

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

February 22, 1994

NRC INFORMATION NOTICE 94-13: UNANTICIPATED AND UNINTENDED MOVEMENT OF FUEL ASSEMBLIES AND OTHER COMPONENTS DUE TO IMPROPER OPERATION OF REFUELING EQUIPMENT

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to potential problems resulting from inadequate oversight of refueling operations and inadequate performance on the part of refueling personnel. It is expected that recipients 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 are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

Vermont Yankee Events

The Vermont Yankee facility was in a refueling outage with fuel movement in progress on September 3, 1993, when an irradiated fuel assembly became detached from the grapple after being lifted out of its position in the reactor core. The assembly fell approximately 2.4 m [8 ft] back into its original location in the reactor core. The licensee suspended fuel handling and investigated the event. The licensee determined that the grapple had not properly engaged the lifting bail on the fuel assembly and that the personnel performing the fuel handling activities had failed to verify proper grapple engagement. After completing the investigation and taking corrective actions, the licensee resumed fuel handling activities on September 7, 1993.

On September 9, 1993, a fuel assembly that was being moved to a fuel sipping can was inadvertently lowered, instead of raised, striking another core component. The potentially damaged fuel assembly was then moved to the fuel sipping can and the licensee again suspended fuel handling activities. The NRC dispatched an augmented inspection team (AIT) on September 9, 1993, to investigate the fuel handling incidents.

The AIT documented its findings in NRC Inspection Report 50-271/93-81, issued October 21, 1993. The AIT concluded that mistakes made by refueling personnel

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were the immediate causes of both events. In addition, weaknesses in the human factors aspects of the controls for the fuel handling equipment contributed to the event in which a fuel assembly was lowered rather than raised. The controls for the fuel handling equipment had been modified shortly before this event occurred. The team concluded that the root cause of the events was a significant weakness in management oversight of fuel handling activities. Weak management oversight had allowed many of the measures intended to prevent a fuel handling accident to be neglected. The AIT found that (1) design changes were not transmitted to allow timely and accurate training on modifications to the refueling bridge, (2) procedures were not always used and, when they were used, they were not always adhered to, and (3) supervisors did not ensure that procedures were followed. In addition, the AIT found that training was not effective in that operators were not aware of certain key procedure steps in most instances. Specifically, the personnel monitoring the fuel handling activities were not aware of the requirement to visually verify grapple closure when engaging and lifting fuel assemblies. The AIT found that management did not communicate expectations and provide proper oversight of fuel handling activities.

Peach Bottom Events

With Unit 3 shut down for refueling on September 23, 1993, a fuel assembly could not be fully inserted into its spent fuel rack cell. It was thought that the fuel assembly had swelled due to irradiation in the core, and the fuel assembly was successfully placed in a different cell. It was further postulated that there might be some debris in the cell, and that the cell should be checked at some future date. On September 24, 1993, another fuel assembly became stuck in its spent fuel rack cell. The licensee evaluated the material condition of the fuel assembly, calculated an allowable lifting force, and conferred with the fuel vendor. The licensee increased the load limit of the refueling hoist and the fuel assembly was freed from the rack with no damage to the fuel assembly. Subsequent examinations revealed that sections of local power range monitor instrument strings that had previously been cut up were in the bottoms of three cells in the rack, including the two cells with which difficulties were experienced. The licensee believes that the debris may have fallen into the cells during a fuel pool cleanup effort conducted during the previous summer.

The licensee is currently investigating why the debris was in the spent fuel pool and why the refueling personnel did not ensure that the spent fuel rack cells did not contain any debris prior to inserting the fuel assemblies.

Susquehanna Events

The Susquehanna Steam Electric Station Unit 1 was shut down with defueling in progress on October 6, 1993, when the personnel performing the fuel handling activities removed an incorrect fuel assembly from a peripheral location in the core. The personnel involved realized they had removed the wrong assembly and they inappropriately decided to return the assembly to its prior position in the core. The appropriate action, per licensee procedures, would have been to place the bundle in the spent fuel pool and secure fuel handling activities until the cause of the error was determined and corrected.

