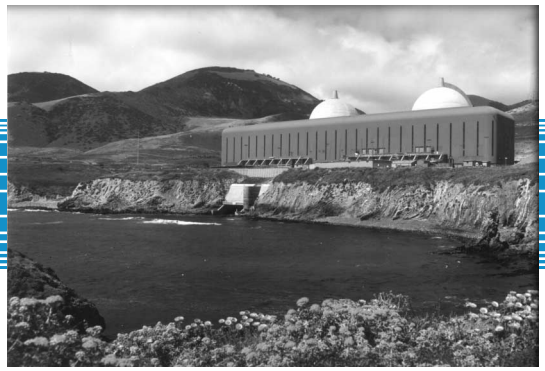
Guidance on Overhaul of Magne-Blast Circuit Breakers

Supplements and Revises NP-7410-V2P2

Technical Report



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Supplements and Revises NP-7410-V2P2

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Final Report, December 2000

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REPORT SUMMARY

This guidance provides a comprehensive list of overhaul tasks for General Electric (GE) Magne-Blast circuit breakers. In addition, it establishes a consensus among utility personnel that considers the manufacturer's recommendations and the unique application of these circuit breakers within the nuclear industry.

Background

From 1990 to 1994, the EPRI Nuclear Maintenance Applications Center (NMAC) published EPRI NP-7410, Volumes 1–3, commonly known as the Circuit Breaker Maintenance Guide series. These documents, although comprehensive, were developed by independent contractors and lacked complete participation and extensive input from utility personnel. In addition, a procedure format, which complicated application of the guidance, was followed in NP-7410. To resolve these issues, NMAC began to form circuit breaker users groups in 1994. These groups consisted of cognizant, responsible plant personnel who tasked themselves with revising the guidance found in NP-7410. In addition, the groups addressed other technical issues such as circuit breaker timing and travel analysis, reduced control voltage testing, trending, as-found testing, troubleshooting, lubrication, and receipt inspection guidance. The revised guidance developed by these users groups supplements and revises the guidance found in NP-7410.

Objectives

- To provide general guidance on overhaul maintenance for GE Magne-Blast medium voltage (600–15,000 volts) circuit breakers
- To identify and list overhaul maintenance tasks for these circuit breakers and, where appropriate, provide the purpose, justification, and description of each maintenance task
- To develop a consensus on overhaul practices among utility personnel that considers the manufacturer's recommendations and the unique application of these circuit breakers within the nuclear industry
- To develop a technical basis for proper circuit breaker overhaul, such that utilities can enhance and justify their specific site procedures or enhance their overhaul procurement specifications

Approach

A working group consisting of a subset of the nuclear power industry's Magne-Blast Circuit Breaker Users Group developed this document. The working group reviewed utility procedures and vendor manuals and obtained input from utility personnel, the manufacturer, and other organizations. After initial development, the draft was provided to the Circuit Breaker Users Group and the manufacturer for review and comment. GE participated in the development and review of this document. Guidance was developed through a collaborative industry effort with numerous utility and nonutility personnel providing their experience and knowledge.

This guidance is not a procedure and is not intended to be used as a procedure. It is intended to assist plants in determining which overhaul tasks may be considered for their maintenance program and to provide general guidance with respect to maintenance of these specific circuit breakers.

Results

This guidance identifies overhaul maintenance tasks for Magne-Blast circuit breakers. Each task attempts to clearly identify each task, the purpose of the task, the justification (or basis) for each task, and where appropriate, it provides additional description of the task. Guidance on lubrication, troubleshooting, and overhaul intervals is also provided.

EPRI Perspective

Through the development of this and similar guidance documents on other types of circuit breakers, the industry has made significant progress in addressing circuit breaker maintenance issues and improving circuit breaker maintenance. Through the development of these documents and various working group and users group meetings, utilities have increased the quantity and quality of their communication, improved maintenance procedures, and educated system engineers about circuit breaker maintenance and maintenance programs. This process has increased awareness of circuit breaker maintenance within the industry. The efforts of these users groups have also improved communication among utility personnel and their circuit breaker manufacturers and service providers.

Keywords

Circuit breaker
Maintenance
Preventive maintenance
Switchgear
Overhaul maintenance

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1
BACKGROUND

Goals and Benefits

This document provides guidance on overhaul (refurbishment) maintenance for General Electric (GE) Magne-Blast medium voltage metal-clad circuit breakers. It identifies overhaul maintenance tasks for these circuit breakers and, where appropriate, provides the task's associated purpose, justification, and description.

This guidance represents a consensus among utility personnel that considers the manufacturer's recommendations and the unique application of these circuit breakers within the nuclear industry. Guidance was developed through a collaborative industry effort with numerous utility and nonutility personnel providing their experience and knowledge.

By using overhaul maintenance guidance that contains the collective experience of the users group, utilities can establish a platform from which the entire industry can justify and improve maintenance programs for these circuit breakers. This effort was designed to develop a technical basis for proper maintenance so that utilities can enhance and justify their specific site procedures. This guidance should be used in conjunction with all relevant and applicable manufacturer's literature.

Scope

This document identifies and discusses overhaul tasks and provides guidance on selecting an appropriate overhaul interval. The following should be noted with respect to the scope of this document:

Guidance - Not a Procedure

This guidance is not a procedure and is not intended to be used as a procedure. It is intended to assist plants in determining which maintenance tasks may be considered for their maintenance program.

Detail of Task Descriptions

The level of detail for each task description is not limited and varies based on the discretion of the working group. However, the initial intent of the working group is not to provide a detailed description of each task or to provide corrective actions for all tasks if specifications are not met.

Rather, the initial intent is to identify maintenance tasks that represent a consensus of utility personnel, with input from the manufacturer and other organizations.

Future users group work may provide more detail on selected tasks, including corrective actions if specifications are not met. It is not the intent of the users group to develop the level of detail of a plant procedure.

Circuit Breaker Model Applicability

This document is applicable to both vertical lift and horizontal (AM and AMH) Magne-Blast circuit breakers with the following characteristics:

- ML-13 operating mechanism
- Nominal voltage: 4.16–13.8 kV
- Nominal MVA class: 150–1,000 MVA
- Continuous current: 1,200–3,000 amps

Approach

This guidance identifies individual Magne-Blast maintenance tasks. Manufacturer's terminology is used whenever possible. The following information is included for each maintenance task:

- Name
- Purpose
- Justification - Applicable NRC Information Notices (INs), Licensee Event Reports, CFR Part 21 Notices, Institute of Nuclear Power Operations (INPO) SERs, SENs, OEs, and SOERs, manufacturer's service advice letters (SALs) or bulletins, good industry practice, and personnel safety
- Description - Additional information to clarify the task or uniquely identify the task. If the task is complex, or there is more than one acceptable method of completing the task, or there is any confusion on the nature or intent of the task, the guidance could provide a more elaborate description of the task. If a task is performed based on the results of another test or inspection, this should be identified.

Development

This document was developed by a working group consisting of a subset of the Magne-Blast Circuit Breaker Users Group. The working group 1) reviewed utility procedures and vendor manuals and 2) obtained input from utility personnel, the manufacturer, and other organizations. After initial development, the draft was provided to the remaining users group members and the manufacturer for review and comment.

Living Document

This is intended to be a living document. The users group is tasked with providing an annual forum or mechanism to incorporate additions or changes to this guidance. It is expected that the contents will be continually reviewed by utility personnel and the Circuit Breaker Users Group.

The users group currently provides two methods for utility personnel to recommend updates or changes to this document. Changes will be approved by the entire users group prior to incorporation into the document.

Recommendations for changes to this document can be submitted to the users group via:

- Internet: *http://www.epri.com.* An EPRI ID and password are necessary to access this web page.
- Mail:

  EPRI-NMAC
  Circuit Breaker Users Groups Project Manager
  1300 W.T. Harris Blvd.
  Charlotte, NC 28262

Information Sources

The following sources of information were reviewed and considered in the development of this guidance:

- Selected procedures from the following plants:

AmerenUE	Callaway
Baltimore Gas & Electric Co.	Calvert Cliffs
Entergy Operations, Inc.	Waterford
South Texas Project Nuclear Operating Company	South Texas Project
PECO Energy Co.	Peach Bottom
TVA	Watts Bar
Vermont Yankee Nuclear Operating Company	Vermont Yankee

- Utility personnel experience
- Industry good practices
- Manufacturer instruction and maintenance manuals
- Experience of GE personnel
- NRC INs
- Licensee Event Reports
- EPRI Report NP-7410-V2P2, *Circuit Breaker Maintenance, Volume 2: Medium Voltage Circuit Breakers, Part 2: GE Magne-Blast Circuit Breakers*, August 1995.

The list of notices (documents) contained in Appendix A can be found at *http://www.epri.com*.

Manufacturer Review and Participation

GE has reviewed draft revisions of this document during its development. Future revisions, including this one, will be forwarded to GE for review and comment. GE comments will be reviewed and incorporated as deemed appropriate by the Magne-Blast Circuit Breaker Users Group.

Measurements and Clearances

The scope of this guidance includes various models and vintages of Magne-Blast circuit breakers. In some cases, measurements and clearances vary between circuit breakers. Consequently, users must verify all criteria for measurements and clearances provided in this document.

Illustrations

All illustrations are typical and may not be applicable to your circuit breaker model or vintage. Refer to the GE instruction bulletin for information unique to your circuit breaker type and vintage.

Terminology

Where possible, manufacturer's terminology is used to reduce confusion and ensure consistency. Common industry terminology is also identified when appropriate.

Task Sequence

It is not necessary to perform maintenance tasks listed in this document in sequential order. However, these tasks are presented in a reasonable sequence intended for ease of performance. Plant personnel should make reasonable attempts to avoid preconditioning of a circuit breaker prior to performing as-found maintenance tests.

Personnel Qualification and Training

INPO has published the Guidelines for Training and Qualification of Maintenance Personnel, ACAD 92-008, which provides the framework for maintenance personnel training and qualification programs at nuclear power plants. These guidelines incorporate the results of an industry-wide job and task analysis. The guidelines are intended to be used in combination with plant-specific job and task analysis to develop and revise training programs.

Utilities should use these guidelines in conjunction with plant-specific job and task analysis results when establishing, upgrading, or validating maintenance training programs.

Circuit breaker crews often consist of an experienced journeyman and an apprentice. In order to develop a training program and qualify crews, the total scope of work to be performed on-site should be defined. For the purposes of this maintenance guide, the scope of work will consist of three major areas: preventive maintenance (PM), corrective maintenance, and circuit breaker overhaul.

PM and corrective maintenance will normally be performed by an experienced journeyman and possibly by an apprentice. The maintenance apprentice should be trained on the equipment to the extent that common failure mechanisms and operating principles of the circuit breaker are readily known. For both PM and corrective maintenance, the journeyman should have specialized skills training. As a minimum, the journeyman should be able to demonstrate disassembly and assembly methods, adjustment and calibration steps, and repair and part replacement techniques. The journeyman should also be proficient with all measuring and test equipment. Maintenance personnel should be trained on proper lubrication methods.

Circuit breaker overhaul is typically performed by individuals who are considered job specialists. Overhaul is not directly addressed by the INPO training document. During the utility phone survey, the overhaul process was discussed with site personnel. Most utilities that accomplish the process on-site utilize a vendor representative, journeyman, and an apprentice. The vendor representative conducts on-the-job training and provides technical guidance as needed. Most individuals felt confident after performing three to four circuit breaker overhauls.

If a utility chooses to establish a formal training program targeted to overhauls, it is recommended that the proposed instructor work with the OEM instructor until proficiency is established.

Other EPRI Guidance on Circuit Breakers

Guidance developed by the Magne-Blast Circuit Breaker Users Group should be used in lieu of EPRI Report NP-7410-V2P2, *Circuit Breaker Maintenance, Volume 2: Medium Voltage Circuit Breakers, Part 2: GE Magne-Blast Circuit Breakers*, August 1995.

2
OVERHAUL MAINTENANCE INTERVALS (FREQUENCIES)

Users Group Guidance

It is the responsibility of each licensee (plant) to determine its own circuit breaker maintenance intervals. Furthermore, it is recommended that the justification for these intervals be documented in the plant's maintenance program.

A variety of factors should be considered when determining circuit breaker maintenance intervals (frequencies). The following section, "Factors Affecting Maintenance Intervals," lists these factors. Factors vary in importance depending on a plant's particular situation.

It is impossible to develop an overhaul maintenance interval that is applicable to all plants in all situations. When determining an overhaul maintenance interval, plant personnel should consider their particular situation and the factors listed under "Factors Affecting Maintenance Intervals."

The Magne-Blast Circuit Breaker Users Group has identified typical overhaul intervals and established some generic guidance based on these intervals. Plant personnel may wish to consider this guidance when considering industry experience for these circuit breakers. Plant personnel should use caution and analyze their specific situation rather than merely accept a manufacturer's recommendation or generic guidance provided by industry organizations. In addition, any maintenance interval that falls well outside either of these two should be reviewed for adequacy.

Considering Manufacturer's Recommendations

A common myth among industry personnel is that manufacturer's guidance, including that on maintenance intervals, must be followed without deviation. This guidance, by their own admission, represents their best generalized advice and includes assumptions about the circuit breaker's environment, lubrication, previous maintenance, and operational history. Without exception, manufacturers encourage plant personnel to identify plant-specific considerations and modify their maintenance intervals as needed. Although deviations from manufacturer's recommendations are acceptable, they should be justified—and this justification documented.

Manufacturer's Recommendations

In August 1995, GE published SAL 073-354.1, which recommends an overhaul interval of five years.

Factors Affecting Maintenance Intervals

The following factors can affect circuit breaker maintenance intervals (see Figure 2-1). Plants may wish to consider these factors in their maintenance program.

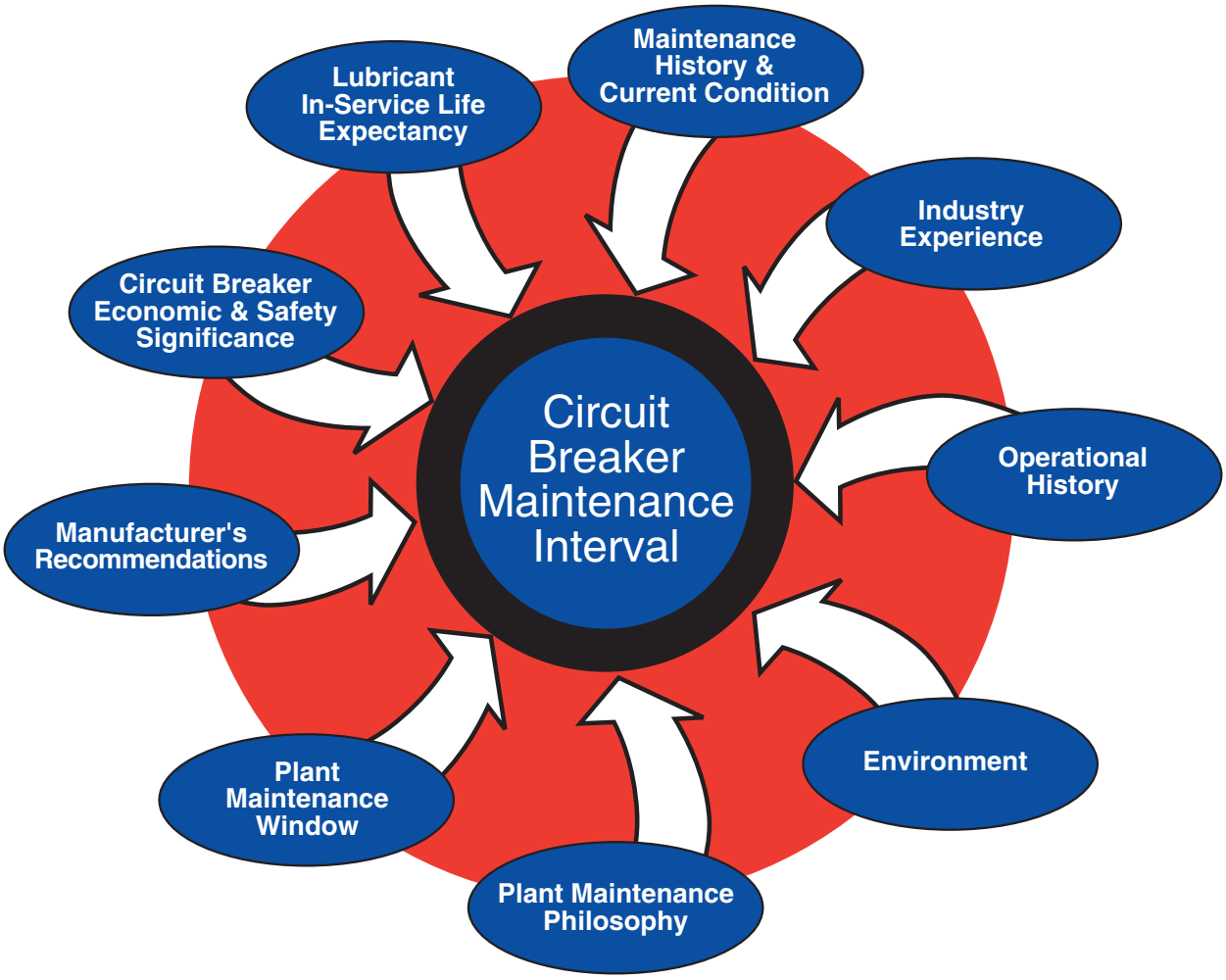


Figure 2-1
Factors Affecting Maintenance Intervals

Industry Experience

- Industry experience with maintenance of circuit breakers with similar design, age, lubrication, environment, and operation and maintenance (O&M) history

- Other significant industry experience that may be applicable or affect the maintenance interval

Lubrication

- Inservice anticipated life of the lubricant
- Actual or typical lubricant condition at your plant
- Type of lubricant used

Maintenance History

- Previous maintenance performed
- Previous lubrication practices
- Previous environmental effects
- Previous routine maintenance intervals
- Findings or deficiencies found during maintenance

Current Condition

- The current condition of circuit breakers can be evaluated to the extent possible and considered when determining maintenance intervals. This could be performed by sampling and inspecting typical circuit breakers. In addition, as-found data can be useful in determining the current condition of a circuit breaker.

Operational History

- Number of operations since the last maintenance performed
- Duty cycle (that is, rough percentage of carrying load and the percentage of circuit breaker rating this represents)
- Quantity and severity of fault interruptions or overcurrent conditions since the last maintenance interval—distinguishing between overloads (time overcurrent) and fault level currents (instantaneous operations)
- Number of clearances and associated racking-in/out (wear on main and auxiliary contact/connectors)
- Degree to which the circuit breaker is “exercised”

Circuit Breaker Significance

The importance of the breaker, which includes:

- Its safety significance (use of probabilistic risk assessment [PRA] and IPE for prioritization of circuit breakers for maintenance)
- Its commercial or economic significance

Maintenance Philosophy

- The utility's or plant's current maintenance program and philosophy

Environment

- Past and current service condition or environment

Maintenance Windows

- Availability of the circuit breaker for maintenance
- Outage (refueling) schedule
- Use of on-line maintenance
- Critical/noncritical nature of the circuit breaker (that is, LCOs and need for power production)

Manufacturer's Recommendations

- Recommendations provided by the manufacturer through manuals, letters, or bulletins

3
AS-FOUND TESTS AND INSPECTIONS

As-found data are used to document the condition of the circuit breaker prior to maintenance and to create a maintenance history in the plant records. This maintenance history can serve as input to the overall circuit breaker maintenance program. Collecting and reviewing as-found data of the aggregate circuit breaker population can be useful in adjusting maintenance intervals. As-found data also determine any degraded conditions early in the maintenance process.

Preconditioning of the circuit breaker through excessive cycling or other means may affect as-found data. Consequently, when performing as-found tests and inspections, preconditioning should be minimized as much as practical. Typical as-found inspections are performed outside the switchgear cubicles.

As-Found Visual Inspection

Purpose
Identifies any components or subcomponents that may have abnormal degradation or need additional attention during the overhaul process.

Justification
As-found visual inspection findings can be used as an input for justifying maintenance intervals.

Description
Inspect the circuit breaker for dirt, overheating, and/or corrosion, loss of zinc plating, or degradation of painted surfaces (indicated by the presence of oxidation or rust) on steel parts. Inspect the silver plating at the electrical contact areas. Inspect interphase and box barriers for burning, tracking, excessive warping, cracks, and/or separations.

Record Counter Reading (If Applicable)

Purpose
Documents the number of circuit breaker cycles if the circuit breaker has a cycle counter.

Justification
Good industry practice. Maintenance frequencies are sometimes based on the number of circuit breaker cycles.

Description
Record the circuit breaker cycles (operations) prior to any cycling of the circuit breaker.

Reduced Control Voltage Testing

Purpose
Demonstrates that the circuit breaker will perform its function (to open and close) with reduced control voltage.

Justification
Low dc voltage could occur during a plant transient. Good industry practice and recommended by the manufacturer. See EPRI TR-112814, TI 2515/137, and IN 99-13.

Description
To perform a reduced voltage test, a minimum operating control voltage is determined and applied to the circuit breaker's close and trip control circuitry. The circuit breaker is then cycled open and closed, and the circuit breaker's operation is verified. GE does not perform reduced control voltage testing unless specifically requested by the utility.

As-Found Timing Test

Purpose
Time tests the circuit breaker contacts open and closed. Timing tests indicate the condition of specific circuit breaker subcomponents.

Justification
As-found timing test results can be used to justify maintenance intervals and to determine if there are any binding problems with the mechanism. However, timing tests may be required for time response, circuit breaker coordination, or other plant requirements. See EPRI TR-112783, *Circuit Breaker Timing and Travel Analysis*, May 1999. See also OE 8070, OE 10054, IN 96-43, and SER 97-07.

Description
The closing time is the time between the initiation of an electrical close signal and the touching of the arcing contacts of the phase under test. The opening time is the time between the initiation of an electrical trip signal and the separation of the arcing contacts of the phase under test. Circuit breaker opening time helps to ensure the proper arc cessation if the circuit breaker trips on fault or opens under load. Failure to meet vendor acceptance criteria requires detailed troubleshooting. See EPRI TR-112783, *Circuit Breaker Timing and Travel Analysis*, May 1999.

This task is performed with a high-speed recorder or digital timer capable of reading 0–150 milliseconds to monitor the circuit breaker opening and closing times. Nominal voltage is used for this test. The recorder/timer should start as soon as voltage is applied to the coil and should stop when the circuit breaker arcing contacts open or close, depending on the operation being timed. The coil voltage (start circuit) can be monitored at the proper secondary coupler pins, and the main contact state (stop circuit) can be monitored at one line-and-load primary disconnect stab. GE has stated that the maximum opening (trip) times for all circuit breaker sizes is 50 milliseconds. The closing times for different circuit breaker sizes vary. Table 3-1 provides nominal closing times.

Table 3-1
Nominal Closing Times*

Close to "K" Times (Milliseconds)			
Circuit Breaker Rating	Continuous Current Rated Time (Milliseconds)		
kV–MVA	1,200	2,000	3,000
4.16–250	84	100	N/A
4.16–350	84	100	117
7.2–500	84	100	N/A
13.8–500	100	100	N/A
13.8–750	100	100	N/A
13.8–1,000	84	N/A	117
Open Times (Milliseconds)			
kV–MVA	1,200	2,000	3,000
All	50	50	50

* Courtesy of GE.

Users should contact GE for proper closing times for circuit breakers of other sizes in use at their site.

Travel/velocity testing at nominal voltage provides additional information beyond timing tests and can therefore be performed in lieu of the timing test. A travel test indicates degraded puffer tube seals and any excessive main contact rebound problems and can indicate any excessive contact bounce. GE usually performs this test whenever a circuit breaker is sent back to the OEM service shops for repairs.

Insulation Resistance Test of Primary (Current Carrying) Components

Purpose
Ensures the as-found insulation integrity of the circuit breaker.

Justification
Good industry practice and recommended by the manufacturer.

Description
Measure the insulation resistance of the following:

- Line side bushings to load side bushings with the circuit breaker in the open position
- Each phase bushing to ground with the circuit breaker in the closed position
- Phase to phase with the circuit breaker in the closed position

Appendix B contains acceptance criteria from the National Electrical Testing Association's (NETA*) Maintenance and Testing Specifications for Electrical Power Distribution Equipment and Systems* (NETA MTS-1997). This test can be performed with either an ac or dc overpotential (hi pot) test or a megger.

Contact Resistance Test

Purpose
Measures and documents the as-found contact resistance.

Justification
As-found contact resistance data can be used to justify maintenance intervals.

Description
Measure the contact resistance of each phase using a micro-ohmmeter, digital low resistance ohmmeter (DLRO), ductor, or millivolt drop test. It is important to be consistent with how and where the measurements are obtained. It is also possible to measure the resistance of the contacts or the entire primary contact circuit between the primary disconnects (stabs).

