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Dr. Thomas E. Murley, Director
United States Nuclear Regulatory Commission
Office of Inspection and Enforcement, Region I
631 Park Avenue
King of Prussia, PA 19406

OFFICE OF SECRETARY
DOCKETING & SERVICE
BRANCH

Subject: Limerick Generating Station, Unit 1
Significant Deficiency Report No. 149
G. H. Bettis Actuators with Swollen Seals

Attachment: 10CFR21 Report No. CAR #0023 from G. H. Bettis
to the U.S. NRC

File: QUAL 2-10-2 (SDR-149)

Dear Dr. Murley:

PECo. has become aware of a deficiency regarding nuclear actuators supplied to the Clow Corporation by G. H. Bettis. The problem was due to the reaction of ethylene propylene seals with lubricant Mobile #28, resulting in seal swelling. This deficiency has been previously reported to the U.S. NRC under the provisions of 10CFR21.

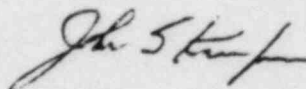
We consider the deficiency described in the Attachment as a significant deficiency per 10CFR50.55(e) and are hereby notifying you as required.

We believe that the G. H. Bettis report submitted under the provisions of 10CFR21 provides the information required for 10CFR50.55(e) reporting. Therefore, we anticipate that this letter will be our only report to you on this subject.

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S PDR

PECo. has tested all Limerick Unit 1 and common valves that use the subject Bettis actuators and it was determined that no stroke time degradation had occurred. PECO. will replace the seals and grease, with the material recommended by G. H. Bettis, at the time of the first scheduled maintenance. A nonconformance report has been written against the subject actuators in Unit 2 at Limerick Generating Station.

Sincerely,



WSS/amv/08248410

Attachment

Copy to: Director of Inspection and Enforcement
United States Nuclear Regulatory Commission
Washington, DC 20555

S. J. Chaudhary, Resident NRC Inspector (Limerick)
J. Wiggins, Resident NRC Inspector (Limerick)

cc: Judge Lawrence Brenner
Judge Peter A. Morris
Judge Richard F. Cole
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Appeal Board
Atomic Safety & Licensing
Board Panel
Docket & Service Section
Mr. James Wiggins
Mr. Timothy R. S. Campbell

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10CFR21 REPORT NO. CAR#0023

ADVISORY NOTIFICATION

FEBRUARY 13, 1984

FOR INFORMATION ONLY

February 13, 1984

ABSTRACT

Actuator stroking times can be lengthened to beyond 15 seconds by the swelling action of ethylene propylene seals when used with hydrocarbon based lubricants.

IEEE 382-1977 section 6.3, in-house testing and technical literature supplied by other organizations was used as a basis for the upgrade to Molykote 44 silicone lubricant from the synthetic hydrocarbon Mobilgrease 28 lubricant.

Periodically exercising of installed units can be used as a guide for determining when maintenance is required.

Henceforth, Molykote 44 will be used in the construction of all new 'N' series actuators.

Summary

GH-Bettis issued a 10CFR-21 report on November 18, 1983. This report was based on GH-Bettis laboratory testing of a series of nuclear qualified actuators. The results of these tests indicated that there existed a potential degradation of actuator stroking times related to elapsed time from original manufacture. The reason for this potential degradation of actuator performance was traced to the specific combination of seals and grease used in original manufacture. The Ethylene Propylene seals absorbed hydrocarbons from the grease causing them to swell. Seal swell increased the time required to initialize stroke. Both the seal material and grease were identical to those tested in GH-Bettis qualification report 37274 which has been submitted to and approved by all GH-Bettis nuclear customers. Engineering analysis and laboratory testing have yielded the following conclusions:

1. The GH-Bettis actuators identified as having the potential of stroking speeds greater than 15 seconds are NCB Series, N52X, N72X, N73X series and the NT310-SR4 & 5, NT312-SR5. The 15 second stroking time was selected as representative of customer specifications submitted for safety related pneumatic valve actuators.
2. The remainder of the NT series GH-Bettis actuators did not suffer degradation in stroking times beyond normal operating limits.
3. Stroking of actuators at frequent intervals appears to inhibit stroking time degradation. Therefore, "exercising" actuators at a minimum of 15 day intervals while monitoring initial stroking times will provide positive indication of actuator performance. This procedure has long been recommended by GH-Bettis as a reliable method to minimize the effects of seal "set". Seal "set" or flattening at the contact surface can cause jerky operation and/or leakage.
4. Any installed actuator that fails to stroke within the time limit as originally specified must be serviced immediately with new seals and Dow Corning Molykote 44 lubricant.

