UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, DC 20555-0001

February 3, 2010

NRC INFORMATION NOTICE 2010-03: FAILURES OF MOTOR-OPERATED VALVES DUE TO DEGRADED STEM LUBRICANT

ADDRESSEES

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

All certificate holders for gaseous diffusion plants certified under 10 CFR Part 76, "Certification of Gaseous Diffusion Plants".

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of recent failures and corrective actions for motor-operated valves (MOVs) because of degraded lubricant on the valve stem and actuator stem nut threaded area. Recipients are expected to review the information for applicability to their facilities and consider actions to avoid similar problems. The suggestions contained in this IN are not NRC requirements and no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

Peach Bottom Atomic Power Station

On March 12, 2009, while the licensee was aligning the condensate storage tank to torus suction for high-pressure coolant injection (HPCI) testing at Peach Bottom Unit 2, the inboard torus suction MOV failed to fully open and the HPCI was declared inoperable. The licensee found dried and hardened grease on the valve stem and stem nut of this Unit 2 HPCI MOV.

On March 21, 2009, while the licensee was conducting a surveillance at Peach Bottom Unit 3, the HPCI outboard torus suction MOV failed to fully open, and HPCI was declared inoperable. The licensee found dried and hardened grease on the valve stem and stem nut, as well as stem nut wear, in this Unit 3 HPCI MOV.

Both MOV failures occurred because the valve stem grease had hardened, increasing the coefficient of friction of the valve stem so that higher torque was required to open the valves. The required torque was beyond the open torque switch set point, resulting in the open torque

switches activating to trip the MOVs and stop valve movement prior to attaining the full open position. The root cause was that the Peach Bottom preventive maintenance (PM) program for MOVs had not appropriately evaluated actuator stem lubricant performance when establishing PM frequencies and actions. A significant contributing cause was that the grease used for stem lubrication was beyond its manufacturer recommended shelf life and degraded in service at a more rapid rate.

Licensee corrective actions for these MOV failures included identifying other valves that could be susceptible to this type failure mode and performing a visual inspection, grease evaluation, diagnostic testing, and/or corrective maintenance. The licensee also initiated corrective action to review the stem lubrication and periodic verification testing intervals for all MOV Program valves. The use of the grease was discontinued at Peach Bottom and replaced with MOV Long Life grease for all future stem lubrication PMs. Additional information is available in NRC Inspection Report 05000277/2009003 and 05000278/2009003 dated August 10, 2009, which can be found on the NRC's public website in the Agency Documents Access and Management System (ADAMS) under Accession No. ML092220599.

Vogtle Electric Generating Plant

On March 29, 2009, at Vogtle Unit 2, the 2B core spray pump containment suction MOV was stroked to the open position satisfactorily during its quarterly inservice test (IST) but when the plant staff attempted to stroke the valve closed, the valve failed after moving only 5 percent of the stroke length. The licensee concluded that chattering of the MOV actuator was sufficient to cause the close torque switch contact finger to rotate in its holder and break the circuit which prevented the valve from going full closed. The chattering was due to hardening of the valve stem lubricant, Felpro N 5000. The Felpro N 5000 lubricant had likely prematurely aged and hardened because of cross contamination with actuator internal grease, Nebula EP-0.

Licensee corrective actions included replacing the torque switch, rebuilding the actuator, and cleaning and lubricating the valve stem. In addition, the licensee performed an extent of condition analysis, inspected, and stroked suspect MOVs. During extent of condition inspections, the licensee identified another MOV with hardened lubricant that had likely prematurely aged and hardened, but no cross-contamination was found.

On August 5, 2009, at Vogtle Unit 1, during the routine 54 month PM and additional extent of condition diagnostic testing, the core spray pump train 'A' containment suction MOV failed its as-found diagnostic test in the closed direction due to apparent stem lubrication degradation.

Licensee corrective actions included reviewing the adequacy of the 54 month PM frequency, performing as-found diagnostic testing for long stroke MOVs approaching their 54 month PM due date and re-lubricating all long-stroke safety-related MOVs during the refueling outages 1R15 and 2R14, whose last stem lubrication is approaching or has exceeded 36 months.

