

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

September 16, 1991.

NRC INFORMATION NOTICE 91-55: FAILURES CAUSED BY AN IMPROPERLY ADJUSTED
TEST LINK IN 4.16 KV GENERAL ELECTRIC
SWITCHGEAR

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 a problem that could result from the use of an improperly adjusted test link in vertical-lift switchgear manufactured by the General Electric Company (GE). It is expected that recipients will review this information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On September 24, 1990, during an emergency diesel generator (EDG) surveillance test, the load shedding and emergency load sequencing (LSELS) logic failed to sequence the loads at the Callaway Plant Unit 1 because the LSELS logic did not receive the required permissive signal from a GE air-magnetic 4.16 kV EDG output circuit breaker. The licensee determined that the LSELS logic did not receive the permissive signal because the interlock clip on the breaker was bent and could not push the operating rod of the cell-mounted auxiliary switch far enough to actuate it. The licensee examined 34 similar breakers installed in safety-related applications at Callaway and determined that the clips on 32 of them had been deformed. The clips on two spare breakers were not bent because they had not been used.

Discussion

The permissive signal for the LSELS logic should have come from contacts in the auxiliary switch in the EDG output circuit breaker cubicle (cell), indicating that the breaker was in the cell and in the closed position. However, this signal was not received because the contacts in the auxiliary switch did not change state even though the breaker was correctly inserted into the cell and was in the closed position. During subsequent troubleshooting, the licensee observed that the switch contacts failed to change state because the breaker's interlock clip was bent.

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updated on 9/30/91


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The bent clip was unable to transmit sufficient motion to the plunger bolt and push the operating rod of the switch far enough to change the state of the contacts. The licensee determined that the clip deformed because an improperly adjusted test link was used previously during the operation of the breaker in the test position. The improperly adjusted test link had insufficient clearance between its top and the bottom of the auxiliary switch housing. As a result, the plunger did not travel the designed distance and the top of the test link struck the switch housing and exerted an excessive force on the plunger mechanism and bent the interlock clip.

GE's evaluation of this deviation concluded that this problem could only exist where users have optional cell-mounted auxiliary switches and an improperly adjusted test link. Although GE concluded that the test link was a maintenance tool which did not directly perform a safety-related function, they also concluded that the original design of the test link, coupled with less than optimum maintenance practices, could result in bent interlock clips. This damage could degrade the safety-related function of the auxiliary switch. As corrective action, GE has developed a modified test link which should prevent recurrence of this maintenance problem. Addressees may wish to contact GE directly for further information concerning the modified test link.

Attachment 1 describes how the test link interacts with other components to actuate the auxiliary switch with the breaker placed in the test position. This attachment also includes sketches which illustrate the orientation of the auxiliary switch and the plunger and illustrate the modified test link.

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


Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical contact: Kamal R. Naidu, NRR
(301) 492-0980

Attachments:

1. Operation of Test Links used in 4.16 kV GE Circuit Breakers
2. List of Recently Issued NRC Information Notices

OPERATION OF TEST LINKS USED IN 4.16 KV GE CIRCUIT
BREAKERS

Description of Switchgear

A typical General Electric Company (GE) vertical-lift air-magnetic series (4.16, 7.2 or 13.8 kV) switchgear unit consists of a stationary cell and a withdrawable (drawout) cubicle containing the circuit breaker. The line and load side (bus or cable) terminations are connected to female receptacles in the stationary cell. These female receptacles mate with the male primary "stabs" of the breaker when the drawout cubicle is inserted into the stationary cell and the breaker is mechanically lifted into position. The stabs are the primary disconnects. The switchgear design permits the breaker and its drawout cubicle to be withdrawn from the stationary cell to an intermediate "test position" from which the breaker can be operated without being connected to the bus and unnecessarily operating other safety-related switchgear.

Operation of the Test Link

When the breaker is fully inserted in the cell and lifted vertically into the operating position, an interlock clip contacts a plunger bolt through a cam. When the breaker is being closed, the clip, which is bolted to the breaker crank-shaft, rotates, pushing the plunger upward by moving the cam. The plunger bolt pushes the operating rod of the cell-mounted auxiliary switch vertically to change the state of its contacts. After the circuit breaker is placed in the test position, a test link is inserted between the plunger bolt and the operating rod to bridge the gap between them to actuate the switch when the breaker is closed. The length of the test link has to be properly adjusted so that the depth that the rod is inserted into a recess in the test link provides the correct clearance between the top of the link and the bottom of the switch housing. A test link is improperly adjusted when this clearance is insufficient to permit the plunger to travel its designed distance and causes the top of the test link to strike the switch housing before the plunger completes its travel. In striking the switch housing, the link exerts an excessive force on the plunger mechanism and bends the interlock clip. Page 3 of attachment 1 includes an illustration of the orientation of an interlock clip in relation to the breaker in the operating and test positions with the existing test link.

