

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

July 3, 2000

NRC INFORMATION NOTICE 95-03, SUPPLEMENT 2: LOSS OF REACTOR COOLANT
INVENTORY AND POTENTIAL LOSS
OF EMERGENCY MITIGATION
FUNCTIONS WHILE IN A
SHUTDOWN CONDITION

Addressees

All holders of operating licenses for nuclear power reactors except those who have ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice supplement to alert addressees to insights from inspections related to losses of reactor coolant while the reactor is in a hot, pressurized, shutdown condition with the potential for adversely affecting accident mitigation capability. It is expected that recipients will review the information in this supplement 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 an incident at Wolf Creek involving the loss of reactor coolant while the reactor was in a hot, pressurized, shutdown condition. At Wolf Creek, all residual heat removal (RHR) and emergency core cooling system (ECCS) pump suction lines are supplied by a common suction header. When the loss of reactor coolant occurred, hot reactor coolant system (RCS) water was introduced into this common suction header between the refueling water storage tank (RWST) and the RHR and ECCS pumps. This hot water flashed to steam, resulting in a steam/water mixture in the header. Had an ECCS actuation occurred, this mixture could have been introduced into the suction of the ECCS pumps. If operators had not been able to terminate the event, the hot water in the suction piping may have led to steam binding, which could have adversely affected the pumps in both ECCS trains. In addition, water flashing to steam in the header and the RWST could have caused serious mechanical damage to the RHR piping and the RWST as a result of water hammer. Finally, the flow path from the RCS through the RWST establishes a containment bypass path.

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The NRC issued Generic Letter (GL) 98-02, "Loss of Reactor Coolant Inventory and Associated Potential for Loss of Emergency Mitigation Functions While in a Shutdown Condition," on May 28, 1998, to request that addressees (1) perform an assessment to determine if their ECCSs include certain design features, such as a common pump suction header, which can render the systems susceptible to common-cause failure and if this susceptibility is found, (2) prepare, with consideration of plant-specific design attributes, a description of the features of their Appendix B quality assurance program (for example, the methods used to verify valve position; the controls in place to ensure compliance with plant surveillance, maintenance, modification, and operating procedures; and the adequacy of operator training for such activities) that provide assurance that the safety-related functions of the RHR system and the ECCS will not be adversely affected by activities conducted at hot shutdown.

This information notice supplement discusses additional insights that have been gained from NRC inspections performed in response to GL 98-02.

Discussion

Licensee and staff analyses of the Wolf Creek event assumed failure to isolate the RCS draindown path. If this were to occur, within 5 minutes, the reactor vessel water level could drain to the bottom of the hot leg, and, as a consequence, the operating RHR pump would lose suction, cavitate, and fail. Continued boiloff would result in uncovering of the core in less than 1 hour. Failure to quickly isolate the flow path could also result in the RWST suction header filling with steam, which would continually discharge into the RWST. This steam could lead to water hammer events with the potential for mechanical damage to pump components, piping, and tank structural components.

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 RWST piping. Considering pressurized-water reactor 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, the accuracy of administrative procedures, and disciplined adherence to those procedures.

GL 98-02 focused on requesting that affected licensees take adequate protective measures to minimize the likelihood of a Wolf Creek type event. The generic letter was not intended to address all aspects related to recovery from a shutdown loss-of-coolant accident (LOCA). However, during NRC inspections performed in response to GL 98-02, the staff identified a potentially generic weakness regarding the procedures used to mitigate a Wolf Creek type event that licensees may wish to review.

At one facility, the procedure used to recover from a hot, pressurized shutdown LOCA directs operator actions that could increase the probability that ECCS equipment would be disabled and could delay recovery from the LOCA. Specifically, for entry conditions in which the pressurizer level is less than 10 percent or RCS subcooling is less than 32 degrees C (58 degrees F), and the RWST level is greater than 27 percent, that is, a Wolf Creek type scenario,

closure of the RHR hot-leg isolation valves are not explicitly directed early in the procedure, and, as such, the LOCA is not terminated. The procedure subsequently directs alignment of the suction of the operating centrifugal charging pump to the common suction header, potentially exposing it to hot reactor coolant and rendering it inoperable. If that centrifugal charging pump is rendered inoperable, the operator is expected to evaluate aligning the suction of the second centrifugal charging pump to the common suction header, exposing it to the same conditions which rendered the first centrifugal charging pump inoperable. This progression continues with the two safety injection pumps, potentially rendering them inoperable, also, and could ultimately result in a significant loss of ECCS capability.

Related Generic Communications

- GL 98-02, "Loss of Reactor Coolant Inventory and Associated Potential for Loss of Emergency Mitigation Functions While in a Shutdown Condition," May 28, 1998.
- Information Notice 95-03, "Loss of Coolant Inventory and Potential Loss of Emergency Mitigation Functions While in a Shutdown Condition," January 18, 1995.
- Supplement to Information Notice 95-03, March 25, 1996.

This information notice requires no specific action or written response. However, recipients are reminded that they are required to consider industry-wide operating experience (including NRC information notices), where practical, when setting goals and performing periodic evaluations under Section 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," of Part 50 of Title 10 of the Code of Federal Regulations. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

/RA/

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LIST OF RECENTLY ISSUED
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
2000-09	Steam Generator Tube Failure Indian Point Unit 2	06/28/2000	All holders of operating licenses for nuclear power reactors except those who have ceased operations and have certified that fuel has been permanently removed from the reactor vessel
2000-08	Inadequate Assessment of the Effect of Differential Temperatures on Safety-Related Pumps	5/15/2000	All holders of operating licensees for nuclear power reactors
2000-07	National Institute for Occupational Safety and Health Respirator User Notice: Special Precautions for Using Certain Self-Contained Breathing Apparatus Air Cylinders	4/10/2000	All holders of operating licenses for nuclear power reactors, non-power reactors, and all fuel cycle and material licensees required to have an NRC-approved emergency plan
2000-06	Offsite Power Voltage Inadequacies	3/22/2000	All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor
2000-05	Recent Medical Misadministrations Resulting from Inattention to Detail	3/06/2000	All medical licensees
2000-04	1999 Enforcement Sanctions for Deliberate Violations of NRC Employee Protection Requirements	2/25/2000	All NRC licensees
2000-03	High-Efficiency Particulate Air Filter Exceeds Mass Limit Before Reaching Expected Differential Pressure	2/22/2000	All NRC licensed fuel-cycled conversion, enrichment, and fabrication facilities

OL = Operating License
 CP = Construction Permit