

Status and Plans for ANS Standard 19.1

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Abstract

ANSI/ANS-19.1, “Nuclear Data Sets for Reactor Design Calculations,” is one of a series of Reactor Physics standards developed by the American Nuclear Society. The standard identifies and describes the specifications for developing, preparing, and documenting nuclear data sets to be used in reactor design calculations. ANS-19.1 was first published in 1983. It has been revised or reaffirmed several times since then. The most current version was approved in 2002 (ANSI/ANS-19.1-2002) and issued in 2004. This paper will briefly summarize the scope, purpose, history and contents of the standard. The status of an ongoing effort to revise the standard will be described, including the process, schedule, and opportunities for input. Areas currently being emphasized during the course of the revision will be highlighted.

KEYWORDS: *Standards, Nuclear Data, Cross Sections, Reactor Design, Reactor Physics*

1. Introduction

ANSI/ANS-19.1, “Nuclear Data Sets for Reactor Design Calculations,” is one of a series of Reactor Physics standards developed by the American Nuclear Society. [1] This paper will briefly summarize the scope, purpose, history and contents of the standard. The status of an ongoing effort to revise the standard will be described, including the process, schedule, and opportunities for input. Areas currently being emphasized during the course of the revision will be highlighted.

Section 2 of the paper will provide an overview of ANS-19 standards and a brief history of ANS-19.1. Section 3 will detail the current contents of ANS-19.1. In Section 4, the plans and status of an ongoing revision to the standard will be described. Section 5 summarizes the paper.

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2. Background

Standards Subcommittee ANS-19 of the American Nuclear Society has responsibility for developing consensus standards in the area of Reactor Physics. There are currently five active standards maintained and updated by ANS-19, and several others under development.

The intent of ANS-19.1 is to present specifications for the preparation of nuclear data sets for use in reactor physics computer programs employed in the design of nuclear reactors and to specify certain data sets as standards. It is a fundamental Reactor Physics standard, which is built upon by other standards that describe various reactor physics applications.

ANS-19.1 was first published in 1983. It has been revised or reaffirmed several times since then. The most current version was approved in 2002 (ANSI/ANS-19.1-2002) and issued in 2004. The chairman of Working Group ANS-19.1 at the time of this revision was Donald R. Harris.

3. Contents of Standard

The current standard contains a foreword, seven sections and an appendix. The foreword and appendix are not part of the official standard. A summary of the contents of each section found in the current standard will now be provided.

3.1 Foreword

The foreword summarizes the objective and contents of the standard. It indicates that while the intended use of the standard is for nuclear data in reactor core calculations, that there may be utility in other applications. The foreword concludes by reviewing the process and membership of the various working groups and committees responsible for the standard's content, processing, and approval.

3.2 Section 1 - Scope

Section 1 defines the scope of the standard, namely that ANS-19.1 identifies and describes the specifications for developing, preparing, and documenting nuclear data sets to be used in reactor design calculations.

Specific types of data sets considered to be within the scope of ANS-19.1 are evaluated nuclear data sets, processed continuous data, and processed averaged data. Averaged data are defined within the standard to be multigroup in nature, but applicable to a wide range of reactor analyses. Excluded from the scope of ANS-19.1 are experimental techniques for measurement of nuclear data and the development of nuclear model theory. Also excluded are few-group collapsed data sets, which have the distinguishing feature of being application dependent. Such data sets are covered in ANSI/ANS-19.3, "Determination of Steady-State Neutron Reaction-Rate

Distributions and Reactivity of Nuclear Power Reactors.” [2]

Within the scope, the standard indicates that specifications will be provided as follows:

- Criteria for acceptance of evaluated nuclear data sets
- Criteria for processing evaluated data and preparation of processed continuous data and averaged data sets
- Identification of specific evaluated, processed continuous and averaged data sets that meet these criteria for specific reactor types.

3.3 Section 2 - Definitions

Section 2 of ANS-19.1 provides definitions for several key terms and concepts. Among the terms defined are evaluated data set, processing code, processed continuous data set, averaged data set, benchmark, and standard data set.

3.4 Section 3 - Evaluated Data Sets

Section 3 of ANS-19.1 focuses on evaluated data sets. Specifications and requirements for evaluated data sets are provided, including data sources, evaluation content and procedures, data uncertainties, verification, testing, and documentation.

Data sources to be used in evaluations are experimental reaction and structure data and nuclear model codes. The standard mandates that evaluated data be represented in a well-defined and documented format, with the ENDF format provided as an example. [3]

Criteria for acceptable evaluation content are provided for incident neutrons in various energy regions (resonance, continuum, and thermal). The standard indicates that evaluated data should contain a covariance file.

Specifications for qualification of the evaluated data are provided, in the categories of clerical and numerical accuracy, internal and physical consistency, consistency with data sources, and completeness of the data. Documentation requirements are also provided in this section.

3.5 Section 4 - Processed Continuous Data Sets

Section 4 describes processed continuous data sets.

Processed continuous data sets are derived from evaluated data sets described in the previous section. They are continuous in incident energy, emission energy, and emission angle. They are created by use of a processing program.

