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DRAFT REGULATORY GUIDE

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DRAFT REGULATORY GUIDE DG-1143

(Proposed Revision 1 of Regulatory Guide 1.76, dated April 1974)

DESIGN-BASIS TORNADO AND TORNADO MISSILES FOR NUCLEAR POWER PLANTS

A. INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) proposes this draft regulatory guide as an update to Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants." Toward that end, this draft regulatory guide provides licensees and applicants with new guidance that the NRC staff considers acceptable for use in selecting the design-basis tornado and design-basis tornado-generated missiles that a nuclear power plant should be designed to withstand in each of the three regions within the contiguous United States to prevent undue risk to the health and safety of the public. This guide does not address the determination of the design-basis tornado and tornado missiles for sites located in Alaska, Hawaii, or Puerto Rico; such determinations will be evaluated on a case-by-case basis. This guide also does not identify the specific structures, systems, and components that should be designed to withstand the effects of the design-basis tornado or should be protected from tornado-generated missiles and remain functional. In addition, this guide does not address the missiles attributable to extreme winds, such as hurricanes, which will be considered on a case-by-case basis when identified.

This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. It has not received staff review or approval and does not represent an official NRC staff position.

Public comments are being solicited on this draft guide (including any implementation schedule) and its associated regulatory analysis or value/impact statement. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rules and Directives Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Comments may be submitted electronically through the NRC's interactive rulemaking Web page at http://www.nrc.gov/what-we-do/regulatory/rulemaking.html. Copies of comments received may be examined at the NRC Public Document Room, 11555 Rockville Pike, Rockville, MD. Comments will be most helpful if received by **March 27, 2006**.

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General Design Criterion (GDC) 2, "Design Bases for Protection Against Natural Phenomena," of Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10, Part 50, of the *Code of Federal Regulations* (10 CFR Part 50), requires that structures, systems, and components that are important to safety must be designed to withstand the effects of natural phenomena such as tornadoes without loss of capability to perform their safety functions. GDC 2 also requires that the design bases for these structures, systems, and components shall reflect (1) appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (3) the importance of the safety functions to be performed.

GDC 4, "Environmental and Dynamic Effects Design Bases," of Appendix A to 10 CFR Part 50 requires, in part, that structures, systems, and components that are important to safety must be protected against the effects of missiles from events and conditions outside the plant.

For stationary power reactor site applications submitted before January 10, 1997, Paragraph 100.10(c)(2) of 10 CFR Part 100, "Reactor Site Criteria," states that meteorological conditions at the site and in the surrounding area should be considered in determining the acceptability of a site for a power reactor.

For stationary power reactor site applications submitted on or after January 10, 1997, Paragraph 100.20(c)(2) of 10 CFR Part 100 requires that meteorological characteristics of the site that are necessary for safety analysis or may have an impact upon plant design (such as maximum probable wind speed) must be considered in determining the acceptability of a site for a nuclear power plant. In addition, Paragraph 100.21(d) of 10 CFR Part 100 requires that the physical characteristics of the site, including meteorology, must be evaluated and site parameters established such that potential threats from such physical characteristics will pose no undue risk to the type of facility proposed to be located at the site.

The NRC issues regulatory guides to describe to the public methods that the staff considers acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations, and compliance with regulatory guides is not required. The NRC issues regulatory guides in draft form to solicit public comment and involve the public in developing the agency's regulatory positions. Draft regulatory guides have not received complete staff review and, therefore, they do not represent official NRC staff positions.

This regulatory guide contains information collections that are covered by the requirements of 10 CFR Part 50 which the Office of Management and Budget (OMB) approved under OMB control number 3150-0011. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

Regionalization of Tornado Wind Speeds

Nuclear power plants must be designed so that the plants remain in a safe condition in the event of the most severe tornado that can reasonably be predicted to occur at a site as a result of severe meteorological conditions. The original version of Regulatory Guide 1.76, published in April 1974, was based on WASH-1300 (Ref. 1). WASH-1300 chose the design-basis tornado wind speeds so that the probability of occurrence of a tornado that exceeded the design-basis was on the order of 10^{-7} per year per nuclear power plant. WASH-1300 used 2 years of observed tornado intensity data (1971 and 1972) to derive design-basis tornado characteristics for three regions within the continental United States.

