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

September 4, 1996

NRC INFORMATION NOTICE 96-50: PROBLEMS WITH LEVERING-IN DEVICES IN WESTINGHOUSE CIRCUIT BREAKERS

Addresses

All holders of operating licenses and construction permits for nuclear power plants.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees that some 4.16 and 6.9 kV circuit breakers may fail to close on demand because worn levering-in devices can provide a false indication that the breaker is completely engaged onto the bus and ready to close. The problems affect all 4-15 kV range Porcel-line DHP magnetic circuit breakers manufactured by Westinghouse Electric Corporation (Westinghouse). 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

On October 19, 1995, during Refuel Outage A1R05 at Braidwood Station Unit 1, Commonwealth Edison Company (ComEd) discovered that a diesel generator output breaker (Westinghouse Model 50DHP250) failed to close on demand. ComEd determined that the levering-in device on the breaker was worn, permitting the device to "spin free" before the breaker was fully engaged.

Discussion

When installing a Model DHP breaker, a plant equipment operator first pushes it into a cell in the switchgear until the rail latch catches and stops further movement toward the rear of the cell. At this point the breaker is in the TEST position and the levering-in device is not yet engaged. By pressing down on the rail latch, the operator can push the breaker another small increment until the levering nut at the rear of the breaker contacts the levering screw in the cell. The operator then attaches a manual crank to the levering shaft at the front of the breaker and turns the crank. Turning the crank causes the levering nut to traverse the levering screw, drawing the breaker into the cell until the breaker stops moving toward the rear of the cell and the crank and levering shaft spin free, indicating that the breaker is fully engaged. Figure 5 is a schematic diagram of the levering-in device.

If the levering-in device is worn, the operator receives an erroneous indication that the breaker is fully engaged and ready to operate, when in fact the floor tripping mechanism is still engaged. The floor tripping mechanism consists of cam plates on the cell floor that lift trip levers on the underside of the breaker while the breaker is being inserted or removed from the cell. With the floor tripping mechanism engaged, the breaker will not close onto the bus. The Braidwood licensee subsequently removed the defective levering-in device and replaced it with a redesigned levering-in device.

The root cause of the failure was a worn levering shaft key and a worn and cracked guide tube. The mating surfaces between the shaft key and the guide tube were worn and permitted the levering-in device to spin free while the breaker was still about a quarter inch from being fully engaged on the bus.

An NRC search of industry data revealed that other nuclear power plants have experienced similar breaker failures because (1) a levering-in shaft was found to be worn or cracked; (2) the guide tube for the levering-in device was cracked or broken, with one of its "ears" rounded off and catching under the guide tube, causing it to bind; and (3) the key on the levering-in device was found to be rounded off because of wear.

In response to the problems seen at Braidwood, Westinghouse issued the enclosed Technical Bulletin 96-05-R0, "DHP Breakers: Levering-In Device," on June 19, 1996. The bulletin explains that the spinning free of the levering crank and observance of a small space between the face of the breaker and the steel support barrier of the breaker cubicle are not sufficient to ensure the breaker is fully engaged. The best way to check that the breaker is in the correct position is to actuate the breaker. When breaker actuation is not feasible, the Westinghouse bulletin describes a two-step process that the operator can employ to determine if the breaker is properly positioned.

An analysis of the failures seen in the industry, and discussions with operators at plants that recently experienced failures, indicate that the levering-in devices were not maintained properly. Recommended maintenance entails cleaning and removing old grease from the device components, and subsequent application of fresh Westinghouse-recommended grease. Damaged or worn parts can be detected by inspection and replaced, if necessary, during routine maintenance, but some plants do not include detailed inspection of the levering-in device in the maintenance procedure. The vendor manual does not specifically address inspection and cleaning of the levering-in device.

The Westinghouse technical bulletin recommends that the inspection and lubrication of the levering-in device be included in the maintenance procedures. The levering-in device is designed to insert and withdraw the breaker 100 times. Because nuclear plants may subject breakers to numerous levering operations during initial construction and periodic surveillance testing, the levering-in devices may require inspection and replacement during their service life in nuclear applications.

Westinghouse redesigned the levering-in device in 1982 to extend its service life. Figures 1 and 2 in the attached Westinghouse bulletin show the original and redesigned device installed in the breaker. Figure 6 is a sketch illustrating the difference in the guide tubes and levering shafts of the two designs. Interface between licensees and vendors in accordance with Generic Letter 83-28, "Required Actions Based on Generic Implications of Salem ATWS Events," issued July 8, 1983, can help ensure that information on safety-related components is complete and up to date.

