UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
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NRC INFORMATION NOTICE 2003-02: RECENT EXPERIENCE WITH REACTOR COOLANT SYSTEM LEAKAGE AND BORIC ACID CORROSION

Addressees

All holders of operating licenses or construction permits for pressurized water reactors (PWRs).

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to inform addressees of recently observed reactor coolant leakage at two pressurized water reactor facilities, one of which resulted in the subsequent degradation of the reactor pressure vessel head. 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 in this information notice are not NRC requirements; therefore no specific action or written response is required.

Description of Circumstances

Sequoyah Unit 2

On December 26, 2002, the unit tripped from full power as a result of low reactor coolant system (RCS) flow due to a ground fault in a reactor coolant pump motor winding. In the ensuing shutdown to correct the pump problem, the licensee initiated a search to locate and correct a suspected RCS leak that, prior to the trip, had resulted in elevated moisture and activity levels inside containment. During this inspection, the licensee identified an accumulation of boric acid on the reactor vessel head insulation that resulted from a leaking reactor vessel level indication system (RVLIS) compression fitting. The leakage had seeped through a seam in the insulation onto the reactor pressure vessel (RPV) head and resulted in minor boric acid corrosion of the head. This RVLIS compression fitting had been disconnected and reconnected during the May 2002 refueling outage. The licensee also identified a small leak through a canopy seal weld on an empty control rod drive mechanism (CRDM) penetration that did not result in any boric acid corrosion of the reactor vessel head.

Based on the location of the leaking RVLIS fitting, the temperature of the leakage fluid was close to the ambient temperature outside the vessel insulation. The licensee estimated the mass of boric acid crystals on this insulation surface at about 9 kilograms (20 pounds). A seam

in the insulation was in this area. On removing the insulation and cleaning the area, the licensee observed boric acid corrosion of the head near the flange. The licensee determined that the amount of material loss from the head was small, in the shape of a groove less than one centimeter (cm) [0.3 inch] wide, about twelve cm [4.6 inches] long, and at most about one-third cm [0.125 inch] deep.

The licensee's evaluation indicated that 98 percent or better of the structural wall remained intact and that no abrupt corners existed in the degraded area. The licensee justified continued operation based on the minor extent of the degradation.

Comanche Peak Unit 1

On November 30, 2002, a control rod dropped into the core. The licensee suspected a fault in the CRDM coils. Failing to identify the cause of the dropped rod while at reduced power, the licensee decided to shut down. While continuing to troubleshoot the CRDM problem in Mode 3, the licensee observed a leak around the CRDM housing. The leak was from a CRDM canopy seal weld. Water from the leaking canopy seal weld apparently entered the CRDM coils, causing coil failure. Boric acid crystals were found around the leak site, on the vessel head insulation, and on the reactor pressure vessel head. The licensee repaired the canopy weld with a weld overlay and cleaned the CRDM housing, the head insulation, and the head to remove the boric acid deposits. The amount of boric acid crystals recovered from the head was about 1 kilogram (2 pounds). The licensee did not find any reactor coolant pressure boundary degradation.

Other operating experiences of similar character may be found in the generic communications listed in NRC Bulletin 2002-01, "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity."

Discussion

A number of mechanical and welded connections exist above the reactor pressure vessel head that, historically, have leaked at a number of plants. This leakage of borated water may lead to degradation of the low alloy steel reactor vessel head by boric acid corrosion. At Sequoyah Unit 2, the leakage resulted in relatively minor degradation of the reactor vessel head. At Comanche Peak Unit 1, the leakage resulted in no apparent degradation of the RCS pressure boundary. In the Sequoyah Unit 2 and Comanche Peak Unit 1 events, the unidentified reactor coolant leakage had not shown a discernible increase from the very low levels that typically occur at a PWR facility.

Common assumptions that RCS leakage onto a hot surface, such as the reactor pressure vessel head, will not cause corrosion may not be justified and are the subject of ongoing research. Usually, small quantities of water coming into contact with a surface as hot as the reactor vessel head would be expected to flash and leave a noncorrosive dry boric acid residue on the surface. However, at Sequoyah Unit 2 the resulting condition produced an environment in which boric acid corrosion could occur. This experience challenges current assumptions with respect to the potential effects of RCS leakage. The NRC is continuing to consider the safety and regulatory aspects of this experience.

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 contact listed below or the appropriate project manager from the NRC's Office of Nuclear Reactor Regulation (NRR).

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