

# Brown Boveri Electric, Inc.

Manufacturer of I-T-E Electrical Power Equipment

45368

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November 29, 1983

Mr. Robert L. Baer, Chief  
Engineering and Generic  
Communications Branch  
Division of Emergency Preparedness  
and Engineering Response  
Office of Inspection and Enforcement  
United States Nuclear Regulatory  
Commission  
Washington, D. C. 20555

Subject: Cracked and Broken Piston Rods in Brown Boveri Electric  
(Formerly I-T-E) Type SHK Circuit Breakers

Dear Mr. Baer:

This letter is in response to your letter of November 23, 1983 which enclosed a Draft NRC IE Information Notice pertaining to the subject.

Since the submittal of the BBE Interim Report on this subject dated October 3, 1983, some of the broken puffer piston rods were subjected to a micro-structural analysis wherein the samples were microtomed in the area of the failure to enhance the crystalline structure of them for microscopic analysis. This analysis revealed that there were some material voids in the broken area which suggested that there were venting problems with the tool used to mold the puffer piston rod. These voids could also be caused by trapped moisture during the molding process which would weaken the part. Another broken sample revealed a nonhomogeneity of the crystalline structure which would cause local areas of high stress which could result in breakage. The most likely cause of this problem is a non-uniform tool temperature, which was caused by operating the tool while it was in the state of initial heat up for molding the part. The few random problems that have been experienced to date for the most part could be attributed to problems in processing the material by the vendor. The fact that failures have been experienced in very few and random areas reinforces this hypothesis.

The failed parts have been limited to those made with the material identified as Zytel 101 (Nylon 6/6). Since 1980, the parts have been manufactured with a toughened and reinforced material identified as Nylafil. No problems have been reported on the parts manufactured with the Nylafil material.

Recently some puffer piston assemblies were recovered from the Oconee Nuclear Station at Duke Power. Examination of these parts from circuit breakers manufactured in 1969 revealed no defects whatsoever. It appears that the

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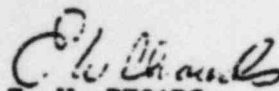
relatively few processing problems that were experienced are random in nature. It has also been determined that although some parts will crack, they will not necessarily fail. Some cracked parts returned from Detroit Edison (Fermi 2) were subjected to an endurance test of 1,200 operations without any propagation of cracks.

The actual number of failed puffer piston push rods (broken) that have been reported is less than twenty (20). Although others have been reported as being cracked, and the parts should be replaced, they are not considered failures. The total number of puffer piston assemblies installed in 5HK circuit breakers since 1968 is over 75,000.

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

In the Draft IE Information Notice, the second paragraph under "Description of Circumstances" is a correct statement in that spare puffer piston assemblies were found to be defective in receiving inspection at the Fermi plant and were returned to BBE. The parts were determined to be defective because of shipping damage and other concerns which were not related to cracking or breakage of the puffer piston push rods. As presented, this infers that BBE is having similar problems with the parts currently being used and this is not the case.

Enclosed is a list of 5HK circuit breakers that are being used in Class 1E applications at nuclear power plants. The circuit breakers manufactured after 1980 have puffer piston push rods made with the Nylafil material and there is no reason to suspect that these will be subject to cracking or breakage. Inspection of circuit breakers with manufacturing dates of 1981 or later for cracking or breakage should not be necessary.

  
E. W. RHOADS  
Manager Quality Assurance

EWR/jm

Enclosure

cc: D. D. Duvall  
C. E. Kunkel  
W. E. Laubach  
W. Laudan - NRC  
L. H. Schmidt  
A. E. Stringfellow

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SSINS No.: 6835  
IN 83-84

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF INSPECTION AND ENFORCEMENT  
WASHINGTON, D.C. 20555

December 30, 1983

IE INFORMATION NOTICE NO. 83-84: CRACKED AND BROKEN PISTON RODS IN BROWN  
BOVERY ELECTRIC TYPE 5HK BREAKERS

Addressees:

All holders of a nuclear power reactor operating license (OL) or construction permit (CP).

Purpose:

This information notice is provided as notification of a potentially significant problem pertaining to Brown Boveri Electric (BBE) type 5HK 250/350, 1200/2000 ampere circuit breakers. Addressees are expected to review the information for applicability to their facilities. No specific action or response is required at this time.

Description of Circumstances:

On March 21, 1983, Detroit Edison notified the NRC under the provisions of 10 CFR 50.55(e) of a potential problem with BBE 5HK 4160 volt breaker puffer piston rods at the Fermi 2 nuclear plant. The puffer piston connecting rods developed cracks and one shaft failed. The manufacturer's part number is 193642B. The cracking and failure occurred at the hole in the shaft where the linkage is connected by a pin. These breakers were manufactured in 1973. A total of five breakers were affected at the Fermi 2 site.