Processed continuous sets are intended for use either directly in continuous-energy Monte Carlo codes, or as input for further processing, e.g., to a multigroup processing code.

The standard describes the contents of continuous data sets, accuracy requirements, and checking requirements. There is a discussion of validation of the continuous data sets by performing calculations on physical configurations and benchmark experiments that are appropriate to reactor design applications. Finally, documentation requirements are specified.

3.6 Section 5 - Averaged Data Sets

Section 5 provides guidance on processed averaged data sets. Once again, requirements associated with the preparation, checking, testing, and documentation of these processed data

sets are included in ANS-19.1.

An averaged data set is derived by a processing code from either an evaluated data set or a processed continuous data set. It consists of group parameters on a specified energy structure, and requires that a weight function be used in the averaging process. Averaged data sets may be used either directly in reactor calculations or as a starting point for the creation of few-group, application-dependent data sets. An averaged data set is expected to be independent of reactor type, composition, geometry, and spectrum.

Data types to be included on the averaged data sets are described in the standard, including information that may be required to create application-dependent, few-group data sets, such as resonance parameters, background cross sections, and self-shielding factors. Requirements for the weighting function, energy grid, accuracy, checking, validation, and documentation are specified.

3.7 Section 6 - Data Sets Meeting the Specifications of this Standard

Section 6 identifies data sets meeting the specifications of the standard. The current version of ANS-19.1 identifies ENDF/B-VI as a standard evaluated data set. [4] Two MCNP cross-section libraries (ENDF60 and MCPLIB02) are identified as standard processed continuous data sets. [5-6] The current standard does not identify any standard averaged data sets.

3.8 Section 7 - References

Section 7 of ANS-19.1 provides references to other relevant standards, to nuclear data publications, and to selected computer codes.

3.9 Appendix

The Appendix of ANS-19.1 includes references for evaluated nuclear data sets other than ENDF/B-VI. This information is provided for information only; these other evaluations are not defined as standards.

4. Plans for Revision

All ANSI/ANS standards must be reviewed on a regular basis and either reaffirmed, revised or withdrawn. The four authors of this paper make up the initial Working Group to do just that for ANS-19.1. A decision has been made by the Working Group to pursue a revision to ANS-19.1 at this time. Our objective is to have an initial draft revision for ANS-19 to consider by late 2006 or early 2007, with an approved revision in place by 2008.

Our plans are to include relatively substantial updates for the revision. Our focus is currently in the following six areas:

- We hope to simplify the document by eliminating sentences or paragraphs that do not add value.
- We plan to reduce or eliminate the focus on ENDF as the “only” source of evaluated data discussed in the body of the standard by including other international evaluation

efforts.

- We intend not to include any recommended data sets within the body of the standard, although we might consider providing examples of sets that could be considered as meeting the standard in an appendix.
- The new standard will likely have increased emphasis on the importance of providing cross-section covariances in evaluated files.
- We need to address some inconsistencies in the current standard with respect to “application-independent” and “application-dependent” multigroup data.
- Advances in methods, techniques, and technology over the past decade need to be accounted for in the standard.

We plan a first iteration on the revision with a relatively small Working Group. However, before submitting a proposed revision to ANS-19 for review, we would like to expand the Working Group to include a much broader representation of members, with additional expertise in nuclear data and reactor design. Please contact any author to indicate interest in contributing to the revision of ANS-19.1, or to submit comments or questions.

Eventually, the Working Group will reach a consensus and submit a proposed revision to ANS-19. Comments from ANS-19 will be addressed until that body approves the revision. Then, the revision will be reviewed by the N17 Consensus Committee (Research Reactors, Reactor Physics, Radiation Shielding, and Computational Methods) before ultimate submittal to ANSI.

5. Summary

In summary, ANSI/ANS-19.1-2002 provides a valuable resource for the community by presenting specifications for the preparation of nuclear data sets for use in reactor physics computer programs employed in the design of nuclear reactors. We plan to incorporate revisions that preserve the strengths of the current standard while updating other aspects of the standard that may require adaptation to new realities of the 21st century.

References

- 1) American National Standard, “Nuclear Data Sets for Reactor Design Calculations,” ANSI/ANS-19.1-2002.
- 2) American National Standard, “Determination of Steady-State Neutron Reaction-Rate Distributions and Reactivity of Nuclear Power Reactors,” ANSI/ANS-19.3-2005.
- 3) M. Herman, Ed., “ENDF6 Formats Manual, Data Formats and Procedures for the Evaluated Nuclear Data File ENDF/B-VI and ENDF/B-VII,” BNL-NCS-44945-05-Rev. (ENDF-102), National Nuclear Data Center, Brookhaven National Laboratory (2005).
- 4) V. McLane, Ed., “ENDF/B-VI Summary Documentation,” BNL-NCS-17541 4th Edition (ENDF/B-VI) Supplement 1 (ENDF-201), National Nuclear Data Center, Brookhaven National Laboratory (1996).
- 5) X-5 Monte Carlo Team, “MCNP - A General Monte Carlo N-Particle Transport Code, Version 5,” Los Alamos

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