American Nuclear Society

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determining design basis flooding at power reactor sites

an American National Standard

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American National Standard for Determining Design Basis Flooding at Power Reactor Sites

Secretariat
American Nuclear Society

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Working Group ANS-2.8

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American National Standard

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Foreword

(This Foreword is not a part of the American National Standard for Determining Design Basis Flooding at Power Reactor Sites, ANSI/ANS-2.8-1992.)

The purpose of this document is to specify criteria for determining design basis flooding at power reactor sites. This standard was prepared by Working Group ANS-2.8 of ANS-2 Subcommittee, Site Evaluation, of the American Nuclear Society Standards Committee. The directive to the working group was as follows: "Guidelines are to be developed to establish design basis flooding at power reactor sites as a result of river, stream, or seismically induced dam failure; surge, seiche, or wave action flooding, or any combination of these events. Methodology will be described 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."

This standard covers material that meets the requirements of Section 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," issued by the Regulatory Staff of the U.S. Nuclear Regulatory Commission (NRC). This standard does not cover requirements of this Regulatory Guide on the following Standard Format 2.4 sections:

(1) Low Water Considerations—Addressed by American National Standard Evaluation of Surface-Water Supplies for Nuclear Power Sites, ANSI/ANS-2.13-1979 (R1988).

(2) Dispersion, Dilution, and Travel Times of Accidental Releases of Liquid Effluents in Surface Waters—Addressed by American National Standard Evaluation of Radionuclide Transport in Ground Water for Nuclear Power Sites, ANSI/ANS-2.17-1980 (R1989).

(3) Groundwater—Addressed by American National Standard Evaluation of Ground Water Supply for Nuclear Power Sites, ANSI/ANS-2.9-1980 (R1989).

(4) Technical Specifications and Emergency Operation Requirements.

(5) Probable Maximum Tsunami Flooding.

Before preparing the Safety Analysis Report (SAR) Section 2.4, Hydrologic Engineering, for the licensing of nuclear power plants, the applicant should be aware of hydrologic work that has been done by others in the area of interest. Almost invariably, much work can be saved by utilizing all or parts of studies by local, state, and federal agencies. Such information as dimensioned or dimensionless unit hydrographs, loss rates, lag times, historical floods, and geologic and groundwater data, etc., may be obtained from such sources. Sometimes the probable maximum flood has already been derived at the site or at a point near enough to be transposed.

The prime source of such information is the U.S. Army (Corps of Engineers). Other federal agencies that may have useful data are the Bureau of Reclamation, Soil Conservation Service, Weather Service, Geological Survey, Tennessee Valley Authority, Environmental Protection Agency, Federal Energy Regulatory Commission (formerly Federal Power Commission), Federal Emergency Management Agency, and the NRC. Most states have one or more agencies that are concerned with various aspects of water resources. Power companies, particularly those with hydropower capacity, are another source, as are municipal or regional water-supply organizations.

Safety Analysis Reports for other nuclear plants in the area may also provide useful information. It is also profitable to discuss the specific site in detail with the hydrology staff of the NRC prior to starting preparation of Section 2.4.

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

The first revision of the standard was approved on February 17, 1981; it was published as American National Standard ANSI/ANS-2.8-1981.

This revision of the standard was developed by a reconstituted working group of ANS-2.8, which had the following members:

R. M. Noble, Chairman, *Noble Consultants, Inc.*
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Fei-Fan Yeh, *Ebasco Services, Inc.*

Subcommittee ANS-2, Site Evaluation, of the American Nuclear Society Standards Committee had the following members at the time it approved this revision:

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The American Nuclear Society's Nuclear Power Plant Standards Committee had the following membership at the time it of its approval of this standard:

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G. L. Wessman	Torrey Pines Technology
G. J. Wrobel	Rochester Gas & Electric Corporation

Contents

Determining Design Basis Flooding at Power Reactor Sites

1. Introduction and Scope

1.1 Scope. This document presents criteria to establish design basis flooding for nuclear safety-related features at power reactor sites. Methodology is described to evaluate the flood having virtually no risk of exceedance that can be caused by precipitation and snowmelt and any resulting dam failures; seismically induced dam failures; surge or seiche and attendant wind-generated wave activity; or a reasonable combination of these events.

1.2 Discussion. This standard covers that material necessary to develop the design basis flooding for use in the evaluation of the adequacy of a nuclear power plant site. Water-related effects such as water levels, waves, wave forces, ice, erosion, and sedimentation are included to assist in the design of safety-related facilities. Where information presentation requirements are stated in this standard, such as "provide," "tabulate," or "describe," such information shall be provided as a part of the documentation for the design basis flood estimate.

1.2.1 Exclusions. This standard does not cover:

(1) Probable maximum tsunami flooding.

(2) Low water considerations.

(3) Dispersion, dilution, and travel times of accidental releases of liquid effluents.

(4) Groundwater.

(5) Technical specification and emergency operation requirements.

(6) Channel diversions.

(7) Flooding protection requirements (partially addressed).

(8) Flooding from pipe rupture or on-site tank failures.

1.2.2 Probabilistic Approach. In this standard, guidelines to determine design basis floods are primarily associated with "probable maximum" events of deterministic origins. The standard does not include guidelines for using a probabilistic approach, including stochastic techniques. It does, however, recommend in 9.1.2 a target annual exceedance probability of less than 1×10^{-6} for selecting combined events that collectively comprise design bases floods. At the time this standard was prepared, there were no recognized procedures to accurately and objectively define the exceedance probabilities of significant rare events included in probable maximum analysis. As data and procedures improve, probabilistic approaches are encouraged. The exclusion of probabilistic approaches from this standard should not be construed in a manner to inhibit innovation because preferred methodology for a particular case could likely be beneficial and acceptable for a specific site.

2. Definitions

moving squall line. A line or narrow band of active thunderstorms having a pressure jump with the cold front providing the initial piston-like impetus, and a mature instability line that is located in the warm sector of a wave cyclone about 50 to 200 miles in advance of a cold front usually oriented roughly parallel to the cold front and moving in about the same direction and speed as the cold front.

probable maximum flood (PMF). The hypothetical flood (peak discharge, volume, and hydrograph shape) that is considered to be the most severe reasonably possible, based on comprehensive hydrometeorological application of probable maximum precipitation and other hydrologic factors favorable for maximum flood runoff such as sequential storms and snowmelt.

probable maximum gradient wind. A probable gradient wind of a designated duration above the surface friction layer, of which there is virtually no risk of being exceeded. The event may be considered to have a probability of occurence comparable to that of a probable maximum precipitation.

probable maximum hurricane (PMH). A hypothetical hurricane having that combination of characteristics that makes it the most severe that can reasonably occur in the particular region involved. The hurricane approaches the point under study along a critical path and at an optimum rate of movement, which results in the most adverse flooding.