American Nuclear Society

standard for estimating tornado and extreme wind characteristics at nuclear power sites

an American National Standard

WITHDRAWN
April 16, 1993
ANSI/ANS-2.3-1983

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published by the
American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60525 USA

ANSI/ANS-2.3-1983

American National Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-2.3

Published by the
American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60525 USA

Approved October 17, 1983
by the
American National Standards Institute, Inc.

American National Standard

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Published by

American Nuclear Society
555 North Kensington Avenue, La Grange Park, Illinois 60525 USA

Price: $25.00

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Printed in the United States of America

Foreword

(This Foreword is not a part of American National Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites, ANSI/ANS-2.3-1983.)

The purpose of this standard is to specify guidelines to determine the wind velocity, atmospheric pressure change, missile type, size, and velocity that result from tornadoes, hurricanes, and other extreme winds to be used in nuclear plant design. The standard does not treat the forces that result from these natural events.

This proposed standard was prepared by Working Group ANS-2.3 of the Subcommittee ANS-2, Site Evaluation, of the American Nuclear Society Standards Committee. Working Group ANS-2.3 was formed in the fall of 1973 and had its initial meeting in November. The working group has met 15 times during the succeeding years to develop Draft 2, Revision 5 of the standard. Draft 1, Revision 0 was written in November 1974 and was circulated for comments internal to Working Group ANS-2.3. These comments resulted in Draft 1, Revision 1, which was circulated to utilities, architect-engineers, and universities for comments. Thirty of these groups responded with comments that were incorporated into the proposed standard as Draft 1, Revision 2. Additional review and comments by the working group resulted in Draft 1, Revision 3, Revision 4, and Revision 5. Draft 2, Revision 0 was reviewed by ANS-2, whose comments led to Draft 2, Revision 1, 2, 3, 4 and this Revision 5.

History of Major Points Discussed and Their Resolution

(These points are not a part of the proposed ANS-2.3 Standard.)

Point 1: Choice of 1° latitude by 1° longitude area as the base for data analysis.

The 5° by 5° area, which was considered initially, was determined to be too large after study. It used results in understanding the frequency of occurrence of tornadoes when the proposed site is in a high frequency region, and it results in overestimating the frequency of occurrence in lower frequency regions. However, due to population bias in reporting tornadoes and differing opinions regarding intensities as well as meteorological and topographical variations, the averaging approach utilizing the 3° by 3° running mean was chosen to smooth out apparent inconsistencies.

Point 2: Initially, special "local areas" were considered in nonhomogeneous terrain. This method permitted the regionalization of "design basis tornado" windspeeds. Local variations exist within the different regions, but the regional values are meant to provide an upper limit on 10^{-5}, 10^{-6}, and 10^{-7} tornadic windspeeds.

Point 3: The need for a prototype wind profile for a design basis tornado.

The Dallas, Texas, tornado documented by W. H. Hoecker (*Monthly Weather Review*, **88**, 167-180; 1960) was originally chosen as the prototype wind profile for the design basis tornado. However, the review and comments on Draft 1, Revision 1, by both the working group members and by reviewers from industry and universities indicated a strong preference for the combined Rankine tangential wind field model for a design tornado.

Point 4: The original intent of the working group was to provide explicit guidance on tornado-borne missiles using two approaches: specified missile velocities for a representative list of missiles and methods based on risk analyses. A consensus was achieved on specified missile velocities for each tornado windspeed corresponding to 10^{-5}, 10^{-6}, and 10^{-7} per year probabilities as given on the regionalization maps by relying on methods such as the one recommended by E. Simiu and M. Cordes ("Tornado-Borne Missile Speeds," NBSIR 76-1050, National Bureau of Standards, Washington, D.C., 1976). For risk analysis methods, a consensus was gained only on an acceptable level of risk. This approach is still under development, and the amount of experience necessary to develop a consensus on standardized procedures has not yet been accumulated.

Point 5: The tornadic windspeeds presented in Section 3, Tornadoes, are meant to apply at the 33 ft (10 m) level above ground. This height is consistent with standard meteorological practice.