Ground Strap Resistance Check

Purpose
Measures and documents the ground strap resistance.

Justification
Ensures that the ground strap does not contain a high-resistance connection that could cause ohmic heating and damage to the circuit breaker during fault conditions.

Description
Measure the ground strap resistance of each phase using a micro-ohmmeter, DLRO, ductor, or millivolt drop test. It is important to be consistent with how and where the measurements are obtained. The users group requested acceptance criteria from GE; however, GE was unable to provide criteria before this document was published. Consult with GE for acceptance criteria.

Lubrication Condition Assessment

Purpose
Checks the condition of the lubrication in the bearings, rollers, and bushings.

Justification
Tracking the lubricant condition may be helpful in justifying the current overhaul frequency or changing the frequency at a later date. Poor lubrication condition could cause binding problems in the circuit breaker and/or the ML-13 operation mechanism that could degrade the minimum opening speed required for reliable arc interruption. See SEN 169, SER 84-48, SER 95-19, SER 97-07, OE 7874, OE 8213, OE 8796, IN 96-43, IN 95-33, IN 95-22, SAL 354.1, and LER 95-001-00.

Description
Observe and note the general condition of the lubrication. Good condition is recognized when the lubrication is visible on all wear surfaces, is of uniform color, and is still a grease consistency. Poor conditions include a dry and crusty top surface, absence of visible grease, presence of more oil than grease, and discolored grease. Manually move the following components to determine if there is any stiffness in the movement or evidence of binding (this can also be done throughout the overhaul process as subassemblies are removed and disassembled):

- Trip latch rollers (three)
- Close latch roller
- Cam follower roller (the circuit breaker must be open and discharged with the cam rotated out of the way of the cam roller)
- Three-piece collapsible mechanism (the circuit breaker must be open and discharged with the cam rotated out of the way of the cam roller)
- Trip shaft
- Trip coil armature linkage
- Close latch

4
DISASSEMBLY, CLEANING, INSPECTION, LUBRICATION, AND REASSEMBLY

General Industry Practice

General industry practice is to disassemble the circuit breaker to the subassembly level and then disassemble the subassemblies to a subcomponent level where adequate cleaning, inspection, and lubrication can be performed.

Lubrication

The GE-recommended lubricant for Magne-Blast breakers in both the electrical and mechanical areas is Mobilgrease 28. Industry experience has shown that Mobilgrease 28 is less susceptible to hardening than D50H15 (white grease) or D50H47 (black grease). GE SAL 352.1, which applies to Magne-Blast breakers manufactured after 1962, highly recommends the use of Mobilgrease 28 during the next scheduled overhaul. Another lubricant approved for use during the overhaul process is GE's molybdenum disulfide dry lubricant, applied by spraying or brushing on a thin coat. GE recommends coating the molybdenum disulfide with a light coat of Mobilgrease 28 on the following parts:

- Center cam
- Outer cam
- Ratchet teeth
- Driving pawl
- Latching pawls
- Prop

Box Barriers and Mechanism Covers

Purpose
Ensures that the box barriers and mechanism covers are not damaged or contaminated during removal and inspection.

Justification
Recommended in the GE technical manuals. The mechanism covers and box barriers provide personnel protection and are a barrier to foreign material.

Description
The box barriers provide insulation between phase and ground and phase to phase. Box barriers also provide control of combustible gases during arc interruption. Box barriers with irreparable holes and cracks should be replaced. GE part number 0172C8208G001 is a repair kit for the box barriers.

Arc Chutes

Purpose
Ensures that the arc chutes are not damaged or contaminated during removal and inspection.

Justification
Arc chute conditions can indicate possible problems within the circuit breaker or with the load. Recommended in the GE technical manuals.

Description
Tears in the plastisol insulation covering the arc chute pole pieces should be repaired, with a Solastic sealant (RTV-103). GE part number 0172C8076G001 is a repair kit for the plastisol insulation. Broken fins visible from the throat area of the arc chute indicate that replacement is necessary. Small broken fin corners at the exhaust end of the arc chute will not interfere with arc interruption and can be disregarded. Heavy contamination or fin erosion in the throat area of the arc chute should be noted: it indicates that replacement may be necessary.

Primary Bushings

Purpose
Proper cleaning, inspection, and lubrication of the primary bushings ensures proper circuit breaker operation.

Justification
Recommended by the manufacturer and in SAL 354.1.

Description
Completely clean, inspect, and lubricate the primary bushings. On vertical lift circuit breakers, the plating condition of the bushing ball ends should be inspected. For horizontal circuit breakers, the plating condition of the stationary and movable bushing ends should be inspected. All bushing surfaces should be inspected for damaged silver plating and severe gouges. Removal of the phase bushings is not recommended. The bushings have been carefully aligned with the circuit breaker frame during factory assembly. Maintain bushing-to-frame alignment to ensure proper alignment with the mating disconnect in the switchgear and the interchangeability of the breakers in the metal-clad switchgear. Ensure that the bushing ball ends have a fine coat of lubricant applied at the completion of the overhaul.

Primary Stationary Contacts

Purpose
Proper disassembly, cleaning, inspection, lubrication, and reassembly ensures proper circuit breaker operation.

Justification
Recommended by the manufacturer and in SAL 354.1.

Description
Completely disassemble, clean, inspect, lubricate, and reassemble the primary stationary contacts. The J-bar can be removed from the load side bushing. The location of the arc chute brackets should be documented for reference during reassembly. The stationary contacts may then be removed from the J-bar for maintenance. The stationary contact springs may be removed with a spring compression tool. Inspect the contact buffer blocks for damage and cracks. Clean, lubricate, and inspect the contact fingers for wear on the contact surface, and check the silver plating on the pivot point. The location of any washer/spacers should be documented for reference during reassembly.

Primary Moving Contact Assemblies

Purpose
Proper disassembly, cleaning, inspection, lubrication, and reassembly ensures proper circuit breaker operation.

Justification
Recommended by the manufacturer and in SAL 354.1. If the hinge pin lubricant is not changed, it can cause a high resistance connection or premature wear of the moving contact arms and hinge washer. See SAL 354.1, SAL 319.1, and PS 2992.

Description
Completely disassemble, clean, inspect, lubricate, and reassemble the primary moving contact assemblies. Location of any washer/spacers should be documented for reference during reassembly. Removal of the phase bushings is not recommended because the bushings have been carefully aligned with the circuit breaker frame during factory assembly. Maintain bushing-to-frame alignment to ensure proper alignment with the mating disconnect in the switchgear and the interchangeability of the breakers in the metal-clad switchgear.

Arcing Contact Visual Inspection (Stationary and Movable)

Purpose
Ensures that the arcing contact components are operating properly and have not been damaged.

Justification
Failure of the arcing contacts to operate properly can result in failure to interrupt a fault, premature primary contact wear, and severe equipment damage. See OE 6737.

Description
Proper alignment and appearance of the arcing contacts are the primary concern. Broken stationary contact pigtails or movable contact tips are indications of misalignment.

Spring Charging Motor

Purpose
Removal and limited disassembly provides a check of brushes, gearboxes, eccentric bearing (or chain drive, if installed), and lubrication. Also allows cleaning, inspection, lubrication, and assembly.

Justification
Failure of the charging motor prevents the closing springs from being charged electrically, although they could still be charged manually. Based on industry experience, the length of the charging motor mounting bolts has been changed. In addition, during the reassembly process, OE 1863, OE 8140, IN 97-08, SER 87-14, SER -97-07, LER 87-006-01, LER 88-012-00, and SAL 352.1 (#12) should be considered when addressing the mounting bolts and the spring charging motor.

Description
The charging operation of the closing springs is accomplished by a high-speed gearmotor that compresses the springs through the action of an eccentric, ratchet, and pawl assembly. Particular attention should be paid to the brush holder box set screws and the brush holder caps during the inspection process.

Secondary Disconnects

Purpose
The connections should be removed, cleaned, inspected, checked for tightness, and lubricated during circuit breaker overhaul.

Justification
Cleaning the secondary disconnects minimizes heating due to high-resistance connections and maximizes control voltage available to the circuit breaker, which could be significant under reduced control voltage conditions. Recommended by GE and in OE 3436 and SIL 039.

Description
Electrical control power enters the circuit breaker at the secondary disconnects. Individual fingers can be cleaned, straightened, checked for tightness, relubricated, and have burrs removed without disturbing the overall position of the disconnect.

Spring Release Coil (Closing Coil)

Purpose
The spring release coil should be cleaned and inspected, and alignment and any electrical connections should be checked for cleanliness and/or tightness.

Justification
The coil resistance does not have to be measured if the circuit breaker successfully passes the reduced voltage tests. Checking the electrical connections is recommended by the GE technical manuals. See also OE 9970.

Description
The spring release coil releases the stored energy of the closing springs. Energizing the closing coil drives the close latch out from under the closing release roller, thereby closing the circuit breaker. With the circuit breaker in the open and discharged position, move the release coil plunger and armature; check for proper alignment.

Trip Coil

Purpose
The trip coil should be cleaned and inspected, and alignment and any electrical connections should be checked for cleanliness and/or tightness.

Justification
The coil resistance does not have to be measured if the circuit breaker successfully passes the reduced voltage tests. Checking the electrical connections is recommended by the GE technical manual. See also OE 9970.

Description
The trip coil actuates a latch that allows the collapsible linkage to collapse, subsequently tripping the circuit breaker. With the circuit breaker in the open and discharged position, move the armature and linkage and ensure that they move freely. Check that the armature is aligned with the centerline of the coil.

Anti-Pump (“Y”) Relay

Purpose
Check electrical connections for cleanliness and inspect for degradation. Pay particular attention to the installation of the leads to the coil. Check the armature for the proper clearances.

Justification
Proper operation of this relay prevents damage to the operating mechanism and load equipment. Armature binding has been reported in IN 97-08. OE 9857 reported a failure of a circuit breaker to close due to a high-resistance contact on the relay. See also LER 91-006-00.

Description
The anti-pump relay prevents the circuit breaker from continuously closing (cycling) when the circuit breaker is tripped. (This directly prevents repetitive cycling of the mechanism if a close input is applied to a trip-free condition). Ensure the tightness of all of the screw connections, and inspect for coil discoloration due to heating.

Control Wiring

Purpose
Provides a visual check of the control wiring for degradation and tightness of connections.

Justification
Specified in the GE technical manuals and considered a good industry maintenance practice. Although a control circuit insulation resistance test (megger test) is recommended for both PM and overhaul activities, it should not be performed in lieu of this visual check.

Description
Clean and inspect the control wiring for degradation and any obvious damage that might not appear during the megger test, such as broken wire strands, improper lug crimps, or degraded insulation.

Operating Mechanism

This section outlines significant tasks involved with the removal, disassembly, cleaning, inspection, lubrication, and assembly of the operating mechanism.

Closing Springs

Purpose
Removing the closing springs places the circuit breaker in a safe working condition and facilitates disassembly of the operating mechanism. The bearing blocks should be removed, cleaned, inspected, and lubricated.

Justification
Good industry practice.

Description
Removal of a circuit breaker's closing springs requires that they be either manually or electrical charged in order to capture the springs with a retaining (gag) pin (slow close device). Once captured, the springs can be safely removed.

Opening Spring(s)

Purpose
Removing the opening spring(s) places the circuit breaker in a safe working condition and facilitates disassembly of the operating mechanism.

Justification
OE 9979 describes interference of the opening springs with the positive interlock.

Description
Manually depress the open button to discharge the opening spring(s). The spring(s) can then be safely removed from the circuit breaker. OE 9979 states that a loose check nut on the opening spring assembly causes the washer under the stop plate to rotate freely, interfering with the positive interlock.

Prop Spring(s)

Purpose
Removing the prop spring(s) places the circuit breaker in a safe working condition and facilitates disassembly of the operating mechanism.

Justification
SAL 348.1 recommends that all nuclear-safety-related or critical circuit breakers be inspected as soon as possible for continued operation of the prop spring. Replacement springs should be ordered and, during scheduled maintenance, the prop spring should be replaced. This is especially critical on circuit breakers approaching 2,000 cumulative operations. SAL 351.1 recommends that a new prop spring be installed on all circuit breakers with close and latch ratings of 77 kA or above. See also SAL 352.1,OE 3578, IN 90-41, IN 94-54, SER 97-07, LER 92-002-00, LER 94-006-00, and SAL 348.1.

Description
SAL 348.1 provides a drawing for making a spring pulling tool for easy removal or installation of the prop latch springs. The prop spring is used to reset the mechanism prop to a position under the prop pin at the end of a closing operation. This locks the circuit breaker in the closed position. Some circuit breakers manufactured after approximately 1968 are equipped with a second prop spring, which increases the speed of the prop reset action.

Plunger Interlock Assembly (Vertical Lift Circuit Breakers Only)

Purpose
Remove, disassemble, clean, inspect, lubricate, and assemble.

Justification
See SAL 350.1, IN 93-91, SEN 79, SEN 76, and OE 4329.

Description
Inspect the assembly for defective or worn parts. Replace standard replacement parts, such as

cotter pins and snap rings. When cleaning, remove all residual grease. Before disassembly, note the position and quantity of all washers. Square and mark the position of the interlock assembly bracket on the main mechanism frame. In addition, note the type and orientation of the mounting hardware, and lubricate appropriate parts using Mobilgrease 28.

Main Operating Crank (Crankshaft) Assembly

Purpose
Remove, disassemble, clean, inspect, lubricate, and assemble.

Justification
SAL-352.1 (#3) describes the need to replace the cast iron square shaft bushings with newer design bushings. See SAL 354.1 for lubrication recommendations.

Description
Lubricate the square shaft bushings with Mobilgrease 28.

Positive Interlock Assembly (Vertical Only)

Purpose
Remove, disassemble, clean, inspect, lubricate, and assemble.

Justification
See SAL 354.1 for lubrication recommendations. Failure of the interlock shaft to reset could cause failure of the circuit breaker to close mechanically if the blocking cams do not rest.

Description
Lubricate the interlock shafts with Mobilgrease 28.

Three-Piece Collapsible Mechanism Assembly

Purpose
Remove, disassemble, clean, inspect, lubricate, and assemble.

Justification
Recommended in SAL 318.1A and SAL 354.1. Based on information contained in the SALs, bushings were changed to aluminum bronze, and the lubrication was changed to Mobilgrease 28. See IN 84-29 and OE 10747.

Description
Inspect for defective or worn parts and welds. Replace worn or damaged parts and standard replacement parts, such as cotter pins and snap rings. When cleaning, remove all residual grease. Carefully inspect existing (aluminum bronze) bearings to be reused. Lubricate appropriate parts using Mobilgrease 28. OE 10747 describes finding the lower link stop pin bent, causing a circuit breaker to fail to reset.

Trip Shaft Assembly

Purpose
Remove, disassemble, clean, inspect, lubricate, and assemble.

Justification
Recommended in IN 97-08, SAL 359.1, LER 88-014-01, and OE 5781. For horizontal circuit breakers, see also SAL 360.1, which describes problems with the trip shaft and manual trip lever. SAL 363.1 specifies trip shaft cotter pin installation instructions for circuit breakers with a latch checking switch. OE 10557 describes cotter pin problems on the trip shaft.

Description
Inspect for defective or worn parts. Inspect for cracked or degraded trip crank pin welds (see SAL 359.1). Replace worn or damaged parts and standard replacement parts, such as cotter pins and snap rings. When cleaning, remove all residual grease. Lubricate appropriate parts using Mobilgrease 28. Install cotter pins on the trip shaft according to SAL 363.1 if a latch checking switch is installed on the circuit breaker.

Latching Pawl Assembly

Purpose
Remove, disassemble, clean, inspect, lubricate, and assemble.

Justification
Several plants have reported routinely finding loose latching pawl spring support block bolts. A loose spring support block can cause failure of the latching pawls to operate properly and can affect the charging of the close springs. SAL 358.1 strongly recommends an upgrade to the new latching pawl pivot pin design when a circuit breaker is next scheduled for overhaul. SAL 318.2 revised the latching pawl bushings to aluminum bronze. SAL 312 and SAL 358.1 (#5) revised the latching pawl stop block. See SAL 352.1 (#1, #5, and #6) SAL 358.1, SAL 318.1A, IN 84-29, IN 96-46, IN 97-08, OE 3153, OE 7572, OE 8140, PS 6005, SEN 150, SER 97-7, SAL 312.1, and LER 86-018-00.

Description
Inspect for defective or worn parts. Replace worn or damaged parts and standard replacement parts, such as cotter pins and snap rings. When cleaning, remove all residual grease. Lubricate appropriate parts using Mobilgrease 28 or molybdenum disulfide. When reassembling, ensure that the lock washer spacer is replaced under the large retaining washer so that the pivot pin is free to rotate.

Driving Pawl Assembly

Purpose
Remove, disassemble, clean, inspect, lubricate, and assemble.

Justification
SAL 352.1 (#4) recommends an upgrade to the new driving pawl design when a circuit breaker is next scheduled for overhaul. SAL 318.1A revised the driving pawl bushing to aluminum bronze. See also IN 84-29 and LER 98-006 (for driving pawl failure).

Description
Inspect for defective or worn parts. Replace worn or damaged parts and standard replacement parts, such as cotter pins, snap rings, and safety wire. When cleaning, remove all residual grease. Lubricate appropriate parts using Mobilgrease 28 or molybdenum disulfide.

Prop and Cam Shaft Assembly

Purpose
Remove, disassemble, clean, inspect, lubricate, and assemble. Align the prop on the cam shaft during reassembly.

Justification
SAL 352.1 (#20) changed the length of the set screws used on cam shafts with double keyways. SAL 318.2 and SAL 352.1 (#2) revised the prop bushings. SAL 352.1 (#4) revised the driving crank assembly. SAL 351.1A revised the prop springs and added a bracket to the prop. OE 7571 describes cracked cam shafts. See SAL 354.1 for lubricant information; also see OE 7846, OE 10557, IN 84-29, and LER 96-009-00.

Description
The cam shaft assembly comprises the ratchet wheel, center cam, switch cam, and driving pawl assembly. Inspect for defective or worn parts and damaged prop tips and welds. Upgrade the prop bushings to aluminum bronze according to SAL 318.2. The second prop spring bracket should be added at this time or inspected if installed. The cam shaft set screw is usually damaged by the locking set screw and should be replaced. Replace other worn or damaged parts and standard replacement parts, such as cotter pins, snap rings, and safety wire. When cleaning, remove all residual grease. Carefully inspect existing bearings to be reused. Lubricate appropriate parts using Mobilgrease 28 or molybdenum disulfide.

Spring Discharge Linkage Assembly

Purpose
Remove, disassemble, clean, inspect, lubricate, and assemble.

Justification
Proper operation of the spring discharge assembly is required to protect personnel when moving circuit breakers into or out of switchgear cubicles. See SAL 311.1 and SAL 327.1. OE 10818 describes cracked roll pins on the discharge crank.

Description
Inspect for defective or worn parts, welds, and any bending of the pin that engages the cam on the cubicle. Replace worn or damaged parts and standard replacement parts, such as cotter pins

and snap rings. When cleaning, remove all residual grease. Lubricate appropriate parts using Mobilgrease 28.

Closing Latch Assembly

Purpose
Remove, disassemble, clean, inspect, lubricate, assemble, and align the closing latch.

Justification
See IN 94-02, OE 5765, OE 6698, OE 7546, and SAL 352.1 (#22), which changed the tension spring to a torsion spring.

Description
Inspect for defective or worn parts. Replace worn or damaged parts and standard replacement parts, such as cotter pins and snap rings. When cleaning, remove all residual grease. Lubricate appropriate parts using Mobilgrease 28. Align the closing latch on the shaft to avoid binding on the frame and to fully engage the closing cam roller. Carefully note the position of the stop bolt on the end of the latch assembly. If its position is disturbed, the close latch wipe may be affected.

Circuit Breaker Truck/Frame Inspection

Truck/Mechanism Frame Inspection

Purpose
Clean and inspect the circuit breaker truck and mechanism frame.

Justification
See SAL 352.1 (#1), SAL 312.1, SAL 318.1A, SAL 351.1A, OE 7128, IN 84-29, and LER 84-006-00.

Description
Check the circuit breaker frame (truck) and mechanism frame for abnormalities, rust, corrosion, and cracked welds, ground stab, and bushing. Determine whether any upgrades will be required according to SAL 352.1 (#1) and SAL 318.1A, in which bushing material is changed to aluminum bronze. SAL 312.1 revised the latching pawl stop block, and SAL 351.1A revised the prop springs. A second spring mount and prop stop should be added to the mechanism frame during this inspection. The circuit breaker wheels should also be cleaned and relubricated.

Striker Plate Weld Inspection

Purpose
Check the striker plate for deformation and/or cracked welds.

Justification
Good maintenance practice and recommended in OE 2995 and IS 842. Cracking of the striker

plate weld has been documented in SEN-53. To alert users of this condition, GE stated in SAL 325.1, “tests have proven that the deformation will not prevent the circuit breaker from closing or tripping.” However, it is recommended that the weld be checked and repaired if it is deformed or cracked. SAL-325.1 requires a continuous weld across the top of the striker plate.

Description
It is recommended that the weld be inspected and/or repaired according to SAL 325.1.

Mechanical Adjustments and Measurements

Arcing Contact Wipe

Purpose
Ensures that the arcing contacts “make” before and “break” after the main contacts.

Justification
Determines whether the arcing contacts need to be replaced. This check is specified in the GE technical manuals.

Description
Block the closing springs and slow close the circuit breaker while verifying that there is clearance between the arcing contact and the slot in the throat baffle during the stroke. Measure the gap between the stationary and movable main contacts when the movable arcing contacts just touch the stationary arcing contacts. This gap measurement represents the dimensions of the arcing contact wipe.

The acceptance criteria for the arcing contact wipe measurements and adjustments can be found in the applicable GE technical manuals.

Primary Contact Wipe

Purpose
Ensures that the main contacts have the appropriate pressure to ensure a good electrical connection.

Justification
Essential for carrying the load rating of the circuit breaker.

Description
With the circuit breaker in the open position, measure from a fixed reference point to the main stationary contacts. Close the circuit breaker and measure from the same reference point to the main stationary contacts. The difference between the two measurements is the primary contact wipe. The acceptance criteria for the primary contact wipe measurements and adjustments can be found in the applicable GE technical manuals.

Primary Contact Gap

Purpose
Ensures that the main contacts have the appropriate gap when the circuit breaker is open.

Justification
Ensures that there is no re-strike of the arc when the circuit breaker is open. This check is specified in the GE technical manuals.

Description
With the circuit breaker open, measure the distance between the moving and stationary main contacts without allowing the moving contacts to move any further toward the open position. The acceptance criteria for the primary contact gap measurements and adjustments can be found in the applicable GE technical manuals.

Trip Latch Wipe

Purpose
Measures and verifies that the trip latch has sufficient wipe to allow the circuit breaker operating mechanism to latch without tripping free.

Justification
Specified in the GE technical manuals. The interface between the trip latch and roller is critical in keeping the circuit breaker closed and allowing the circuit breaker to trip on demand. See IN 74-09, IN 96-43, SEN 142, SAL 62.1, and OE 10747.

Description
The wipe is controlled by the stop pin on the "U" link. It is not an adjustable dimension but should be checked to ensure that there is no other mechanism problem. The trip latch roller applies pressure to the trip latch when the circuit breaker is closed. If this dimension is too large, the trip coil will have to develop excessive force to move the trip shaft. If the dimension is too small, the circuit breaker may fail to close, or it may open if subjected to abnormal vibration or a seismic event.

Trip Latch Clearance

Purpose
Measures the clearance the between the trip latch and the trip latch roller with the circuit breaker in the open position and the springs charged and gagged.

Justification
While not specified in the GE technical manuals, this check and the acceptance criteria are addressed in SAL 362.1. See also OE 8070 and OE 10557.

Description
With the circuit breaker in the open position and the springs charged and gagged, measure the

clearance between the trip latch and the trip latch roller. There should be sufficient clearance to allow the latch to reset completely so that the mechanism is properly set up for a closing operation. This check can alert personnel to possible degradation of mechanism components. The normal clearance is 0.031–0.062".

Trip Armature Pretravel and Overtravel

Purpose
Measures and adjusts the amount of trip coil armature travel required to trip the circuit breaker.

Justification
If this measurement is out of adjustment, the circuit breaker may fail a minimum voltage trip test. The GE technical manual specifies the trip armature travel measurements but was revised by SAL 328.1.

Description
Measure the amount of free play that exists in the trip linkage prior to movement of the trip latch. Sufficient free play ensures that proper force will be applied to the trip latch and that the stroke of the armature is sufficient to carry the trip linkage past a positive trip.

Closing (Release) Latch Wipe

Purpose
Measures and adjusts the release latch wipe.

Justification
Required according to the GE technical manuals. Insufficient wipe causes the circuit breaker to close automatically after it is charged. See OE 7546.

