

American Nuclear Society

WITHDRAWN

**the determination of neutron reaction rate
distributions and reactivity of nuclear reactors**

an American National Standard



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**American National Standard
for The Determination of Neutron Reaction Rate
Distributions and Reactivity of Nuclear Reactors**

**Secretariat
American Nuclear Society**

**Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-19.3**

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American National Standard

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Foreword

(This Foreword is not a part of American National Standard for The Determination of Neutron Reaction Rate Distributions and Reactivity of Nuclear Reactors, ANSI/ANS-19.3-1983.)

It is the intent of this American National Standard to provide guidance for performing and validating the sequence of calculations leading to prediction of reaction rate spatial distributions and reactivity of nuclear reactors, and to provide guidelines by which the adequacy of design calculations may be demonstrated. This standard recognizes the diversity of the calculational procedures employed in reactor design. Consequently, the major thrust of this standard is in the areas of verification and documentation. The standard is intended to cover reactor physics calculations for the entire nuclear industry, from fast to thermal reactors and from research to power reactors. Since many different kinds of calculations are performed, each having its own requirement for accuracy and verification, it is necessary that this standard be of a general nature.

Compliance with the intent of this standard can be demonstrated for an intended area of applicability of the calculational system used by meeting the following requirements:

Selection of Models and Methods

a. Consideration of all conditions of reactor composition, temperature, and configuration which significantly affect the calculated quantities and justification of the resultant model approximations.

b. Preparation of multi-group constants, if employed, in conformance with American National Standard Nuclear Data Sets for Reactor Design Calculations, ANSI/ANS-19.1-1983, by using an application dependent energy spectrum estimate.

c. Justification of geometric and neutronic transport approximations utilized in the spectrum calculation.

d. Inclusion of all important space and energy effects in the calculation utilized for the generation of few group cross sections, if few group cross sections are employed.

e. Demonstration of capability, as required by the application, to retrieve required neutron reaction rates in the physical reactor components from the computations, and to justify any assumptions that need to be made in order to perform this retrieval.

f. Justification of the spectrum calculation interval used in burnup calculations, and justification that the numerical integration time step is sufficiently small to ensure numerical stability and accuracy appropriate to the application.

Calculational System Verification

Establishment of degree of agreement over a limited area of applicability by correlating experimental results or results of calculations using a more accurate model with results obtained by the system being verified.

Evaluation of Accuracy

Evaluation of accuracy and range of applicability of data and methods by establishment of biases and uncertainties, with degree of confidence, for the calculations that include allowance for uncertainties in the comparison data.

Documentation

Documentation of details of the above procedures.

It is the intent of this standard to require the individual to: (1) give careful consideration to those physical and numerical effects that may contribute to the validity of his results; (2) document the reasons for his choice of calculational path, and; (3) verify the calculational system used over the intended range of applicability by testing it against appropriate experiments or more rigorous calculations.

The requirement for documentation is a crucial part of this standard and will provide an auditable path. In those instances where the foregoing documentation is proprietary in nature, documentation edited by excluding the proprietary information shall be prepared and be publicly available or available on request. Areas omitted due to proprietary consideration shall be noted where possible. The standard would not require all documentation to be made public, and thus by implication acknowledges the existence of proprietary documentation.

The most important ways in which this revision differs from its earlier version, N412-1975/ANS-19.3, are as follows:

- Reactor depletion (or burnup) calculations have now been included, since this is a natural extension of reaction rate calculations.
- A section on common practice for PWR, BWR, and LMFBR reactors has been added.
- Terminology has been somewhat modified to be in closer agreement with that used in ANSI/ANS-19.1-1983.

This standard for reactor physics calculations will undergo review and revision within five years. Suggestions for the improvement of this standard will be welcome. They should be sent to the American Nuclear Society, 555 North Kensington, La Grange Park, Ill. 60525.

This standard was developed and later revised by Working Group ANS-19.3 of the American Nuclear Society which had the participation of the following members during the period it last revised and approved the standard:

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