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

April 4, 2007

NRC INFORMATION NOTICE 2007-13: USE OF AS-FOUND CONDITIONS TO EVALUATE CRITICALITY-RELATED PROCESS UPSETS AT FUEL CYCLE FACILITIES

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 regarding the use of as-found conditions to establish the efficacy of double contingency protection during evaluation of criticality-related process upsets 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 nor written response is required.

DESCRIPTION OF CIRCUMSTANCES

An NRC licensee transferred critical masses of low-enriched uranium in and out of unsafe geometry vessels at a transfer facility on the licensee site. During processing operations at the transfer facility, the fissile material vessels were weighed and briefly stored. A pit beneath the scale in the facility was an unsafe geometry collection point for which the licensee had implemented double contingency protection to prevent the accumulation of fissile material and water. The licensee double contingency arrangement consisted of controls to assure the structural integrity of fissile material-containing vessels and processing equipment along with controls to limit the amount of water, allowed in the scale pit, to less than a safe slab height. Fissile material assay of 5.5 weight percent (wt%) ^{235}U was considered a normal operating condition for the transfer facility and was the analytical basis for the slab height limit in the scale pit. The controls limiting the amount of water in the scale pit consisted of a moisture indicator that notified operators with an alarm when the water level in the scale pit reached an action limit of 2.5 inches and procedures to remove accumulating water before the established criticality safety limit of 3.68 inches was reached.

The licensee site recently experienced flooding in operational areas due to heavy rains. As a result of the flooding, a drain system servicing the fissile material transfer facility overflowed, allowing water to enter the scale pit. During the flooding event, no failure of structural integrity or escape of fissile material was identified, but enough water entered the scale pit to exceed the 3.68 inch slab height limit. Licensee investigation revealed that over 4.3 inches of water had entered the scale pit during the flooding event, and that the moisture detector in the scale pit had failed and had not notified operators to begin compensatory action to remove the water.

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The licensee had committed to report events involving the loss of double contingency to the NRC, and it recognized that the criticality safety limit of 3.68 inches of water in the scale pit had been violated due to failure of the planned and implemented criticality safety controls. Subsequent to the flooding event, the licensee determined that double contingency was not violated by the accumulation of 4.3 inches of water in the scale pit due to the as-found operating conditions at the time of the event. The licensee determined that the maximum assay of fissile material in the transfer facility at the time of the event was 2.0 wt% ^{235}U which would have required more than 7.0 inches of water to create an unsafe slab in the scale pit. As a result of the conclusion that double contingency was maintained due to as-found conditions during the event, the licensee did not report the failure of double contingency to the NRC.

DISCUSSION

The specific commitment to double contingency at an NRC licensee is contained in the individual facility license. In this case, the licensee had committed to a typical definition of double contingency requiring that process designs should incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. Double contingency arrangements under this and related definitions are developed from credible upsets that are based on bounding normal case conditions. Planned double contingency arrangements are implemented by establishing safety limits and then using controls to ensure that the limits are not exceeded during operations. Double contingency protection is considered lost when control has been lost over one of the controlled parameters, such that only one change in process conditions would be needed to create a critical system. Exceeding a criticality safety limit on a process parameter clearly demonstrates loss of control over that parameter.

A double contingency arrangement is implemented with a specific accident sequence in mind. In the case of the fissile material transfer facility, the accident sequence was the creation of a critical system in the scale pit, due to the concurrent accumulation of fissile material and intrusion of water. Fissile material in the facility is assumed to accumulate in the scale pit if it is released from vessels or equipment; thus, the controlled parameter is the integrity of the vessels or equipment. Fissile material in the scale pit accident sequence is assumed to mix uniformly with water in the pit and is also assumed to be 5.5wt% ^{235}U because 5.5wt% bounds the uranium assay at the transfer facility, and there are no controls implemented at the facility to limit assay to less than 5.5wt%. These assumptions are part of the analytical basis for the 3.68 inch water level limit in the scale pit, resulting in controls designed to protect this particular limit. The NRC considers that the control failure (i.e., failed moisture detector) and the safety limit being exceeded during the flooding event constitute a failure of the planned and implemented double contingency arrangement for the accident sequence of water intrusion into the scale pit in the presence of a critical mass of low-enriched uranium.

The validity of a particular safety limit must be established before, not after, an upset has occurred. If a licensee analysis of an accident sequence in an as-found condition results in a revised safety limit to bound a specific upset, this revision cannot alter what was relied on for safety prior to the upset. In the transfer facility flooding event, on the basis of how the safety limit was constructed, control was lost over the moderation parameter by water intrusion into

the scale pit. The NRC is concerned that licensees understand that it is the loss of control over a controlled parameter that is of concern in double contingency failure analysis. A safety limit could theoretically be constructed to vary along with a specified process condition, if that process condition varied predictably through a controlled range. For example, the limiting height of a fissile slab could be tabulated based on a range of available fissile assay and the tabulated values could be designated as the safety limit which would be applicable based on the available assay at the time of an upset. Such an approach would require analysis in advance, like any other safety limit. Without such analysis, it is not immediately clear that a limiting slab height different from the one originally analyzed is bounding. In the transfer facility flooding event accident sequence, variation in the safe slab height based in variation in the facility fissile assay was not considered in advance.

Inappropriate consideration of as-found conditions, during event analysis, may result in the failure to correctly characterize the event. Improper characterization of the event could, in turn, lead to an inadequate response, such as a failure to make a required event report. NRC criticality safety inspections typically include review of facility events to determine the adequacy of licensee reportability determinations, including the licensee rationale for conclusions regarding the efficacy of double contingency protection during the event.

CONTACT

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

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Enclosure: List of Recently Issued FSME/NMSS Generic Communications

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.
03/15/07	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.
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

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