

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

February 13, 2002

NRC INFORMATION NOTICE 2002-09: POTENTIAL FOR TOP NOZZLE SEPARATION
AND DROPPING OF A CERTAIN TYPE OF
WESTINGHOUSE FUEL ASSEMBLY

Addressees

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

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the recent nozzle separation and dropping of a Westinghouse fuel assembly during movement. Even though the nozzle separation affects only fuel of a type last manufactured almost 20 years ago, the fuel is perhaps being moved to dry storage or high-density racks and could drop during movement. 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 Circumstance

On March 24, 2001, operators at the North Anna Power Station of Virginia Electric and Power Company were inspecting older spent fuel assemblies in advance of transferring them to dry cask storage. As assembly G45 was being returned to its spent fuel rack, the top nozzle separated from the assembly and the assembly dropped about 12 feet into its storage cell. The top nozzle, with the burnable poison rod assembly still attached, remained on the handling tool. Since the assembly bottom nozzle was already in the cell, the falling assembly did not contact any other fuel assemblies or the rack structure. There was no collateral damage. An initial visual inspection of the top of the assembly within the cell using a TV camera revealed that the bulge joints connecting the stainless steel sleeves to the Zircaloy 4 guide tubes had failed. No fission gas activity was detected afterwards, indicating that none of the fuel rods in the assembly had been fractured by the drop.

The assembly was supplied by Westinghouse in 1984, spent a short time in the spent fuel pool during 1984, and then was loaded into the Unit 1 reactor. It was burned during cycles 5 and 6 from September 1984 to April 1987 and then offloaded to the spent fuel pool. The assembly was moved 10 times in all for the receipt inspection and refueling operations. Prior to the recent event, it was last moved in 2000 for ultrasonic testing.

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Discussion

A historical review by Westinghouse revealed that similar events had occurred in the past. These included an event at Prairie Island in 1981 and several events at foreign plants in the 1980s. In all these events the fuel assembly had separated at the top bulge joint that connects the stainless steel grid sleeves to the Zircaloy guide tube, just as at North Anna. Hot cell metallography after the earlier events indicated that the likely root cause was intergranular stress-corrosion cracking (IGSCC) accelerated by the presence of chlorides, fluorides, and sulfates.

The method of fabrication of the top grid assembly is believed to have been among major factors in these failures. The grid nozzle assembly was fabricated by brazing the Alloy 304 stainless steel grid sleeves to the upper nozzle assembly prior to age-hardening heat treatment. It is believed that the heat sensitization of the Alloy 304 grid sleeves and the residual stresses in the roll bulge used to connect the grid to the guide thimble make the area highly susceptible to IGSCC when an appropriate contaminant like chloride, fluoride, or sulfate is present at a high enough concentration. The grid sleeve was the part of the assembly that failed at North Anna.

For this reason, the grid sleeve material was changed to Alloy 304L in 1984. This material was not subjected to heat sensitization during the age-hardening process, protecting against IGSCC. Even though the design was changed in 1984, some Alloy 304 sleeves were shipped up through 1987. The North Anna fuel assembly had Alloy 304 sleeves. In the late 80s, Westinghouse introduced removable top nozzles (RTNs). In this design, the guide tube is bulged onto an Alloy 304L insert tube, which is held in place by an Alloy 304L lock tube. This lock tube is then bulged into a groove in the top nozzle adapter plate. Neither the insert tube nor the lock tube undergoes grid age-hardening heat treatment and neither is sensitive to IGSCC.

A review of the spent fuel pool chemistry records at North Anna indicated that the levels of chlorides and fluorides in the spent fuel pool or reactor coolant system were not excessively high while the assembly in question was exposed. Westinghouse did not specify a limit for sulfates for spent fuels, nor did the Electric Power Research Institute (EPRI) guidelines for pool chemistry. However, sulfates had been monitored in the North Anna spent fuel pool starting in 1989 and were below 150 ppb for most of the period. Sulfates exceeded 150 ppb for 469 days of the 11 years measured, and never exceeded 630 ppb. Westinghouse therefore concluded that acid sulfate contamination was unlikely to have caused the IGSCC of the joints. Westinghouse speculated that a more aggressive reduced sulfur species caused the corrosion.

According to Westinghouse, North Anna visually inspected 208 fuel assemblies; 54 had indications of corrosion at the bulge joint and 10 had indications of cracking. North Anna, with the help of Westinghouse, is procuring appropriate tooling to lift the assemblies without putting load on the bulge joints. Westinghouse has informed all its fuel customers of the situation and provided recommendations on inspecting or using special lifting methods.

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

/RA/

William D. Beckner, Program Director
Operating Reactor Improvements Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Technical contacts: Michael J. Morgan, Region II
540-894-5421
E-mail: mjm@nrc.gov

James A. Canady, Region II
540-894-5422
E-mail: jac6@nrc.gov

Ian C. Jung, NRR
301-415-1837
E-mail: ixj@nrc.gov

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LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
2002-08	Pump Shaft Damage Due to Excessive Hardness of Shaft Sleeve	01/30/2002	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.
2002-07	Use of Sodium Hypochlorite for Cleaning Diesel Fuel Oil Supply Tanks	01/28/2002	All holders of operating licenses for nuclear power except those who have ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
2002-06	Design Vulnerability in BWR Reactor Vessel Level Instrumentation Backfill Modification	01/18/2002	All holders of operating licenses or construction permits for boiling water reactors (BWRs).
2002-05	Foreign Material in Standby Liquid Control Storage Tanks	01/17/2002	All holders of licenses for nuclear power reactors.
2002-04	Wire Degradation at Breaker Cubicle Door Hinges	01/10/2002	All holders of operating licenses for nuclear power reactors.
2002-03	Highly Radioactive Particle Control Problems During Spent Fuel Pool Cleanout	01/10/2002	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.
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.