

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, DC 20555-0001

March 3, 2004

NRC INFORMATION NOTICE 2004-05: SPENT FUEL POOL LEAKAGE TO ONSITE
GROUNDWATER

Addressees:

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) and for research and test reactors, and all holders of fuel storage licenses and construction permits.

Purpose:

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to inform addressees of the recent identification of a longstanding leak to onsite groundwater from the spent fuel pool of an operating pressurized water reactor facility. 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:

On September 18, 2002, the licensee for the Salem Nuclear Generating Station identified evidence of radioactive water leakage through an interior wall located at the 24-meter (78-foot) elevation of the Unit 1 auxiliary building mechanical penetration room, a radiologically controlled area. The leak location, about 3 meters (10 feet) up a wall surface, was identified while the licensee was following up low-level shoe contamination of personnel who had traversed the room. The licensee established a comprehensive task action plan to identify and stop the source of the leakage and evaluate possibly undetected leakage outside building structures. The licensee did identify other locations where radioactive water was leaking through interior walls or penetrations into both the Unit 1 auxiliary building and the Unit 1 fuel handling building (FHB).

On February 6, 2003, the licensee identified the radionuclide tritium (H-3) in groundwater in two test locations near the Unit 1 FHB. The test locations were within the licensee-controlled restricted area. The licensee identified other locations of groundwater contamination in the general vicinity of the Unit 1 FHB and within the restricted area. No other reactor-produced radionuclides were detected in the groundwater sampling test locations.

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The licensee obtained technical support and concluded (based on leak testing of suspect systems, chemical analysis of water samples, system and building configuration reviews, and a geohydrological evaluation) that the likely source of the tritium was the Unit 1 spent fuel pool (SFP). The licensee believes that the leakage was the result of the obstruction of the leakage detection and collection system of the SFP stainless steel liner.

Discussion:

The Salem Unit 1 FHB is a seismically qualified structure that contains the Unit 1 SFP. Unit 1 SFP support systems in the Unit 1 auxiliary building pass through adjacent building walls to the Unit 1 FHB. The walls are separated by a Styrofoam® -filled 15-cm (6-inch) seismic gap and the support systems traverse the seismic gap.

The Unit 1 SFP is a concrete structure with a stainless steel liner. The SFP includes an integral liner leakage detection and collection system, consisting of an extensive network of collection lines running both horizontally and vertically within the narrow gap between the SFP liner and the concrete SFP structure. The collected liner leakage is discharged to a collection trough through 17 drain lines (tell-tale drains). The tell-tale drains provide a means to detect, monitor, and quantify potential leakage from the SFP liner. The collected leakage is subsequently directed to the liquid radioactive waste system for processing.

The licensee's reviews discovered that over the years since initial facility startup, materials such as boric acid residue and minerals accumulated within the leak collection and detection system and restricted the normal drainage of liquid. The reviews also found that a modification to the tell-tale drains in 1998 resulted in the inadvertent introduction of sealant into the tell-tale drains, further restricting the free drainage of leakage from the liner. As a result, through-liner leakage accumulated between the SFP liner and the concrete structure of the SFP. The accumulated water, containing tritium, subsequently migrated to other locations through penetrations, concrete construction joints, and cracks. The seismic gap was confirmed to contain water with radionuclides characteristic of Unit 1 SFP water. The water is believed by the licensee to have made its way to the groundwater in the restricted area via the seismic gap.

The licensee cleaned the tell-tale drains, improving the drainage of the accumulated water between the liner and spent fuel pool concrete structure and stopping the through-wall and penetration leakage. After the cleaning effort, the leak rate from the tell-tale drains increased from about 19 liters per day (5 gallons per day) to about 380 liters per day (100 gpd). The leakage was properly collected.

The NRC conducted a special inspection of this issue (NRC Inspection Report 50-272/2003-006; 50-311/2003-006, ADAMS Accession No. ML032890212). The NRC's and the licensee's reviews identified the following information about this situation.

1. The licensee took actions to identify specific leak locations, repair and mitigate the leak, and assess potential health and safety impacts. A comprehensive groundwater sampling and analysis program was implemented. Although the licensee believes, with a high degree of confidence, that the leak originated from the SFP, the licensee is continuing evaluations to confirm this conclusion. The leakage itself was not accompanied by large fluctuations in SFP water levels and was likely masked by approximately equal volumes of evaporation from the SFP.
2. The licensee stopped the identified through-wall leakage by cleaning the tell-tales and resumed controlled collection of SFP liner leakage via the installed leakage detection and collection system. Extent-of-condition reviews revealed no apparent accumulation of water between the SFP liner and concrete structure at Salem Unit 2.
3. The licensee's evaluations did not identify any immediate health and safety consequences to onsite workers or members of the public. No radionuclides associated with the leakage were detected outside the onsite areas administered as access-controlled areas for purposes of radiation protection. The licensee did not detect any tritium associated with this leak in areas accessible to the public (i.e., the unrestricted area). The licensee subsequently developed and implemented an onsite groundwater remedial investigation work plan in conjunction with State of New Jersey representatives.
4. The Unit 1 SFP had exhibited detectable leakage from the tell-tales since initial plant operations. To monitor leakage from the tell-tales, the licensee established a surveillance program. Over the years, the leakage from the tell-tales diminished but the licensee was not able to tell from leakage changes if they needed further evaluation. There was also a missed opportunity to evaluate earlier through-wall contaminated leakage for possible accumulation of water between the Unit 1 FSP liner and concrete structure.
5. There was no periodic maintenance of the SFP leakage detection and collection system to ensure that drainage channels remained free and clear so that the system could perform its design function of preventing water from accumulating behind the FHB walls. The licensee initiated actions to develop a cleaning and maintenance process.
6. The licensee conducted evaluations of potential short-term adverse impacts to the SFP structure. The preliminary evaluations did not identify any adverse effects that would impact the design bases of the SFP or FHB structure. Nonetheless, the licensee initiated laboratory testing of the effects of boric acid on concrete. The results of these tests are being evaluated by the licensee for potential long-term effects.

The licensee developed numerous corrective action documents to track the review, evaluation, and correction of identified deficiencies.

This information notice requires no specific action or written response. If there are any questions about this notice, contact one of the persons listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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2004-03	Radiation Exposures to Members of the Public in Excess of Regulatory Limits Caused by Failures to Perform Appropriate Radiation Surveys During Well-logging Operations	02/24/2004	All well-logging licensees.
2004-02	Strontium-90 Eye Applicators New Calibration Values and Use	02/05/2004	All U.S. Nuclear Regulatory Commission (NRC) medical-use licensees and NRC master materials license medical-use Permittees.
2004-01	Auxiliary Feedwater Pump Recirculation Line Orifice Fouling - Potential Common Cause Failure	01/21/2004	All holders of operating licenses or construction permits for nuclear power reactors, except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.

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