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

January 29, 1990

NRC INFORMATION NOTICE NO. 90-05: INTER-SYSTEM DISCHARGE OF REACTOR COOLANT

Addressees:

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

Purpose:

This information notice is intended to alert addressees to a potentially significant problem in identifying and terminating reactor coolant system leakage in operating modes 4 and 5. It is expected that licensees 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 December 1, 1989, Braidwood Unit 1 experienced the unplanned inter-system discharge of approximately 68,000 gallons of water. The discharge was caused by the inadvertent opening of a residual heat removal (RHR) system suction relief valve. The valve failed to reclose, allowing an open flow path from the reactor vessel, through the RHR system, into the unit's two recycle hold-up tanks (HUTs).

The unit, which had been in a refueling outage since September 2, 1989, was heating up in operational mode 5, preparing to enter operational mode 4. The plant was solid and in the process of drawing a bubble in the pressurizer. The RHR train "A" pump was in operation and, although the "B" pump was not running, the "B" train was unisolated and available. The reactor coolant system (RCS) was at a pressure of 350 psig and a temperature of 175°F. Charging flow to the vessel was being provided by the "A" charging pump. Pressurizer heaters were on. The "B" charging pump was isolated and tagged out of service. (Technical Specifications governing cold overpressure protection require that only one charging pump be available. The other charging pump and the safety injection pumps are required to be tagged out of service, with power supplies removed). To protect against a pressure switch failure and the subsequent automatic isolation of the RHR system, the train "A" RHR suction isolation valve was open and tagged out of service.

IDtR-1C

Concurrence

At 1:42 a.m., operators throttled the charging flow and maximized the letdown flow in preparation for drawing a bubble in the pressurizer. The RCS pressure was 404 psig and the pressurizer level was off scale, high. At 1:44 a.m., a rapid reduction in the pressurizer level occurred, with the pressurizer level off scale, low, at 1:52 a.m. Approximately 14,000 gallons of water drained from the pressurizer and the pressurizer surge line; however, the reactor vessel level instrumentation system indicated that the vessel level remained at 100 percent. At 1:49 a.m., the charging flow was increased and the charging pump suction was switched from the volume control tank to the refueling water storage tank (RWST).

About 30 to 50 gallons of water were observed on the floor of the auxiliary building in proximity to the RHR train "A" suction relief valve, leading plant personnel to believe that this valve had lifted. At 1:53 a.m., the letdown flow was reduced to minimum and charging was maximized. The RHR trains were switched from "A" to "B", the "A" pump was stopped, and the isolation of the "A" train was initiated. At 1:59 a.m., one of the two running reactor coolant pumps (RCPs) was stopped because of low RCS pressure.

A second charging pump, "B", was started following completion of the formal procedure for tagout removal. At 2:35 a.m., the "A" RHR suction isolation valve was returned to service and closed, completing the isolation of the "A" train of the RHR system. The pressurizer level began to recover and the RCS pressure increased slightly, giving operators the impression that the discharge had been isolated. The "B" charging pump was therefore secured at 2:45 a.m. The pressurizer level, however, did not recover. At 2:54 a.m., the "B" charging pump was restarted. At 3:49 a.m., the inter-system discharge was terminated when the RHR train "A" pump was started, the "B" pump shut down, and the "B" train was isolated. The level indication for the HUTs stabilized and the pressurizer level began to recover at 3:52 a.m.

By 5:06 a.m., the pressurizer level had fully recovered and the unit was stabilized at 360 psi and 175°F. Approximately 68,000 gallons of water had been discharged from the reactor vessel to the HUTs. (The total amount of water was composed of 14,000 gallons of initial pressurizer inventory and 54,000 gallons of makeup water).

Following the event, it was determined that the RHR "B" train suction relief valve had lifted at 411 psi. The lift setpoint for the valve should have been 450 psi. The valve should have reclosed on reducing pressure but failed to do so. The premature opening of the valve was attributed to the presence of foreign material lodged between the valve spindle and the spindle guide. This foreign material either prohibited the correct adjustment of the valve or affected the valve's lift setpoint. The valve's failure to reclose was attributed to improper nozzle ring adjustment. The reset pressure is strongly influenced by the dynamic forces created by the nozzle ring. If the ring is located too high on the nozzle, it may result in an inadequate ventilation area just above the nozzle. Undesirable forces will develop which may cause a much lower reseat pressure.