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

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Kamalakar Naidu, NRR
(301) 415-2980
E-mail: krn@nrc.gov

Zelig Falevits, R-III
((718) 829-9717
E-mail: zxf@nrc.gov

David L. Skeen, NRR
(301) 415-1174
E-mail: dls@nrc.gov

Attachments: Attachment - Westinghouse Technical Bulletin 96-05-R0
Figure 5 - Schematic of Levering-in Device and Interlock
Figure 6 - Difference in Original and 1982 Redesigned Levering-in Devices
List of Recently Issued NRC Information Notices

Attachment filed in Jacket

ENERGY SYSTEMS BUSINESS UNIT

Westinghouse Technical Bulletin

An advisory notice of a recent technical development pertaining to the installation or operation of Westinghouse-supplied Nuclear Plant equipment. Recipients should evaluate the information and recommendation, and initiate action where appropriate.

P.O. BOX 355, Pittsburgh, PA 15230

Subject: DHP BREAKERS: LEVERING-IN DEVICE			Number: ESBU-TB- 96-05-R0
System(s): BALANCE OF PLANT SWITCHGEAR USING TYPE DHP MAGNETIC AIR CIRCUIT BREAKERS			Date: 06/19/96
Affected Plants: CAE, CBE, CCE, CDE, GCLN1, BDAV1, CSTL1, CSTL2, CYW, ANG, GHAT1, GHAT2, KPR, B3MI1, GSUS1, GSUS2, KRK, SCE, GCH1, GCH2, GWNP2			S.O.(s):
References: Westinghouse Instruction Books I.B. 32-253-2 and I.B. 32-253-4A & 4B, "Instructions for Procal-line Type DHP Magnetic Air Circuit Breakers"	Affects Safety: Yes ☒		Sheet: 1 of 7
	Related Equipment: No ☐		

INTRODUCTION

This technical bulletin addresses levering the DHP breaker into the OPERATE/ENGAGED position in the switchgear cell and confirming that it is properly levered into the OPERATE/ENGAGED position.

BACKGROUND

The existing instruction books, I.B.32-253-2 and I.B.32-253-4A &-4B, describe procedures for installing the breaker in the switchgear cell including all the safety precautions to be observed. This is a two step process involving moving the breaker into the TEST position then to the OPERATE/ENGAGED position.

The breaker is first pushed into the cell until the rail latch at the front of the guide channel catches in the notch in the guide rail and stops further movement of the breaker toward the rear of the cell. The breaker is now in the TEST position. At this point the levering-in device is not engaged. The secondary contacts can now be engaged for electrical testing of the breaker.

To move the breaker to the OPERATE/ENGAGED position first press down on the rail latch on the right side of the breaker and push the breaker toward the rear of the cell as far as it will go, about 1/4 inch. Be sure the breaker is pushed until it stops. This should only require a few pounds of push. This brings the levering nut on the breaker up to the screw in the cell. Engage the crank on the levering shaft, push moderately toward rear of the cell. After the breaker starts to move it is not necessary to push. Continue

Additional Information, if Required, may be Obtained from the Originator. Telephone 412- 829-3739 or (WIN) 244-3739

Originator

T. R. Critchlow
Assembly, Qualification and Test Operations

T. D. Moser, Manager
Assembly, Qualification and Test Operations

Approval

J. J. Sandrovich
Regulatory and Licensing Initiatives

cranking until the crank turns freely and the breaker stops moving. When the breaker is fully engaged the front steel barrier should be about 1/4 inch or less from the cell frame angles. This is the OPERATE/ENGAGED position. The breaker can now be closed and tripped electrically using the control switch on the cell door.

It has come to our attention that some utilities may be relying on the crank going spin free and/or the steel barrier being 1/4 inch or less from the cell frame angles as the only indication that the breaker is in the fully OPERATE/ENGAGED position rather than actually closing and tripping the breaker. These two visual indicators may not be the best means of determining that the breaker is fully engaged.

The spin free of the crank could occur prematurely if the levering-in device is worn at the mating pieces of the shaft and tube. Refer to Figures 1 & 2 for the two versions of the levering-in devices and the area of wear. The earlier version has a key welded in one side of the shaft and the later version has a pin through the shaft that protrudes on both sides. The key/pin interfaces with the slot in the tube and as the crank is turned the key/pin travels along this slot to the end of the tube. At the end of the tube the key/pin reaches the tapered part of the sleeve on the tube and no longer engages with the slot and the crank becomes spin free stopping travel of the breaker. When this area at the end of the tube and the key/pin become worn, the crank can go spin free before the breaker has traveled all the way to the proper OPERATE/ENGAGED position.

