American Nuclear Society

WITHDRAWN
June 26, 2001
ANSI/ANS-52.1-1983;R1988

nuclear safety criteria for the design of stationary boiling water reactor plants

an American National Standard

No longer being maintained as an American National Standard. This standard may contain outdated material or may have been superseded by another standard. Please contact the ANS Standards Administrator for details.

REAFFIRMED
September 26, 1988
ANSI/ANS-52.1-1983 (R1988)

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

American National Standard Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactor Plants

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-52.1

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

Approved April 29, 1983
by the
American National Standards Institute, Inc.

American National Standard

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether he has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review and users are cautioned to obtain the latest editions.

CAUTION NOTICE: This American National Standard may be reviewed or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of this standard may receive current information, including interpretation, on all standards published by the American Nuclear Society by calling or writing to the Society.

Published by

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

Price: $40.00

Printed in the United States of America

Foreword

(This Foreword is not a part of American National Standard Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactor Plants, ANSI/ANS-52.1-1983.)

This standard is a complete revision of ANSI/ANS-52.1-1978. It has been prepared by Subcommittee ANS-52, Boiling Water Reactor Criteria, to incorporate additional requirements for the design of boiling water reactor (BWR) nuclear power plants and to address three major areas:

1. **Safety Classes**

   The results of the ANS Nuclear Power Plant Standards Committee (NUPPSCO) Ad Hoc Committee and NUPPSCO Coordinating Working Group 3 on Equipment Classification are incorporated. These results define Safety Classes and specify requirements for all equipment and structures in a stationary nuclear power plant having a nuclear safety function. A methodology is given to classify all equipment into one of three Safety Classes according to its importance to nuclear safety and its capability for maintenance, surveillance testing, and inspection, or into a Non-Nuclear Safety Class. In addition, classification interface criteria are defined.

2. **Plant Conditions**

   The results of the NUPPSCO Coordinating Working Group 2 have been incorporated. The concept of Plant Conditions is developed that includes individual process conditions, combinations of process conditions, and the combinations of process conditions and external hazards that could result in simultaneous effects on plant equipment. Probability of occurrence is the unifying basis for the categorization of Plant Conditions.

3. **Design Requirements**

   This standard provides a set of design requirements for all Safety Classes and Non-Nuclear Safety Class in terms of industry codes and standards for each category of Plant Conditions. The design requirements reference specific standards and ensure substantial interrelationship with other codes and standards.

The content of this standard reflects an attempt to achieve the following objectives:

a. To establish a consistent set of requirements for light water reactor nuclear power plants;

b. To establish a disciplined, systematic method for defining nuclear safety requirements for nuclear power plants;

c. To establish and delineate the functional nuclear safety requirements for the design of nuclear power plants;

d. To be responsive to both the regulatory requirements of the Nuclear Regulatory Commission and the design and technical requirements of industry codes and standards;

e. To provide a framework for augmenting these criteria as additional standards are developed within the nuclear industry; and

f. To provide a uniform basis for design safety requirements which may be reflected in regulatory documents.

The existence of unique plant or site characteristics might require the consideration of alternate design concepts. This standard has been developed along functional lines to permit this flexibility. The standard has, however, cited many standards, some of which were still in draft form at the time this document was published. Provisions contained in any draft standard should be considered and used with great discretion.

It is strongly suggested that the prospective user fully understand the present status of the referenced standard and major factors on why it might be still in draft form; for example, controversial issues should be recognized.

A number of considerations under development concurrent with the preparation of this standard are not addressed in this standard. Examples of these considerations include: human factors engineering (HFE), probabilistic risk assessment (PRA), systems interaction, diversity, plant security, emergency response facilities, degraded core, minimizing challenges to engineered safety features, safety goals and consideration of cost/benefit analysis, and anticipated transients without scram. Subsequent revisions of this standard will address these considerations as appropriate when they become adequately defined.