The water found near the RHR train "A" suction relief valve had leaked from a weep hole on a relief valve in a radwaste evaporator line connected to the common discharge header of the train "A" and "B" suction relief valves. Contrary to original assumptions, there was no evidence that the "A" train suction relief valve had lifted. The root cause of the problem with the relief valve on the evaporation line is under investigation but is thought to be unrelated to the failure of the "B" suction relief valve.

Hampering operators' efforts throughout this event was the lack of an appropriate emergency operating procedure (EOP) to detect coolant leaks while in operating modes 4 and 5. However, the operators were able to combine two related abnormal operating procedures for guidance during this event. One of the procedures is designed to locate system leaks while in modes 3 and 4. The other provides guidance for the restoration of the RHR system following its loss during conditions in which the reactor vessel inventory is at a reduced level.

Discussion:

The event at Braidwood 1 is significant because it underscores the need to have EOPs available for use in other than "at power" operating modes. The fact that over 2 hours were required to locate the stuck-open valve, to terminate the discharge, and to begin refilling the pressurizer highlights the need to provide personnel with adequate tools to perform their tasks. Relying on ad hoc procedures during significant events places an unnecessary burden on operating personnel. The lack of adequate EOPs could handicap the most competent operators in their efforts to address significant operational problems.

Also illustrated by this event is the need for procedures to assure that adequate RCS makeup capability and cooling options are available in a timely fashion during shutdown. The discharge through the stuck-open relief valve exceeded the capability of a single charging pump. Starting a second charging pump required that formal procedures for tag removal be conducted. This effort necessitated a considerable amount of time, which may not be available should a similar event occur while the RCS is at a higher temperature.

The severity of this event could have been increased if greater decay heat were present in the reactor vessel or if a gross failure of the relief valve discharge header had occurred. Greater decay heat would have increased the potential for voiding in the core. Also, because the header discharges to the HUTs which are located outside containment, a piping failure could have resulted in all or a portion of the RCS water being discharged to the building floor. This event would have necessitated a major cleanup effort and increased the potential for personnel contamination.

If this event had occurred at one of the nuclear plants that has a single suction line from the RCS to the RHR system, all shutdown cooling would have been lost as a result of isolating the failed suction relief valve. An alternate heat sink would likely have been required; however, in mode 5, an alternate heat sink may not be readily available.

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 NRR project manager.

Charles E. Rossi

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

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Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
90-04	Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam Generators	1/26/90	All holders of OLs or CPs for Westinghouse-designed and Combustion Engineering-designed nuclear power reactors.
90-03	Malfunction of Borg-Warner Bolted Bonnet Check Valves Caused by Failure of the Swing Arm	1/23/90	All holders of OLs or CPs for nuclear power reactors.
90-02	Potential Degradation of Secondary Containment	1/22/90	All holders of OLs or CPs for BWRs.
90-01	Importance of Proper Response to Self-Identified Violations by Licensees	1/12/90	All holders of NRC materials licenses.
89-90	Pressurizer Safety Valve Lift Setpoint Shift	12/28/89	All holders of OLs or CPs for PWRs.
89-89	Event Notification Worksheets	12/26/89	All holders of OLs or CPs for nuclear power reactors.
89-88	Recent NRC-Sponsored Testing of Motor-Operated Valves	12/26/89	All holders of OLs or CPs for nuclear power reactors.
89-87	Disabling of Emergency Diesel Generators by Their Neutral Ground-Fault Protection Circuitry	12/19/89	All holders of OLs or CPs for nuclear power reactors.
89-45, Supp. 2	Metalclad, Low-Voltage Power Circuit Breakers Refurbished with Substandard Parts	12/15/89	All holders of OLs or CPs for nuclear power reactors.
89-86	Type HK Circuit Breakers Missing Close Latch Anti-Shock Springs.	12/15/89	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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Statements in the notice on EOPs and equipment availability in shutdown modes were concurred in by R. Jones
E. Rossi

*SEE PREVIOUS PAGE FOR CONCURRENCE

*EAB:NRR	*TECH:EDITOR	*EAB:NRR	*C:EAB:NRR	*C:OGCB:NRR	D:DOEA:NRR
NFields:db		DCFischer	CJHaughney	CHBerlinger	CERossi
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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 one of the technical contacts listed below or the Regional Administrator of the appropriate regional office.

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NF	NF comments on initial version rec'd	DCF	DCF for	CHB	
EAB:NRR	TECH:EDITOR	EAB:NRR	C:EAB:NRR	C:OGCB:NRR	D:DOEA:NRR
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