American Nuclear Society

REAFFIRMED

October 25, 2017
ANSI/ANS-8.3-1997 (R2017)
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criticality accident alarm system

an American National Standard

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reviewed and reaffirmed with the recognition that it may reference other standards and documents that may have been superseded or withdrawn.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.

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Criticality Accident Alarm System

Secretariat
American Nuclear Society

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American National Standard

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Comments on this standard are encouraged and should be sent to Society Headquarters.

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Foreword

(This Foreword is not part of American National Standard Criticality Accident Alarm System, ANSI/ANS-8.3-1997.)

The usefulness and protective features of criticality accident alarm systems have been demonstrated in instances of accidental criticality that have occurred during the processing of fissionable materials. This standard provides guidance for the establishment and maintenance of an alarm system to initiate personnel protective actions in the event of inadvertent criticality.

Preparation of the standard, begun in 1966, resulted in the issuance of N16.2-1969, and an initial revision was issued in 1979. A second revision, issued in 1986, incorporated relevant features of American National Standard Immediate Evacuation Signal for Use in Industrial Applications, ANSI N2.3-1979. The 1986 revision also deleted the section that addressed emergency planning; such guidance is now provided in American National Standard Administrative Practices for Nuclear Criticality Safety, ANSI/ANS-8.19-1996.

Most of the changes incorporated into this revision of ANS-8.3 are oriented towards clarification, rather than change, of existing standard requirements and recommendations. Where concern exists for accidents of smaller magnitude than alarm systems have traditionally been designed to detect, additional guidance is now provided.

Use of portable instruments to augment an installed accident alarm system is now more specifically addressed. The term "immediate evacuation" has been replaced with "personnel protective action" since for some shielded facilities or locations, proper immediate response by some personnel may be to remain at their current location rather than to evacuate.

This standard is compatible with ISO 7753, *Nuclear energy—Performance and testing requirements for criticality detection and alarm systems*. IEC 860, *Warning equipment for criticality accidents*, contains useful information regarding electrical characteristics and testing procedures for alarm equipment.

Appendix B has been extensively revised to provide analytical methods and example applications for determining detector placement.

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This standard was prepared under the direction of Subcommittee ANS-8, Fissionable Materials Outside Reactors, of the Standards Committee of the American Nuclear Society. The membership of ANS-8 at the time of draft preparation and approval was:

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Contents

Criticality Accident Alarm System

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] In most operations with fissionable materials the risk of inadvertent criticality is very low; however, this risk cannot be eliminated. Where a criticality accident may lead to an excessive radiation dose, it is important to provide a means of alerting personnel and a procedure for their prompt evacuation, or other protective actions to limit their exposure to radiation.

2. Scope

This standard is applicable to all operations involving fissionable materials in which inadvertent criticality can occur and cause personnel to receive unacceptable exposure to radiation.

This standard is not applicable to detection of criticality events where no excessive exposure to personnel is credible, nor to nuclear reactors or critical experiments. This standard does not include details of administrative actions or of emergency response actions that occur after alarm activation.

3. Definitions

3.1 Limitations. The following definitions are of a restricted nature for the purpose of this standard. Other specialized terms are defined in the *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. To conform with this standard, all operations shall be performed in accordance with its requirements but not necessarily with its recommendations.

3.3 Glossary of Terms

criticality accident. The release of energy as a result of accidental production of a self-sustaining or divergent neutron chain reaction.

excessive radiation dose. Any dose to personnel corresponding to an absorbed dose from neutrons and gamma rays equal to or greater than 0.12 Gy (12 rad) in free air.

minimum accident of concern. The smallest accident, in terms of fission yield and dose rate, that a criticality alarm system is required to detect.

4. General Principles

4.1 General

4.1.1. Installation of an alarm system implies a nontrivial risk of criticality. Where alarm systems are installed, emergency procedures shall be maintained. Guidance for the preparation of emergency plans is provided in American National Standard Administrative Practices for Nuclear Criticality Safety, ANSI/ANS-8.19-1996 [3].

4.1.2. Process equipment used in areas from which immediate evacuation is required should be so designed that leaving the equipment will not introduce significant risk.

4.1.3. The purpose of an alarm system is to reduce risk to personnel. Evaluation of the overall risk should recognize that hazards may result from false alarms and subsequent sudden interruption of operations and relocation of personnel.

4.2 Coverage

4.2.1. The need for criticality alarm systems shall be evaluated for all activities in which the inventory of fissionable materials in individual unrelated areas exceeds 700 g of U-235, 500 g of U-233, 450 g of Pu-239, or 450 g of any com-

[1] Numbers in brackets refer to corresponding numbers in Section 8, References.