

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

December 1, 1989

NRC INFORMATION NOTICE NO. 89-80: POTENTIAL FOR WATER HAMMER, THERMAL STRATIFICATION, AND STEAM BINDING IN HIGH-PRESSURE COOLANT INJECTION PIPING

Addressees:

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

Purpose:

This information notice is being provided to alert addressees to potential problems resulting from failure of high-pressure coolant injection (HPCI) valves in a boiling-water reactor (BWR) to prevent leakage of feedwater into the HPCI system during operation of the reactor at power. 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:

On February 21, 1989, with Dresden Unit 2 operating at power, temperature was greater than normal in the HPCI pump and turbine room. The abnormal heat load was caused by feedwater leaking through uninsulated HPCI piping to the condensate storage tank. During power operation, feedwater temperature is less than 350°F, and feedwater pressure is approximately 1025 psi. Normally, leakage to the condensate storage tank is prevented by the injection check valve, the injection valve, or the discharge valve on the auxiliary cooling water pump. The injection valve and the injection check valve are shown in Attachment 1.

On October 23, 1989, with the reactor at power, leakage had increased sufficiently to raise the temperature between the injection valve and the HPCI pump discharge valve to 275°F and at the discharge of the HPCI pump to 246°F. Pressure in the HPCI piping was 47 psia. On the basis of the temperature gradient and the pressure in the piping, the licensee concluded that feedwater leaking through the injection valve was flashing and displacing some of the water in the piping with steam. This conclusion was confirmed by closing the pump discharge valve and monitoring the temperature of the piping. As expected, the pipe temperature decreased to ambient.

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Attachment in jacket

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Accessible portions of the HPCI piping were inspected, and some loose pipe supports were found near the injection valves. Concrete surfaces near the support attachment points were spalled.

The licensee declared the HPCI system inoperable on October 23, 1989, and notified NRC pursuant to 10 CFR 50.72. After performing a review under 10 CFR 50.59, the licensee opened the normally closed injection valve, closed the normally open discharge valve, and will use the discharge valve temporarily as the injection valve.

Temperature measurements on the HPCI piping at Dresden Unit 3 indicated that less significant leakage was occurring.

Discussion:

The event at Dresden is significant because the potential existed for water hammer or thermal stratification to cause failure of the HPCI piping and for steam binding to cause failure of the HPCI pump. Further, failure of HPCI piping downstream from the injection valves would cause loss of one of two feedwater pipes.

The licensee has not heard the noise that is usually associated with water hammers. Nevertheless, loosening of the pipe supports, damage to concrete surfaces, and the presence of steam in the piping strongly indicate that water hammers had occurred in the HPCI system, probably during HPCI pump tests or valve manipulations. Temperature-monitoring instrumentation on the piping near the injection valves was useful in detecting the leak. NRC Information Notices 85-76, 86-01, 87-10, and 88-13 all address water hammer events at other facilities. Attachment 2 lists these and other references mentioned in this notice.

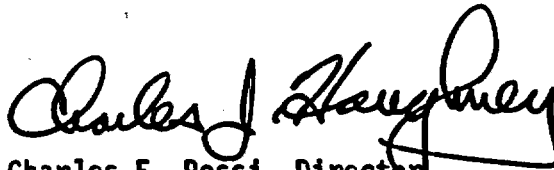
Concern for potential thermal stratification in the HPCI piping is related to three events in pressurized-water reactors (PWRs) that were the basis for issuing NRC Bulletin 88-08 and the three supplements to that bulletin. These events occurred in one of the Farley units and in two foreign reactors. In all of the events, water leaked either from or to the reactor coolant system through closed valves in an emergency coolant system. Thermal stratification of water in the piping of the emergency coolant system and fluctuations of the interface between the hot and cold streams of water resulted in thermal fatigue and cracking of the piping wall in the heat-affected zones of welds and in the base metal. For these reactors, the configuration of the piping between the reactor coolant system and the first valve in the emergency cooling system is approximately like the configuration of the piping at Dresden. The licensee for Dresden does intend to examine the piping ultrasonically at the next scheduled outage to determine whether detectable damage has occurred.

During the event at Dresden, the potential for steam binding the HPCI pump existed because the discharge valve was normally open. Events have occurred in PWRs that have resulted in steam binding of auxiliary feedwater pumps. Because the NRC staff was concerned about the availability of the auxiliary

feedwater pumps when needed to mitigate the consequences of an accident, the staff issued NRC Bulletin 85-01. The bulletin required that certain licensees develop procedures for monitoring the temperature of the pump discharge to ensure that it remains at less than saturation temperature and to identify steam binding and restore the operability of the system if it occurs.

The NRC may issue additional information as more inspection and analysis is completed.

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.