Description
Verify that there is sufficient wipe of the roller onto the latch when the closing springs are fully charged. Also verify that the latch adjustment screw is in contact with the circuit breaker frame and that the release latch foot is parallel to the frame. Verify that the release (close) latch roller rotates freely when the mechanism is in the reset position. Verify that the stop bolt on the rear of the latch assembly is the stop for the latch and that the spring discharge linkage does not prevent the latch motion from resetting.

Plunger Interlock Adjustment (Vertical Lift Circuit Breakers Only)

Purpose
Measures and adjusts the travel height of the plunger bolt.

Justification
Improper travel of the plunger could cause the "A" and "B" contacts on the stationary auxiliary switch in the switchgear cubicle to fail to operate properly or to become damaged. Because

circuit breaker swapping during PM could result in significant misalignment between the new circuit breaker and the switch mounted in the switchgear cubicle, measurements of the plunger should be taken and recorded before the overhaul process to provide data for resetting the plunger back to its original setting. See SAL 350.1, SEN 79, OE 4329, and OE 6226.

Description
The travel height of the plunger bolt is measured with the circuit breaker in the open and closed positions. The difference between these two measurements is the total plunger travel. Insufficient travel of the plunger bolt may require that the plunger interlock clip be replaced.

Driving and Latch Pawl Adjustment

Purpose
Measures and adjusts the clearance between the driving and latching pawls and the ratchet wheel teeth and between the latching pawls and the stop block.

Justification
Specified in the GE technical manuals. See SAL 352.1 (#5) for the revised stop block design.

Description
Ensure that the driving pawl advances the ratchet wheel sufficiently on each stroke to allow the latching pawls to fall into the ratchet teeth. Perform this adjustment with the closing spring load against the driving members while manually charging the breaker. Check the clearance between the latching pawl and the stop block to eliminate excessive latching pawl bounce. Clearances and adjustments can be found in the applicable GE technical manuals.

Closing (Release) Latch Monitoring Switch Clearance/Wipe

Purpose
Measures and adjusts the clearance between the switch striker arm and the switch mounting bracket.

Justification
This check is specified in the GE technical manuals. If the switch is not adjusted properly, the circuit breaker will not charge even when the release (close) latch is reset, or the circuit breaker will charge and close when the release (close) latch is not reset. See OE 6367, OE 6698, OE 7546, OE 7699, LER 96-002-00, IN 94-02, IN 95-02, and IN 97-08.

Description
Measure and adjust the clearance between the switch striker arm and switch mounting bracket. This task ensures that when the release (close) latch is reset, there is proper clearance between the switch striker arm and the switch mounting bracket for proper operation of the switch. This will allow the spring charging motor to start and recharge the closing springs after the circuit breaker is closed.

Motor/Relay Switch Clearance/Wipe

Purpose
Measures and adjusts the clearance between the switch striker arm and the switch mounting bracket.

Justification
Specified in the GE technical manuals. When the closing springs are charged, the clearance between the striker and the switch support must be sufficient for proper operation of the charging motor and relay switches. Improper operation of these switches can cause failure of a circuit breaker to close, failure of the spring charging motor to charge, or improper operation of the anti-pump relay. Potential failures of the CR2940 contact blocks used in this application have been identified in IN 97-08. See OE 6367, OE 7699, LER 96-002-00, IN 95-02, and IN 97-08.

Description
Measure and adjust the clearance between the switch striker arm and switch mounting bracket. This task ensures proper clearance between the switch striker arm and the switch mounting bracket for proper operation of the switch. This allows the spring charging motor to start and recharge the closing springs after the circuit breaker is closed. Most circuit breakers have two 52/SMLS switches: one to de-energize the charging motor and one to de-energize the anti-pump relay. The optional third 52/SMLS switch is known as the “white light switch” and indicates that the circuit breaker is in the “ready-to-close” condition.

Interlock Switch Wipe (Vertical Lift Only)

Purpose
Measures and adjusts the clearance between the switch striker arm and the switch mounting bracket.

Justification
Specified in the GE technical manuals. The clearance between the striker and the switch support must be sufficient to ensure proper operation of the charging motor and relay switches. Improper operation of these switches can cause failure of a circuit breaker to close or failure of the spring charging motor to charge. See OE 6367, OE 6502, OE 6527, OE 7699, IN 95-02, IN 97-08, LER 85-023-00, LER 90-029-00, LER 94-006-00, and LER 96-002-00.

Description
Ensure that when the positive interlock is in the reset position, the clearance between the interlock switch arm and the switch mounting plate is sufficient for the proper electrical operation of the closing coil and anti-pump and spring charging motor circuits. The clearance should be $> 0 \leq 1/32$”.

Latch Checking Switch Clearance/Wipe (If Installed and Utilized)

Purpose
Measures and adjusts the clearance between the switch striker arm and the switch mounting bracket.

Justification
The contacts of the latch checking switch must "make up" when the trip latch is reset, when the gap between the trip latch and trip latch roller is at the specified clearances, and when the trip latch is resting on the stop pin of the latch roller link. The latch checking switch completes the electrical closing circuit when the trip latch has reset to a position where the circuit breaker can be closed. Incorrect adjustment of this switch can cause the circuit breaker to attempt to close when the trip latch is not reset, resulting in a trip-free operation. Incorrect adjustment of the switch can also disable the circuit breaker close circuit when the trip latch is reset, resulting in a failure of the circuit breaker to close electrically. SAL 363.1 provides instructions on adjusting the switch to avoid trip-free operations. See OE 6367, OE 7699, OE 9895, PE 35677, IN 95-0, IN 97-08, LER 96-002-00, LER 395-99006, and SAL 363.1.

Description
Ensure that when the trip latch is in the reset position, the clearance between the switch arm and the switch mounting plate is sufficient for the proper electrical operation of the closing coil. The clearance should be $> 0 \leq 1/32$". SAL 363.1 addresses possible interference between the switch striker and the switch bracket and describes the procedure for checking the clearance.

Early "A"/"B" Switch Inspection (If Installed and Utilized)

Purpose
Measures and adjusts the operation of the switch contacts in relation to the main contacts parting.

Justification
Early "A" or "B" contacts are used for interlocks in bus transfer schemes. Proper operation of these switches is vital to fast transfer schemes. See SER 95-19 and LER 91-003-00.

Description
This single roller-type microswitch is actuated by the main square crankshaft movement and allows the fast transfer to begin prior to the circuit breaker auxiliary switch actuation. These switches have not indicated problems and differ from the previously described CR2940 switch.

5
AS-LEFT CONDITION TESTING

Insulation Resistance Testing of Primary Current Components

Purpose
Evaluates the as-left insulation integrity of the circuit breaker.

Justification
Good industry practice and recommended in the GE technical manuals. See SAL 324.2 for information about power factor testing.

Description
Measure the insulation resistance of the following:

- Line to load with circuit breaker opened
- Phase to ground with circuit breaker closed
- Phase to phase with circuit breaker closed

Appendix B contains acceptance criteria from NETA's *Maintenance and Testing Specifications for Electrical Power Distribution Equipment and Systems* (NETA MTS-1997). This test can be performed with either an ac or dc overpotential (hi pot) test or a megger.

Contact Resistance

Purpose
Measures and documents the as-left contact resistance.

Justification
As-left contact resistance data can be used as an input for justifying maintenance intervals. This check will ensure that the contacts do not contain a high-resistance connection that could cause ohmic heating.

Description
Measure the contact (phase) resistance of each phase using a micro-ohmmeter, DLRO, ductor, or millivolt drop test. It is important to be consistent with how and where the measurements are obtained. It is also possible to measure the resistance of the contacts or the entire primary contact circuit between the primary disconnects (stabs). Check the applicable vendor manual for acceptance criteria.

Table 5-1 presents typical acceptance criteria.

Table 5-1
Typical Acceptance Criteria

Contact Resistance (Micro-Ohms)			
Circuit Breaker Rating	Continuous Current Rated Time (Milliseconds)		
kV–MVA-model	1,200	2,000	3,000
4.16–250-7,-8,-9	≤ 50	≤ 25	N/A
4.16–350-1,-2	≤ 50	N/A	≤ 20
7.2–250-6	≤ 53	≤ 25	N/A
7.2–500-6	≤ 53	≤ 25	N/A
13.8–500-7	≤ 57	≤ 25	N/A
13.8–750-5	≤ 53	≤ 25	N/A
13.8–1,000-4	≤ 54	≤ 30	≤ 20

Ground Strap Resistance Check

Purpose
Measures and documents the ground strap resistance.

Justification
Ensures that the ground strap does not contain a high-resistance connection that could cause ohmic heating and damage the circuit breaker during fault conditions.

Description
Measure the ground strap resistance of each phase using a micro-ohmmeter, DLRO, ductor, or millivolt drop test. It is important to be consistent with how and where the measurements are obtained. The users group requested acceptance criteria from GE; however, GE was unable to provide criteria before this document was published. Consult with GE for acceptance criteria.

Insulation Resistance Test of Control Wiring

Purpose
Measures and documents the insulation resistance of the control wiring to ground and verifies the integrity of the control wiring insulation.

Justification
Recommended in the GE technical manual.

Description
Disconnect the motor leads and megger the control wiring at 250 V. See Appendix B for NETA acceptance criteria.

Auxiliary Switch Contact Resistance and Functional Check

Purpose
Verifies that the circuit breaker auxiliary switch contacts change state properly, the contacts do not have high resistance, and connections are tight. This check also verifies that the mounting bolts are tight.

Justification
High-resistance contacts in series with the trip or close coils can prevent the circuit breaker from operating electrically and can damage the trip and/or close coil. SAL 313.1 describes a condition where the mounting bolts on SBM and SB-12 auxiliary switches were insufficiently tightened. See OE 4536, SER 87-24, SAL 313.1, IN 93-91, LER 91-004-00, and PS 4706.

Description
With the circuit breaker open, verify that the "A" contacts are open, and measure the "B" contact resistance. With the circuit breaker closed, measure the "A" contact resistance, and verify that the "B" contacts are open. Use a Simpson analog meter for best results. Verify that the contact resistance measurements are within the user's own plant criteria. If the contact resistance is not acceptable, burnishing contacts is an acceptable cleaning method. Torque the SBM and SB-12 switch mounting bolts to 23–27 inch-pounds. After initial torquing, the bolt torque does not have to be checked again.

Control Switch Contact Resistance Checks

Purpose
Measures and records the switch contact resistance.

Justification
Ensures that all electrical circuits are functional and that the circuit breaker will operate properly. Because of past problems with the CR2940 switches and the circuit breaker auxiliary switch contacts, this check is recommended for all plants. See OE 7699, OE 6527, OE 6367, IN 95-02, and LER 96-002-00.

Description
A DLRO may be used to ensure that contacts are good if they fail the resistance test (acceptable resistance to be determined by each user per site-specific criteria). This measurement should be taken using a Simpson analog meter because of the silver oxide layer that develops on the switch contacts during normal operation. The switch rating should be considered when performing tests with a DLRO. This test should be performed on all CR2940 switches, such as the close latch

monitoring switch (CL/MS), the positive interlock switch, shutter interlock switch (horizontal circuit breakers only), and the spring motor limit (power) switch. A visual inspection of the switches should also be performed.

Circuit Breaker Functional Checks

Purpose
Verifies the electrical opening and closing operation of the circuit breaker and the proper function of the other interlocks and components.

Justification
Recommended in the GE technical manuals and considered a good test to verify that the circuit breaker and circuit breaker components operate properly. See OE 3917, SOER 82-16.

Description
Perform this test after all circuit breaker maintenance has been completed and prior to re-installing the circuit breaker into the cubicle.

Anti-Pump Functional Test

Purpose
Verifies the functionality of the anti-pump (52Y) relay.

Justification
Verifies that equipment damage does not result from the failure of this relay. See IN 88-75.

Description
With the circuit breaker in the charged and open position, apply control power. Apply an electrical close signal to the circuit breaker and maintain the close signal when the circuit breaker closes. With the close signal still applied, apply a trip signal to the circuit breaker or push the manual trip level and verify that the circuit breaker trips but does not re-close. If the testing of the Y relay fails, measure the coil resistance.

Reduced Control Voltage Test (Close and Trip)

Purpose
Demonstrates that the circuit breaker will perform its function (to open and close) with reduced control voltage.

Justification
Low dc voltage could occur during a plant transient. This test is good industry practice and recommended by the manufacturer. See EPRI TR-112814 and IN 99-13.

Description
Determine the minimum operating control voltage and apply it to the circuit breaker's close and trip control circuitry. Cycle the circuit breaker open and closed and verify its operation. GE does not perform reduced control voltage testing unless specifically requested by the utility. Reduced voltage testing was performed when the circuit breakers were originally manufactured, and voltage slightly less than the minimum listed on the circuit breaker nameplate was used.

General Visual Inspection

Purpose
Provides a visual inspection of the circuit breaker, including missing retainers or cotter pins, loose hardware, foreign material, and items that may have been overlooked during the overhaul process.

Justification
Missing retainers, foreign material, and/or loose hardware could interfere with normal circuit breaker operation.

Description
Use normal mechanical practices to check the seating of the lock washers to verify that the hardware is tight. Check for loose control wire connections. Remove any tools and hi pot wire that may have been left on the circuit breaker.

Timing Test

Purpose
Provides some indication of the condition of specific circuit breaker subcomponents.

Justification
As-left timing test results can be used as an input for justifying maintenance intervals. This test is useful in determining whether there are any binding problems with the mechanism. A timing test may be required for circuit breaker response time, coordination, or other plant requirements. See EPRI TR-112783, *Circuit Breaker Timing and Travel Analysis*, May 1999. See also OE 8070, OE 10054, IN 96-43, and SER 97-07.

Description
The closing time is the time that elapses between the initiation of an electrical close signal and the arcing contacts of the phase under test just touching. The opening time is the time that elapses between the initiation of an electrical trip signal and the arcing contacts of the phase under test just separating. Circuit breaker opening time helps to ensure the proper arc cessation if the circuit breaker trips on fault or opens under load. Failure to meet vendor acceptance criteria requires detailed troubleshooting. See EPRI TR-112783, *Circuit Breaker Timing and Travel Analysis*, May 1999.

Perform this task with a high-speed recorder or digital timer capable of reading 0–150 milliseconds to monitor the circuit breaker opening and closing times. Use nominal voltage for this test. The recorder/timer should start as soon as voltage is applied to the coil and should stop when the circuit breaker arcing contacts open or close, depending on the operation being timed. The coil voltage can be monitored (start circuit) at the proper secondary coupler pins; the main

contact state (stop circuit) can be monitored at one line-and-load primary disconnect stab. GE has stated that the maximum opening (trip) times for all sizes of circuit breakers is 50 milliseconds. The closing times for the different size circuit breakers vary. Table 5-2 presents nominal closing times.

Table 5-2
Nominal Closing Times*

Close to "K" Times (Milliseconds)			
Circuit Breaker Rating	Continuous Current Rated Time (Milliseconds)		
kV–MVA	1,200	2,000	3,000
4.16–250	84	100	N/A
4.16–350	84	100	117
7.2–500	84	100	N/A
13.8–500	100	100	N/A
13.8–750	100	100	N/A
13.8–1,000	84	N/A	117
Open Times (Milliseconds)			
kV–MVA	1,200	2,000	3,000
All	50	50	50

* Courtesy of GE.

Users should contact GE for proper closing times for circuit breakers of other sizes utilized at their site.

At a minimum, timing test should be performed during as-left testing. As noted in Section 3, "As-Found Tests and Inspections," travel/velocity testing provides additional information beyond timing tests and may therefore be performed in lieu of the timing test.

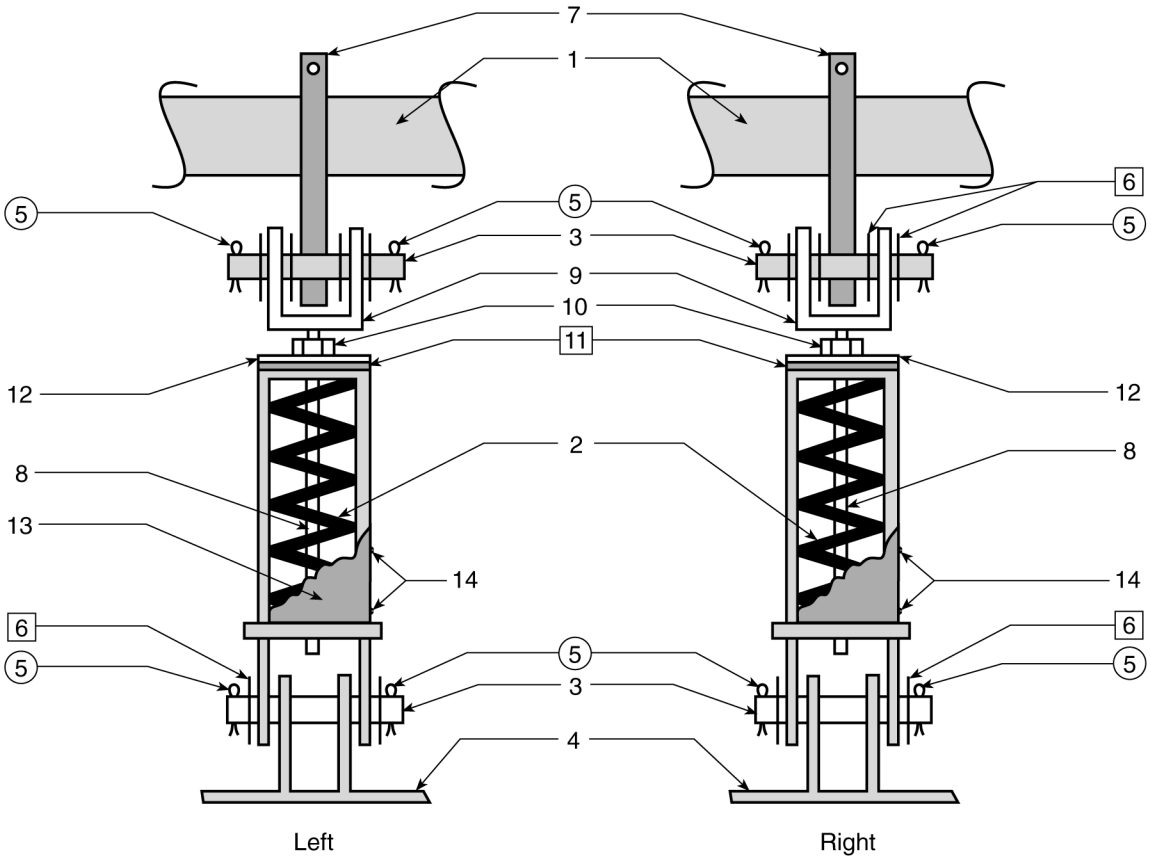
Counter Reading

Purpose
Documents the number of circuit breaker cycles if the circuit breaker has a cycle counter.

Justification
Good industry practice. Maintenance frequencies are sometimes based on the number of circuit breaker cycles.

Description
Record circuit breaker cycles (operations) of the circuit breaker. This allows a record of the number of operating cycles vs. the number of maintenance cycles on the circuit breaker.

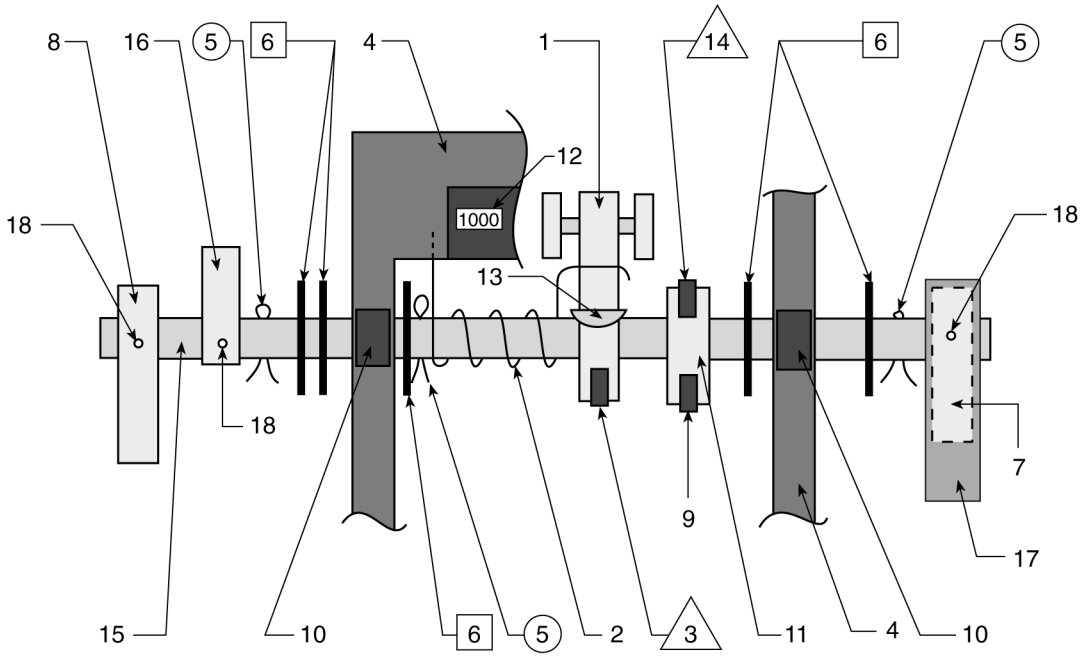
6
ILLUSTRATIONS



1.	Crankshaft	8.	Opening Springshaft
2.	Opening Springs	9.	Opening Spring Yoke
3.	Pin	10.	Lock Nut
4.	Frame	11.	Buffer Washer
5.	Cotter Pin	12.	Adjustment Plate
6.	Washer/Spacer	13.	Guard
7.	Crankshaft Arms	14.	Screw (Round Head)

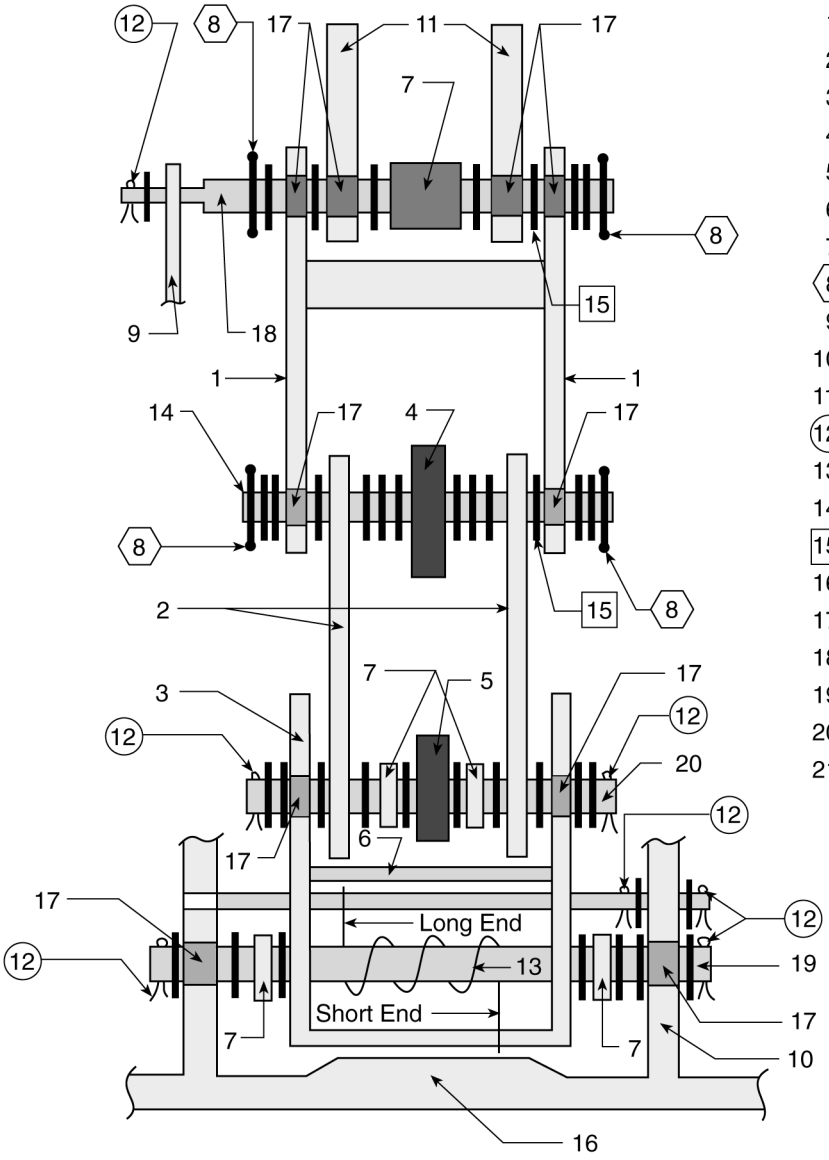
Figure 6-1
Opening Springs

Illustrations



1. Trip Latch
2. Trip Latch Spring
3. Set Screw
4. Mechanism Frame
5. Cotter Pin
6. Washer
7. Manual Trip Lever
8. Spring Discharge Trip Lever
9. Socket Head Cap Screw
10. Bushing
11. Trip Crank
12. Operations Counter
13. Woodruff Key
14. Locking Set Screw
15. Trip Shaft
16. Latch Checking Switch Striker (optional)
17. Manual Trip Crank
18. Hex Head Cap Screw

