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

December 4, 1987

NRC INFORMATION NOTICE NO. 87-60: DEPRESSURIZATION OF REACTOR COOLANT SYSTEMS IN PRESSURIZED-WATER REACTORS

Addressees:

All holders of operating licenses or construction permits for pressurized water reactors.

Purpose:

This notice is being provided to alert addressees of potential problems resulting from the loss of pressure control in the reactor coolant system (RCS) which could affect the operator's ability to depressurize the reactor coolant system in a timely manner during a steam generator tube rupture accident, or to control the plant during natural circulation cooldown. 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 information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

Two events have occurred which demonstrate the importance of maintaining the capability to depressurize the RCS in emergencies.

The importance of maintaining effective pressure control in mitigating a steam generator tube rupture event was positively demonstrated during the North Anna Unit 1 tube rupture which occurred on July 15, 1987. A double ended rupture of a single tube occurred in the "C" steam generator causing an initial break flow of around 600 gpm.

The plant was manually tripped from 100% power at about five minutes into the event. This was followed in about 20 seconds by an automatic safety injection actuation. After positively identifying and isolating the steam generator with the rupture, the operators initiated a rapid cooldown to 480 degrees F in order to establish an adequate subcooling margin. This was accomplished by dumping steam from the undamaged steam generators to the main condenser using steam dump valves. A few minutes later a rapid RCS depressurization was commenced by fully opening the two pressurizer spray valves. As this pressure reduction began to tail off, the operators briefly opened a pressurizer PORV causing an additional rapid 40 psi drop in RCS pressure. The primary to secondary leakage was promptly terminated when the RCS pressure was equalized with the pressure of the steam generator having the ruptured tube at about 30

minutes into the event. During the remainder of the cooldown the primary pressure was maintained below the pressure of the steam generator with the rupture to minimize secondary contamination and to facilitate cooldown of the steam generator using backfill.

Because they were able to maintain good primary pressure control, the operators were able to minimize the radiological release during this event. None of the secondary atmospheric relief valves were actuated. The release was limited to the contamination of the secondary system before the steam generator with the rupture could be isolated. The total release was estimated at 159 mCi for the entire event.

On August 26, 1986, a reactor trip occurred at Salem Unit 2 when a technician inadvertently grounded a 120 VAC instrument bus, causing a spurious loss-of-reactor-coolant-pump reactor trip signal. The voltage spike generated by the grounding also generated a spurious low-steam line pressure signal which, in conjunction with a high-steam flow indication, initiated a safety injection signal. About 30 seconds later, a series of vital bus transfers were generated by the protective relaying logic. During these transfers, two of the vital buses were without power simultaneously for about two seconds, which resulted in the generation of a station blackout signal. However, offsite power was actually available and the reactor coolant pumps continued to operate. The coincident safety injection and station blackout signals disconnected all vital power buses and automatically sequenced selected safety injection loads onto the emergency buses powered by the already operating diesel generators. The number two vital bus remained deenergized because the diesel generator for this bus had been taken out of service for maintenance. However, in accordance with the plant design, this automatic sequencing did not load the component cooling water pumps onto the emergency buses.

The reactor operators secured the reactor coolant pumps after 5 minutes of operation because component cooling water was not available to cool the motor bearings and the thermal barrier. The high-pressure safety injection pumps continued to operate after the receipt of the safety injection signal. The resulting rise in reactor coolant system pressure caused a power-operated relief valve (PORV) to lift numerous times. Normal pressurizer spray was not available to control the primary system pressure rise once the reactor coolant pumps were tripped.

Although safety injection was not needed, the charging pumps continued to inject water into the primary system through the emergency core cooling system (ECCS) piping. The isolation valves had assumed their safeguards (open) position following initiation of the safety injection signal. Since the vital bus that powered the ECCS isolation valves was deenergized, the control room operators could not isolate the ECCS flow without taking local manual control of the isolation valves. The operators elected not to shutdown the charging pumps because they were needed to supply injection water to the reactor coolant pump seals. In addition, the operators were unable to initiate the auxiliary pressurizer spray even with the charging pumps running because the spray isolation valve, also connected to the deenergized vital bus, was closed as part of the automatic safeguards alignment and could not be opened remotely.

The operators manually energized the component cooling water pumps after 7 minutes. However, it took more than 20 minutes for the operators to secure safety injection, start a reactor coolant pump, and reestablish normal pressure control.

Discussion:

Reactor coolant system pressure control is necessary for the timely recovery from steam generator tube rupture accidents; i.e., to minimize the discharge of reactor coolant into the faulted steam generator and the subsequent loss of coolant outside containment, such as occurred during the Ginna accident (January 25, 1982). Pressure control also is important to facilitate natural circulation cooldown. Generally, the normal pressurizer spray system is used to control or reduce reactor coolant system pressure. However, this system requires the operability of the reactor coolant pumps and the pressurizer spray control valves. In the Salem event, the reactor coolant pumps were secured and one of the normal pressurizer spray lines had been isolated for about three months because of excessive leakage.

