

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

January 10, 2002

NRC INFORMATION NOTICE 2002-03: HIGHLY RADIOACTIVE PARTICLE CONTROL
 PROBLEMS DURING SPENT FUEL POOL
 CLEANOUT

Addressees

All holders of operating licenses for nuclear power reactors, holders of licenses for permanently shutdown facilities with fuel onsite, and holders of licenses for non-power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to recent issues involving evaluation and control of radioactive particles generated during removal of material from a spent fuel pool prior to shipping the material offsite for disposal. The issue emphasized in this notice is that highly radioactive (hot) particles represent a radiological hazard not just in terms of shallow dose to the skin or an extremity but also as a deep or whole-body dose. 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

Toward the end of a 5-month spent fuel pool cleaning project, the Susquehanna Steam Electric Station completed compacting irradiated components that had been temporarily stored in the pool. Working under water remotely, the licensee had used an "advanced crusher and shearer" (ACS) unit to compact control rod blades and local power range monitors. On October 12, 2000, the ACS was removed from the cask storage pit with a crane after apparently inadequate cleaning with a high-pressure spray Hydrolazer. The ACS was moved over the refueling floor and into the reactor head washdown area for further decontamination prior to shipment offsite. The ACS was not totally wrapped or sealed during this movement. Also, access to the ACS pathway over the refueling floor was not radiologically controlled during the move.

During the movement of the ACS, the refueling floor local area radiation monitor began to alarm. The cause was a previously unidentified highly radioactive particle which had fallen from the ACS. The particle was later determined to be a 2.78 gigabecquerel (Gbg) [75 millicuries (mCi)] Co-60 particle, reading approximately 8 sievert/h (Sv/h) (800 rem/h) at contact.

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The licensee stopped work, shielded and captured the particle, and initiated radioactive particle control zone coverage for the entire refueling floor. Additional actions undertaken at that time included formation of a root cause event review team. The team's work led to upgraded controls, surveying, more management oversight and more detailed planning and work procedures for handling high specific activity particles.

A search was then begun for additional hot particles on the refueling floor. Workers in particle control zones were surveyed for particles every 15 minutes, and more protective clothing (PC) was required for certain work activities. The 15-minute control was a default stay time, and not based on dose calculations for the high-activity particles known to be present.

During the cleanup activities, more than 30 radioactive particles were found on the refueling floor. Two high activity radioactive particles found on September 9 and December 6, 2000, had resulted in shallow-dose equivalent (SDE) exposures of 0.12 and 0.17 Sv (12 and 17 rem), which is below the annual SDE limit of 50 rem. The licensee discovered two more high-activity particles, a 0.78 Gbq (21 mCi) particle on November 28, and a 0.7 Gbq (19 mCi) particle on December 4, 2000; these particles did not result in significant exposure to personnel. No actual exposures in excess of any annual dose limits occurred during the cleanup activities.

During a scheduled NRC health physics, rad-waste transportation, baseline inspection during December 11-15, 2000 (Inspection Report Nos. 05000387/2000-009 and 05000388/2000-009, ADAMS Accession No. ML010250469), the NRC inspector identified significant weaknesses in the licensee's particle control program. The inspector noted that the licensee had failed to identify that conventional hand-held survey instruments using standard survey methods were underestimating the contact dose rates of the particles, thus underestimating the radiological hazards not just to the skin but in terms of whole body exposure.

The licensee's evaluation had failed to consider properly and account for the potential for substantial dose to personnel from the high-activity particles. Specifically, the 15-minute worker stay time was not adequate to prevent potential overexposures from the particles known to be present in and around the refueling floor. The stay time would have allowed both SDE and total effective dose equivalent (TEDE) annual exposure limits to be exceeded.

Four of the particles found ranged from 0.7 to 2.78 Gbq (19 to 75 mCi). Had the particles been directly on the workers' PCs, the TEDE annual limit of 0.05 Sv (5 rem) could have been exceeded in 25 seconds to 2 minutes, and the SDE limit exceeded in 6 to 21 seconds, depending on the activity of the individual particle.

