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

August 20, 1992

NRC INFORMATION NOTICE 92-60: VALVE STEM FAILURE CAUSED BY EMBRITTLEMENT

Addressees

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

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to problems in which valve stems manufactured from American Society of Mechanical Engineers (ASME) SA 564, Type 630, H900 through H1150 age treatment condition (17-4 PH) stainless steel could become brittle and fail if used in environments that exceed 600 °F. It is expected that recipients will review this information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Background

Power-operated relief valves (PORVs) connected to the pressurizer are designed for the valve stems to operate at saturated steam temperatures. The valve stem thermal history is affected by thermal conduction through the valve disk and by direct contact to the fluid discharge as a result of valve actuation. The normal operating saturation temperature in a PWR is approximately 650 °F. The maximum design temperatures are higher.

Data obtained by the Duke Power Company from testing on 17-4 PH material in the age treated condition indicate that this material will, after several thousand hours at 600 °F, exhibit an increase in tensile strength with an accompanying large decrease in ductility (secondary aging). The secondary aging mechanisms are the continued precipitation of the intermetallic compounds and the precipitation of chromium in ferrite (885 °F embrittlement). After secondary aging occurs, the material with low ductility will have an increased susceptibility for fracture, especially when subjected to high torque from a power actuator.

Description of Circumstances

On December 9, 1991, the Catawba Nuclear Station, Unit 2, was in Mode 5 (hot shutdown) in the final stages of a refueling outage. The pressure in the reactor coolant system was approximately 177 psig.

IDHR-11C

Operations personnel had noted some unexpected perturbations in the pressurizer relief tank earlier during the normal reactor coolant system fill-and-vent process which led them to suspect that either pressurizer PORV 2NC-32B or its associated block valve 2NC-31B may not be opening properly. Both valves appeared to stroke when observed locally. To verify that the valves were functioning properly, operations personnel attempted to depressurize the reactor coolant system by opening the PORV from the control room. When the PORV was opened, and the block valve 2NC-31B indicated an open condition, the reactor coolant system pressure remained stable. Operations personnel suspected that the PORV block valve was stuck in the closed position.

The PORV block valve is a motor operated 3-inch Rockwell International (now Edward Valve Company) Equiwedge gate valve. The licensee reviewed the data on a test performed on the block valve actuator on November 25, 1991, which suggested that the stem of the valve had separated from the gate assembly because the stem pullout force was much lower than normal. The licensee replaced the PORV block valve and verified that the stem had failed. The failure occurred in an area where the valve stem attached to the gate assembly. The licensee replaced the valve with a different type of valve, and radiographically tested the other PORV block valves on both units to verify that they were intact and open.

Discussion

The licensee performed a metallurgical analysis of the fractured stem and found that the material had lost ductility at the point of fracture. Apparently, the stem end attached to the disk was exposed to pressurizer temperatures above 600 °F for several thousand hours. The high torque applied by the power operator was sufficient to shear the stem.

The Edward Valve Company indicated that valve stems made of this material, ASME SA 564, Type 630 (17-4 PH, with an aging treatment of H1100), can become embrittled in as little as 5,000 hours when exposed to temperatures greater than 600 °F. Preliminary information indicates that this material is widely used in the stems of PORVs and PORV block valves.

It is important to note that a valve with a severed stem may pass a surveillance test. For example, if the safety function of the valve is to close, and the valve is tested in the closed direction, an acceptable closing force can be obtained even with a severed stem. This was, in fact, the case with the 2NC-31B valve. Determining the valve disk position is an operability concern for those systems with valves that are normally opened during operations but are closed during accident conditions.

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 project manager in the Office of Nuclear Reactor Regulation (NRR).

Charles E. Rossi

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

Technical contacts: William Orders
(803) 831-2963

Donald Naujock
(301) 504-2767

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
92-59	Horizontally-Installed Motor-Operated Gate Valves	08/18/92	All holders of OLs or CPs for nuclear power reactors.
92-58	Uranium Hexafluoride Cylinders - Deviations in Coupling Welds	08/12/92	All Fuel Cycle Licensees.
92-57	Radial Cracking of Shroud Support Access Hole Cover Welds	08/11/92	All holders of OLs or CPs for boiling water reactors (BWRs).
92-56	Counterfeit Valves in the Commercial Grade Supply System	08/06/92	All holders of OLs or CPs for nuclear power reactors.
92-55	Current Fire Endurance Test Results for Thermo-Lag Fire Barrier Material	07/27/92	All holders of OLs or CPs for nuclear power reactors.
92-54	Level Instrumentation Inaccuracies Caused by Rapid Depressurization	07/24/92	All holders of OLs or CPs for nuclear power reactors.
92-53	Potential Failure of Emergency Diesel Generators due to Excessive Rate of Loading	07/29/92	All holders of OLs or CPs for nuclear power reactors.
91-52, Supp. 1	Nonconservative Errors in Overtemperature Delta-Temperature (OTΔT) Setpoint Caused by Improper Gain Settings	07/16/92	All holders of OLs or CPs for Westinghouse (W)-designed nuclear power reactors.
92-52	Barriers and Seals Between Mild and Harsh Environments	07/15/92	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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 project manager in the Office of Nuclear Reactor Regulation (NRR).

