

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

April 26, 1993

NRC INFORMATION NOTICE 93-34: POTENTIAL FOR LOSS OF EMERGENCY COOLING
FUNCTION DUE TO A COMBINATION OF
OPERATIONAL AND POST-LOCA DEBRIS IN CONTAINMENT

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 potential problems regarding operational and post-accident debris that could block emergency core cooling pump strainers in a boiling water reactor (BWR) or containment emergency sump screens in a pressurized water reactor (PWR). 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 paragraphs discuss instances that involve either the actual clogging of emergency core cooling (ECC) or residual heat removal (RHR) pump suction strainers or the potential for clogging of suction strainers in both BWRs and PWRs.

Perry (BWR-6)

On May 22, 1992, during refueling outage 3 at the Cleveland Electric Illuminating Company, Perry Nuclear Plant, the licensee performed an inspection of the suppression pool floor and all suction strainers in the suppression pool using an underwater video camera mounted on a robotic submarine. The licensee found debris on the suppression pool floor and on RHR "A" and "B" suction strainers. The debris consisted of general maintenance-type material and a coating of fine dirt that covered most of the surface of the strainers and the pool floor. As a corrective action, the licensee vacuumed the suppression pool and cleaned the strainers during a mid-cycle outage in January 1993. After cleaning the strainers, it became evident that the RHR "A" and "B" strainers were deformed. The strainers are conical shaped devices made of 18 gauge stainless steel perforated plate with 0.18 cm

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[0.07 inch] diameter holes at 0.287 cm [0.113 inch] centers with internal cruciform shaped stiffener plates for support. The deformation consisted of a buckling of the stainless steel plate between the stiffeners and 3 small cracks were observed on one of the strainers. The licensee replaced the deformed strainers in February 1993, prior to startup from the mid-cycle outage. When the licensee reviewed the historical data on RHR "A" and "B" pump suction pressure and strainer differential pressure, it found no significant trend in pump suction pressure.

After the licensee cleaned the suppression pool and replaced the strainers, an event occurred at the plant in March 1993, during which several safety relief valves (SRVs) were manually lifted and RHR was then used for suppression pool cooling. The licensee inspected the strainers to assess their condition after use and found that the RHR "B" strainer was again coated with debris. A test was run on the RHR "B" pump with the strainer in the as-found condition to determine pump operability and was terminated after 10 hours at the direction of the system engineer when pump suction pressure dropped from an initial reading of 44.1 kPa gauge [6.4 psig] (after pump start) to 0 kPa gauge [0.0 psig]. A second test that used improved suction pressure instrumentation was run on the same loop with similar results (pump suction pressure dropped to 0 kPa gauge [0.0 psig] after 18 hours). The licensee continued to run that pump for an additional 8 hours during the second test, and observed no further decrease in pump suction pressure. Also, in both tests, no change in system flow rates or pump motor amperage was observed.

Grand Gulf (BWR-6)

Entergy Operations' Grand Gulf Nuclear Station experienced similar problems with RHR suction strainers. On March 18, 1988 and again on July 2, 1989, the RHR "A" pump before-start suction pressure fell below the inservice inspection (ISI) acceptance criteria of 17.2 kPa gauge [2.5 psig]. The licensee determined that the low suction pressure was caused by a clogged strainer that takes suction from the suppression pool. The licensee developed more stringent suppression pool cleanliness requirements and more restrictive pump suction pressure limits to ensure that the strainers are cleaned when pump after-start pressures reach the new limits. After an initial cleaning including hydrolazing the walls and floor, the licensee also established a requirement for vacuum cleaning the suppression pool at the end of every refueling outage. Since the July 1989 problem occurred, Grand Gulf has not observed any additional instances of before-start or after-start suction pressures falling below the minimum requirement of 17.2 kPa gauge [2.5 psig].

North Anna (Westinghouse, PWR)

Virginia Power Company's North Anna, Unit 1 personnel removed the mirror insulation from the steam generators (SGs) as part of their SG replacement program and discovered that most of the unqualified silicon aluminum paint covering the SGs had come loose from the SG exterior surface and was only being supported by the insulation jacketing. The pieces of paint ranged in size from sheets 0.61 m [2 feet] wide to dust particles. The same paint had also been used on the pressurizer and was also loose. The quantity of this

coating is significant, approximately 1,087 square meters [11,700 square feet] in containment. Although the loose paint is held in place by the insulation during normal operation, it could be exposed during a design basis accident, if there was a pipe or component breach in the vicinity of the SGs or pressurizer causing the insulation jacketing to be removed. Paint fragments could potentially reach the containment sump and reduce the net positive suction head (NPSH) of ECC system pumps that take suction from the sump.

Discussion

It is important that emergency coolant is provided to maintain the reactor at safe temperature levels during all postulated design basis accident conditions. This function is performed by the ECC systems. In the long-term cooling, suction for these systems is either the containment sump (for PWRs) or the suppression pool (for BWRs). In addition, the RHR system provides suppression pool cooling for BWRs during normal operation and transients.