The design-basis tornado wind speeds presented in this draft regulatory guide are based on Revision 1 to NUREG/CR-4461 (Ref. 2). The tornado database used in the revised NUREG/CR-4461 includes information recorded for more than 46,800 tornado segments occurring from January 1, 1950, through August 31, 2003. More than 39,600 of those segments had sufficient information on location, intensity, length, and width to be used in the analysis of tornado strike probabilities and maximum wind speeds. The methods used in this analysis are similar to those used in the analysis of the initial tornado climatology leading to initial publication of NUREG/CR-4461 in 1986, with the addition of a term to account for finite dimensions of structures (sometimes called the "lifeline" term), as well as consideration of the variation of wind speeds along and across the tornado footprint. The term associated with the finite dimensions of structures was discussed in detail by R.C. Garson et al. (Ref. 3). The basic idea is that, for finite structures, a tornado striking any point on the structure can cause damage. The original NUREG/CR-4461 used a point model, where the nuclear power plant was assumed to be a point structure. Therefore, including the finite dimensions of structures increases the tornado strike probability.

The basic model of a tornado footprint is a rectangle characterized by the width and length of the tornado path. The analysis accounts for the variation of wind speeds within the rectangle area, whereas the model in the original version of NUREG/CR-4461 did not.

Meteorological and topographic conditions, which vary significantly within the continental United States, influence the frequency of occurrence and intensity of tornadoes. The NRC staff has determined that the design-basis tornado wind speeds for new reactors should be such that the best estimate of the exceedance frequency is 10^{-7} per year, retaining the same exceedance frequency as in the original version of this regulatory guide. The results of the analysis indicated that a maximum wind speed of 134 m/s (300 mi/h) is appropriate for tornadoes for the central portion of the United States; a maximum wind speed of 116 m/s (260 mi/h) is appropriate for a large region of the United States along the east coast, the northern border, and western great plains; and a maximum wind speed of 89 m/s (200 mi/h) is appropriate for the western United States. These geographic wind speed regions are defined by observed tornado occurrence within 2° latitude and longitude boxes in the contiguous United States. Figure 1 shows the three tornado intensity regions for the contiguous United States for the 10^{-7} per year probability level, in which the abscissa is the longitude (degrees West) and the ordinate is the latitude (degrees North).

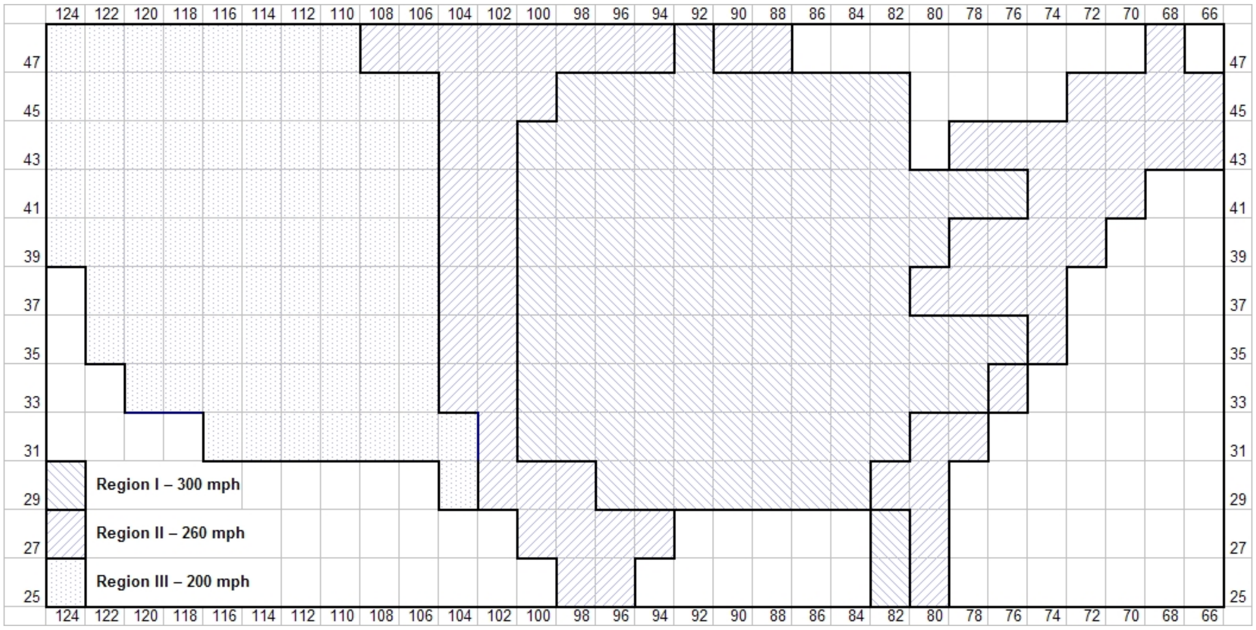

Figure 1. Tornado Intensity Regions for the Contiguous United States
for Exceedance Probabilities of 10^{-7} per Year

Tornado Characteristics

Tornadoes can be characterized by a mutually consistent set of parameters including maximum total wind speed; radius of maximum tangential (rotational) wind speed; tornado tangential, vertical, radial, and translational wind speeds; and associated atmospheric pressure changes within the core.

