

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

August 30, 1994

NRC INFORMATION NOTICE 94-63: BORIC ACID CORROSION OF CHARGING PUMP CASING
CAUSED BY CLADDING CRACKS

Addressees

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

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the potential for significant damage that could result from corrosion of reactor system components caused by cracking of the stainless steel cladding. 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 are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

During July and August 1993 the Virginia Electric Power Company discovered severe corrosion damage of the carbon steel casing of a high head safety injection pump at North Anna Unit 1. The damage was caused by cracks through the stainless steel cladding in the pump that allowed corrosive attack by the boric acid coolant. The cracks were discovered when the pump was disassembled for maintenance and rust was observed on the otherwise shiny surface of the cladding in the discharge section of the pump.

When the licensee ground out the cracked area to repair the pump by welding, it discovered that the boric acid corrosion had penetrated to within about 3 mm [0.125 inch] of the outside surface of the pump. The licensee then ground out the corroded material, producing a cavity that was approximately 64 mm long by 38 mm wide by 13 mm deep [2.5 by 1.5 by 0.5 inches].

Discussion

The damaged pump, designated the IC pump, is one of three such pumps designed for both emergency high head safety injection and normal charging to the reactor vessel of each North Anna unit. In September 1989, the licensee discovered cladding cracking in the suction section of the Unit 1 A pump.

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This cracking resulted in boric acid attack of the carbon steel base metal. However, the extent of the damage is not known for this pump because the licensee replaced the pump casing with an all stainless steel casing and did not make a detailed examination of the old casing. In August 1993, the licensee inspected the Unit 1 B charging pump cladding but did not discover any deterioration in this pump.

The discovery of cladding cracks in the 1C charging pump prompted the licensee to visually inspect the remaining stainless steel clad charging pumps at North Anna. In January 1994, the licensee found eight cracks that extended through the cladding of the Unit 2 B charging pump. Six were located in the pump suction section and two in the pump discharge section. Although the licensee did not measure the damaged volume of the base metal, rust on the surface of the stainless steel cladding indicated that base metal corrosion attack had occurred. After an unsuccessful attempt to repair the 2B charging pump casing, the licensee replaced it with one made entirely of stainless steel. In May 1994, the licensee found numerous cracks through the cladding of the end of the Unit 2 A charging pump. The licensee also found a large hole (approximately 2.5 cm [1 inch] in diameter) through the cladding in the discharge end of the pump. The licensee decided that repairing the 2A charging pump casing was not practical and replaced the casing with one made of solid stainless steel.

Corrosive attack by boric acid coolant resulting from small cracks in charging pump cladding generally proceeds relatively slowly due, apparently, to the low temperature of the charging coolant. However, as the experience discussed in this notice shows, such attack can eventually lead to significant thinning of the pump casing and possibly substantial leakage. Since these pumps are normally relied on for high head emergency injection, as well as normal charging, this type of attack, if not identified, could eventually result in the inability of the pump to perform a vital safety function in an emergency. This experience also shows that the corrosion of the base metal due to cladding cracks is usually relatively easy to identify through visual inspection.

Related Generic Communications

On October 29, 1980, NRC issued Information Notice 80-38, "Cracking in Charging Pump Casing Cladding", in which it discussed cracking at the transition between the pump casing barrel and the pump suction end plate in a Zion Unit 1 charging pump. The cracking allowed localized boric acid attack in the base metal to a maximum depth of 1.6 mm [0.0625 inch]. The Zion licensee replaced this pump with one that had a solid stainless steel casing.

In June 1983, the Pacific Pump Division of Dresser Industries (the vendor) issued procedure bulletin 037-0-0104-0 listing its pumps constructed with cladding and suggesting methods for field inspection of the pumps. A list of nuclear power plants with these pumps is attached.

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 Office of Nuclear Reactor Regulation (NRR) project manager.

