

**GE Nuclear Energy**

PDS-96-020

Power Delivery Services
6901 Elmwood Avenue
Philadelphia, PA 19142

Monday, July 29, 1996

US-Nuclear Regulatory Commission
Washington, DC 20555-0001
ATTN: Vern Hodge, NRR/PECB
Mail Stop: 011E1

SUBJECT: Technical Review of Draft Information Notice
Regarding Recent Failures of Magne-Blast Circuit Breakers

REFERENCE: NRC letter of July 24, 1996 requesting technical review of
draft information notice

Dear Mr. Hodge:

We have reviewed the draft information notice and have the following comments. We believe that these changes will clarify the document. Each comment is preceded by a reference to the applicable portion of the draft document.

Page 1, "Purpose", end of the first sentence; Replace "mispositioning of the prop pin" with "unreliable prop reset action".

Page 2, "Failure Due to Mispositioning of Prop Pin"; Replace "Mispositioning of the Prop Pin" with "Unreliable Prop Reset Action".

Page 3, "Discussion"; Replace the first two sentences of the second paragraph (beginning with, "Through the use.." and ending with, "... closed position") with the following.

The licensee and GE have jointly utilized high-speed digital video equipment and learned 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/rebound. Also that 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 and the breaker will fail to latch if the prop does not have sufficient time to recover and reset to a position under the pin before the pin falls.

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Page 3, "Discussion"; Third paragraph, revise the breaker model numbers as follows; 4.16-250-8HB, -9HB, 13.8-750-5HB, -6HB, and 13.8-1000-3H, 4H.

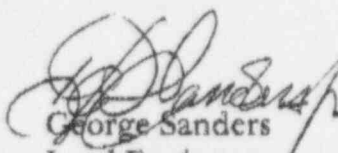
Page 3, "Discussion"; Revise the first sentence of the fourth paragraph as follows. "The Salem licensee concluded that the following symptoms are indicative of the conditions present during the high speed prop reset action that could result in failure of the breaker to latch closed.

Page 3, "Discussion"; Revise the last sentence of the fourth paragraph to read, "There is unequal prop wipe, indicating prop or prop pin twist".

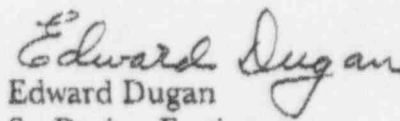
Page 4, "Discussion"; Revise the last paragraph to replace "GE Specialty Breaker" with "GE Philadelphia Operations"

Page 4, "Discussion"; Revise the last sentence to add that GE will issue a SAL on this subject when the testing is complete.

We appreciate the opportunity to provide input to this notice. If you require any additional clarification please contact either of us at your convenience.



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Description of Circumstances

On June 11, 1996, at the Dresden Nuclear Power Station, Unit 3, a 4.16-kV GE Magne-Blast power supply breaker associated with a low pressure coolant injection loop failed to open on demand from the control room following a surveillance run of the pump. Examination of the failed breaker indicated hardened grease in the breaker trip latch roller bearing.

In subsequent testing of four similar spare breakers, all tripped at required low voltage conditions, but 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.

The licensee identified 23 safety-related breakers on Unit 3 as susceptible to this failure mechanism. On June 20, 1996 the Dresden licensee initiated a shutdown of Unit 3 and contracted with the vendor, GE, to completely overhaul each of these 23 breakers and the similar ones on Unit 2. During bench testing of breakers pulled out of 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. Only one of the three failed bearings to date have shown the presence of fiber particles possibly from associated Tuf-Loc Teflon bushings.

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Discussion

In 1989, the NRC Maintenance Team Inspection at Dresden identified a lack of lubrication of these same breakers. At that time, the licensee instituted a preventive maintenance program as a correction measure. Recent resident inspector review of that program indicates that the Dresden licensee had not fully incorporated vendor (GE) recommendations.

The GE vendor manuals (GEK-7320F and GEI-88771D) and GE Safety Advisory Letter (SAL) 354.1, dated August 25, 1995, on Magne-Blast circuit breakers recommends that these circuit breakers be lubricated once every two years. The licensee, however, had been using a 6-year maintenance period and had not maintained the failed breaker for 6.5 years. The following factors may have contributed to grease aging and hardening over this protracted maintenance period: (1) An aerosol degreaser was used in maintenance in 1989; (2) During the 1989 maintenance, application of a light coating of grease (not required by the vendor) to external surfaces precluded lubrication with light weight oil possibly preventing the oil from reaching internal bearing surfaces and refreshing the grease; (3) Heaters were installed within some of the breaker cubicles as original equipment, and (4) presence of fibrous material in the one affected bearing.

Post-It™ brand fax transmittal memo 7671		# of pages >
To: John Slamy	From: Bob Rybak	
Co. NRC	Co. ComEd	
Dept.	Phone #	
Fax # 301-415-3861	Fax #	

Dr. Vernon

The corrections in this copy
reflect those suggested by Salem, Alexander the Great and me.
I would like to reward (4) on page 2 of 5

Mon 22 Jul 96 0930

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

July xx, 1996

NRC INFORMATION NOTICE 96-XX: 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 (IN) to alert addressees to recent failures of General Electric (GE) ~~medium-voltage~~ Magne-Blast circuit breakers caused by hardened grease at the Dresden Nuclear Power Station, Unit 3, and by failing to latch closed at the Salem Nuclear Generating Station at the Maine Yankee Atomic Power Plant. The NRC staff is preparing a separate IN to discuss failures related to refurbishment practices, including recently discovered broken lock washers from hydrogen embrittlement 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 IN are not NRC requirements; therefore, no specific action or written response is required.

