American Nuclear Society

REAFFIRMED

October 11, 2007

ANSI/ANS-1-2000 (R2007)

conduct of critical experiments

an American National Standard

REAFFIRMED

October 5, 2012

ANSI/ANS-1-2000 (R2012)

This standard has been reviewed and reaffirmed with the recognition that it may reference other standards and documents that may have been superseded or withdrawn. The requirements of this document will be met by using the version of the standards and documents referenced herein. It is the responsibility of the user to review each of the references and to determine whether the use of the original references or more recent versions is appropriate for the facility. Variations from the standards and documents referenced in this standard should be evaluated and documented.
This standard does not necessarily reflect recent industry initiatives for risk informed decision-making or a graded approach to quality assurance. Users should consider the use of these industry initiatives in the application of this standard.

ANSI/ANS-1-2000

published by the

American Nuclear Society

555 North Kensington Avenue

La Grange Park, Illinois 60526 USA

ANSI/ANS-1-2000

American National Standard for Conduct of Critical Experiments

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-1

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

Approved March 23, 2000
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 for Conduct of Critical Experiments, ANSI/ANS-1-2000.)

Critical experiments are an essential part of nuclear research and development. They yield information valuable for the design of nuclear reactors, for the specification of processes and operations with fissionable materials, and for furthering fundamental scientific knowledge.

Because of this diversity of purpose and the exploratory nature of critical experiments, their conduct differs from routine reactor operation. In many cases, for example, it is not possible to predetermine the exact value of operational controls or of shutdown devices, for to obtain the required information is the purpose of the experiment. Good practice dictates a minimum of perturbations extraneous to the equipment necessary to the objective of the experiment. Accordingly, assemblies for this purpose are operated remotely behind shielding, and are often equipped with control and safety devices quite different from those in reactors designed to produce power. The information demanded from critical experiments requires great latitude in both the equipment and the operational practices, to allow the necessarily frequent and often extensive changes in the assembly configuration.

These characteristics result in a higher probability of an accidental nuclear excursion than could be tolerated for reactors. This greater probability is made acceptable by the absence of the large fission-product inventory and large internal energy that characterize reactors which have produced power; effective radiation protection therefore can be provided in a properly designed facility by adherence to simple operating rules.

This standard contains nuclear safety criteria and practices that have evolved and have been tested during half a century of critical experimentation. It was initially prepared by Subcommittee ANS-1, Performance of Critical Experiments, of the American Nuclear Society Standards Committee, and was approved by the Subcommittee on November 1, 1966. On August 18, 1967, the document was certified by the Board of Directors of the Society as ANS-STD.1-1967.

A revision of ANS-STD. 1-1967 was prepared by Subcommittee ANS-1 on July 6, 1971, and was certified by the Society as ANS-STD.1-1972 on September 19, 1972. The membership of the subcommittee which prepared that revision was:

A. D. Callihan, Chairman, *Union Carbide Corporation, Nuclear Division*
E. B. Johnson, Secretary, *Union Carbide Corporation, Nuclear Division*
E. D. Clayton, *Battelle Pacific Northwest Laboratories*
D. F. Hanlen, *Westinghouse Electric Corporation, Atomic Power Division*
R. G. Luce, *General Electric Company, Knolls Atomic Power Laboratory*
E. I. Nowstrup, *U.S. Atomic Energy Commission*
H. C. Paxton, *Los Alamos Scientific Laboratory*
G. A. Price, *Brookhaven National Laboratory*
W. C. Redman, *Argonne National Laboratory*
N. L. Snidow, *Babcock and Wilcox Company*

The stature of, and the breadth of interest in, this standard were increased on April 29, 1975, when it was approved as an American National Standard by the American National Standards Institute, Inc. The designation then was ANSI N405-1975.

The content of N405-1975 was reaffirmed October 21, 1981, and the standard was revised in 1986, with consensus being achieved on November 7. The membership of the ad hoc group performing those actions was:

E. D. Clayton, *Battelle Pacific Northwest Laboratories*
E. B. Johnson, *Oak Ridge National Laboratory*
D. W. Magnuson, *Individual*
H. C. Paxton, *Individual*
A. D. Callihan, *Individual*

That version included textual modifications solely for the purpose of updating references and of recounting procedural matters necessary to the action. The technical content was in no way altered.