A designer is not restricted by this standard from proposing or using alternate criteria to ensure adequate nuclear safety. Frequently, a desirable overall result can be obtained by any of several design concepts. The designer may choose from several alternatives in satisfying the specifics of this standard by the proper consideration of the interrelationship of components and systems within the plant. For example, the PRA approach may be used as an alternative method to evaluate plant design; however, its usefulness is somewhat limited without safety goals that are currently under development.

Portions of this standard were prepared separately under ANS-50, Nuclear Power Plant Systems Engineering, and were reviewed individually by ANS-52, ANS-50, and NUPPSCO which replaced ANS-50 during this time. The separate documents that have been incorporated into this standard include the Glossary (CWG-1), Conditions of Design (CWG-2), and Equipment Classification (Ad Hoc Committee on Equipment Classification). The structure of this standard is based on the standard format guide (CWG-4). This standard was approved by NUPPSCO in 1982.

This standard and all other ANS standards have been written for prospective use.

Continuing efforts will be required to augment or modify the criteria in this standard to implement changing licensing requirements, to achieve standardization among the various industry criteria and standards currently being developed, and to provide additional clarification or interpretation as appropriate. The ANS-52 BWR Criteria Committee meets periodically to consider revisions or modifications to this standard.

Comments, suggestions, and requests for interpretations should be addressed to the Chairman, ANS-52 BWR Criteria Committee, American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525.

Working Group ANS-52.1 of the Standards Committee of the American Nuclear Society, had the following membership at the time it developed this standard:

W. H. D'Ardenne, Chairman, *General Electric Company*
D. M. Crowe, *Southern Company Services, Inc.*
E. E. Fricks, *Stone & Webster Engineering Corporation*
R. E. Scott, *General Electric Company*

At the time of its approval of this standard, Subcommittee ANS-52 had the following membership:

W. H. D'Ardenne, Chairman, *General Electric Company*
D. M. Crowe, *Southern Company Services, Inc.*
E. E. Fricks, *Stone & Webster Engineering Corporation*
H. B. Friend, *Bechtel Corporation*
O. J. Foster, *General Electric Company*
R. J. Mazza, *Sargent & Lundy*
P. D. Metcalf, Jr., *Tennessee Valley Authority*
R. A. Newkirk, *Puget Sound Power & Light Company*
P. M. Pivawer, *Consolidated Edison Company*
H. A. Putre, *Cleveland Electric Illuminating Company*
T. J. Raney, *Ebasco Services, Inc.*
R. E. Scott, *General Electric Company*

The American Nuclear Society's Nuclear Power Plant Standards Committee (NUPPSCO) had the following membership at the time of its approval of this standard.

L. J. Cooper, Chairman
M. D. Weber, Secretary

Name of Representative	Organization Represented
R. G. Benham	General Atomic Company
	(for the Institute of Electrical and Electronics Engineers, Inc.)
B. M. Rice (Alt.)	Duke Power Company
	(for the Institute of Electrical and Electronics Engineers, Inc.)
R. V. Bettinger	Pacific Gas and Electric Company
P. Bradbury	Westinghouse Advanced Reactor Division
D. A. Campbell	Westinghouse Electric Corporation
C. O. Coffer	Pacific Gas and Electric Company
L. J. Cooper	Nebraska Public Power District
	(for the American Nuclear Society)
W. H. D'Ardenne	General Electric Company
S. B. Gerges	NUS Corporation
C. J. Gill	Bechtel National, Inc.
C. Johnson	U.S. Nuclear Regulatory Commission
R. W. Keaten	GPU Services Corporation
J. W. Lentsch	Portland General Electric Company
J. F. Mallay	NUTECH Engineers*
L. M. Mills	Tennessee Valley Authority
A. T. Molin	United Engineers and Constructors, Inc.
T. J. Pashos	Individual
P.T. Reichert	Catalytic, Inc.
S. L. Rosen	Institute of Nuclear Power Operations
J. E. Smith	Duke Power Company
J. W. Stacey	Yankee Atomic Electric Company
S. L. Stamm	Stone & Webster Engineering Corporation
L. Stanley	Quadrex/Nuclear Services Corporation
J. D. Stevenson	Structural Mechanics Associates
	(for the American Society of Civil Engineers)
C. D. Thomas	Science Applications, Inc.
G. P. Wagner	Commonwealth Edison Company
G. L. Wessman	Torrey Pines Technology
J. E. Windhorst	Individual

