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

June 17, 1994

NRC INFORMATION NOTICE 94-45: POTENTIAL COMMON-MODE FAILURE MECHANISM FOR LARGE VERTICAL PUMPS

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 potential common-mode failure mechanism for large vertical pumps. 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

On March 3, 1994, while performing vibration tests on standby service water pump "B," Grand Gulf personnel noted that vibration levels at all monitored points were higher than the reference values. Additional testing exhibited a rapidly degrading trend in pump vibration performance. The pump was declared inoperable and disassembled for inspection.

The pump is a two-stage vertical line shaft pump with the pump impellers coupled to the pump motor via a segmented vertical line shaft, approximately 18 meters [60 feet] long (see Figure 1). Six couplings (see Figure 2) are used to connect the shaft segments. The pumps are located in large cooling towers that contain water which is chemically treated to reduce biofouling. The pumps are run weekly for 24 hours to permit addition and circulation of the chemicals.

Disassembly showed extensive corrosion of the carbon steel bolts and lockwashers used in the pump shaft coupling assemblies. Some lockwashers were missing and were assumed to have corroded away completely. The corrosion allowed each retainer to move away from its contact surface on the sleeve. This allowed the gaps between the pump shaft sections to increase. This process increased the effective shaft length which reduced the clearance between the pump impellers and the bottom of the bowls.

Inspection of pump "B" revealed that the impellers had milled into the pump bowls, extensively damaging the impellers and the bowls. The licensee estimated that more than 2.54 cm [1 inch] of material had been worn away from the impellers and bowls. Subsequent disassembly and inspection of the "A" standby service water pump also showed corrosion of the coupling fasteners, but there was only minor damage to the impellers and bowls.

The standby service water pumps are tested in accordance with the licensee's inservice testing program. Neither pump indicated any degradation in developed head, flow, or vibration during quarterly inservice testing performed previously. Vibration measurements are taken near the motor bearing housing because the pump bearings are submerged. Vibration measurements taken at this location may not identify this type of failure mechanism until significant damage has occurred. In addition, the motor did not indicate any increase in running current during testing.

Discussion

This style of coupling is used by several manufacturers of vertical line shaft pumps. The event at Grand Gulf indicates that current testing of vertical line shaft pump hydraulic and mechanical performance may not identify, before damage occurs, interference between the pump impellers and bowls caused by a change in shaft length. Current manufacturer's recommendations do not require "as-found" measurements of pump lift to be taken and evaluated whenever the pump is uncoupled from the motor. The licensee of the Grand Gulf Station has now added this inspection to its inservice testing program. In addition, after the pumps were rebuilt subsequent to this event, measurements of as-found total float between the impellers and the bowls were taken by the licensee. The measurements were taken by lifting the shaft until the upper part of the impeller contacted the bowl, then measuring the change when the impeller was lowered and allowed to rest on the bottom of the bowl. This measurement was taken after the pump was installed, and is to be used to evaluate measurements taken during the service life of the pump.

Dissimilar materials used in the coupling assembly may have contributed to this event. The retainer bolts and lockwashers were made of carbon steel; the pump shafts and remaining coupling components were made of stainless steel.

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: Rudolph H. Bernhard, RII
(601) 437-4620

Joseph Colaccino, NRR
(301) 504-2753

Attachments:
1. Figure 1, Grand Gulf Standby Service Water Pump
2. Figure 2, Standby Service Water Pump Coupling
3. List of Recently Issued NRC Information Notices

