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

October 15, 2007

NRC INFORMATION NOTICE 2007-32: OUT-OF-SERVICE EQUIPMENT CONNECTED TO IN-SERVICE PROCESS LINE RESULTS IN FISSILE SOLUTION SPILL AT FUEL CYCLE FACILITY

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 criticality safety concern regarding failure to fully disconnect out-of-service equipment from operational equipment at fuel cycle facilities. NRC expects 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 or written response is required.

DESCRIPTION OF CIRCUMSTANCES

An NRC licensee that operates a fuel cycle facility with high-enriched uranium (HEU) processes, constructed a new facility to convert HEU compounds into concentrated uranyl nitrate (UN) solution, and process the UN solution through a solvent extraction system, for final purification. The new solvent extraction system included a tray dissolver and filter system in two large gloveboxes. The tray dissolver glovebox system, as shown in Figure 1, was designed to recover small amounts of uranium from various sources and return filtered UN solution directly to the solvent extraction system.

Delays in the construction of the new facility placed schedule pressure on the licensee. The tray dissolver glovebox system, installed during facility construction, was considered non-essential to process startup, and finalization of equipment installation was delayed. The tray dissolver glovebox system was connected to a main HEU solution transfer line which was connected to the solvent extraction system collection vessel. The tray dissolver glovebox system was flagged as out-of-service but was not isolated from the main HEU solution transfer line.

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Before initiating operation of the new HEU process system, the licensee conducted reviews of the newly constructed facility, including requiring process engineers to compare installed piping and valves to design drawings. During this process, an engineer mistook a diverter valve in the tray dissolver filter glovebox for a block valve, and the associated as-built drawing was changed to reflect the error. The incorrect drawing gave the impression that the tray dissolver filter glovebox was isolated from other process lines and the error was not detected during subsequent readiness reviews. The diverter valve directed flow towards a sample point, and could not have impeded solution flow in the process line.