for

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

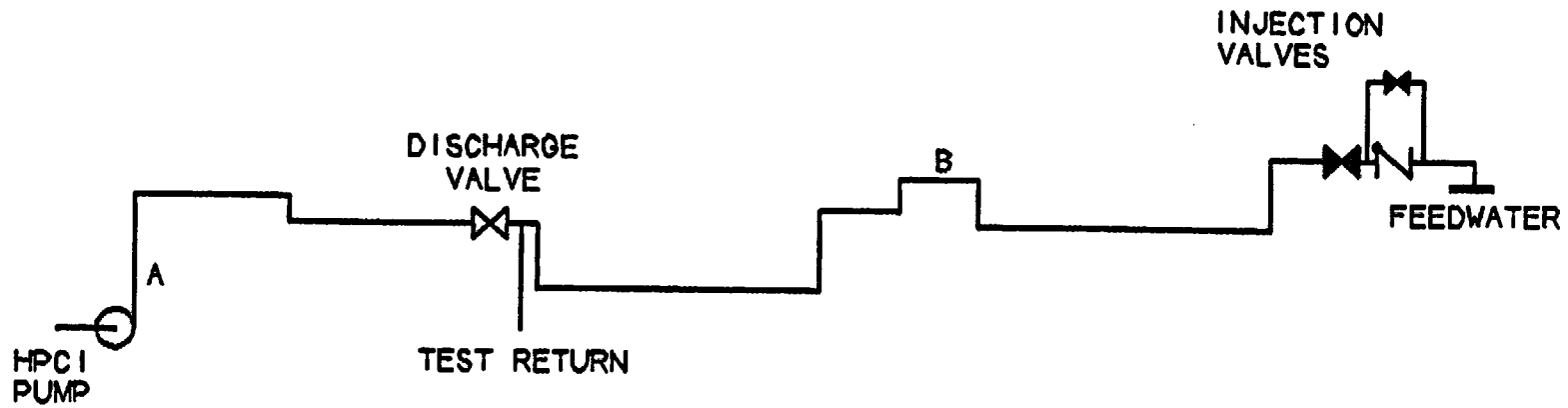
Technical Contacts: Eric W. Weiss, AEOD  
(301) 492-9005

Roger Woodruff, NRR  
(301) 492-1180

Attachments:

1. Dresden 2 - High-Pressure Coolant Injection Line
2. Referenced Generic Communications
3. List of Recently Issued NRC Information Notices

	<u>A</u>	<u>B</u>
5/11/89	140 F	160 F
7/18/89	175 F	220 F
10/23/89	248 F	275 F



DRESDEN 2 - HIGH-PRESSURE COOLANT INJECTION LINE

REFERENCED GENERIC COMMUNICATIONS

1. NRC Information Notice No. 85-76, "Recent Water Hammer Events," September 19, 1985.
2. NRC Information Notice No. 86-01, "Failure of Main Feedwater Check Valves Causes Loss of Feedwater System Integrity and Water Hammer Damage," January 1, 1986.
3. NRC Information Notice No. 87-10, "Potential for Water Hammer During Restart of Residual Heat Removal Pumps," February 2, 1987.
4. NRC Information Notice No. 88-13, "Water Hammer and Possible Piping Damage Caused by Misapplication of Kerotest Packless Metal Diaphragm Globe Valves," April 18, 1988.
5. NRC Bulletin 85-01, "Steam Binding of Auxiliary Feedwater Pumps," October 29, 1985.
6. NRC Bulletin No. 88-08, "Thermal Stresses in Piping Connected to Reactor Coolant Systems," June 22, 1988; Supplement 1, June 24, 1988; Supplement 2, August 4, 1988; and Supplement 3, April 11, 1988.

LIST OF RECENTLY ISSUED  
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
89-79	Degraded Coatings and Corrosion of Steel Containment Vessels	12/1/89	All holders of OLs or CPs for LWRs.
89-56, Supp. 1	Questionable Certification of Material Supplied to the Defense Department by Nuclear Suppliers	11/22/89	All holders of OLs or CPs for nuclear power reactors.
89-78	Failure of Packing Nuts on One-Inch Uranium Hexafluoride Cylinder Valves	11/22/89	All NRC licensees authorized to possess and use source material and/or special nuclear material for the heating, emptying, filling, or shipping of uranium hexafluoride in 30- and 48-inch diameter cylinders.
89-77	Debris in Containment Emergency Sumps and Incorrect Screen Configurations	11/21/89	All holders of OLs or CPs for PWRs.
89-76	Biofouling Agent: Zebra Mussel	11/21/89	All holders of OLs or CPs for nuclear power reactors.
89-75	Falsification of Welder Qualifications for Contractor Employees	11/20/89	All holders of OLs or CPs for nuclear power reactors.
89-74	Clarification of Transportation Requirements Applicable to Return of Spent Radiopharmacy Dosages from Users to Suppliers	11/7/89	All manufacturers and distributors of radiopharmaceuticals for medical use, nuclear pharmacies, and medical licensees.
89-73	Potential Overpressurization of Low Pressure Systems	11/1/89	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License  
CP = Construction Permit

feedwater pumps when needed to mitigate the consequences of an accident, the staff issued NRC Bulletin 85-01. The bulletin required that certain licensees develop procedures for monitoring the temperature of the pump discharge to ensure that it remains at less than saturation temperature and to identify steam binding and restore the operability of the system if it occurs.

The NRC may issue additional information as more inspection and analysis is completed.

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

Technical Contacts: Eric W. Weiss, AEOD  
(301) 492-9005

Roger Woodruff, NRR  
(301) 492-1180

Attachments:

1. Dresden 2 - High-Pressure Coolant Injection Line
2. Referenced Generic Communications
3. List of Recently Issued NRC Information Notices

\*SEE PREVIOUS CONCURRENCE

EAB:NRR  
\*RWoodruff:db  
11/12/89

IRB:AEOD  
\*EWeiss  
11/14/89

TECH EDITOR  
\*RSanders  
11/15/89

EAB:NRR  
\*PBaranowsky  
11/15/89

PM:PD32:NRR  
\*BSiegel  
11/15/89

C:PB1:RIII  
\*WShafer  
11/13/89

C:EAB:NRR  
\*CChaughney  
11/15/89

C:OGCB:NRR  
\*CBerlinger  
11/22/89

D:DOEA:NRR  
CERossi  
11/27/89

monitoring the temperature of the pump discharge to ensure that it is at less than saturation temperature and to identify steam binding if it occurs.

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