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

January 18, 1995

NRC INFORMATION NOTICE 95-03: 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 nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to alert addressees to a recent incident involving a loss of reactor coolant inventory while in a shutdown condition at a Westinghouse pressurized-water reactor. The incident is unique because the initiating event has the potential to create an accident and cause a loss of accident mitigation capability. 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 notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Background

NRC has issued a number of generic communications describing events at reactor facilities involving inadvertent loss of reactor coolant inventory while the facility was in a shutdown condition. In Generic Letter 88-17, "Loss of Decay Heat Removal (DHR)," the staff requested several actions to address loss of DHR events that occurred while the reactor was in a shutdown condition. In two information notices (IN 90-55, "Recent Operating Experience on Loss of Reactor Coolant Inventory While in a Shutdown Condition," and IN 91-42, "Plant Outage Events Involving Poor Coordination Between Operations and Maintenance Personnel During Valve Testing and Manipulations"), the staff discussed inadvertent loss of inventory events. A document issued by the NRC Office for Analysis and Evaluation of Operational Data (AEOD/E704), "Discharge of Primary Coolant Outside of Containment at PWRs While on RHR Cooling," reported six additional events having similar characteristics.

This IN deals with the Wolf Creek draindown event of September 17, 1994. A similar event occurred at Braidwood in 1990. Both events involved operators inadvertently transferring more than 9000 gallons of reactor coolant system (RCS) inventory to the refueling water storage tank (RWST) while preparing to shift operation of the residual heat removal (RHR) trains. However, the Wolf Creek event occurred when the RCS was pressurized to 340 psi at a temperature

The Wolf Creek draindown event has been classified (November 22, 1994) by the Office for Analysis and Evaluation of Operational Data and the Office of Nuclear Reactor Regulation as a "Significant Event for the Performance Indicator Program."

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

Brian K. Grimes, Director
Division of Project Support
Office of Nuclear Reactor Regulation

Technical contacts: J. Frederick Ringwald, RIV
(316) 364-8653

John Kauffman, AEOD
(301) 415-6830

Attachment:
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DOCUMENT NAME: G:\JRT\INDRAFT.WC
Reviewed via QTE by Tech Editor on 12/28/94

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of 300 °F. As a result, more than 9000 gallons of RCS inventory was drained from the RCS to the RWST in about 1 minute.

The Wolf Creek design incorporates a 24 inch header pipe from the RWST from which the RHR pumps, the charging pumps, the high-head injection pumps, and the containment spray pumps take suction. If an RCS to RWST fluid transfer filled the 24 inch header with steam and pump operation were attempted, the pump could have been severely damaged and lost as a means of supplying RCS makeup and core cooling. In addition, such steam would create conditions favoring water hammer, which could be destructive to involved components.

Description of Circumstances

On September 17, 1994, the Wolf Creek Generating Station experienced a loss of reactor coolant inventory while in a shutdown condition when operators performed two incompatible activities concurrently. Preceding the event, operators were controlling the reactor coolant system in Mode 4 (hot shutdown) at approximately 300 °F and 340 psig. Operations personnel found that during the latter part of the cycle leaking check valves had diluted the boron concentration in the RHR train B piping. Licensee procedures require that the water in the piping be reborated before the RHR B train is put into operation in this circumstance. This was routinely done by recirculating the RHR piping water through the RWST using a containment spray pump.

Maintenance personnel were repairing a packing leak and performing valve motor-operator diagnostic testing on the train A RHR discharge crossover isolation valve. The shift supervisor decided that it would be acceptable to stroke the train A discharge crossover isolation valve provided that the RHR train B discharge crossover isolation valve and the RHR crossover return to the RWST manual isolation valve remained shut. To continue the cooldown to Mode 5, operators began preparations to start RHR train B so that reactor coolant pumps could be secured. While personnel continued the repair and valve motor-operator diagnostics on the train A crossover isolation valve, an auxiliary operator opened the RHR crossover return to the RWST manual isolation valve for the reboration. When both valves were opened, the reactor coolant system had a draindown flowpath through RHR train A into the 24-inch pipe that leads from the RWST. After approximately 1 minute, operators recognized an unintended flowpath and shut the train A discharge crossover isolation valve to terminate the draindown. The event transferred approximately 9200 gallons of RCS water to the RWST, depressurized the RCS to approximately 225 psig, and allowed the RCS temperature to increase by approximately 7 °F.

