SSINS No.: 6835
IN 87-57

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

November 6, 1987

NRC INFORMATION NOTICE NO. 87-57: LOSS OF EMERGENCY BORATION CAPABILITY DUE TO NITROGEN GAS INTRUSION

Addressees:

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

Purpose:

This information notice is being provided to alert addressees to potentially significant problems resulting from air/gas intrusion into fluid systems. The event described is also an example of fault propagation between units with shared systems. 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 do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On May 28, 1987, with Turkey Point Units 3 and 4 in Mode 6 (refueling) and Mode 5 (cold shutdown), respectively, a loss of all boric acid flowpaths to both units occurred. Nitrogen gas entered the Unit 4 boric acid pumps resulting in these pumps being gasbound and inoperable. At Turkey Point, the boric acid system (which is part of the chemical, volume and control system) consists of four boric acid transfer pumps (two per unit) and three boric acid storage tanks. Each unit normally has one boric acid transfer pump aligned to take suction from a boric acid storage tank, injecting boric acid into the charging pump suction header. The second boric acid transfer pump is normally aligned to circulate boric acid solution through the boric acid storage tanks. The boric acid system design allows for various system alignments, including interconnecting Units 3 and 4. During this event, a Unit 3 boric acid transfer pump and a boric acid storage tank were out of service. Loss of the boric acid system resulted in the licensee being unable to borate or emergency borate the reactor coolant system to ensure maintenance of the required shutdown margin.

Nitrogen entered the boric acid system through a failed Unit 4 boric acid transfer pump mechanical seal. To provide cooling for this seal, the seal is provided an accumulator tank partially filled with demineralized water. The accumulator is given a 40-psi nitrogen overpressure to preclude leakage of the boric acid

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across the seal faces (i.e., in the event of seal failure, the differential pressure will ensure that demineralized water flows into the boric acid system). The design of this accumulator provided a continuous nitrogen supply from a 3000-gallon liquid nitrogen storage tank, through a 40-psi pressure regulator, and isolation valves that were normally open. Apparently, as demineralized water entered the boric acid system through the failed seal, additional nitrogen was automatically supplied to the accumulator to maintain pressure. The falling water level then allowed the nitrogen cover gas to enter the boric acid system through the failed seal.

Based on previous operating experience, the licensee initially assumed that the loss of boric acid flow to Unit 4 was due to plugging of the piping caused by inadequate heat tracing and boric acid crystallization. While troubleshooting efforts were being conducted to locate the source of the boric acid blockage, the Unit 3 boric acid system was cross connected to Unit 4 to provide a temporary boric acid flowpath. This allowed nitrogen gas intrusion into the Unit 3 boric acid system and gas binding of the available Unit 3 boric acid transfer pump, resulting in the loss of both normal and emergency boration flowpaths to both units on May 28 and June 3, 1987.

On June 3, 1987, when the licensee observed that the water level in an accumulator for a Unit 4 boric acid transfer pump could not be maintained within the sight glass, the cause of the problem was properly diagnosed as gas binding of the pumps as a result of nitrogen intrusion. The licensee restored a boric acid flowpath by isolating the affected pump and venting the boric acid system.

One of the root causes of this event appears to be the design of the accumulator cover gas system. A continuous supply of nitrogen allowed the uncontrolled intrusion of nitrogen gas into the Unit 4 boric acid system through the failed boric acid transfer pump mechanical seal. To preclude recurrence of this, the licensee intends to (1) lock closed the nitrogen supply valves to the pump seal water accumulators, and (2) add nitrogen only in a batch method, as required to maintain seal pressure. The inability of the operators to recognize the symptoms of gas binding in fluid systems permitted nitrogen gas intrusion into the Unit 3 boric acid system when Units 3 and 4 boric acid systems were interconnected. In response, the licensee is providing additional operator training, upgraded procedures, and emphasizing management control of system configurations and compliance with procedures.

Discussion:

The event described above is intended to be illustrative of the potential for system inoperability resulting from air/gas intrusion. Since 1981, more than 90 licensee event reports (LERs) have been submitted to the NRC pertaining to events involving air/gas intrusion. The most significant events of those reported have involved: (1) the loss of reactor coolant makeup capability, (2) the loss of essential service water flow, (3) the inoperability of emergency diesel generators (loss of cooling flow), (4) the loss of shutdown cooling, and (5) water hammer. System or component failures resulting from air/gas intrusion can be significant.

