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DRAFT REGULATORY GUIDE

Contact: S.A. Parra (301)415-6433

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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, 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 76.35(4) states that the application for an initial certificate of compliance must establish technical safety requirements for preventing a nuclear criticality accident.

This regulatory guide is being 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 is not intended to be used by nuclear reactor licensees.

Regulatory guides are issued to describe to the public methods acceptable to the NRC staff for implementing specific parts of the NRC's regulations, to explain techniques used by the staff in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations, and compliance with these guides is not

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This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. It has not received complete staff review and does not represent an official NRC staff position.

Public comments are being solicited on the draft guide (including any implementation schedule) and its associated regulatory analysis or value/impact statement. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rules and Directives Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Copies of comments received may be examined at the NRC Public Document Room, 2120 L Street NW., Washington, DC. Comments will be most helpful if received by **March 31, 1998.**

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required. Regulatory guides are issued in draft form for public comment to involve the public in developing the regulatory positions. Draft regulatory guides have not received complete staff review; they therefore do not represent official NRC staff positions.

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 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"

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. The final version of this regulatory guide would consolidate and replace the following regulatory guides without altering any existing licensing commitments nor introducing any new requirements.

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 safety margins 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 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 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, "Criticality Accident Requirements," and 10 CFR 76.89, "Criticality Accident Requirements."

The nuclear criticality safety practices, limits, and conditions for the storage of special nuclear material and the guidance for other storage configurations contained in ANSI/ANS-8.7-1975 (Reaffirmed in 1987), "Guide for Nuclear Criticality Safety in the Storage of Fissile Materials," provide procedures generally acceptable to the NRC staff for the prevention of nuclear criticality accidents in the storage of special nuclear materials. The exception to this standard is that the mass limits tabulated in the standard that are

marked by a superscript "a" to show that they exceed 90 percent of the critical mass of a water-reflected sphere should not be used unless it can be demonstrated that their use could not result in criticality under conditions involving errors or accidents such as double batching or water immersion.

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 1E+18 fissions in 0.5 second followed successively at 10 minute intervals by 47 bursts of 1.9E+17 fissions for a total of 1E+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 draft regulatory guide.

This draft guide has been released to encourage public participation in its development. Except in those cases in which an applicant or licensee proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the methods to be described in the active guide reflecting public comments will be used in the evaluation of submittal 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

This regulatory guide is being developed to endorse 13 ANSI/ANS-8 nuclear criticality safety standards and consolidate their guidance. These standards were issued by the American Nuclear Society's Standards Subcommittee 8, "Operations with Fissionable Materials Outside Reactors," and they are listed in the Regulatory Position of Draft Regulatory Guide DG-3013. Issuing this regulatory guide is consistent with the NRC policy of evaluating the latest national consensus standards in terms of their suitability for endorsement by regulatory guides.

The methods described in this guide were applied to a number of specific cases during reviews and selected licensing actions. These methods reflect the latest general NRC approach to criticality safety in operations involving nuclear criticality control of special nuclear material operations involving handling, processing, storing, and transporting special nuclear material at fuels and materials facilities.

The value to NRC operations and industry is that there would be (1) a systematic method for specifying and reviewing technical specifications on preventing nuclear criticality accidents, (2) more established methods for specifying technical specifications, (3) guidance on design, evaluation, verification, and inspection of nuclear criticality safety programs, and (4) less chance for unwarranted nuclear criticality accidents.

The ANSI/ANS-8 national standards on nuclear criticality safety provide more specific guidance on establishing a nuclear criticality safety program and preventing nuclear criticality accidents. They do not provide any new methodology for establishing nuclear criticality safety than is presently required in 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," or 10 CFR Part 76, "Certification of Gaseous Diffusion Plants." Thus, the incremental cost should be negligible (or at most marginal) if an applicant or licensee follows the guidance provided in the ANSI/ANS-8 national standards as opposed to not following these standards.

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