American Nuclear Society

light water reactors fuel assembly mechanical design and evaluation

an American National Standard

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

ANSI/ANS-57.5-1981

American National Standard for Light Water Reactors Fuel Assembly Mechanical Design and Evaluation

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-57.5

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

Approved May 14, 1981
by the
American Nuclear 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CAUTION NOTICE: This American National Standard may be reviewed or withdrawn at any time.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: $24.00

Printed in the United States of America

Foreword

(This Foreword is not a part of American National Standard for Light Water Reactors Fuel Assembly Mechanical Design and Evaluation, ANSI/ANS-57.5-1981.)

This American National Standard provides a procedure for determining the mechanical adequacy for Fuel Assembly designs for light water nuclear reactors. Specific requirements for design and specific rules for demonstrating compliance are also included.

It is not the intent of this standard to endorse any design feature, material, material property information, analysis method or other procedure, or in any way to inhibit development or innovation in any of these areas. However, this standard does include certain requirements intended to ensure that the methods or material properties which are used are appropriate and adequately documented.

The working group responsible for this standard, ANS-57.5, was originally (August 1973) organized as Working Group ANS-13.1 under Subcommittee ANS-13. The subcommittee voted to dissolve when work was sufficiently advanced on this standard and a companion quality assurance standard developed by Working Group ANS-13.2. The effort was then placed under the auspices of Subcommittee ANS-57, now ANS-55, Fuel and Waste Management.

The initial scope of the project was to consider only upset, emergency and faulted plant conditions as they affect fuel. The working group felt that a proper understanding of transient behavior depended on a knowledge of how the plant has been operating under normal conditions, and so the scope of the standard was expanded accordingly.

Suggestions for improvement of this standard are welcome. They should be sent to the American Nuclear Society, 555 North Kensington Avenue, La Grange Park, Illinois 60525.

The membership of Working Group ANS-57.5, at the time it submitted Revision 1 of this standard, was as follows:

R. E. Schreiber, Chairman, *Battelle Pacific Northwest Laboratories*
M. P. Bohn, *EG&G Idaho, Inc.*
F. M. Bordelon, *Westinghouse Electric Corporation*
E. J. Brown, *U. S. Nuclear Regulatory Commission*
C. G. Dideon, *Babcock and Wilcox Company*
T. G. Dunlap, *General Electric Company*
J. W. Heard, *Yankee Atomic Electric Company*
H. B. Meieran, *Consultant*
W. S. Nechodom, *Exxon Nuclear Company, Inc.*
W. D. Wohlsen, Co-Chairman, *Combustion Engineering, Inc.*

We also wish to thank for their participation:

G. Anderson, *General Electric Company*
J. A. Dearien, *EG&G Idaho, Inc.**
S. B. Kim, *U. S. Nuclear Regulatory Commission*
W. Moore, *Southern California Edison Company (now with Washington Public Power Supply System)*
P. Shen, *Southern California Edison Company (now Director, Joint Center for Graduate Study in Richland, Washington)*
L. Walton, *Babcock and Wilcox Company*
W. Willoughby, *Stone and Webster Corporation**
A. Roberts, *Electric Power Research Institute*

*Members of the working group during the development of the original standard.