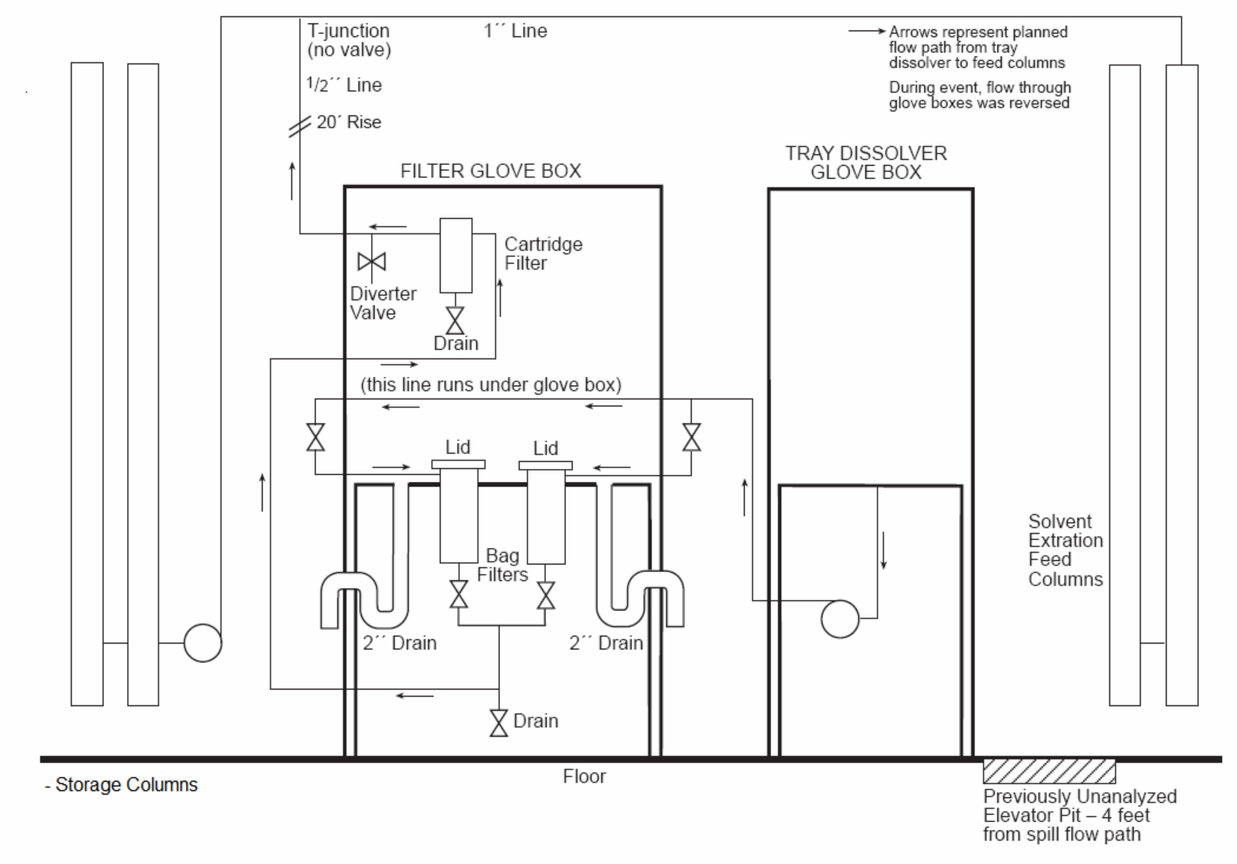

Figure 1
Tray Dissolver Filter Glovebox Equipment Arrangement

Licensee startup procedures included hydrostatic testing of process equipment with natural (non-enriched) UN solution. On several occasions after system startup, operators observed and reported yellow solution in the tray dissolver filter glovebox, and these instances were attributed to the hydrostatic testing. The solutions in the filter glovebox were assumed to be natural UN solution and were recovered, but not sampled.

After a few years of operation, the licensee decided to move the unused tray dissolver glovebox system to a new location in the facility. UN solution was found in the system filters and operators drained the system without a specific work procedure and thus did not sample the solution in the filters, restore the original valve line-up, or fully re-tighten the filter cover bolts. The next day a large HEU solution transfer took place through the transfer line to the solvent extraction system collection vessel. Approximately 37 liters of concentrated HEU solution spilled into the filter glovebox, through the glovebox drains, and to the floor of the facility. Licensee operators observed the spill as it passed under a door, investigated, observed solution spraying from the tray dissolver filters, and took corrective actions that terminated the event.

The tray dissolver filter glovebox was an unfavorable geometry configuration. To protect against criticality in its gloveboxes, the licensee normally installed two glovebox drains consisting of 1-inch or greater diameter tubes, and implemented controls to assure that the drains were not blocked during operation. The tray dissolver glovebox was constructed with the drains, but because the system was considered out-of-service, no controls were implemented to prevent blockage of the drains. Subsequent to the spill event, the licensee discovered that tools and cleaning material had been stored in the tray dissolver filter glovebox and had partially obstructed one of the drains.

To protect against criticality during spill events, the licensee had surveyed the facility floor and eliminated or directed flow away from solution collection points. During investigations conducted immediately after the event, the licensee discovered an elevator pit, near the path of the solution flow, which was not protected against solution ingress. The elevator pit was an unfavorable geometry configuration.

SUBCRITICAL MARGIN

NRC considers this spill to be significant because the mass involved exceeded the minimum critical mass for the fissile solution. A minimum critical mass is a theoretical value used to analyze safety margin for events involving fissile material. For a solution, the minimum critical mass is determined based on a critical reflected sphere of the solution. An approximate value for a critical sphere can be taken from Figure 2 which is Atlantic Richfield Hanford Company Criticality Handbook (ARH 600), Volume 2, Figure III.B.6(100)-1. The as-found solution can be represented by UN solution containing 170 grams uranium-235 (U-235) per liter. Figure 2 shows that UN solution at 170 grams U-235 per liter has a minimum critical mass of 1.4 kilograms. 37 liters of UN solution at 170 grams U-235 per liter results in approximately 6.5 kilograms of U-235 which exceeds the minimum critical value of 1.4 kilograms.

Although the volume of spilled solution would not have attained the critical slab height at the collection points, the mass spilled in the event would have been sufficient to sustain criticality in a slab configuration of sufficient thickness. An approximate value for a critical slab can be taken from Figure 3 which is ARH 600, Volume 2, Figure III.B.5(100)-1. The most likely way to reach the critical slab would have been with additional process solution since 200 liters were available in the transfer that led to the spill. Critical slab heights were estimated based on the actual process solution by filling both collection points with process solution until the critical height was determined. The estimated critical slab height in the glovebox is approximately 4.1 inches and