Figure 6-2
Trip Shaft Assembly



1. Upper Link (H-Link)
2. Middle Link (Hardened Link)
3. Lower Link (U-Link)
4. Cam Follower Roller
5. Trip Latch Roller
6. Stop Pin (Part of Lower Link)
7. Spacer
8. Snap Ring
9. Indicator Link
10. Frame
11. Center Crank
12. Cotter Pin
13. Spring
14. Prop Pin
15. Washers
16. Striker Plate (On Frame)
17. Brass Bushing
18. Upper Link Pin
19. Lower Link Pin
20. Trip Roller Pin
21. Lower Link Stop Pin

Figure 6-3
Collapsing Mechanism

Illustrations

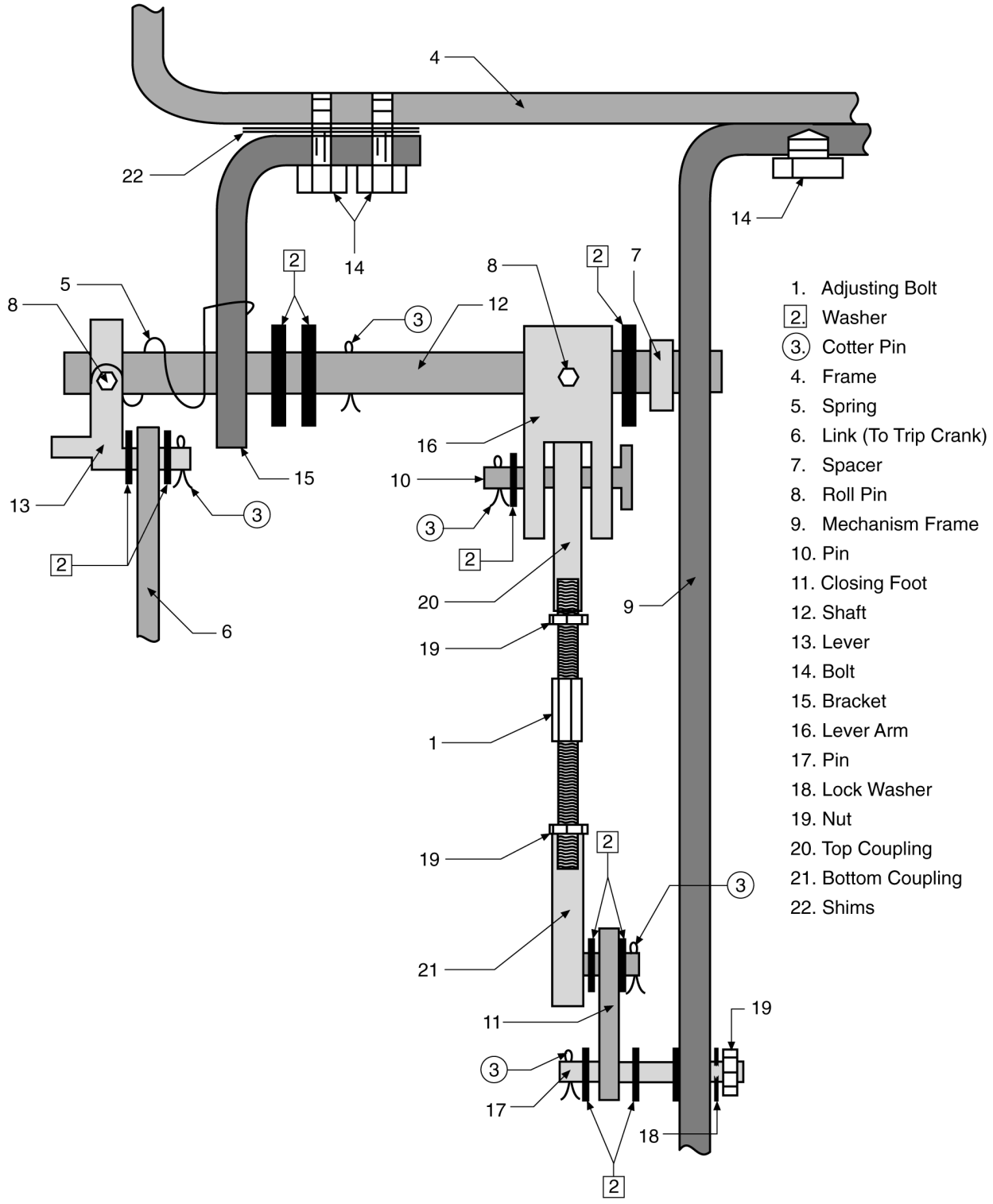
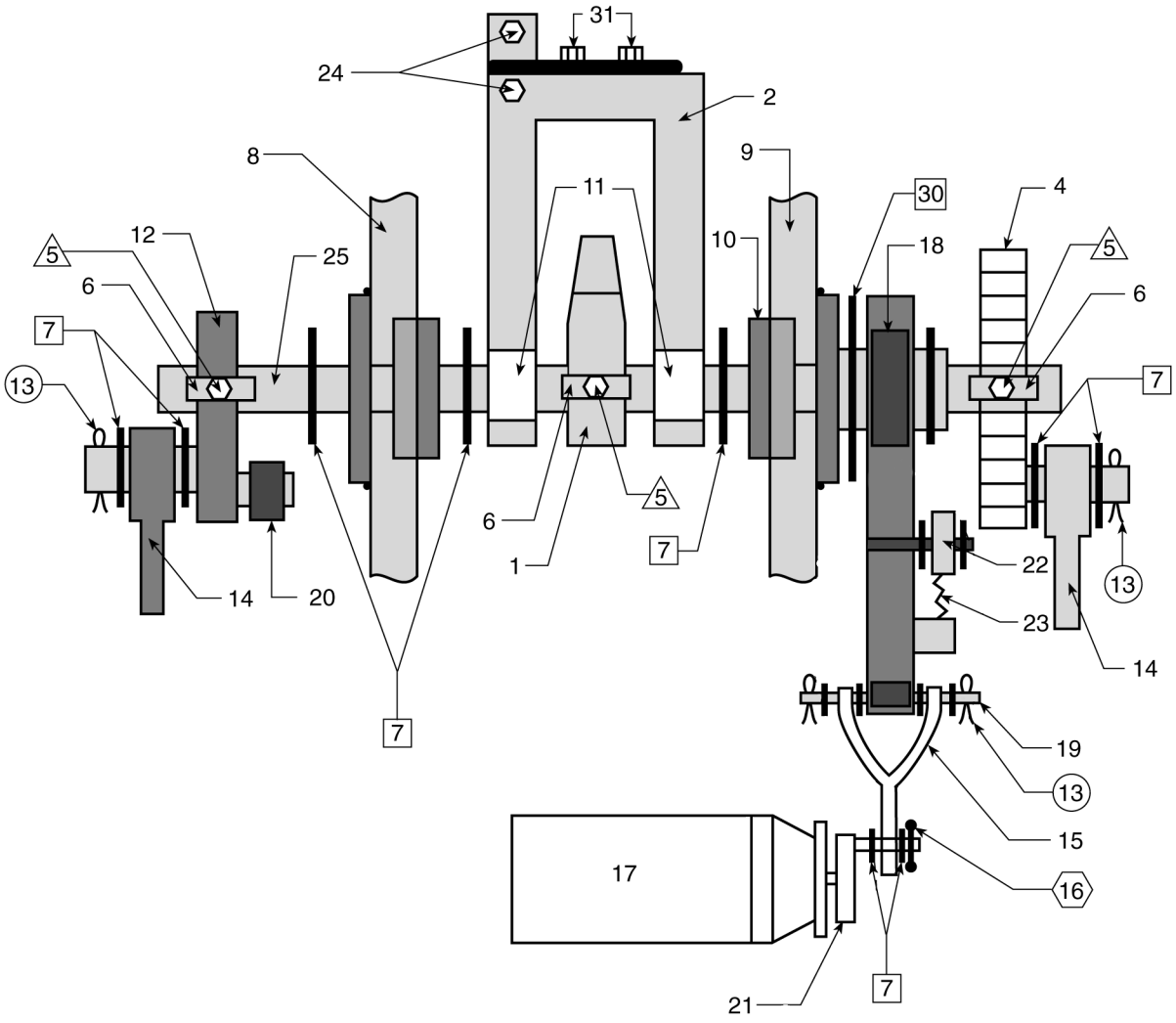


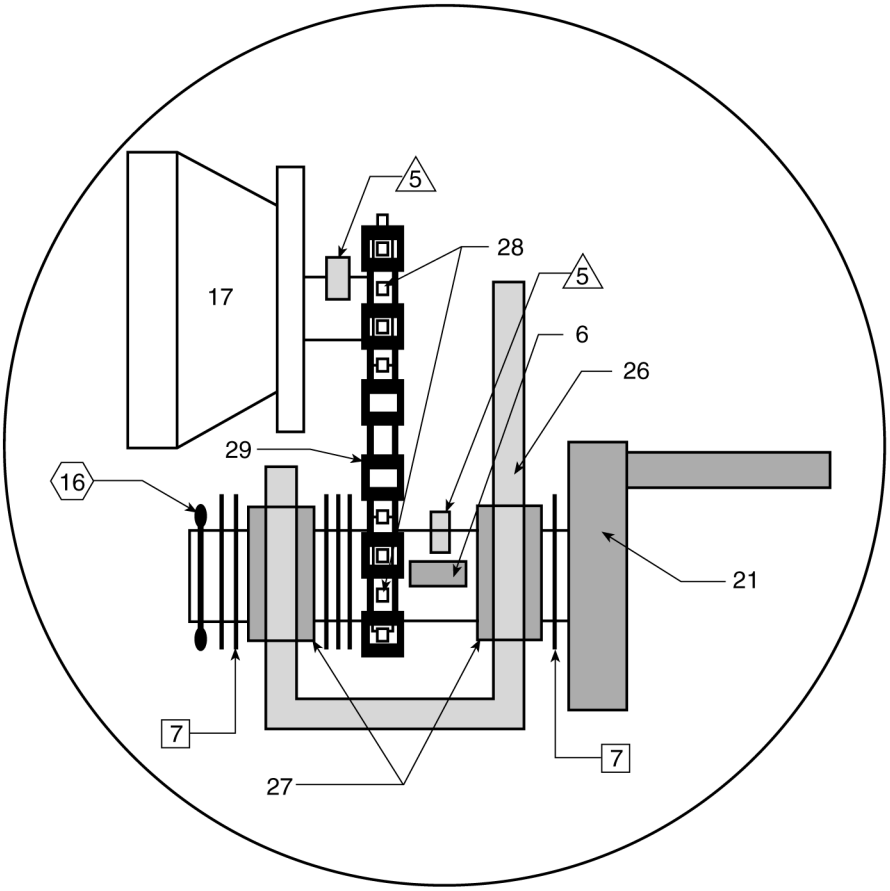
Figure 6-4
Spring Discharge Assembly



1. Cam
2. Prop
3. Crank
4. Rachet Wheel
5. Set Screws
6. Key
7. Washer
8. Left Frame
9. Right Frame
10. Roller Bearing
11. Prop Bushing
12. Switch Cam
13. Cotter Pin
14. Bearing Block
15. Link
16. Snap Ring
17. Charging Motor
18. Brass Bushing
19. Pin
20. Closing Latch Roller
21. Eccentric
22. Driving Pawl
23. Spring
24. Prop Spring Hole
25. Shaft
30. Large Washers
31. Hex Head Cap Screws

Figure 6-5
Cam Shaft Assembly

Illustrations



5. Set Screw	21. Eccentric
6. Key	26. Frame
7. Washer	27. Needle Bearing
16. Snap Ring	28. Chain Sprocket
17. Charging Motor	29. Chain

Figure 6-6
Cam Shaft Assembly–Chain Drive

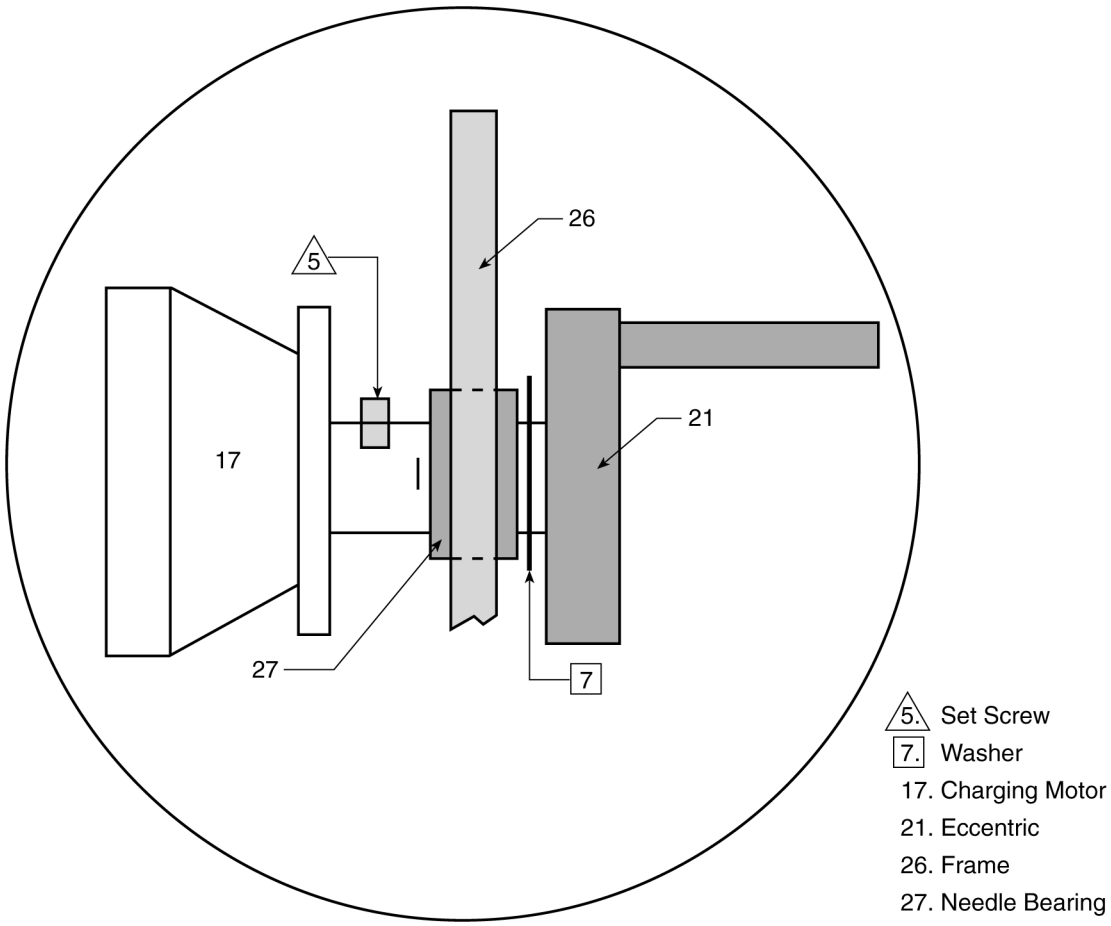


Figure 6-7
Cam Shaft Assembly–Normal Drive

Illustrations

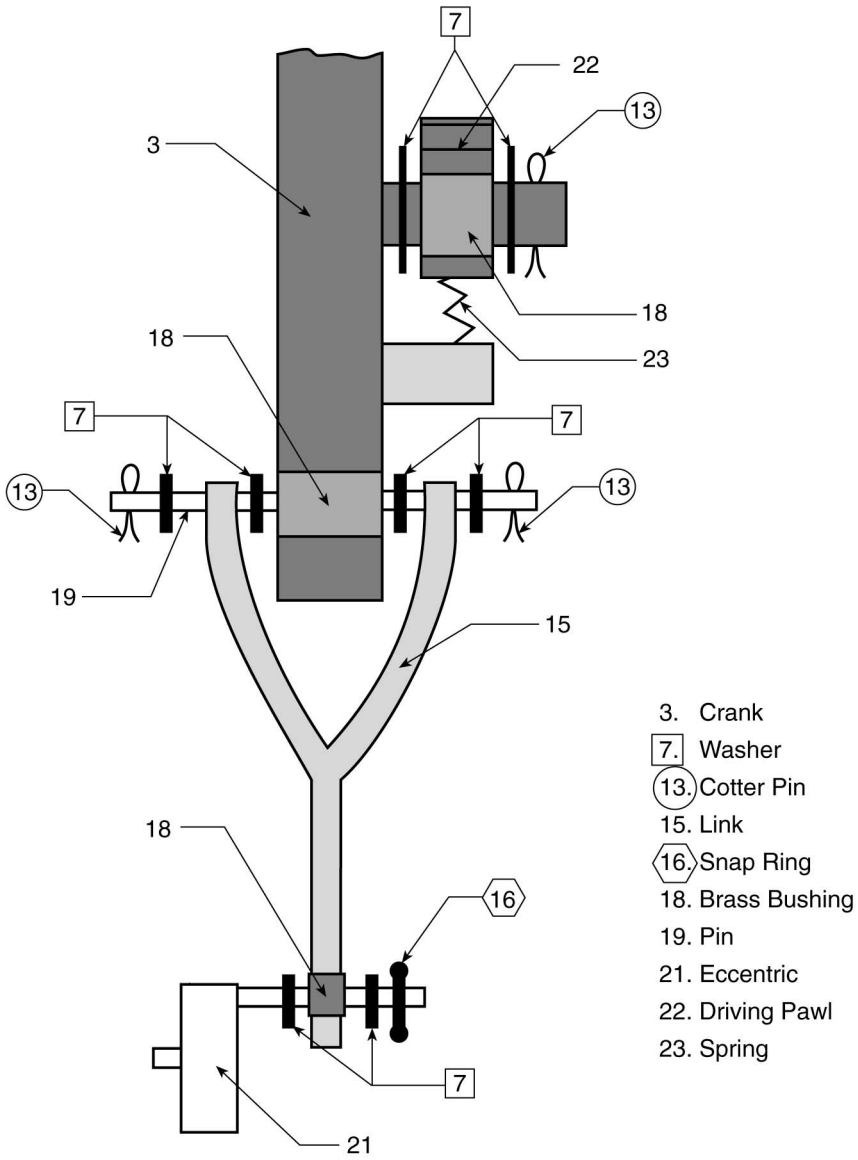


Figure 6-8
Cam Shaft Assembly–Driving Pawl (Old Style)

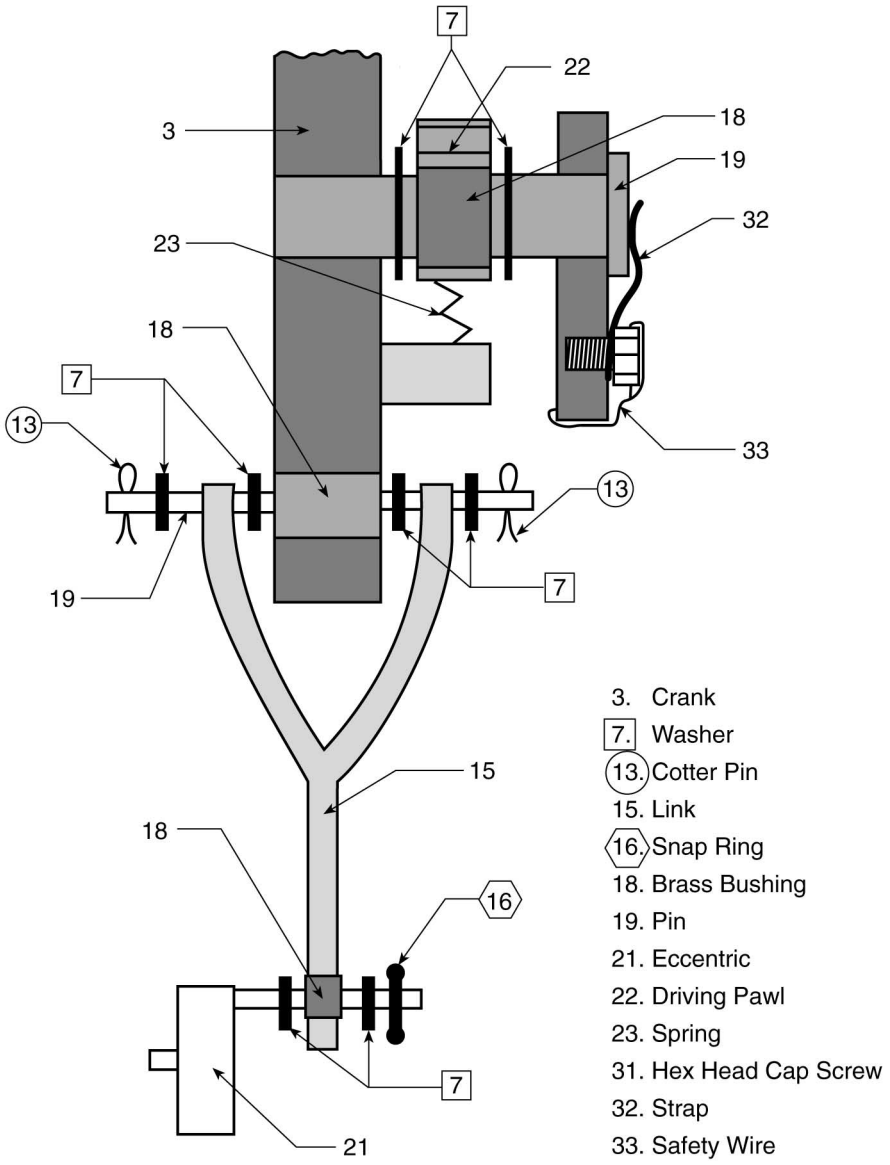
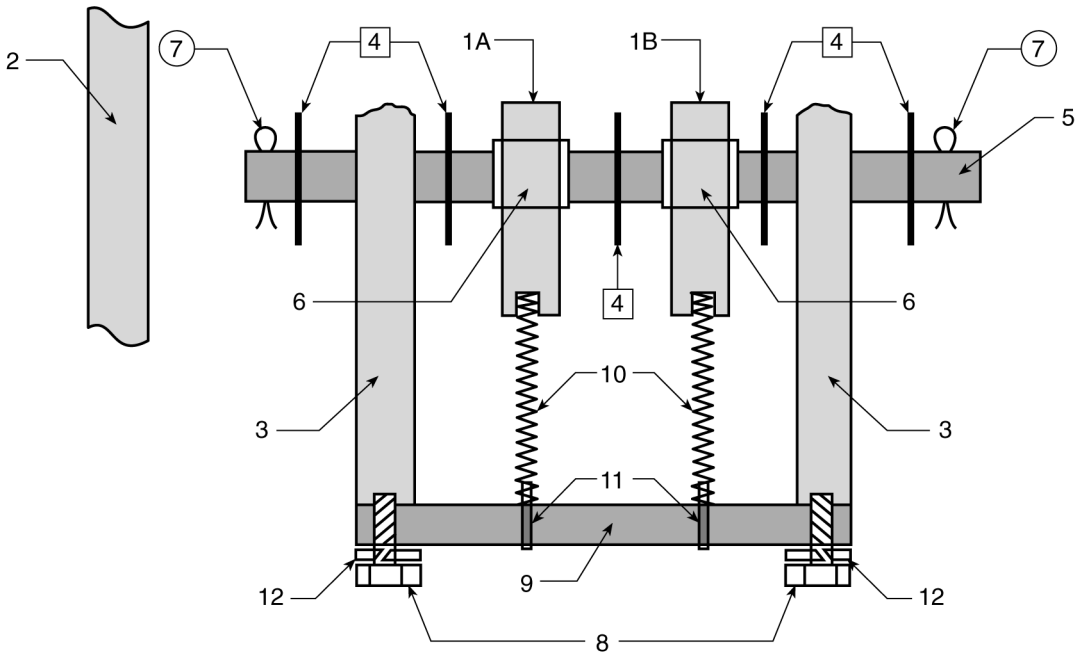


