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

February 14, 1996

INFORMATION NOTICE 96-11: INGRESS OF DEMINERALIZER RESINS INCREASES POTENTIAL FOR STRESS CORROSION CRACKING OF CONTROL ROD DRIVE MECHANISM PENETRATIONS

Addressees

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

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the increased likelihood of stress corrosion cracking of pressurized water reactor (PWR) control rod drive mechanism (CRDM) penetrations if demineralizer resins contaminate the reactor coolant system (RCS). 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 supplement are not NRC requirements; therefore, no specific action or written response is required.

Background

In 1990, the NRC staff issued Information Notice 90-10, "Primary Water Stress Corrosion Cracking (PWSCC) of Inconel 600," informing PWR licensees that PWSCC was an emerging technical issue. PWSCC was noted in Inconel 600 pressurizer heater sleeve penetrations at a domestic PWR facility. The NRC staff determined that the safety significance of the cracking was low because the cracks were axial, had a low growth rate, and were in a material with an extremely high flaw tolerance (high fracture toughness). Accordingly, the cracks were unlikely to propagate very far.

In December 1991, after cracks were found in a CRDM penetration in the reactor head at a French plant, an NRC action plan was implemented to address PWSCC at all U.S. PWRs. The NRC staff met with the Westinghouse Owners Group, the Babcock and Wilcox Owners Group, and the Combustion Engineering Owners Group to discuss their respective programs for investigating PWSCC of Inconel 600 and to assess the possibility of cracking of CRDM penetrations in their respective plants. Subsequently, the staff asked the Nuclear Management and Resources Council, now the Nuclear Energy Institute, to coordinate future industry actions because the issue was applicable to all PWRs. Each owners

group submitted individual safety assessments, dated February 1993, through Nuclear Energy Institute to the NRC on the CRDM penetration cracking issue. In July 1993, the Institute submitted to the NRC proposed acceptance criteria for flaws identified during inservice examination of CRDM penetrations. On the basis of the owners group analyses and the European experience, the NRC staff concluded, in a safety assessment dated November 19, 1993, (NRC Accession No. 9403020162), that there is a high probability that CRDM penetrations at U.S. plants may contain similar axial cracks caused by PWSCC.

The Electric Power Research Institute is engaging in ongoing research on methods for mitigating PWSCC. They also have developed a demonstration program to ensure that inspections performed on CRDM penetrations are highly reliable in detecting and determining the size of flaws.

The first of three U.S. inspections took place in the spring of 1994 at the Point Beach Nuclear Generating Station. No indications were uncovered in the CRDM penetrations. The eddy current inspection at the Oconee Nuclear Station, Unit 2, in the fall of 1994 revealed 20 indications in one penetration. Ultrasonic testing did not reveal the depth of these indications because they were shallow. These indications may be associated with the original fabrication and may not grow; however, the licensee has committed to reexamine this penetration during the next refueling outage. An examination of the CRDM penetrations at the Donald C. Cook Nuclear Plant Unit 2 in the fall of 1994 revealed three clustered indications in one penetration. The indications were 46 mm (1.7 in.), 16 mm (0.63 in.), and 7 mm (0.28 in.) in length and the deepest flaw was 6.8 mm (0.27 in.) deep. The tip of the 46 mm (1.7 in.) flaw was just below the J-groove weld. These results are consistent with the PWR owners group analyses, the NRC staff safety evaluation of the owners group analyses, and the PWSCC found in the CRDM penetrations in European reactors. The results of these inspections are documented in Safety Evaluation Reports dated January 1995 for the D.C. Cook Plant (Accession Nos. 9504050173, 9504050168, 9503220149) and January 1995 for the Oconee Plant (Accession No. 9503270178).