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

Technical contacts: William Orders
(803) 831-2963

Donald Naujock
(301) 504-2767

Attachment: List of Recently Issued NRC Information Notices

DISTRIBUTION:

Central Files
DET RF
EMCB RF
DGNaujock
WFOrders
RAHermann
CBerlinger
CRossi

DET:EMCB	DET:EMCB	EMCB:AC	TechEd	DOEA:OGCB	DET:D	DOEA:D
DGNaujock	RAHermann for		JMain	CBerlinger	JRichardson	CRossi
7/13/92	7/13/92	/ /92	7/13/92	/ /92	/ /92	/ /92

OFFICIAL RECORD COPY WP FILENAME: g:\EDWARDS

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 project manager in the Office of Nuclear Reactor Regulation (NRR).

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

Technical contacts: William Orders
(803) 831-2963

Donald Naujock
(301) 504-2767

Attachment: List of Recently Issued NRC Information Notices

Document Name: 92-60.IN
* See previous concurrence

*OGCB:DOEA:NRR	*C/OGCB:DOEA:NRR	D/DOEA:NRR		
AJKugler	GHMarcus	CERossi		
08/03/92	08/05/92	08/14/92		
*EMCB:DET:NRR	*EMCB:DET:NRR	*AC/EMCB:DET:NRR	*RPB:ADM	*D/DET:NRR
DGNaujock	RAHermann	WBateman	JMain	JERichardson
07/13/92	07/13/92	07/17/92	07/13/92	07/21/92

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 project manager in the Office of Nuclear Reactor Regulation (NRR).

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

Technical contacts: William Orders
(803) 831-2963

Donald Naujock
(301) 504-2767

Attachment: List of Recently Issued NRC Information Notices

* See previous concurrence

OGCB:DOEA:NRR	C/OGCB:DOEA:NRR	D/DOEA:NRR		
AJKugler	CHBerlinger	CERossi		
08/3/92	08/5/92	08/ /92		
*EMCB:DET:NRR	*EMCB:DET:NRR	*AC/EMCB:DET:NRR	*RPB:ADM	*D/DET:NRR
DGNaujock	RAHermann	WBateman	JMain	JERichardson
07/13/92	07/13/92	07/17/92	07/13/92	07/21/92

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 project manager in the Office of Nuclear Reactor Regulation (NRR).

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

Technical contacts: William Orders
(803) 831-2963

Donald Naujock
(301) 504-2767

Attachment: List of Recently Issued NRC Information Notices

DISTRIBUTION:

Central Files	RAHermann
DET RF	CBerlinger
EMCB RF	CRossi
DGNaujock	
WFOrders	

* See previous concurrence

*DET:EMCB	*DET:EMCB	*AC:EMCB	*TechEd
DGNaujock:dn	RAHermann	WBateman	JMain
07/13/92	07/13/92	07/17/92	07/13/92
DOEA:OGCB	DET:D	DOEA:D	
CBerlinger	JERichardson	CRossi	
/ /92	7/21/92	/ /92	

OFFICIAL RECORD COPY WP FILENAME: g:\EDWARDS

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 project manager in the Office of Nuclear Reactor Regulation (NRR).

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

Technical contacts: William Orders
(803) 831-2963

Donald Naujock
(301) 504-2767

Attachment: List of Recently Issued NRC Information Notices

DISTRIBUTION:

Central Files	RAHermann
DET RF	CBerlinger
EMCB RF	CRossi
DGNaujock	
WFOrders	

*See Previous Concurrences

*DET:EMCB	*DET:EMCB	AC:EMCB	*TECHEd
DGNaujock:dn	RAHermann	WBateman	JMain
07/13/92	07/13/92	07/17/92	07/13/92

DOEA:OGCB	DET:D	DOEA:D
CBerlinger	JERichardson	CRossi
07/ /92	07/ /92	07/ /92

WP Filename: g:\EDWARDS