

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

August 12, 1994

NRC INFORMATION NOTICE 94-57: DEBRIS IN CONTAINMENT AND THE RESIDUAL HEAT REMOVAL SYSTEM

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 the problem associated with debris recently discovered in the containment and the residual heat removal (RHR) system at some BWR sites. 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

The following are instances in which debris were found in BWR suppression pools.

LaSalle County Station, Unit 1

On April 26 and May 11, 1994, while in a refueling outage, the licensee made two dives into the Mark II design suppression pool to clean the emergency core cooling system (ECCS) suction strainers of a small amount of debris which caused less than 1 percent clogging. The diver found that the strainers had experienced no apparent damage or deformation of the strainer faces. However, while in the pool on both occasions, the divers found and removed an assortment of operational debris. On the first dive, the diver removed a hardhat, a pair of anti-contamination coveralls, a 15.2 meter (m) [50 ft] length of Tygon tubing, 3 nuts, and a 4.6 m [15 ft] length of black duct tape. On the second dive, the diver removed four lengths of 1.9 cm [3/4 in] hose ranging in length about 8 m [25 ft] to about 46 m [150 ft], three lengths of Tygon tubing ranging in length from 6 m [20 ft] to 15 m [50 ft], a short length of 5 cm by 10 cm [2 in by 4 in] wood, and a flashlight.

The diver also noted that a sediment had formed on the suppression pool floor ranging in thickness from 0.3 cm to 5 cm [1/8 in to 2 in]. The suppression pool floor is a level floor with raised ridges in a waffle pattern. The 5 cm [2 in] accumulations of sediment were found in the raised corners of

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the waffle pattern. The licensee took a sample of the sediment and had it analyzed. The analysis results showed that the filterable solid consisted of over 99 percent iron oxide, with trace amounts of nickel, copper, and chrome. The filtrate contained 120 parts per billion (ppb) dissolved nickel. No organic constituents were found. Radiologically, the sample consisted of 75 percent cobalt-60 with small contributions from manganese-54, cobalt-58, and iron-59. The licensee concluded that the sample contained normal system corrosion products with no contaminants such as hydraulic fluid or solvents. Before startup, the licensee cleaned all ECCS strainers of debris and removed all objects from the pool.

### River Bend Nuclear Station

On June 13, 1994, while the plant was in a refueling outage, the licensee conducted an inspection of the ECCS suction strainers and the Mark III design suppression pool. During the inspection, 16 objects were located in the suppression pool. One of these objects, a plastic bag, was removed from the residual heat removal system "A" suction strainer. The other objects that were removed from the pool included a hammer, grinding wheel, slugging wrench, socket, hose clamp, bolt, nut, step-off-pad, two ink pens, antenna, scaffold knuckle, short length of rope, and used tape. Most of these items were not listed in the station suppression pool lost item log. These findings prompted the licensee to take the following corrective actions: (1) remove all items from the suppression pool, (2) inspect all accessible areas for additional debris, (3) verify the strainers for all ECCS pumps to be clean, and (4) increase surveillance of the suppression pool work area to minimize additional objects dropped into the pool. The licensee is reviewing its policies and practices regarding loose objects in and around the grating areas in the containment to determine their adequacy.

The licensee also found sediment in the suppression pool. During the previous refueling outage, that ended in September 1992, the licensee drained and cleaned the pool. However, the licensee was unable to completely clean the pool. After draining the pool, there was still about 0.3 m [1 ft] of water inside the weir wall that was "mucky." During the current refueling outage, the licensee used a portable cleanup system to clean the water in the pool. By the end of the outage, water clarity in the pool significantly improved. However, a layer of sediment still remains on the pool floor. The licensee is planning to install a permanent pool cleanup system two outages from now; however, the planned system will not be able to remove the sediment inside the weir wall.

The following is an instance in which debris was found in the RHR system.

### Quad Cities Unit 1

On July 14, 1994, during a post-maintenance test run of the "A" loop of the RHR system, test data indicated that the RHR torus cooling/test return valve, valve 1001-36A, was plugged. When the 36A valve was opened for inspection, the remains of a plastic bag were found shredded and caught within the

anti-cavitation trim which was installed during the recent outage. Some of the material appeared to have travelled the entire way through the anti-cavitation trim. The majority of the material was found lodged on the suction side of the valve trim. A few small pieces of plastic were found in the Mark I design suppression pool and removed.

Subsequent to the July 14 event, the licensee observed reduced flow from the "C" RHR pump and initiated further investigation. On July 23, 1994, licensee maintenance personnel removed a drain plug on the volute of the "C" RHR pump and used a boroscope to inspect the pump internals. A 10 cm [4-inch] diameter wire brush wheel and a piece of metal were found wrapped around a vane of the pump. The licensee had opened the RHR system during the outage to work on the RHR 7D valve and removed a butterfly valve on the common suction line (valve RHR 6B). The licensee retrieved the wire wheel brush, the metal and two washers from the pump.

### Discussion

The events described above illustrate the potential for adverse effects on emergency core cooling system performance due to debris. The debris resulted from inadequate control of foreign material inside the containment or resulted from inadequate inspection after maintenance activities were performed on a safety system (the RHR system).