BK Grimes
Brian K. Grimes, Director for
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Technical contacts: John York, RII
(404) 331-5536

Don Taylor, RII
(703) 894-5421

Attachments:

1. List of Power Plants with Pumps Identified by Dresser
2. List of Recently Issued NRC Information Notices

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<u>PACIFIC PUMP</u> <u>SHOP ORDER</u>	<u>SERIAL NO.</u>	<u>USER</u>	<u>PLANT</u>
B46-617	45603/04	Public Service Electric & Gas	Salem #1
B46-617	45605/06	Indiana & Michigan Electric Co.	D.C. Cook #1
B46-617	45607/08	Indiana & Michigan Electric Co.	D.C. Cook #2
B46-617	45609/10	Commonwealth Edison Co.	Zion #2
B46-617	45611/12	Pacific Gas & Electric Co.	Diablo Canyon #1
B46-617	45613/14	Public Service Electric & Gas	Salem #2
B46-617	45615/16	Commonwealth Edison Co.	Zion #1
B46-617	45617/18	Pacific Gas & Electric Co.	Diablo Canyon #2
B46-617	45619/20	Tennessee Valley Authority	Sequoyah #1
B46-617	45621/22	Tennessee Valley Authority	Sequoyah #2
B47-096	46352/53	Duquesne Light Co.	Beaver Valley #1
B47-096	46354/55/56	Southern Nuclear Co.	J. M. Farley #1
B47-096	46357/58/59	Virginia Electric and Power Co.	North Anna #1
B47-096	46360/61	Portland General Electric Co.	Trojan
B47-096	46362/63/64	Virginia Electric and Power Co.	North Anna #2
B47-096	46365/66/67	Kansai Electric & Power Co.	Takahama #1

LIST OF RECENTLY ISSUED
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-62	Operational Experience on Steam Generator Tube Leaks and Tube Ruptures	08/30/94	All holders of OLs or CPs for pressurized water reactors.
94-61	Corrosion of William Powell Gate Valve Disc Holders	08/25/94	All holders of OLs or CPs for nuclear power reactors.
94-60	Potential Overpressurization of Main Steam System	08/22/94	All holders of OLs or CPs for pressurized-water reactors.
94-30, Supp. 1	Leaking Shutdown Cooling Isolation Valves at Cooper Nuclear Station	08/19/94	All holders of OLs or CPs for nuclear power reactors.
94-59	Accelerated Dealloying of Cast Aluminum-Bronze Valves Caused by Microbiologically Induced Corrosion	08/17/94	All holders of OLs or CPs for nuclear power reactors.
94-58	Reactor Coolant Pump Lube Oil Fire	08/16/94	All holders of OLs or CPs for pressurized water reactors.
94-57	Debris in Containment and the Residual Heat Removal System	08/12/94	All holders of OLs or CPs for nuclear power reactors.
94-56	Inaccuracy of Safety Valve Set Pressure Determinations Using Assist Devices	08/11/94	All holders of OLs or CPs for nuclear power reactors.
94-55	Problems with Copes-Vulcan Pressurizer Power-Operated Relief Valves	08/04/94	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
 CP = Construction Permit

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Brian K. Grimes, Director
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

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*SEE PREVIOUS CONCURRENCE

OFFICE	*OGCB:DORS	*DFIPS:ADM	*C/EMCB:NRR	*DRP:RII	*R:RII
NAME	DKirkpatrick	JMain	JStrosnider	JYork	DTaylor
DATE	07/07/94	07/13/94	07/27/94	08/08/94	08/08/94

OFFICE	*AD/DRP:RII	*C/OGCB:NRR	D/DORS:NRR		
NAME	JJohnson	EDoolittle	BGrimes (67)		
DATE	08/08/94	08/15/94	08/24/94		

DOCUMENT NAME: 94-63.IN

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Related Generic Communications

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In June, 1983, the Pacific Pump Division of Dresser Industries, the vendor, issued a procedure bulletin (designated No 037-0-0104-0) identifying their pumps that were constructed with cladding and suggesting methods for field inspection of the pumps. A list of nuclear power plants with these pumps is attached.

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