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

April 12, 1994

NRC INFORMATION NOTICE 94-30: LEAKING SHUTDOWN COOLING ISOLATION VALVES AT COOPER NUCLEAR STATION

Addressees

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

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to a precursor to an unisolable rupture of shutdown cooling piping with the potential for core damage and release of radioactive material outside the containment. 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

While the Cooper Nuclear Station (Cooper) was operating in May 1992, the high-pressure alarm on the residual heat removal (RHR) system suction piping alarmed. The normal pressure for this piping should not have been above 0.52 MPa [75 psia], the alarm setpoint was 0.79 MPa [115 psia], and the piping design pressure was 1.14 MPa [165 psia]. The licensee established a path to vent the low-pressure suction piping into the pressure maintenance system (a multi-header distribution system that keeps the emergency core cooling system discharge piping filled with water). The licensee measured the leakage through the inboard shutdown cooling suction isolation valve and found it to be 1.5 lpm [0.38 gpm]. The licensee was not able to measure the leakage through the outboard valve.

The two shutdown cooling suction isolation valves are Anchor-Darling 20-inch nominal, double-disk, flex-wedge, gate valves, and perform the pressure isolation function between the high-pressure primary coolant system and the low-pressure RHR piping. These valves also perform a containment isolation function. Although the plant technical specifications did not specify a limit for pressure isolation valve leakage, the licensee concluded that the valves were operable because the leakage was below the pressure isolation valve leakage limit of 4 lpm [1 gpm] in the Standard Technical Specifications. The licensee did not evaluate the operability of the containment isolation function of these valves.

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While the reactor was shut down on March 29, 1993, the licensee performed a local leak rate test on the inboard valve with pressure applied in the same direction as the accident pressure. The valve failed the test. The leakage limit was 0.57 m^3/h [20 SCFH] and the measured leakage was 1.08 m^3/h [38.1 SCFH]. The integrity of this valve seat and disk is critical because they perform the pressure and containment isolation functions of the valve.

The licensee disassembled both the inboard and outboard valves and found cracks in the seating surfaces of both valves. The majority of the cracks were in the stellite facing of the normally loaded (outboard) sides of the valve disks. The outboard valve had one crack and the inboard valve had five cracks on the outboard side disk facing. Cracks were only at the "bottom" (from about the 4 to 8 o'clock positions) of the disks and reached to the base metal, except for two cracks in the inboard valve that extended into the base metal, but not more than 3.2 mm [1/8 inch]. In addition, four "matching" cracks were found in the inboard valve's loaded side seat ring. The outboard valve also had two cracks on the normally unloaded (inboard) side. Crack orientation in all cases was radial. The licensee determined that the cracking was most likely caused by high residual stresses in the material due to inadequate stress relief or by fatigue resulting from differential thermal expansion forces combined with casting voids and small flaws in the disk base metals and pinholes in the stellite facing.

Discussion

From May 1992 until March 1993, the licensee for the Cooper Nuclear Station had operated with a reactor coolant system leak in the RHR shutdown cooling suction line. The leakage was initially measured to be 1.5 lpm [0.38 gpm] through the inboard valve and was sufficient to activate the high-pressure alarm for the suction line. Although the cause of the leakage had not been identified, the licensee established a path to vent the leakage from the RHR suction piping into the pressure maintenance system, and continued operation.

In March 1993, when the licensee inspected the isolation valves for the suction line, the licensee found cracks in the valve disks and seats. A gross failure of these isolation valves would have created an interfacing-systems loss-of-coolant accident (ISLOCA), and would have pressurized the suction piping beyond its design pressure. A rupture of the suction piping outside containment, coupled with postulated failure of the two valves, would have been unisolable and may have led to a release of radioactive material outside the containment. Further, because the emergency cooling system could not have been used in a recirculation mode, core damage accident sequences would have been more likely. The licensee failed to promptly identify and correct this condition and operated for an extended period of time in this condition.

Related Generic Communications

- NRC Information Notice 84-74, "Isolation of Reactor Coolant System From Low-Pressure Systems Outside Containment," September 28, 1984.

- NRC Information Notice 86-40, "Degraded Ability to Isolate the Reactor Coolant System from Low-Pressure Coolant Systems in BWRs," June 5, 1986.
- NRC Generic Letter 87-06, "Periodic Verification of Leak Tight Integrity of Pressure Isolation Valves," March 13, 1987.
- NRC Information Notice 92-36, "Intersystem LOCA Outside Containment," May 7, 1992.

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.

C I Grimes

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

Technical contacts: Elmo E. Collins, RIV
(817) 860-8291

Neal K. Hunemuller, NRR
(301) 504-1152

Attachment:
List of Recently Issued NRC Information Notices
Computer Printout/see Jacket

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-29	Charging Pump Trip during a Loss-of-Coolant Event Caused by Low Suction Pressure	04/1[illegible]/94	All holders of OLs or CPs for pressurized water reactors.
92-51, Supp. 1	Misapplication and Inadequate Testing of Molded-Case Circuit Breakers	04/12/94	All holders of OLs or CPs for nuclear power reactors.
94-28	Potential Problems with Fire-Barrier Penetration Seals	04/05/94	All holders of OLs or CPs for nuclear power reactors.
94-27	Facility Operating Concerns Resulting from Local Area Flooding	03/31/94	All holders of OLs or CPs for nuclear power reactors.
94-26	Personnel Hazards and Other Problems from Smoldering Fire-Retardant Material in the Drywell of a Boiling-Water Reactor	03/28/94	All holders of OLs or CPs for nuclear power reactors.
93-17, Rev. 1	Safety Systems Response to Loss of Coolant and Loss of Offsite Power	03/25/94	All holders of OLs or CPs for nuclear power.
94-25	Failure of Containment Spray Header Valve to Open due to Excessive Pressure from Inertial Effects of Water	03/25/94	All holders of OLs or CPs for nuclear power reactors.
94-24	Inadequate Maintenance of Uninterruptible Power Supplies and Inverters	03/24/94	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

- NRC Information Notice 86-40, "Degraded Ability to Isolate the Reactor Coolant System from Low-Pressure Coolant Systems in BWRs," June 5, 1986.
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NAME	TCollins	MJVirgilio
DATE	03/17/94	03/25/94

OFFICE	EAB:DORS*	SC/EAB:DORS*	C/EAB:DORS*	RGN-IV*	PDIV-I*
NAME	NHunemuller	RDennig	AChaffee	ECollins	KConnaughton
DATE	01/04/94	01/04/94	01/24/94	12/29/93	01/03/94

SPSB:DSSA*	Tech Ed*	OGCB:DORS*	C/OGCB:DORS*	D/DE:NRR*	D/DORS:NRR
SLong	RSanders	JBirmingham	GMarcus	MWHodges	BKGrimes
01/18/94	12/27/93	01/24/94	01/24/94	02/23/94	03/6/94 for

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