On October 26, 1993, while lowering a fuel assembly into the core during refueling, an unexpected drop of 25 to 38 cm [10 to 15 in] of one of the sections of the fuel handling mast occurred. The fuel assembly was not released and it did not strike the vessel internals. Subsequent testing reproduced mechanical binding of the mast, and a bend in the mast was observed. The binding temporarily restrained one section of the mast while a lower section extended. Eventually weight or motion caused the bound section to release and drop down a limited distance. The licensee subsequently determined that the mast had been bent by an impact with the flange protector for the reactor vessel while traversing through the "cattle chute" between the core and fuel pool, because the mast was not raised high enough. The Unit 2 refueling bridge was transferred to Unit 1 and, after satisfactory completion of surveillance testing, refueling was resumed.

On October 27, 1993, while transferring a double blade guide to the spent fuel pool, the blade guide hit the side of the reactor vessel because it was not raised high enough to clear the vessel. The licensee suspended refueling activities, revised the associated procedure, and inspected the mast. The core reload was resumed after surveillances on the fuel handling equipment were successfully conducted. On October 28, 1993, while attempting to grapple a new fuel assembly in the fuel pool, the personnel performing the fuel handling activities heard two loud bangs and observed bubbles in the pool for 5 to 10 seconds. Subsequent inspection revealed that one section of the mast from Unit 2 was bent. The licensee believes that the mast was weakened by the impact with the reactor vessel that occurred during the October 27 event.

On October 29, 1993, the NRC dispatched an AIT to the site to review the events. The AIT documented its findings in Inspection Report 50-387/93-80, issued on December 21, 1993. The AIT concluded that facility management did not maintain proper oversight of refuel floor activities and that inadequate corrective actions were implemented in the past for problems with the fuel handling equipment. The AIT also concluded that the licensee fuel handling procedures were adequate for the proper completion of the fuel handling activities, although certain improvements could be made to increase the awareness of the operators concerning potential problems.

Nine Mile Point Event

Nine Mile Point Unit 2 was shut down with refueling in progress on November 1, 1993, when a blade guide was moved from the core into the spent fuel pool. The contractor refueling operator disengaged the grapple and observed the correct light indication on the bridge. There was no procedural requirement to visually verify disengagement or for the Senior Reactor Operator Limited to Fuel Handling (LSRO) or the spotter to verify disengagement. The refueling operator noticed increased drag after the refueling bridge crane had been moved approximately 23 cm [9 in] toward the next location. At that time, licensee personnel determined that the blade guide was still engaged on the grapple. The bridge was returned to its previous position, the blade guide was lowered and disengaged (positive verification was obtained this time), and the operator proceeded to move the next component, which was a fuel assembly. While lowering that fuel assembly

into the core, the refueling operator noticed that the mast was binding. At this point, the LSRO became involved and directed that the fuel assembly be returned to the fuel pool. While lowering the fuel assembly into the rack in the fuel pool, the inner section of the mast dropped between 61 and 76 cm [24 and 30 in]. However, the fuel assembly was not released. After the fuel assembly was lowered, the grapple was disengaged and the LSRO halted further fuel movement. The licensee subsequently determined that the mast was bent and that the blade guide was not damaged. After the licensee reviewed the event, modified the procedure, and repaired the fuel handling equipment, fuel movements were resumed on November 4, 1993.

The licensee determined that there were several personnel performance issues that needed to be addressed. The refueling operator had been trained to verify disengagement after releasing each component, although the procedure only required verification of ungrappling when handling fuel assemblies. Disengagement was to be verified by raising and rotating the mast. The refueling operator did not verify disengagement after releasing the blade guide. In addition, the refueling operator did not notify the LSRO of the unanticipated equipment response (remaining connected to the blade guide while traversing the bridge). Also contributing to the event was the fact that the LSRO was observing a refueling bridge trolley bearing about which he was concerned, rather than the handling of the blade guide. Licensee review determined that management expectations regarding the supervision of refueling activities had not been clearly expressed to the LSROs.

Discussion

Refueling activities are safety-significant operations that are not conducted on a routine basis. In addition, fuel handling activities are often performed by contractor personnel under the supervision of licensee personnel. As a result, fuel handling personnel may not be familiar with the fuel handling equipment or may feel that their experience in fuel handling operations permits them to ignore some requirements for procedural use and adherence. Either of these situations could require increased management attention and oversight by the licensee to ensure proper and safe performance of fuel handling activities.