On September 12, 1983, Detroit Edison advised an NRC inspector that during a receiving inspection at the Fermi plant, spare puffer piston connecting rods were found to be defective. They were all returned to the vendor. BBE informed the NRC on November 29, 1983 that the damage to these puffer piston connecting rods were a result of shipping problems and were not related to the manufacturing process.

On October 12, 1983, BBE provided the NRC with an Interim Report pertaining to the 5HK breaker puffer piston connecting rod problem. The report indicated that at a Southern California Edison (SCE) non-nuclear plant eight puffer piston connecting rods were found to be broken.

Puffer pistons in the BBE 5HK breakers perform two functions. For low current interruptions the puffer is needed to assist the magnetic forces to move the

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arc into the interrupting chamber. The arc may not be extinguished if the puffer piston fails. The other function performed by the puffer piston is to provide a pneumatic cushion which reduces the shock forces imposed on the mechanism and current carrying parts upon opening. A failure of the puffer piston could reduce the number of operations before maintenance on the breaker would be necessary.

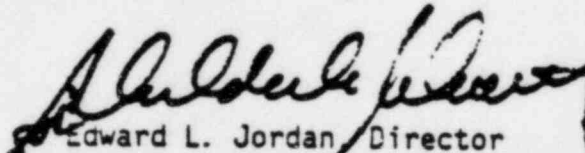
BBE indicated that no breaker failed because of a broken puffer piston rod, however, the breaker's capability to interrupt at low current may be impaired.

BBE subjected broken piston rods to failure analysis including microscopic analysis of the failed area and found that failed parts were limited to those made with the material identified as Zytel 101 (Nylon 6/6). Since 1980, the parts have been manufactured with a toughened and reinforced material called "Nylatil." No problems have been reported on Nylatil material parts.

Based on the test results and presently available information, BBE recommends inspecting for cracked or broken puffer piston rods at normal maintenance intervals and replacing the puffer piston assembly if this condition is found. It should be noted that the nozzle of the puffer piston must be removed to inspect the rod properly.

Attached is a list provided by BBE of SHK circuit breakers that they supplied for use in Class 1E applications at nuclear power plants, and which may be affected. Since breakers can also be obtained from intermediate sources, the list may not be complete. It is suggested that licensees evaluate their equipment lists to determine if BBE SHK breakers are used in safety-related applications in their plant. Inspection of circuit breakers with manufacturing dates of 1981 or later for cracking or breakage of puffer piston rods should not be necessary.

If you have any questions regarding this matter, please contact the Regional Administrator of the appropriate NRC Regional Office, or this Office.

  
Edward L. Jordan, Director  
Division of Emergency Preparedness  
and Engineering Response  
Office of Inspection and Enforcement

Technical Contact: W. Laudan, IE  
(301) 492-9759

Attachments:

1. List of SHK Breaker Customers
2. List of Recently Issued IE Information Notices



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Attachment 1  
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BBE TYPE 5HK BREAKER CUSTOMERS

<u>CUSTOMER</u>	<u>BBE SALES ORDER</u>	<u>DATE OF MANUFACTURE</u>
CEI Perry 1&2	51958	8/78, 9/78, 10/78
CFE Laguna Verde	53462	11/74 - 1/80
CP&L Brunswick 1 Brunswick 2	54792 47219 49839	10/81 11/71 - 8/72 3/74 - 3/79
Cincinnati G&E Zimmer	51828	6/77 - 11/77
Commonwealth Edison LaSalle County 1&2	50080 52612	10/75 - 12/75 4/78, 5/78
Zion 1&2	45122	5/70 - 2/71
Consumers Power Midland 1&2	50382	4/75 - 9/75 9/75 - 6/76 8/75 - 9/75
Detroit Edison Fermi 2	47196	12/73 - 9/74
Duke Catawba 1 & 2 McGuire 1 & 2 Oconee 3	50465 48560 44349	4/78 - 4/79 9/72 - 11/74 8/69 - 8/71
Duquesne Light Co. Beaver Valley 1&2	46690	8/71 - 8/78
Florida Power Corp Crystal River 3	46256	11/70
Georgia Power Company Vogtle 1 Vogtle 2	51903 51904	9/81 - 3/82 7/81 - 2/83

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BBE TYPE 5HK BREAKER CUSTOMERS

<u>CUSTOMER</u>	<u>BBE SALES ORDER</u>	<u>DATE OF MANUFACTURE</u>
Gulf States Utilities River Bend 1&2	51126 51128	11/80 - 3/83 10/80 - 4/82
Indiana Michigan Electric Co. Cook 1 Cook 2	44322 53372	8/71 - 3/72 5/79
Mississippi Power & Light Grand Gulf 1&2	50469	1/76 - 5/77
Northern States Power Prairie Island 1&2	44477	2/70 - 10/71
PE Limerick 1&2	47651	3/77 - 5/77
PSE&G Hope Creek 1&2	52260	10/79 - 1/80
PSI Marble Hill 2	52661	11/80 - 8/82
PSNH Seabrook 1&2	50750	1/77 - 8/77
Portland General Electric Trojan	47354	2/73
Sacramento Municipal Utility District Rancho Seco 1	45966	5/71
South Texas Project 1 Project 2	52769 52914	10/78 5/79 - 12/79
Southern California Edison San Onofre 2&3	50395	3/76, 4/76
Taiwan Kuo Sheng/Unit 1&2	50735	5/77 - 12/76, 11/75 - 12/75, 3/76

