American Nuclear Society

WITHDRAWN

April 11, 2017 ANSI/ANS-19.11-1997 (W2017) calculation and measurement of the moderator temperature coefficient of reactivity for water moderated power reactors

an American National Standard

REAFFIRMED

June 17, 2011 ANSI/ANS-19.11-1997 (R2011) 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 This standard may contain outdated material or may have been superseded by another standard.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.



published by the American Nuclear Society 555 North Kensington Avenue La Grange Park, Illinois 60525 USA American National Standard
Calculation and Measurement of the
Modular Temperature Coefficient of Reactivity
for Water Moderated Power Reactors

Secretariat
American Nuclear Society

Prepared by the American Nuclear Society Standards Committee Working Group ANS-19.11

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

Approved September 25, 1997 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 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. Requests for interpretation should be sent to the Standards Department at Society Headquarters. Action will be taken to provide appropriate response in accordance with established procedures that ensure consensus on the interpretation.

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

Copyright © 1997 by American Nuclear Society. All rights reserved.

Any part of this standard may be quoted. Credit lines should read "Extracted from American National Standard ANSI/ANS-19.11-1997 with permission of the publisher, the American Nuclear Society." Reproduction prohibited under copyright convention unless written permission is granted by the American Nuclear Society.

Printed in the United States of America

Foreword

(This Foreword is not a part of American National Standard for the Calculation and Measurement of the Moderator Temperature Coefficient of Reactivity for Water Moderated Power Reactors, ANSI/ANS-19.11-1997.)

It is the intent of this American National Standard to provide guidance and specify criteria for the calculation and measurement of the moderator temperature coefficient of reactivity (MTC) in water moderated power reactors. At present, this standard addresses the calculation and measurement of the MTC only in pressurized water reactors (PWRs), because PWRs are the only type of power reactor currently sited in the United States for which measurement of the MTC is required.

This standard was developed by Working Group ANS-19.11 of the American Nuclear Society. During the period when the standard was prepared, the working group had the active participation of the following members:

- R. D. Mosteller, Chair, Los Alamos National Laboratory
- C. E. Apperson, Jr., Westinghouse Savannah River Company
- S. P. Baker, Public Service Electric & Gas Company
- R. J. Cacciapouti, Yankee Atomic Electric Company
- P. H. Gavin, ABB Combustion Engineering Nuclear Operations
- R. A. Hall, Virginia Power Company
- J. L. Judd, Idaho National Engineering Laboratory
- C. F. Karlson, Arizona Public Service Company
- L. I. Kopp, U. S. Nuclear Regulatory Commission
- D. B. Lancaster, TRW Environmental Safety Systems, Inc.
- J. D. Luoma, GPU Nuclear Corporation
- R. G. McAndrew, Virginia Power Company
- B. M. Moore, Washington Public Power Supply System
- L. D. Noble, GE Nuclear Energy
- S. T. Robertson, B&W Nuclear Technologies
- S. Yang, Commonwealth Edison Company
- E. H. Young, Commonwealth Edison Company

The membership of Subcommittee ANS-19 at the time of its approval of this standard was:

- D. M. Cokinos, Chairman, Brookhaven National Laboratory
- C. T. Rombough, Secretary, CTR Technical Services, Inc.
- S. Baker, Public Service Electric & Gas Company
- M. C. Brady, Sandia National Laboratories
- R. J. Cacciapouti, Yankee Atomic Electric Company
- A. L. Casadei, Westinghouse CNFD
- D. J. Diamond, Brookhaven National Laboratory
- T. R. England, Los Alamos National Laboratory
- D. R. Harris, Jr., Rensselaer Polytechnic Institute
- P. B. Hemmig, U.S. Department of Energy
- A. I. Jonsson, ABB / Combustion Engineering
- J. Katakura, Japan Atomic Energy Research Institute
- L. Lois, U.S. Nuclear Regulatory Commission
- A. F. McFarlane, Westinghouse Savannah River Company
- R. D. Mosteller, Los Alamos National Laboratory
- L. D. Noble, General Electric
- S. N. Purohit, Individual
- R. B. Rothrock, Oak Ridge National Laboratory
- M. Salvatores, CEA-Cadarache DRP/SPRC
- R. E. Schenter, Westinghouse Hanford Company
- E. L. H. Tang, Westinghouse Hanford Company
- A. Weitzberg, Halliburton NUS Corporation
- W. Wilson, Los Alamos National Laboratory
- H. H. Windsor, ABB / Combustion Engineering

Consensus Committee N17, Research Reactors, Reactor Physics, Radiation Shielding, and Computational Methods, had the following membership at the time it reviewed and approved this standard:

T. M. Raby, Chairman

A. Weitzberg, Secretary

A. D. Callihan
R. E. Carter
D. Cokinos Brookhaven National Laboratory
A. De La Paz
B. Dodd
D. Duffey
W. A. Holt
W. C. Hopkins Bechtel Corporation
L. I. Kopp
J. Miller Institute of Electrical and Electronics Engineers, Inc.
J. E. Olhoeft
T. M. Raby
W. J. Richards
T. R. Schmidt Sandia National Laboratories
R. L. Seale
A. O. Smetana Westinghouse Savannah River Company
J. F. Torrence
D. K. Trubey Individual
S. H. Weiss
A. Adams, Jr. (Alt.)
A. Weitzberg
W. L. Whittemore

Contents	Section	Page
	1. Introduction	1
	2. Scope	1
	3. Definitions 3.1 Limitations 3.2 Glossary	2
	4. Moderator Temperature and Reactivity 4.1 Moderator Temperature 4.2 Moderator Temperature Coefficient of Reactivity	3
	5. Calculation of the Moderator Temperature Coefficient of Reactivity 5.1 Numerics and Convergence 5.2 Zero Power Calculation 5.3 At-Power Calculation	4
	6. Measurement of the Moderator Temperature Coefficient of Reactivity at Power 6.1 Measurement Techniques for PWRs 6.2 Extrapolation	6
	7. Documentation	16
	8. References	17