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

May 9, 1990

NRC INFORMATION NOTICE NO. 90-33: SOURCES OF UNEXPECTED OCCUPATIONAL RADIATION EXPOSURES AT SPENT FUEL STORAGE POOLS

Addressees:

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

Purpose:

This information notice is intended to alert addressees to potential sources of unexpected occupational radiation exposures at spent fuel storage (SFS) pools. 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 do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

SFS pools provide a water-shielded location for the storage of spent fuel and other highly radioactive materials that are potential sources of high radiation exposures. SFS pools also may be contaminated with highly radioactive particles having activities of tens of millicuries (mCi) or more. This information notice identifies a number of events in which sources of unexpected occupational radiation exposures were encountered in the activities associated with SFS pools.

Events Involving Highly Radioactive Objects That Floated in SFS Pools

In June 1989, several individuals involved in SFS pool cleanup activities at the James A. FitzPatrick Nuclear Power Plant received unexpected radiation exposures (within NRC limits) from an object floating near the surface of the SFS pool near their work location. Subsequent radiation surveys of the object indicated contact radiation exposure rates of about 1000 roentgens per hour (R/hour). The licensee believes that the source of the radiation was a small fragment of radioactive material imbedded in a piece of floating material. The floating material probably was a piece of a 5-gallon polyethylene container in which irradiated components had been stored underwater for more than a year. Apparently, the polyethylene container began to disintegrate as a result of radiation from the irradiated components stored inside it.

The problem of contaminated objects floating to the surface of SFS pools is not new. In December 1984, complete canister filters from a portable underwater vacuuming system floated at least 15 feet toward the top of the spent

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fuel racks at the Peach Bottom Atomic Power Station. Licensee personnel speculated that the filters may have surfaced and then sank to the spent fuel storage racks. Although no personnel received unexpected exposures, this event could have caused significant exposure to personnel.

In May 1987, floating vacuum cleaner filters were also involved in a similar event at the Millstone Nuclear Power Station, Unit 1. During that event, the radiation level on the refueling floor increased momentarily to more than 100 mR/hour, then quickly returned to a normal level of about 10 mR/hour. The high radiation level occurred at the same time that the spent fuel pool cooling system was returned to use following valve maintenance. Refilling of the system forced air into the SFS pool through the sparger. The bubbles rose in the pool, causing agitation. The licensee postulated that the agitation forced highly contaminated vacuum cleaner filter cartridges stored in the pool to the surface. These filters contained debris from past cleaning evolutions of the reactor vessel and were suspended by nylon line in the SFS pool. After this event, the licensee decided to remove disposable items from the pool and to replace nylon lines, used for suspending items in the pool, with wire cables.

Events Involving Highly Radioactive Particles or Fragments of Radioactive Material Removed from SFS Pools

During reracking operations in the SFS pool at the Diablo Canyon Nuclear Power Plant, Unit 1, in December 1987, a highly radioactive particle (45.5 mCi of Co-60) was inadvertently removed from the SFS pool. The particle was attached to an air grinder hose that was partially pulled from the pool by the diver tender when the grinder hose became entangled with the diver's hose. When the Co-60 particle was removed from the pool, the radiation from the particle caused the fuel handling building (FHB) area radiation monitor to alarm, resulting in a shift of the FHB ventilation system to the iodine removal mode. The air grinder hose was not monitored for radiation while it was being removed from the pool. Conservative estimates by the licensee indicated that had the diver tender come in contact (0.5 second) with the Co-60 particle with his hands, he could have received an extremity dose of 895 mrem.

In October 1989, personnel at the Byron Station found unexpectedly high activity Co-60 particles (8 mCi and 77 mCi) during efforts to decontaminate and remove a portable filter assembly that had been used in an underwater vacuum cleaner to clean the bottom of the SFS pool. Three individuals received unexpected doses to their hands and forearms from these highly radioactive particles. These doses were calculated to be 1.25, 1.95, and 11.6 rem.