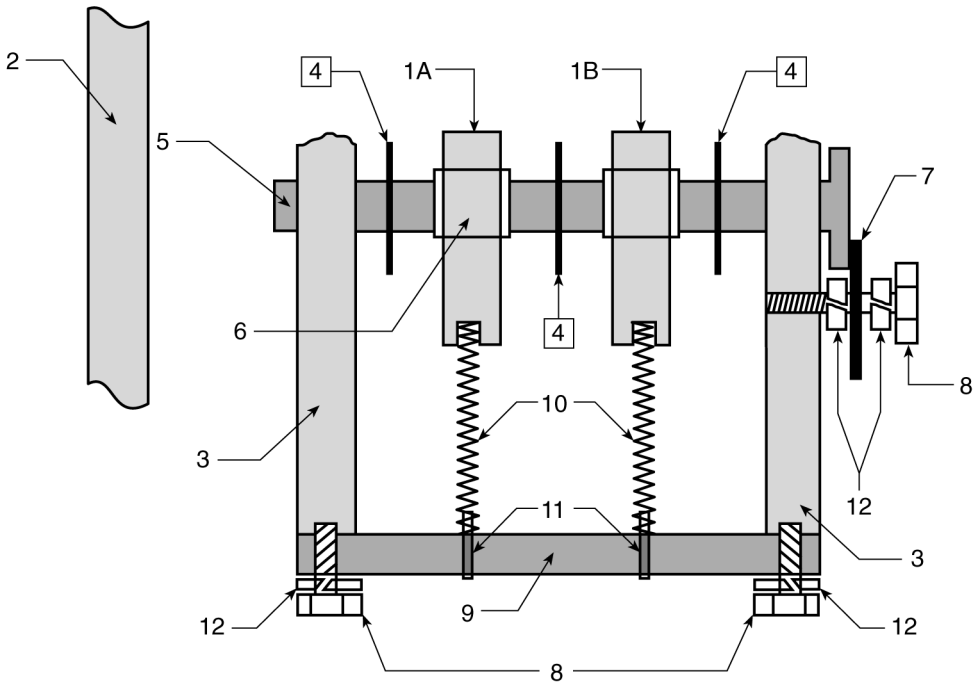
Figure 6-9
Cam Shaft Assembly–Revised Driving Pawl

Illustrations



1A. Latching Pawl (Long)
1B. Latching Pawl (Short)
2. Mechanism Frame
3. Mounting Support
4. Washers
5. Shaft
6. Bushing
7. Cotter Pin
8. Bolt
9. Spring Retainer
10. Spring
11. Roll Pin
12. Lock Washer

Figure 6-10
Latching Pawls–Old Style



1A. Latching Pawl (Long)
1B. Latching Pawl (Short)
2. Mechanism Frame
3. Mounting Support
4. Washers
5. Pivot Pin
6. Bushing
7. Pivot Pin Retainer
8. Bolt
9. Spring Retainer
10. Spring
11. Roll Pin
12. Lock Washer

Figure 6-11
Latching Pawls–New (Revised) Style

Illustrations

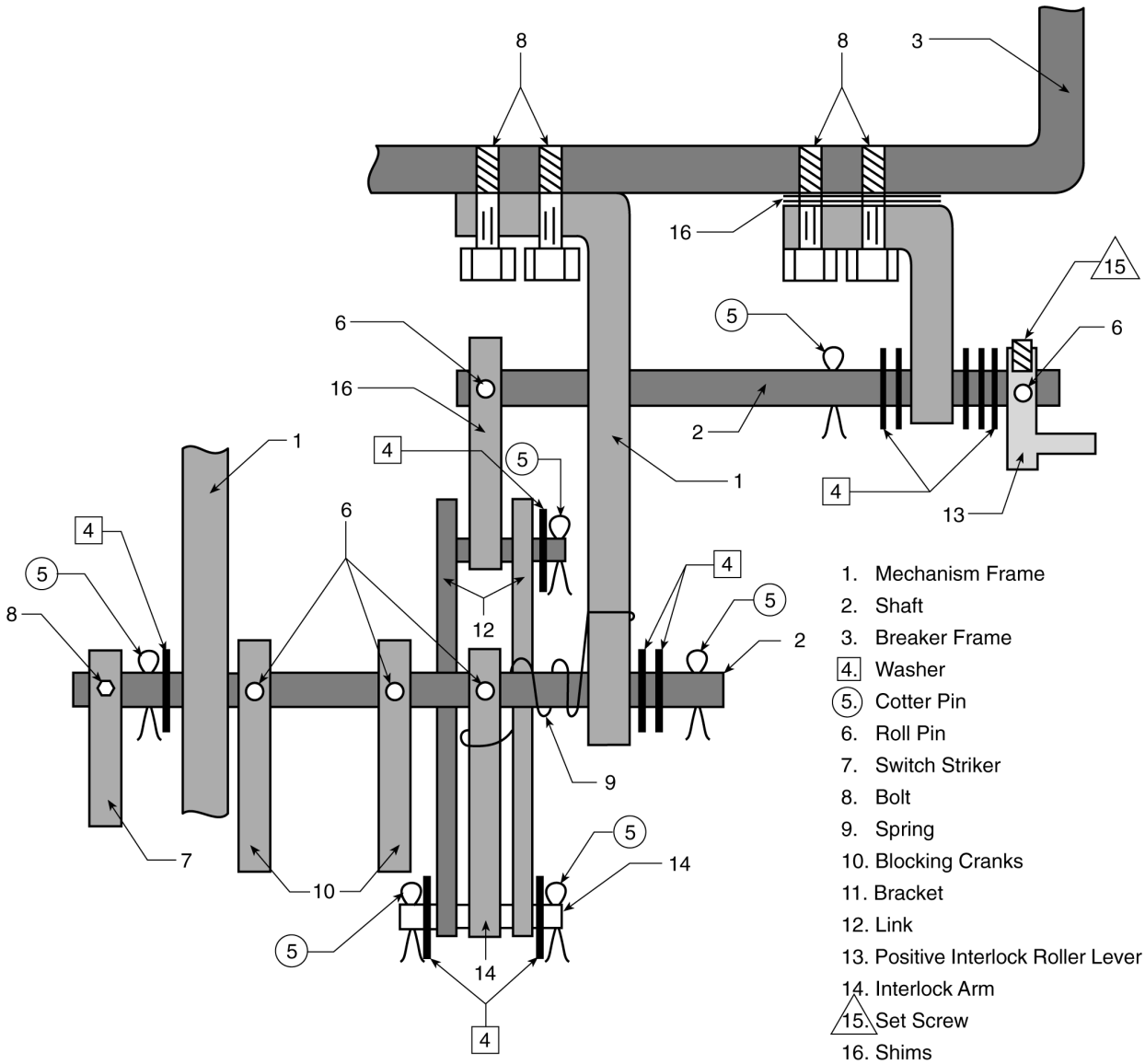


Figure 6-12
Positive Interlock Assembly

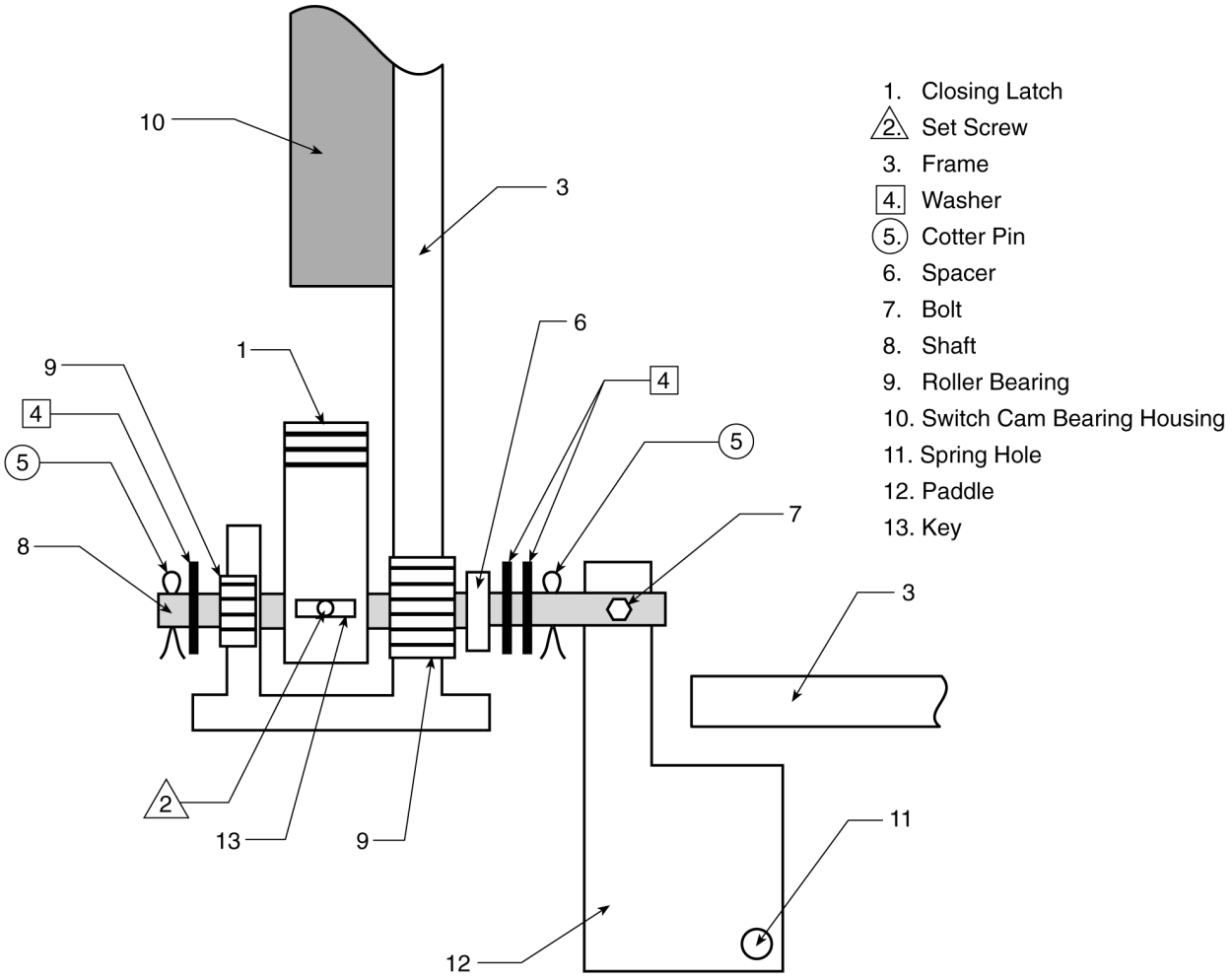


Figure 6-13
Closing Latch Assembly–Tension Spring Style

Illustrations

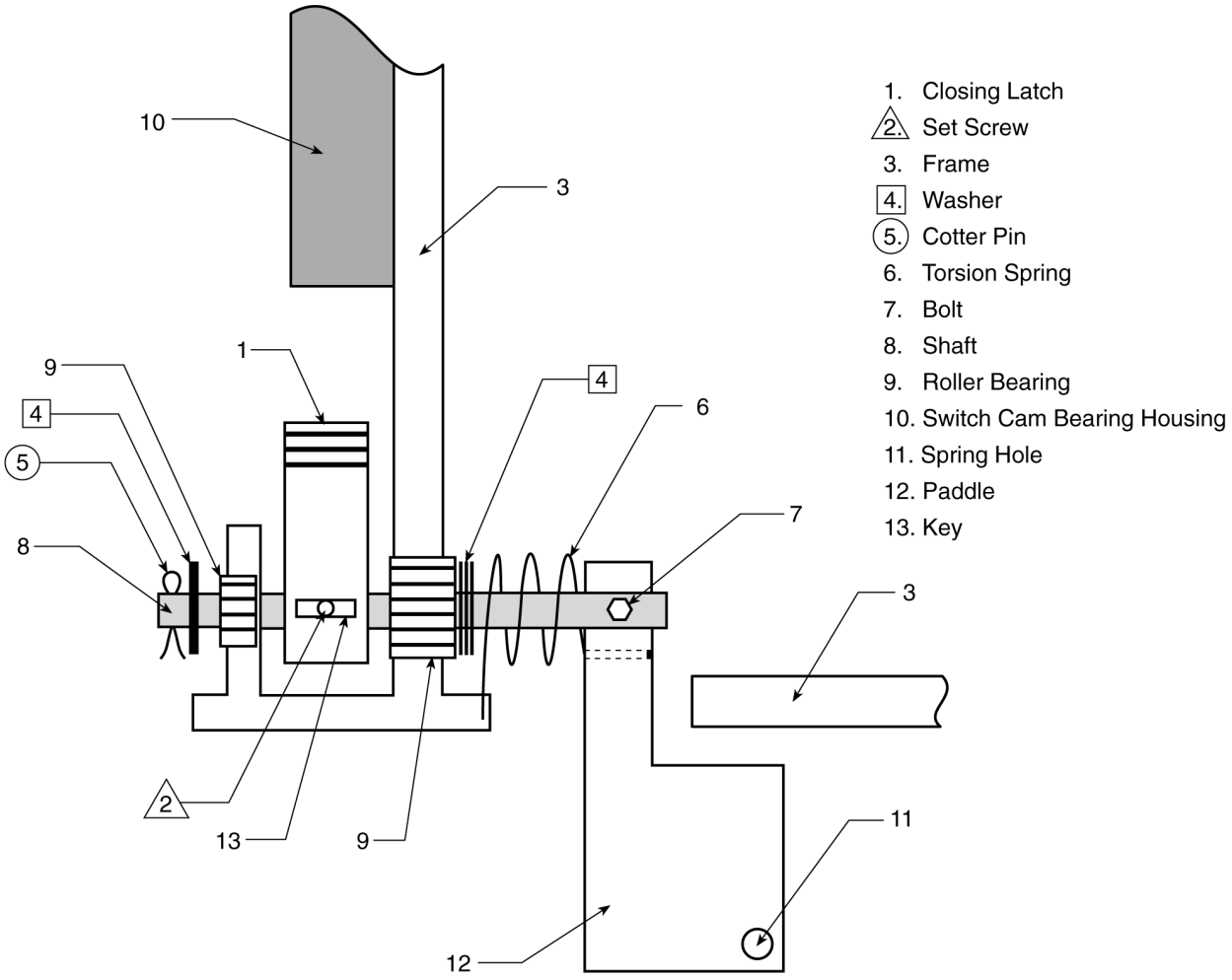
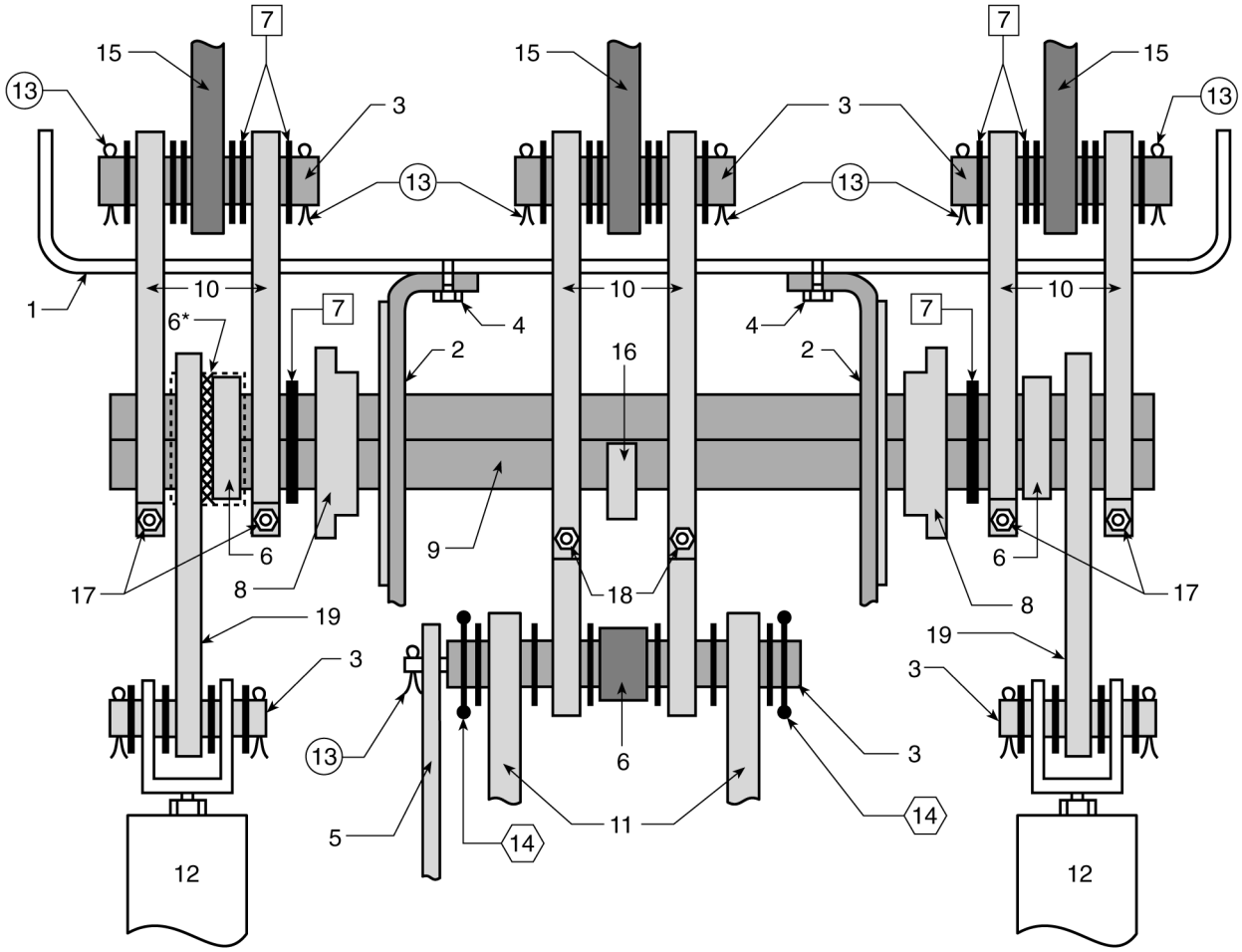


Figure 6-14
Closing Latch Assembly–Torsion Spring Style



1. Frame
2. Mechanism Frame
3. Pin
4. Bolt
5. Indicator Link
6. Spacer

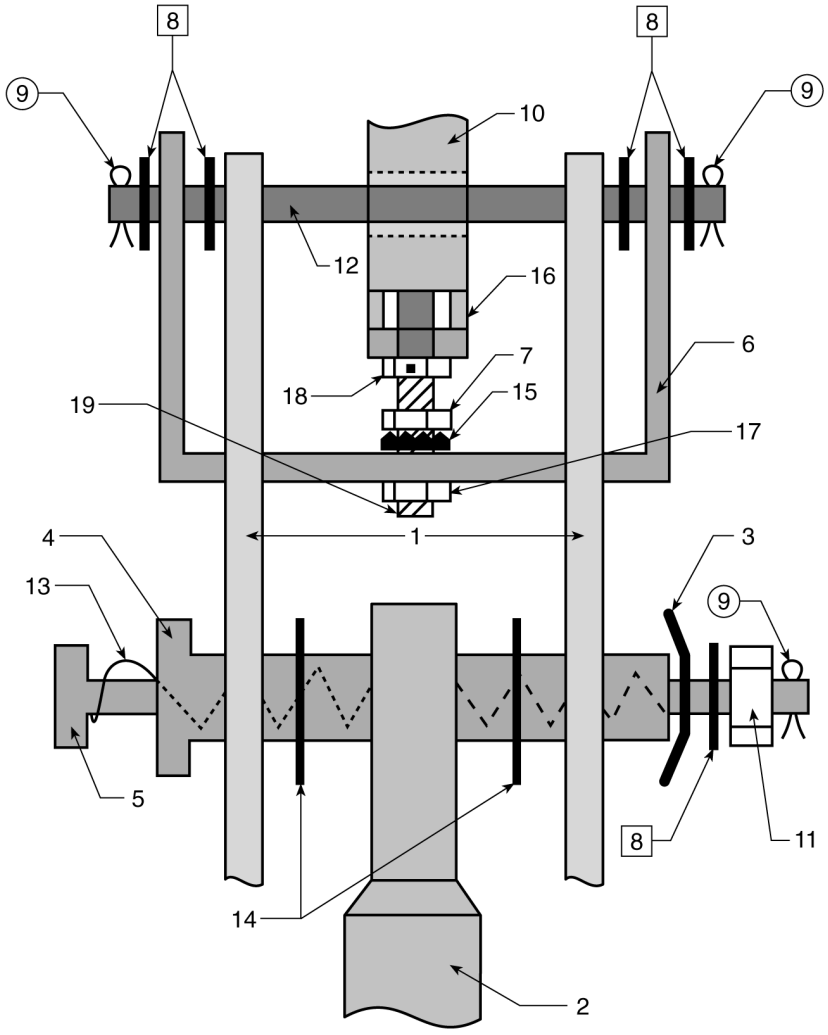
* Only installed if one opening spring

7. Washer
8. Bushing
9. Crankshaft
10. Crankshaft Arms
11. Mechanism Link (Upper)
12. Opening Spring
13. Cotter Pin

14. Snap Ring
15. Operating Rod
16. Plunger Interlock Cam
17. Hex Nut
18. Socket Head Cap Screw
19. Spring Arm

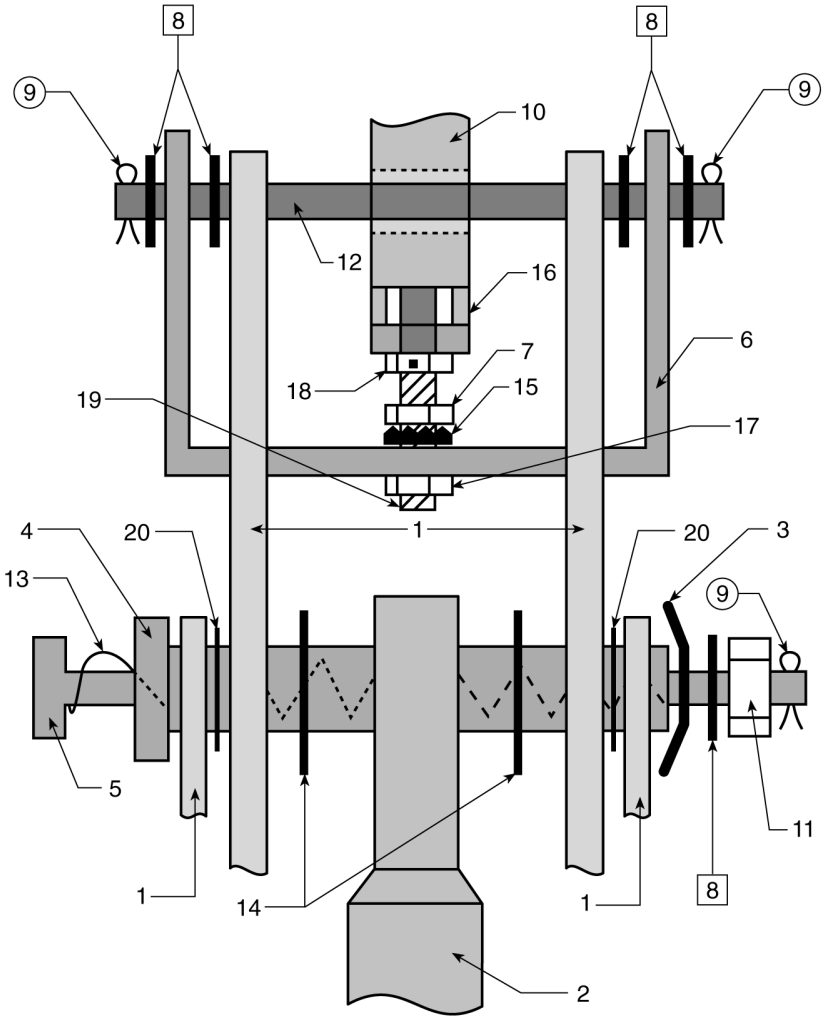
Figure 6-15
Crankshaft Assembly

Illustrations



1. Contact Arm
2. Main Bushing (Front)
3. Cup Bearing
4. Hinge Pin Bushing
5. Bolt
6. Yoke
7. Adjusting Nut
8. Spacers/Washers
9. Cotter Pin
10. Operating Rod
11. Castle Nut
12. Pin
13. Spring
14. Contact Ring (Silver)
15. Star Lock Washer
16. Barrel Nut (Not on Some Models)
17. Lock Nut
18. Roll Pin
19. Threaded Stud

Figure 6-16
Typical “H” Style Contact Arm



1. Contact Arm
2. Main Bushing (Front)
3. Cup Bearing
4. Hinge Pin Bushing
5. Bolt
6. Yoke
7. Adjusting Nut
8. Spacers/Washers
9. Cotter Pin
10. Operating Rod
11. Castle Nut
12. Pin
13. Spring
14. Contact Ring (Silver)
15. Star Lock Washer
16. Barrel Nut (Not on Some Models)
17. Lock Nut
18. Roll Pin
19. Threaded Stud
20. Silver Washer

Figure 6-17
Typical "HB" Contact Arm

Illustrations

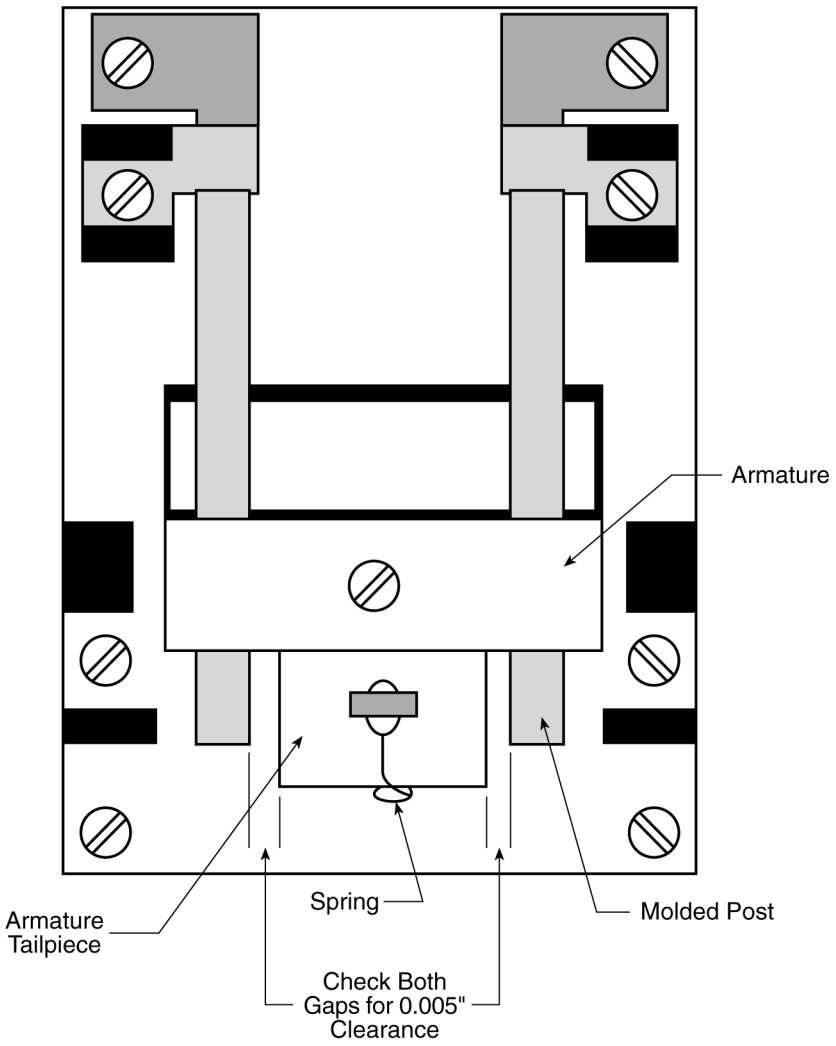


Figure 6-18
HMA Relay Measurement Location

7
REFERENCES

EPRI Documents

1. *Circuit Breaker Timing and Travel Analysis.* EPRI, Palo Alto, CA: May 1999. TR-112783.