In order to estimate the pressure drop and rate of pressure drop associated with the design-basis tornado, this draft regulatory guide models the tornado as a single Rankine combined vortex, as in the original version of Regulatory Guide 1.76. A single Rankine combined vortex is a simple model possessing only azimuthal velocity. The wind velocities and pressures are assumed not to vary with the height above the ground. Therefore, the flow field is two-dimensional. The flow field of a Rankine combined vortex is equivalent to that of a solid rotating body within the core of radius R_m. Outside the core, the rotational speed falls off as *1/r.* That is to say, the rotational speed V_R is given by

(1a) $$V_R = \frac{V_{Rm}\, r}{R_m} \quad for\ r \le R_m$$

(1b) $$V_R = \frac{V_{Rm}\, R_m}{r} \quad for\ r \ge R_m$$

Here, V_{Rm} is the maximum rotational speed, occurring at radius $r = R_m$. Moreover, the Rankine combined vortex moves with the translational speed V_T of the tornado.

The pressure drop from normal atmospheric pressure to the center of the Rankine combined vortex is computed by balancing the pressure gradient and the centrifugal force (cyclostrophic balance), and integrating from infinity to the center of the vortex. It is given by

(2) $\Delta p = \rho V_{Rm}^2$, where ρ is the air density, taken as 1.226 kg/m^3 (0.07654 lbm/ft^3).

The maximum rate of pressure drop is given by the following equation:

(3) $(dp/dt)_{max} = (V_{Rm}/R_m)\,\Delta p$

The NRC staff chose the Rankine combined vortex model for its simplicity, over the model developed by T. Fujita (Ref. 4). Fujita's model has a tornado with an inner core and an annulus (outer core) where the vertical motions are concentrated. In the annulus between the inner core radius and the outer core radius, suction vortices form in strong tornadoes. These suction vortices rotate around the center of the parent tornado.

In the Fujita model, the tornado radius R_m is larger than the 45.7 meters (150 feet) assumed in the original version of Regulatory Guide 1.76. In fact, the tornado radius of maximum rotational wind speed for a 134 m/s (300 mi/h) tornado is 157.5 meters (517 feet). However, the suction vortices have their maximum rotational wind speed at a radius of 33 meters (108 feet). Despite the fact that the pressure drop associated with a suction vortex (that is, the pressure drop from ambient pressure to the center of the suction vortex) is somewhat less than for the parent tornado, the maximum rate of pressure drop is greater, because the maximum time rate of change of pressure is inversely proportional to the Rankine combined vortex radius and is directly proportional to the translational speed of the Rankine combined vortex. The radius for the suction vortex is smaller than that for the parent tornado, and the maximum translational speed for a suction vortex is the sum of the translational speed of the tornado, and the speed with which the suction vortex rotates around the center of the parent tornado. In order to avoid a nonconservative maximum time rate of change of pressure, this draft regulatory guide retains the 45.7-meter (150-foot) radius of maximum wind speed for the tornado used in the original version of Regulatory Guide 1.76. In addition, this draft regulatory guide retains the definition of the tornado maximum rotational wind speed V_{Rm} as the difference between the maximum tornado wind speed V and the translational speed V_T. The tornado translational speed for the tornado is one fifth of the maximum tornado wind speed, which is consistent with the tornado translational speeds in the original version of Regulatory Guide 1.76.

Design-Basis Tornado Characteristics

In the original version of Regulatory Guide 1.76, tornadoes in each geographical region were characterized by (1) maximum wind speed, (2) translational speed, (3) maximum rotational speed, (4) radius of maximum rotational speed, (5) pressure drop, and (6) rate of pressure drop. Because the model used in this draft regulatory guide is based on a single Rankine combined vortex, the same parameters are used herein. If a tornado model with suction vortices were used, additional parameters would have had to be included. Table 1 summarizes the design-basis tornado characteristics for this draft regulatory guide.

