



# REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

## REGULATORY GUIDE 3.71

(Draft was issued as DG-3013)

### NUCLEAR CRITICALITY SAFETY STANDARDS FOR FUELS AND MATERIAL FACILITIES

#### A. INTRODUCTION

In 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," Section 70.20, "General License To Own Special Nuclear Material," defines a specific license to acquire, deliver, receive, possess, use, transfer, import, or export special nuclear material. According to 10 CFR 70.22, "Contents of Applications," each application for such a license must contain proposed procedures to avoid nuclear criticality accidents. In 10 CFR Part 76, "Certification of Gaseous Diffusion Plants," Section 76.87, "Technical Safety Requirements," states that the technical safety requirements should reference procedures and equipment applicable to criticality prevention.

This regulatory guide has been developed to provide guidance on complying with these portions of the NRC's regulations by describing procedures for preventing nuclear criticality accidents in operations involving handling, processing, storing, and transporting special nuclear material at fuels and material facilities. This regulatory guide endorses specific ANSI/ANS-8 nuclear criticality safety standards for these purposes. This guide also consolidates and replaces the guidance from a number of regulatory guides, thereby withdrawing those regulatory guides. This guide is not intended to be used by nuclear reactor licensees.

The information collections contained in this regulatory guide are covered by the requirements of 10 CFR Part 70, which were approved by the Office of Management and Budget, approval number 3150-0009, and 10 CFR Part 76. The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

#### B. DISCUSSION

The American Nuclear Society's Standards Subcommittee 8, "Operations with Fissionable Materials Outside Reactors" (ANS-8), has developed national standards for the prevention and mitigation of criticality accidents during handling, processing, storing, and transporting special nuclear materials at fuels and material facilities. These national standards have been approved by the American Nuclear Society Committee N16 on Nuclear Criticality Safety and by the American National Standards Institute (ANSI). The ANSI/ANS-8 nuclear criticality safety standards provide guidance and criteria on good practices for nuclear criticality safety at fuels and material facilities.

The ANSI/ANS-8 national standards list additional documents as references. The specific applicability or acceptability of these listed documents will be covered

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#### USNRC REGULATORY GUIDES

Regulatory Guides are issued to describe and make available to the public such information as methods acceptable to the NRC staff for implementing specific parts of the Commission's regulations, techniques used by the staff in evaluating specific problems or postulated accidents, and data needed by the NRC staff in its review of applications for permits and licenses. Regulatory guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions different from those set out in the guides will be acceptable if they provide a basis for the findings requisite to the issuance or continuance of a permit or license by the Commission.

This guide was issued after consideration of comments received from the public. Comments and suggestions for improvements in these guides are encouraged at all times, and guides will be revised, as appropriate, to accommodate comments and to reflect new information or experience.

Written comments may be submitted to the Rules Review and Directives Branch, DFIPS, ADM, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

The guides are issued in the following ten broad divisions:

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separately in other regulatory guides, where appropriate.

### C. REGULATORY POSITION

The following ANSI/ANS-8 nuclear criticality safety standard documents describe procedures and recommendations that should be followed to prevent and mitigate nuclear criticality accidents.

ANSI/ANS-8.1-1983 (Reaffirmed in 1988), "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors"

ANSI/ANS-8.3-1997, "Criticality Accident Alarm System"

ANSI/ANS-8.5-1996, "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material"

ANSI/ANS-8.6-1983 (Reaffirmed in 1995), "Safety in Conducting Subcritical Neutron-Multiplication Measurements In Situ"

ANSI/ANS-8.7-1975 (Reaffirmed in 1987), "Guide for Nuclear Criticality Safety in the Storage of Fissile Materials"

ANSI/ANS-8.9-1987 (Reaffirmed in 1995), "Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials"

ANSI/ANS-8.10-1983 (Reaffirmed in 1988), "Criteria for Nuclear Criticality Safety Controls in Operations With Shielding and Confinement"

ANSI/ANS-8.12-1987 (Reaffirmed in 1993), "Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors"

ANSI/ANS-8.15-1981 (Reaffirmed in 1995), "Nuclear Criticality Control of Special Actinide Elements"

ANSI/ANS-8.17-1984 (Reaffirmed in 1997), "Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors"

ANSI/ANS-8.19-1996, "Administrative Practices for Nuclear Criticality Safety"

ANSI/ANS-8.20-1991, "Nuclear Criticality Safety Training"

ANSI/ANS-8.21-1995, "Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors"

ANSI/ANS-8.22-1997, "Nuclear Criticality Safety Based on Limiting and Controlling Moderators"

ANSI/ANS-8.23-1997, "Nuclear Criticality Accident Emergency Planning and Response"

The methods described in the ANSI/ANS-8 nuclear criticality safety standards have been applied in a number of specific cases during reviews and selected licensing actions. These methods reflect the latest general NRC approach to nuclear criticality safety in operations involving handling, processing, storing, and transporting special nuclear material at fuels and material facilities.

Most of the ANSI/ANS-8 nuclear criticality safety standards have been endorsed by NRC in other regulatory guides. This regulatory guide consolidates and replaces the following regulatory guides without altering any existing licensing commitments nor introducing any new requirements. These regulatory guides are therefore being withdrawn.

