Consumers Power Company

James W Cook
Vice President - Projects, Engineering and Construction

General Offices: 1945 West Parnall Road, Jackson, MI 49201 • (517) 788-0453

January 12, 1984

83-13 #1

Mr J G Keppler, Regional Administrator
US Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

MIDLAND ENERGY CENTER PROJECT
DOCKET NOS 50-329 AND 50-330
BROWN-BOVERI BROKEN/CRACKED PUFFER PISTON RODS
FILE: 0.4.9.85 SERIAL: 26661

On December 13, 1983, Consumers Power Company notified your staff of a potential 10CFR50.55(e) condition involving broken/cracked Puffer Piston Rods in Model 5 Hk breakers manufactured by Brown-Boveri.

This letter is an interim 10CFR50.55(e) report. The attachments to this letter describe the concern and summarize the investigation and corrective action taking place.

Another report, either interim or final, will be sent on or before March 30, 1984.

James W. Cook

JWC/AHB/lr

Attachments: (1) MCAR-1, Report No 77, dated December 14, 1983.

(2) MCAR-77, Interim Report 1, dated January 3, 1984.

CC: Document Control Desk, NRC
Washington, DC

RJCook, NRC Resident Inspector
Midland Nuclear Plant

DHood, USNRC Office of NRR

INPO Records Center

OC0184-0025A-MP01

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Attachment 1

13737

QUALITY ASSURANCE PROGRAM

MANAGEMENT CORRECTIVE ACTION REPORT

MCAR-1 REPORT NO. 77

JOB NO. 7220 Q NO. _____ DATE 12/14/83

I* DESCRIPTION (Including references):

Model 5 Hk breakers manufactured by Brown Boveri from 1960 through 1980 may have broken/cracked puffer pistons. If these puffer pistons are not broken/cracked, there is potential for such cracking.

(continued)

* RECOMMENDED ACTION (Optional)

1. Complete a safety evaluation to determine the impact on safety of operations at the Midland plant.

2. Identify all suspect breakers and ensure they are controlled in accordance with project procedures for nonconforming items.

(continued)

REFERRED TO ☒ ENGINEERING ☐ CONSTRUCTION ☐ QA MANAGEMENT ☐ _____

☐ PROCUREMENT

ISSUED BY for Project QA Engineer 12/14/83 Date

**NOTE: This was reported to the NRC by client on 12/13/83 as a potentially reportable 10CFR 50.55(e) condition.

II REPORTABLE DEFICIENCY

☐ NO ** ☒ YES

NOTIFIED CLIENT

Project Manager 12/14/83 Date

Date

III CAUSE

CORRECTIVE ACTION TAKEN

AUTHORIZED BY _____ Date

STANDARD DISTRIBUTION

DIVISION QA MANAGER
MANAGER OF QA - BPC
GPD - QA MANAGER
LAPD QA MANAGER
SFPD QA MANAGER
PROJECT MANAGER
CLIENT

ADDITIONAL DISTRIBUTION - AS APPROPRIATE

ENGINEERING MANAGER
PROJECT ENGINEER
QE SUPERVISOR

CONSTRUCTION MANAGER
PROJ SUPT/PROJ CONSTR MANAGER
CHIEF CONSTR QC ENGINEER

DIVISION PROCURENT MGR
PROJ PROCUREMENT MGR
PROCUREMENT SUPPLIER QUALITY MGR AND DIV SUPPLIER QUALITY MGR

FORMAL REPORT TO CLIENT _____ Date
(If Section II Applies)

CORRECTIVE ACTION IMPLEMENTED

VERIFIED BY _____
Project QA Engineer Date

*Describe in space provided and attach reference document.

AAPD-0161

137137

Description (continued):

Because the puffer pistons are needed to extinguish an arc at low current values (approximately 1,000 amperes and below), the damaged puffer pistons could result in failure to open circuit breakers on demand. The inability to extinguish an arc may result in permanent damage to the switchgear. The inability to open circuit breakers on demand and possible damage resulting from not extinguishing an arc could result in inability of safety-related loads to perform their intended function.

Recommended Action (continued):

3. Coordinate with Brown Boveri to determine the cause of puffer piston cracking and corrective actions necessary to prevent recurrence.

4. Investigate and determine if there are similarities in design and/or materials in other types of breakers which may make them subject to puffer piston cracking.