Callaway Plant

On May 25, 2009, the turbine driven auxiliary feedwater pump (TDAFP) failed to start during surveillance testing. The failure occurred due to excessive frictional loading from the cumulative

effects of a lack of lubrication effectiveness coupled with an incorrectly installed thrust washer for the TDAFP trip & throttle valve (TTV).

The licensee determined that the TTV PM lubrication frequency was inadequate for the operating conditions. In addition, the licensee found that the last scheduled TTV lubrication had not been performed, and that an error occurred during TTV assembly. Licensee corrective actions included revising the trip/throttle MOV installation procedure to incorporate valve lubrication requirements as a critical step. The TTV was lubricated and a new thrust washer was installed correctly. Additional information is available in Callaway Licensee Event Report 50-483/2009-002-00 dated November 11, 2009 (ADAMS Accession No. ML093100103).

BACKGROUND

Related NRC Communications

- Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," dated June 28, 1989, ADAMS Accession No. ML031150300.

- Generic Letter 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Power-Operated Valves," dated September 18, 1996, ADAMS Accession No. ML031110010.

- IN 97-07, "Problems Identified during Generic Letter 89-10 Closeout Inspections," dated March 6, 1997, ADAMS Accession No. ML031050376.

- IN 2006-29, "Potential Common Cause Failure of Motor-Operated Valves as a Result of Stem Nut Wear," dated December 14, 2006, ADAMS Accession No. ML062890437.

- NUREG/CR-6750, "Performance of MOV Stem Lubricants at Elevated Temperatures," dated October 2001, ADAMS Accession Nos. ML020150273 and ML020150277.

DISCUSSION

At operating nuclear power plants, safety-related MOVs perform a wide range of functions in controlling fluid flow in plant systems. For example, licensees rely on the operability of MOVs to satisfy many technical specification requirements. MOVs are also used in systems credited in accident analyses. Since licensees often use MOVs of the same type and by the same manufacturers in redundant trains of various fluid systems, the potential for MOV actuator failures raises the possibility of a common-mode failure of plant safety systems. Safety-related MOVs are within the scope of 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants." The NRC regulations in 10 CFR 50.55a(b)(3)(ii) require licensees implementing the American Society of Mechanical Engineers Code for Operation and Maintenance of Nuclear Power Plant as part of their IST program to ensure that MOVs continue to be capable of performing their design-basis safety functions. Further, the NRC regulations in 10 CFR 50.65, Maintenance Rule, require licensees to monitor the performance or condition of structures, systems, and components (SSCs) in a manner

sufficient to provide reasonable assurance that these SSCs are capable of fulfilling their intended functions.

In an MOV, the stem nut converts the rotational motion of the drive sleeve in the motor actuator to the lateral motion of the stem to open and close the valve. Lubricant must be applied to the stem in an effective manner at appropriate intervals to ensure that the coefficient of friction between the stem and stem nut remains within the design assumptions for the MOV. Improper or inadequate stem lubrication can result in excessively high friction that can cause the torque switch in the MOV to trip the motor actuator and stop the valve operation. Inadequate lubrication can also cause excessive wear and degradation of the MOV stem nut such that the actuator cannot move or control the valve stem.

Degradation of the lubricant or stem and stem nut interface, or both, can affect the efficiency of the torque conversion thereby reducing the design margin for ensuring the performance of an MOV. This is of particular concern for MOVs with small design margins. Lubricant type, lubrication frequency, environmental conditions, and manufacturing tolerances of the stem and stem nut can affect the coefficient of friction of the stem and stem nut interface. This was verified during GL 89-10 testing. Problems identified during GL 89-10 testing were distributed to the industry via IN 97-07. An important observation noted in IN 97-07 was that it is difficult to apply information on stem friction coefficient and rate-of-loading effects from sources other than the licensee's testing program. Therefore, it is important to assess lubricant performance in MOV applications as it relates to PM intervals, PM practices, environmental conditions, safety margins, and surveillance testing.

CONTACT

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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