

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

February 1, 1993

NRC INFORMATION NOTICE 93-08: FAILURE OF RESIDUAL HEAT REMOVAL PUMP BEARINGS  
DUE TO HIGH THRUST LOADING

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 failure of certain residual heat removal (RHR) pump bearings due to high thrust loading. 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.

Background

On November 10, 1987, reactor operators at the Seabrook Station noted that the "A" RHR pump had become noticeably noisier. The RHR pumps at Seabrook are of an Ingersoll-Rand model 8X20WDF driven by a Westinghouse vertical, 400-horsepower motor (frame 5009P39). After operators measured the vibration, they declared the pump inoperable and removed it from service. Operators disassembled the pump and found that the thrust bearing had been damaged. Subsequent analysis of the failed bearing concluded that the bearing had been subject to a thrust loading substantially greater than the design value of 7,562 newtons (1,700 pounds force).

In situ testing was performed to determine the actual thrust on both the A and B train RHR pumps. The measured values confirmed that the bearing thrust loading was significantly greater than the design value and varied with flow rate. A licensee event report, LER 50-443/88-09, was submitted which described the failure and the proposed corrective actions. The corrective actions were to include modification of the Seabrook RHR pumps and further testing of a spare pump at the vendor facility.

During the period between July 20 and August 2, 1992, an NRC inspection team conducted a probabilistic risk assessment based inspection at the Seabrook Station. The potential failure of the RHR pump due to high thrust bearing load was identified as a result of this inspection. This prompted further licensee review and a supplemental LER was issued in November 1992, describing actions taken to address the problem.

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### Description of Circumstances

On November 19, 1992, North Atlantic Energy Service Corporation, the licensee for Seabrook Station, filed an LER supplement (LER 50-443/88-09 R1) documenting actions taken following the 1987 failure of an RHR pump thrust bearing. The supplement states that the modification consisted of reducing both the inner diameter of the suction side wear ring and the outer diameter of the impeller wear area. The bearing design was not modified. The supplement notes that thrust bearing loading, although reduced by the modification, would remain substantially above the original design value, reducing the expected life of the bearing.

The LER supplement also documented the results of the testing of the spare pump at the vendor facility. The test results verified that the in situ values were not caused by such site-specific factors as installation details or piping geometry. Thus, the test results indicated that all pumps of the same design were probably subject to similar high thrust values.

NRC Inspection Report No. 50-443/92-80 contains additional information about this matter.

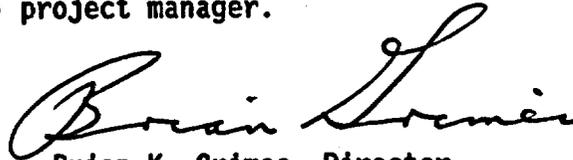
### Discussion

The licensee estimated that the operating time for the failed Seabrook RHR pump corresponded to about eight refueling outages, due to extended operation of the RHR system preceding issuance of the full-power license. Other facilities that have the same model pumps could be vulnerable to the same failure mechanism.

The RHR pump thrust test results are shown in Figure 1, adapted from a licensee report. The highest thrust values occurred in the flow range of 3,785 - 9,842 liters per minute (1,000 - 2,600 gallons per minute) and remained well above the design thrust in that range even after the pumps were modified. During normal shutdown cooling operation, RHR flow typically exceeds 11,356 liters per minute (3,000 gallons per minute) which is sufficient flow to remain above the design thrust of the bearings, but during mid-loop conditions, the flow rate is limited to a maximum of 5,678 liters per minute (1,500 gallons per minute). Such a reduction is necessary to prevent the formation of a vortex and the consequent introduction of air into the RHR pump suction that could cause cavitation and damage the pump (see NRC Generic Letter 88-17, "Loss of Decay Heat Removal.")

The Figure 1 thrust values for the mid-loop flow rate were about three times the original design value before the Seabrook pumps were modified. The thrust values for mid-loop operation remain at about 175 percent of design value after the modification. The design life of the bearing was substantially reduced because of the higher thrust conditions. Seabrook has developed maintenance schedules to ensure thrust bearings are replaced before they reach the end of predicted service life.

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 Reactors Support  
Office of Nuclear Reactor Regulation

Technical contacts: James E. Beall, RI  
(215) 337-5374

Patricia L. Campbell, NRR  
(301) 504-1311

**Attachments:**

1. Figure 1. Ingersoll-Rand Test Curve -  
RHR Pump Thrust Bearing Loads
2. List of Recently Issued NRC Information Notices

