UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF NEW REACTORS
WASHINGTON, DC 20555

June 13, 2018

NRC INFORMATION NOTICE 2018-07: PUMP/TURBINE BEARING OIL SIGHT GLASS PROBLEMS

ADDRESSEES

All holders of an operating license or construction permit for a nuclear power reactor under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

All holders of and applicants for a combined license under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of operating experience regarding pump or turbine bearing oil sight glass issues. The NRC expects recipients of this IN to review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this IN are not NRC requirements; therefore, no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

Davis-Besse Nuclear Power Station, Unit 1

On September 13, 2017, while conducting a quarterly test for Auxiliary Feedwater (AFW) Pump No. 1, the licensee at the Davis-Besse Nuclear Power Station manually tripped the turbine due to the inboard (pump end) bearing temperature exceeding the procedural limit of 220 degrees Fahrenheit. The two AFW Pump Turbines are single-stage impulse turbines manufactured by Terry Turbines (now Dresser-Rand), each of which drive a Byron-Jackson centrifugal pump. The turbine rotor is radially supported by two plain journal bearings lubricated by shaft-mounted oil slinger rings. Initial oil samples from the inboard turbine bearing were dark, indicating bearing damage. The licensee disassembled the inboard bearing and found scarring on the bearing's upper and lower surfaces resulting from an apparent lack of lubrication.

The licensee performed an investigation and identified the apparent cause for the bearing damage was a failure to replenish the oil reservoir after removal of a 10- to 11-ounce oil sample following the last quarterly surveillance test on June 21, 2017. The technician did not replenish the oil reservoir because the vertical (columnar) sight glass indicated that the oil level was within the marked bands. The vendor manual states that the minimum proper oil level (in the reservoir) in slinger ring lubricated bearings is 0.250 (¼) inch above the bottom dead center of

the inside diameter of the oil slinger rings (see Figure 1). The vendor manual also states that the sight glass should have two marks that indicate the minimum and maximum oil levels. Although these marks should be approximately 0.375 (3/8) inch apart, the as-found marks were significantly wider than 3/8 inch. The licensee determined the as-found oil level after the September 13, 2017, event was below the minimum recommended level on the vendor drawing even though the oil level was observed to be within the normal range of the as-found scribe marks on the sight glass.

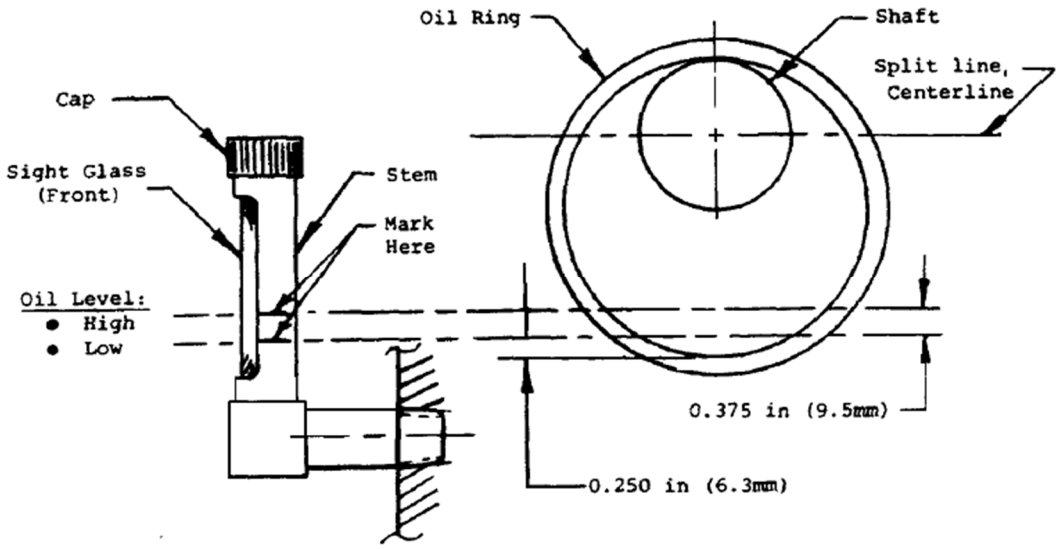

Figure 1 Recommended oil level for ring oil lubricated bearings (Source: Davis-Besse Vendor Manual Guidance, Terry Corporation)

Arkansas Nuclear One, Unit 2

On September 16, 2016, Arkansas Nuclear One, Unit 2, declared the "A" emergency diesel generator inoperable during its 24-hour surveillance test run after the licensee noticed sparks in the area of the inboard generator bearing. A licensee-conducted investigation revealed that the inboard generator bearing lacked sufficient lubrication, which led to the bearing failure. The lack of lubrication was determined to be caused by a previous maintenance activity that did not replenish the oil to the correct level. A contributing factor identified by the licensee included the sight glass with its scribe marks had been "inverted" during a 2014 surveillance activity. Because the scribe marks were not on the centerline of the glass, inverting the sight glass caused the marks to shift in the vertical direction. The shift in the marks was below the level stated in the vendor technical manual and gave a false impression of the correct bearing oil level. This NRC determined that the licensee failed to properly preplan and perform maintenance on a diesel generator inboard bearing because of inadequate work instructions and issued the licensee a violation of Technical Specification 6.4.1.a, associated with a White Significance Determination Process finding (See NRC Inspection Report 05000368/2016-011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17019A288) and Licensee Event Report 05000368/2016-001-00 (ADAMS Accession No. ML16320A437).)