Regulatory Guide 3.1, "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material" (Revision 2, September 1987)

Regulatory Guide 3.4, "Nuclear Criticality Safety in Operations with Fissionable Materials at Fuels and Materials Facilities" (Revision 2, March 1986)

Regulatory Guide 3.43, "Nuclear Criticality Safety in the Storage of Fissile Materials" (Revision 1, April 1979)

Regulatory Guide 3.45, "Nuclear Criticality Safety for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials" (Revision 1, April 1989)

Regulatory Guide 3.47, "Nuclear Criticality Control and Safety of Homogeneous Plutonium-Uranium Fuel Mixtures Outside Reactors" (July 1981)

Regulatory Guide 3.57, "Administrative Practices for Nuclear Criticality Safety at Fuels and Materials Facilities" (October 1986)

Regulatory Guide 3.58, "Criticality Safety for Handling, Storing, and Transporting LWR Fuel at Fuels and Materials Facilities" (October 1986)

Regulatory Guide 3.68, "Nuclear Criticality Safety Training" (April 1994)

Regulatory Guide 3.70, "Use of Fixed Neutron Absorbers at Fuels and Materials Facilities" (August 1997)

Regulatory Guide 8.12, "Criticality Accident Alarm Systems" (Revision 2, October 1988)

The ANSI/ANS-8 nuclear criticality safety standards listed above provide procedures and methodology generally acceptable to the NRC staff for the prevention and mitigation of nuclear criticality accidents. However, use of the ANSI/ANS-8 nuclear criticality safety standards is not a substitute for detailed nuclear criticality safety analyses for specific operations. Exceptions to some of the ANSI/ANS-8 nuclear criticality safety standards are as follows.

The guidelines for validating calculational methods for nuclear criticality safety contained in ANSI/ANS-8.1-1983 (Reaffirmed in 1988), "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors," provide a procedure acceptable to the NRC staff for establishing the validity and applicability of calculational methods used in assessing nuclear criticality safety. However, it will not be sufficient merely to refer to this guide in describing the validation of a method. The details of validation stated in Section 4.3.6 of the standard should be provided to demonstrate the adequacy of the margins of subcriticality relative to the bias and criticality parameters, to demonstrate that the calculations embrace the range of variables to which the method will be applied, and to demonstrate the trends in the bias upon which extension of the area of applicability will be based.

The guidance on criticality accident alarm systems contained in ANSI/ANS-8.3-1997, "Criticality Accident Alarm System," is generally acceptable to the NRC staff. An exception is that criticality alarm systems are required by 10 CFR 70.24, "Criticality Accident Requirements," in each area in which special nuclear material is handled, used, or stored, while Section 4.2.1 of the standard requires an evaluation for such areas. Another exception is that each area is required by 10 CFR 70.24 and 10 CFR 76.89, "Criticality Accident Requirements," to be covered by two detectors, whereas Section 4.5.1 of the standard permits coverage by a single reliable detector. Finally, a monitoring system capable of detecting a nuclear criticality that produces an absorbed dose in soft tissue of 20 rads of combined neutron and gamma radiation at an unshielded distance of 2 meters from the reacting material within 1 minute is required by 10 CFR 70.24 and 10 CFR 76.89.

The guidance on using shielding and confinement as a nuclear criticality safety control contained in ANSI/ANS-8.10-1983 (Reaffirmed in 1988), "Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement," is generally accepted by the NRC staff. An exception to Section 4.2.1 is that the radiation source strengths and releases from a nuclear criticality accident are assumed to be from an excursion occurring in an unfavorable geometry containing a solution of 400 g/l of uranium enriched in U-235. The excursion produces an initial burst of  $1\text{E}+18$  fissions in 0.5 second followed successively at 10 minute intervals by 47 bursts of  $1.9\text{E}+17$  fissions for a total of  $1\text{E}+19$  fissions in 8 hours. The excursion is assumed to be terminated by evaporation of 100 liters of the solution. A less conservative nuclear criticality accident condition may be used if detailed analyses of credible nuclear criticality accidents are performed and shown to be applicable to the conditions being evaluated.

The general safety criteria and criteria to establish subcriticality contained in ANSI/ANS-8.17-1997, "Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors," provide guidance acceptable to the NRC staff for preventing nuclear criticality accidents in handling, storing, and transporting fuel assemblies at fuels and material facilities. The only exception is that credit for fuel burnup may be taken only when the amount of burnup is confirmed by physical measurements that are appropriate for each type of fuel assembly in the environment in which it is to be stored.

The NRC staff will follow the requirements as denoted in the ANSI/ANS-8 national standards. The word "shall" in a standard denotes a requirement, the word "should" denotes a recommendation, and the word "may" denotes permission, neither a requirement nor a recommendation. When an applicant or licensee commits to the ANSI/ANS-8 national standards cited in this regulatory guide, all operations must be performed in accordance with the requirements stated in the national standards but not necessarily with its recommendations. Recommendations given in the ANSI/ANS-8 national standards may be followed unless an exception is stated in this regulatory guide or otherwise specified in 10 CFR Part 70 or Part 76, or addressed by other acceptable methods.

#### **D. IMPLEMENTATION**

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which an applicant or licensee proposes an acceptable alternative method for complying with the specified portions of the NRC's regulations, the methods in this guide will be used in

the evaluation of submittals in connection with license applications submitted under 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," and 10 CFR Part 76, "Certification of Gaseous Diffusion Plants."

## **REGULATORY ANALYSIS**

A draft regulatory analysis was published with the draft of this guide when it was published for public comment (Task DG-3013, January 1998). No changes were necessary, so a separate regulatory analysis has not been prepared for Regulatory Guide 3.71. A copy of the draft regulatory analysis is available for inspection or copying for a fee in the NRC's Public Document Room at 2120 L Street NW., Washington, DC, under Task DG-3013.



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