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

Log 1-1594

April 20, 1987

NRC INFORMATION NOTICE NO. 86-108, SUPPLEMENT 1: DEGRADATION OF REACTOR COOLANT SYSTEM PRESSURE BOUNDARY RESULTING FROM BORIC ACID CORROSION

Addressees:

All pressurized water reactor (PWR) facilities holding an operating license or a construction permit.

Purpose:

This notice is to alert recipients of another severe instance of boric acid induced corrosion of ferritic steel components on the pressure boundary of a PWR. Recipients are expected to review the information for applicability to their facilities and consider actions, if appropriate, to preclude similar problems occurring at their facilities. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On March 13, 1987, personnel at Turkey Point Unit 4 discovered more than 500 lbs. of boric acid crystals on the RV head. There also was a large amount of boric acid crystals in the exhaust cooling ducts for the control rod drive mechanisms (CRDMs). After removal of this boric acid and steam cleaning of the RV head, severe corrosion of various components on the RV head was noted. Boric acid corrosion of a reactor coolant system (an HPI nozzle at Arkansas Nuclear One, Unit 1) was discussed previously in Information Notice 86-108 of December 1986.

This event at Turkey Point Unit 4 has once again demonstrated that boric acid will rapidly corrode ferritic (carbon) steel components and it also again demonstrated that if a small leakage occurs near hot surfaces and/or surroundings, then the boric acid solution will boil and concentrate, becoming more acidic and thus more corrosive. In addition, the evaporation of the water will cause the boric acid crystals to accumulate at that point.

The source of the boric acid crystals was found to be a leaking lower instrument tube seal, (conoseal), on one of the incore instrument tubes. This seal is a flanged joint with an oval metal gasket that is held together by clamps bolted in place. This seal, which is inside the CRDM cooling shroud, was observed to

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have a very small leak as evidenced by some boric acid crystals during a plant outage in August 1986. An evaluation by the licensee at that time concluded that plant startup was acceptable provided the seal was inspected again within 6 months. The seal was again inspected while the plant was shut down for an unrelated problem in October 1986. The leak rate was still judged to be acceptable for plant operation. About 1 ft³ of boric acid crystals were found and removed from the RV head at that time. However, the CRDM cooling ducts were apparently not closely inspected at that time. The licensee's evaluation was updated to require another inspection within 6 months and the plant was started up.

On March 13, 1987, Westinghouse, the NSSS vendor, completed a review of boric acid corrosion rates, as earlier requested by the licensee, and reported that the corrosion rate might be much faster than assumed when the licensee's evaluation was performed. This reassessment was based in part on the experience of a PWR in Europe that had experienced an accumulation of boric acid crystals on the RV head in 1970. Turkey Point Unit 4 was in hot shutdown at this time and the licensee promptly cooled the unit to cold shutdown to inspect the RV head and discovered the conditions discussed.

The leakage from the conoseal apparently ran down one side of the RV head insulation and much of it leaked under the insulation to the bare RV head. In addition, a large amount of vapor was apparently carried up into the CRDM cooling coils and ducts where it condensed and deposited boric acid crystals. Of 58 RV head bolts, 3 are severely corroded above the associated nuts and will be replaced. The CRDM cooling shroud support is severely corroded in the affected sector and the entire shroud will be replaced. The conoseal clamps also were corroded. The RV head will be removed to inspect for additional damage. The RV head, bolts, and other components will be non-destructively tested (NDT) to check for additional damage.

The licensee has made a preliminary determination that the leak rate from the conoseal was less than 0.25 gpm between startup in October 1986 and the recent shutdown. The total leakage from the reactor coolant system during this period was equal to or less than 0.45 gpm. The average reactor coolant system boron concentration during this period was about 500 ppm.

The NRC dispatched an augmented inspection team (AIT) to the plant site on March 18, 1987. The NRC's and licensee's investigations into this event are still in progress.

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No specific action or written response is required by this information notice. If you have any questions about this matter, please contact the Regional Administrator of the appropriate NRC regional office or this office.

Charles E. Rossi

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