The 1/4 inch dimension between the breaker barrier and the cell frame is a reference dimension. This gap may be larger or smaller depending on how square the barrier is in relation to the circuit breaker. The gap may also vary depending on the final position of the breaker in relation to the center line of the breaker cubicle due to the offset levering-in mechanism.

Because these two initial checks may not be sufficient, without the actual testing of the breaker, Westinghouse is advising all utilities to follow the recommendations stated below.

RECOMMENDED ACTION

A. The actual operation of the breaker after it has been positioned in the OPERATE/ENGAGED position is still the best/preferred way to insure that the breaker is properly levered into this position. However, if this is not possible, a good visual check is to determine that the floor trippers are not hung up. Refer to I.B. 32-253-2, Figure 6, item 2, and I.B. 32-253-4A/4B, Figure 14 item 12 and Figure 28. The utility can accomplish this check by performing the following two steps:

   1. Lever the breaker into the TEST position. Look under the front panel to see that the levers are down at the rear. Note the relative position of the tripping and closing

linkage on the front panel (refer to Figure 3). From an operator safety standpoint when the breaker is in the TEST position the main contacts are not engaged as they remain behind an insulating shutter in the cell.

2. Lever the breaker from the TEST position to the fully OPERATE/ENGAGED position. Note the relative position of the tripping and closing linkage on the front panel. They should be in the same position noted in the TEST position. If not, remove the breaker and perform complete examination of the levering-in device and floor trippers as they may need replaced.

B. The levering-in device on the DHP breakers is designed per ANSI/IEEE standard C37.20.2 for inserting and withdrawing the breaker from the TEST to the OPERATE/ENGAGED position 100 times. Because the breakers at nuclear plants have been subjected to numerous levering operations over the constructing and testing phases of the plant, it would be prudent to include the inspection and lubrication of the levering-in device in the preventative maintenance procedures.

During preventive maintenance inspection, or when the breaker is out of the cell between maintenance intervals, the following checks should be made to insure that the levering-in device is in good working condition:

- The tube and shaft are free of cracks
- The pin or key and the mating area of the tapered part of the sleeve on the end of the tube are not worn
- The levering-in nut (refer to Figure 4) has a coating of Molykote BR2 Plus grease (Westinghouse P/N 53701QB12J)
- The threads on the levering-in nut and screw should be checked with go/no-go thread gages
- Additionally, the floor trippers should be checked to insure that they are not bent.