*Formerly with Babcock & Wilcox Company

Contents

*Each subsection of Section 4 adheres to the following outline:

4.X Title

4.X.1 Function
4.X.2 Definition
4.X.3 Performance Criteria
4.X.4 Safety Class
4.X.5 Design Criteria

4.X.5.1 Nuclear Design Criteria
4.X.5.2 Systems Design Criteria
4.X.5.3 Mechanical Design Criteria
4.X.5.4 Electrical Design Criteria
4.X.5.5 Instrumentation and Control Design Criteria
4.X.5.6 Structural Design Criteria
4.X.5.7 Testing and Inspection Criteria
4.X.5.8 Layout Criteria

Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactor Plants

1. Introduction

1.1 Scope. This standard establishes the nuclear safety criteria and functional design requirements of structures, systems, and components of stationary boiling water reactor (BWR) power plants. Operations, maintenance, and testing requirements are covered only to the extent that they affect design provisions.

A methodology is given for classifying all equipment into one of three Safety Classes according to its importance to nuclear safety or into a Non-Nuclear Safety Class. Another methodology is given for identifying and categorizing into one of five Plant Conditions the normal operations and events for which the plant shall be designed. Acceptance criteria are given for each Plant Condition.

Specific design requirements are given for each major system in a typical plant. These requirements are related to other, more specific design standards and are intended to amplify the criteria given in the Code of Federal Regulations, Title 10, "Energy," Part 50, "Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants" [1].[1]

1.2 Purpose. Incorporating the requirements of this standard provides a degree of assurance that, in their entirety, plants are designed and constructed so that they can be operated without undue risk to the health and safety of the public. It is intended that this standard lead to attainment of this objective by defining existing practices that are consistent with the licensing requirements of the U.S. Nuclear Regulatory Commission (NRC), appropriate industry codes, and good engineering practice. References to regulations, codes, and other standards are included where appropriate.

A designer of a plant has a responsibility, even at the design stage, going beyond conformance to the criteria defined in this standard. In addition to considering this standard, the NRC regulations, and other published guidance, the designer must ensure that the design bases and expected operational characteristics are supported, to the extent practical, by design analyses, experimental verifications, and comparisons to accepted designs or experience gained from similar designs.

Consideration of alternate or additional criteria and requirements may be necessary to accommodate unique site characteristics.

This standard is written specifically for a BWR nuclear power plant. A BWR plant is based on a direct-cycle system. This system is comprised of the reactor coolant system and the power conversion system. The reactor coolant system contains the reactor core, a water-cooled and water-moderated nuclear assembly that utilizes fissionable fuel. Heat is transferred by the reactor coolant system from the reactor core to the power conversion system. The power conversion system converts thermal energy into electrical energy by means of a turbine generator. Both the reactor coolant system and the power conversion system are provided with a number of auxiliary systems that supply, service, and control circulated fluids, processes and environmental conditions, and remove undesirable byproducts, distribute power, and ensure safe conditions, during normal or accident conditions. A number of structures are provided to house, contain, protect, and shield both equipment and personnel. For the purpose of this standard, a BWR plant has the following characteristics:

a. Solid ceramic fuel enclosed in metallic cladding,

b. Fixed geometry for the fuel and coolant (which acts as the moderator),

c. Core and core coolant enclosed in an envelope of high integrity,

d. Core and core coolant envelope enclosed in a primary containment barrier of high integrity, and

e. Pressure suppression to limit primary containment internal pressure.

[1] Numbers in brackets refer to corresponding numbers in Section 5, References.