

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

March 17, 1993

NRC INFORMATION NOTICE 93-19: SLAB HOPPER BULGING

Addressees

All nuclear fuel cycle licensees

Purpose

This information notice is provided to alert addressees to possible bulging that may occur in slab hoppers. It is expected that licensees will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute new Nuclear Regulatory Commission requirements; therefore, no specific action or written response is required.

Description of Circumstances

In October 1992, a licensee notified an NRC Regional Office that a visual inspection had identified the bulging of an empty slab hopper used to store calcined UO<sub>2</sub> powder. This bulging caused the slab thickness of the hopper to exceed the safe value specified in the nuclear criticality safety analysis. As such, this event constituted a nuclear criticality hazard. At that time, the acting shift supervisor, in conjunction with the safety supervisor, tagged the slab hopper "out of service," pending further investigation. The bulging occurred about one-half of an inch from the lower end of the hopper and comprised an area of about 1 ft<sup>2</sup>. Subsequently, the event was reported to the NRC Operations Officer, in accordance with NRC Bulletin 91-01.

The licensee convened an investigation to determine the cause(s) of the slab hopper bulging and to identify needed corrective actions, to preclude recurrence. This investigation revealed that, in addition to the originally cited slab hopper, all other slab hoppers had bulged and exceeded their design thicknesses, in the same general area as the initial slab hopper. Accordingly, all were removed from service. Additional analyses of the initially bulged slab hopper, performed using an ultrasonic examination, revealed that the specified wall thickness was actually thinner than that specified in the drawings of the slab hopper. At this point, the licensee is unclear as to whether the hopper was fabricated with thinner material or material thinning had taken place because of extended use. As a result of these findings, it was decided that all slab hoppers will remain "locked out" until corrective actions identified by the investigation have been implemented.

Although the licensee has not completed its investigation, the preliminary conclusion is that bulging occurred because of metal fatigue, caused by

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extended service, and heat and powder expansion that occurs when  $UO_2$  powder oxidizes while in the slab hoppers. The licensee's final investigation will be reviewed in a subsequent NRC inspection and is considered as an inspector followup item.

### Discussion

The bulging of the slab hoppers used to store  $UO_2$  constitutes a nuclear criticality threat. This is so because the inside thickness of the slab hopper is used as the primary criticality safety control. Therefore, it is imperative that all possible events that might perturb the thickness of the slab hopper be examined. In this instance, however, the licensee did not examine the possibility of slab bulging as a consequence of the chemical reaction of  $UO_2$  with oxygen to form  $U_3O_8$  (which releases energy), or the hydrostatic forces that result from the associated volume expansion. In fact, an NRC inspection revealed that the licensee did not have documentation of the design loading and design criteria for the existing slab hoppers. Furthermore, no quality assurance program or material specifications for the slab hoppers existed.

To ensure that adequate safety for the slab hoppers is provided, licensees with slab hoppers may wish to review their nuclear safety programs and consider the need to incorporate the following elements:

1. Specifications that identify design loadings, criteria, and methods and acceptance criteria for the slab hoppers.
2. A QA program for slab hoppers to address all activities, including design, purchase, fabrication, inspection, operation, and maintenance.
3. A preventive maintenance program that provides for the performance of routine surveillance and periodic dimensional checks of the slab hoppers.

In addition, when geometric control is used for nuclear criticality safety, the choice between geometric shapes should be based on the inherent ability of the equipment to retain its integrity. This is of particular concern for equipment subject to bending stresses in the side walls during normal and accident conditions. The following geometric shapes are listed in descending order of stability: spherical, cylindrical, annular, and slab geometry. It should be noted that for reasonable sizes and comparable wall thicknesses, each descent of the scale decreases the inherent pressure failure limit of the vessel by about an order of magnitude.

This information notice requires no specific action or written response. If you have questions about the information in this notice, please contact the technical contact listed below or the appropriate regional office.