Highly radioactive materials also have been lifted, unexpectedly, to the surface of SFS pools. At the FitzPatrick plant in February 1987, a worker received an overexposure to the hand during the cutting and removal of in-core instrumentation dry tubes from the reactor vessel. During this operation, the cutting tool was removed from the water for inspection. A piece of highly radioactive dry tube that had been stuck in the tool fell out on the refueling floor. A worker immediately picked up the piece of dry tube and threw it back into the water. As a result of this brief contact with the dry tube, the worker received a radiation dose of about 30 rem to his hand, which exceeds the NRC limit of 18.75 rem per calendar quarter.

At the Callaway Plant, personnel discovered that an inadequate survey had been made on an underwater fuel elevator following its removal from the SFS pool on April 23, 1989. On April 29, 1989, a metal object was found to read 1000 R/hour at contact, but the object was shielded by the elevator structure so that only a localized area exceeded 100 mR/hour. The highly radioactive metal object was found to be a piece of a torn grid strap from a fuel assembly that had been repaired in the fuel elevator on April 21, 1989. Personnel had attempted to flush the piece out of the bottom of the fuel basket. However, because the piece was never seen in the fuel elevator basket and because no abnormal radiation readings were reported, personnel incorrectly assumed that the piece had been flushed from the elevator basket and was at the bottom of the fuel pool.

Event Involving Inadvertent Lifting of Highly Radioactive Material by Hoist

In April 1982 at the Peach Bottom Atomic Power Station, Unit 2, personnel inadvertently lifted a highly radioactive (in the million R/hour range) control rod blade (CRB) near the surface of the water for 5 to 10 seconds. This event occurred when a hafnium test blade (HFB) was to be moved from the fuel preparation machine to a CRB rack location. This evolution was being supervised by a senior licensed operator. When an operator attempted to move the HFB using the fuel grapple, the operator could not engage the temporary C clamp on the HFB. An auxiliary hoist was subsequently used to successfully move the HFB to the CRB rack location. After completing the HFB movement, the operator proceeded to pull the hoist grapple to its normal storage location out of the water. While the hoist was rising, its grapple engaged and picked up an adjacent CRB. The hoist limit switch stopped the upward movement when the grapple was still under 8 to 10 feet of water. At that time the operator, without looking, used the "override" button to bypass the limit switch and raised the grapple with the attached CRB. The area radiation monitor started alarming as the grapple with the CRB approached the surface of the water. Upon hearing the alarm, the refueling floor supervisor looked and saw a brown object approaching the water surface and yelled, "Put it down, put it down." The grapple was stopped before the CRB reached the surface. No radiological surveys were performed during this evolution. However, individuals at the pool area were unnecessarily exposed to radiation. Although these doses were about 300 mrem or less, if the CRB had reached the surface, the doses could have been much greater.

Event Involving Radiation Streaming

Underwater tools are designed with flood holes to allow water to fill the hollow sections of tubes. These flood holes provide shielding against radiation streaming from highly radioactive materials that are stored under water. At Indian Point Station, Unit 3, in July 1989, a worker using a tool to perform reconstitution of a spent fuel assembly noticed that a 12-foot-long 3/4-inch-diameter hollow section of the tool did not have a flood hole. As a result of this equipment design deficiency, the worker received an unplanned exposure. Although the licensee estimated that the worker received a radiation dose of only 30 mrem as a result of this incident, a hollow tool filled with air rather than water can result in much higher doses when the lower end of the tool is under water and near a highly radioactive source.

Additional Information:

Additional information on these events is provided in the documents listed in Attachment 1. The NRC and licensee documents are available in the NRC Public Document Room.

Discussion:

Although the events described above were associated with SFS pools, similar problems can occur during the removal and handling of material from flooded reactor cavities.

A review of licensee evaluations of these events, the licensee corrective actions, and feedback from NRC inspectors indicate that the following radiological control considerations can help minimize the possibility of unexpected exposures from radiation sources in SFS pools:

- Thorough evaluations of the contents of, and activities involving, SFS pools from a radiological perspective to identify potential unexpected exposure situations.