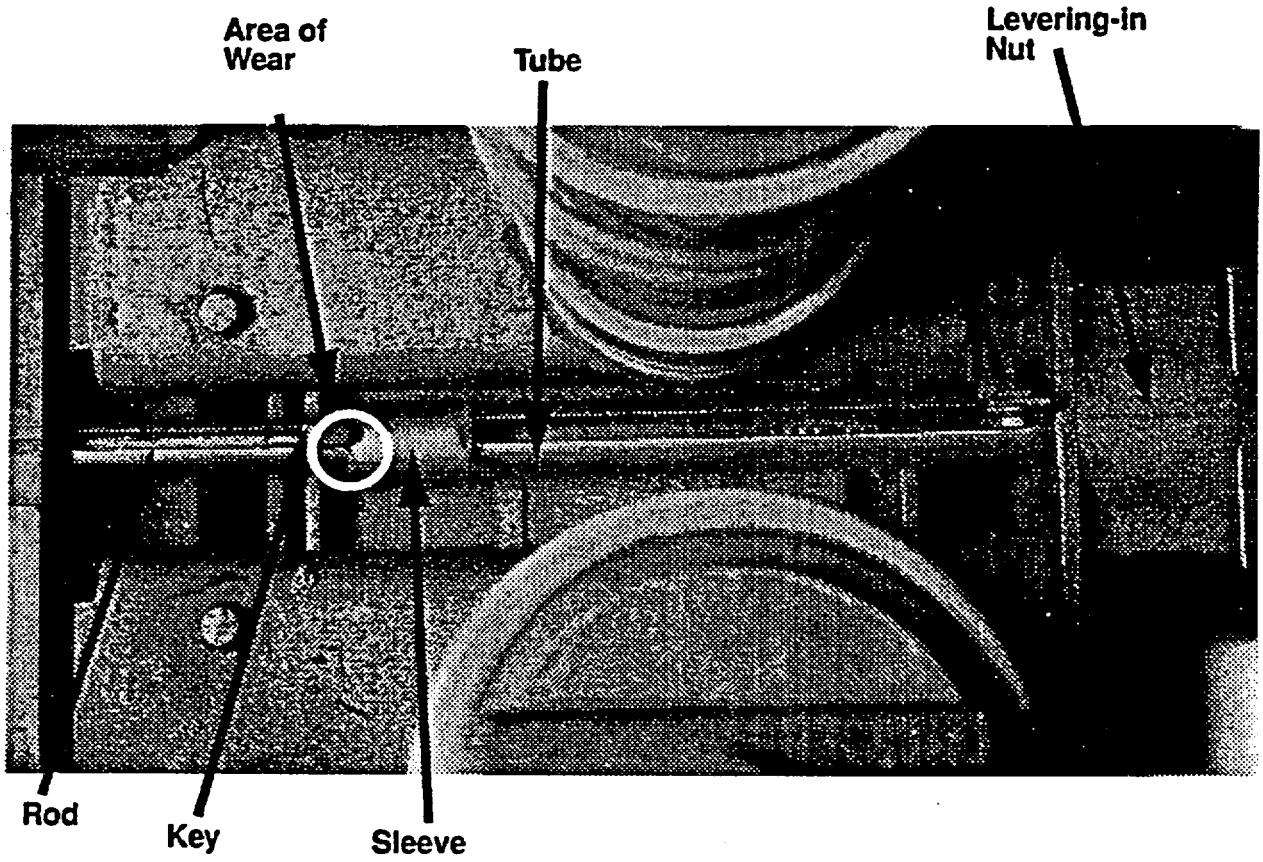


Figure 1. Levering-in Device Prior 1982

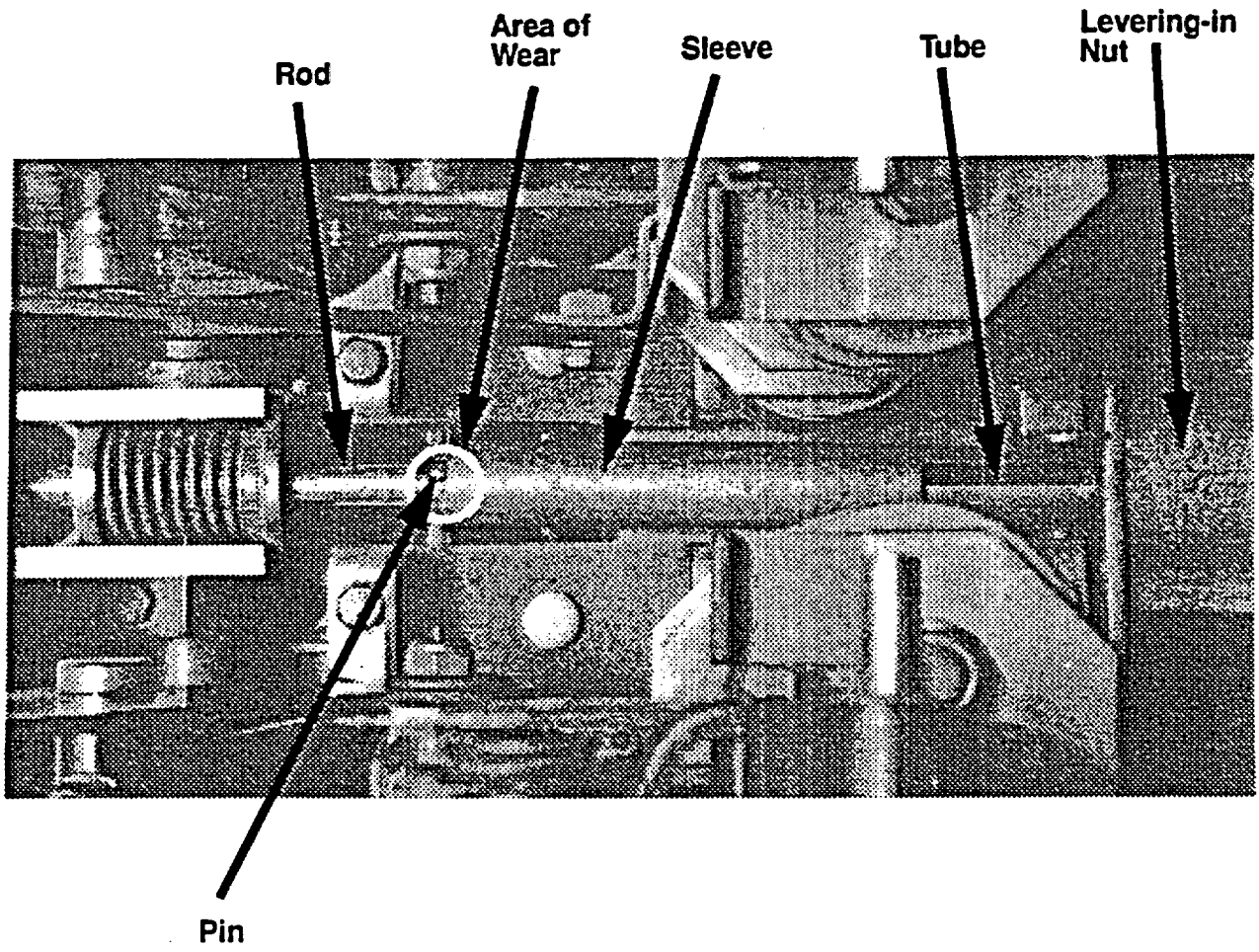


