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

September 13, 1989

NRC INFORMATION NOTICE NO. 89-67: LOSS OF RESIDUAL HEAT REMOVAL CAUSED BY ACCUMULATOR NITROGEN INJECTION

Addressees:

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

Purpose:

This information notice is intended to alert addressees to potential problems resulting from the loss of residual heat removal (RHR) caused by the injection of nitrogen from an accumulator into the reactor coolant system (RCS). 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:

Salem Unit 1 lost both RHR pumps for about 50 minutes on May 20, 1989, as a result of an injection of nitrogen from an accumulator into the RCS and, subsequently, into the RHR system. This injection occurred while the licensee was conducting full-flow testing of the accumulator check valves. The reactor was in Mode 5 (cold shutdown) after a recent refueling with the reactor head installed. The RCS was filled to a cold calibrated pressurizer level of 10 percent with air contained in the reactor vessel head and in the steam generator U-tubes. All accumulators were filled to normal operating level and were pressurized to approximately 600 psig.

At 9:25 a.m., while performing a post-maintenance full-flow test of the check valves for accumulator 13, the accumulator isolation valve remained open for about 70 seconds as a result of an operator error. During this time, approximately 1800 cubic feet of nitrogen at about 62 psig entered the RCS. As the nitrogen expanded into the RCS, the pressurizer level went off-scale high, and the reactor pressure rose from 14 psig to about 51 psig. The operator, not realizing that nitrogen had been injected into the RCS, initiated pressurizer level restoration by draining the RCS to the refueling water storage tank (RWST). At 9:35 a.m., the operator observed zero RHR flow and a reduction of the pump motor current from 44 amps to about 21 amps.

IQ+R 11C

The operator, assuming that the pump was mechanically damaged, secured the pump and started the second RHR pump. When this pump exhibited the same characteristics as the other pump, the operator realized that the pumps were gas bound and started venting the RHR system. Venting was slow because of the size of the vent lines and an RHR system configuration that allowed air entrapment. Operators also had difficulty in locating one vent and drain valve; when it was located, an installed cap had to be removed. Slow venting continued until 10:18 a.m. when the operators initiated filling of the RHR system, using gravity feed from the RWST. At this time, the core exit temperature had increased to 122°F from a pre-event value of 92°F. At 10:23 a.m., the RHR system was filled, and RHR pump 11 was successfully started. At 10:37 a.m., RHR pump 12 was placed in service, and RHR pump 11 was secured to return the system to normal operation. Because of an inadequate abnormal operating procedure and emergency classification guide, a 10 CFR 50.72 report for this loss of RHR pumps was not made until May 22, 1989.

Discussion:

An assessment of this loss-of-RHR-pump event at Salem Unit 1 identified the following concerns:

1. The operators appeared to believe that nitrogen injection into the RCS was not possible during the full-flow test of the accumulator check valves. This mindset caused the operators to drain the RCS when the pressurizer level kept increasing due to the expansion of injected nitrogen.

2. The abnormal operating procedures and the emergency classification guide did not adequately address the potential for loss of RHR cooling. The symptom-oriented procedures did not address the reactor parameters during a loss of shutdown cooling while in Modes 5 and 6. Consequently, the event was not reported immediately under 10 CFR 50.72.

3. The operators were not adequately trained to differentiate gas binding of the RHR pumps from mechanical damage. This caused the operators to start RHR pump 11 when they erroneously concluded that RHR pump 12 was mechanically damaged.

4. Elevation differences in the RHR suction pipe, the difficulty in locating one vent and drain valve, and the size of the vent lines caused the venting operation to be extremely slow. In addition, complete system venting was not possible because gas was trapped in the high points of the RHR system.

5. The appropriateness of performing a full-flow test of the accumulator check valves with fuel in the reactor vessel had not been fully assessed. An event similar to the one described in this information notice would not occur to this extent if this test had been conducted while the core was off-loaded. Furthermore, if this test had been performed with either reduced accumulator nitrogen pressure or with the reactor vessel head removed, the effects of nitrogen injection into the RCS would have been minimized.

It is important to note that if the accumulator check valve full-flow tests had been conducted when they are more commonly performed, during the shutdown prior to refueling, and an event similar to the one described in this information notice had occurred, the consequences could have been much more significant. It is also important to note that operator training provided in response to NRC Generic Letter 88-17, "Loss of Decay Heat Removal," did assist the operators in restoring the RHR system once gas binding of the system was recognized.