2. *Reduced Control Voltage Testing of Low and Medium Voltage Circuit Breakers.* EPRI, Palo Alto, CA: 1999. TR-112814.

3. *Circuit Breaker Maintenance, Volume 2: Medium Voltage Circuit Breakers, Part 2: GE Magne-Blast Circuit Breakers.* EPRI, Palo Alto, CA: August 1995. NP-7410-V2P2.

4. *Guidance on Routine Preventive Maintenance for Magne-Blast Circuit Breakers, Final Report.* EPRI, Palo Alto, CA: October 1998. Supplement to NP-7410-V2P2.

The list of notices (documents) contained in Appendix A can be found at *http://www.epri.com*.

Other

1. The National Electrical Testing Association's (NETA) *Maintenance and Testing Specifications for Electrical Power Distribution Equipment and Systems* (NETA MTS-1997). (Table 10.1 in MTS-1997).

2. GE letter to Vermont Yankee dated December 24, 1986. EFS-86-048. This letter is a response to Vermont Yankee's Letter, VY-86-354, dated October 21, 1986, and discusses contact resistances, megger values, and timing criteria.

3. GE Report of Test-Circuit Breakers, to Tennessee Valley Authority, November 1981. Testing criteria for 7.2 and 13.8 kV Magne-Blast circuit breakers.

4. TI 2515/137, "Inspection of Medium Voltage and Low Voltage Metal-Clad Circuit Breakers." March 9, 1998.

5. TI 14894, "GE AM and Siemens-Allis type FA NNS 4.16 kV Circuit Breaker Problems." A retaining ring (snap ring) came out of the groove on the drive shaft engaging roller, resulting in the circuit breaker being in trip-free condition (Florida Power & Light).

A
MAGNE-BLAST CIRCUIT BREAKER USERS GROUP LIST OF RELATED NOTICES

Table A-1
Magne-Blast Circuit Breaker Users Group List of Related Notices

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
GE SAL 303.1	GE SERVICE ADVICE LETTER SAL 303.1 Cleaning Lexan or Noryl Bus Insulation. Vertical Lift Metal clad Switchgear.	19-Feb-75	SWGR INFO, Bus (bus bar Insulation)	Only denatured or isopropyl alcohol is recommended for cleaning Lexan or Noryl insulation on bus bar.
GE SAL 305.1	GE SERVICE ADVICE LETTER SAL 305.1 Tapped Bus Connections, Metal clad Switchgear.	19-Feb-75	SWGR INFO, Bus	Informational; Late 1970/ early 1971 Solarite KM 1592 replaced John Mansville type MSG Duxseal for taped bus connections
GE SAL 308.2	GE SERVICE ADVICE LETTER SAL 308.2 Elevating Motor Defect addendum for Vertical Lift Metal - Clad Switchgear .	19-Aug-74	SWGR INFO, Motor (Elevating)	Recommends providing five (5) minute cooling off period between elevator operations. Replace failed P1 and P3 motors with P2 or P4 motors.
GE SAL 309.1	GE SERVICE ADVICE LETTER SAL 309.1 Excess Grease in Bus Bar Connections.	27-Jun-73	SWGR INFO, Bus (Excess Grease, bus bar connection)	Change to instruction manual GEH-1802U P.19, to, "Wipe off all excess grease from the external surfaces of the joint area." Ensures that no grease comes in contact with the Noryl insulation.
GE SAL 310.1	GE SERVICE ADVICE LETTER SAL 310.1 Manual Elevating Mechanism Crank. Alignment problem may exist with manual crank elevating assemblies. If existing it will be impossible to engage the mechanism assembly with the switchgear clutch.	22-Apr-74	SWGR INFO, Elevating Assembly Manual, Manual Crank	Action is to realign or replace.
GE SAL 311.1	GE SERVICE ADVICE LETTER SAL 311.1 MC-4.16 Hor. Drawout - Stationary Aux. SW. Linkage and Breaker Discharge Crank Roller.	28-Jun-74	BKR HZR INFO, Switch (Stationary Aux., Linkage, & Discharge Crank Roller)	Recommends replacing redesigned drag link, forward stationary aux. switch operating cam and spring discharge roller for "Nuclear Plant Application."