Discussion

The Office for Analysis and Evaluation of Operational Data (AEOD) reviewed this event at the Wolf Creek site from November 7 through 10, 1994, and plans to issue a report. The following discussion is, in part, based on the AEOD review and, in part, on the Office of Nuclear Reactor Regulation (NRR) and regional staff view of the potential safety implications.

Two incompatible activities were performed concurrently, causing this event: (1) alignment of the RHR train B crossover isolation valve (to adjust the boron concentration) required the valve to be opened and (2) motor-operator diagnostic testing required the train A RHR discharge crossover isolation valve to be stroked open and closed. These two activities inadvertently created the flow path for the draindown. The failure of several individuals, including the reactor operator, supervising operator, and shift supervisor, to recognize that these activities were incompatible resulted in a loss of control of plant configuration and directly caused the draindown event.

The shift supervisor initially recognized the potential for diverting RHR flow from the RCS to the RWST; however, the shift supervisor failed to establish a positive barrier, such as tagging or padlocking, to ensure that the manual crossover return to the RWST manual isolation valve remained shut. Repair and diagnostic testing of the train A discharge crossover isolation valve represented work on the only available train of a safety system. These decisions permitted work on a safety system required for safe operation of the plant without proper controls in place to prevent an inappropriate system configuration.

In recognition of additional challenges to plant operators during outage conditions, the licensee had established an outage emergent work process to evaluate unscheduled work. This process was intended to relieve some of the additional burden that might distract the operators from properly monitoring the safe condition of the plant. It was also intended to provide additional assurance that potential adverse impacts on plant operation were fully considered. However, this emergent work process was not used to evaluate the motor-operated valve work on RHR train A.

The presence of the deborated water in the RHR train B piping, the attempt to reborate, and the concurrent repair and testing of the RHR train A crossover isolation valve raises the following concerns:

1. There is a possibility of introducing hot RCS water into the common 24-inch suction header supplied from the RWST. The RHR pumps, the charging pumps, the high-head injection pumps, and the containment spray pumps take suction from this header. Introducing hot RCS water into this header could create steam conditions and interfere with RHR pump operation. If the RHR pump were lost, alignment of the other pumps to this header as a response to the loss of RHR cooling could have also interfered with the operation of these other pumps.

2. There is the potential that if the draindown continued, the RHR piping could become filled with steam. This would create conditions favoring water hammer, which could damage valves, pumps, piping, or pipe supports. The RWST supply to the ECCS and containment spray could be jeopardized.

3. There was the possibility for inadvertent injection of relatively cold, lightly borated water from the RHR train B piping into the RCS. In the hot shutdown condition (Mode 4), where the reactor is being borated as it cools down, introduction of cold, lightly borated water reduces the margin to criticality. The licensee determined that the injection of the water from the RHR train B piping into the RCS would not have brought the reactor to a critical state. However, the potential for criticality may exist at other facilities under similar conditions.

The Wolf Creek draindown event has been classified by the NRC staff as a significant event for the NRC Performance Indicator Program.

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(301) 504-3233

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LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
95-02	Problems with General Electric CR2940 Contact Blocks in Medium-Voltage Circuit Breakers	01/17/95	All holders of OLs or CPs for nuclear power reactors.
95-01	DOT Safety Advisory: High Pressure Aluminum Seamless and Aluminum Composite Hoop-Wrapped Cylinders	01/04/95	All U.S. Nuclear Regulatory Commission licensees.
94-90	Transient Resulting in a Reactor Trip and Multiple Safety Injection System Actuations at Salem	12/30/94	All holders of OLs or CPs for nuclear power reactors.
94-89	Equipment Failures at Irradiator Facilities	12/28/94	All U.S. Nuclear Regulatory Commission irradiator licensees.
94-88	Inservice Inspection Deficiencies Result in Severely Degraded Steam Generator Tubes	12/23/94	All holders of OLs or CPs for pressurized water reactors.
94-87	Unanticipated Crack in a Particular Heat of Alloy 600 Used for Westinghouse Mechanical Plugs for Steam Generator Tubes	12/22/94	All holders of OLs or CPs for nuclear power reactors.
94-86	Legal Actions Against Thermal Science, Inc., Manufacturer of Thermo-Lag	12/22/94	All holders of OLs or CPs for nuclear power reactors.
94-85	Problems with the Latching Mechanism in Potter and Brumfield R10-E3286-2 Relays	12/21/94	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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