American Nuclear Society

WITHDRAWN

August 28, 2013

ANSI/ANS-6.1.2-1999 (R2009)
(W2013)

neutron and gamma-ray cross sections for nuclear radiation protection calculations for nuclear power 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 This standard may contain outdated material or may have been superseded by another standard.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.

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

ANSI/ANS-6.1.2-1999 (R2009)

American National Standard
Neutron and Gamma-Ray Cross Sections for Nuclear Radiation Protection Calculations for Nuclear Power Plants

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-6.1.2

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

Approved February 11, 1999
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

Printed in the United States of America

Foreword

(This Foreword is not a part of American National Standard Neutron and Gamma-Ray Cross Sections for Nuclear Radiation Protection Calculations for Nuclear Power Plants, ANSI/ANS-6.1.2-1999.)

A need for computer-readable standard reference neutron and gamma-ray cross section data was identified by American Nuclear Society Standards Subcommittee ANS-6 in 1975. These cross sections are required for materials and energy ranges of importance in nuclear radiation protection and shielding calculations for nuclear power plants. It was observed at that time that data sets not meeting high standards of documentation and verification were becoming *de facto* standards.

This standard provides guidance in the preparation and verification of neutron and gamma-ray cross section sets and identifies several sets of standard reference data which meet the procedures specified. The identification of standard neutron and gamma-ray data is expected to improve the efficiency of shielding and radiation protection computations by reducing redundant validating and processing operations by each user. In addition, shielding computations are expected to become more accurate as a result of the focusing of effort on the development and testing of nuclear data to be used as a standard. A coupled neutron-gamma multigroup cross section set, referred to as BUGLE, was developed and tested for this purpose. A revised data set, BUGLE-80, was developed in 1980 on the basis of the BUGLE test results, and the BUGLE-80 data set was identified as meeting the requirements of the standard. The BUGLE-80 data set uses a multigroup energy structure which permits useful shielding and radiation protection calculations. A more detailed coupled neutron-gamma multigroup data set, VITAMIN-C, also was identified as meeting the requirements of the standard. The SAILOR cross section set was added to the standard in 1987-88.

The present edition of this standard cites the BUGLE-96 broad-group cross section library as the recommended set, replacing both the BUGLE-80 and SAILOR sets. The more detailed VITAMIN-B6 set is also cited as a replacement for the VITAMIN-C set. Both are based on the most recent version of the evaluated cross-section library, ENDF/B-VI, Release 3. ENDF/B-VI contains numerous significant changes to available nuclear data relative to earlier versions of ENDF/B. Improved experimental data and model predictions are included and several format changes were made to provide for better representation of the underlying physics and the extension to higher energies.

This standard is related to American National Standard Nuclear Data Sets for Reactor Design Calculations, ANSI/ANS-19.1-1989. The scope of that standard includes data of importance for reactor core design, while ANS-6.1.2 covers radiation transport and shielding applications, especially for nuclear power plants.

This standard is intended to prescribe recommended practices. The data sets identified are those a novice may use with some confidence and should be seriously considered by the expert. The expert might be expected to provide strong reasons why he did not use the reference sets if he selects other data. The working group was unanimous in its decision to recommend specific data sets.

The membership of Working Group ANS-6.1.2 at the time it prepared this standard was:

D. R. Harris, Chairman, *Rensselaer Polytechnic Institute*
S. Anderson, *Westinghouse Electric Corporation*
J. Carew, *Brookhaven National Laboratory*
G. Cavanaugh, *Ryker Associates*
J. Helm, *Columbia University*
D. Ingersoll, *Oak Ridge National Laboratory*
R. W. Roussin, *Radiation Safety Information Computational Center, Oak Ridge National Laboratory*
W. Urban, *Los Alamos National Laboratory*
J. E. White, *Radiation Safety Information Computational Center, Oak Ridge National Laboratory*
M. Williams, *Louisiana State University*

Subcommittee ANS-6 had the following membership at the time of its approval of this standard:

W. C. Hopkins, Chair, *Bechtel Corporation*
D. R. Harris, *Rensselaer Polytechnic Institute*
J. Kamphouse, *Individual*
D. Kaul, *Science Applications International Corporation*
R. Klann, *Argonne National Laboratory*
D. K. Trubey, *Individual*
N. Tsoulfanidis, *University of Missouri-Rolla*
R. M. Westfall, *Oak Ridge National Laboratory*

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

T. M. Raby, Chairman
A. Weitzberg, Secretary

A. D. Callihan ..... Individual
R. E. Carter ..... Individual
D. Cokinos ..... Brookhaven National Laboratory
A. De La Paz ..... Vista Technologies
B. Dodd ..... Health Physics Society
D. Duffey ..... American Institute of Chemical Engineers
W. A. Holt ..... American Public Health Association
W. C. Hopkins ..... Bechtel Corporation
L. I. Kopp ..... Individual
J. Miller ..... Institute of Electrical and Electronics Engineers, Inc.
J. E. Olhoeft ..... Individual
T. M. Raby ..... American Nuclear Society
W. J. Richards ..... U. S. Department of Defense
T. Schmidt ..... Sandia National Laboratory
R. Seale ..... University of Arizona
A. Smetana ..... Westinghouse Savanna River Company
J. F. Torrence ..... National Institute of Standards and Technology
D. K. Trubey ..... Individual
S. H. Weiss ..... U. S. Nuclear Regulatory Commission
A. Weitzberg ..... Scientech
W. L. Whittemore ..... Sorrento Electronics

Contents