Table 1. Design-Basis Tornado Characteristics

Region	Maximum wind speed m/s (mi/h)	Translational speed m/s (mi/h)	Maximum rotational speed m/s (mi/h)	Radius of maximum rotational speed m (ft)	Pressure drop mb (psi)	Rate of pressure drop mb/s (psi/s)
I	134 (300)	27 (60)	107 (240)	45.7 (150)	141 (2.0)	83 (1.2)
II	116 (260)	23 (52)	93 (208)	45.7 (150)	106 (1.5)	54 (0.8)
III	89 (200)	18 (40)	72 (160)	45.7 (150)	63 (0.9)	25 (0.4)

Tornado-Generated Missile Characteristics

To ensure the safety of nuclear power plants in the event of a tornado strike, NRC regulations require that nuclear power plant designs must consider the impact of tornado-generated missiles (i.e., objects moving under the action of aerodynamic forces induced by the tornado wind), in addition to the direct action of the tornado wind and the moving ambient pressure field. Wind velocities in excess of 34 m/s (75 mi/h) are capable of generating missiles from objects lying within the path of the tornado wind and from the debris of nearby damaged structures.

The two basic approaches used to characterize tornado-generated missiles are (1) a standard spectrum of tornado missiles, and (2) a probabilistic assessment of the tornado hazard. No definitive guidance has been developed for use in characterizing site-dependent tornado-generated missiles by hazard probability methods. The damage to safety-related structures by tornado or other wind-generated missiles implies the occurrence of a sequence of random events. That event sequence typically includes wind based occurrence in the plant vicinity in excess of 34 m/s (75 mi/h), existence and availability of missiles in the area, injection of missiles into the wind field, suspension and flight of those missiles, impact of the missiles with safety-related structures, and resulting damage to critical equipment. Given defense-in-depth considerations, the uncertainties in these events preclude the use of a probabilistic assessment as the sole basis for assessing the adequacy of protection against tornado missile damage.

Protection from a spectrum of missiles (exemplified by a massive missile that deforms on impact at one end of the spectrum and a rigid penetrating missile at the other) provides assurance that the necessary structures, systems, and components will be available to mitigate the potential effects of a tornado on plant safety. Given that the design-basis tornado wind speed has a very low frequency, to be credible, the representative missiles must be common around the plant site and must have a reasonable probability of becoming airborne within the tornado wind field.

In order to evaluate the resistance of barriers to penetration and gross failure, the tornado missile speeds must also be defined. Estimates of tornado-generated missile speeds for nuclear plant design purposes are presented in "Wind Effects on Structures," by E. Simiu and R.H. Scanlan (Ref. 5). One of the assumptions on which these estimates were based was that the missiles start their motion from a point located on the tornado translation axis, at a distance downward of the tornado center equal to the radius of maximum circumferential wind speeds. In addition, it was assumed that the speed with which a missile hits a target is equal to the maximum speed (V^{max}) that the same missile would attain if its trajectory were unobstructed by the presence of any obstacle.

The tornado wind field model used in the calculational method for the maximum missile velocities differs somewhat from the tornado wind field model used in the discussion of tornado characteristics (above) to obtain the tornado pressure drop and maximum time rate of change of the pressure. The tornado wind field model (which includes a radial component for the tornado wind speed) and the equations of motion used for the maximum missile velocities are given in Chapter 16 of Reference 5. A computer program was written to calculate the maximum horizontal missile speeds by solving the equations of motion given in Chapter 16 of Reference 5.

Design-Basis Tornado Missile Spectrum

In accordance with 10 CFR 50.34, GDC 2, and GDC 4, structures, systems, and components that are important to safety must be designed to withstand the effects of natural phenomena without losing the capability to perform their safety function. Tornado missiles are among the most extreme effects of credible natural phenomena at nuclear power plant sites. The selected design-basis missiles for nuclear power plants include at least (1) a massive high-kinetic-energy missile that deforms on impact, (2) a rigid missile that tests penetration resistence, and (3) a small rigid missile of a size sufficient to pass through any opening of protective barriers. The NRC staff determined that a 15.24-cm (6-inch) Schedule 40 steel pipe and an automobile are acceptable as the penetrating and massive missiles, respectively, for use in the design of nuclear power plants as common objects near the plant site. In order to test the configuration of openings in the protective barriers, the missile spectrum also includes a 2.54-cm (1-inch) solid steel sphere as a small rigid missile. The characteristics of these missiles are based on methods described in Reference 5. Table 2 summarizes the design-basis tornado missile spectrum and maximum horizontal speeds.