Point 6: Methods of determining velocities of extreme winds other than tornadoes.

In Draft 1, Revision 1, two methods of determining extreme winds, were considered. Method One, utilizing the approach in ANSI A58.1-1972, was recommended for open areas and coastal regions including hurricanes. Method Two provided for the development of design windspeeds in areas other than open country and to gain more accuracy and precision in estimating the speeds.

The working group agreed to eliminate Method One in Draft 1, Revision 3, because:

(1) The maps used in American National Standard Minimum Design Loads for Buildings and Other Structures, ANSI A58.1-1972 were developed using 13 years of data to determine the design basis windspeed; over nine additional years of data are available that significantly increase the statistical validity of the data.

(2) The isolines of design basis windspeeds for the 100-year return interval contain errors and should not be used.

(3) There is a tendency for designers to extract interpolated values from the ANSI A58.1-1972 maps; these approach maps do not adequately represent appropriate windspeeds.

In Draft 2, Revision 3, the committee decided, on the basis of recent publications, that the Fisher-Tippett Type I extreme value distribution should be used to determine design basis windspeeds from available windspeed records. This approach is proposed in lieu of use of the Fisher-Tippett Type II distribution proposed in earlier revisions of the standard. In most cases of well-behaved wind climates, the Type I distribution fits the windspeed data better than the Type II. (E. Simiu and J. J. Filliben, "Statistical Analysis of Extreme Winds," National Bureau of Standards, Technical Note No. 868, 1975.)

The Type I distribution will likely be used in the revised version of the American National Standard ANSI A58.1-1972. The National Building Code of Canada (1975) also assumes that the extreme winds are modeled by the Type I distribution.

Point 7: Severe weather warning systems.

Draft 1, Revision 1, contained a section on severe weather warning systems as directed by ANS-2. It was later decided that ANS-2.3 was concerned with the design phase of nuclear power plants and not the operational phase. ANS-2.3 agreed to eliminate this section, as it was an operational and not a design function of nuclear power plants.

Point 8: Probability of tornado hazard.

Draft 1, Revision 1, contained one tornado windspeed regionalization map for a hazard probability of 10^{-7} per year. Comments were received to suggest that additional maps be prepared to correspond to annual probabilities of 10^{-5} and 10^{-6} as well. Depending on type of facility and consistency with American National Standard Guidelines for Combining Natural and External Man-Made Hazards at Power Reactor Sites, ANSI/ANS-2.12-1978, the appropriate tornado windspeed and missile characteristics can be selected for a given region.

Point 9: As recent data became available during the Draft 2, Revision 5 update, the committee found it necessary to increase the maximum tornado windspeed from 300 to 320 mph and to change the areas of windspeed categories on the regionalization maps.

Working Group ANS-2.3 of the Standards Committee of the American Nuclear Society had the following membership:*

G. W. Nicholas, Chairman, *Dames & Moore*
R. F. Abbey, Jr., *Department of the Navy, Office of Naval Research (formerly with the U.S. Nuclear Regulatory Commission)*
J. E. Cermak, *Colorado State University*
J. F. Costello, *U.S. Nuclear Regulatory Commission*
T. T. Fujita, *University of Chicago*
J. R. McDonald, *Texas Tech University*
K. Wiedner, *Bechtel Power Corporation*

*Contributions were also made by the following individuals who served as members of ANS-2.3 for a significant portion of this effort:

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****The American Nuclear Society's Nuclear Power Plant Standards Committee (NUPPSCO) had the following membership at the time it balloted this standard in May 1980:**

J. F. Mallay, Chairman
M. D. Weber, Secretary

Name of Representative	*Organization Represented*
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R. G. Benham	*General Atomic Company*
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R. E. Allen (Alt.)	*United Engineers & Constructors, Inc.*
	(for the Institute of Electrical and Electronics Engineers Inc.)
R. V. Bettinger	*Pacific Gas and Electric Company*
P. Bradbury	*Westinghouse Advanced Reactor Division*
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****This roster indicates NUPPSCO members' affiliations at the time of consensus committee ballot.**

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