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Attachment  
IN 83-84  
December 30, 1983LIST OF RECENTLY ISSUED  
IE INFORMATION NOTICES

Information Notice No.	Subject	Date of Issue	Issued to
83-83	Use of Portable Radio Transmitters Inside Nuclear Power Plants	12/19/83	All power reactor facilities holding an OL or CP
83-82	Failure of Safety/Relief Valves to Open at BWR - Final Report	12/16/83	All power reactor facilities holding an OL or CP
83-81	Entry Into High Radiation Areas From Areas Which Are Not Under Direct Surveillance	12/7/83	All licensees authorized to use portable radiography devices in radiography programs
83-80	Use of Specialized "Stiff" Pipe Clamps	11/23/83	All power reactor facilities holding an OL or CP; NSSS and AEs
83-79	Apparently Improper Use of Components in Safety-Related Systems	11/23/83	All power reactor facilities holding an OL or CP
83-78	Apparent Improper Modification of a Component Affecting Plant Safety	11/17/83	All power reactor facilities holding an OL or CP
83-77	Air/Gas Entrainment Events Resulting in System Failures	11/14/83	All power reactor facilities holding an OL or CP
83-76	Reactor Trip Breaker Malfunctions (Undervoltage Trip Devices on GE Type AK-2-25)	11/2/83	All power reactor facilities holding an OL or CP
83-75	Improper Control Rod Manipulation	11/03/83	All power reactor facilities holding an OL or CP

OL = Operating License  
CP = Construction Permit

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BBE TYPE 5HK BREAKER CUSTOMERS

<u>CUSTOMER</u>	<u>BBE SALES ORDER</u>	<u>DATE OF MANUFACTURE</u>
VEPCO North Anna 2	48709	9/76, 10/76
WPPSS WNP 1&2	51659	3/78 - 1/79





12/1/83

500K BREAKERS

<u>Customer</u>	<u>BBE Sales Order</u>	<u>Date of Mfgr.</u>
CP&L/Brunswick 2	47219	11/71 - 8/72
Brunswick 1	54792	10/81
Brunswick 2	49839	3/74 - 3/79
Cincinnati G & E/Zimmer	51828	6/77 - 11/77
CEI/Perry 1 & 2	51958	8/78 9/78 10/78
Commonwealth Edison/Zion 1 & 2	45122	5/70 - 2/71
/LaSalle County 1 & 2	50080	10/75 - 12/75
/LaSalle County 1 & 2	52612	4/78, 5/78
Consumers Power/Midland 1 & 2	50382	4/75 - 9/75 9/75 - 6/76 8/75 - 9/75
Detroit Edison/Ferri 2	47196	12/73 - 9/74
Duke/Oconee 3	44349	8/69 - 8/71
/McGuire 1 & 2	48560	9/72 - 11/74
/Catawba 1 & 2	50465	4/78 - 4/79
Duquesne Light Co./Beaver Valley 1 & 2	46690	8/71 - 8/76
Florida Power Corp/Crystal River 3	46256	11/70
Georgia Power Company/Vogtle 1	51903	9/81 - 3/82
/Vogtle 2	51904	7/81 - 2/83
Gulf States Utilities/River Bend 1 & 2	51126 51128	11/80 - 3/83 10/80 - 4/82
Indiana Michigan Electric Co./Cook 1	44322	8/71 - 3/72
/Cook 2	53372	5/79

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<u>Customer</u>	<u>BBE Sales Order</u>	<u>Date of Mfgr.</u>
Mississippi Power & Light/Grand Gulf 1 & 2	50469	1/76 - 5/77
Northern States Power/Prairie Island 1 & 2	44477	2/70 - 10/71
P.E./Limerick 1 & 2	47651	3/77 - 5/77
Portland General Electric/Trojan	47354	2/73
PSI/Marble Hill 2	52661	11/80 - 8/82
PSNH/Seabrook 1 & 2	50750	1/77 - 8/77
PSE&G/Hope Creek 1 & 2	52260	10/79 - 1/80
Sacramento Municipal Utility District/ Rancho Seco 1	45966	5/71
Southern California Edison/ San Onofre 2 & 3	50395	3/76, 4/76
South Texas/Project 1	52769	10/78
/Project 2	52914	5/79 - 12/79
VEP Company/North Anna 2	48709	9/76, 10/76
WPPSS/WNP 1 & 4	51659	3/78 - 1/79
Taiwan/Kuo Sheng/Unit 1 & 2	50735	5/77 - 12/76 & 11/75 - 12/75 & 3/76
CFE/Laguna Verde	53462	11/74 - 1/80

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