Emergency operating procedures for many plants utilize the PORVs for depressurizing the primary system following a steam generator tube rupture accident if the normal pressurizer spray system is not available. In the Salem event, one of the PORVs had been isolated for about 2 weeks prior to the event, also because of excessive leakage. Although an isolated PORV could probably be unblocked if it was seriously needed for pressure reduction, the PORV isolation represents an additional loss of redundancy and reliability. If the normal pressurizer spray system is out of service and the PORVs are unavailable, the auxiliary pressurizer spray system on plants having such a system can be used to depressurize the primary system. However, during the Salem event the auxiliary pressurizer spray system was also unavailable because its isolation valve was closed and could not be repositioned from the control room due to the loss of its vital bus. This vital bus was not re-energized immediately because the diesel generator supplying power to this bus was out of service for preventive maintenance.

The availability of the pressurizer spray system, the PORVs for some plants and the auxiliary pressurizer spray system are generally not assured by the limiting conditions for operation contained in the Technical Specifications. Nevertheless, as these events demonstrate, these systems can be important to the safety of the plant under certain emergency conditions. Consequently, it is important that out of service periods for repairs or maintenance be minimized for these systems. In the case of the PORVs the reliability of the closing capability as well as the assurance of availability for pressure control is important. During the Ginna accident the PORV stuck open causing a loss-of-coolant to the containment and the formation of coolant voids in the reactor vessel head and the tube bundle of the faulted steam generator. At Indian Point Unit 2 (LER 247/85-002) and Callaway Unit 1 (LER 483/84-064) all of the PORVs were found to have been isolated during normal operation, inhibiting their ability to provide pressure control and to promptly mitigate

a potential accident. Further information regarding this issue can be found in AEOD/E708, "Depressurization of Reactor Coolant Systems in PWRs," an engineering evaluation report issued by the NRC Office for the Analysis and Evaluation of Operational Data.

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

Charles E. Rossi

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

Technical Contacts: Sanford Israel, AEOD
(301) 492-4437

Donald C. Kirkpatrick, NRR
(301) 492-8166

Attachment: List of Recently Issued NRC Information Notices

Attachment
IN 87-60
December 4, 1987

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES 1987

Information Notice No.	Subject	Date of Issuance	Issued to
86-108, Supp. 2	Degradation of Reactor Coolant System Pressure Boundary Resulting from Boric Acid Corrosion	11/19/87	All holders of OLs or CPs for nuclear power reactors.
87-59	Potential RHR Pump Loss	11/17/87	All holders of OLs or CPs for nuclear power reactors.
87-58	Continuous Communications Following Emergency Notifications	11/16/87	All nuclear power reactor facilities holding an OL and the following fuel facilities that have Emergency Notification Systems: Nuclear Fuel Services, Erwin, TN; General Atomics, San Diego, CA; UNC, Montville, CT; and B & W LRC and B & W Navy, Lynchburg, VA.
87-57	Loss of Emergency Boration Capability Due to Nitrogen Gas Intrusion	11/6/87	All holders of OLs or CPs for nuclear power reactors.
87-56	Improper Hydraulic Control Unit Installation at BWR Plants.	11/4/87	All holders of OLs or CPs for boiling water reactors (BWRs).
87-55	Portable Moisture/Density Gauges: Recent Incidents of Portable Gauges Being Stolen or Lost	10/29/87	All NRC licensees authorized to possess portable gauges.
87-54	Emergency Response Exercises	10/23/87	All holders of OLs or CPs for nuclear power reactors.
87-53	Auxiliary Feedwater Pump Trips Resulting from Low Suction Pressure	10/20/87	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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Robert Jones of SRXB reviewed Notice from standpoint of photography for depressurization pressure units and indicated no problems in a telephone discussion with C E Rossi on 11/20/87. He did not review details of the events

*SEE PREVIOUS CONCURRENCES

*OGCB:DOEA:NRR	*ROAB:DSP:AEOD	*PPMB:ARM	*C/OGCB:DOEA:NRR	D/DOEA:NRR
DCKirkpatrick	SIsrael	TechEd	CHBerlinger	CERossi
09/17/87	09/29/87	09/18/87	10/19/87	11/30/87

North Anna event was reviewed by Leon Engle and he indicated it was correctly described in a telephone discussion with E. Rossi on 12/1/87. CER

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CHB 11/19/87

If the normal spray systems and the PORVs are all unavailable, the auxiliary spray system can be used to depressurize the primary system. However, in this instance, the isolation valve could not be actuated from the control room because of the loss of a vital bus. Again, the availability of this system is not controlled by the limiting conditions for operation.

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09/17/87	09/29/87 verbal by Phone	09/18/87	09/ /87	09/ /87

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