

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR REACTOR REGULATION  
WASHINGTON, D.C. 20555-0001

August 2, 1996

NRC INFORMATION NOTICE 96-43: FAILURES OF GENERAL ELECTRIC MAGNE-BLAST  
CIRCUIT BREAKERS

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to recent failures of General Electric (GE) 4.16 kV Magne-Blast circuit breakers at the Dresden Nuclear Power Station, Unit 3 (Dresden 3), caused by hardened grease and failures of Magne-Blast breakers to latch closed at the Salem Nuclear Generating Station (Salem) and the Maine Yankee Atomic Power Plant (Maine Yankee). The NRC staff is preparing a separate information notice to discuss failures related to refurbishment practices, including zinc plating of surfaces and recently discovered broken lock washers at Salem. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

Failure Due to Hardened Grease

On June 11, 1996, at Dresden 3, a 4.16-kV GE Magne-Blast circuit breaker that supplies power to a low-pressure coolant injection pump motor failed to open on demand from the control room following a surveillance run of the pump. Examination of the failed breaker showed hardened grease in the breaker mechanism.

In subsequent testing of four similar spare breakers, all tripped at required low voltage conditions. However, two of the breakers showed the potential for unreliable operation because their trip latch roller bearings did not freely rotate. The cause was hardened grease. During bench testing of breakers pulled from the cubicles to date, two additional breakers failed to trip on required low voltage. Both breakers exhibited hardened grease conditions in trip latch roller bearings.

The licensee identified 23 safety-related breakers in Dresden 3 as susceptible to this failure mechanism. On June 20, 1996, the licensee initiated a

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shutdown of Dresden 3 and contracted with GE Nuclear Energy to completely overhaul each of these 23 breakers and the similar ones in Dresden 2.

#### Failure to Latch Closed

On January 5, 1996, at Salem, a 4.16-kV GE Magne-Blast circuit breaker that supplies power to a service water pump motor failed to latch closed on demand from the control room. During the subsequent investigation with the breaker in test position, the breaker failed to latch closed on the seventh attempt after successfully latching closed six times.

On February 15, 1996, a different service water pump breaker at Salem failed to latch closed. This breaker had been returned to service after an overhaul at the GE Apparatus Service Center in Philadelphia.

On September 27, 1993, at Maine Yankee, a 4.16-kV GE Magne-Blast component cooling water pump breaker failed to latch closed on demand from the control room. The licensee enabled this breaker to close reliably by replacing the upper prop spring with a heavier prop spring (of the gold-colored type used as a lower prop spring).

#### Discussion

In 1989, during an NRC maintenance team inspection at Dresden, the team found a lack of lubrication of these same breakers. At that time, the licensee instituted a preventive maintenance program as a corrective measure. Subsequent NRC review of that program showed that the licensee had not fully implemented recommendations of the manufacturer, GE Specialty Breaker Plant.

The GE instruction book applicable to the horizontal-drawout Magne-Blast circuit breakers used at Dresden (GEI-88771D), a similar book applicable to vertical-lift breakers used elsewhere (GEK-7320F), and GE Service Advice Letter (SAL) 354.1, dated August 25, 1995, recommend that these breakers be lubricated once every 2 years. The licensee, however, had been using a six-year maintenance period and had not maintained (cleaned and lubricated) the failed breaker for six and a half years. The following factors may have contributed to the aging and hardening of grease over this protracted maintenance period: (1) contamination of grease by an aerosol degreaser during maintenance in 1989, (2) prevention of the light-weight lubricating oil applied during the 1989 maintenance from reaching internal bearing surfaces and refreshing the grease (the licensee had applied a light coating of grease before applying the oil), (3) premature aging of grease from cubicle heaters, and (4) presence of fibrous material in the one affected bearing.

In Information Notice 94-54, the NRC staff alerted licensees to failures of Magne-Blast breakers to latch closed and discussed the recommendation (GE SAL 352) to add a second prop spring to correct the failure. The staff pointed out that breakers that are grossly out of adjustment or badly worn may fail to latch closed even with the addition of a second prop spring.

The Salem licensee and GE jointly used high-speed digital video equipment to learn that the failure mechanism is complex and that the prop-to-prop pin

motion is influenced by the opening and closing spring energy, prop spring force, and primary contact assembly wipe or rebound. The timing of the rebound of the prop pin (if it is present) relative to the prop reset motion is critical to reliable operation. If the prop pin impacts the tip of the prop, it may reverse the prop motion. The breaker will fail to latch if the prop does not have sufficient time to recover to a position under the pin before the pin falls. The impact also may cause the tips of the prop to become chipped or flattened.

In agreement with GE, the Salem licensee believes the prop pin may fail to achieve the required position because of (1) the age and wear of the breaker, (2) misalignment of the prop mechanism, (3) errors that may be introduced in the alignment of the operating mechanism causing the prop and or articulated mechanism to twist, (4) misalignment of the stationary cubicle in which the breaker operates, and (5) opening spring adjustment. The cause of any particular failure to latch may have to be determined on an individual basis.

This problem affects vertical-lift Magne-Blast circuit breakers with ML-13 mechanisms that have close-latch ratings of 77 kA or above (high momentary ratings).