5. Issue a report, interim or final, by December 29, 1983.

Attachment 2

138701

Bechtel Power Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

Mail Address: P.O. Box 1000, Ann Arbor, Michigan 48106

January 3, 1984

BLC-18756

Consumers Power Company
1945 Parnall Road
Jackson, Michigan 49201

Attention: Mr. J.W. Cook
Vice President
Projects, Engineering and Construction

Subject: Midland Plant Units 1 and 2
Consumers Power Company
Bechtel Job 7220
MCAR 77 - Interim Report 1

Interim Report 1 for MCAR 77, concerning broken/cracked puffer pistons in Class 1E type 5 HK breakers (manufactured by Brown Boveri between 1960 and 1980), is attached for your information and use.

The next report, interim or final, will be issued by March 14, 1984.

Very truly yours,

for John A. Rutgers
Project Manager

JAR/GEC/mrv

Attachment: MCAR 77 - Interim Report 1

CC: W.R. Bird
F.W. Buckman
J.W Cook
G.R. Eagle
W. Friedrich
L. Gibson
J.P. Knight
D.T. Perry
D.L. Quamme
B.W. Marguglio
R.A. Wells
(all w/a)

Written Response Requested: No

138554

Bechtel Associates Professional Corporation

138701

SUBJECT: MCAR 77 (issued 12/14/83)

Broken/Cracked Puffer Piston Rods in Model 5 Hk Breakers Manufactured by Brown Boveri Between 1960 and 1980

INTERIM REPORT 1

DATE: January 3, 1984

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

Introduction

This report provides the status and course of action required pursuant to MCAR 77.

Description of Deficiency

Brown Boveri Type 5 Hk circuit breakers manufactured between 1960 and 1980 may have broken/cracked puffer piston rods.

Summary of Investigation and Historical Background

This deficiency was identified by The Detroit Edison Company at the Fermi nuclear plant and documented in a Brown Boveri letter to Bechtel dated October 31, 1983 (Com 133441) (Attachment 1).

The Midland 4,160 V, Class 1E switchgear uses Brown Boveri Model 5 Hk circuit breakers. All breakers (except breakers in cubicles 1A06-12 and 2A06-12) supplied for the Midland plant were manufactured between 1960 and 1980.

Analysis of Safety Implication

The puffer piston rods (one for each pole of a breaker) ensure extinction of an arc at low current values (below 1,000 amperes). If the puffer piston rods of a circuit breaker are broken, opening of the breaker may not interrupt the resulting arc. The presence of an arc could lead to a path to ground resulting in a ground fault for the entire assembly, causing permanent damage to the switchgear. The safety-related ac loads, powered from these switchgears, may therefore be unable to perform their intended function.

The above analysis is based on Brown Boveri's interim report and verbal clarifications. Further analysis will be made upon receipt of the final report from Brown Boveri and will be included in our next report.

Probable Cause

Brown Boveri stated in a telephone conversation that the root cause is a lack of quality control at the subsupplier's facility manufacturing the puffer piston rods. There was a lack of definition of the length of time for holding the temperature of the puffer piston rod material before pouring. Written confirmation and further explanation are being requested from the vendor regarding the probable cause and corrective actions taken to prevent recurrence and will be included in our next report.

Corrective Action

The corrective actions to resolve this MCAR are as follows.

1. A safety evaluation was performed to determine the impact on safety of operations at the Midland plant, and was documented in Bechtel internal correspondence (Com 137410, dated December 16, 1983).

2. Nonconformance Report (NCR) D-00005 was issued December 20, 1983, to identify and control this nonconforming condition. The Class 1E breakers will be examined for broken/cracked puffer piston rods (see Attachment 2). This activity is forecast to be complete by February 29, 1984. Any broken/cracked puffer piston rods found during the field inspection will be replaced.

3. Requirements will be added to inspect the breakers at normal maintenance intervals for broken/cracked puffer piston rods. QAR RD0023 was issued for inclusion of the puffer piston rod inspection into the appropriate maintenance procedure.

4. An investigation of the Midland design indicates that there are no other safety-related breakers with similar design and/or material. Therefore, only Class 1E, 4,160 V breakers manufactured by Brown Boveri (see Attachment 2) could be subject to the concern of broken puffer piston rods.

