.7	100.0

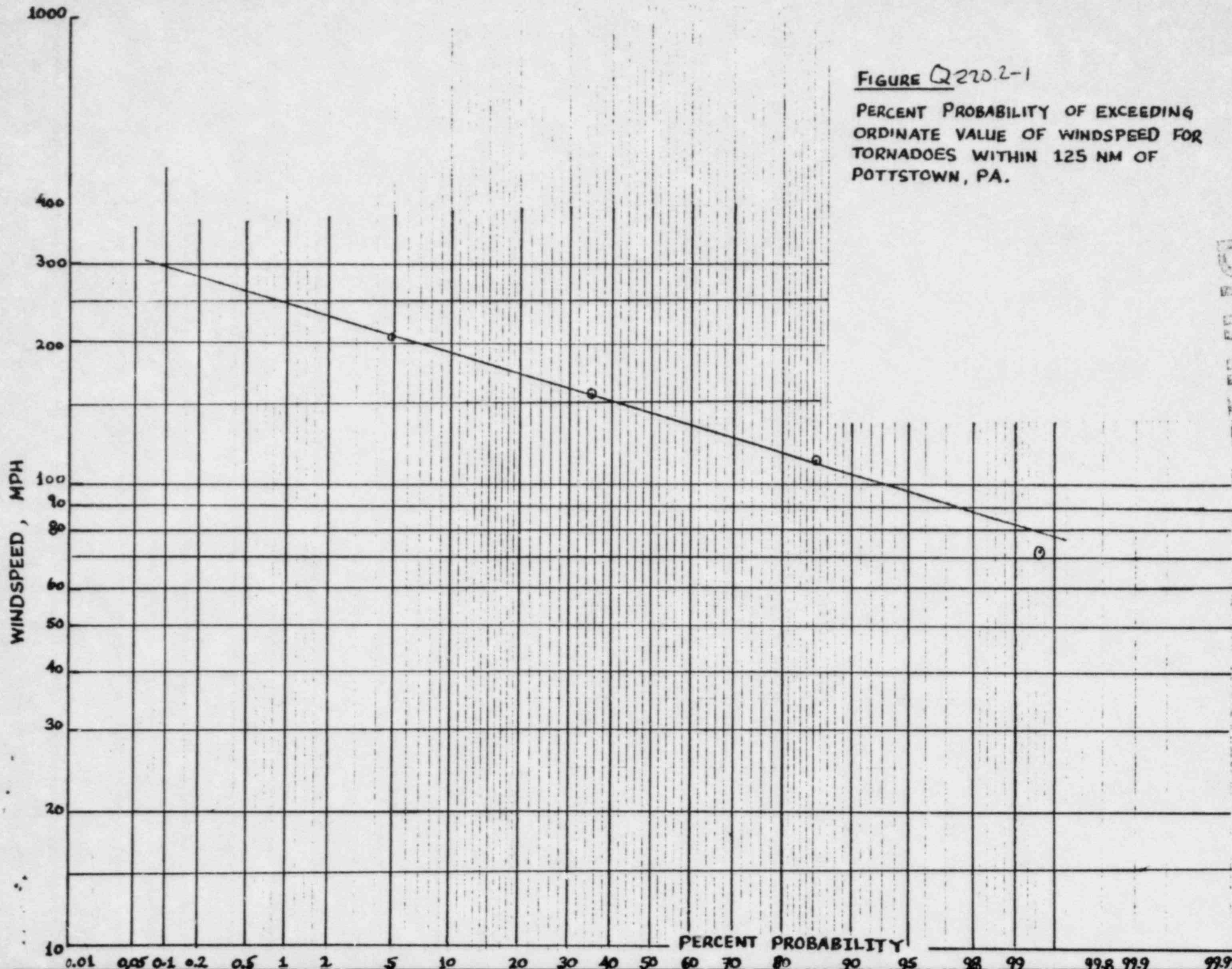

FIGURE Q220.2-1

PERCENT PROBABILITY OF EXCEEDING ORDINATE VALUE OF WINDSPEED FOR TORNADOES WITHIN 125 NM OF POTTSTOWN, PA.

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