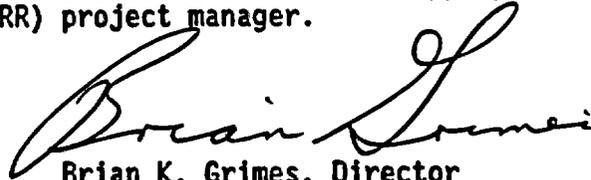
Previous NRC generic communications have noted that ECCS strainer clogging represents a potential threat to the reliable functioning of the ECCS pumps throughout a design basis accident. These previous NRC communications have dealt with the potential to clog ECCS strainers with debris generated during plant work activities, debris from a loss-of-coolant accident (LOCA), or a combination of these. The types of debris described herein are further examples of debris licensees have found in their suppression pools or in the RHR system. Although the licensees in the LaSalle and River Bend cases stated that the debris found in their suppression pools would have been insufficient to clog strainers, these debris in combination with the debris generated during a LOCA could accelerate a loss of net positive suction head for the ECCS pumps or cause other types of damage to the strainers. For example, corrosion sediment in the pool could clog the strainers if debris such as the anti-contamination clothing were already drawn to the strainer surface where the clothing could filter the finer particles of sediment out of the water. In addition, damage to strainers might occur if some of the heavier tools were to strike the strainers during the early stages of a LOCA blowdown.

Previous NRC generic communications also have addressed plant events where debris was found in safety systems, namely the auxiliary feedwater system and the safety injection system, and resulted in reduced flow during testing of the systems. The Quad Cities event discussed above involved debris in the RHR system. The debris in this case could potentially cause a transient, result in failure to mitigate a transient or accident, or result in damage to equipment.

Related Generic Communications

- NRC Information Notice 93-34 and Supplement 1: "Potential for Loss of Emergency Core Cooling Function due to a Combination of Operational and Post-LOCA Debris in Containment"
- NRC Bulletin 93-02 and Supplement 1: "Debris Plugging of Emergency Core Cooling Suction Strainers"
- NRC Information Notice 92-85: "Potential Failures of Emergency Core Cooling Systems caused by Foreign Material Blockage"
- NRC Information Notice 92-71: "Partial Plugging of Suppression Pool Strainers at a Foreign BWR"
- NRC Information Notice 88-87: "Pump Wear and Foreign Objects in Plant Piping Systems"
- NRC Information Notice 88-28: "Potential for Loss of Post LOCA Recirculation Capability Due to Insulation Debris Blockage"

This information notice requires no specific action or written response. If you have any questions regarding 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.



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

Technical contacts: Robert B. Elliott, NRR  
(301) 504-1397

Amy E. Cabbage, NRR  
(301) 504-2875

Attachment:  
List of Recently Issued NRC Information Notices

*Enclosure filed in Jacket*

LIST OF RECENTLY ISSUED  
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
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.
91-79, Supp. 1	Deficiencies Found in Thermo-Lag Fire Barrier Installation	08/04/94	All holders of OLs or CPs for nuclear power reactors.
94-54	Failures of General Electric Magne-Blast Circuit Breakers to Latch Closed	08/01/94	All holders of OLs or CPs for nuclear power reactors.
91-45, Supp. 1	Possible Malfunction of Westinghouse ARD, BFD, and Nbfd Relays, and A200 DC and DPC 250 Magnetic Contactors	07/29/94	All holders of OLs or CPs for nuclear power reactors.
94-42, Supp. 1	Cracking in the Lower Region of the Core Shroud in Boiling-Water Reactors	07/19/94	All holders of OLs or CPs for boiling water reactors (BWRs).
94-53	Hydrogen Gas Burn Inside Pressurizer During Welding	07/18/94	All holders of OLs or CPs for nuclear power reactors.
94-52	Inadvertent Containment Spray and Reactor Vessel Draindown at Millstone Unit 1	07/15/94	All holders of OLs or CPs for nuclear power reactors.
94-51	Inappropriate Greasing of Double Shielded Motor Bearings	07/15/94	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License  
CP = Construction Permit

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Original signed by

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SCSB:DSSA  
RBelliott\*  
07/14/94

OGCB:DORS  
PCWen\*  
07/14/94

TECHED  
JDMain\*  
07/15/94

SC/SCSB:DSSA  
RMLobel\*  
07/15/94

C/SCSB:DSSA  
RJBarrett\*  
7/15/94

SRXB:DSSA  
AECabbage\*  
07/29/94

AC:SRXB:DSSA  
TECollins\*  
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AD/DSSA  
MJVirgilio\*  
08/01/94

C/OEAB:DORS  
AChaffee\*  
08/02/94

AC/OGCB:DORS  
ELDoolittle\*  
08/03/94

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SCSB:DSSA	OGCB:DORS	TECHED	SC/SCSB:DSSA
RBElliott*	PCWen*	JDMain*	RMLobel*
07/14/94 07/28/94	07/14/94 07/28/94	07/15/94	07/15/94 07/28/94

C/SCSB:DSSA	SRXB:DSSA	SC/SRXB:DSSA	AC:SRXB:DSSA	AD/DSSA <sup>MR</sup>
RJBarrett*	AECabbage	MPRubin	TECollins	MJVirgilio
7/15/94 07/28/94	07/29/94	07/1/94	07/2/94	07/1/94 8 229

C/OEAB:DORS	AC/OGCB:DORS	D/DORS
AEChaffee	EDoLittle	BKGrimes
07/1/94	07/3/94	07/1/94

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C/SCSB:DSSA RJ Barrett* 7/15/94 <i>7/28/94</i>	SRXB:DSSA AE Cabbage 07/ /94	SC/SRXB:DSSA MP Rubin 07/ /94	AC:SRXB:DSSA TE Collins 07/ /94	AD/DSSA MJ Virgilio 07/ /94	
C/OEAB:DORS AE Chaffee 07/ /94	AC/OGCB:DORS EL Doolittle 07/ /94	D/DORS BK Grimes 07/ /94			

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