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
GE SAL 312.1, 318.1, 318.1A, & 318.2	GE SERVICE ADVICE LETTER SAL 312.1 AM 13.8-1000-3H & 4H & AM 4.16-350-1: Tuf-Loc Bushing and Latch Pawl Stop Block. (ML-13 Mech: Sleeve bearing replacement	22-Jul-74	BKR/ OVHR INFO, Bushing (Tuf-Loc), Sleeve Bearing, Latch Pawl Stop Block	Install replacement bushings made of aluminum bronze as part of a maintenance program or where the problem evidences itself. Check clearance between stop block and latching pawl. Replace stop block with new style as required.
GE SAL 313.1	GE SAL 313.1 STATIONARY AUXILIARY SWITCHES IN M-26 & M-36 VERTICAL LIFT METAL CLAD SWITCHGEAR. THIS SAL IDENTIFIED A CONCERN ABOUT TIE BOLTS WHICH CLAMP INDIVIDUAL STAGES OF TYPE SBM AND S-12 STATION AUX.	24-May-95	BKR INFO, Switch (Aux. switch tie bolts), SB-12	Recommends checking aux. sw. on 5kv and 15kv Vertical Lift Metal-Clad SWGR. in nuclear stations immediately if not in service (energized) and otherwise during first planned shutdown to determine switch tie bolt tightness.
GE SAL 315.2 (Supercedes 315.1)	GE Service Advise Letter SAL 315.2, Lexan or Noryl bus insulation may have stress cracking if it comes in contact with petroleum based greases, plasticizers, paint thinners, ind. cleaning fluids, or chem. contaminants.	30-Jun-77	SWGR INFO, Bus (bus bar Insulation)	GE recommendations, requirements for inspections, and repair methods are provided, ref. the SAL for specifics.
GE SAL 316.2 (Sup. SAL 316.1)	GE SERVICE ADVISORY LETTER SAL 316.2: MEDIUM VOLTAGE SWITCHGEAR EQUIPMENT BOLTED BUS BAR JOINT COMPOUND. 5, 15, and 34.5KV Metal clad Switchgear, 5 and 15KV Bus Ducts, and 5 and 15KV Breakmaster Equipment.	26-May-95	SWGR INFO, Bus bar (Joint Compound)	Provides instructions on how to apply joint compound on copper and aluminum bolted joints.
GE SAL 317.2	(Supercedes SAL 317.1) Opening dashpot adjustment addendum VH-13.8-500 Vacuum Circuit Breakers	14-Dec-79	PWR VAC INFO, Dashpot (adjustment)	Urges customers to make dashpot readjustments as outlined and adds post maintenance test requirements.
GE SAL 319.1	AM breakers: Main movable contacts with holes.	10-Feb-77	BKR INFO, Contacts (Moveable)	Info Only - Discusses holes drilled in main moveable contacts during manufacturing. Does not affect operability.
GE SAL 320.1	PT rollout assembly barrier, vertical lift switchgear only.	8-Jun-77	SWGR INFO, Barrier , Potential Transformer (PT)	Inspect for missing insulating barrier. Install missing barriers immediately.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
GE SAL 321.1	Silver plating - use of field facilities (GE precaution)	8-Aug-77	OVRH INFO, Plating (Silver)	Make sure technical requirements are met when silver plating is performed.
GE SAL 322.1	Type NEC fuse holders, 30 & 60 amp	24-Feb-78	SWGR INFO, Fuse holder	Provide adjustment measurements and methods to ensure or get the proper fuse holder clip gap.
GE SAL 324.2	GE SERVICE ADVICE LETTER SAL 324.2: MAINTENANCE, MAGNE-BLAST CIRCUIT BREAKERS POWER FACTOR TESTING. (Com Ed/Zion 1 & 2)	31-Oct-95	BKR INFO, Bushing	Provides helpful info. on doing power factor testing. 1) Measure bushing with it isolated. 2) Recommends replacement of bushing if PF greater than 5%.
GE SAL 325.2	AM BKR striker plate (addendum to 325.1) (Wolf Creek)	3-Mar-78	BKR INFO, Plate (Striker)	Perform visual inspection for a complete weld, not just a tack weld, across the entire latch roller link striker plate. Perform repair as directed.
GE SAL 326.1	GE SERVICE ADVISORY LETTER SAL 326.1: VERTICAL LIFT 5 & 15 KV METAL CLAD SWITCHGEAR BREAKER POSITION SWITCH OPERATION.	26-May-95	SWGR INFO, Switch (Position)	Suggests an inspection for damage to position switch assembly be conducted. Replace if necessary. Add holes to switch operator guide to improve mounting and remove material from gusset in framework.
GE SAL 327.1	M36HH-13.8-1000 V/L: Spring discharge cam	7-Jun-78	BKR INFO, Cam (Spring Discharge)	Replace spring discharge cam. Modify positive interlock assembly with new striker.
GE SAL 328.1	GE SERVICE ADVICE LETTER 328.1: TYPE AM MAGNE-BLAST CIRCUIT BREAKER WITH ML-13 MECHANISM - TRIP ARMATURE TRAVEL. All Magne-Blast Breakers 5 and 15KV with ML-13 mechanisms	28-Apr-95	BKR INFO, Coil (Trip Armature travel)	Informs end user of dimensional change for trip armature travel. Each plant needs to evaluate for applicability.
GE SAL 332.1	5 & 15 KV Outdoor V/L: Filter Assembly Redesign	28-Sep-79	SWGR INFO, Filter (Outdoor)	Provides new filter assembly design for outdoor switchgear ventilation.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
GE SAL 333.1, 335.1, & 336.1	Power/Vac: PV42A inter. integrity test, manual grd & test device, warranty & other work by I&SE, and handling elec. grd & test dev. GMV-1000, Power Vac 4.16KV-250MVA-1200 and 2000 amp breakers with PV42A interrupters.	03/28/80 through 11/03/80	Test Device (Test/Ground) Interrupters, Hi-pot test	Chgs Hi-pot test values to 19KKV (ac), 60HZ & 27KV (dc) for Pwr Vac interrupters PV42A. Ref. GEK-39671. Rec not using the original Bkr Lift Truck shipped with Pwr Vac equipment through 7/80 to lift the new GMV-1000 Ground & Test Device.
GE SAL 337.1	Tape Insulation Instructions 5, 15, and 34.5KV Metal clad Switchgear.	New	SWGR INFO, Bus Bar, Taping, Insulation	Bus bar and bus joint taping instructions for 5, 15 and 34.5KV bus applications
GE SAL 340.1	Power/Vac: Operating arm Coupler Clamp may not have been properly tightened at the factory (May be the same SAL as SAL 349.1 intended to be).	10-Sep-81	BKR INFO, Arm (Coupler Clamp)	Check tightness of connection clamps between the Vac bottle and the operating rod insulator.
GE SAL 341.1	5 & 15 KV 2000A old style bus update Vertical Lift Switchgear.	28-Sep-91	SWGR INFO, Bus	Field modification offer to upgrade old style 2000 Amp bus insulated with Herkolite to Noryl insulation and porcelain inserts. More reliable design.
GE SAL 342.1, 2, 3, & 4	SALs on Arc Chutes that GE identified as being Not applicable and provided no copies of them.	10/28/81 through 08/25/82	BKR INFO, Arc Chutes	No recommended corrective action.
GE SAL 343.1	GE Service Advisory Letter SAL 343.1: 5kv & 15kv Vertical Lift Metal-Clad Switchgear Positive Interlock.	29-Oct-96	BKR INFO, Switch (Positive interlock)	Recommends lower notch in positive interlock plate be closed off and provides modification.
GE SAL 344.1	GE SERVICE ADVISORY LETTER SAL 344.1: 4.16KV - 250 & 350 MVA - 78,000 AMPERES HI-MOMENTARY. Vertical Lift Metal clad Switchgear	26-May-95	SWGR INFO, Bus bar (Bracing, Rating)	Switchgear shipped during the period of 1965 through 1978 may require additional bracing. Recommended that owners of such equipment review momentary duty requirements. If greater than 50,000 Amps for 10 cycles need additional bracing.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
GE SAL 345.1	Power/Vac: Racking Mechanism Mod Kit to resolve worn racking wrench socket and racking rail acceptor hood to the point the negative interlock no longer makes the bkr trip free during the racking process.	16-Apr-82	PWR VAC/ SWGR INFO, Racking Mechanism	A modification kit # is provided that changes the racking rail acceptor hood on the racking mechanism and a new racking wrench P/N is identified.
GE SAL 346.1	Power/Vac: Remote Racking Device Mod. Kit as a result of trouble mounting the power/VAC remote racking device. The force created by racking with the device tends to drive the device away from the door.	15-Sep-82	PWR VAC/ SWGR INFO, Remote Racking Device	A modification kit # that provides quick disconnect and connect fasteners on the door, plus brackets and disconnect connectors on the remote racking device with a template to locate the parts.
GE SAL 347.1	Power/Vac: Field Mod. Mechanical Bkr closing required as some bkrs may have been furnished with control power transformer that did not have control PWR available to close the bkr through the 52 control switch.	15-Sep-82	PWR VAC/ DES INFO, push button	A modification kit that provides a manual close button to be operated from the front of the equip.
GE SAL 348.1	GE SERVICE ADVICE LETTER 348.1: PROP SPRING FAILURES IN AM ML-13,ML-13A and ML-13C breaker op. mechanisms on AMH 4.76-250, AM 4.76-250/350, AM 7.2-500 and AM 13.8-500/750/1000.	15-Mar-91	BKR INFO, Spring (Prop)	Recommends inspection of prop spring. Install replacement (lower) prop spring during scheduled maintenance esp. prior to 2000 accumulative operations. File, chamfer and countersink holes for spring loops.
GE SAL 349.1	Morman Clamp Bolts - AM Circuit breakers & Switchgear, Type VVC GE/Vac Breakers. This SAL has to do with the clamp that hold the Vac. bottle on GE Vac bkrs.	Later	PWR VAC INFO, Bolts (Morman Clamp)	This SAL has not and may never be issued.
GE SAL 351.1	GE SERVICE ADVICE LETTER GE SAL 351.1: 10CFR21 NOTIFICATION/SERVICE ADVISORY LETTER GE HIGH MOMENTARY TYPE AM MAGNE BLAST CIRCUIT BREAKERS. ML-13, ML-13A & ML-13C on type AM ,V V C & AMH breakers.	28-Apr-95	BKR INFO, Spring (Prop)	Recommends the addition of a second prop spring to all breakers with close & latch ratings > 77ka or if any problems described in S.A.L. have occurred.
GE SAL 351.1A	Revision A is an addendum to SAL 351.1: New prop spring No. 2 for ML-13 & ML-13A mechanisms on all 4.16KV, 7.2KV, & 13.8KV type AM and AMH Breakers. In some cases the prop tip is being hit by the prop pin.	18-Oct-96	BKR INFO, Spring (Prop)	GE is providing a new #2 prop spring with increased force for all breakers with a close and latch rating of 77KA or above.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
GE SAL 352.1	GENERAL ELECTRIC SERVICE ADVICE LETTER SAL 352.1, LATEST DESIGN CONFIGURATION: GE TYPE AM CIRCUIT BREAKERS AND MEDIUM VOLTAGE SWITCHGEAR.	28-Jul-95	OVH/ DES INFO, (Design Latest Changes)	Review the list of modifications and GE recommendations for importance to identified if the changes that are applicable and when the change needs to be made.
GE SAL 354.1	GE Service Advisory Letter SAL 354.1: Magne-Blast Circuit Breaker Maintenance.	28-Oct-96	BKR INFO, Grease Types	GE specifies new lubrication requirements and types, supplement to manual.
GE SAL 501.1	GE SERVICE ADVICE LETTER SAL 501.1 SLR12B RECLOSER RELAY. Discusses problems with SLR12B recloser relays that may pump a breaker if certain conditions are met (AC powered only).	30-Oct-95	DES INFO, Relay (Anti-pump circuit)	Provides modification kit to prevent the misoperation of the anti-pumping. This may not be related to the Magne-Blast bkr.
GE SAL 509.0	GE SERVICE ADVICE LETTER 509.0: POWER/VAC Breakers (only) LIFT TRUCK INTERLOCK GUIDE PIN MODIFICATION kit that eliminates the problem of them breaking.	26-Jun-89	PWR VAC INFO, Pin (Lift truck interlock)	Identifies a modification kit ordering information and provides a drawing.
GE SAL 510.0	GE SERVICE ADVICE LETTER 510.0: POWER/VAC BREAKER LIFT TRUCK MODIFICATION FOR USE WITH ELECTRICAL GROUND AND TEST DEVICE. Power Vac Equipment Switchgear, warranty, service.	26-Jun-89	Test Device (Test/Ground)	Informational, some I&SE personnel had not been trained on servicing Power Vac Equipment. Switchgear Product Service not obligated to honor complaint charges from unqualified I&SE personnel.
GE SAL 511.0	GE SERVICE ADVICE LETTER 511.0 AND SERVICE ADVICE INDEX: EDGING STRIPS USED ON POWERVAC CIRCUIT BREAKER INTER-UNIT BARRIERS.	25-Jan-89	PWR VAC INFO, Barrier (Edging Strips)	Recommend inspecting for looseness of this edging strips during maintenance and provides means to repair areas of concern.
GE SIL 39	GE SERVICE INFORMATION LETTER SIL 39: GENERAL ELECTRIC MAGNE-BLAST AIR CIRCUIT BREAKERS. Type 4.16KV Vertical Lift Metal clad Switchgear.	31-Oct-95	BKR INFO, Disconnect fingers, finger alignment, primary disconnect	Identifies two field conditions that need to be checked during maintenance or installation. They are depth of penetration of the breaker bushings into the primary disconnect fingers and finger alignment. Inspection and correction criteria given in SAL.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
IN 74-09	Oversized spring discharge roller bar / loose auxiliary switch mounting bolt. A) Metal-Clad, M26 Switchgear; various Magne-Blast breakers B) MC 4.76 Horizontal Drawout Metal-Clad Switchgear w/ AMH 4.76-250 breaker.		BKR INFO, Switch (aux., mounting bolt, roller bar)	A) Determine whether safety related c/b's installed at your facilities use oversized roller trip bars w/ completion date for corr. actions and B) ascertain bolt tightness conditions of aux, switch assembly including long term verification & corr. action.
IN 83-50	General NRC breaker failure concerns dealing with the breakers failing to close on demand due (fuses, connections, contacts)	1-Aug-83	BKR INFO, Failure (close, fuse, connections, contacts)	1) Provide monitoring methods for BKR closing circuit. 2) Check elect. connections, blown fuses, proper return of bkr, and include measures to preclude dirty or corroded contacts (include on PM's). 3) Provide shift Operators training periodically.
IN 84-29	NRC INFORMATION NOTICE 84-29: GENERAL ELECTRIC MAGNE-BLAST CIRCUIT BREAKER PROBLEMS. GE Magne-Blast circuit breakers with the ML-13 operating mechanism.	3-Nov-94	OVRH INFO, Bearings (Aluminum Bronze)	Review this IN and GE's SAL's 318.1,318.1A and 318.2 for applicability and take appropriate action. This SAL also provides ordering information for the Aluminum Bronze bushing & methods to detect potential concerns.
IN 88-50	NRC Information Notice 88-50: EFFECT OF CIRCUIT BREAKER CAPACITANCE ON AVAILABILITY OF EMERGENCY POWER. Affect that can be on all circuit breakers (Duke Power/Oconee)	15-Nov-90	DES INFO, Capacitance (Emergency Power)	Informational; need to consider effects of induced voltages when replacing breakers of a higher interrupting capacity. Higher capacitance across the breaker contacts may be needed.
IN 88-75	NRC Information Notice : DISABLING OF DIESEL GENERATOR OUTPUT CIRCUIT BREAKERS BY ANTI-PUMP CIRCUITRY.	18-Oct-88	DES INFO, Relay (Anti-pump circuit)	Recommends verifying that the configuration of the anti-pump relays are checked to ensure they do not prevent the breaker from operating properly.
IN 88-75 S1	NRC Information Notice (Supplement 1): DISABLING OF DIESEL GENERATOR OUTPUT CIRCUIT BREAKERS BY ANTI-PUMP CIRCUITRY. Magne-Blast and other breakers with anti-pump circuitry. (TVA/Browns Ferry 3, Wolf Creek)	30-Mar-90	DES INFO, Relay (Anti-pump circuit)	Provides additional information on the deficiencies in the anti-pump circuit configuration that causes the relay to stay energized and prevent the breaker from closing.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
IN 91-55	NRC Information Notice 91-55: FAILURES CAUSED BY AN IMPROPERLY ADJUSTED TEST LINK IN 4.16 KV G.E. Vertical Lift Swgr. AFFECTING BREAKER AUXILIARY SWITCH OPERATION	15-Oct-91	SWGR INFO, Link (Test, Aux. Switch)	Review for applicability. Recommends using a modified test link which should prevent recurrence of bent interlock clip.
IN 91-78	NRC Information Notice 91-78: STATUS INDICATION OF CONTROL POWER FOR CIRCUIT BREAKERS USED IN SAFETY-RELATED APPLICATIONS. (Palisades & Ft. Calhoun)	21-May-92	SWGR INFO, Control power (fuse holder clip, indication)	Check BKR DC control power circuit for means of indication in the event of a loss of power to the closing circuit (fuse blown, improperly installed, or removed).
IN 93-28	(Also ref. IN 93-11& generic letter 89-18) Failure to consider loss of DC Bus in ECCS evaluation. (Cooper & Millstone)	4/9/93	DES INFO, Control power (loss, evaluation)	Check to make sure most limiting single failure is considered in LOCA analysis.
IN 93-91	NRC INFORMATION NOTICE 93-91: MISADJUSTMENT BETWEEN GE 4.16-KV Magne-Blast Vertical Lift CIRCUIT BRRS AND THEIR ASSOCIATED CUBICLES.	30-Dec-93	BKR INFO, Switch (Aux, plunger)	Misadjustment between the stationary auxiliary switch and the bkr plunger has the potential to cause multiple common-cause failures of many different logic functions. Refer to GE S.A.L. 350.1.
IN 94-02	NRC INFORMATION NOTICE 94-02: INOPERABILITY OF GENERAL ELECTRIC MAGNE-BLAST BREAKER BECAUSE OF MISALIGNMENT OF CLOSE-LATCH SPRING (PALO VERDE).	1-Feb-94	BKR INFO, Spring (Close-Latch)	1) Inspect the close latch reset spring clearance to the monitoring switch/mounting plate. 2) Incorporate Inspect. into BKR PM procedures. OR 3) Install alternate spring design (Ref. SAL 352.1 for design).
IN 94-54	NRC INFORMATION NOTICE 94-54: FAILURES OF GENERAL ELECTRIC MAGNE-BLAST CIRCUIT BREAKERS TO LATCH CLOSED.	6-Sep-94	BKR INFO, Spring (prop, bushings, overhaul)	1) Bkrs should have two prop springs . 2) Monitor for greater than minimum allowed prop wipe and the absence of failures to latch. 3) Bkrs overhauled that have the new aluminum-bronze bushings, vs. the Teflon ones require two prop springs.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
IN 95-02	NRC INFORMATION NOTICE 95-02: PROBLEMS WITH GENERAL ELECTRIC CR2940 CONTACT BLOCKS IN MEDIUM-VOLTAGE CIRCUIT BREAKERS. (Maine Yankee)	24-Feb-95	BKR INFO, Switch (power, interlock contacts (CR 2940)	1) Iso or rem 5 & 6 interlock contacts. 2) Check interlock switches special mounting screws/ threads missing (d/code MA3XX= (1993). 3) Watch how manual interlock lever op. is done. 4) Monitor new switches for incorrect install. of int. parts.
IN 95-22	HARDENED OR CONTAMINATED LUBRICANTS CAUSE METAL-CLAD CIRCUIT BREAKER FAILURES. ABB HK series 4KV, 6.9KV, K-Line 600V & West. DB-50 600V bkrs. (RIVER BEND UNIT 1, D.C. COOK UNIT 1, LASALLE UNIT 1)	11-May-95	BKR INFO, Grease (Hardening)	While this notice does not identify any problem with a Magne-Blast brk it does make reference that the same issue exist on other bkrs. Ensure manuals and equipment are kept up to date, ref. NRC commitment to Generic Letter 90-03.
IN 95-33	(Also ref. SER 19-95) NRC INFORMATION NOTICE 95-33: SWITCHGEAR FIRE AND PARTIAL LOSS OF OFFSITE POWER AT WATERFORD GENERATING STATION, UNIT 3.	25-Sep-95	BKR/ DES INFO, Switchgear (Fire), grease hardening	Check design of any fast bus transfer circuit to ensure an interlock exist to prevent dual supply of power to a bus. Also ensure proper fire protect requirements exist.
IN 96-43	NRC INFORMATION NOTICE 96-43: FAILURES OF GENERAL ELECTRIC MAGNE-BLAST CIRCUIT BREAKERS. (Dresden, Maine Yankee, Salem)	4-Sep-96	BKR INFO, Grease (Hardening, Dresden)	1) Do not use aerosol degreaser. 2) Putting grease on before the light weight oil will prevent the oil from reaching internal bearings surfaces. 3) Watch out for premature aging of grease by energized heaters. Salem issues also Ref. in SER 7-97.
IN 96-46	Zinc Plating of Hardened Metal Parts and Removal of Protective Coatings in Refurbished/overhaul of Circuit Bkrs. When acid cleaning and electroplating is done on parts hardened to more than RC 30 delayed crack can occur.	4-Sep-96	OVRH INFO, Plating (Zinc, lockwashers (arc chute holders), & latching pawl spring), lubricant (dry film)	Set up requirements on overhauls for plating of parts hardened to RC 30 or greater. Bake at 275 degrees F for 23 hours & do magnetic particle inspection. The parts that have a dry film lubricate and may be removed in an overhaul were identified.
IN 97-08	(Also Ref. SER 7-97, PS 6055, OE 8140, OM 7941, GE SC 97-01, SEN 150, IN 95-02, & OE 7699) POTENTIAL FAILURE OF GE MAGNE-BLAST CIRCUIT bkr subcomponents. (TVA/Watts Bar, NYPA/JAF,BG&E/ Calvert Cliffs, Vermont Yankee, PSE&G/Salem)	12-Mar-97	BKR INFO, Trip Crank, Contact Block, Manual trip lever, Cotter Pins, Latch Pawl pin, Charging motor tie bolts, & HMA Control Relay	Discusses failures of 6 breaker subcomponents; trip crank, CR2940 contact blocks, latch pawl cotter pins, charging motor tie bolts, anti-pump relay and manual trip lever. Inspections recommended of several types, the notice needs to be read.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
IS 842	(Also see SEN-53) Cracked welds discovered between the latch roller link striker plate and the operating mechanism frame (Wolf Creek)	14-Dec-88	BKR INFO, Plate (Striker)	Provide clarification on the SAL 325.1, that this can occur on breakers that have been shipped after 1973 also. Note: This has also been seen on 13.8KV BKRs also.
NRC GL 91-11 (Generic Issues 48 & 49)	LCOs for class 1E vital instrument buses, " and 49, "Interlocks and LCOs for class 1E tie breakers" pursuant to 10 CFR 50.54(f)	18-Jul-91	DES/ OP GENERIC INFO, Scheduling (Tie breakers)	Include time limitations and surveillance requirements for vital instrumentation buses (typically 120VAC), inverters or other onsite power sources to vital instr. buses, and tie bkrs connecting redundant Class 1E buses.
OE 1863	Charging motor mounting bolts loose on AMH breaker.	28-Oct-86	BKR INFO, Motor (Charging Springs, Mounting bolts)	Found insuffient thread engagement from 3/4" long 1/4"-20 bolts. Recommend replace bolts to provide sufficient thread engagement.
OE 2245	(Also ref. SER 87-37, SEN 023, OE 2230) Operator racking out wrong bkr while it was closed, causing a bus loss. Also the bkr interlock that prevents racking out a closed AMH-4.76-250-OD bkr did not function properly. (Quad Cities 2)	29-Oct-87	SWGR INFO, Racking (personnel error)	Operator racked out wrong breaker while it was closed causing a loss of bus. In addition the breaker interlock preventing racking out a closed breaker did not function properly. Info only.
OE 2995	Cracked Welds in GE Magne-Blast circuit breakers. (Wolf Creek)	4-Nov-88	BKR INFO, Plate (Striker)	Provide clarification on the SAL 325.1, that this can occur on breakers that have been shipped after 1973 also. Note: This has also been seen on 13.8KV BKRs also.
OE 3153	(Also Ref. PS 6055, SEN 150 (IS 1330), SER 7-97, NRCN 97-08) Potential common cause failure of circuit breakers due to procedure deficiency. AM/AMH Magne-Blast Breakers at least 4KV (New York Power Authority- JAF)	6-Feb-89	OVRH BKR INFO, Prop pin, snap ring, refurbishment, overhauling, Latch Pawl	Describes failure at Fitzpatrick, of a breaker to trip as a result of improper overhaul by OEM. Prop pin was misaligned which resulted in the prop striking the snap ring and coming loose. The prop pin may have come loose axially and entered the hole.
OE 3436	Problems with circuit breaker control circuit stabs, two secondary stabs shorted together. (Commonwealth Edison)	29-Jun-89	BKR INFO, Control power (Secondary pins, contacts)	1) Use a protective cover over the pins when working on the BKR. and/or 2) Inspect secondary pins for damage just prior to racking the breaker up.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
OE 3578	Pump trip due to circuit breaker prop spring failure. (New York Power Authority)	4-Oct-89	BKR INFO, Spring (Prop)	Information concerning fatigue failure of prop spring. No recommended action. Contact NORM HOY (315)-349-6203.
OE 3917	GE Magne-Blast Circuit breakers, manual close push button found stuck in depressed position. (Arizona Public Service)	3-May-90	BKR INFO, Manual trip push button	Provide measures to ensure that the manual push button and prop latch roller are in the correct position following manual closing or maintenance.
OE 4329	Bending of plunger interlock clip during testing.	10/10/90	BKR INFO, Switch (plunger clip)	Fuel Building Flooding Event check for bent clip.
OE 4500	Holes found in booster cylinder of GE Magne-Blast circuit breaker. AM/AMH Breakers at least 6.9KV. (TVA - Watts Bar)	4-Apr-91	BKR INFO, Booster Cylinder (Holes)	No corrective actions. Information describing degraded condition of booster cylinders. Small holes found in lower half of some cylinders.
OE 4536	High resistance on aux switch contacts. Type SBM aux sw. with Magne-Blast type AMH 4.76-250-0D/1D breaker. (Northern States Power)	4/16/91	BKR INFO, Switch (Aux., Contacts)	Maint. procedure upgraded to include cleaning of contacts. Operations procedures revised to provide instructions for loss of red light condition.
OE 5176	Unit 1 RPS power supply circuit breaker tripped during breaker indication light change out Browns Ferry Nuclear plant. This occurred as a result of the an arc that was generated by the lamp socket. (TVA)	26-Mar-92	SWGR INFO, Control power (indication light)	Recommend ensuring that a separate fuse be used for breaker indicating circuit than the fuse for protective circuitry, such as undervoltage, overvoltage and underfrequency.
OE 5765	Inoperable 6.9 KV circuit breaker (Manf. not identified) for the unit 1, B train, safety injection pump as a result of the manual push button becoming lodged behind the coverplate. (TVA/ Sequoyah)	7-Jan-93	OP INFO, push button	Provide means for trip push button verification after use.
OE 5781	Mechanical binding of the trip coil, eventual burnup and failure of breaker to open. AM/AMH at least 4K. (Maine Yankee)	1/19/93	BKR INFO, Coil (Trip Armature binding)	May want to inspect beakers for similar binding of the trip coil.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
OE 5881	Breaker did not latch closed due to a bent trip latch crank which held the bkr in a trip-free condition. The crank was bent when it impacted the door of the cubicle as the bkr was rolled out. Magne-Blast AM4.16KV (Millstone Unit 1)	23-Mar-93	BKR INFO, Trip Crank latch, interlock	Check for bent trip latch crank during PM and be careful while removing and installing bkrs.
OE 6367	GE 4KV Circuit Breaker Limit Switch Failure model CR2940U301 sw. on Magne-Blast type AM 4.16-250 breaker. (Maine Yankee)	20-Dec-93	BKR INFO, Switch (Limit)	Due to failure of normally closed sw. recommends verifying continuity of close permissive sw. (when closing spring is charged). Contact Bill Barry (207) 882-5681.
OE 6502	Positive interlock assembly out of adjustment on GE metal clad switchgear - 4.16KV NNS circuit breaker cubicle. Found positive interlock assembly out of adjustment with damaged interlock switches. (Maine Yankee)	15-Mar-94	BKR INFO, Switch (Positive interlock)	Recommends visual inspection with breaker in operating position to determine whether maintenance adjustments are required.
OE 6527	Adverse conditions found on 1E 4.16KV safety related circuit breakers. (Maine Yankee)	28-Mar-94	BKR INFO, Switch,(interlocking, close latch monitoring)	Found loosely secured lower interlock switch and a failure of the close latch monitoring switch to reset due to interference from tension style spring.
OE 6595	Intermittent automatic bus transfer failure due to circuit breaker malfunction. During testing of the automatic bus transfer circuit. Found snap ring out of position. Transfer Switch Manufacturer and type unknown. (Northeast Utilities/ Connecticut Yankee)	26-Apr-94	BKR/ SWGR INFO, Bus (transfer)	Info only, concern of missing parts on bkr. identified.
OE 6698	(Also ref. SAL 352.1) Close (Release) Paddle return spring modification (Torsion style) on safety related 4.16 KV Magne-Blast Circuit Breaker. (Maine Yankee)	7-Jun-94	BKR INFO, Spring (Close release paddle, torsion style)	When the new close paddle spring mod. is performed, by outside agents during an overhaul, a review for proper installation is recommended.
OE 6737	(Also ref. OE 6741 for a phone contact correction) SAFETY RELATED 4.16 KV MAGNE-BLAST CIRCUIT BREAKER. Identifies potential concern of broken arcing contact tips. AM/AMH at least 4kV (Maine Yankee)	1-Jul-94	BKR INFO, Contacts (arcing contact tips cracked)	May want to inspect for broken arcing contact tips.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
OE 6790	Failure of a trip circuit breaker to open during functional testing of an RPS due to broken switch piece lodged in the trip mech. Ground and Test Device type GV for Vertical Lift Switchgear Type M26, M26H, M36, M36H, M36HN, M36HH (Florida Power & Light).	27-Jul-94	Test Device (Test/Ground) Object (Broken switch piece)	Informational to inform owners of vertical switchgear that the "simple" ground and test device type GV is still in production.
OE 7128	GE Magne-Blast type AM 4.16-250-8H Medium Voltage Circuit breaker fails to properly align with switchgear Cubicle. Guide pin spacer washers were not installed to match the breaker truck with the guide tracks of the cubicle. (PECO)	2-Mar-95	SWGR INFO, Spacers (alignment)	Recommends attention to dimensions and number of spacers should be highlighted or recorded during maint. tasks to prevent recurrence of problem.
OE 7300	4160 Volt Circuit Breakers Secondary Disconnect Pins on an ABB replacement BKR for the Magne-Blast BKR were made of a softer material that could be radially compressed. (Omaha Public Power)	2-Jun-95	OVRH INFO, Control power (secondary disconnect Pins, ABB)	If replacing BKR's check to make sure the new BKR pins are made of hard enough material to prevent radial compression.
OE 7571	OPERATING PLANT EXPERIENCES OE 7571 - CRACKED CAM SHAFTS ON GENERAL ELECTRIC (GE) MAGNE-BLAST CIRCUIT BREAKERS. 4 kv and 7.2 kv Magne-Blast circuit breakers. (MAINE YANKEE)	30-Nov-95	BKR INFO, Cam (Shaft Crack)	1) Elect Maint.: Incorporate a cam shaft inspection into Maint. Program. Check set screws holding sw. cam, main cam and ratchet wheel. 2) Training: Incorporate as above for Training Program. 3) Engineering: find root cause of shaft failure.
OE 7572	OPERATING PLANT EXPERIENCES OE 7572: MISALIGNED LATCHING PAWL SPRINGS ON GENERAL ELECTRIC (GE) MAGNE-BLAST CIRCUIT BREAKERS (MAINE YANKEE).	28-Nov-95	BKR INFO, Spring (Latching Pawl, misalignment)	Include in PM procedure & training a check to make sure that the latching pawl spring and pin are inspected.
OE 7874	(Also ref. OE 8213) OPERATING PLANT EXPERIENCES OE 7874: FAILURES OF GENERAL ELECTRIC (GE) MAGNE-BLAST BREAKERS TO OPEN. (ANO)	10-Jun-96	BKR INFO, Roller (trip latch, hardened grease), coil (trip, loose set screw)	1) Provides some evidence for the need to overhaul to remove the old D50H15 grease. 2) Check trip coil linkage set screw for alignment and tightness.
OE 7875	(Also ref. NRC IN 96-46 & PS 5647) OPERATING PLANT EXPERIENCES OE 7875: ZINC PLATING OF CIRCUIT BREAKER PARTS CAN CAUSE INADVERTENT HYDROGEN EMBRITTLEMENT OF OTHER PARTS. (SALEM)	27-Jun-96	OVRH INFO, Plating (Zinc, Hardened Metal Parts)	Set up requirements on overhauls for plating of parts hardened to RC 30 or greater. Bake at 275 degrees F for 23 hours & do magnetic particle inspection. The parts that have a dry film lubricate and may be removed in an overhaul were identified.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
OE 7921	Inadvertent closing of #235 circuit breaker in 500KV switchyard, 500KV Circuit Breaker Manufacturer & type unknown. (PEC/Limerick 2)	27-Jun-96	SWGR INFO, Failure (Inadvertent Closing)	Operator inadvertently closed the generator output breaker without the generator being aligned for closure. Info only.
OE 7994	Door latch failure on GE 4.16KV Class 1E Switchgear. (Wolf Creek)	23-Aug-96	SWGR INFO, Latch (Door)	Monitor switchgear door latches and assemble for proper contact, missing handle shaft pins, latch C-clips, and proper tightness of latch nuts.
OE 8015	Door latch failure on GE 4.16KV switchgear, additional clarification. (Wolf Creek)	9/9/96	SWGR INFO, Latch (Door)	Monitor switchgear door latches and assemble for proper contact, missing handle shaft pins, latch C-clips, and proper tightness of latch nuts.
OE 8070	4KV Magne-Blast Breaker Trips Free Following Closing Actuation, Adjusting primary gap by adjusting the opening spring length reduced the trip latch clearance to zero. (Salem)	28-Oct-96	BKR INFO, Prop, Latch, (trip latch gap, failure (trips free after close signal)	Alert the industry adjusting the trip latch by adjusting the opening spring can cause trip free operations. Perform complete PM on bkrs after an overhaul. Ref. This OE notice and others for corrective action.
OE 8213	(Update to OE 7874) INPO Operating Plant Experiences OE 8213: Failures of General Electric (GE) Magne-Blast Breakers to Open. (ANO)	27-Feb-97	BKR INFO, Roller (trip latch, hardened grease), coil (trip, loose set screw)	1) Provides some evidence for the need to overhaul to remove the old D50H15 grease. 2) Check trip coil linkage set screw for alignment and tightness.
OE 8289	Class 1E 4160 VAC relays on swgr compartment doors not seismic qualified when cubicle doors are left open and unattended, or when the breaker is in any position except the fully racked-in position. (Peach Bottom)	6-Mar-97	SWGR INFO, Latch (Door)	Recommend that the seismic requirements be reviewed. Install seismic restraints between the compartment doors and the compartment walls, if needed, to keep the door as rigid as if the door was closed.
PS 2992	NRC DAILY PLANT STATUS REPORT PS 2992: INCORRECTLY ASSEMBLED PUFFER TUBE ASSEMBLIES FOR 4160VAC GENERAL ELECTRIC BREAKERS (10CFR21) (CLINTON).	13-Jan-94	BKR INFO, Booster (Puffer Tube)	New parts (puffer tube assemblies) were found to be incorrectly configured and poorly constructed. Lesson; inspect parts prior to installation.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
PS 4706	NRC DAILY PLANT STATUS REPORT PS 4706: FAILURE OF 4KV GENERAL ELECTRIC (GE) SWITCHGEAR. Failed plastic (lexan) parts within aux. switches are causing switch failures. Signs of stress or hydrocarbon corrosion were found. (SALEM).	29-Dec-95	BKR INFO, Switch (Aux. Contact)	Check Aux. switches to see if your plant uses the plastic (lexan) parts that are failing and if so check for signs of stress or hydrocarbon corrosion. Contact Steve Hill, INPO (770) 644-8384 for additional info.
PS 6055	(Also Ref. OE 8140, SEN 150 [IS 1330], SER 7-97, & NRC IN 97-08) Safety Class Breaker Common Cause Failure Mode, AM/AMH at least 4KV. (Vermont Yankee)	26-Nov-96	BKR INFO, Pin; Cotter Pin	None per PS, Recommend cotter pin inspection and consider replacing cotter pins with hinge pin. See SAL 352.1 item 6
PS 6459	INPO Daily Plant Status Report PS 6459: Circuit Breaker Test Equipment Not Calibrated (Millstone)	13-Mar-97	OP INFO, Test Equipment (Calibration)	Ensure calibration program include all measuring devices used on the breakers.
SEN 142	(Also ref. IS 1310 & OE 8007) Significant Event Notification SEN 142: Failure of Safety-Related Circuit Breakers to Latch Closed During Testing due to interference between the trip paddle and the trip latch on horizontal breakers. (Calvert Cliffs)	12-Dec-96	BKR INFO, Failure (Latch closed)	Re-enforce the trip paddle on horizontal breaker per GE instructions to follow. GE is also looking into, with a future SAL, a method of measuring the trip latch force. (Ref. GE SAL 360.1)
SEN 150	Significant Event Notification SEN 150: Potential Common-Cause 4kV Breaker Failures because of the latching pawl hinge pin cotter pins had failed. (Vermont Yankee)	7-Mar-97	BKR INFO, Spring (Latching Pawl, Pin)	1) Recommend specific checks of the latch pawl cotter pin as well as all other bkr cotter pins. 2) Establish a process and/or indication that can ensure that the charging spring status is properly verified.
SEN 76	(Also Ref as IS 1004) Breaker auxiliary switch failure due to bending of the plunger interlock clip during testing. GE Magne-Blast Vertical Lift breakers with optional cell mounted aux. switches.	18-Jan-91	BKR INFO, Switch (plunger clip)	Discovered bent interlock clips to some degree in 32 breakers. Maint. procedures were revised to inspect the interlock plunger gap to help detect a bent interlock clip. Evaluated the design and use of test link. Replace bent interlock clips in breakers.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
SER 12-96	Significant Event Report SER 12-96: Nonlicensed Operator Rounds and Surveillances Fail to Detect Missing Diesel Generator Breaker for 3 weeks, General bkr issue. (Susquehanna)	24-Dec-96	OP INFO, Rack out (operator error, missing Bkr)	This notice is included as an info. only issue. During walkdowns monitor for proper configuration and after tests establish effective post maintenance tests.
SER 13-89	(Also ref. as IS-880) Fire in 1TA 6.9KV switchgear; cause not given (Oconee 1)	12-May-89	OP/ SWGR INFO (Fire)	Provide discussion on the proper chemicals to use when fighting a fire in switchgear.
SER 14-87	SIGNIFICANT EVENT REPORT 14-87: BREAKER FAILURE DUE TO LOOSE CLOSING SPRING CHARGING MOTOR MOUNTING BOLTS.	11-Jul-88	BKR INFO, Motor (Charging Springs, Mounting bolts)	1) Maint. inspections should include tightness check. 2) Should consider use of a thread adhesive. 3) Consider replacement of bolts with longer bolts as directed by GE. 3) Operations should monitor charging motor indication.
SER 16-95	SIGNIFICANT EVENT REPORT 16-95: INAPPROPRIATE OPERATOR ACTION RESULTS IN STARTING A CORE SPRAY PUMP IN A DRAINED LOOP.	13-Jul-95	SWGR INFO, Operator action	Human factor concerns in the process of racking out a bkr are identified. Should use selective sequencing to ensure a selective trip feature exists. Maintaining proper labeling and operator instructions for racking bkrs in and out is important.
SER 19-95	(Also ref. IN 95-33 & same as IS 1257) SIGNIFICANT EVENT REPORT 19-95: DEFICIENT FAST BUS TRANSFER RESULTS IN REACTOR SCRAM AND FIRE IN 4.16-KV NON-VITAL SWITCHGEAR. (Waterford 3)	29-Sep-95	BKR/ DES INFO, Switchgear (Fire), grease hardening	Check design of any fast bus transfer circuit to ensure an interlock exist to prevent dual supply of power to a bus. As so ensure proper fire protect requirements exists.
SER 24-87	(Also ref as IS 701) FAILURE OF 4KV BRKS TO TRANSFER on demand due to binding (caused by hardened grease & dirt) of the stationary auxiliary switch (SBM, SB-12) linkage. (Id. on GE TYPE MC-4.76 Horizontal bkr)	20-Jun-88	BKR/ SWGR INFO Switch (Auxiliary, switchgear (transfer)	Periodically inspect aux. switches during PM for adequate lubrication, cleanliness, and operability.
SER 36-87	(Also ref. as IS-726) Electrocution while performing maintenance on a partially energized switchgear	4-Dec-87	OP/ MNT/ SWGR INFO (Electrocution)	Precautionary methods identified, info. only.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
SER 37-87	(Also ref. as IS 727) ELECTRICAL FLASH RESULTING FROM ATTEMPT TO RACK-OUT CLOSED 4.16 KV BUS BREAKER. (Quad Cities)	27-Jul-88	BKR/ SWGR INFO, Rack out (operator error)	1) Use proper safety equip. 2) Check and test interlocks during PM. 3) Use self verification method & make sure you check both mech. and elect. indicators. 4) Provide comp. identification on the inside of the cabinet.
SER 48-84	(Also ref. as IS 460 & ref. IS 395, SER 83-28, LER 84007 & 8) AMH-4.76-250-OD, AKF-2-25 Bkrs failed to open due to Trip latch roller lubrication hardening on separate occasions. (Monticello)	6-Feb-84	BKR INFO, Grease (Hardening, Trip Latch)	Info only, but recommend checking lubricant condition.
SER 7-97	(Also ref. as IS 1347 & ref. PS 6055, OEs 3153 & 8140, SEN 150, NRC INs 96-43 & 97-08) Operating Mechanism Problems in Medium-Voltage Circuit Bkr. Failure to latch, hydrogen embrittlement, hardened grease, cotter pin failure, & control of info.	27-Mar-97	BKR INFO, prop, Latch, spring, plating, hardened grease, cotter pin	The information in this SER is too extensive to do justice to the recommendations provided in this list. Thus, the recommendation is to get a copy of the notice and evaluate it for improvements in each plant's program.
SOER 82-16	DE-ENERGIZED BREAKER CHARGING SPRING MOTOR as a result of operator or maintenance failure to realize that the control circuitry has been de-energized, with no monitor with shift changes.	13-May-87	BKR INFO, Motor (Charging, circuit energized check)	1) Ensure training emphasizes methods to verify the bkr charging motor circuits are energized. 2) Ensure bkr charging motors are energized after maint. or testing, following extended outages and during bkr lineup cks.
SOER 83-06 R4	UNAVAILABILITY OF EMERG POWER CAUSED BY DIESEL AND BRK CONTROL CIRCUITRY DESIGN. Recom 4: OP Training programs should be revised to include operation of bkrs under normal operations. (Almaraz 1, North Anna 2, & Millstone 1)	25-Sep-86	DES INFO, Control power (design problems)	Breakers used to connect emergency buses to offsite power sources need to have their control circuitry design reviewed (per this document concerns).
TI 14894	GE AM and Siemens-Allis type FA NNS 4.16 KV Circuit breaker Problems. A retaining ring (snap ring) came out of the groove on the drive shaft engaging roller, bkr in trip-free condition as a result. (Florida Power & Light)	22-Nov-95	BKR INFO, retaining ring	Check as part of PM procedures for missing snap rings on the bkr.
GE SAL 304.1	GE SERVICE ADVICE LETTER SAL 304.1 V/L (vertical lift) Spring Discharge Cam (this SAL discusses a new cam mounted on the left side).	3-Sep-70	DES INFO, Cam (Spring Discharge)	No corrective action required, this SAL identifies the function of the left side spring discharge cam.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
GE SAL 314.1	GE SERVICE ADVICE LETTER SAL 314.1 4.16 Hor. Drawout: SB-1 Switches.	20-Sep-74	BKR INFO, Switch (Horizontal Drawout, SB-1)	If 'a' contacts fail to make contact or switch shaft is misaligned replace with new switch shaft crank and verify proper operation .
GE SAL 318.1, 1A, & 2	(Supercedes the sleeve bearing replacement part of SAL 312.1) Provides replacement of TUF-LOC sleeve bearings with Aluminum Bronze ones.	2/17/77 through 3/22/1979	BKR/ OVHR INFO, Bushing (Tuf-Loc), Sleeve Bearing	Urges customers to replace tuf-loc with al-bronze bushings. Per 318.1A breakers mfg since 1975 have used the al-bronze bushings. See SAL 312.1 and SAL 352.1. SAL 352.1 covers prop bushings not covered in this SAL. See IN 84-29.
GE SAL 323.1	4.16 V/L: Primary Disconnecting devices, specifies breaker critical dimensions for interface with cubicle.	1-Feb-78	BKR/ SWGR INFO, Plunger, interlock, penetration	Provides recommendations for checking critical breaker to cubicle dimensions.
GE SAL 330.1	AM bkrs: SB-12 switches used in nuclear sites & Power Vac BKRs in nuclear applications. (Also ref. GE SAL 175-9.5 for the same issue on AKR bkrs)	2-Jul-79	BKR INFO, Switch (SB-12)	Replace type SB-12 switches shipped from GE between Aug. 1, 1978 to July 1, 1979. Check for intermittent continuity through 'a' contacts in trip coil circuit.
GE SAL 334.1	Power/ VAC Manual ground & Test Devices, Ground and Test Device Type PVV Power Vac Switchgear	27-Jun-80	Test Device (Test/Ground)	Potential safety hazard, BUS/LINE OR LOAD label could be reversed. Recommend installing a padlock clip field modification.
GE SAL 350.1	Adjustments between GE type AM circuit breakers and vertical lift switchgear stationary auxiliary switch-plunger interlock, and other breaker to switchgear interfaces.	31-Mar-94	BKR/ SWGR INFO, Plunger, switch, interface plate, stop bolts	Check breaker to switchgear interfaces for correct plunger travel & gap, make & break of 152 STA aux. switch, bent plunger clips, elev. mech. limit switch & stop bolts, primary & secondary disconnect penetration, and positive interlock mechanism.
GE SAL 353.1	Available ground & Test Devices for Medium voltage vertical lift switchgear, Ground and Test Device Type GV Power	25-Aug-95	Test Device (Test/Ground)	This SAL is for information only. It states that the GE ground and test device is available and provides the part number for the different types.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, If Any
GE SAL 356.1	GE Service Advice Letter SAL 356.1: M26, M26H, M36, M36HN, M36H Vertical Lift Switchgear 52 STA Auxiliary Switch Test Position Operator (test linkage) can bend the plunger clip.	18-Feb-98	BKR/ SWGR INFO, Test linkage, plunger	Recommends using the new still test linkage as specified in the SAL to avoid bending of the plunger clip. The new linkage has a guiding slot in it.
GE SAL 358.1	(Also ref. SAL 352.1) GE Service Advice Letter SAL 358.1: ML-13, ML-13A Mechanism 4.16, 7.2 and 13.8 KV AM & AMH Circuit Breakers Latching Pawl Pivot Pin redesigned to no longer use cotter pins.	20-Feb-97	BKR INFO, Latch pawl, cotter pins	Provides a recommended latch pawl pivot pin modification. The new design uses a sholder pin as a pivot & a bolt to hold it in place versus cotter pins to secure the pivot pin. Item 6 of SAL 352.1 recommendation was upgraded to strongly recommended.
GE SAL 359.1	GE Service Advice Letter SAL 359.1: Trip Crank (0105C9816G001) Ml-13, ML-13A Mechanisms Type AM Circuit Breakers. Trip crank pin that connects to the trip coil linkage is subject to breaking off due to improper welding/grinding.	18-Feb-98	BKR INFO, trip crank pin	Visual inspection of the trip crank assembly pin is needed to determine if weld on the back of the pin has been ground off too far. A minimum weld height of .031 to .062 is specified.
GE SAL 360.1	GE Service Advice Letter SAL 360.1: Manual Trip Lever Mechanisms 4.76 KV-250 MVA Horz. draw out Type AM Breakers was bending and the spring was found with not enough force. Required trip latch reset spring force is specified.	18-Feb-98	BKR INFO, Horz., trip lever/ shaft/ latch spring	As problem is experienced it is recommended that the trip lever and spring discharge link be replaced with redesigned ones and make other mod. as identified in SAL.
GE SAL 362.1	GE Service Advice Letter SAL 362.1: Trip Latch to Roller Clearance on ML-13 & ML-13A Mechanisms all Type AM Breakers. The min. clearance between the trip latch and trip latch roller are identified.	18-Feb-98	BKR INFO, trip latch/ roller	Check and apply the identified preferred/ min. trip latch to roller clearance if the check is normally done, whenever the adjusting plate on the opening spring is moved, and if the bkr is experiencing trip free operations.
GE SAL 508.0	ROOF ENTRANCE BUSHING FIELD EXAMINATION AND SEAL ASSEMBLY TO PREVENT MOISTURE LEAKAGE due to part dimensions & assembly techniques on POWER/VAC DISTRIBUTION BREAKERS. Generic bkr issue.	10-Apr-85	BKR/ SWGR INFO, Bushing (Switchgear, Outdoor)	1) Non-organic, air filled bushings power factor concerns identified about storing without heat. 2) Design to improve the seal is identified.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
GE SIL 498	GE SERVICE INFORMATION LETTER SIL 498: SB1 AND SB-9 SWITCH LOCKUP S498. SIL 498 describes two events where SB-1 and SB-9 switches that were equipped with Corbin lock handles failed to operate properly due to loose screws.	3-Jul-96	BKR INFO, Switch (SB-1 and SB-9)	Inspect switches for looseness in the lock handle. Tighten handle lever casting to lock cylinder screws per notice instructions and apply sealant such as Loctite 242.
IN 87-41	NRC Info Notice 87-41: ABB/ Brown Boveri loose spring charging motor bolts.	31-Aug-87	BKR GENERIC INFO, Motor (Charging Springs, Mounting bolts)	This IN was for ABB breakers but generic loose bolts could be applicable to Magne-Blast BKRs and has been documented. Ref. SER 7-97, PS 6055, OE 8140, OM 7941, GE SC 97-01, SEN 150, IN 95-02, IN 97-08, & OE 7699.
IN 88-42	NRC INFO Notice 88-42: ABB/Brown Boveri loose spring charging motor bolts.	23-Jun-88	BKR GENERIC INFO, Motor (Charging Springs, Mounting bolts)	This IN was for ABB breakers but generic loose bolts could be applicable to Magne-Blast BKRs and has been documented. Ref. SER 7-97, PS 6055, OE 8140, OM 7941, GE SC 97-01, SEN 150, IN 95-02, IN 97-08, & OE 7699.
IN 89-86	NRC INFO Notice 89-86 ABB HK Circuit breakers missing close latch anti-shock spring.	15-Dec-89	BKR GENERIC INFO, spring, close latch	The Magne-Blast breakers do not use an "anti-shock spring." Various spring issues have been addressed for GE breakers under other notices.
IN 96-50	NRC INFO Notice 96-50: Levering in problems with Westinghouse breakers	4-Sep-96	SWGR/ BKR Generic INFO, Racking, ravering	Inspect racking mechanism and lube as necessary.
IN 97-53	NRC Info Notice IN 97053: Circuit Bkrs left Racked out in Non-Seismically Qualified Positions is a concern in various racked out positions. (Also ref. OE 8289 Peach Bottom, OE 7994 Wolf Creek, PS 6235 WNO, PS 6223 South Texas, & PS 6140 Susquehanna)	20-Aug-97	SWGR/ BKR/ DES INFO, Qualification, Seismic	Check to ensure seismic qualification of switchgear exists for the breaker in all positions (racked out, test position, etc.).
LER 84-006-00	Magne-Blast bkr failure to remain closed due to excessive wear in the TEFLON coated fiberglass sleeve bearings used in the mechanical actuator.	17-Feb-84	BKR INFO, bearings	Check for excessive wear, repair using aluminum bronze sleeve bearings.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
LER 85-023-00	Magne-Blast bkr problems with the positive interlock microswitch failing to get fully actuated as it does not engage until the last 3/32". Actuated when operator pulled back the racking motor clutch and allowed it to spring return. (Waterford 3)	8-Jun-85	BKR INFO, micro switch	Train Operations personnel on racking in techniques and put together bkr/cubicle check list to be used when racking in the bkr.
LER 86-004-00	Magne-Blast bkrs failed to close on demand due to charging motor secondary coupler pin being misaligned. (Maine Yankee)	9-Jul-86	BKR/ SWGR INFO, secondary coupler	Provide a specific reference in the inspection procedure to check for misaligned coupler pins and bent/pitted tips.
LER 87-006-01 LER 86-018-00	(also ref. SER 14-87) Magne Blast bkr spring charging motor was found not attached. The motor was mounted with three 5/8" long bolts and one 3/4" long bolt. BKR had been overhauled about one year before the failure. (Salem 1)	25-May-87	BKR INFO, Motor, bolts	Use a 1/4"X20X3/4" bolt with flat washer, shim, and lockwasher. Check tightness of bolt during PM, tighten until lockwasher is flat plus 1/4 turn, and apply F-900-torque seal over bolt head, lockwasher, flatwasher, and mounting plate to detect movement.
LER 87-012-01	Magne-Blast bkr mechanical linkage of the cell switch was binding because of grease and dirt accumulation on the linkage. (Browns Ferry 1)	6-May-87	BKR INFO, grease/ dirt, cell switch linkage	Clean and lubricate all similar position & cell switch linkages.
LER 88-010-01	Bus faulted to ground and started a fire in the switchgear & bkr did not open. Fast bus transfer did not take place, drawing discrepancy existed in other circuit, bus insulation was degraded and the XMFR protection scheme allow damage. (Palo Verde)	6-Jul-88	SWGR/ DES INFO, insulation, degraded grease	Check house cleaning controls for buses and identify proper methods for cleaning the bus and the breakers. Do cleaning at an adequate frequency.
LER 88-012-00	Magne-Blast bkr charging motor failed as the motor fan (press fit to the rotor shaft) had loosened. This damaged the internal parts of the motor preventing it from functioning. (Salem 2)	18-Jun-88	BKR INFO, Motor	No real recommendation just identification of a different type of motor failure.
LER 88-014-01	Procedural deficiencies by the vendor performing overhauls caused Magne-Blast bkr failures to trip probably due to improper assembly of a portion of the trip linkage such that the prop struck and bent snap rings and spacers. (Fitzpatrick)	5-Dec-88	BKR/ OVRH INFO, trip linkage, snap rings, spacers	Check tolerance between the prop and the snap-ring on the prop pin. Verify before/during/after overhauls that equal right and left hand clearances between the prop and the prop-pin snap-ring and shims exist (end of prop pin to frame clearance).