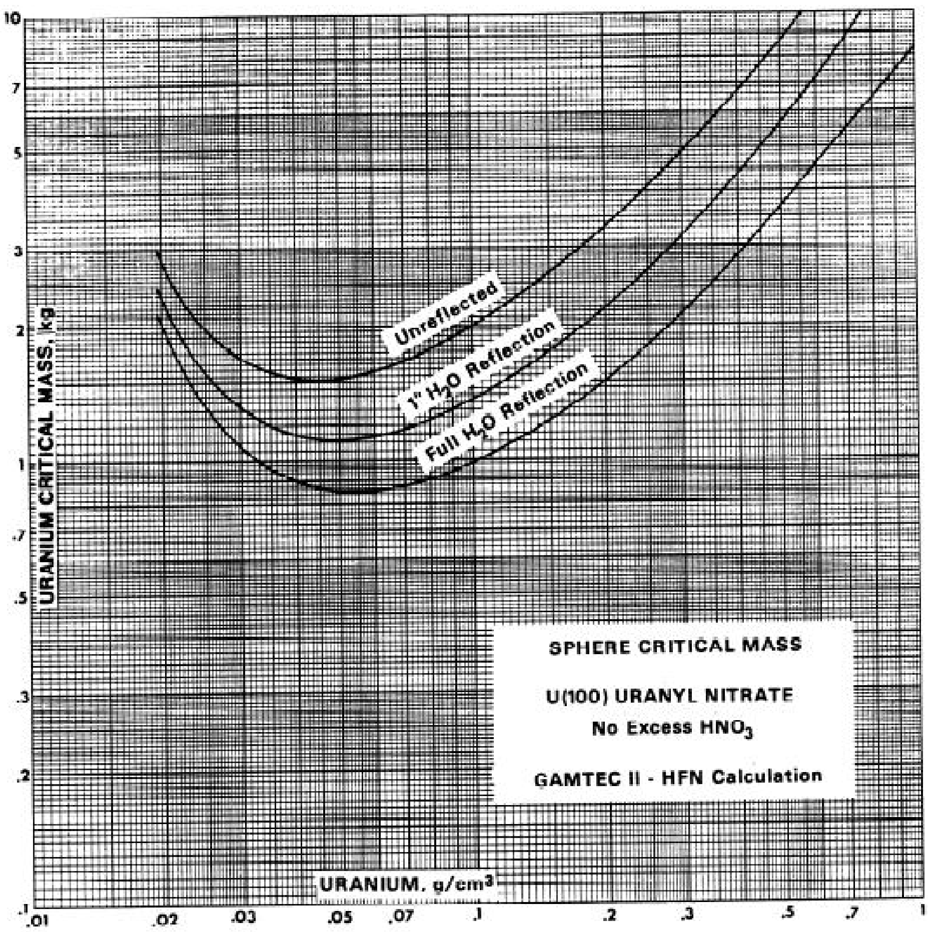

Figure 2
Spherical Critical Mass for UN Solution

is attained with 130 liters of process solution. The estimated critical slab height in the elevator pit is approximately 3 inches and is attained with 100 liters of solution. A critical slab height can be determined based on the mass actually spilled by converting that mass into a concentration based on the two estimated critical volumes.

The mass in the 37 liters spilled can be converted from 170 grams U-235 per liter in 37 liters to 48 grams U-235 per liter in 130 liters or 63 grams U-235 per liter in 100 liters. Figure 3 shows that the minimum critical slab height at 48 grams U-235 per liter is approximately 4.2 inches and that the minimum critical slab height at 63 grams U-235 per liter is approximately 3.4 inches. This analysis demonstrates that the height of a critical slab at the collection points would not be affected significantly by reducing the uranium concentration of the process solution. This supports the conclusion that sufficient mass was available during the event to attain criticality if a suitable geometry had been reached.

