ANSI/ANS-2.8-2019

Probabilistic Evaluation of External Flood Hazards for Nuclear Facilities

An American National Standard

Published by the
American Nuclear Society
555 N. Kensington Ave
La Grange Park, IL 60526

ANSI/ANS-2.8-2019

ANSI/ANS-2.8-2019

American National Standard Probabilistic Evaluation of External Flood Hazards for Nuclear Facilities

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-2.8

Published by the
American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60526 USA

Approved December 17, 2019
by the
American National Standards Institute, Inc.

American National Standard

Designation of this document as an American National Standard attests that the principles of openness and due process have been followed in the approval procedure and that a consensus of those directly and materially affected by the standard has been achieved.

This standard was developed under the procedures of the Standards Committee of the American Nuclear Society; these procedures are accredited by the American National Standards Institute, Inc., as meeting the criteria for American National Standards. The consensus committee that approved the standard was balanced to ensure that competent, concerned, and varied interests have had an opportunity to participate.

An American National Standard is intended to aid industry, consumers, governmental agencies, and general interest groups. Its use is entirely voluntary. The existence of an American National Standard, in and of itself, does not preclude anyone from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard.

By publication of this standard, the American Nuclear Society does not insure anyone utilizing the standard against liability allegedly arising from or after its use. The content of this standard reflects acceptable practice at the time of its approval and publication. Changes, if any, occurring through developments in the state of the art, may be considered at the time that the standard is subjected to periodic review. It may be reaffirmed, revised, or withdrawn at any time in accordance with established procedures. Users of this standard are cautioned to determine the validity of copies in their possession and to establish that they are of the latest issue.

The American Nuclear Society accepts no responsibility for interpretations of this standard made by any individual or by any ad hoc group of individuals. Inquiries about requirements, recommendations, and/or permissive statements (i.e., “shall,” “should,” and “may,” respectively) should be sent to the Society headquarters, ATTN: Standards or to standards@ans.org. Action will be taken to provide appropriate response in accordance with established procedures that ensure consensus.

Comments on this standard are encouraged and should be sent to Society headquarters.

Published by

American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60526 USA

Printed in the United States of America

Inquiry Requests

The American Nuclear Society (ANS) Standards Committee will provide responses to inquiries about requirements, recommendations, and/or permissive statements (i.e., "shall," "should," and "may," respectively) in American National Standards that are developed and approved by ANS. Responses to inquiries will be provided according to the Policy Manual for the ANS Standards Committee. Nonrelevant inquiries or those concerning unrelated subjects will be returned with appropriate explanation. ANS does not develop case interpretations of requirements in a standard that are applicable to a specific design, operation, facility, or other unique situation only and therefore is not intended for generic application.

Responses to inquiries on standards are published in ANS's magazine, *Nuclear News*, and are available publicly at www.ans.org or by contacting standards@ans.org.

Inquiry Format

Inquiry requests shall include the following:

(1) the name, company name if applicable, mailing address, and telephone number of the inquirer;

(2) reference to the applicable standard edition, section, paragraph, figure, and/or table;

(3) the purpose(s) of the inquiry;

(4) the inquiry stated in a clear, concise manner;

(5) a proposed reply, if the inquirer is in a position to offer one.

Inquiries should be addressed to

American Nuclear Society
ATTN: Standards
555 N. Kensington Avenue
La Grange Park, IL 60526

or standards@ans.org

Foreword

(This foreword does not contain any requirements of American National Standard "Probabilistic Evaluation of External Flood Hazards for Nuclear Facilities," ANSI/ANS-2.8-2019, but is included for informational purposes.)

The purpose of this standard is to establish a process for identifying and evaluating design-basis flood hazards at nuclear facilities using a probabilistic approach. This standard represents a major revision to ANS-2.8-1992 (W2002), "Determining Design Basis Flooding at Power Reactor Sites." ANS-2.8-1992 specifically focused on design-basis flood methodologies for "evaluating the worst site-related flood at a power reactor site caused by either a probable maximum flood on streams and rivers and any dam failures resulting therefrom; a seismically induced dam failure flood; a probable maximum surge and seiche flood; and any attendant wind-generated wave activity associated with these events or caused by a reasonable combination of less severe events." Despite the reference to probable maximum flood hazards, the resulting hazard was established based on deterministic rules and did not rely on probabilistic concepts. As part of a periodic review of the standard's applicability in 2002, the American Nuclear Society (ANS) judged the standard in need of revision, and therefore, it was withdrawn. The working group to revise the standard was formed in 2012. At that time, the working group—composed of members from the U.S. Department of Energy, the National Performance of Dams Program, the U.S. Geological Survey, the U.S. Nuclear Regulatory Commission, and various representatives from the nuclear industry—jointly undertook comprehensive reviews of the applicability of ANS-2.8-1992 (W2002) and recommended a major rewrite be performed. By that time, through insights gained from the events at the Blayais reactor as well as experience with Hurricane Katrina and, more recently, Fukushima, it became clear to the working group that a more formal probabilistic approach should be used for setting design flood parameters. The rewrite was therefore to focus on a probabilistically based approach for assessing the magnitude and occurrence of flood hazards that could be used in applications for the evaluation of nuclear facilities, including risk assessments, establishing the design-basis flood hazard, etc.