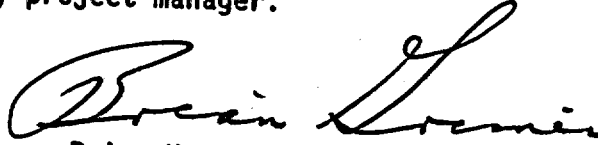
As a result, it is important that adequate NPSH be provided to the pumps throughout the long-term cooling phase. One threat to NPSH is the clogging of the strainers on the suction inlet. Excessive deposits of foreign material on the surfaces of strainers in the suppression pools of BWRs or debris screens in the containments of PWRs can lead to challenges to pump operability. These deposits can reduce the hydraulic head at the suction nozzles of emergency core cooling pumps to less than the net positive suction head required to ensure that the pumps operate without cavitation. If cavitation occurs, the pumps may fail to deliver adequate flow to maintain the integrity of the fuel cladding and the containment pressure boundary.

These recent events, as well as the stuck open relief valve event referenced in NRC Information Notice 92-71, "Partial Plugging of Suppression Pool Strainers at a Foreign BWR," have revealed that debris can be created during the LOCA event as well as during normal operation. Therefore, the complete evaluation of the effects of debris on the performance of safety related systems would consider the combination of both sources.

Related Generic Communications

- (1) NRC INFORMATION NOTICE 92-71: "Partial Plugging of Suppression Pool Strainers at a Foreign BWR"
- (2) 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 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.



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

Technical contacts: B. Wetzel, NRR
(301) 504-1355

J. Kudrick, NRR
(301) 504-2871

Attachment:
List of Recently Issued NRC Information Notices

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List of Recently Issued NRC Information Notices

*See Previous Concurrences

LA:PDIII-3
M. Rushbrook
/ /93

*PE:PDIII-3
B. Wetzel/baw/bj
4/22/93

*SC:SCSBBAR
J. Kudrick
4/21/93

*PUB:ADM
Tech Ed.
4/22/93

*PD:PDIII-3
J. Hannon
4/22/93

*AD:AD3/DRPW
J. Zwolinski
4/22/93

*BC:SCSB
R. Barrett
4/22/93

*DD:DRPW
J. Roe
4/22/93

*DD:DSSA
GHolahan
4/23/93

*C:OGCB
G. Marcus
4/23/93

DB: DORS
BGrimes
4/26/93

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LIST OF RECENTLY ISSUED
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
93-33	Potential Deficiency of Certain Class 1E Instrumentation and Control Cables	4/28/93	All holders of OLs or CPs for nuclear power reactors
93-32	Nonconservative Inputs for Boron Dilution Event Analysis	4/21/93	All holders of OLs or CPs for pressurized water reactors (PWRs).
93-31	Training of Nurses Responsible for the Care of Patients with Brachytherapy Implants	04/13/93	All U.S. Nuclear Regulatory Commission medical licensees.
93-30	NRC Requirements for Evaluation of Wipe Test Results; Calibration of Count Rate Survey Instruments	04/12/93	All U.S. Nuclear Regulatory Commission medical licensees.
93-29	Problems with the Use of Unshielded Test Leads in Reactor Protection System Circuitry	04/12/93	All holders of OLs or CPs for nuclear power reactors.
93-28	Failure to Consider Loss of DC Bus in the Emergency Core Cooling System Evaluation May Lead to Nonconservative Analysis	04/09/93	All holders of OLs or CPs for nuclear power reactors.
93-27	Level Instrumentation Inaccuracies Observed during Normal Plant Depressurization	04/08/93	All holders of OLs or CPs for nuclear power reactors.
93-26	Grease Solidification Causes Molded Case Circuit Breaker Failure to Close	04/07/93	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
 CP = Construction Permit

Discussion

In the event of a loss-of-coolant accident or a stuck open SRV, one of the three barriers to the release of fission products, the primary pressure boundary of the reactor, has failed. Therefore, it is important that emergency coolant is provided to maintain the reactor at safe temperature levels. This function is provided by the ECC systems. In the long term, suction for these systems is either the containment sump for PWRs or the suppression pool for BWRs. In addition, the RHR system provide suppression pool cooling for BWR, during normal operation and transients.

As a result, it is important that adequate NPSH be provided to the pumps throughout the long term cooling phase. One threat to NPSH is the clogging of the strainers on the suction inlet. Excessive deposits of foreign material on the surfaces of strainers in the suppression pools of BWRs or debris screens in the containments of PWRs can lead to challenges to the other two barriers. These deposits can reduce the hydraulic head at the suction nozzles of emergency core cooling pumps to less than the net positive suction head required to assure that the pumps operate without cavitation. If cavitation occurs, the pumps may fail to deliver adequate flow to maintain the integrity of the fuel cladding and the containment pressure boundary.

These recent events, as well as the stuck open relief valve event referenced in IN 92-71, have identified that debris can be created both during the LOCA event as well as during normal operation. Therefore, the combination of both sources must be considered in the complete evaluation of the effects of debris on the performance of safety related systems.

Related Generic Communications

NRC INFORMATION NOTICE 92-71: "Partial Plugging of Suppression Pool Strainers at a Foreign BWR"

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Discussion

When a loss-of-coolant accident or a stuck open SRV occurs, one of the three barriers to the release of fission products, the primary pressure boundary of the reactor, has failed. Therefore, it is important that emergency coolant is provided to maintain the reactor at safe temperature levels. This function is provided by the ECC systems. In the long term, suction for these systems is either the containment sump for PWRs or the suppression pool for BWRs.

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