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84-02 #2

Mr J G Keppler, Regional Administrator
US Nuclear Regulatory Commission
Region III
799 Roosevelt Road
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MIDLAND ENERGY CENTER PROJECT
DOCKET NOS 50-329 AND 50-330
EXCESSIVE WEAR - LINEAR CONVERTER SHAFT GUIDES
FILE: 0.4.9.89 SERIAL 30349

Reference: J W Cook letter to J G Keppler:

Serial 28057, dated March 29, 1984

On February 28, 1984 Consumers Power Company notified your staff of a potential 10CFR50.55(e) condition involving excessive wear in the shaft guides of Pacific Air Products linear converters. This is a final report.

Investigation has determined that this condition, if undiscovered, probably would not have affected the safety of plant operations, however, because available evidence could not completely rule out some failure modes, this condition is considered reportable under the requirements of 10CFR50.55(e).

Attachment 1 provide a description of the deficiency, the root cause and corrective actions being taken.

James W. Cook

JWC/AHB/cd

Attachments 1: MCAR 81, Final Report, dated June 14, 1984

CC: Document Control Desk, NRC
Washington, DC

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Serial 30349
Attachment 1

Bechtel Associates Professional Corporation

SUBJECT: MCAR 81

Excessive Wear of Pacific Air Products Company Linear
Converter Shaft Guides

FINAL REPORT

DATE: June 14, 1984

PROJECT: Consumers Power Company
Midland Plant Units 1 and 2
Bechtel Job 7220

REFERENCES: A) Letter, Pacific Air Products Co. to CPCo, 2/1/84
B) Letter, Pacific Air Products Co. to CPCo, 3/7/84
C) Letter, CPCo to Bechtel, 3/28/84
D) Letter, Pacific Air Products Co. to CPCo, 3/26/84

Introduction

This report addresses linear converter shaft guides supplied on HVAC dampers manufactured by Pacific Air Products Co. (PAPCo) that have potential excessive shaft guide wear problems. The converters transform linear actuator motion to rotary motion to operate the dampers. The linear converters are designed, manufactured, and installed by PAPCo on dampers manufactured by PAPCo which use ITT actuators.

Background

PAPCo received two linear converters that exhibited excessive wear to the brass shaft guides from the nonnuclear Edgewood generating plant as reported in the letter (Ref. A). Pacific Air Products notified the NRC and Consumers Power Company of the potential 10 CFR 21 reportability. Subsequently, Pacific Air Products received two additional converters exhibiting excessive shaft guide wear from the Byron Nuclear Station.

Investigative Action

Pacific Air Products has conducted tests on linear converters in their shop and has solicited operating experience information from Buyers. PAPCo has issued several interim reports and a final report on this subject.

In their laboratory tests, PAPCo has been able to reproduce wear patterns similar to those exhibited by linear converters returned from the field. The tests consisted of operating the linear converters with a torque and a side load for 2,000 full stroke cycles and 100,000 20% stroke cycles. Linear converters were tested with dry bushings and with lubricated bushings. It was necessary to replace several bushings in the unlubricated linear converter in order to complete the test. The unit with lubricated bushings showed little wear at the end of the test.

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Bechtel's review of the operating and maintenance instructions supplied by the vendor indicated that maintenance, lubrication, and inspection of the linear converters are not specifically addressed.

PAPCo has learned from the owner of the units which originally exhibited excessive wear that the dampers were subject to control hunting. They estimate that one unit could have been subject to 21,000 strokes per day.

Of the eight safety-related dampers that use these converters on the Midland project, four modulate and four do not. The four modulating dampers control air flow in response to a temperature control loop and hunting is not anticipated.

Analysis of Safety Implication

PAPCo's letter to Consumers Power Company dated February 1, 1984, listed in Attachment A the number of linear converters they have built and where they have been delivered. Of the total production, 21 linear converters have been delivered to the Midland project, all on Purchase Order 7220-M-154(Q)AC equipment. The converters are used on 8 safety-related and 13 nonsafety-related dampers. This is the only equipment on the project which is affected by the MCAR condition and no design discipline besides mechanical and no support group work is affected.

