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

September 16, 2005

NRC INFORMATION NOTICE 2005-26: RESULTS OF CHEMICAL EFFECTS HEAD LOSS TESTS IN A SIMULATED PWR SUMP POOL ENVIRONMENT

ADDRESSEES

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.

PURPOSE

The U.S. Nuclear Regulatory Commission is issuing this information notice to inform addressees about recent NRC-sponsored research results related to head loss from chemical effects in a simulated PWR sump pool environment. The NRC anticipates that recipients will review the information for applicability to their facilities and consider taking actions, as appropriate, to avoid similar issues. However, no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

Generic Safety Issue (GSI) 191 addresses the potential for debris accumulation on PWR sump screens to affect emergency core cooling system (ECCS) pump net positive suction head margin. The NRC has issued Bulletin 2003-01, "Potential Impact of Debris Blockage On Emergency Sump Recirculation At Pressurized Water Reactors," and Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents At Pressurized Water Reactors," related to the GSI-191 resolution.
GL 2004-02 requests, in part, that licensees evaluate the maximum head loss postulated from debris accumulation (including chemical effects) on the submerged sump screen. Chemical effects are corrosion products, gelatinous material, or other chemical reaction products that form as a result of interaction between the PWR containment environment and containment materials after a loss-of-coolant accident (LOCA). NRC and the nuclear industry jointly developed an integrated chemical effects test (ICET) program to determine if chemical reaction products can form in representative PWR post-LOCA containment sump environments. These tests were conducted by Los Alamos National Laboratory at the University of New Mexico. The ICET series involved five tests, each representing a different subset of expected post-LOCA environments within existing PWR plants. Although chemical products were observed in all of

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the ICET environments, the head loss associated with these products was not evaluated as it was outside the scope of the ICET program. NRC initiated additional testing to obtain some insights on the head loss associated with chemical products that may form in PWR sump pools.

Head loss testing is being performed at the Argonne National Laboratory. Initial testing has been done in a piping loop containing a simulated sump pool environment intended to represent the ICET Test 3 conditions. ICET Test 3 was performed in a borated water environment containing trisodium phosphate (TSP), various metallic and non-metallic sample coupons representative of containment materials, and a mixture of insulation (80% calcium silicate, 20% fiberglass) samples. This environment was selected for initial head loss testing based on the early formation of chemical product during ICET Test 3 and the characteristics of this product observed during and after this test (NRC ADAMS Package Accession Number ML052140490). During initial testing to simulate these observed products, significant head loss was measured across a test screen containing a preexisting fiber bed. The Argonne tests and initial test results are described in detail in the attachment, "Chemical Effects/Head Loss Testing Quick Look Report, Tests 1 and 2," dated September 16, 2005.

DISCUSSION

As part of the GL 2004-02 response, licensees are required to evaluate the sump screen head loss consequences of any chemical effects in an integrated manner with other postulated post-LOCA conditions. These recent research results indicate that a simulated sump pool environment containing phosphate and dissolved calcium can rapidly produce a calcium phosphate precipitate that, if transported to a fiber bed covered screen, produces significant head loss. The attachment report contains several interesting observations:

- Significant head loss was observed in tests combining TSP with a higher concentration of dissolved calcium (simulating the ICET Test 3 environment) and in tests with TSP and lower dissolved calcium concentrations (i.e., less than the ICET 3 environment).

- Small-scale leaching tests were done with calcium silicate insulation. The amount of calcium that will dissolve appears to depend more on the initial pH of the solution than on the amount of calcium-silicate insulation placed into solution. Lower initial pH solutions produced greater amounts of dissolved calcium.

- The amount of calcium phosphate precipitant in an ICET Test 3 type environment may be limited by the amount of phosphate available from the TSP.

This information is relevant to plants containing phosphate (e.g., plants using TSP as a sump pool buffering agent) and calcium sources (e.g., insulation, concrete) that may dissolve within the post-LOCA containment pool with sufficient concentrations to form calcium phosphate precipitate. These test results indicate that substantial head loss can occur if sufficient calcium phosphate is produced in a sump pool and transported to a preexisting fiber bed on the sump screen.

Although significant increases in head loss were observed due to chemical effects in these tests, it is important to note that these head loss results were obtained in a recirculating test

loop not intended to be prototypical of a PWR plant containment. For example, the calcium phosphate precipitant was formed by introducing calcium chloride into a TSP buffered solution immediately upstream and at a higher elevation than a screen with a preestablished fiber bed. The test loop orientation and method of calcium introduction result in transport of virtually all chemical products to the fiber bed covered screen. Parameters that may influence head loss in these tests include screen approach velocity, fiber bed thickness, relative arrival times for debris and chemical precipitates, and loop fluid recirculation time. Applicability of these results to plant specific environments may also be affected by these and other variables (e.g., insulation materials, break location, and sump design).

The NRC is continuing head loss testing in simulated PWR sump pool environments that use other chemical species to buffer pH.

CONTACTS

This information notice does not require any specific action or written response. Please direct any questions about this matter to the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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Attachment: Chemical Effects/Head-Loss Testing Quick Look Report, Tests 1 and 2

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