- Measures such as task analysis and training to ensure awareness of the potential for uncontrolled, unplanned transfer of highly radioactive materials, including highly radioactive particles, to the surface of SFS pools with the attendant potential for high radiation exposure of workers.

- Measures to ensure awareness of the need for thorough radiation surveys of all materials being removed from SFS pools.

- Measures to eliminate or secure floatable material in SFS pools.

- Avoidance of the use of containers made of materials (particularly plastics) that are subject to radiation damage and disintegration for the storage of highly radioactive materials in SFS pools. If such containers are used, limiting the radiation dose to the container can be used to prevent disintegration of the container as a result of radiation damage.

- Measures to ensure that highly radioactive objects stored under water at one end of a line whose other end is secured above the surface of the pool are not unexpectedly pulled to the surface.

- Measures to ensure awareness of the need to prevent radiation streaming through hollow sections of handling tools.

- Enhanced use of alarming personal dosimeters and of alarming area radiation monitors around SFS pools.

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 NRR project manager.

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Attachments:
1. Documents Providing Information on Events Involving Spent Fuel Storage Pools
2. List of Recently Issued NRC Information Notices

Documents Providing Information on Events Involving Spent Fuel Storage Pools

James A. FitzPatrick, June 1989 Event

- Inspection Report Nos. 50-333/89-08, August 10, 1989; 50-333/89-13, August 2, 1989; and 50-333/89-21, December 29, 1989.

Peach Bottom, December 1984 Event

- Memorandum from R. R. Bellamy, Region I, to L. J. Cunningham, NRR, August 16, 1989.

Millstone Unit 1, May 1987 Event

- Inspection Report No. 50-245/87-11, July 1, 1987.

Diablo Canyon, December 1987 Event

- Inspection Report No. 50-275/88-01, February 12, 1988.
- LER 87-27-00 (Docket No. 50-275).

Byron, October 1989 Event

- Inspection Report No. 50-454/89-21, December 8, 1989.

James A. Fitzpatrick, February 1987 Event

- Inspection Report No. 50-333/87-07, March 11, 1987.
- Letter from John C. Brons, New York Power Authority, to the Director, Office of Inspection and Enforcement, NRC, May 21, 1987.

Callaway, April 1989 Event

- Inspection Report No. 50-483/89-16, September 8, 1989.

Peach Bottom, April 1982 Event

- Inspection Report No. 50-277/82-11, July 13, 1982.

Indian Point Unit 3, July 1989 Event

- Inspection Report No. 50-286/89-18, September 12, 1989.

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
90-32	Surface Crack and Subsurface Indications in the Weld of A Reactor Vessel Head	5/3/90	All holders of OLs or CPs for nuclear power reactors.
90-31	Update on Waste Form and High Integrity Container Topical Report Review Status, Identification of Problems with Cement Solidification, and Reporting of Waste Mishaps	5/4/90	All holders of OLs or CPs for nuclear power reactors, fuel cycle licenses, and certain by-product materials licenses.
90-30	Ultrasonic Inspection Techniques for Dissimilar Metal Welds	5/1/90	All holders of OLs or CPs for nuclear power reactors.
90-29	Cracking of Cladding and Its Heat-Affected Zone in the Base Metal of a Reactor Vessel Head	4/30/90	All holders of OLs or CPs for nuclear power reactors.
90-28	Potential Error in High Steamline Flow Setpoint	4/30/90	All holders of OLs or CPs for BWRs.
90-27	Clarification of the Recent Revisions to the Regulatory Requirements for Packaging of Uranium Hexafluoride (UF_6) for Transportation	4/30/90	All uranium fuel fabrication and conversion facilities.
89-70, Supp. 1	Possible Indications of Misrepresented Vendor Products	4/26/90	All holders of OLs or CPs for nuclear power reactors.
90-26	Inadequate Flow of Essential Service Water to Room Coolers and Heat Exchangers for Engineered Safety-Feature Systems	4/24/90	All holders of OLs or CPs for nuclear power reactors.

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