Regulatory History of the Evolution of the Differing Design Basis Tornado Wind Speeds

The Nuclear Regulatory Commission (NRC) licensing regulations related to the consideration of tornados in the siting and design of nuclear power reactors include 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 2, "Design Bases for Protection Against Natural Phenomena," GDC 4, "Environmental and Dynamic Effects Design Bases," 10 Code of Federal Regulations (CFR) §100.20(c), "Factors To Be Considered When Evaluating Sites," and §100.21(d), "Non-Seismic Siting Criteria." Specific guidance regarding the implementation of these regulations has traditionally been provided in regulatory guides and the Standard Review Plan (SRP), NUREG-0800.

Currently licensed reactors are designed to Regulatory Guide 1.76. The design basis tornado wind speeds in Regulatory Guide 1.76 are based on assumptions and mathematical models in the 1974 document WASH-1300, "Technical Basis for Interim Regional Tornado Criteria." As set forth in this document, the staff calculated the expected frequency of different tornado wind speeds using two years of available tornado data (1971-1972) in three different regions in the continental United States. The staff selected maximum design basis wind speeds based on the premise that the probability of occurrence[1] of a tornado that exceeds the design basis tornado should be on the order of 10^{-7} per year per nuclear power plant. This evaluation concluded that a maximum wind speed of 360 mph would be consistent with this probability of occurrence for much of the United States east of the Rocky Mountains (Region I) as defined in Regulatory Guide 1.76. The regulatory guide specified that nuclear plants should be designed to withstand the design basis tornado for each region, or a comprehensive analysis be provided to justify the selection of a less conservative design basis tornado.

The staff subsequently issued an interim position on the design basis tornado[2] based on NUREG/CR-4461, "Tornado Climatology of the Contiguous United States," dated May 1986. NUREG/CR-4461 revised certain aspects of the WASH-1300 methodology and recalculated tornado wind speed frequencies using 30 years of more detailed tornado data (1954-1983). The resulting wind speed estimates were lower than the wind speed estimates presented in WASH-1300 and Regulatory Guide 1.76 for most of the United States. To account for uncertainties in the database and analyses, the staff concluded in its interim position that the 10^{-7} per year probability of occurrence wind speed at the upper end of the middle 90 percent confidence level from NUREG/CR-4461 should be used as the wind speed for the design basis

[1] *Probability of occurrence per unit time* and *frequency* are quantitatively the same for values much less than one and can be used interchangeably in the discussions provided here. Current risk-informed guidance documents normally use frequency. Many earlier documents use probability of occurrence per unit time. This document uses frequency unless referring directly to a parameter in an earlier document where probability of occurrence was used.

[2] Lester S. Rubenstein letter to Edwin E. Kintner, "ALWR Design Basis Tornado," dated March 25, 1988.

tornado.[3] On this basis, the document recommended a maximum wind speed of 330 mph for Region I.

The staff recommended in SECY-93-087 that a 10^{-7} per year mean probability of occurrence instead of the more conservative upper 90 percent confidence level used in the staff interim position should be used as the basis for the certified standardized design basis tornado wind speed. The staff estimated that this corresponded to a maximum wind speed of 300 mph for Region I. SECY-93-087 also stated that the staff expected that this criterion would not preclude siting the advanced light water reactor (ALWR) plant designs on most sites in the United States. Furthermore, if a hazard at a selected site exceeded the approved certified standardized design envelope, the combined license applicant would have the option of performing a site-specific analysis to demonstrate that the design is acceptable for the site.

[3]The middle 90 percent confidence interval extends from the five percent confidence limit to the 95 percent confidence limit. The upper end of the middle 90 percent is the 95 percent confidence limit.