

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

March 6, 1989

NRC INFORMATION NOTICE NO. 89-24: NUCLEAR CRITICALITY SAFETY

Addressees:

All fuel cycle licensees and other licensees possessing more than critical mass quantities of special nuclear material.

Purpose:

This information notice is being provided to alert addressees to potential problems resulting from inadequate administration and application of the double contingency principle in establishing nuclear criticality safety limits and controls. 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 U.S. Nuclear Regulatory Commission (NRC) requirements; therefore, no specific action or written response is required.

Description of Circumstances:

The double contingency principle, as used in ANSI/ANS-8.1-1983\*, states that "Process designs should, in general, incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible." Proper application of the double contingency principle provides assurance that no single error or loss of a control will lead to the possibility of a criticality accident.

In March 1988, an NRC licensee was authorized to operate a new pilot plant operation involving highly enriched uranium solution. Provisions were made to remove liquid scrap in 2.5 liter bottles from the operations area (Area 1). Because of increased quantities of scrap solution and lack of temporary storage, an alternate liquid-handling process was established. The alternate method allowed both dilute and concentrated scrap solution to be stored in 11-liter bottles in the same area. After an analysis of a single sample, the 11-liter bottles of dilute scrap solution were to be transferred to an adjacent area (Area 2) and emptied into mass-limited 55-gallon drums.

-----  
\*American National Standard For Nuclear Criticality Safety in Operations With Fissionable Materials Outside Reactors, ANSI/ANS-8.1-1983.

8902280162 ZA

EDAR-11C

During an inspection in July 1988, NRC personnel recognized that an operator could inadvertently transfer an unsafe quantity of scrap solution into a drum by either selecting the wrong bottle of solution or as a result of an erroneous sample analysis. Such an unsafe transfer could have been effected with only one unlikely, independent, and concurrent change in process conditions (viz., selecting the wrong bottle, recording the wrong analysis or using the wrong sample analysis, etc.) and hence, the double contingency principle was not satisfactorily implemented. Because this method of handling 11-liter bottles was somewhat similar to the handling method contributing to the Wood River Junction accident in 1964, the NRC inspectors expressed concern. The licensee immediately ceased all scrap handling and subsequently shutdown the entire process area to review the safety limits and controls.

Further review disclosed that the nuclear criticality safety analyst who had analyzed the process before startup was not familiar with the alternate scrap-solution-handling procedure. Administrators within the licensee's safety group had approved the change because a safe mass limit had been imposed on each drum in Area 2. The licensee claimed that the alternate method of solution-handling, permitted by procedure, had not been used because the material control and accounting restrictions made the method inefficient.

NRC personnel also noted that Area 2 contained several open 55-gallon drums. Area 2 was used to remove solids from Raschig ring filled drums which were used in Area 3 (scrap recovery). Raschig ring filled drums and drums of chemicals were taken from Area 2 into Area 3. Because a 55-gallon drum was involved in the Oak Ridge Y-12 accident, NRC personnel expressed concern with the lack of controls on open drums. The licensee immediately shutdown Areas 2 and 3 so that the nuclear criticality safety limits and controls could be re-examined.

#### Discussion:

These events highlight the need for continuing vigilance in providing a sound nuclear safety program. Some of the licensee's actions taken after the inspection are discussed here. Licensees are encouraged to review these actions and their own vigilance in assuring nuclear criticality safety.

A team led by a safety director from another of the licensee's nuclear facilities conducted an immediate audit of the three areas. The team consisted of safety and production personnel. The audit team confirmed NRC's findings and identified other safety items.

All nuclear criticality safety analyses were reviewed to ensure proper application of the double contingency principle. Documentation of analyses has been revised to provide explicit consideration of the double contingency principle.

The nuclear criticality safety analysis group now reviews all changes to nuclear criticality limits and controls. The administrative group can no longer approve seemingly simple changes such as authorizing new mass limits for work stations, based on established safe mass limits.

Production personnel were not involved in establishing nuclear safety limits and were not familiar with the above-mentioned nuclear criticality accidents. The safety training program has been revised to include selected accident histories.

All involved personnel, including production operators, have reviewed all procedures. Before startup of Areas 1, 2, and 3, procedures were revised to include nuclear safety limits and controls. Procedures in other plant areas will be revised to include safety limits.

Liquid scrap from Area 1 is now collected in favorable geometry containers. After analysis, the solution is transferred to a favorable geometry quarantine tank for a second analysis. Then the solution is transferred to uniquely identified favorable geometry containers, for transfer to the drums in Area 2.

Most 55-gallon drums in Area 2 have been eliminated by engineering redesign. Barriers and other controls are in place to prevent unauthorized transfer of drums into Area 3. Engineering studies are underway to eliminate or reduce the use of all unfavorable geometry containers in Area 3.

No specific action or written response is required by this information notice. If you have questions about this matter, please contact the technical contacts listed below or the Regional Administrator of the appropriate regional office.