Page 4 of attachment 1 includes an illustration of the new modified test link. The test link is installed by sliding the open-ended slot "A" over the brass bushing "B" on the switch housing and then lowering the socket at the bottom end of the link onto the top of the plunger "D." The length of the test link can be adjusted by rotating the hexagonal nut "E" so that there is a 1/16-inch gap between the top surface "G" of the test link and the bottom of the rod "F." If the test link is improperly adjusted (allowing an insufficient gap) the clip can be bent.

When the circuit breaker operates from the "open" to the "closed" position, the test link will move the operating rod approximately 15/16 inch vertically and actuate the switch. When the breaker moves from the "closed" to the "open" position, the operating rod will drop down 15/16 inch vertically, and both the test link and the plunger will drop down 1 inch (15/16 plus 1/16) through the return springs. However, a deformed clip cannot reliably transmit the required 15/16-inch vertical motion to the plunger to operate the switch during normal breaker operation (or during subsequent tests with the link installed). Note in the plan view of page 4 of attachment 1, that while the slot in the operator engages the brass bushing, the test link keeper "K" engages the side of the housing. In this position, the test link is secure, and testing may proceed.

Improper Compensation for Deformed Interlock Clips

Unaware that the clips have been deformed by operating the circuit breaker in the test position with an improperly adjusted test link, operators may add washers to the plunger to restore the correct gap between the plunger and the operating rod. If enough washers are placed on the plunger, a bent interlock clip can remain undetected because it then may not prevent the breaker from operating the switch in the test or operating positions. However, adding washers to the plunger is intended to be only a minor adjustment and not to compensate for a bent clip; such compensation is unreliable and not recommended.

