UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

March 25, 1996

NRC INFORMATION NOTICE 95-03, SUPPLEMENT 1: LOSS OF REACTOR COOLANT INVENTORY AND POTENTIAL LOSS OF EMERGENCY MITIGATION FUNCTIONS WHILE IN A SHUTDOWN CONDITION

Addressees

All holders of operating licenses or construction permits for PWR power plants.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice supplement to alert addresses to insights from additional analysis related to reactor coolant system drain-down events with the potential for adversely impacting accident-mitigation capability. It is expected that recipients will review the information in this supplement in conjunction with Information Notice 95-03 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

Information Notice 95-03, "Loss of Reactor Coolant Inventory and Potential Loss of Emergency Mitigation Functions While in a Shutdown Condition," issued on January 18, 1995, discusses the Wolf Creek drain-down event of September 17, 1994. In that event, operators were attempting to reborate residual heat removal train B while at the same time, maintenance personnel were repacking a residual heat removal train A to train B crossover isolation valve. Train B is reborated by recirculating water through a loop that contains the residual heat removal system piping, the refueling water storage tank, a containment spray pump, a manual refueling water storage tank isolation valve, and a residual heat removal system crossover line.

When the storage tank isolation valve was opened for the reboration process and the train A to train B crossover isolation valve was opened for stroke testing, a drain-down path was inadvertently created from the reactor coolant system to the refueling water storage tank. As a result, an unintentional reactor coolant system flow path was created allowing approximately 35,000 liters (9200 gallons) of reactor coolant to transfer to the refueling water storage tank. If the drain-down had not been promptly terminated, the operability of the emergency core cooling system would have been compromised. Also, reactor coolant system water flashing to steam in the piping or in the refueling water storage tank would likely have created conditions conducive to water hammer.

This information notice supplement discusses additional insights that have been gained from analyses of the Wolf Creek event.

Discussion

Licensee and staff analyses of the event assumed failure to isolate the drain-down path. If this were to occur, within 5 minutes, reactor vessel water level could drain to the bottom of the hot leg and as a consequence the operating residual heat removal pump would lose suction, cavitate, and fail. Continued boil-off would result in uncovering of the core in less than one hour. If the event were to occur at the beginning of mode 4, at a higher reactor coolant temperature and pressure, the transient could evolved even faster.

Failure to quickly isolate the flow path could result in the refueling water storage tank suction header filling with steam which would continually discharge into the refueling water storage tank. This steam could lead to water hammer events with the potential for mechanical damage to pump components, piping, and tank structural components. Even if the drain-down path is isolated, if sufficient steam ingress has occurred, a potential continues to exists for water hammer and mechanical damage to components. In addition, there exists the potential for containment bypass through the refueling water storage tank.

Considering the size of the header and the geometrical arrangement of the pipe (i.e., no U or inverted U arrangements) it is estimated that, after drain-down isolation, water from the refueling water storage tank will flow back down into the header. However, adequate suction may or may not be available to all emergency core cooling system pumps because of steam or air pockets in the intakes of individual pumps. Therefore, even with isolation, the risk of pump damage could remain for some time.

Plants could be susceptible to events of this nature while operating the shutdown cooling system when the reactor coolant system is at more than 121 °C (250 °F). These conditions exist shortly after the plant is shut down for refueling, maintenance, or a forced outage.

A special NRC report dated March 1995 and titled "Reactor Coolant System Blowdown at Wolf Creek on September 17, 1994" (AEOD/S95-01), identified 19 loss-of-coolant events that have occurred at reactors during shutdown. Of these 19 events, only 2 have taken place at temperatures and pressures sufficient to result in voiding refueling water storage tank piping. Considering PWR operating experience, the staff estimated the initiating event frequency may be equal to or greater than 1E-3 per reactor year. The initiating event frequency and the heavy dependence upon short term operator action, highlight the importance of careful planning, accuracy of administrative procedures, and disciplined adherence to those procedures.

This information notice supplement requires no specific action or written response. If you have any questions about the information in this supplement, please contact the technical contact listed below or the Office of Nuclear Reactor Regulation project manager.

Dennis M. Crutchfield, Director
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LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
96-17	Reactor Operation Inconsistent with the Updated Final Safety Analysis Report	03/18/96	All holders of OLs or CPs for nuclear power reactors
96-16	BWR Operation with Indicated Flow Less Than Natural Circulation	03/14/96	All holders of OLs or CPs for boiling-water reactors
96-15	Unexpected Plant Performance During Performance of New Surveillance Tests	03/08/96	All holders of OLs or CPs for nuclear power reactors
96-14	Degradation of Radwaste Facility Equipment at Millstone Nuclear Power Station, Unit 1	03/01/96	All holders of OLs or CPs for nuclear power reactors
96-13	Potential Containment Leak Paths Through Hydrogen Analyzers	02/26/96	All holders of OLs or CPs for nuclear power reactors
96-12	Control Rod Insertion Problems	02/15/96	All holders of OLs or CPs for nuclear power reactors
96-11	Ingress of Demineralizer Resins Increases Potential Stress Corrosion Cracking of Control Rod Drive Mechanism Penetrations	02/14/96	All holders of OLs or CPs for pressurized water nuclear power reactors
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

OL = Operating License
CP = Construction Permit

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original signed by

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Tech Editor reviewed and concurred on 08/23/95. *SEE PREVIOUS CONCURRENCES

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loss-of-coolant events at reactors during shutdown. Of these 19 events, only two have occurred at temperatures and pressures sufficient to result in voiding refueling water storage tank piping. Considering PWR operating experience, the staff estimated the initiating event frequency to be on the order of 1E-2 to 1E-3 per reactor year. The initiating event frequency and the heavy dependence upon short term operator action, highlights the importance of careful planning, accuracy of administrative procedures, and disciplined adherence to those procedures.

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