Hope Creek Generating Station, Unit 1

In December 2009, NRC inspectors identified that the high-pressure core injection (HPCI) booster pump outboard bearing oil level in the sight glass was below the minimum level mark and that oil was leaking from the bearing sight glass housing threaded connection. The inspectors determined the gradual loss of oil level in the HPCI booster pump outboard bearing could have resulted in insufficient lubrication for the outboard bearing and may have prevented the HPCI system from performing its safety function. Additionally, the inspectors noted that some equipment operators believed that it was acceptable for the oil level just to be visible within the sight glass instead of between the minimum and maximum level marks. This would have allowed the oil level to be below acceptable limits. Inspectors also noted that the reactor building log did not specifically state that oil levels needed to be verified between the minimum and maximum level marks. As part of the corrective actions, the licensee added an operator aid with minimum and maximum level marks. However, in subsequent reviews of the licensee's corrective actions, the inspectors identified that the marks on the operator aid were less restrictive than the level marks that were etched in the sight glass housing to ensure an adequate volume of oil. The licensee had not evaluated the impact of replacing the sight glass housing which provided the appropriate level marks for the correct oil level. Furthermore, the licensee had not evaluated the impact of the less restrictive level marks on the new operator aid. These circumstances led inspectors to identify a condition adverse to quality and resulted in a noncited violation of Criterion XVI, "Corrective Action," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50. (See NRC Inspection Report 05000354/2010002 (ADAMS Accession No. ML101250642).)

DISCUSSION

A review of operating experience indicates that events involving inadequate oil levels in the reservoirs of pumps and other rotating equipment where issues with the sight glass contributed to the event continue to occur. These events/conditions led to demand/run failures or allowed latent failures to exist. Underlying causes have been attributed to incorrect markings on the oil level sight glass, sight glass installation errors (e.g., installed upside down), and a lack of procedural guidance on how to maintain adequate oil levels to the bearings of safety-related pumps and turbines. Oil sight glasses, whether they are of the bubbler/bull's eye or the columnar (vertical) gauge type, play a critical role in maintaining proper lubrication of pump/turbine bearings and in the early detection of problems with these bearings. These devices allow for constant monitoring of these critical parameters by operators who perform daily checks or periodic rounds. It is also critical that the methods used to determine appropriate oil levels in sight glasses are correctly transcribed from vendor manuals and drawings (as appropriate), contained, as required, within approved procedures, and properly maintained.

Bubbler sight glasses are limited in that these devices only indicate that oil is available to the pump/turbine bearing. If the level-setting ring is installed incorrectly or is not functioning as intended, the presence of oil in the bubbler's sight glass may not accurately indicate the presence of oil in the bearing. Columnar sight glasses are more indicative of the actual oil level, but they can be problematic if proper engineering controls are not practiced. The ends of the glass may have fittings that leak, and the glass can be installed upside down. If the preexisting scribe marks are etched on the glass, then correct orientation of the glass would be critical to maintaining the proper oil level. Additionally, airflow from room cooler ventilation units can blow

directly towards open vent/fill caps on the pump/turbine inboard/outboard oil reservoirs, causing a false high indication of proper oil level in the sight glass.

Related NRC Generic Communications

Information Notice 1981-24, "Auxiliary Feed Pump Turbine Bearing Failures," dated August 5, 1981, discusses several events involving AFW pump inboard turbine bearing failures caused by a failure to maintain an adequate oil level in the sight glass. Typically, each reservoir is fitted with a columnar sight glass about 3 inches long to monitor the oil level, and the oil level is usually maintained within a narrow ¼-inch band. In the examples discussed in IN 81-24, the pump bearings are lubricated by a slinger oil ring that picks up oil in a reservoir at either end of the turbine. Too much or too little oil would result in improper operation of the oil slinger ring and possible damage to the bearing. In addition, IN 1981-24 discusses instances in which the vendor technical manual did not show or indicate the proper oil-level range. In both instances described in IN 1981-24, the corrective action was to clearly mark the maximum and minimum levels of oil on the sight glass.

CONTACT

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below.

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Note: NRC generic communications may be found on the NRC public Web site, http://www.nrc.gov, under "NRC Library," "Document Collections."

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ADAMS Accession No.: ML17332A541; *concurred via email

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