*See file jacket*

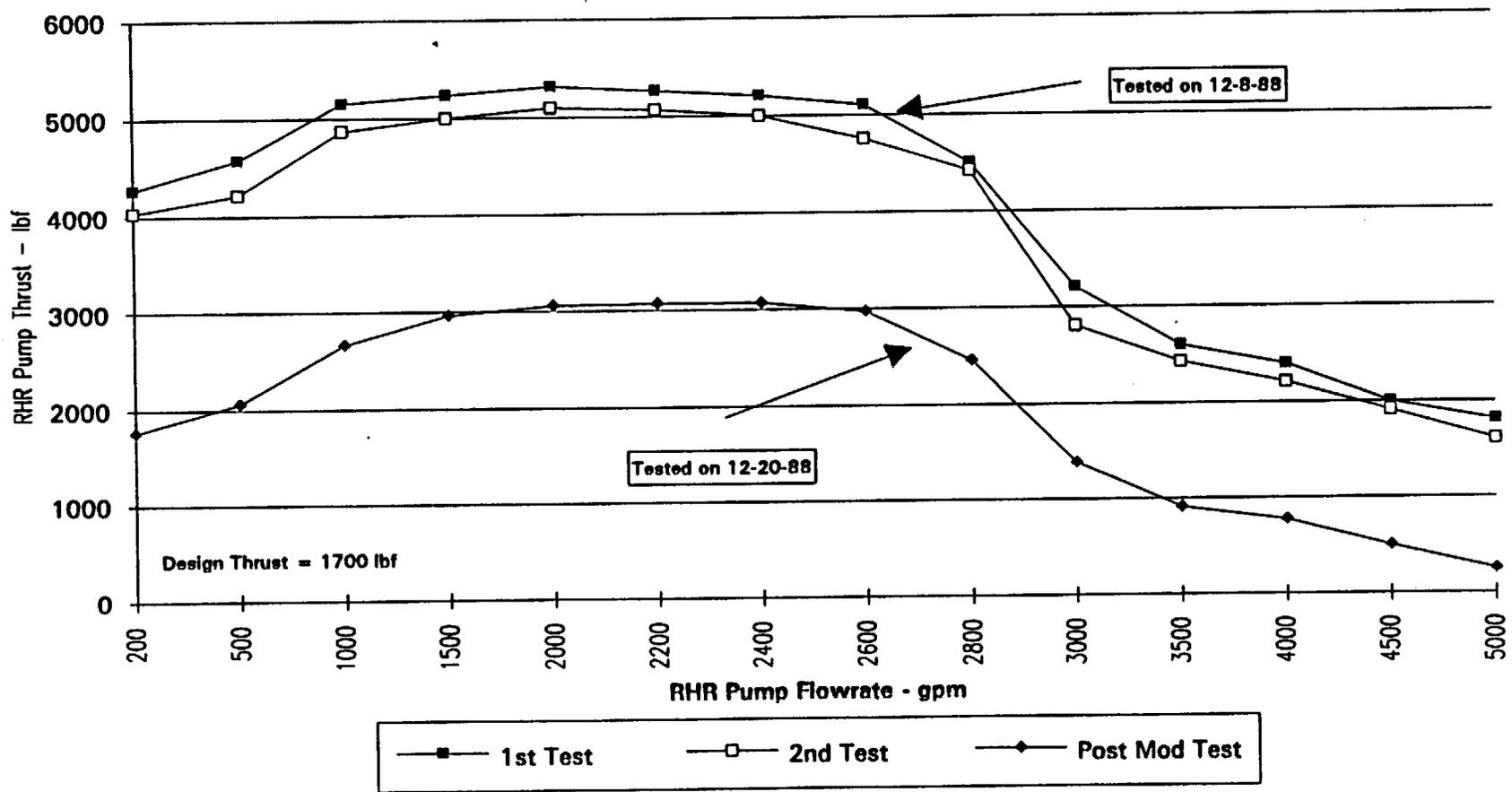


Figure 1. IngersollRand Test Curve - RHR Pump Thrust

LIST OF RECENTLY ISSUED  
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
93-07	Classification of Transportation Emergencies	02/01/93	All Licensees required to have an emergency plan.
93-06	Potential Bypass Leakage Paths Around Filters Installed in Ventilation Systems	01/22/93	All holders of OLs or CPs for nuclear power reactors.
93-05	Locking of Radiography Exposure Devices	01/14/93	All Nuclear Regulatory Commission industrial radiography licensees.
93-04	Investigation and Reporting of Misadministrations by the Radiation Safety Officer	01/07/93	All U.S. Nuclear Regulatory Commission medical licensees.
93-03	Recent Revision to 10 CFR Part 20 and Change of Implementation Date to January 1, 1994	01/05/93	All byproduct, source, and special nuclear material licensees.
93-02	Malfunction of A Pressurizer Code Safety Valve	01/04/93	All holders of OLs or CPs for nuclear power reactors.
93-01	Accuracy of Motor-Operated Valve Diagnostic Equipment Manufactures by Liberty Technologies	01/04/93	All holders of OLs or CPs for nuclear power reactors.
92-86	Unexpected Restriction to Thermal Growth of Reactor Coolant Piping	12/24/92	All holders of OLs or CPs for nuclear power reactors.
92-85	Potential Failures of Emergency Core Cooling Systems Caused by Foreign Material Blockage	12/23/92	All holders of OLs or CPs for nuclear power reactors.

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1. Figure 1. Ingersoll-Rand Test Curve -  
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2. List of Recently Issued NRC Information Notices

OGCB:NRR  
PCWen:mkm  
01/31/93  
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EMEB:DE  
PLCampbell  
01/04/93

D:DORS  
BKGrimes  
01/ /93

TECH ED

JMain for R...  
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EMEB:DE  
EJSullivan  
01/6/93

DRS:RI

JEBeall  
01/4/93

C. EMB:DE  
JANorberg  
01/6/93

\*DRS:RI

JPDurr  
01/3/93

D:DE  
JERichardson  
01/7/93

\*D:DRS:RI

MWHodges  
01/3/93

C:OGCB:DORS  
GHMarcus  
01/ /93

MEMO FROM MWHodges to BKGrimes dated 12/3/92

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Document Name: BEARING.WP5

\*See memo from MWHodges to BKGrimes dated 12/3/92

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Original signed by  
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Brian K. Grimes, Director  
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1. Figure 1. Ingersoll-Rand Test Curve -  
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2. List of Recently Issued NRC Information Notices

Document Name: 93-08.IN

\*See memo from MWHodges to BKGrimes dated 12/3/92

\*\*SEE PREVIOUS CONCURRENCES

B/DORS:NRR

BKGrimes

01/26/93

\*\*C/OGCB:DORS:NRR\*\*RPB:ADM

GHMarcus

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