SSINS No.: 6835
IN 87-10

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

February 11, 1987

IE INFORMATION NOTICE NO. 87-10: POTENTIAL FOR WATER HAMMER DURING RESTART OF RESIDUAL HEAT REMOVAL PUMPS

Addressees:

All boiling water reactor (BWR) facilities holding an operating license or a construction permit.

Purpose:

This information notice is to alert addressees of the potential for water hammer in the residual heat removal (RHR) system of BWRs during a design basis loss of coolant accident (LOCA) coincident with a loss of offsite power (LOOP) if the RHR system is aligned to suppression pool cooling. 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 December 11, 1986, the Susquehanna nuclear power plant reported that based on results of an ongoing review of the potential effects of water hammer events, the RHR system could be susceptible to water hammer loads that would exceed the allowable stresses in the RHR system and piping. The specific condition of concern involves a design-basis LOCA coincident with a LOOP, while one or one RHR loops are in the suppression pool cooling mode. During the power loss and subsequent valve realignment, portions of the RHR system will void because of the drain down to the suppression pool as a result of elevation differences. A water hammer may occur in those RHR loops that were in the suppression pool cooling mode when the RHR pumps restart after the diesel generators reenergize the buses.

The core spray system also may be subject to such a water hammer if it is lined up in the suppression pool mixing mode full flow test.

The Susquehanna design basis for LOCA/LOOP assumes that the suppression pool cooling flow path valves are initially closed in the standby lineup. The potential duration factor used in the consideration of the coincident LOCA/LOOP with the RHR in suppression pool cooling mode was one percent, or roughly 90 hours per year.

Contrary to the design basis assumption, a licensee review of operating history found that the worst case RHR system usage factor approached 25% during cycles in which significant safety relief valve weeping was experienced.

For interim corrective action, the licensee has modified operating procedures to allow, at a time, only one loop of RHR to operate in suppression pool cooling. In addition, the licensee will revise plant procedures to address the restart of an RHR pump if it trips while operating in the suppression pool cooling mode. The core spray system is currently prohibited from being operated in the suppression pool mixing mode, except for required surveillance testing.

Discussion:

The NRC discussed the potential for this general type of event in Engineering Evaluation No. AEOD/E309, "The Potential for Water Hammer During the Restart of RHR Pumps at BWR Nuclear Power Plants," dated April 1983.

In the type of scenario discussed in AEOD/E309, the line most likely to drain and experience a water hammer is the drywell spray line because it has the largest elevation difference between it and the suppression pool. RHR system pipes less than 33 feet above the suppression pool will not usually drain because atmospheric pressure will support a column of water that high. A water hammer in the drywell spray line could endanger RHR system integrity, and thus jeopardize all modes of RHR including low-pressure coolant injection.

The analysis performed by the licensee of the Susquehanna nuclear power plant goes beyond AEOD/E309 in that detailed site-specific computer modeling was performed which shows that piping system integrity could be challenged.

Besides Susquehanna, other plants may have high usage factors for suppression pool cooling mode and large elevations differences in the RHR system, making those plants potentially subject to water hammer in the RHR system.

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

Edward L. Jordan, Director
Division of Emergency Preparedness
and Engineering Response
Office of Inspection and Enforcement

Technical Contacts: Eric Weiss, IE
(301) 492-9005

George Lanik, IE
(301) 492-9007

Attachment: List of Recently Issued IE Information Notices

by phone
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Attachment 1
IN 87-10
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LIST OF RECENTLY ISSUED
IE INFORMATION NOTICES

Information Notice No.	Subject	Date of Issue	Issued to
87-09	Emergency Diesel Generator Room Cooling Design Deficiency	2/5/87	All power reactor facilities holding an OL or CP
87-08	Degraded Motor Leads in Limitorque CD Motor Operators	2/4/87	All power reactor facilities holding an OL or CP
87-07	Quality Control of Onsite Dewatering/Solidification Operations by Outside Contractors	2/3/87	All power reactor facilities holding an OL or CP
87-06	Loss of Suction to Low-Pressure Service Water System Pumps Resulting From Loss of Siphon	1/30/87	All power reactor facilities holding an OL or CP
87-05	Miswiring in a Westinghouse Rod Control System	2/2/87	All Westinghouse power reactor facilities holding an OL or CP
87-04	Diesel Generator Fails Test Because of Degraded Fuel	1/16/87	All power reactor facilities holding an OL or CP
87-03	Segregation of Hazardous	1/15/87	All NRC licensees
87-02	Inadequate Seismic Qualification of Diaphragm Valves by Mathematical Modeling and Analysis	1/15/87	All power reactor facilities holding an OL or CP
87-01	RHR Valve Misalignment Causes Degradation of ECCS in PWRs	1/6/87	All PWR facilities holding an OL or CP
86-110	Anomalous Behavior of Recirculation Loop Flow in Jet Pump BWR Plants	12/31/86	All BWR facilities holding an OL or CP

OL = Operating License
CP = Construction Permit

Contrary to the design basis assumption, a licensee review of operating history found that the worst case RHR system usage factor approached 25% during cycles in which significant safety relief valve weeping was experienced.

For interim corrective action, the licensee has modified operating procedures to allow, at a time, only one loop of RHR to operate in suppression pool cooling. In addition, the licensee will revise plant procedures to address the restart of an RHR pump if it trips while operating in the suppression pool cooling mode. The core spray system is currently prohibited from being operated in the suppression pool mixing mode, except for required surveillance testing.

Discussion:

The NRC discussed the potential for this general type of event in Engineering Evaluation No. AEOD/E309, "The Potential for Water Hammer During the Restart of RHR Pumps at BWR Nuclear Power Plants," dated April 1983.

In the type of scenario discussed in AEOD/E309, the line most likely to drain and experience a water hammer is the drywell spray line because it has the largest elevation difference between it and the suppression pool. RHR system pipes less than 33 feet above the suppression pool will not usually drain because atmospheric pressure will support a column of water that high. A water hammer in the drywell spray line could endanger RHR system integrity, and thus jeopardize all modes of RHR including low-pressure coolant injection.

The analysis performed by the licensee of the Susquehanna nuclear power plant goes beyond AEOD/E309 in that detailed site-specific computer modeling was performed which shows that piping system integrity could be challenged.

Besides Susquehanna, other plants may have high usage factors for suppression pool cooling mode and large elevations differences in the RHR system, making those plants potentially subject to water hammer in the RHR system.

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Contrary to the design basis assumption, a licensee review of operating history found that, during cycles in which significant safety relief valve weeping was experienced, the worst case RHR system usage factor approached 25%.

For interim corrective action, the licensee has modified operating procedures to allow only one loop of RHR to operate in suppression pool cooling or one loop of core spray in suppression pool mixing mode at a time. In addition, the licensee will revise plant procedures to address the restart of an RHR pump if it trips while operating in the suppression pool cooling mode. The core spray system is currently prohibited from being operated in the suppression pool cooling mode, except for required surveillance testing.

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