American Nuclear Society

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the determination of thermal energy deposition rates in nuclear reactors

an American National Standard

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Secretariat
American Nuclear Society

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Working Group ANS-19.3.4

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Foreword

(This Foreword is not a part of American National Standard for the Determination of Thermal Energy Deposition Rates in Nuclear Reactors, ANSI/ANS-19.3.4-2002 [formerly N676-1976].)

It is the intent of this American National Standard to provide guidance for performing and validating the sequence of calculations leading to prediction of thermal energy deposition rates in 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 thermal energy deposition calculations for the entire nuclear industry—from fast to thermal reactors, 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:

(1) *Source Distribution*. Neutron reaction rate distributions and photon and beta particle emitter distributions are to be obtained from calculations made in accordance with American National Standard "The Determination of Neutron Reaction Rate Distributions and Reactivity of Nuclear Reactors," ANSI/ANS-19.3-1995, or similar applicable standard. Data are to be found in accordance with American National Standard "Nuclear Data Sets for Reactor Design Calculations," ANSI/ANS-19.1-1983 (R1989), or equivalent standard.
(2) *Selection of Models and Methods*. All phenomena listed in Table 1 are to be considered, and their treatment justified. Use of any approximation and application not explicitly permitted in Table 2 is to be justified. Acceptable justification may be degree of rigor, conservatism, or increased margin incorporated in design.
(3) *Verification*. The method of analysis is to be verified against experiments or more rigorous and well-established analytical methods.
(4) *Evaluation of Accuracy*. Accuracy and range of applicability of data and methods are to be evaluated by establishment of biases and uncertainties, with degree of confidence, for the calculations including allowance for uncertainties in the comparison data.
(5) *Documentation*. Details of the above procedures are to be documented.

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 the results, (2) document the reasons for the choice of calculational path, and (3) verify the calculational system used over the intended range of applicability by testing it against appropriate experiments and 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.

This standard, ANS-19.3.4, as revised, was first approved in 1976. It was reaffirmed in 1983 and again in 1989. This revision now provides better guidance for

the CANDU Reactor, and these changes are mostly reflected in Table 2. There are some minor changes for clarification. Suggestions for improvement should be sent to the American Nuclear Society, 555 N. Kensington Ave., La Grange Park, IL 60526.

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