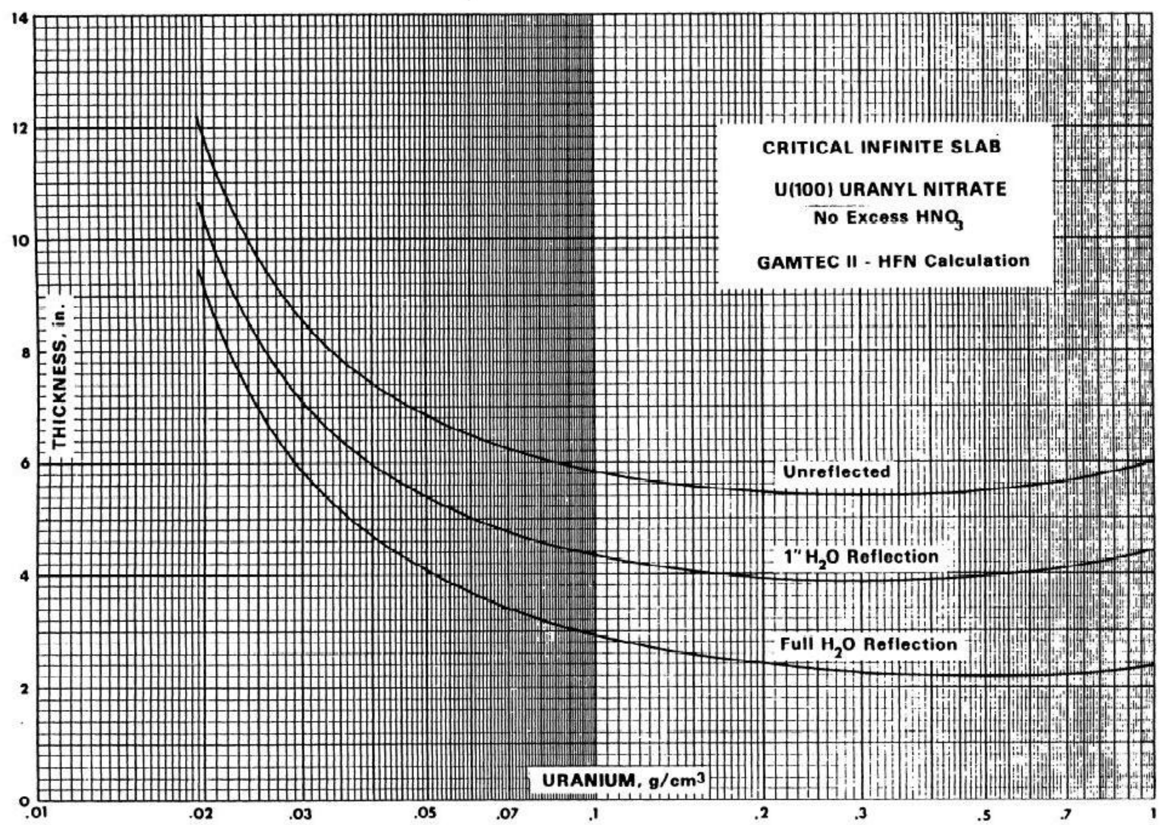

Figure 3
Critical Slab Height versus Solution Concentration

DISCUSSION

When handling licensed material, licensees must completely understand the material flowpath. In the above spill, the licensee lost control of configuration and did not clearly understand the flowpath of HEU solution. No safety controls existed to preclude inadvertent criticality. Criticality did not occur because the spilled solution did not assume a favorable configuration.

NRC is concerned that fuel cycle licensees have configuration management and start-up procedures that detect and preclude starting a process with out-of-service equipment cross-connected to in-service equipment. NRC is also concerned that licensees use formal work processes such as written procedures to accomplish work related to licensed activities.

The failure to develop, maintain, and fully integrate management measures, operating procedures, and criticality, radiological, fire, and chemical controls can lead to uncontrolled process operations as in the above spill event. NRC safety inspections typically include review of the licensee safety audit program, to ensure that analytical assumptions are regularly reviewed in all areas. NRC safety inspections also routinely review licensee configuration management programs, to ensure that plant changes are controlled, and design and as-built information are updated to accurately reflect criticality safety assumptions and controls.

This information notice does not require any specific action or written response. Please direct any questions about this matter to the technical contact below.

/RA/

Robert C. Pierson, Director
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

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NAME	D.Morey	E.Kraus: fax	A.McIntosh	D.Jackson	J.Giitter	R.Pierson
DATE	9/ 20 /07	9/ 12 /07	9/ 11 /07	9/ 25 /07	10/15/07	10/15/07

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Recently Issued FSME/NMSS Generic Communications			
Date	GC No.	Subject	Addressees
02/02/07	IN-07-03	Reportable Medical Events Involving Patients Receiving Dosages of Sodium Iodide Iodine-131 less than the Prescribed Dosage Because of Capsules Remaining in Vials after Administration	All U.S. Nuclear Regulatory Commission medical use licensees and NRC Master Materials Licensees. All Agreement State Radiation Control Program Directors and State Liaison Officers.
02/28/07	IN-07-08	Potential Vulnerabilities of Time-reliant Computer-based Systems Due to Change in Daylight Saving Time Dates	All U. S. Nuclear Regulatory Commission licensees and all Agreement State Radiation Control Program Directors and State Liaison Officers.
03/13/07	IN-07-10	Yttrium-90 Theraspheres® and Sirspheres® Impurities	All U.S. Nuclear Regulatory Commission (NRC) Medical Licensees and NRC Master Materials Licensees. All Agreement State Radiation Control Program Directors and State Liaison Officers.
04/04/07	IN-07-13	Use of As-Found Conditions to Evaluate Criticality-related Process Upsets at Fuel Cycle Facilities	All licensees authorized to possess a critical mass of special nuclear material.
05/02/07	IN-07-16	Common Violations of the Increased Controls Requirements and Related Guidance Documents	All licensees who are implementing the U.S. Nuclear Regulatory Commission (NRC) Order Imposing Increased Controls (EA-05-090), issued November 14, 2005 and December 22, 2005.
05/21/07	IN-07-19	Fire Protection Equipment Recalls and Counterfeit Notices	All holders of operating licenses for nuclear power reactors and fuel cycle facilities; except those licensees for reactors that have permanently ceased operations and who have certified that fuel has been permanently removed from the reactor vessel; and except those licensees for decommissioned fuel cycle facilities.
06/11/07	IN-07-20	Use of Blank Ammunition	All power reactors, Category I fuel cycle facilities, independent spent fuel storage installations, conversion facility, and gaseous diffusion plants.