Failure due to Hardened Grease

Description of Circumstances

On June 11, 1996, at the Dresden Nuclear Power Station, Unit 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.

In subsequent testing, two similar spare breakers exhibited indications of hardened grease. In one, which had a high number of cycles, hardened grease was observed on the trip latch roller bearing, making the mechanism stiff to operate and unreliable. In the other, the latch mechanism moved freely but fibrous material from an adjacent bushing was observed in the bearing grease. *After* ~~From its subsequent root cause~~ investigation, the licensee concluded that the hardening of grease in the trip latch roller bearing was the most likely cause of the failure but did not believe that the grease hardening was caused by the fibrous material.

The licensee identified several safety-related breakers in Unit 3 as susceptible to this failure mechanism because of infrequent operations since the last

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overhaul. On June 20, 1996, the licensee initiated a shutdown of ~~Unit 3~~ ^{Dresden 3} and contracted with GE Nuclear Energy to completely overhaul each of the suspected breakers and similar ones in ~~Unit 2~~ ^{Dresden 2}.

Discussion

In 1989, during the NRC maintenance team inspection at Dresden, the team found that these same breakers were not adequately lubricated. The licensee instituted a preventive maintenance program as a corrective measure. NRC review of that program showed that the licensee had not fully implemented recommendations of the manufacturer, GE Specialty Breaker Plant (SBP).

The GE ~~manufacture~~ ^{SBP} instruction booklet applicable to the horizontal-drawout Magne-Blast circuit breakers used at Dresden (GEI-88771D), a similar booklet applicable to vertical drawout breakers used elsewhere (GEK-7320F), and GE Service Advice Letter (SAL) 374.1, dated August 25, 1995, ~~on Magne-Blast circuit breakers~~ ^{by} recommend that these breakers be lubricated once every 2 years. The licensee, however, had been using a 6-year maintenance period and had not maintained 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 a degreaser used during maintenance in 1989, (2) contamination of grease by an additive in lubricating oil also used, (3) premature aging of grease from cubicle heaters, and (4) ~~incompatible mixing of grease used in subsequent maintenance with the lithium-based grease (no longer used) originally packed in the trip latch roller bearing~~ ^{with grease used in subsequent relubrications without removing old grease}.

Failure to Latch Closed

Description of Circumstances

~~On June 11, 1996, at the Dresden Nuclear Power Station, Unit 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~~
On January 5, 1996, at the Salem Nuclear Generating Station, 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 ~~root cause~~ investigation, the breaker failed to latch closed on the seventh attempt after successfully closing six times.

with the breaker in test position,

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 the ~~Maine Yankee Atomic Power Plant~~, 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 IN 94-54, the NRC staff alerted licensees to failures of Magne-Blast breakers to latch closed and discussed the recommendation (GE SBP 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 reset spring.

Through the use of high-speed digital video equipment at Salem, GE has learned that the failure occurs when the prop pin fails to achieve the required position above the prop and causes the prop to hit the prop pin. Such impact causes the prop to bounce back, allowing the prop pin to miss the prop; in this way the breaker fails to latch in the closed position. The impact also may cause the tips of the prop to become chipped and flattened. *or* In agreement with GE SBP, the 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) ~~misadjustment of the opening springs~~. The cause of any particular failure to latch may have to be determined on an individual basis. *required opening spring adjustment*

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

The Salem licensee concluded that the following conditions indicate that a breaker is likely to fail to latch closed:

- The prop stop pin is not in the fully forward position in the inspection window when the breaker is closed.
- The ~~leading~~ 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 twist.

In agreement with GE SBP, 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.

The GE SBP 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. GE SBP plans to issue an SAL on this subject.

Related Generic Communications

1. Information Notice 95-22, "Hardened or Contaminated Lubricants Cause Metal-Clad Circuit Breaker Failure," April 21, 1995
2. Information Notice 94-54, "Failures of General Electric Magne-Blast Circuit Breakers To Latch Closed," August 1, 1994
3. Information Notice 94-02, "Inoperability of General Electric Magne-Blast Breaker Because of Misalignment of Close-Latch Spring," January 7, 1994
4. Information Notice 93-31, "Misadjustment Between General Electric 4.16-KV Circuit Breakers and Their Associated Cubicles," December 3, 1993
5. Information Notice 93-26, "Grease Solidification Causes Molded Case Circuit Breaker Failure To Close," April 7, 1993
6. Information Notice 90-41, "Potential Failure of General Electric Magne-Blast Circuit Breakers and AK Circuit Breakers," June 12, 1990
7. Information Notice 84-29, "General Electric Magne-Blast Circuit Breaker Problems," April 17, 1984
8. Bulletin 74-09, "Deficiency in General Electric Model 4KV Magne-Blast Breakers," August 6, 1974

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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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Attachment: List of Recently Issued NRC Information Notices

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Attachment: List of Recently Issued NRC Information Notices

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NAME	VHodge	JCalvo	RGallo	BGrimes
DATE	07/ /96	07/ /96	07/ /96	07/ /96

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