UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, D.C. 20555

March 31, 2006

NRC INFORMATION NOTICE 2006-07: INAPPROPRIATE USE OF A SINGLE-PARAMETER LIMIT AS A NUCLEAR CRITICALITY SAFETY LIMIT

ADDRESSEES

All licensees authorized to possess a critical mass of special nuclear material.

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to alert addressees to a concern arising from the inappropriate use of single-parameter limits as nuclear criticality safety limits at fuel cycle facilities. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this IN are not new NRC requirements; therefore, no specific action nor written response is required.

DESCRIPTION OF CIRCUMSTANCES

Under 10 CFR Parts 70 and 76, certain licensees processing, storing, or handling critical masses of fissile material are required to analyze accident scenarios leading to criticality and provide safety limits that bound potential criticality events. A fuel cycle licensee relied on a single-parameter limit from a national consensus standard as the safety limit for the concentration of fissile material in a nonuniform aqueous solution stored in unsafe-geometry tanks. The licensee took the single-parameter limit for concentration of uranium-235 in uranyl nitrate solution from Table 1 of ANSI/ANS-8.1, “Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,” and applied it as the concentration limit for a set of large unsafe-geometry tanks used to store waste water.

The value chosen is considered to be always subcritical for a uniform solution and was designated in the consensus standard as applying to “uniform aqueous solutions.” The waste water solution was mixed and uniform on discharge to storage, but settled into solids on arrival in the storage tanks, in a verifiable manner such that the solution was nonuniform while actually in storage. Although the licensee had referred to the concentration limit in parameter studies, the limit was not discussed nor justified in criticality analyses for the systems and processes involved.

Fuel cycle facilities licensed under Parts 70 and 76 have specific limits on subcritical margin specified in their licenses or certificates. These limits on subcritical margin are typically specified in terms of effective neutron multiplication or k_{eff}. The single-parameter limits in

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Table 1 of ANSI/ANS-8.1 were based on a subcritical margin of between 1 and 2% Δk[1] as noted in technical documentation of the standard. The minimum subcritical margin allowed by the license was 2% Δk, and the licensee did not otherwise specifically commit to this consensus standard application in the facility license. As a result, the safety limit relied on by the licensee for concentration control in this case exceeded the license limit on minimum subcritical margin for normal and credible abnormal conditions.

DISCUSSION

NRC Regulatory Guide 3.71, "Nuclear Criticality Safety Standards for Fuels and Material Facilities," describes methods that the NRC staff considers generally acceptable for complying with regulations. This regulatory guide endorses specific nuclear criticality safety standards developed by the American Nuclear Society's Standards Subcommittee 8 (ANS-8), "Operations with Fissionable Materials Outside Reactors." NRC endorsement of a consensus standard applies to the use of information and methodology from the standard in licensing applications. NRC endorsement of consensus standards does not supersede approved license conditions.

The NRC is concerned that licensees clearly understand the relationship of consensus standards to the approved facility license. The facility license in this situation allowed the use of experimental data to establish safety limits. Data from ANSI/ANS-8 series nuclear criticality safety standards are typically calculated by computer methods and should, in most cases, be considered analytical data.

In addition, NRC is concerned about the application of limits from consensus standards without regard to their applicability. In this case, the standard required aqueous solutions to be uniform for the limits to be applicable and the underlying basis for the standard noted that subcritical margin may be as low as 0.01. Inappropriate use of a single-parameter limit exposes fuel cycle licensees to the possibility of implementing inadequate nuclear criticality safety controls which, in this case, resulted in inadequate subcritical margin in an unfavorable geometry tank.

NRC criticality safety inspections typically include the review of the adequacy and applicability of single-parameter limits used as safety limits, including the completeness and adequacy of nuclear criticality safety analyses, to ensure that controlled parameters and their associated limits are adequate to maintain fissile material operations within subcritical limits.

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[1]Nuclear Science and Engineering: 81, 371 (1982), Subcritical Limits for Uranium-235 Systems, "...three [calculational] methods were used to compute limits...a margin as small as 0.01 was occasionally considered acceptable, even though with no method was the margin as great as 0.02."

This IN requires no specific action nor written response. If you have any questions about the information in this notice, please contact the technical contact listed below.

/RA/

Robert C. Pierson, Director
Division of Fuel Cycle Safety
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Office of Nuclear Material Safety
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Attachments:
1. Referenced Codes and Standards
2. “List of Recently Issued NMSS Generic Communications”

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Referenced Codes and Standards

American National Standards Institute/American Nuclear Society, ANSI/ANS 8.1-1998, “Nuclear Criticality Safety in Operations With Fissionable Materials Outside Reactors,” ANS, LaGrange Park, Illinois

Recently Issued NMSS Generic Communications

Date	GC No.	Subject	Addressees
01/26/06	RIS-02-15, Rev. 1	NRC Approval of Commercial Data Encryption Products For the Electronic Transmission Of Safeguards Information	All authorized recipients and holders of sensitive unclassified safeguards information (SGI).
01/24/06	RIS-06-01	Expiration Date for NRC-Approved Spent Fuel Transportation Routes	The U.S. Nuclear Regulatory Commission (NRC) licensees who transport, or deliver to a carrier for transport, irradiated reactor fuel (spent nuclear fuel (SNF)).
01/13/06	RIS-05-27, Rev. 1	NRC Regulatory Issue Summary 2005-27, Rev. 1, NRC Timeliness Goals, Prioritization of Incoming License Applications and Voluntary Submittal of Schedule for Future Actions for NRC Review	All 10 CFR Parts 71 and 72 licensees and certificate holders.
01/19/06	IN-06-02	Use of Galvanized Supports and Cable Trays with Meggitt Si 2400 Stainless-Steel-jacketed Electrical Cables	All holders of operating licenses for nuclear reactors except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel; and fuel cycle licensees and certificate holders.

Note: NRC generic communications may be found on the NRC public website, http://www.nrc.gov, under Electronic Reading Room/Document Collections.