The standard was again revised in 1998 with consensus achieved on August 27, 1999. The membership of the working group responsible for the revision is:

R. L. Seale, Chair, *University of Arizona*
R. D. Busch, *University of New Mexico*
R. A. Knief, *XE Corporation*
T. P. McLaughlin, *Los Alamos National Laboratory*
R. Paternoster, *Los Alamos National Laboratory*
S. S. Payne, *U. S. Department of Energy*
J. S. Philbin, *Sandia National Laboratories*
T. R. Schmidt, *Sandia National Laboratories*

Consensus Committee N17, Research Reactors, Radiation Physics and Radiation Shielding, had the following membership at the time of its approval of this standard:

Tawfik M. Raby, Chair
Shawn Coyne-Nalbach, Secretary

A. D. Callihan	Individual
R. E. Carter	E.G. & G.
D. Cokinos	Brookhaven National Laboratories
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. B. Marsh	U.S. Nuclear Regulatory Commission
J. Miller	Institute of Electrical and Electronics Engineers
J. E. Olhoeft	Individual
T. M. Raby	American Nuclear Society
W. J. Richards	U.S. Department of Defense
R. Seale	American Nuclear Society
T. Schmidt	Sandia National Laboratories
A. Smetana	Savannah River Laboratory
J. F. Torrence	National Institute of Standards Technology

Contents

Conduct of Critical Experiments

1. Scope

This standard provides for the safe conduct of critical experiments. Such experiments study neutron behavior in a fission device where the energy produced is insufficient to require auxiliary cooling, and the power history is such that the inventory of long-lived fission products is insignificant.

2. Definitions

2.1 Limitations. The definitions given below are restrictive for the purposes of this standard. Other specialized terms are defined in the *Glossary of Terms in Nuclear Science and Technology* [1][1] or have definitions accepted by usage.

2.2 Shall, Should, and May. The word "shall" is used to denote a requirement, the word "should" to denote a recommendation, and the word "may" to denote permission, neither a requirement nor a recommendation. To conform with this standard, all operations shall be performed in accordance with its requirements, but not necessarily with its recommendations.

2.3 Glossary of Terms

assembly area. A region in the vicinity of a critical assembly where personnel would have inadequate protection from radiation associated with a criticality accident.

assembly shutdown. The state of the assembly when it is subcritical by at least one dollar.

critical assembly (assembly). A device or physical system for performing critical experiments. In a critical assembly, the energy produced by fission is insufficient to require auxiliary cooling, and the power history is such that the inventory of long-lived fission products is insignificant.

critical experiment (experiment). An experiment or series of experiments performed with a fissionable material configuration which may be at or near critical. The principal purpose of the experiment is the study of neutron behavior within the critical assembly.

[1]Numbers in brackets refer to corresponding numbers in Section 6, References.

critical facility. All areas directly associated with operation of one or more critical assemblies.

criticality accident. The release of energy as a result of accidentally producing a self-sustaining or divergent fission chain reaction.

management. The administrative body to which the supervision of a critical facility reports.

neutron source. Any material, combination of materials, or device that emits neutrons, including materials undergoing fission.

remote operation. Planned reactivity additions to a critical assembly with no personnel in the assembly area.

safety device. A mechanism designed to reduce the reactivity of a critical assembly.

scram. A rapid reduction of reactivity for shutting down the assembly.

3. Administrative Practices

3.1 Management shall assign responsibility and commensurate authority for the safe operation of critical experiments unambiguously and singularly through the line organization.

3.2 Written general operational restrictions for each critical facility, based on a safety assessment and consideration of characteristics including shielding and confinement, shall be approved by management and the cognizant regulating authority. Criteria for the safety assessment may be derived from American National Standard for Format and Content of Safety Analysis Reports for Research Reactors, ANSI/ANS-15.21-1996 [2]. Criteria for operational restrictions may be derived from American National Standard for Development of Technical Specifications for Research Reactors, ANSI/ANS-15.1-1990 [3].

3.3 Each new program of experiments shall be documented, independently reviewed, and approved in a manner established by management.

3.4 Operations personnel shall be trained to ensure that they are capable of performing their assigned work. Continuing training shall be pro-