The linear converters are used on the eight safety-related dampers listed below:

| <u>Quantity</u> | <u>Tag No.</u> | <u>Nomenclature</u> |
|-----------------|--|---|
| 2 | OMO-54003 OMO-54004 | Auxiliary building normal exhaust isolation damper |
| 2 | OMO-54005 OMO-54006 | Engineered safety feature (ESF) filtration system control damper |
| 4 | 1TV-6803A1 1TV-6803B1 2TV-6803A1 2TV-6803B1 | Diesel generator building exhaust modulating damper |

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The safety concern is that excessive wear of the converter shaft guides could lead to failure of a damper to function. The auxiliary building exhaust isolation dampers and the ESF filtration system dampers are used after a loss-of-coolant accident (LOCA) to provide filtration of the ESF pump room air. These dampers are not expected to function often during plant operation, and wear would not be a factor during plant life. Damper failure is acceptable because the current Final Safety Analysis Report radiation analysis does not take credit for the ESF filtration of normal leakage in ESF systems post-LOCA. Even assuming a passive failure, such as pump seal leakage, it can be shown using realistic design assumptions that the doses released will be below 10 CFR 100 guidelines, without taking credit for the ESF filters. Therefore, there is no safety concern in the auxiliary building.

The diesel generator (DG) building exhaust modulating dampers are used for temperature control in each of the four diesel generator rooms. Shaft guide wear can be considered a common mode failure. Failure of the damper to operate could lead to excessive temperatures in the diesel generator room. Although this condition could occur, failure is considered unlikely because system design precludes hunting. However, sufficient information is not currently available concerning the effect of wear on the damper's ability to function. Therefore, the safety impact of this concern will remain indeterminate.

Root Cause

Four elements caused this concern.

The first element is transverse loads on the input and output shafts. Known possible sources are misalignment and gear separation forces. The operator shaft is aligned with the linear converter shaft and free operation is achieved before the mounting bolts are secured prior to shipment. If a damper assembly is mishandled, or if an actuator is removed to ease installation, misalignment during field installation is possible.

The second element is operation without lubrication. PAPCo calculated when they designed the linear converters that the converters could operate without lubrication. Their test results show that this is not the case (Reference C). Lubricating the converters greatly reduces wear even with transverse shaft loads.

Thirdly, the discrepant units returned to PAPCo from the field had experienced control hunting. The hunting caused the dampers to experience a number of cycles equal to many years of operation in one day.

Lastly, the lack of specific inspection and maintenance procedures leaves the condition of the converters unknown.

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Since this safety concern results from a combination of four separate elements, it is unlikely that this condition will occur within any other mechanical equipment nor within any other discipline's equipment.

Corrective Action

The following discussion provides an item-by-item response to the Recommended Action section of the MCAR-81.

1. Vendor drawings have been reviewed to ensure that all safety-related dampers that use this converter have been identified. Those dampers are the 8 safety-related dampers listed in the Analysis of Safety Implication section of this report.
- 2&4 In their final report (Ref. D), PAPCo has recommended three separate maintenance alternatives and has issued a maintenance instruction for the linear converters.

Bechtel engineering has obtained maintenance instructions as vendor prints and has incorporated three alternatives into the vendor drawing package, Vendor Print 7220-M154(Q)-105-1. Considering the operation of the modulating dampers for the DG building, this provides adequate assurance that the linear converter will meet its required design life.

3. Nonconformance Report H-00396-ZZ has been written against the affected safety-related dampers.
5. Incorporation of the recommended maintenance instructions eliminates two of the four elements of the root cause previously discussed; i.e., operation without lubrication and the lack of maintenance and inspection procedures. In addition, PAPCo has supplied an instruction for field alignment of the converter with the operator. This will eliminate the controllable source of transverse loads which is misalignment. System hunting, which is defined as rapid cycling in excess of normal modulation action, is not anticipated based on the specific diesel generator building HVAC controls design using the modulating dampers.

These steps preclude recurrence.

6. Based upon coordination with affected disciplines, no related equipment on the Midland project, other than those dampers already identified, is affected by the MCAR condition.

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Reportability

This concern was reported to the NRC by Consumers Power Company as a potential reportable condition on February 28, 1984.

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