Figure 2. Levering-in Device After 1982

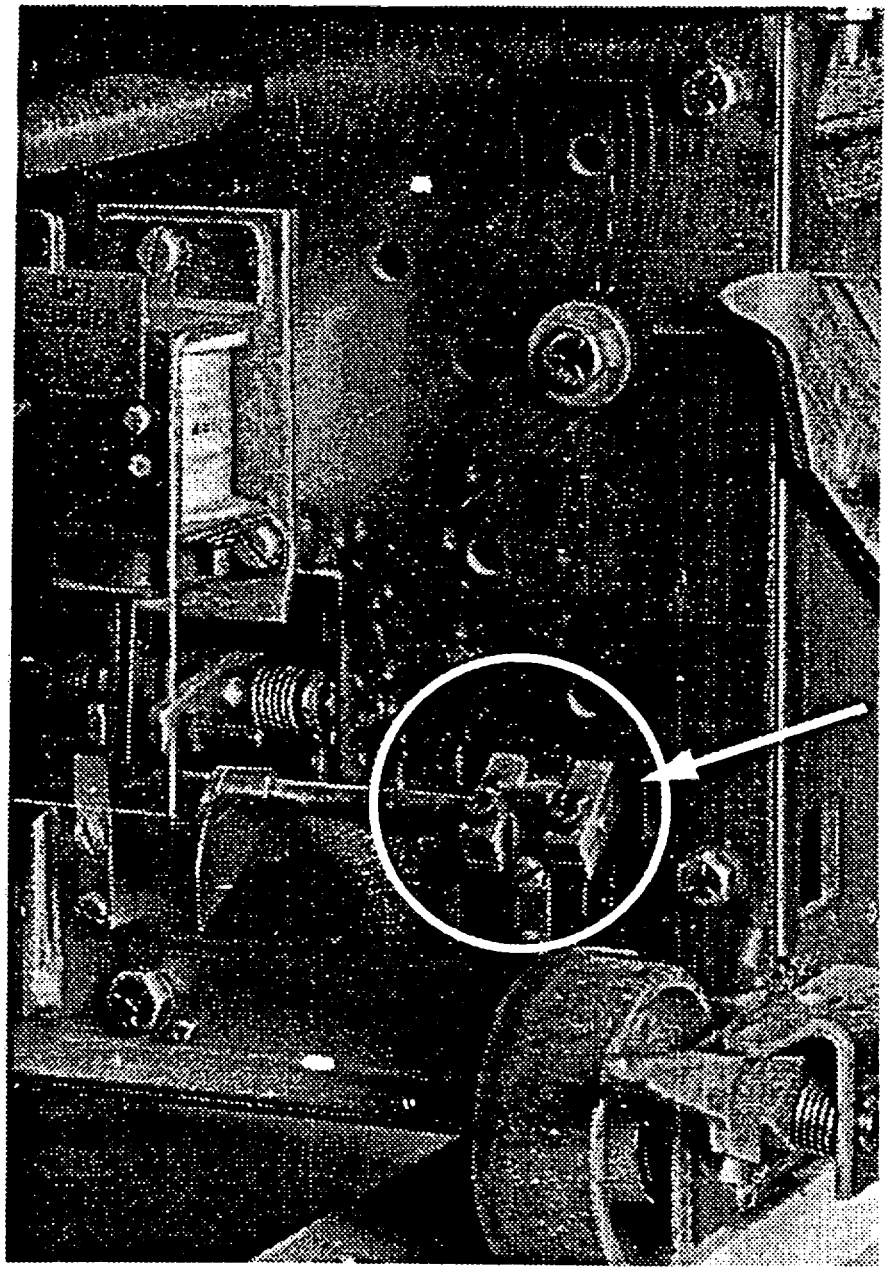


