

American Nuclear Society

REAFFIRMED

**December 8, 2006
ANSI/ANS-8.22-1997
(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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REAFFIRMED

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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**

Published by the
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Approved October 31, 1997
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:

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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:

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This is a preview of "ANSI/ANS-8.22-1997 (...". [Click here to purchase the full version from the ANSI store.](#)



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.

² Examples of typical moderators are provided in Appendix A.

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

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