This standard differs from its predecessor in the following areas:

- The applicability of the standard extends to all nuclear facilities, not just power reactors.
- Probabilistic assessment: This standard replaces the prescriptive "probable maximum" approach for establishing design flood hazards with a probabilistic approach for analyzing the frequency and magnitude of flood hazards. Thus, this standard focuses on the performance of a probabilistic flood hazard assessment and development of site probabilistic hazard frequency curves. An integral part of this process is the treatment of uncertainty.
- The scope of this standard is expanded to include tsunamis.

The first issue of the standard was approved by the American National Standards Institute (ANSI) on November 1, 1976, and was published by ANS as ANSI N170/ANS-2.8-1976, "Determining Design Basis Flooding at Power Reactor Sites."

The first revision of the standard was approved on February 17, 1981, and was published as ANS-2.8-1981.

The standard was revised in 1992 to cover material that meets the requirements of Sec. 2.4, "Hydrologic Engineering," of Regulatory Guide 1.70, Revision 3, November

1978, “Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” issued by the U.S. Nuclear Regulatory Commission for the flood hazards within the scope of that standard.

This standard might reference documents and other standards that have been superseded or withdrawn at the time this standard is applied. A statement has been included in the references section that provides guidance on the use of references.

The working group has incorporated risk-informed and/or performance-based requirements into this standard.

The ANS-2.8 Working Group, which developed this standard, had the following members*:

Y. Gao (Co-Chair), *Individual*
R. E. Schneider (Co-Chair), *Westinghouse Electric Company*

V. Anderson, *Nuclear Energy Institute*
J. August, *Southern Nuclear Co.*
K. R. Bryson, *Individual*
M. Carr, *U.S. Nuclear Regulatory Commission*
L. Cieslik, *HDR Company*
J. Dababneh, *U. S. Army Corps of Engineers, Pittsburgh District*
D. Finnicum, *Consultant*
Q. Hossain, *Lawrence Livermore National Laboratory*
R. J. Hunt, *Consolidated Nuclear Security, LLC*
K. C. Hyde, *Omaha Public Power District (retired)*
S. Jasim-Hanif, *U.S. Department of Energy*
J. F. Kanney, *U.S. Nuclear Regulatory Commission*
G. Lowe, *Consultant*
C. A. Mazzola, *Project Enhancement Corporation*
M. W. McCann, Jr. *Jack Benjamin & Associates, Inc.*
G. Meyers, *U.S. Department of Energy*
K. Y. Ng, *Bechtel Power Corp.*
R. I. Rishel, *Duke Energy*
J. R. Stedinger, *Cornell University*
J. D. Stevenson, *J.D. Stevenson & Associates (deceased)*

*Special thanks to Jessica Farmer (not an ANS-2.8 Working Group member), U.S. Army Corps of Engineers, who provided additional review comments.

The Siting: Hydrogeological Subcommittee had the following membership at the time of its approval of this standard:

Y. Gao (Chair), *Individual*

K. Y. Ng, *Bechtel Power Corp.*
T. C. Rasmussen, *University of Georgia*
L. Schleicher, *Defense Nuclear Facilities Safety Board*
R. E. Schneider, *Westinghouse Electric Company*
M. J. Truex, *Pacific Northwest National Laboratory*

The Environmental and Siting Consensus Committee had the following membership at the time of its approval of this standard:

C. A. Mazzola (Chair), *Project Enhancement Corporation*
J. Call (Vice Chair), *Oasys, Inc.*

T. Bellinger, *Consolidated Nuclear Security, LLC*
D. A. Bruggeman, *Los Alamos National Laboratory*
K. R. Bryson, *Individual*
W. L. Ebert, *Argonne National Laboratory*
Y. Gao, *Individual*
B. J. Gutierrez, *U.S. Department of Energy*
R. J. Hunt, *Consolidated Nuclear Security, LLC*
M. C. Kinley, *Duke Energy*
Y. Li, *Defense Nuclear Facilities Safety Board*
K. Y. Ng, *Bechtel Power Corp.*
J. O'Brien, *U.S. Department of Energy*
L. Parks, *U.S. Nuclear Regulatory Commission*
S. Rosenbloom, *U.S. Department of Energy*
J. B. Savy, *Individual*
A. A. Simpkins, *Dade Moeller, an NV5 Company*
P. B. Snead, *Duke Energy*
J. Xu, *U.S. Nuclear Regulatory Commission*

Contents

Section Page

Appendices

Tables

Figures