Figure 3. Breaker Front Panel

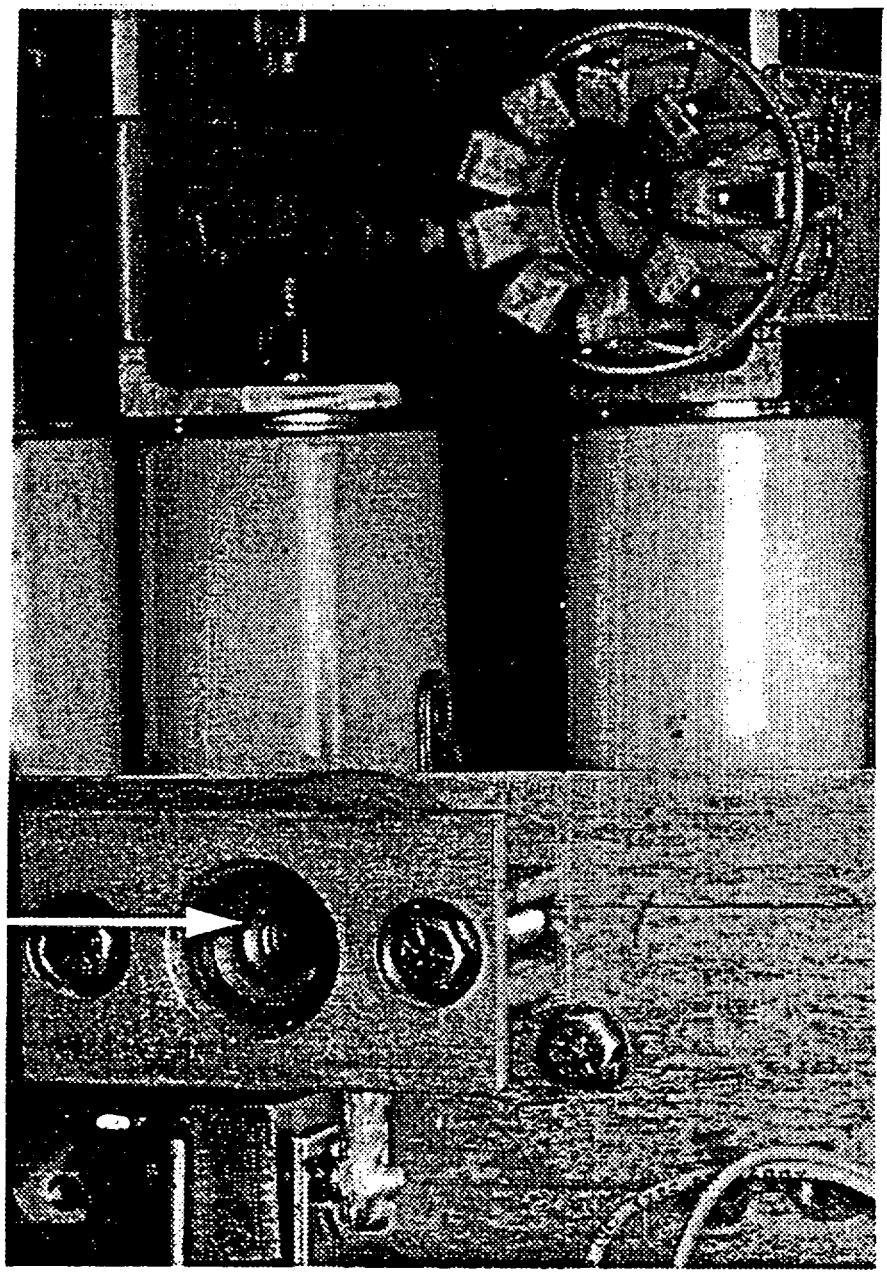


Figure 4. Breaker Rear