Table 2. Design-Basis Tornado Missile Spectrum and Maximum Horizontal Speeds

Missile Type		Schedule 40 Pipe	Automobile	Solid Steel Sphere
Dimensions		0.168 m dia × 4.58 m long (6.625" dia × 15' long)	5 m × 2 m × 1.3 m (16.4' x 6.6' x 4.3')	2.54 cm dia (1 inch dia)
Mass		130 kg (287 lb)	1810 kg (4000 lb)	0.0669 kg (0.147 lb)
C_DA/m		0.0043 m^2/kg (0.0212 ft^2/lb)	0.0070 m^2/kg (0.0343 ft^2/lb)	0.0034 m^2/kg (0.0166 ft^2/lb)
V_{Mh}^{max}	Region I	47 m/sec (155 ft/sec)	52 m/sec (170 ft/sec)	41 m/sec (134 ft/sec)
	Region II	38 m/sec (123 ft/sec)	45 m/sec (149 ft/sec)	21 m/sec (68 ft/sec)
	Region III	8 m/sec (27 ft/sec)	34 m/sec (113 ft/sec)	7 m/sec (23 ft/sec)

The missiles listed in Table 2 are considered to be capable of striking in all directions with horizontal velocities of V_{Mh}^{max} and vertical velocities equal to 67 percent of V_{Mh}^{max}. Barrier design should be evaluated assuming impact normal to the surface for the Schedule 40 pipe and the automobile missile.

C. REGULATORY POSITION

The NRC staff has established the following regulatory positions for licensees and applicants to use in selecting the design-basis tornado and design-basis tornado-generated missiles that a nuclear power plant should be designed to withstand to prevent undue risk to the health and safety of the public:

(1) Nuclear power plants should be designed to withstand the design-basis tornado. The parameter values specified in Table 1 for the appropriate regions identified in Figure 1 are generally acceptable to the NRC staff for defining the design-basis tornado for a nuclear power plant. Sites located near the general boundaries of adjoining regions may involve additional considerations. The radius of maximum rotational speed of 45.7 meters (150 feet) is used for all three tornado intensity regions.

(2) If a design-basis tornado proposed for a given site is characterized by less-conservative parameter values than the regional values in Table 1, a comprehensive analysis should be provided to justify the selection of the less-conservative design-basis tornado.

(3) The design-basis tornado-generated missile spectrum in Table 2 is generally acceptable to the staff for the design of nuclear power plants.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this draft regulatory guide. No backfitting is intended or approved in connection with its issuance.

The NRC has issued this draft guide to encourage public participation in its development. Except in those cases in which an applicant or licensee proposes or has previously established an acceptable alternative method for complying with specified portions of the NRC's regulations, the methods to be described in the active guide will reflect public comments and will be used in evaluating (1) submittals in connection with applications for construction permits, standard plant design certifications, operating licenses, early site permits, and combined licenses; and (2) submittals from operating reactor licensees who voluntarily propose to initiate system modifications if there is a clear nexus between the proposed modifications and the subject for which guidance is provided herein.

REFERENCES

1. U.S. Atomic Energy Commission, "Technical Basis for Interim Regional Tornado Criteria," WASH-1300, May 1974.[1]

2. J.V. Ramsdell, Jr., "Tornado Climatology of the Contiguous United States," NUREG/CR-4461, Revision 1, PNNL-15112, U.S. Nuclear Regulatory Commission, April 2005.[2]

3. R.C. Garson et al., "Tornado Design Winds Based on Risk," *Journal of the Structural Division, Proceedings of the American Society of Civil Engineers*, Vol. 101, No. 9, pp. 1883–1897, September 1975.[3]

4. T. Theodore Fujita, "Workbook of Tornadoes and High Winds for Engineering Applications," SMRP Research Paper No. 165, September 1978.[4]

5. Emil Simiu and Robert H. Scanlan, "Wind Effects on Structures: Fundamentals and Applications to Design," 3rd Edition, John Wiley & Sons, August 1996.[5]

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[1] Copies are available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email PDR@nrc.gov.

[2] Copies are available at current rates from the U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20402-9328 (telephone (202) 512-1800); or from the National Technical Information Service (NTIS) by writing NTIS at 5285 Port Royal Road, Springfield, VA 22161; http://www.ntis.gov; telephone (703) 487-4650. Copies are available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email is PDR@nrc.gov. This document is also available electronically through the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr4461/.