Robert F. Burnett, Director  
 Division of Fuel Cycle Safety  
 and Safeguards  
 Office of Nuclear Material Safety  
 and Safeguards

Technical contact: Marc Klasky, NMSS  
 (301) 504-2504

Attachments: *Filed in jacket*

1. List of Recently Issued NMSS Information Notices
2. List of Recently Issued NRC Information Notices

*SR-11C*

EKrause:TE 1/29/93

\*See previous concurrence

DOC NAME: 93-19.IN

OFC	IMUF*	IMUF*	IMUF*	IMSB*	IMNS*	FCSS <i>A</i>
NAME	MKlasky:	VTharpe	MTokar	JHickey	FCombs	JFreeves
DATE	2/03/93	2/02/93	2/04/93	2/04/93	2/23/93	3/15/93
OFC	D:FCSS <i>164x</i>					
NAME	RBurnett					
DATE	3/11/92					

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DATE	2/03/93		2/02/93		2/04/93		2/04/93		2/11/93		2/ /93	

OFC	D:FCSS											
NAME	RBurnett											
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This information notice requires no specific action or written response. If you have questions about the information in this notice, please contact the technical contact listed below or the appropriate regional office.

Richard E. Cunningham, Director  
 Division of Industrial and  
 Medical Nuclear Safety  
 Office of Nuclear Material Safety  
 and Safeguards

Technical contact: Marc Klasky, NMSS  
 (301) 504-2504

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OFC	IMUF	IMUF	IMUF	IMSB	IMNS	IMNS
NAME	MKlasky	VTharpe	MTokar	JHickey	JGreeves	RCunningham
DATE	2/3/93	2/8/93	2/4/93	2/4/93	2/ /93	2/ /93

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LIST OF RECENTLY ISSUED  
NMSS INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
93-18	Portable Moisture-Density Gauge User Responsibilities during Field Operations	03/10/93	All U.S. Nuclear Regulatory Commission licensees that possess moisture-density gauges.
93-14	Clarification of 10 CFR 40.22, Small Quantities of Source Material	02/18/93	All Licensees who possess source material.
93-10	Dose Calibrator Quality Control	02/02/93	All Nuclear Regulatory Commission medical licensees.
93-07	Classification of Transportation Emergencies	02/01/93	All Licensees required to have an emergency plan.
93-05	Locking of Radiography Exposure Devices	01/14/93	All Nuclear Regulatory Commission industrial radiography licensees.
93-04	Investigation and Reporting of Misadministrations by the Radiation Safety Officer	01/07/93	All U.S. Nuclear Regulatory Commission medical licensees.
93-03	Recent Revision to 10 CFR Part 20 and Change of Implementation Date to January 1, 1994	01/05/93	All byproduct, source, and special nuclear material licensees.
92-84	Release of Patients Treated with Temporary Implants	12/17/92	All Nuclear Regulatory Commission Medical Licensees.
92-72	Employee Training and Shipper Registration Requirements for Transporting Radioactive Materials	10/18/92	All U.S. Nuclear Regulatory Commission Licensees.

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93-17	Safety Systems Response to Loss of Coolant and Loss of Offsite Power	03/08/93	All holders of OLs or CPs for nuclear power reactors.
93-16	Failures of Nut-Locking Devices in Check Valves	02/19/93	All holders of OLs or CPs for nuclear power reactors.
93-15	Failure to Verify the Continuity of Shunt Trip Attachment Contacts in Manual Safety Injection and Reactor Trip Switches	02/18/93	All holders of OLs or CPs for nuclear power reactors.
93-14	Clarification of 10 CFR 40.22, Small Quantities of Source Material	02/18/93	All licensees who possess source material.
93-13	Undetected Modification of Flow Characteristics in the High Pressure Safety Injection System	02/16/93	All holders of OLs or CPs for nuclear power reactors.
93-12	Off-Gassing in Auxiliary Feedwater System Raw Water Sources	02/11/93	All holders of OLs or CPs for nuclear power reactors.
93-11	Single Failure Vulnerability of Engineered Safety Features Actuation Systems	02/04/93	All holders of OLs or CPs for nuclear power reactors.
93-10	Dose Calibrator Quality Control	02/02/93	All Nuclear Regulatory Commission medical licensees.

OL = Operating License  
 CP = Construction Permit