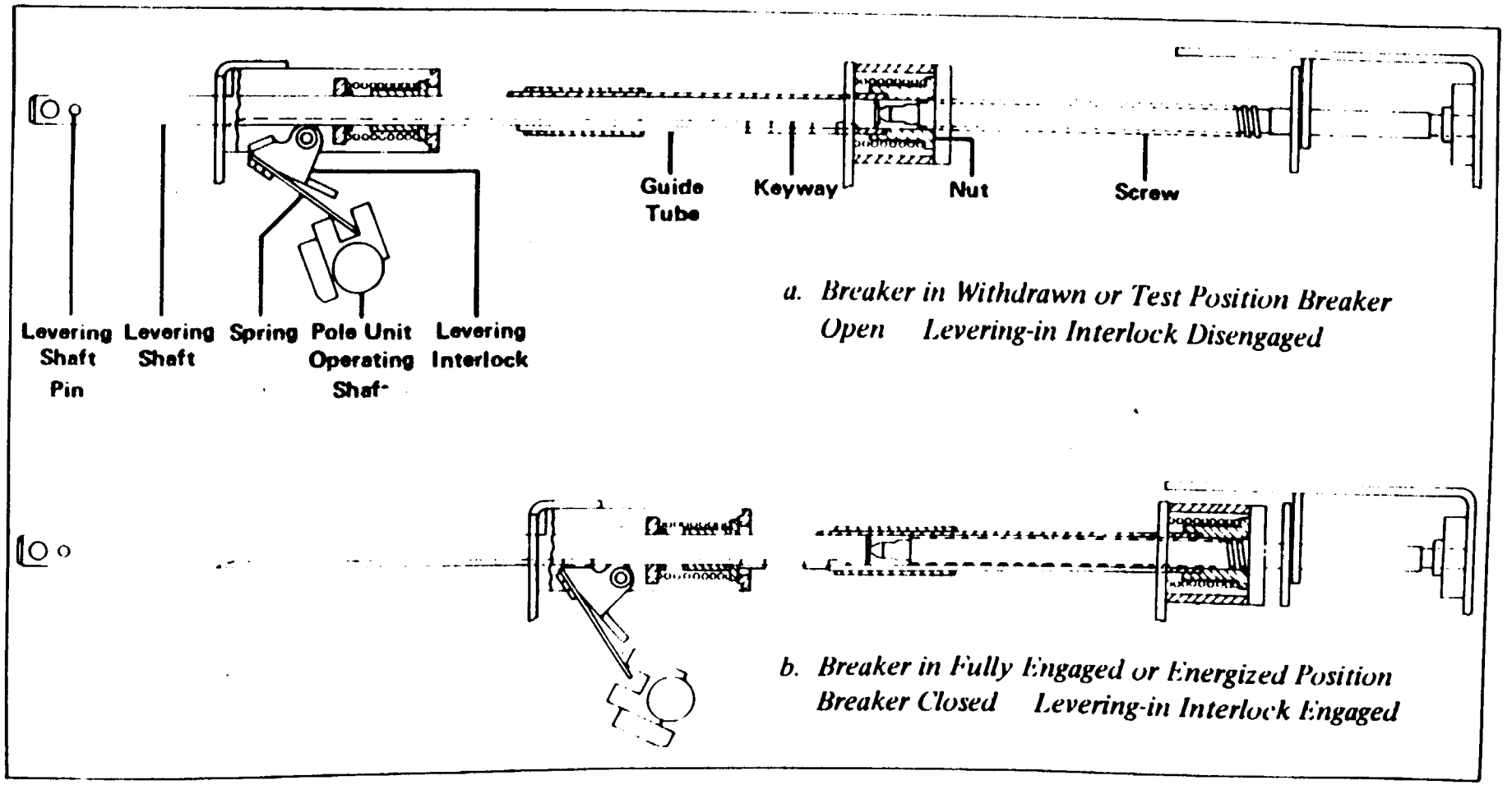
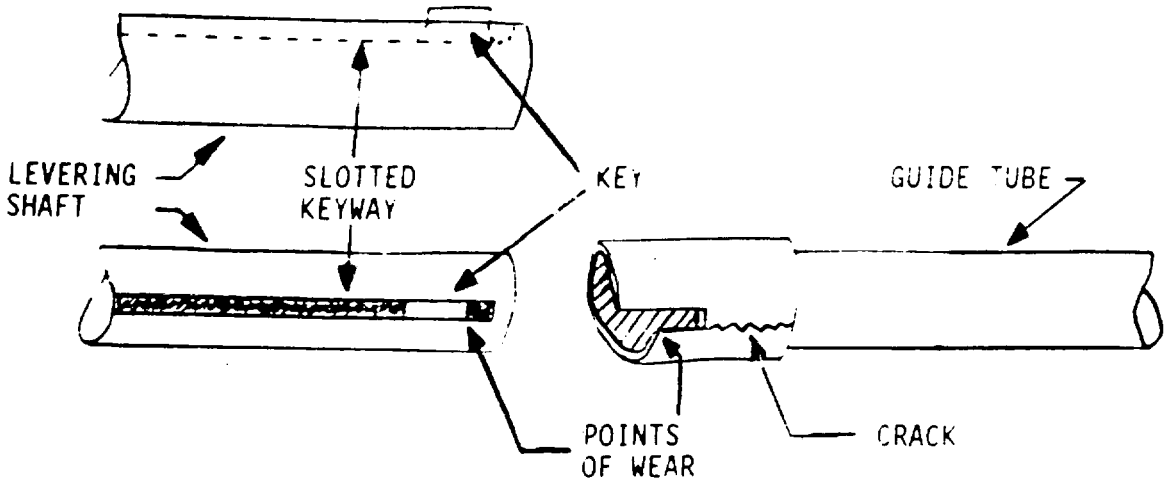
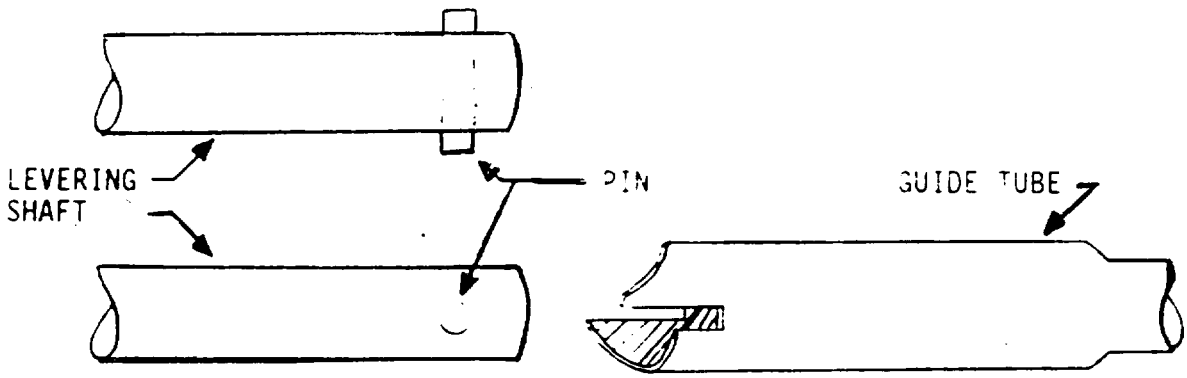