The Salem licensee concluded that the following symptoms are indicative of the conditions present during the high-speed prop reset action that could result in failure of the breaker to latch closed:

- The prop stop pin is not in the fully forward position in the inspection window when the breaker is closed.
- The tips of the prop are chipped or flattened. (The prop tips may be viewed through both inspection holes.)
- The breaker has a history of intermittently failing to latch closed.
- If the arcing contacts have overstroked, the tips of the arcing contacts will probably be damaged by their impact on the dividers in the stationary arcing contacts, and the buffer blocks may be cracked.
- Prop wipe is unequal, indicating prop or prop pin twist.

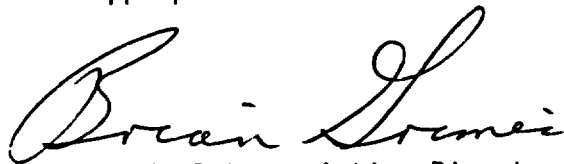
In agreement with GE, the corrective action taken at Salem was to raise the preload on the opening spring to slow down the closing action, thus allowing more time for the prop to get into position. However, this approach is limited by the minimum speed that must be achieved by the moving contacts to maintain the high momentary rating.

GE Philadelphia Operations is pursuing an alternative solution: (1) replacing the second prop spring with a heavier one, currently under development, (2) installing a second prop stop to restrict the prop movement on the left-hand side, and (3) adjusting the wipe on the main contacts. When testing is complete, GE plans to issue a SAL on this subject.

Related Generic Communications

1. Bulletin 74-09. "Deficiency in General Electric Model 4KV Magne-Blast Breakers." August 6, 1974.
2. Information Notice 84-29. "General Electric Magne-Blast Circuit Breaker Problems." April 17, 1984.
3. Information Notice 90-41. "Potential Failure of General Electric Magne-Blast Circuit Breakers and AK Circuit Breakers." June 12, 1990.
4. Information Notice 93-26. "Grease Solidification Causes Molded Case Circuit Breaker Failure To Close." April 7, 1993.
5. Information Notice 93-91. "Misadjustment Between General Electric 4.16-KV Circuit Breakers and Their Associated Cubicles." December 3, 1993.
6. Information Notice 94-02. "Inoperability of General Electric Magne-Blast Breaker Because of Misalignment of Close-Latch Spring." January 7, 1994.
7. Information Notice 94-54. "Failures of General Electric Magne-Blast Circuit Breakers To Latch Closed." August 1, 1994.
8. Information Notice 95-22. "Hardened or Contaminated Lubricants Cause Metal-Clad Circuit Breaker Failure." April 21, 1995.

This information notice requires no specific action or written response. If you have any questions about the information herein, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.



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Office of Nuclear Reactor Regulation

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Attachment: List of Recently Issued NRC Information Notices

*Attachment filed in Jacket*

LIST OF RECENTLY ISSUED  
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
96-42	Unexpected Opening of Multiple Safety Relief Valves	08/05/96	All holders of OLs or CPs for nuclear power reactors
96-41	Effects of a Decrease in Feedwater Temperature on Nuclear Instrumentation	07/26/96	All holders of OLs or CPs for pressurized water reactors
96-40	Deficiencies in Material Dedication and Procurement Practices and in Audits of Vendors	07/25/96	All holders of OLs or CPs for nuclear power reactors
96-09, Supp. 1	Damage in Foreign Steam Generator Internals	07/10/96	All holders of OLs or CPs for pressurized-water reactors
96-39	Estimates of Decay Heat Using ANS 5.1 Decay Heat Standard May Vary Significantly	07/05/96	All holders of OLs or CPs for nuclear power reactors
96-38	Results of Steam Generator Tube Examinations	06/21/96	All holders of OLs or CPs for pressurized water reactors
96-37	Inaccurate Reactor Water Level Indication and Inadvertent Draindown During Shutdown	06/18/96	All pressurized water reactor facilities holding an operating license or a construction permit
96-36	Degradation of Cooling Water Systems Due to Icing	06/12/96	All holders of OLs or CPs for nuclear power reactors
96-35	Failure of Safety Systems on Self-Shielded Irradiators Because of Inadequate Maintenance and Training	06/11/96	All U.S. Nuclear Regulatory Commission irradiator licensees and vendors

OL = Operating License  
 CP = Construction Permit

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**Original signed by Brian K. Grimes**

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Tech Editor has reviewed and concurred on 07/23/96 \*SEE PREVIOUS  
CONCURRENCES

Attachment: List of Recently Issued NRC Information Notices

OFC	PECB:DRPM	C. EELB:DE	C. PSIB:DISP	DIR, DRPM
NAME	VHodge*	JCalvo*	RGallo*	BGrimes
DATE	07/26/96	07/26/96	07/29/96	07/27/96

document: 96-43.IN

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DATE	07/ /96	07/ /96	07/ /96	07/ /96

document: g:\vern\magblast.inf

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NAME	VHodge	JCalvo <i>MG</i>	<i>RG</i>	BGrimes
DATE	07/26/96	07/26/96	07/29/96	07/ /96

document: g:\vern\mag60726.inf

*W/NOTED  
 COMMENTS*