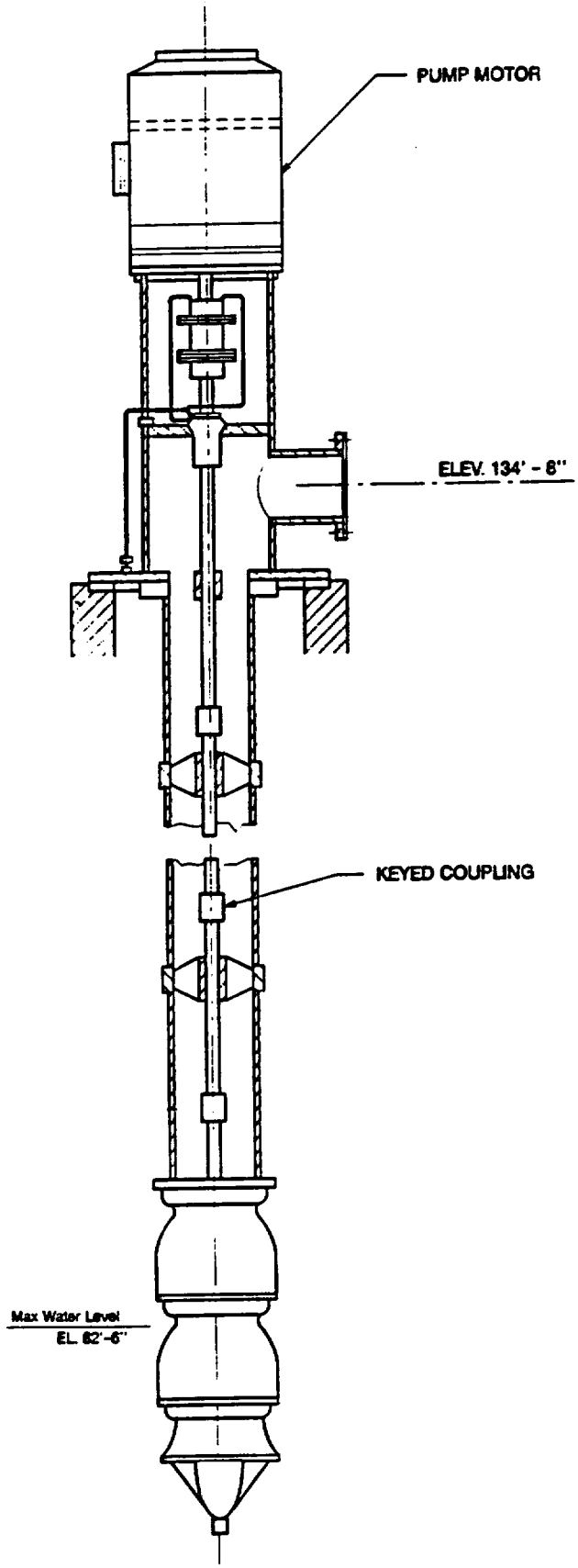

Figure 1 Grand Gulf Standby Service Water Pump

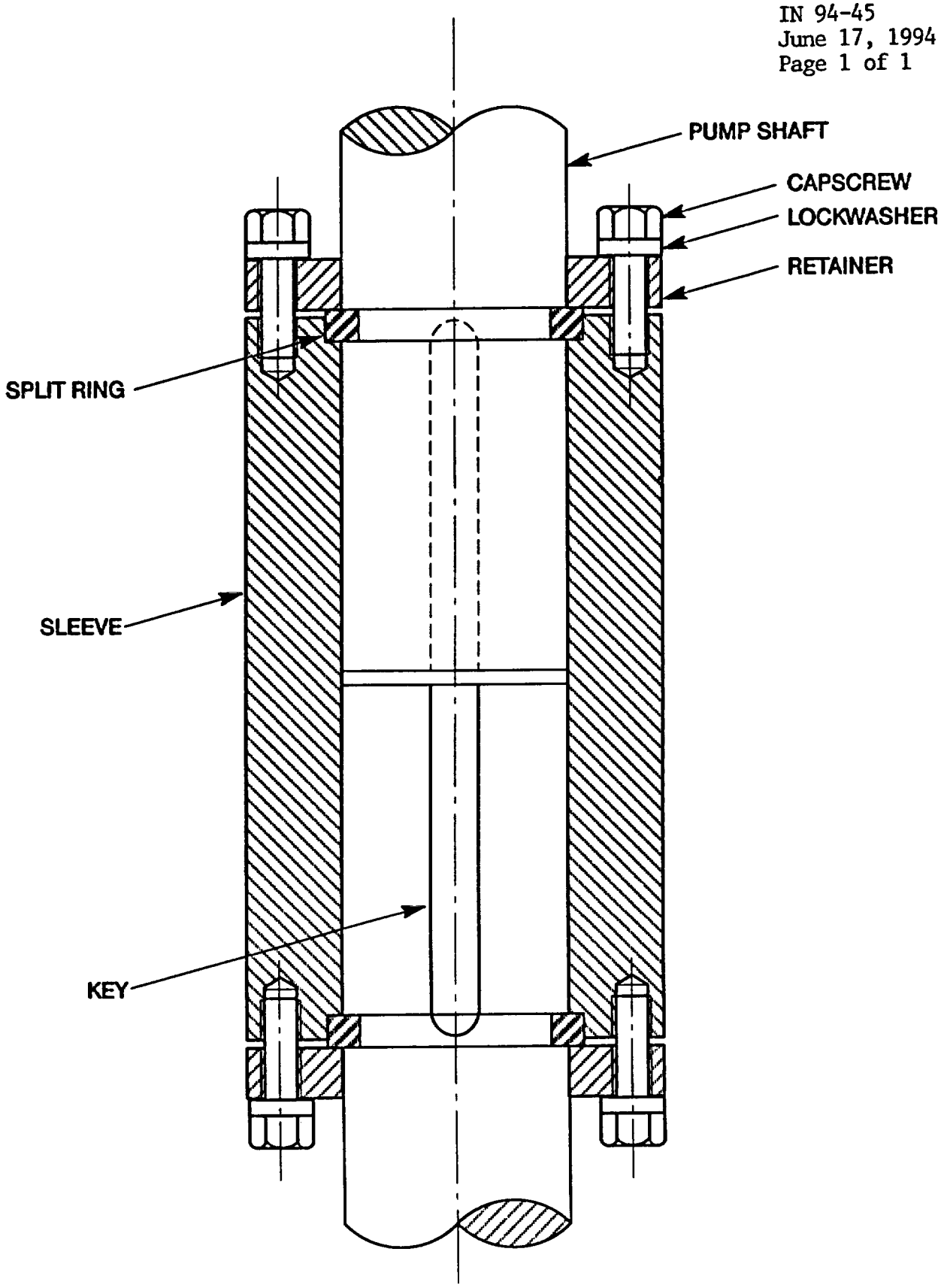

Figure 2 Standby Service Water Pump Coupling (Typical of 6)

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-44	Main Steam Isolation Valve Failure to Close on Demand because of Inadequate Maintenance and Testing	06/16/94	All holders of OLs or CPs for nuclear power reactors.
94-43	Determination of Primary-to-Secondary Steam Generator Leak Rate	06/10/94	All holders of OLs or CPs for pressurized water reactors.
94-42	Cracking in the Lower Region of the Core Shroud in Boiling-Water Reactors	06/07/94	All holders of OLs or CPs for boiling-water reactors (BWRs).
94-41	Problems with General Electric Type CR124 Overload Relay Ambient Compensation	06/07/94	All holders of OLs or CPs for nuclear power reactors.
94-40	Failure of a Rod Control Cluster Assembly to Fully Insert Following a Reactor Trip at Braidwood Unit 2	05/26/94	All holders of OLs or CPs for pressurized-water reactors (PWRs).
94-39	Identified Problems in Gamma Stereotactic Radiosurgery	05/31/94	All U.S. Nuclear Regulatory Commission Teletherapy Medical Licensees.