Figure 5 - Schematic of Levering-in Device and Interlock



Original Design Levering Shaft and Guide Tube



1982 Redesigned Levering Shaft and Guide Tube

Figure 6 - Difference in Original and 1982 Redesigned Levering-in Devices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
96-49	Thermally Induced pressurization of of Nuclear Power facility Piping	08/20/96	All holders of OLs or CPs for nuclear power reactors
96-48	Motor-Operated Valve Performance Issues	08/21/96	All holders of OLs or CPs for nuclear power reactors
96-47	Recordkeeping, Decommissioning Notifications for Disposals of Radioactive Waste by Land Burial Authorized Under Former 10 CFR 20.304, 20.302, and Current 20.2002	08/19/96	All U.S. Nuclear Regulatory Commission licensees
96-46	Zinc Plating of Hardened Metal Parts and Removal of Protective Coatings in Refurbished Circuit Breakers	08/12/96	All holders of OLs or CPs for nuclear power reactors
96-45	Potential Common-Mode Post-Accident Failure of Containment Coolers	8/12/96	All holders of OLs or CPs for nuclear power reactors
96-44	Failure of Reactor Trip Breaker from Cracking of Phenolic Material in secondary contact assembly	8/05/96	All holders of OLs or CPs for nuclear power reactors
96-43	Failures of General Electric Magne-Blast Circuit Breakers	08/02/96	All holders of OLs or CPs for nuclear power reactors
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

OL = Operating License
CP = Construction Permit

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original signed by

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

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(301) 415-2980
E-mail: krn@nrc.gov

Zelig Falevits, R-III
((718) 829-9717
E-mail: zxf@nrc.gov

David L. Skeen, NRR
(301) 415-1174
E-mail: dls@nrc.gov

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List of Recently Issued NRC Information Notices

*See previous concurrence

OFC	PECB:DRPM	PSIB:DISP	C/PSIB:DISP	C/PECB:DRPM
NAME	DLSkeen	KNaidu*	RGallo*	AEChaffee
DATE	8/29/96	8/22/96	8/26/96	8/27/96

OFC	D/DRPM
NAME	TTMartin
DATE	8/29/96

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ATWS Events," issued July 8, 1983, can ensure that information on safety-related components is complete and up to date.

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NAME	DLSkeen*	KNaidu*	RGallo	AEChaffee
DATE	8/22/96	8/22/96	8/26/96	8/ /96 vsb

OFC	D/DRPM
NAME	TTMartin
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