American Nuclear Society

REAFFIRMED

December 8, 2006
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(R2006)

nuclear criticality safety based on limiting and controlling moderators

an American National Standard

REAFFIRMED

November 11, 2011
ANSI/ANS-8.22-1997
(R2011)

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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.

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American National Standard for Nuclear Criticality Safety Based on Limiting and Controlling Moderators

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-8.22

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by the
American National Standards Institute, Inc.

American National Standard

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Foreword

(This Foreword is not a part of American National Standard for Nuclear Criticality Safety Based on Limiting and Controlling Moderators, ANSI/ANS-8.22-1997.)

This standard has been in the draft stage for more than two decades with several different chairmen and several different working groups. The continuing effort over many years illustrates the consistent desire for a standard for moderation control. Diversity in the individuals in the working group and diversity in the organizations that the individuals represent have made this standard a tool that can be used throughout the complex. The interest in this standard is consistently demonstrated by the large attendance at the working group meetings and by the large membership of the current Working Group ANS-8.22. Many ideas have been brought before the working group ranging from publication of definitive limits to a standard for general guidance specific to limiting and controlling moderators.

This new standard was prepared by Working Group ANS-8.22 of Subcommittee 8 of the Standards Committee of the American Nuclear Society. This working group was composed of:

J. S. Bullington, Chairman, *Westinghouse Safety Management Solutions*
J. J. Bazley, *Parallax, Inc.*
G. H. Bidinger, *Individual*
C. L. Brown, *Individual*
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Working Group ANS-8.22 specifically recognizes R. L. Oxenham for his efforts in preparation of this standard. This standard is dedicated in his memory.

The Membership of Subcommittee ANS-8 at the time of this standard's initial vote was:

T. P. Mclaughlin, Chairman, *Los Alamos National Laboratory*
J. A. Schlesser, Secretary, *Los Alamos National Laboratory*
F. M. Alcorn, *Babcock & Wilcox Company*
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Consensus Committee N16, Nuclear Criticality Safety, had the following membership at the time of its approval of this standard:

D. R. Smith, Chairman
R. A. Knief, Vice-Chairman

G. H. Bidinger ..... Individual
R. D. Busch ..... University of New Mexico
S. P. Congdon ..... GE Nuclear Energy
H. L. Dodds, Jr. ..... University of Tennessee
R. A. Knief ..... Ogden Environmental and Energy Services
J. R. LaRiviere ..... American Institute of Chemical Engineers
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Contents

Nuclear Criticality Safety Based on Limiting and Controlling Moderators

1. Introduction

Guidance for the prevention of criticality accidents in the handling, storing, processing, and transporting of fissionable materials is presented in American National Standard for Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors, ANSI/ANS-8.1-1983 (R1988) [1][1].

For many operations, criticality safety is achieved through the limitation of parameters such as geometry, mass, enrichment, and spacing of fissile materials. The amount of fissile material that can be safely handled, stored, or processed at one time can also depend on the credible range of neutron moderation. Optimum moderation, by definition, results in the lowest critical mass of fissile materials, other conditions being unchanged. An allowable mass significantly greater than the allowable mass at optimum moderation can be justified by limitation and control of moderators, i.e., control of moderators within specified limits.

This standard provides guidance for criticality safety by the limitation and control of moderators in the range from no moderation to optimum moderation for fissile materials.

2. Scope

This standard applies to limiting and controlling moderators to achieve criticality safety in operations with fissile materials in a moderator control area. This standard does not apply to concentration control of fissile materials.

3. Definitions

3.1 Limitations. The definitions given in this standard are of a restricted nature for the purposes of this standard. Other specialized terms are defined in the American Nuclear Society publication *Glossary of Terms in Nuclear Science and Technology* [2].

3.2 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.

3.3 Glossary of Terms

moderation. The process of decreasing the energy of neutrons through successive collisions with moderator nuclei without appreciable competing capture.

moderator. A material that reduces neutron energy by scattering without appreciable capture. Materials of prime concern are those containing light nuclei with large scattering cross sections and relatively low absorption cross sections.[2]

moderator control area. An area defined by the process evaluation in which moderators are limited and controlled for nuclear criticality safety.

moderator control engineered barrier. A physical feature of a system specifically identified and used to limit or control the introduction of moderators for nuclear criticality safety.[3]

process evaluation. A document that identifies and defines all known criticality safety concerns; documents criticality safety assumptions, requirements, limits, and controls; and demonstrates subcriticality. The process evaluation is often referred to as a Nuclear Criticality Safety Evaluation (NCSE).

4. Nuclear Criticality Safety Practices

4.1 Administrative Practices for Limitation and Control of Moderators

4.1.1. Written procedures shall include the nuclear criticality safety limits and controls for operation. These procedures should address any steps to be taken if a moderator control fails.

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

[2] Examples of typical moderators are provided in Appendix A.

[3] Examples of typical moderator control engineered barriers are provided in Appendix D.