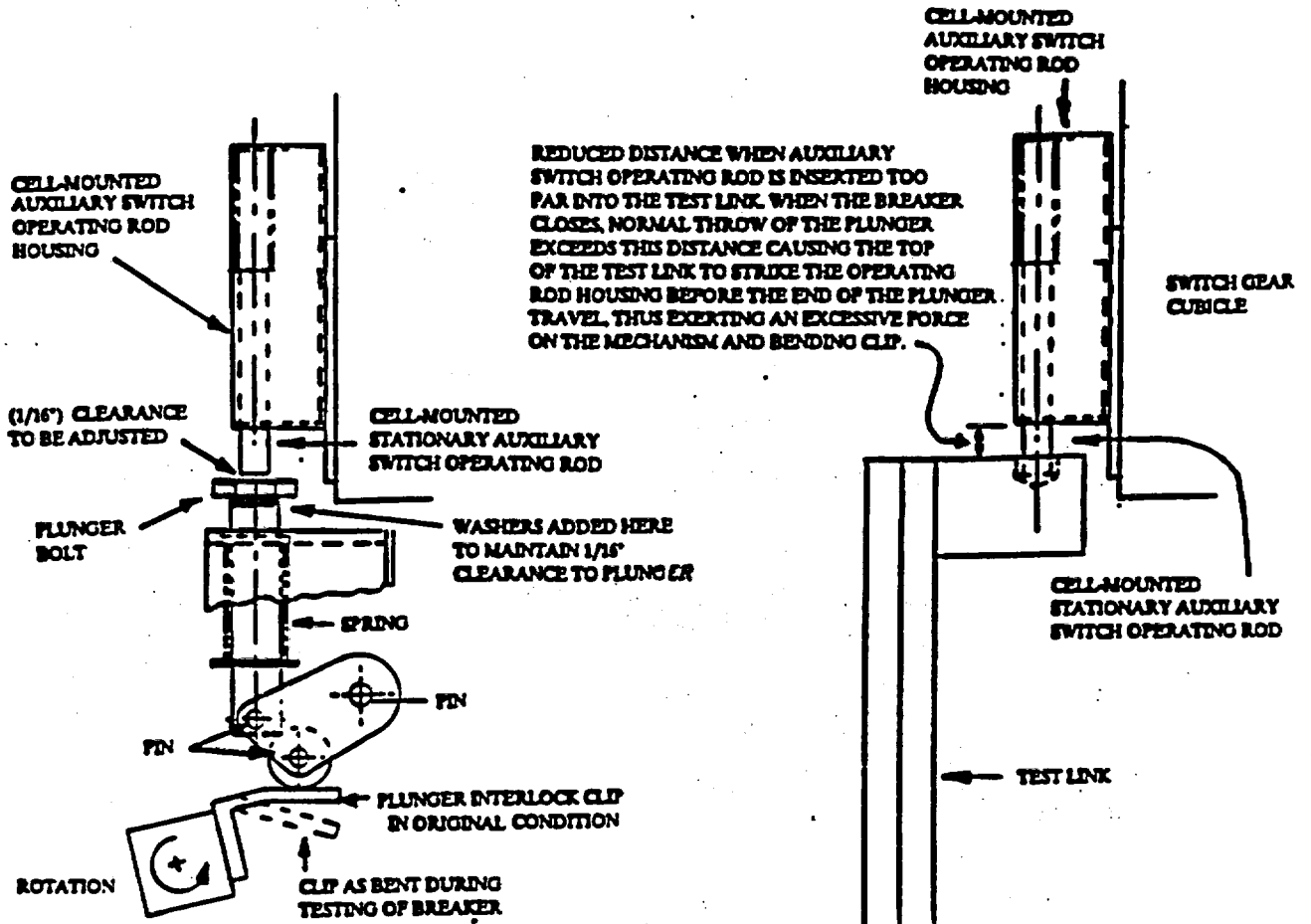
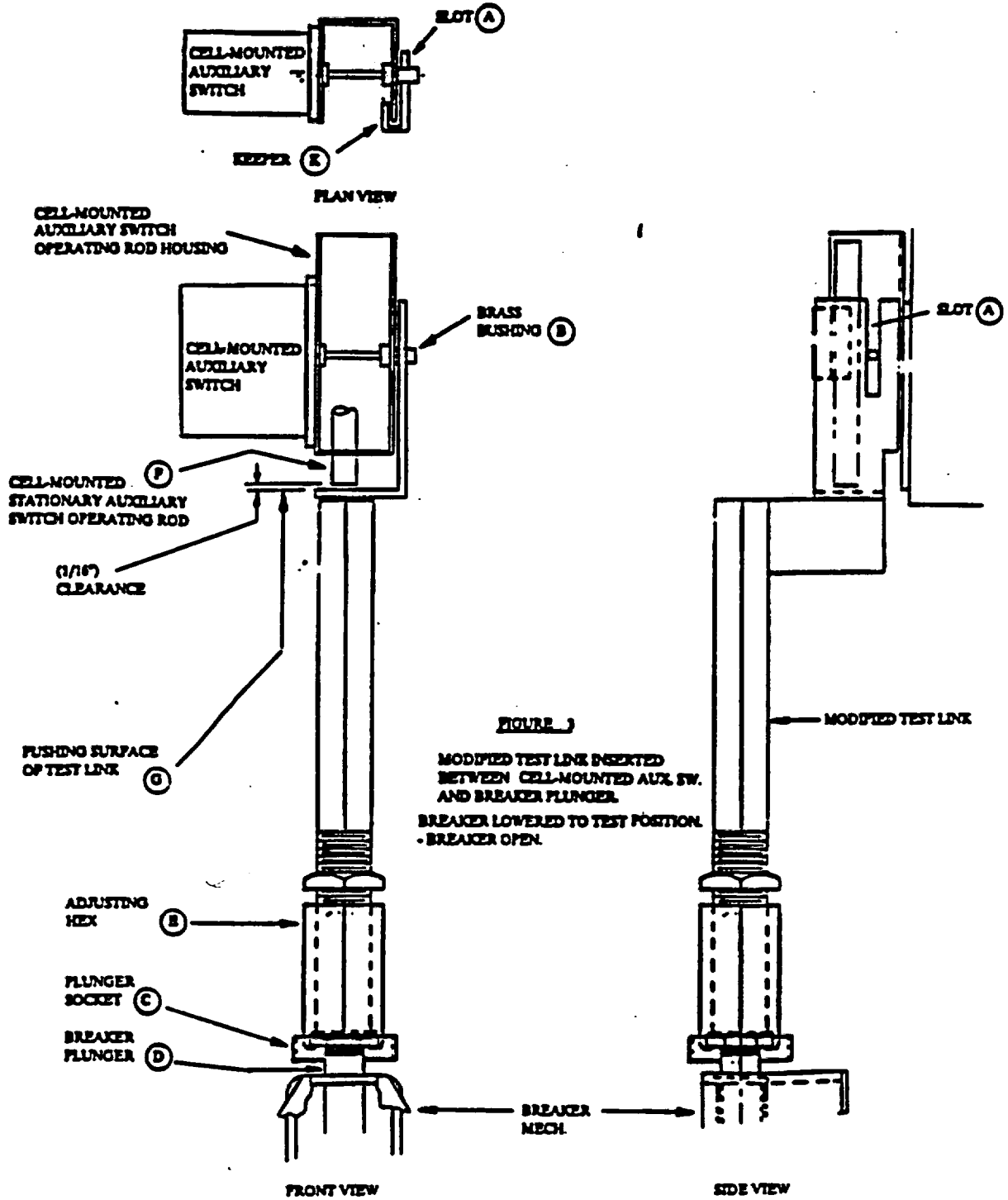


FIGURE 1
 ORIENTATION OF THE CELL-MOUNTED AUXILIARY SWITCH AND THE FLUNGER INTERLOCK CLIP WITH THE CIRCUIT BREAKER IN THE OPERATING POSITION.