Date	GC No.	Subject	Addressees
	IN-07-23	Inadvertent Discharge of Halon 1301Fire-suppression System from Incorrect and/or Out-of-date Procedures	All holders of operating licenses for nuclear power reactors, except those who have permanently ended operations and have certified that fuel has been permanently removed from the reactor vessel. All holders of licenses for fuel cycle facilities.
07/19/07	IN-07-25	Suggestions from the Advisory Committee on the Medical Use of Isotopes For Consideration to Improve Compliance With Sodium Iodide I-131 Written Directive Requirements in 10 CFR 35.40 and Supervision Requirements in 10 CFR 35.27	All U.S. Nuclear Regulatory Commission (NRC) medical-use licensees and NRC Master Materials Licensees. All Agreement State Radiation Control Program Directors and State Liaison Officers.
08/13/07	IN-07-26	Combustibility of Epoxy Floor Coatings at Commercial Nuclear Power Plants	All holders of operating licenses for nuclear power reactors and fuel cycle facilities except licensees for reactors that have permanently ceased operations and who have certified that fuel has been permanently removed from the reactor vessel.
03/01/07	RIS-07-03	Ionizing Radiation Warning Symbol	All U.S. Nuclear Regulatory Commission licensees and certificate holders. All Radiation Control Program Directors and State Liaison Officers
03/09/07	RIS-07-04	Personally Identifiable Information Submitted to the U.S. Nuclear Regulatory Commission	All holders of operating licenses for nuclear power reactors and holders of and applicants for certificates for reactor designs. All licensees, certificate holders, applicants, and other entities subject to regulation by the U.S. Nuclear Regulatory Commission (NRC) of the use of source, byproduct, and special nuclear material
03/20/07	RIS-07-05	Status and Plans for Implementation of NRC Regulatory Authority for Certain Naturally-occurring and Accelerator-produced Radioactive Material	All NRC materials licensees, Radiation Control Program Directors, State Liaison Officers, and NRC's Advisory Committee on the Medical Uses of Isotopes
04/05/07	RIS-07-07	Clarification of Increased Controls for Licensees That Possess Collocated Radioactive Material During Transportation Activities	All U.S. Nuclear Regulatory Commission (NRC) licensees issued NRC's Order Imposing Increased Controls and all Radiation Control Program Directors and State Liaison Officers

Date	GC No.	Subject	Addressees
05/04/07	RIS-07-09	Examples of Recurring Requests for Additional Information (RAIs) for 10 CFR Part 71 and 72 Applications	All holders of, and applicants for, a: (1) 10 CFR Part 71 certificate of compliance (CoC) for a radioactive material transportation package; (2) 10 CFR Part 72 CoC for a spent fuel storage cask; and (3) 10 CFR Part 72 specific license for an independent spent fuel storage installation (ISFSI).
06/27/07	RIS-06-27, Suppl. 1	Availability of NRC 313A Series of Forms and Guidance for Their Completion	All U.S. Nuclear Regulatory Commission (NRC) medical-use licensees and NRC Master Materials licensees. All Radiation Control Program Directors and State Liaison Officers.
05/15/07	RIS-07-10	Subscriptions To New List Server For Automatic Notifications Of Medical-Related Generic Communications, *Federal Register* Notices And Newsletters	All U.S. Nuclear Regulatory Commission (NRC) medical-use licensees and NRC Master Materials licensees. All Radiation Control Program Directors and State Liaison Officers.

Note: A full listing of generic communications may be viewed at the NRC public website at the following address:
http://www.nrc.gov/Electronic Reading Room/Document Collections/Generic Communications