Actuators that are presently in storage must be serviced with new seals and Dow Corning Molykote 44 lubricant prior to placing into service.

5. Henceforth all GH-Bettis qualified actuators will be manufactured using Dow Corning Molykote 44 silicone grease.

Appendix A

Engineering analysis, laboratory testing and consultation with many suppliers research departments have yielded a great deal of information about seals and lubricants. The application of this information to actuators indicates that each design is effected differently. Results indicate that the NCB Series, the N52X, N72X, N73X series and the NT310-SR4 and SR5, NT312-SR5 actuators potentially can degrade to stroking times greater than 15 seconds. This projection is based on worse case analysis. The remainder of the NT series actuators are not projected to degrade in stroking time.

To explain: the actuator seals (ethylene propylene) swell when in contact with the Mobil 28 grease currently used in the manufacture of 'N' series actuators. Seal swell increases seal loading causing greater time required to initialize motion. This problem is a function of seal contact area as it relates to the force available from the actuator piston or spring. As a result the larger the actuator the smaller the effect. In addition the magnitude of stroking time degradation is related to the elapsed time between actuator cycles. The longer the actuator remains stationary the more "set" the seals take. The "set" characteristic causes the seal to form an intimate contact with the sealing surfaces further increasing the time required to initialize stroke. Once the actuator begins to stroke, the seals begin to recover their original shape, thus freeing the unit up. Stroking the actuator three or more complete cycles using pressurize gas will cause the seals to recover sufficiently to reduce stroking time to a minimum. No seal degradation has been traced to periodic actuator stroking, quite the opposite has been experienced. Frequent stroking tends to extend seal life resulting in longer actuator cycle life.

Units should be stroked or exercised at intervals of no more than 15 days. Observation of initial stroke time will provide accurate interpretation of actuator condition and may be used to determine when maintenance is required. Units that are in storage will also benefit from this procedure which has long been recommended by GH-Bettis. This procedure is applicable to all GH-Bettis actuators and has been published under the title "Operating, Storage and Maintenance Instructions for Bettis Rotary Valve Actuators"⁽³⁾.

(3) Refer to attached data sheets.

Appendix B

GH-Bettis laboratory test results and vendor supplied industry accepted specifications for lubrication have yielded the following:

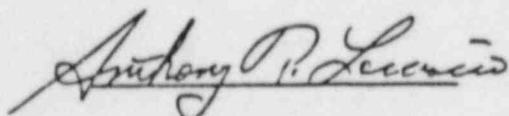
Molykote 44⁽¹⁾ grease has no tendency to swell ethylene propylene seals. Therefore, this grease would not contribute to stroking time degradation.

Molykote 44 grease has proven to be equal to or better than the Mobile 28⁽²⁾ grease in resisting wear in metal to metal contact. Tests were conducted for 5000 full cycles at ambient temperature and 300°F. Molykote remained intact in the piston cylinder area reducing seal wear.

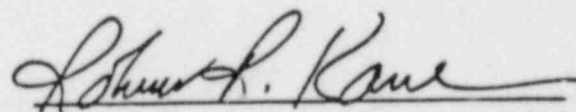
Actuators currently supplied by GH-Bettis incorporate Mobile 28 synthetic hydrocarbon based lubricant which causes Ethylene Propylene seals to swell. Therefore, GH-Bettis has followed IEEE382(1975) section 6.3 which allows the substitution of materials of construction, when test results and analysis can be presented to justify the material upgrade.

Henceforth all GH-Bettis qualified actuators will be manufactured using Dow Corning, Molykote 44, medium grade grease. This grease is being specified as a product improvement and has by GH-Bettis analysis and test proved it is equal to, or better than, the Mobile 28 grease currently used.

Submitted by:



Anthony T. Locascio
Quality Assurance Manager



Robert R. Kane
Director of Engineering & Research

(1), (2), Refer to attached data sheets.

Exhibits

1. Dow Corning, Molykote 44 Data Sheet
2. Mobile 28 Data Sheet
3. Operating, Storage and Maintenance Instructions for GH-Bettis Rotary Valve Actuators.