Description of Circumstances

Early in 1994, an inspection for PWSCC at a reactor in Spain identified cracks which were apparently initiated by high sulfate levels in the reactor coolant system. Two cation resin ingress events had occurred at the reactor. In August 1980, 40 liters of cation resin entered the coolant system. In September 1981, a mixed-bed demineralizer screen failed and five to eight times as much resin entered the coolant system as that entering in the August 1980 event. The coolant conductivity remained high for at least 4 months after the ingress. The increase in conductivity was attributed to acid

sulfate. Sulfates were found around the crack areas and on the fracture surfaces. It is important to note that sulfate cracking occurs in lower stress regions than does PWSCC. The Spanish reactor has 37 CRDM penetrations, of which 20 are active and 17 are spare. Of the 17 spare penetrations, 16 showed stress corrosion cracking and intergranular corrosion. The cracks were both axial and circumferential. Four of the active CRDM penetrations had significant axial and circumferential cracking.

Westinghouse notified the Westinghouse Owners Group plants, the Babcock and Wilcox Owners Group plants, and the Combustion Engineering Owners Group plants of the Spanish reactor incident by issuing NSAL-94-028. Westinghouse informed the NRC staff, during a public meeting on August 24, 1995, that NSAL-94-028 recommends that PWR licensees review their primary coolant system water chemistry to verify that they have not had significant primary system resin bed intrusions, and that U.S. PWRs review their RCS chemistry and other operating records relative to sulfur ingress events. Westinghouse also reported during this meeting that no other plant had been found worldwide that has experienced cracking similar to that at the Spanish reactor and that the U.S. plant inspection results agreed in general with the worldwide experience. The Westinghouse staff further reported that U.S. plants routinely monitor RCS conductivity, follow the Electric Power Research Institute guidelines on primary water chemistry, and monitor for sulfates three times a week. Westinghouse concluded that no immediate safety issue exists and that the conclusions in its CRDM safety evaluation, dated February 1993 (WCAP-13565, NRC Accession No. 9312090177), remain valid.

Discussion

The NRC staff is not aware of any significant primary system resin bed intrusions at any U.S. PWR. However, if any significant resin intrusions have occurred at U.S. PWRs, residual stresses are likely sufficient to cause circumferential intergranular stress corrosion cracking. The NRC staff has agreed to meet with National Electric Institute and the PWR owners groups in early 1996 to continue discussions on this issue.

On the basis of the results of the inspections at three U.S. PWRs, the NRC staff continues to conclude, as stated in the 1993 safety evaluation, that there is a high probability that CRDM penetrations at other plants may contain similar axial cracks caused by PWSCC.

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.

for Brian Grimes

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Information Notice No.	Subject	Date of Issuance	Issued to
96-10	Potential Blockage by Debris of Safety System Piping Which is Not Used During Normal Operation or Tested During Surveillances	02/13/96	All holders of OLs or CPs for nuclear power reactors
96-09	Damage in Foreign Steam Generator Internals	02/12/96	All holders of OLs or CPs for pressurized water reactors
96-08	Thermally Induced Pressure Locking of a High Pressure Coolant Injection Gate Valve	02/05/96	All holders of OLs or CPs for nuclear power reactors
96-07	Slow Five Percent Scram Insertion Times Caused By Viton Diaphragms in Scram Solenoid Pilot Valves	01/26/96	All holders of OLs or CPs for boiling water reactors
96-06	Design and Testing Deficiencies of Tornado Dampers at Nuclear Power Plants	01/25/96	All holders of OLs or CPs for nuclear power reactors
96-05	Partial Bypass of Shutdown Cooling Flow from the Reactor Vessel	01/18/96	All holders of OLs or CPs for boiling water reactors
96-04	Incident Reporting Requirements for Radiography Licensees	01/10/96	All radiography licensees and manufacturers of radiography equipment
96-03	Main Steam Safety Valve Setpoint Variation as a Result of Thermal Effects	01/05/96	All holders of OLs or CPs for nuclear power reactors

OL = Operating License
CP = Construction Permit

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Original signed by Brian K. Grimes

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On the basis of the results of the inspections at three U.S. PWRs, the NRC staff continues to conclude that there is a high probability that CRDM penetrations at other plants may contain similar axial cracks caused by PWSCC. The NRC staff is not aware of any significant primary system resin bed intrusions at any U.S. PWR. However, if any significant resin intrusions have occurred at U.S. PWRs, residual stresses are sufficient to cause circumferential intergranular stress corrosion cracking. The NRC staff has agreed to meet with National Electric Institute and the PWR owners groups in early 1996 to continue discussions on this issue.

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