Appendix B to Part 50 of Title 10 of the Code of Federal Regulations (10 CFR 50) requires licensees to have appropriate procedures to control activities affecting quality (such as the actions to be taken during operation of refueling equipment), and that the procedures are used and followed. In addition, 10 CFR 50.120 requires licensees to implement a training program for various categories of nuclear power plant personnel to ensure that those personnel have the necessary knowledge, skills, and abilities to perform their assigned jobs competently. This rule applies to the personnel (including contractors) who operate or supervise the operation of the refueling equipment. The cases discussed in this notice include situations in which the licensees failed to conduct appropriate training in the use of their refueling equipment, particularly with respect to design modifications made to the controls for the fuel mast. These events also demonstrated that the fuel

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handling personnel involved in certain instances were variously not aware that management expected them to identify deviations from expected results, cease operations when an unexpected or abnormal condition is encountered, and notify operations and/or plant management of unexpected or abnormal conditions.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below, or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.



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Office of Nuclear Reactor Regulation

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Attachment:
List of Recently Issued NRC Information Notices

Attachment
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LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-12	Insights Gained from Resolving Generic Issue 57: Effects of Fire Protection System Actuation on Safety-Related Equipment	02/09/94	All holders of OLs or CPs for nuclear power reactors.
94-11	Turbine Overspeed and Reactor Cooldown during Shutdown Evolution	02/08/94	All holders of OLs or CPs for nuclear power reactors.
94-10	Failure of Motor-Operated Valve Electric Power Train due to Sheared or Dislodged Motor Pinion Gear Key	02/04/94	All holders of OLs or CPs for nuclear power reactors.
94-09	Release of Patients with Residual Radioactivity from Medical Treatment and Control of Areas due to Presence of Patients Containing Radioactivity Following Implementation of Revised 10 CFR Part 20	02/03/94	All U.S. Nuclear Regulatory Commission medical licensees.
94-08	Potential for Surveillance Testing to Fail to Detect an Inoperable Main Steam Isolation Valve	01/01/94	All holders of OLs or CPs for nuclear power reactors.
93-26, Supp. 1	Grease Solidification Causes Molded-Case Circuit Breaker Failure to Close	01/31/94	All holders of OLs or CPs for nuclear power reactors.
94-07	Solubility Criteria for Liquid Effluent Releases to Sanitary Sewerage Under the Revised 10 CFR Part 20	01/28/94	All byproduct material and fuel cycle licensees with the exception of licensees authorized solely for sealed sources.

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Original signed by
Brian K. Grimes

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* SEE PREVIOUS CONCURRENCES
** Concurrence per E-Mail

OFFICE				D/BORS	AC/OGCB:DORS
NAME				BKGrimes	AJKugler*
DATE				02/15/94	02/03/94
OFFICE	D/DRCH*	C/HHFB:DRCH*	HHFB:DRCH*	D/DSSA*	C/SPLB:DSSA*
NAME	BABoger	MMSlosson	PLEng	ACThadani	CMcCracken
DATE	01/25/94	01/25/94	01/14/94	01/15/94	01/12/94
OFFICE	RPB:ADM*	OGCB:DORS*	DRP:RI**	DRP:RI**	SPLB:DSSA*
NAME	TechEd	AJKugler	RFuhrmeister	RWCooper	GHubbard
DATE	12/10/93	12/21/93	12/28/93	01/06/94	01/12/94

DOCUMENT NAME: 94-13.IN

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OFFICE	D/DRCH #2/15/94	C/HHFB:DRCH	HHFB:DRCH*	D/DSSA*	C/SPLB:DSSA*
NAME	BABoger	MMSlosson NC8	PLEng	ACThadani	CMcCracken
DATE	01/15/94	01/06/94	01/14/94	01/15/94	01/12/94
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licensees failed to conduct appropriate training in the use of their refueling equipment, especially on the subjects of limitations on the speed and direction of movement of the fuel mast and of modifications to the controls for the fuel mast. These events also demonstrated that the fuel handling personnel involved were not aware that management expected them to identify deviations from expected results, cease operations when an unexpected or abnormal condition is encountered, and notify operations and/or plant management of unexpected or abnormal conditions.

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