In response to the NRC findings and a 0.17 Sv (17 rem) SDE exposure on December 6 from a particle on a worker's boot, licensee management stopped all high-risk work, initiated a comprehensive events evaluation, requested on-site assistance by an industry expert team, and implemented improved training and communication of lessons learned in this area.

Discussion

During previous similar processing of irradiated components at Susquehanna in 1991, radioactive particles had been identified with external gamma dose rates greater than 100 rem/hr. However, the plant failed to incorporate fully this previous experience and industry-wide experience into the planning for the 2000 fuel pool clean out project. (NRC Information Notice No. 90-33, "Sources of Unexpected Occupational Radiation Exposures at Spent Fuel Storage Pools," also concerns highly radioactive particles.)

Prior to the NRC baseline inspection, after the initial event, the work controls that the licensee had implemented were not sufficient under the circumstances to evaluate and control the potential radiological challenges posed by these extremely high activity particles. A Notice of Violation (failure to conduct adequate evaluation and survey) associated with a White finding (using the Significance Determination Process) was issued. These actions were taken because of the substantial potential for exposure in excess of the annual limit for TEDE even though no worker dose limits were exceeded.

During the regulatory conference for this violation, the licensee stated that it needed to improve its hot particle surveying, identification, handling, and control. The improvements included more effective use of remote handling techniques, proactive staging of particle control zones, and aggressive treatment of potential sources of particles by using decontamination and filtration on systems that communicate with the spent fuel pool.

The licensee noted that in cases like this where a contractor was used for a challenging radiological evolution, plant management oversight was essential. That oversight must focus on, and have sufficient resources to implement and maintain a sense of an acceptable radiation culture and acceptable practices and standards for radiation work. According to the licensee, this can best be accomplished by direct ownership for significant, high-risk projects demonstrated by the visible presence and direct oversight of the work by utility managers.

Most importantly, this occurrence demonstrated a need to strengthen procedural controls to focus attention on the large potential doses from these challenging radiological work environments. The worker training program and job oversight must emphasize the most important lesson learned from the event—that radioactive particles can present not only shallow-dose risks but, at higher activity levels, whole body dose risks, which can be much more significant.

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.

/RA/

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Attachment: List of Recently Issued NRC Information Notices

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*See previous concurrence

OFFICE	REXB	Tech Ed	IOLB	SC:REXB	RORP
NAME	EGoodwin*	PKleene*	GTracy*	JTappert*	Wbeckner*
DATE	12/20/2001	6/19/2001	8/20/2001	6/26/2001	01/08/2002

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LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
2002-02	Recent Experience with Plugged Steam Generator Tubes	01/08/2002	All holders of operating licenses for pressurized-water reactors (PWRs), except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.
2002-01	Metalclad Switchgear Failures and Consequent Losses of Offsite Power	01/08/2002	All holders of licenses for nuclear power reactors.
2001-19	Improper Maintenance and Reassembly of Automatic Oil Bubblers	12/17/2001	All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
2001-18	Degraded or Failed Automated Electronic Monitoring, Control, Alarming, Response, and Communications Needed for Safety and/or Safeguards	12/14/2001	All uranium fuel conversion, enrichment, and fabrication licensees and certificate holders authorized to receive safeguards information. Information notice is not available to the public because it contains safeguards information.
2001-17	Degraded and Failed Performance of Essential Utilities Needed for Safety and Safeguards	12/14/2001	All uranium fuel conversion, enrichment, and fabrication licensees and certificate holders authorized to receive safeguards information. Information notice is not available to the public because it contains safeguards information.
2001-08, Sup. 2	Update on Radiation Therapy Overexposures in Panama	11/20/2001	All medical licensees.
2001-16	Recent Foreign and Domestic Experience with Degradation of	steam Generator	Tubes and Internals