94-38	Results of a Special NRC Inspection at Dresden Nuclear Power Station Unit 1 Following a Rupture of Service Water Inside Containment	05/27/94	All holders of OLs or CPs for NPRs and all fuel cycle and materials licensees authorized to possess spent fuel.
94-37	Misadministration Caused by a Bent Interstitial Needle during Brachy-therapy Procedure	05/27/94	All U.S. Nuclear Regulatory Commission Medical Licensees authorized to use brachy-therapy sources in high-, medium-, and pulsed-dose-rate remote afterloaders.

OL = Operating License
CP = Construction Permit

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orig /s/'d by BKGrimes

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*SEE PREVIOUS CONCURRENCE

OFFICE	DRP/RII*	EMEB/DE*	OGCB/DORS*	TECH ED*	SC:DRP/RII*
NAME	RHBernhard	JColaccino	PCWen	RSanders	FCantrell
DATE	05/25/94	05/25/94	05/25/94	05/25/94	05/25/94

AC:DRP/RII*	SC:EMEB/DE*	AC:EMEB/DE*	D:DE*	AC:OGCB/DORS*	D:DORS
HOChristensen	GJohnson	TChan	BWSheron	RJKiessel	BKGrimes
05/25/94	05/25/94	05/26/94	05/26/94	06/01/94	06/13/94

DOCUMENT NAME: 94-45.IN

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DOCUMENT NAME: VERTPUMP.PCW

NOTE: THE PM FOR GRAND GULF (PAUL O'CONNOR) HAS BEEN INFORMED OF THE DEVELOPMENT OF THIS INFOMATION NOTICE AND HE HAS REVIEWED THE DRAFT IFORMATION NOTICE WITH NO COMMENT.

Peter Wen 5/31/94.

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