5. The next report for this MCAR is forecast to be issued March 14, 1984.

Submitted by: J. Conn for
JGK
E.B. Poser
Project Engineering
Manager

Approved by: J.L. Koupal for
E.H. Smith
Engineering Manager

Concurrence by: JE Crosby
for M.A. Dietrich
Midland Project Quality
Assurance Engineer

JGK/LK/mmc*(E)

Attachments: 1. Brown Boveri Electric, Inc., letter to Bechtel, 10/31/83 (Com 133441)
2. List of Class 1E, 4,160 V Breakers Supplied by Brown Boveri and Manufactured Between 1960 and 1980

Attachment 1 to MCAR 77, Interim Report 1

BBC BROWN BOVERI **Brown Boveri Electric, Inc.** FILE E-205P12

Manufacturer of I-T-E Electrical Power Equipment

138554 13870i 133441

October 31, 1983

Bechtel Power Corporation
P.O. Box 1000
Ann Arbor, MI 48106

ATTENTION: Mr. Rutgers
Project Manager

SUBJECT: P.O. 7220-E-205-AC
Bechtel/Consumers (Midland)
Metal Clad Switchgear
S.O. 33-50382

REFERENCE: Detroit Edison Company
Enrico Fermi Generating Station
CFR50.55 (E) Report Dated March 17, 1983
Brown Boveri Electric 5HK250/350, 1200/2000 amp
Circuit Breakers - Cracked and Broken Puffer
Piston Rods

GENTLEMEN:

Enclosed you will find a copy of a letter from Brown Boveri Electric, Inc. with attachments sent to the US Nuclear Regulatory Commission dated October 5, 1983.

Regards,

BROWN BOVERI ELECTRIC, INC.

I. Jack Fahlen/baf

I. Jack Fahlen
Executive Sales Engineer

IJF/baf

Enclosures

cc: E.M. Hughes - Bechtel

28200 Orchard Lake Road · Suite 110, Farmington Hills, MI 48018 • (313) 855-0333

BBC BROWN BOVERI Brown Boveri Electric, Inc.

Manufacturer of I-T-E Electrical Power Equipment

138554

October 5, 1983

138701

Mr. R. C. DeYoung, Director
Office of Inspection & Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. DeYoung:

On March 17, 1983 Detroit Edison Company (Fermi II) filed a 10CFR50.55(e) report with the NRC concerning some cracked and broken puffer piston rods in the Brown Boveri Electric 5HK 250/350, 1200/2000A circuit breakers.

Attached is an interim report on the BBE evaluation status to date on this condition.

Based on the test results and other information available at this time the BBE recommendation is to inspect for cracked or broken puffer piston push rods at normal maintenance intervals and to replace the puffer piston assembly if this condition is found.

D. D. DUVALL
Vice President

DDD/jm

Attachment

cc: A. E. Boetticher
W. E. Laubach
E. W. Rhoads
L. B. Schmidt
J. R. Silverio

W. Laudan, NRC I & E

Switchgear Systems Division
Spring House, PA 19477 • (215) 628-7400

BBC Brown Boveri Electric, Inc.
138554
138554 Manufacturer of I-T-E Electrical Power Equipment

October 3, 1983

13-87-01

INTERIM REPORT
5HK CIRCUIT BREAKERS
PUFFER PISTON RODS

The purpose of this interim report is to summarize the status of the evaluation to date and to provide a history regarding cracked/broken puffer piston rods (Part No. 193642-B) in the Brown Boveri Electric 5HK 250/350, 1200/2000A circuit breakers.

In January, 1983, a report of some cracked/broken puffer piston rods at the Mohave Generating Station of Southern California Edison in Lauglin, Nevada was received. These circuit breakers are 5HK 350-1200A supplied on S.O. 33-44107 and have been in operation since about 1970. The cracks/breakage of the puffer piston rods occurs at the operating pin hole. The conditions were noted while performing an overhaul on the circuit breakers, with some twenty (20) circuit breakers in Unit No. 1 and twenty (20) in Unit No. 2, thus a total of 120 puffer pistons are in operation at this station. A total of eight (8) puffer piston rods were found to be broken. The number of puffer piston rods that were cracked is not known, however the user ordered a total of twenty (20) replacement parts.

The average ambient temperature at this station is about 80°F. Temperature excursions normally vary between 35°F and 125°F, but extremes to a low of +30°F and a high of 135°F have occurred. The humidity is normally between 10% and 15%. No more than one broken puffer piston rod per breaker was found during any inspection.

