

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, D.C. 20555-0001

April 23, 2006

NRC INFORMATION NOTICE 2006-10: USE OF CONCENTRATION CONTROL FOR
CRITICALITY SAFETY

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 inform addressees of a concern about the use of concentration control for criticality safety as the primary nuclear criticality safety (NCS) control for unsafe-geometry vessels. It is expected that licensees will review this information and consider actions, as appropriate, to avoid similar problems. Suggestions contained in this IN are not 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 identify accident scenarios leading to criticality and develop, implement, and maintain reliable controls to ensure that inadvertent criticality is highly unlikely. Typical criticality safety analyses identify credible accident sequences leading to criticality; identify bounding assumptions related to the processes, equipment, or material being analyzed; and establish limits or boundaries of processes, equipment, or material that comply with corresponding bounding assumptions. Criticality may be deemed not credible when inherent features of the process, equipment, or material in a specific accident sequence leading to criticality can be shown to constrain the reactivity of fissile material within subcritical limits. The safety concern arises when accident scenarios leading to criticality are deemed not credible, based on bounding assumptions that are less than optimal for the system involved.

During a recent review of criticality safety analyses at a fuel cycle licensee facility, NRC inspectors noted routine sampling results showing concentrations near a licensee-proposed bounding concentration value in an unsafe-geometry tank. The fuel cycle licensee relied solely on concentration control to maintain safety in an unsafe geometry tank. The licensee asserted that the NCS method for controlling concentration in the tank was by limiting the concentration in the waste stream leading into the tank. The licensee stated that the waste stream solution was uniform on entry to the tank, and that settling could not result in an unsafe concentration. The analysis demonstrated that by regulating the waste stream concentration to 0.06 grams uranium-235 (U^{235})/liter (0.227 grams U^{235} /gallon), the overall concentration in the tank was guaranteed to remain below the maximum-assumed concentration of 8 grams U^{235} /liter (30.28 grams U^{235} /gallon).

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However, the licensee performed chemical analysis on settled solids in the tank and determined that the solids contained fissile material near 8 grams U^{235} /liter. As part of routine sampling, the licensee found a sample with a concentration of 7.74 grams U^{235} /liter (29.30 grams U^{235} /gallon).

The licensee sparged the tank, but only in instances where a sample was to be extracted from the waste solution. The sparging was not credited with, nor used to maintain uniformity in, the tank.

DISCUSSION

The effective use of concentration control requires a system in which concentration changes are well-understood and controlled. NRC is concerned that, in this instance, the licensee maintained the use of concentration control as the single parameter for assuring criticality safety without adequately maintaining a uniform solution and without treating settling in the tank as an upset condition. In this case, the U^{235} concentration limit was chosen from expected concentrations in the tank as a result of limiting inlet waste stream concentrations. The licensee determined that 8 grams U^{235} /liter (30.28 grams U^{235} /gallon) would bound all known U^{235} concentrations in the unfavorable tanks. Without ensuring uniformity within the tanks, it is credible for settling to occur in the solution. The idea of settling within the tank was not considered as an upset condition in this case. Had possible accumulations of settled solids been further evaluated, it may have been shown to be credible for fissile material concentrations in settled solids to exceed the 8-gram (0.018-pound) limit.

An inappropriate use of concentration control was highlighted in an earlier notice (IN-2004-14), on use of a limit on uranium concentration that was less than bounding for the process in which it was applied. A licensee determined that mass controls would limit the uranium concentration in the incinerator ash to less than 21.6 percent throughout the incinerator system. However, material control and accountability (MC&A) sampling data showed concentration levels above 21.6 percent uranium in some parts of the incinerator system. Although the IN focused on the need to establish appropriate interactions between criticality safety and MC&A staff, it also provides another case which exemplifies the need, when using concentration control, for licensees to ensure that they adequately capture all credible bounding scenarios which could potentially impact their system.

Licensee NCS staff should fully understand their systems and all changes that could upset concentration control in the system. Staff should also ensure that all credible scenarios are addressed, and that analyses governing the process bound all such scenarios. During future inspections, NRC inspectors will review systems using this control to ensure that proper controls are in place and that they are properly implemented.

CONTACT

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.

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Enclosure:
List of Recently Issued NMSS Generic Communications

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.
03/21/06	IN-02-23, Supl. 1	Unauthorized Administration of Byproduct Material for Medical Use	All medical licensees.
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.

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