FIGURE 2
 ORIENTATION OF THE CELL-MOUNTED AUXILIARY SWITCH AND THE FLUNGER INTERLOCK CLIP WITH THE CIRCUIT BREAKER IN THE TEST POSITION.



FOR INFORMATION PURPOSES



LIST OF RECENTLY ISSUED
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
85-18, Supp. 1	Failures of Undervoltage Output Circuit Boards In the Westinghouse-Designed Solid State Protection System	09/10/91	All holders of OLs or CPs for Westinghouse (W)-designed nuclear power reactors.
91-54	Foreign Experience Regarding Boron Dilution	09/06/91	All holders of OLs or CPs for pressurized water reactors (PWRs).
89-90, Supp. 2	Pressurizer Safety Valve Lift Setpoint Shift	09/05/91	All holders of OLs or CPs for nuclear power reactors.
91-53	Failure of Remote Shutdown System Instrumentation Because of Incorrectly Installed Components	09/04/91	All holders of OLs or CPs for nuclear power reactors.
91-52	Nonconservative Errors In Overtemperature Delta-Temperature (OTΔT) Setpoint Caused by Improper Gain Settings	08/29/91	All holders of OLs or CPs for Westinghouse (W)-designed nuclear power reactors.
86-14, Supp. 2	Overspeed Trips of AFW, HPCI and RCIC Turbines	08/26/91	All holders of OLs or CPs for nuclear power reactors.
91-51	Inadequate Fuse Control Programs	08/20/91	All holders of OLs or CPs for nuclear power reactors.
91-50	A Review of Water Hammer Events After 1985	08/20/91	All holders of OLs or CPs for nuclear power reactors.
91-49	Enforcement of Safety Requirements for Radiographers	08/15/91	All Nuclear Regulatory Commission (NRC) licensees authorized to use sealed sources for industrial radiography.

OL = Operating License
 CP = Construction Permit

The bent clip was unable to transmit sufficient motion to the plunger bolt and push the operating rod of the switch far enough to change the state of the contacts. The licensee determined that the clip deformed because an improperly adjusted test link was used previously during the operation of the breaker in the test position. The improperly adjusted test link had insufficient clearance between its top and the bottom of the auxiliary switch housing. As a result, the plunger did not travel the designed distance and the top of the test link struck the switch housing and exerted an excessive force on the plunger mechanism and bent the interlock clip.

GE's evaluation of this deviation concluded that this problem could only exist where users have optional cell-mounted auxiliary switches and an improperly adjusted test link. Although GE concluded that the test link was a maintenance tool which did not directly perform a safety-related function, they also concluded that the original design of the test link, coupled with less than optimum maintenance practices, could result in bent interlock clips. This damage could degrade the safety-related function of the auxiliary switch. As corrective action, GE has developed a modified test link which should prevent recurrence of this maintenance problem. Addressees may wish to contact GE directly for further information concerning the modified test link.

Attachment 1 describes how the test link interacts with other components to actuate the auxiliary switch with the breaker placed in the test position. This attachment also includes sketches which illustrate the orientation of the auxiliary switch and the plunger and illustrate the modified test link.

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Original Signed by
Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical contact: Kamal R. Naidu, NRR
(301) 492-0980

Attachments:

1. Operation of Test Links used in 4.16 kV GE Circuit Breakers
2. List of Recently Issued NRC Information Notices

* SEE PREVIOUS CONCURRENCES

OFC	: VIB:RIS-2:	VIB:RIS-2	:VIB:DRIS	:TECH EDITOR:	C/SELB:DST:NRR:	
NAME	: KNaidu	: CVanDenburgh	:LNorrholm	:JMain	:FRosa	:
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OFC	:D:DRIS/NRR:	C:OGCB:DOEA:NRR:	D/DOEA/NRR:	
NAME	:BGrimes	:CHBerlinger:db	:CERossi	:
DATE	:8/22/91*	:8/28/91*	:9/11/91	:

DOCUMENT NAME: IN 91-55

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DOCUMENT NAME: GE BREAKER TEST LINK IN

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Office of Nuclear Reactor Regulation

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(301) 492 0980~~

Attachments:

1. Vertical-Lift Switchgear Test Linkage
2. Vertical-Lift Switchgear Modified Test Linkage
3. Operation of Test Links used in 4.16 kV GE Circuit Breakers
4. List of Recently Issued NRC Information Notices

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DATE	:	8/24/81	:	8/ /91	:	8/ /91	:

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components to actuate the switch with the breaker placed in the test position.

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