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

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

Name of Representative	*Organization Represented*
G. A. Arlotto	*U.S. Nuclear Regulatory Commission*
R. E. Basso	*Catalytic, Inc.*
R. G. Benham	*General Atomic Company*
	(for the Institute of Electrical and Electronics Engineers Inc.)
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*
D. A. Campbell	*Westinghouse Electric Corporation*
C. O. Coffer	*Kaiser Engineers*
L. J. Cooper	*Nebraska Public Power District*
W. H. D'Ardenne	*General Electric Company*
F. X. Gavigan	*U.S. Department of Energy*
C. J. Gill	*Bechtel Power Corporation*
H. J. Green	*Tennessee Valley Authority*
A. R. Kasper	*Combustion Engineering, Inc.*
W. Johnson	*Catalytic, Inc.*
R. W. Keaten	*GPU Services Corporation*
J. W. Lentsch	*Portland General Electric Company*
D. M. Leppke	*Fluor Power Services, Inc.*
J. F. Mallay	*Babcock & Wilcox Company*
	(for the American Nuclear Society)
A. T. Molin	*United Engineers and Constructors*
J. H. Noble	*Chas. T. Main, Inc.*
E. P. O'Donnell	*Ebasco Services, Inc.*
	(for the Atomic Industrial Forum)
T. J. Pashos	*Quadrex/Nuclear Services Corporation*
M. E. Remley	*Rockwell International*
J. Stacey	*Yankee Atomic Electric Company*
S. L. Stamm	*Stone & Webster Engineering Corporation*
J. D. Stevenson	*Structural Mechanics Associates*
	(for the American Society of Civil Engineers)
G. Wagner	*Commonwealth Edison Company*
J. E. Ward	*Sargent and Lundy*
G. L. Wessman	*Torrey Pines Technology*
J. E. Windhorst	*Southern Company Services, Inc.*
	(for the American Society of Mechanical Engineers)
E. R. Wiot	*NUS Corporation*

Contents

Light Water Reactors Fuel Assembly Mechanical Design and Evaluation

1. Scope

This standard establishes a procedure for performing an evaluation of the mechanical design of fuel assemblies for light water-cooled commercial power reactors. It does not address the various aspects of neutronic or thermal-hydraulic performance except where these factors impose loads or constraints on the mechanical design of the fuel assemblies. The standard provides definition of design conditions. It also presents a list of functional requirements representing the general attributes of fuel assemblies. This standard also includes a set of specific requirements for design, various potential performance problems and criteria aimed specifically at averting them.

NOTE: As used in the context of this standard, the term "mechanical" is best typified by the parameter list presented in 5.3

2. Purpose

The purpose of this standard is to establish the following requirements for the mechanical design of initial core or reload fuel assemblies and the evaluation of that design:

(1) A comprehensive set of functional requirements for fuel assemblies.

(2) A procedure whereby the designer is required to select the specific events in each of the four ANS Design Conditions[1].

(3) A comprehensive list of considerations, including material properties, chemical reactions, irradiation effects, and failure modes, which are known to affect the capability of fuel assemblies to satisfy one or more functional requirements.

(4) A procedure whereby the designer is required to 1) define which considerations affect the capability of the fuel assembly to fulfill each functional requirement under each postulated event, and 2) establish an appropriate limit for each of these considerations, the meeting of which ensures that some aspect of a functional requirement for that event is met.

(5) A procedure whereby the designer is required to document that the fuel assembly design has been evaluated in accordance with the limits discussed in 2.4, and has been shown to fulfill each functional requirement for each event.

3. Definitions

This standard includes a number of terms that, while they have several meanings in common usage, have only one meaning within the standard. Therefore, in order to reduce the possibility for misinterpretation of the standard, the following definitions are provided:

designer. The organization that has the responsibility for preparing the fuel assembly design.

event. A describable situation that must be accounted for in design.

fuel assembly. The smallest modular unit comprised of individual fuel rods, and associated integral component parts for handling, control, support, and maintenance of geometry. For boiling water reactors (BWRs), the channel that encloses the fuel bundle is included as part of the fuel assembly for design purposes.

functional requirement. A statement of the necessary capability of a fuel assembly.

limit. A bounding value of a variable or parameter in design, which is established to ensure that one or more aspects of a functional requirement are satisfied.

margin. A quantitative relationship between a design evaluation result for a given event and a limit associated with a functional requirement.

shall, should and may. The word "shall" is used to denote a requirement; the word "should" to denote a recommendation; and the word "may" to denote permission, neither a requirement nor a recommendation.

[1] Appendix A presents the ANS Design Conditions together with a suggested list of events associated with each condition.