



# Auxiliary Feedwater System for Pressurized Water Reactors

An American National Standard

ANSI/ANS-51.10-2020

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



**ANSI/ANS-51.10-2020**

**American National Standard  
Auxiliary Feedwater  
System for Pressurized  
Water Reactors**

Secretariat  
**American Nuclear Society**

Prepared by the  
**American Nuclear Society  
Standards Committee  
Working Group ANS-51.10**

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

Approved October 23, 2020  
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 It may be reaffirmed, revised, or withdrawn at any time in accordance with established procedures.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](mailto: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**



**This document is copyright protected.**

Copyright © 2020 by American Nuclear Society. All rights reserved.

Reproduction prohibited under copyright convention unless written permission is granted by the American Nuclear Society.

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](http://www.ans.org) or by contacting [standards@ans.org](mailto: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](mailto:standards@ans.org)

This is a preview of "ANSI/ANS-51.10-1991 ...". [Click here to purchase the full version from the ANSI store.](#)

American National Standard ANSI/ANS-51.10-2020

## Foreword

(This foreword does not contain any requirements of American National Standard “Auxiliary Feedwater System for Pressurized Water Reactors,” ANSI/ANS-51.10-2020, but is included for informational purposes.)

This standard is applicable to pressurized light water reactor nuclear power plants using auxiliary feedwater for emergency applications. Plants that rely on passive safety systems independent of the alternating-current (ac) power system are not considered in the scope of this standard.

ANS-51.10 was originally issued in 1979 and has been extensively updated to reflect current regulatory directives, industry practice and experience, and available design guidance.

Among the major changes incorporated in the 1991 revision of ANS-51.10 was station blackout (i.e., the loss of all ac power sources). A requirement was included that the system be capable of operating for a plant-specific duration with the loss of all ac power sources. The rationale for this requirement and the method of determining the plant-specific duration are identified in Title 10, *Code of Federal Regulations*, Part 50, Sec. 50.63, “Loss of All Alternating Current Power.” In the 1979 edition of this standard, a generic duration of 2 hours was identified, and no rationale was included.

Major revision for ANSI/ANS-51.10-2020 includes additional clarification on defense-in-depth and diversity of power sources as well as updated references and probabilistic risk assessment language where appropriate.

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

This standard does not incorporate the concepts of generating risk-informed insights, performance-based requirements, or a graded approach to quality assurance. The user is advised that one or more of these techniques could enhance the application of this standard.

The membership of the ANS-51.10 Working Group of the American Nuclear Society during the revision of this standard was as follows:

E. M. Johnson-Turnipseed (Chair), *Entergy*

S. Gardocki, *U.S. Nuclear Regulatory Commission*

N. Kawata, *Mitsubishi Heavy Industries, Co. LTD*

T. Matin, *MPR Associates*

J. T. McCumber, *AREVA, Inc.*

S. L. Stamm, *Individual*

The Light Water Reactor & Reactor Auxiliary Systems Subcommittee had the following membership at the time of its approval of this standard:

M. L. French (Chair), *WECTEC*

K. J. Geelhood, *Pacific Northwest National Laboratory*

E. M. Johnson-Turnipseed, *Entergy*

M. A. Linn, *Oak Ridge National Laboratory*

K. B. Welter, *NuScale Power*

The Large Light Water Reactor Consensus Committee had the following membership at the time of its approval of this standard:

M. L. French (Chair), *WECTEC*  
W. B. Reuland (Vice Chair), *Individual*

R. E. Becse, *Westinghouse Electric Company, LLC*  
J. M. Bonfiglio (Observer), *Framatome, Inc.*  
R. J. Burg, *Engineering Planning and Management, Inc.*  
C. E. Carpenter, *U.S. Department of Energy*  
M. J. Colby, *Global Nuclear Fuel - Americas*  
J. B. Florence, *Nebraska Public Power District*  
D. Gardner, *Kairos Power, LLC*  
S. W. Gebers, *Quantum Nuclear Services*  
J. P. Glover, *Graftel, Inc.*  
P. K. Guha, *U.S. Department of Energy*  
E. M. Johnson-Turnipseed, *Entergy*  
M. A. Linn, *Oak Ridge National Laboratory*  
E. M. Lloyd, *Exitech Corporation*  
R. Markovich, *Contingency Management Consulting*  
T. K. Meneely, *Westinghouse Electric Company, LLC*  
C. H. Moseley, Jr., *ASME NQA Liaison*  
S. D. Routh, *Bechtel Power Corporation*  
R. M. Ruby (Observer), *Individual*  
J. C. Saldarini (Observer), *Advanced Reactor Concepts, LLC*  
S. L. Stamm, *Individual*

## Contents

<b>Section</b>	<b>Page</b>
<b>1</b> Scope, purpose, and application .....	1
1.1 Scope .....	1
1.2 Purpose .....	1
1.3 Limits of application.....	1
<b>2</b> Acronyms and definitions.....	1
2.1 Acronyms .....	1
2.2 Shall, should, and may.....	2
2.3 Definitions .....	2
<b>3</b> System functions .....	3
<b>4</b> System definition.....	3
4.1 Description of AFS.....	3
<b>5</b> System performance requirements .....	4
5.1 Performance parameters. ....	4
5.2 Redundancy and diversity requirements.....	13
<b>6</b> Design requirements.....	17
6.1 Safety class and applicable codes, standards, or regulations.....	17
6.2 Conditions of design.....	18
6.3 Interface.....	18
6.4 Testing, inspection, and maintenance requirements .....	19
6.5 Quality assurance.....	20
<b>7</b> References.....	21

## Appendices

Appendix A	System Descriptions .....	25
Appendix B	Background and Application Guidance on Design Requirements.....	30

## Figures

Figure A.1	Representative auxiliary feedwater system arrangement.....	26
Figure A.2	(a) Two-loop and (b) four-loop auxiliary feedwater system.....	27



This is a preview of "ANSI/ANS-51.10-1991 ...". Click here to purchase the full version from the ANSI store.

American National Standard ANSI/ANS-51.10-2020

# Auxiliary Feedwater System for Pressurized Water Reactors

## 1 Scope, purpose, and application

### 1.1 Scope

This standard<sup>1)</sup> sets forth the safety-related functional requirements, performance requirements, design criteria, design requirements for testing and maintenance, and interfaces for the safety-related portion of the auxiliary feedwater system (AFS) of pressurized water reactor (PWR) plants.

This standard is written for new facilities that rely on an auxiliary (emergency) feedwater system for a safety-related function.

### 1.2 Purpose

This standard is written for new facilities. This standard reflects existing regulations, design guidance, and operational experience.

The applicability of this standard to a specific operating plant must be determined on a case-by-case basis to be in compliance with the plant's licensing bases. The criteria and guidance provided in this standard may be different from and inconsistent with the licensed design bases of an operating plant.

### 1.3 Limits of application

This standard applies to the safety-related AFS. This standard also discusses relevant requirements associated with the AFS instrumentation and controls, source of power, water supply, and support system interfaces.

## 2 Acronyms and definitions

### 2.1 Acronyms

<b>ac:</b>	alternating-current
<b>AFS:</b>	auxiliary feedwater system
<b>ANS:</b>	American Nuclear Society
<b>ANSI:</b>	American National Standards Institute
<b>ASME:</b>	American Society of Mechanical Engineers
<b>CFR:</b>	<i>Code of Federal Regulations</i>
<b>dc:</b>	direct-current
<b>ESF:</b>	engineered safety feature

---

<sup>1)</sup> The current standard, ANSI/ANS-51.10-2020, is hereinafter referred to as "this standard."