A previous event involving gas intrusion at McGuire Unit 1 is discussed in IE Information Notice 82-19, "Loss of High Head Safety Injection Emergency Boration and Reactor Coolant Makeup Capability." Additional events are discussed in IE Information Notice 83-77, "Air/Gas Entrainment Events Resulting in System Failures." Air/gas intrusion concerns associated with the residual heat removal system of pressurized water reactors are addressed in Generic Letter 87-12, "Loss of Residual Heat Removal (RHR) While the Reactor Coolant System (RCS) is Partially Filled."

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

Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contact: S. D. Stadler, RII
(404) 331-5599

Attachment: List of Recently Issued NRC Information Notices

Attachment
IN 87-57
November 6, 1987

LIST OF RECENTLY ISSUED
INFORMATION NOTICES 1987

Information Notice No.	Subject	Date of Issuance	Issued to
87-56	Improper Hydraulic Control Unit Installation at BWR Plants.	11/4/87	All holders of OLs or CPs for boiling water reactors (BWRs).
87-55	Portable Moisture/Density Gauges: Recent Incidents of Portable Gauges Being Stolen or Lost	10/29/87	All NRC licensees authorized to possess portable gauges.
87-54	Emergency Response Exercises	10/23/87	All holders of OLs or CPs for nuclear power reactors.
87-53	Auxiliary Feedwater Pump Trips Resulting from Low Suction Pressure	10/20/87	All holders of OLs or CPs for nuclear power reactors.
87-52	Insulation Breakdown of Silicone Rubber-Insulated Single Conductor Cables During High Potential Testing	10/16/87	All holders of OLs or CPs for nuclear power reactors.
87-51	Failure of Low Pressure Safety Injection Pump Due to Seal Problems	10/13/87	All nuclear power reactor facilities holding an OL or CP.
87-50	Potential LOCA at High- and Low-Pressure Interfaces from Fire Damage	10/9/87	All nuclear power reactor facilities holding an OL or CP.
87-49	Deficiencies in Outside Containment Flooding Protection	10/9/87	All nuclear power reactor facilities holding an OL or CP.
87-48	Information Concerning the Use of Anaerobic Adhesive/ Sealants	10/9/87	All nuclear power reactor facilities holding an OL or CP.

OL = Operating License
CP = Construction Permit

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*SEE PREVIOUS CONCURRENCES

			D/DOEA:NRR CERossi 11/2/87	*C/OGCB:DOEA:NRR CHBerlinger 10/23/87
*RII SDStadler 10/01/87	*OGCB:DOEA:NRR JERamsey 10/06/87	*C/SPLB:DEST:NRR JCraig 10/ /87	SAD/DEST:NRR AThadani 10/ /87	*PPMB:ARM TechEd 10/06/87

References:

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			10/ /87	10/23/87
*RII	*OGCB:DOEA:NRR	C/SPLB:DEST:NRR	SAD/DEST:NRR	*PPMB:ARM
SDStadler	JERamsey	JCraig	AThadani	TechEd
10/01/87	10/06/87	10/26/87	10/30/87	10/06/87

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10/01/87	10/06/87	10/06/87	10/23/87	10/ /87

To preclude recurrence of this event, the licensee will (1) lock closed the nitrogen supply valves to the pump seal water accumulators, and (2) add nitrogen only in a batch method, as required to maintain seal pressure. The licensee also is providing additional operator training, upgraded procedures, and emphasizing management control of system configurations and compliance with procedures.

Discussion:

The event described is intended to be illustrative. Licensees are cautioned that the types of system inoperability resulting from air/gas intrusion will vary. Since 1981, more than 90 licensee event reports (LERs) have been submitted to the NRC for events involving air/gas intrusion. The events described include (1) the loss of reactor coolant makeup capability, (2) the loss of essential service water flow, (3) the inoperability of emergency diesel generators (loss of cooling flow), (4) the loss of shutdown cooling, and (5) water hammer. The consequences that can result from such a system or component failure cannot be overemphasized.

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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 regional office or this office.

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10/1 /87	10/6/87	10/6 /87	10/ /87	10/ /87

Discussed with D. Stadler on 10/11/87.
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