*Richard E. Cunningham*

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

Technical Contacts: Gerald Troup, Region II  
(404) 331-5566

George Bidinger, NMSS  
(301) 492-0683

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED  
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
89-23	Environmental Qualification of Litton-Yeam CIR Series Electrical Connectors	3/3/89	All holders of OLs or CPs for nuclear power reactors.
89-22	Questionable Certification of Fasteners	3/3/89	All holders of OLs or CPs for nuclear power reactors.
89-21	Changes in Performance Characteristics of Molded-Case Circuit Breakers	2/27/89	All holders of OLs or CPs for nuclear power reactors.
88-73, Supplement 1	Direction-Dependent Leak Characteristics of Containment Purge Valves	2/27/89	All holders of OLs or CPs for nuclear power reactors.
89-20	Weld Failures in a Pump of Byron-Jackson Design	2/24/89	All holders of OLs or CPs for nuclear power reactors.
89-19	Health Physics Network	2/23/89	All holders of OLs or CPs for nuclear power reactors, and the following fuel facilities: Nuclear Fuel Services of Erwin, General Atomic, UNC Montville, B&W LRC Lynchburg, and B&W Lynchburg.
89-18	Criminal Prosecution of Wrongdoing Committed by Suppliers of Nuclear Products or Services	2/22/89	All holders of OLs or CPs for nuclear power reactors.
89-17	Contamination and Degradation of Safety-Related Battery Cells	2/22/89	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License  
CP = Construction Permit

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555

OFFICIAL BUSINESS  
PENALTY FOR PRIVATE USE, \$300

FIRST CLASS MAIL  
POSTAGE & FEES PAID  
USNRC  
PERMIT No. G-87

Production personnel were not involved in establishing nuclear safety limits and were not familiar with the above-mentioned nuclear criticality accidents. The safety training program has been revised to include selected accident histories.

All involved personnel, including production operators, have reviewed all procedures. Before startup of Areas 1, 2, and 3, procedures were revised to include nuclear safety limits and controls. Procedures in other plant areas will be revised to include safety limits.

Liquid scrap from Area 1 is now collected in favorable geometry containers. After analysis, the solution is transferred to a favorable geometry quarantine tank for a second analysis. Then the solution is transferred to uniquely identified favorable geometry containers, for transfer to the drums in Area 2.

Most 55-gallon drums in Area 2 have been eliminated by engineering redesign. Barriers and other controls are in place to prevent unauthorized transfer of drums into Area 3. Engineering studies are underway to eliminate or reduce the use of all unfavorable geometry containers in Area 3.

No specific action or written response is required by this information notice. If you have questions about this matter, please contact the technical contacts listed below or the Regional Administrator of the appropriate regional office.

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

Technical Contacts: Gerald Troup, Region II  
 (404) 331-5566

George Bidinger, NMSS  
 (301) 492-0683

Attachment: List of Recently Issued NRC Information Notices

\*SEE PREVIOUS PAGE FOR CONCURRENCE

OFC:IMUF:*	IMUF:*	IMSB:*	DD/IMNS*	D/IMNS*
NAME:GHBidinger:	VLTharpe:	LCRouse:	GSjoblom:	RECunningham:
DATE:2/24/89	2/21/89	:2/24/89	:2/24/89	:2/24/89

OFFICIAL RECORD COPY

Production personnel were not involved in establishing nuclear safety limits and were not familiar with the above-mentioned nuclear criticality accidents. The safety training program has been revised to include selected accident histories.

All involved personnel, including production operators, have reviewed all procedures. Before startup of Areas 1, 2, and 3, procedures were revised to include nuclear safety limits and controls. Procedures in other plant areas will be revised to include safety limits.

Liquid scrap from Area 1 is now collected in favorable geometry containers. After analysis, the solution is transferred to a favorable geometry quarantine tank for a second analysis. Then the solution is transferred to uniquely identified favorable geometry containers, for transfer to the drums in Area 2.

Most 55-gallon drums in Area 2 have been eliminated by engineering redesign. Barriers and other controls are in place to prevent unauthorized transfer of drums into Area 3. Engineering studies are underway to eliminate or reduce the use of all unfavorable geometry containers in Area 3.

No specific action or written response is required by this Information Notice. If you have questions about this matter, please contact the technical contacts listed below or the Regional Administrator of the appropriate Regional Office.

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

Technical Contacts: Gerald Troup, Region II  
(404) 331-5566

George Bidinger, NMSS  
(301) 492-0683

Attachment: List of Recently Issued NRC Information Notices

EKraus 2/6/89

OFC: IMUF:	IMUF:	IMSB:	DD/IMNS:	D/IMNS:
NAME: GHBS: [Signature]	VLHarpe: [Signature]	LCRouse: [Signature]	GS Johnson: [Signature]	RECunningham: [Signature]
DATE: 2/24/89	: 2/21/89	: 2/24/89	: 2/24/89	: 2/24/89

OFFICIAL RECORD COPY

Liquid scrap from Area 1 is now collected in favorable geometry containers. After analysis, the solution is transferred to a favorable geometry quarantine tank for a second analysis. Then the solution is transferred to uniquely identified favorable geometry containers, for transfer to the drums in Area 2.

Most 55-gallon drums in Area 2 have been eliminated by engineering redesign. Barriers and other controls are in place to prevent unauthorized transfer of drums into Area 3. Engineering studies are underway to eliminate or reduce the use of all unfavorable geometry containers in Area 3.

No specific action or written response is required by this Information Notice. If you have questions about this matter, please contact the technical contacts listed below or the Regional Administrator of the appropriate Regional Office.

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

Technical Contacts: Gerald Troup, Region II  
(404) 331-5566

George Bidinger, NMSS  
(301) 492-0683

Attachment: List of Recently Issued NRC Information Notices

EKraus 2/6/89

OFC:IMUF: <i>JHB</i>	IMUF:	IMSB: <i>[Signature]</i>	DD/IMNS	D/IMNS
NAME: GHBidinger: <i>2/16/89 GHB</i>	VLTharpe: <i>[Signature]</i>	LCRouse: <i>[Signature]</i>	GSjoblom:	RECunningham:
DATE: 2/2/89	: 2/06/89	: 2/7/89	: 2/ /89	: 2/ /89

OFFICIAL RECORD COPY