A March 17, 1983 report received from Detroit Edison (Fermi) indicates that one (1) broken puffer piston rod and nine (9) cracked rods in 5HK 350-1200A circuit breakers were found. These circuit breakers were manufactured in 1973 on S.O. 33-47196 and the reported conditions were noted in a total of five (5) circuit breakers. No operation count was reported on these breakers.

A BBE Service Engineering Report dated August, 1983 identifies that some 5HK 250-1200A and 2000A at the Salt River Project, Navajo Generating Station manufactured between 1972 and 1980 were examined for puffer piston rod cracks. There are approximately eighty-six (86) circuit breakers at this location, some of which have over 10,000 operations. This inspection showed that there were no cracks or breakage in any of the puffer piston rods. The environmental conditions at this station are similar to those noted at the Mohave Generating Station.

Switchgear Systems Division
Spring House, PA 19477 • (215) 628-7400

The 5HK circuit breakers have been in production since 1960 with essentially the same design configuration and materials used today. The puffer piston tube was originally made with Zytel 101 unfilled material. This material was used until 1980 when the vendor and material was changed to Nylafil E1-30-EM. Puffer piston rods of both the Zytel and Nylafil material have been subjected to thermal aging tests with no significant degradation trend being noted after initial "drying out" of the nylon material. When humidified after long exposure at high temperature the material returns to essentially the same strength characteristics as when new. Thermally aged puffer piston rods in the dry condition were subjected to endurance testing of over 5000 operations. Subsequent inspection of these items disclosed no cracking or damage to the puffer piston rods.

Three (3) puffer piston rods with cracks were obtained from Detroit Edison Fermi 2 Station. These were subjected to mechanical endurance testing in a test breaker to investigate the tendency for existing cracks to progress into failures. After 1200 operations, the inspection indicated that the cracks did not propagate nor did any parts break. One of the puffer piston rods for this test was modified wherein the holes for the operating pin were redrilled in a smaller diameter to determine if this interference fit of the pin could result in a test failure. The inspection of this part upon the completion of the endurance test (1200 operations) indicated that cracks had not developed.

A puffer piston in the 5HK circuit breaker performs two functions. For low current interruptions the puffer is needed to assist the magnetic forces to move the arc into the interrupting chamber. A puffer piston also provides a pneumatic cushion which reduces the shock forces imposed on the mechanism and current carrying parts on opening. For lower values of current, arc interruption could be adversely affected by failure of one puffer piston with failure to extinguish the arc. Mechanically, loss of a puffer could reduce the number of operations before maintenance would be necessary.

BBE has never experienced a circuit breaker failure due to a broken puffer piston rod.

At this time, the BBE evaluation of data indicate that aging is not a likely cause for the puffer piston rod cracks. Also, BBE testing and the sampling inspections conducted to date also indicate that the cracking is not a generic defect.

Efforts are under way to obtain additional aged samples from the field and consultations with other materials experts are planned. At the time of this interim report there is no clear explanation for the presence of puffer piston rod cracks at Fermi 2. Information gathered to date also indicates that no more than one broken puffer piston rod per breaker has been found at any inspection.

BBE is continuing its evaluation of this situation and will keep you advised of any significant findings.

The BBE recommendation at this time is to inspect for this condition at normal maintenance intervals and to replace cracked or broken assemblies. The assembly part number is 193989-T2.

138701

LIST OF CLASS 1E 5 HK CIRCUIT BREAKERS IN MIDLAND

Breaker	Startup System	Breaker	Startup System
1A05-501	1-PBA	2A05-501	2-PBA
1A05-502	1-PEA	2A05-502	2-PEA
1A05-503	0-EAA	2A05-503	0-EAA
1A05-505	1-NGE	2A05-505	2-NGE
1A05-506	1-PGA	2A05-506	2-PGA
1A05-507	1-BCA	2A05-507	2-BCA
1A05-508	1-ALA	2A05-508	2-ALA
1A05-510	1-EGA	2A05-510	2-EGA
1A05-512	1-BGC	2A05-512	2-BGC
1A06-601	1-PBB	2A06-601	2-PBB
1A06-602	1-PEB	2A06-602	2-PEB
1A06-603	0-EAA	2A06-603	0-EAA
1A06-605	1-PGB	2A06-605	2-PGB
1A06-606	1-BCA	2A06-606	2-ALA
1A06-609	1-EGA	2A06-608	2-BCA
1A06-611	1-BGC	2A06-610	2-BGC
1A05-511	1-BGC	2A05-511	2-BGC
1A06-607	1-ALA	2A06-611	2-EGA