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, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: Daniel Prochnow, NRR
(301) 492-1166

Warren Lyon, NRR
(301) 492-0891

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
89-66	Qualification Life of Solenoid Valves	9/11/89	All holders of OLs or CPs for nuclear power reactors.
88-46, Supp. 4	Licensee Report of Defective Refurbished Circuit Breakers	9/11/89	All holders of OLs or CPs for nuclear power reactors.
89-65	Potential for Stress Corrosion Cracking in Steam Generator Tube Plugs Supplied by Babcock and Wilcox	9/8/89	All holders of OLs or CPs for PWRs.
89-64	Electrical Bus Bar Failures	9/7/89	All holders of OLs or CPs for nuclear power reactors.
89-63	Possible Submergence of Electrical Circuits Located Above the Flood Level Because of Water Intrusion and Lack of Drainage	9/5/89	All holders of OLs or CPs for nuclear power reactors.
89-62	Malfunction of Borg-Warner Pressure Seal Bonnet Check Valves Caused By Vertical Misalignment of Disk	8/31/89	All holders of OLs or CPs for nuclear power reactors.
89-61	Failure of Borg-Warner Gate Valves to Close Against Differential Pressure	8/30/89	All holders of OLs or CPs for nuclear power reactors.
88-48, Supp. 2	Licensee Report of Defective Refurbished Valves	8/22/89	All holders of OLs or CPs for nuclear power reactors.
89-60	Maintenance of Teletherapy Units	8/18/89	All NRC Medical Teletherapy Licensees.

OL = Operating License
CP = Construction Permit

It is important to note that if the accumulator check valve full-flow tests had been conducted when they are more commonly performed, during the shutdown prior to refueling, and an event similar to the one described in this information notice had occurred, the consequences could have been much more significant. It is also important to note that operator training provided in response to NRC Generic Letter 88-17, "Loss of Decay Heat Removal," did assist the operators in restoring the RHR system once gas binding of the system was recognized.

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Region I / PK Eapen has reviewed this final version and his comments have been incorporated 9/8/89 CHB

*SEE PREVIOUS CONCURRENCES

		D/DOEA:NRR	*C/OGCB:DOEA:NRR	*RPB:ARM
		CERossi	CHBerlinger	TechEd
		9/8/89	9/6/89	9/01/89
*OGCB:DOEA:NRR	*SRXB:DEST:NRR	*C/SRXB:DEST:NRR	*SAD/DEST:NRR	*D/DEST:NRR
DProchnow	WLyon	MHodges	AThadani	JRichardson
8/16/89	8/16/89	8/18/89	8/20/89	8/20/89

It is important to note that if the accumulator check valve full-flow tests had been conducted when they are more commonly performed, during the shutdown prior to fuel refueling, and an event similar to the one described in this information notice had occurred, the consequences could have been much more significant. It is also important to note that operator training provided in response to NRC Generic Letter 88-17, "Loss of Decay Heat Removal," did assist the operators in restoring the RHR system once gas binding of the system was recognized.

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With changes as noted

		D/DOEA:NRR	C/OGCB:DOEA:NRR	*RPB:ARM
		CERossi	CHBerlinger	TechEd
		9/ /89	9/6/89	9/01/89
*OGCB:DOEA:NRR	*SRXB:DEST:NRR	*C/SRXB:DEST:NRR	*SAD/DEST:NRR	*D/DEST:NRR
DProchnow	WLyon	MHodges	AThadani	JRichardson
8/16/89	8/16/89	8/18/89	8/20/89	8/20/89

It is also important to note that this event indicated that operator training provided in response to NRC Generic Letter 88-17 (Loss of Decay Heat Removal) did assist the operators in restoring the RHR system once gas binding of the system was recognized.

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OGCB:DOEA:NRR	SRXB:DEST:NRR	C:SRXB:DEST:NRR	SAD:DEST:NRR	D:DEST:NRR
DProchnow	WLyon	MHodges	AThadani	JRichardson
8/16/89	8/16/89	8/18/89	8/20/89	8/20/89

NBRPM:ARM	C:OGCB:DOEA:NRR	D:DOEA:NRR
Tech Ed	CHBerlinger	CERossi
8/1/89	8/ /89	8/ /89
9		