[3] Copies may be purchased from the American Society for Civil Engineers (ASCE), 1801 Alexander Bell Drive, Reston, VA 20190 [phone: 800-548-ASCE (2723)]. Purchase information is available through the ASCE Web site at http://www.pubs.asce.org/WWWdisplay.cgi?5011559.

[4] Copies are available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email PDR@nrc.gov. This document is also available through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html, under Accession No. ML052650410.

[5] Copies may be purchased from the publisher, John Wiley & Sons, 111 River Street, Hoboken, NJ 07030-5774 [phone: 201-748-6000]. Purchase information is available through the publisher's Web site at http://www.wiley.com/WileyCDA/WileyTitle/productCd-0471121576.html.

REGULATORY ANALYSIS

1. Statement of the Problem

The U.S. Nuclear Regulatory Commission (NRC) issued the original version of Regulatory Guide 1.76 in April 1974 to describe a design-basis tornado that the NRC staff considered acceptable for use in selecting the design-basis tornado that a nuclear power plant should be designed to withstand in each of the three regions within the contiguous United States to prevent undue risk to the health and safety of the public. The criterion used then, and still used in this version of this guide, is that the exceedance frequency for the design-basis tornado should be 10^{-7} per year. However, more data are available now than when the original version of this guide was developed, and the methods used to estimate the frequency of exceedance of tornado wind speeds have improved. A new analysis shows that the tornado design-basis wind speeds corresponding to the exceedance frequency of 10^{-7} per year are lower than those given in the original version of this guide. Therefore, a revision to this regulatory guidance is necessary to include updated information.

2. Objective

The objective of this regulatory action is to update the NRC's guidance with respect to the definition of the design-basis tornado and tornado missiles. This will give applicants and licensees the opportunity to take advantage of the reduced wind speeds of the revised design-basis tornado, which should lead to increased regulatory effectiveness by avoiding unnecessary conservatism that offers little safety benefit.

3. Alternative Approaches

The NRC staff considered the following alternative approaches to the problem of outdated guidance regarding the design-basis tornado and tornado missiles:

(1) Do not revise Regulatory Guide 1.76.
(2) Update Regulatory Guide 1.76.

3.1 Alternative 1: Do Not Revise Regulatory Guide 1.76

Under this alternative, the NRC would not revise this guidance, and licensees would continue to use the original version of this regulatory guide. This alternative is considered the baseline or "no action" alternative and, as such, involves no value/impact considerations.

3.2 Update Regulatory Guide 1.76

Under this alternative, the NRC would update Regulatory Guide 1.76 with new tornado data to reflect the new estimates of the frequency of exceedance of tornado wind speeds. Tornado design-basis wind speeds corresponding to the exceedance frequency of 10^{-7} per year are lower than those given in the original version of this guide.

The benefit of this action would be saving resources on the part of licensees and applicants building new nuclear power plants, with the latter realizing the predominant savings.

The costs to the NRC would be the one-time cost of issuing the revised regulatory guide (that is, relatively small), and applicants and licensees would incur little or no cost. Other possible consequences of this action include the possibility of underestimating the frequencies of exceedance of tornado wind speeds. However, considering the conservatism of structural design for other loads, it is likely that a nuclear power plant could withstand higher tornado wind speeds. It appears very unlikely that the core damage frequency from tornadoes could be much greater than 10^{-7}, and it is even more unlikely that a core damage accident with a large early release will occur. Therefore, any adverse consequences of adopting this alternative are considered extremely remote.

3. Conclusion

Based on this regulatory analysis, the staff recommends that the NRC should revise Regulatory Guide 1.76. The staff concludes that the proposed action will reduce unnecessary conservatism in the specification of the design-basis tornado, leading to cost savings for industry, especially with regard to applications for standard plant design certifications and combined licenses.

BACKFIT ANALYSIS

This draft regulatory guide provides licensees and applicants with new guidance that the NRC staff considers acceptable for use in selecting the design-basis tornado and design-basis tornado-generated missiles that a nuclear power plant should be designed to withstand in each of the three regions within the contiguous United States to prevent undue risk to the health and safety of the public. The application of this guide is voluntary. Licensees may continue to use the original version of this regulatory guide if they so choose. No backfit, as defined in 10 CFR 50.109, is either intended or implied.