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
LER 90-029-00	Magne-Blast bkr failed to close, the positive interlock switch was not closing as the positive interlock assembly was found to be out of adjustment/worn. (Salem 1)	17-Aug-90	BKR INFO, switch, positive interlock	Verify proper positive interlock switch to actuator arm gap setting. May want to visually check after breaker is racked up.
LER 91-003-00	Bus failed to fast bus transfer. A loose and misaligned early "b" contact with a loose wire connection, on the normal supply magne blast bkr, responded to slow to allow the close signal to the alternate fdr bkr. (Palo Verde)	9-Aug-91	BKR INFO, contact early "b"	Time fast bus transfer breaker for the proper response time.
LER 91-004-00	Magne-Blast bkr SBM aux. switch contacts in the trip circuit had high enough contact resistance to prevent the breaker from being tripped. (Monticello)	15-Mar-91	BKR INFO, Aux. switch	Clean contacts at a regular frequency.
LER 91-006-00	Magne-Blast bkr would not stay closed for more than a few seconds as a result of the control (anti-pumping) relay (P/N 0137A7575) having a faulty coil. (Maine Yankee)	30-May-91	BKR INFO, Relay, anti-pump	No real recommendation just identification of a type of relay failure.
LER 91-014-00	(Also ref. IN 97-053) Circuit Bkrs left Racked out in Non-Seismically Qualified Positions is a concern in various racked out positions. This notice specifically addresses a concern with tie bkrs. (ANO 2)	13-Jun-91	SWGR/ BKR/ DES INFO, Qualification, Seismic	Check to ensure seismic qualification of switchgear exists for the breaker in all positions (racked out, test position, etc.) and ensure the review covers the tie breakers.
LER 92-002-00	(Also ref. IN 90-41 & 94-54) Magne-Blast bkr failed to stay latched as a result of a prop spring breaking after over 2900 cycles. (Oyster Creek)	21-Apr-92	BKR INFO, Spring (Prop)	Recommends inspection of prop spring. Install replacement (lower) prop spring during scheduled maintenance esp. prior to 2000 accumulative operations. Also ref. GE SALs on topic.
LER 92-003-00	Magne-Blast bkr failed to close, the pos. interlock switch was not closing as the pos. interlock roller was resting against the upper half of the upper "V" notch of the SWGR. This resulted in high resistance on the pos. interlock switch. (Palo Verde 3)	3-Sep-92	SWGR/BKR INFO, positive interlock roller	Ensure procedures identify the proper position of the pos. interlock roller with respect to the "V" notch and the interference plate. Train/document checks such that each time a bkr is racked up the correct interface with the cubicle is achieved.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
LER 94-006-00	Four Magne-Blast bkrs failing to close after being overhauled. Interlock switch failed in the open position, a weak prop spring was found, sporadic failure of a normally closed power switch (indeterminate), & unsecured int. switch found. (Maine Yankee)	24-Mar-94	BKR/ OVRH INFO, switch, Spring (prop)	Reference IN 95-02, OE 6367, OE 6502, & OE 6527. This LER provides added detail and identifies a check list of items that can cause failures to close.
LER 95-001-00	Magne-Blast bkr failed to open in the time required to complete the fast bus transfer due to hardening of the lubricants. (Wolf Creek)	8-Mar-95	BKR INFO, Lubrication	Review all breaker applications for those that require a fast response time and adjust PM frequencies accordingly.
LER 96-001-01	Horiz. Magne-Blast bkr failed to close as a result of improper auxiliary switch contact alignment with the test linkage (bent arm). (Dresden)	13-Jan-96	BKR/ SWGR INFO, Switch (Aux.), Test link interface	Ensure bkr/ SWGR interfaces with the aux. switch are checked as required by the Manf. during PM & installation of test linkage.
LER 96-005-00	Automatic start occurred of the diesel generator as a result of a contract person improperly taking the continuity readings at the wrong terminal points of the feeder breaker by not following procedures. (Dresden)	18-May-96	OP/ MNT/ SWGR INFO, procedures	Confirmation is provided as to the importance of performing self checks on work activities and job briefing, this should include contract personnel.
LER 97-007-00	(Also ref. IN 97-053) Circuit Bkrs left Racked out in Non-Seismically Qualified Positions is a concern in various racked out positions. (Clinton)	27-Feb-97	SWGR/ BKR/ DES INFO, Qualification, Seismic	Check to ensure seismic qualification of switchgear exists for the breaker in all positions (racked out, test position, etc.).
OE 6226 LER 93-008-00	MAGNE-BLAST bkr with plunger interlock and cell mounted aux. switch. Plunger and metal-clad swgr stationary Aux. switch operating rod interaction concern due to improperly adjusted operating rod on bkr . (Duane Arnold)	5-Oct-93	BKR INFO, Switch (plunger adjustment)	Recommend checking for open 'b' contacts when circuit bkr is open each time the bkr is racked up. Duane Arnold changing maint. proc to require the plunger interlock gap be greater than 0 but less than 1/8".
OE 7521 LER 94-013-00	Closing spring failed to charge due to misalignment of charging solenoid. (Diablo Canyon)	13-Oct-95	BKR INFO, Solenoid/ coil (release/ closing, installation)	If trip/ release coils have been or are to be replaced properly shim/ align spring release solenoid (Ref. pg. 27 of GEK 7320 R/F). Incorporate vendor recommendations for shimming in maintenance procedures.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
OE 7546	Failure of a GE Magne-blast breaker to close due to closing latch getting hung up on the spring release closing foot and due to the closing latch being closer to the bkr frame than other breakers. (Arizona Public Service)	2-Nov-95	BKR INFO, Latch (Closing, spring release foot)	1) Add 3rd washer to the spring release device closing foot pin to reduce the amount of play (ref. fig 2-6, item 2 & 14 of MBUG PM guide R/2). 2) Increase the gap between the closing latch & breaker frame. (Check with GE before doing)
OE 7699 LER 96-002-00	GE MAGNE-BLAST 4.16KV BREAKER FAILURE TO CLOSE - CONTACT BLOCK CR2940 HIGH RESISTANCE as a result of arcing that occurs when interrupting an inductive load. (Also reference OE 8070) (James A. FitzPatrick)	28-Feb-96	BKR INFO, Contact (block, CR2940)	Need to inspect/test the CR2940 switch contacts. 10CFR21 was initiated.
OE 7846 LER 96-009-00	OPERATING PLANT EXPERIENCES OE 7846: GE 4KV MAGNE-BLAST BREAKERS FAIL TO LATCH due to misalignment of the bkr mechanism. Mechanism prop was impacting the prop pin causing it to bounce out of position. (Salem)	29-May-96	BKR INFO, Prop (failure to open, prop pin)	Check for 1) Consistent prop wipe, the more the better, and bkr misalignment. 2) Trending of closing and opening times. 3) Primary and arcing contact wipes adjusted within the manf. spec. and overall dimensional checks.
OE 8140 LER 86-018-00	Broken Latching Pawl shaft cotter pin. Describes breaker failures attributed to loose/ fallen out charging motor mounting bolts and trip latch lock/set screws. AM/AMH Magne-Blast Circuit Breakers at least 4KV. (FitzPatrick)	27-Dec-96	BKR INFO, Bolts, Charging Motor, Set Screw, Lock Screw, Trip Latch	Recommends checking bolt and screw tightness during PM. Also may wish to replace 1/2" long bolts with 3/4" long bolts and tighten to approximately 12 in.-lbs.
OE 8588	DISCREPANCY IN 4.16KV HIGH VOLTAGE BREAKER CLEARING TIME HAS POTENTIAL TO COMPROMISE APPENDIX R PROGRAM. A HEA relay was replaced with one that added 4 cycles to the clearing time which affected the cable protection. (Millstone)	29-Oct-97	DES/ SWGR INFO, Clearing time, cable	Ensure clearing time of new protective devices will properly protect feeder cables.
OE 8796	GE-Magne-Blast Bkr AM-4.16-350 and AM-13.8-1000 Required Overhaul Period. Questions were raised by the NRC as to how it was acceptable not to have already overhauled the bkrs in question. (River Bend)	13-Apr-98	BKR/ OVHR INFO, Frequency	Technical Manual declares that the frequency should be determined by the operating company. Methods that can be considered for use when determining/ developing overhaul frequencies are discussed.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
OE 8820	Undersized GE Primary Disconnect Conductor Bars. On non-safety related GE 1200A SWGR 1/4" thick conductor bars instead of the required 3/8" thickness were found.	14-Apr-98	SWGR INFO, bus bar	Check to ensure the primary disconnects are the proper size.
PS 32815 Part 21	INPO Daily Plant Status Report PS 32815: 10 CFR Part 21 Notification - Control Circuit for EDG Feed Breaker does not Meet Design Basis for safe shutdown in the event of a fire in the control room. (Clinton)	26-Sep-97	DES INFO, Control power	Ensure proper isolation of the breaker control circuits can be achieved in the event of a fire in the control room. (Ref. NRC GL 96-01)
PS 5647	(Also ref. NRC IN 96-46 & OE 7875) NRC DAILY PLANT STATUS REPORT PS 5647: LICENSEE DISCOVERED CRACKED ROLL PIN IN REFURBISHED 4KV CIRCUIT BREAKER. (SALEM)	2-Aug-96	OVRH INFO, Plating (Zinc, Hardened Metal Parts, roll pin)	Provides setup requirements for overhauls of plated parts hardened to RC 30 or greater. Bake at 275 degrees F for 23 hours & do magnetic particle inspection. The parts that have a dry film lubricate and may be removed in an overhaul were identified.
PS 6896 LER 97-011-00	Cracked auxiliary switches, the force of the tripping of the breaker causes excessive vibration of the switch mounting, which is cracking the four small plastic mounting tabs on 4-KV AMHG (Merlin Germin) Circuit bkrs. (Quad Cities)	10-Mar-97	BKR/ OVRH INFO, Switch (Auxiliary, cracks)	Inspect mounting of switches for cracks during general inspection and be aware of this concern if changing to a different type of bkr.
SEN 169	INPO Significant Event Notification SEN 169: Recurring lubrication Event, Operating Mechanism Problems in 4,160-Volt Circuit Breakers. This occurred on a Westinghouse type 50DHP350 bkr. (Generic issue)	6-Oct-97	BKR INFO, Lubrication	Lubrication problem on 4,160 volt bkrs has been the subject of several notices and this is included in the Magne-Blast list for notification of one more lubrication failure as a reminder of the important of proper lubrication.
SEN 177	INPO Significant Event Notification SEN 177: Electrical Fatality While Cleaning 6.9kV Breaker Cubicle. (Generic issue)	18-Feb-98	SWGR GENERIC INFO, Personnel protection	Take great care when working on electrical buses. Provide proper training and keep workers informed of the conditions of the bus before and during the work. Do not go beyond planned procedures.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
GE SAL 359.1 Part 21 1996570	GE Service Advice Letter SAL 359.1: Trip Crank (0105C9816G001) MI-13, ML-13A Mechanisms Type AM Circuit Breakers. Trip crank pin that connects to the trip coil linkage can have the weld ground off to the point it can break off. (Watts Bar)	20-Apr-98	BKR INFO, trip crank pin	Visual inspection of the trip crank assembly pin is needed to determine if weld on the back of the pin has been ground off too far. A minimum weld height of .031 to .062 is specified.
IN 98-38	NRC Information Notice IN 98-38: Metal-Clad Circuit Breaker Maintenance Issues Identified by NRC Inspections.	4-Dec-98	BKR/OVHR INFO, lubrication, reviews	This notice discusses inadequate, ineffective and inappropriate preventive maintenance. The identified problem areas include lubrication, cleaning agents, lack of overhaul sched., and applying too narrow of focus in the review of info. notices.
IN 99-13	NRC Information Notice 99-13: Insights from NRC Inspections of Low- and Medium-Voltage Circuit Breaker Maintenance Programs (General)	20-Jul-99	BKR/OVHR INFO, lubrication, reviews, program	IN 99-13 stated the inspections of 8 plants identified a number of areas in which improvement was desirable: 1) Gen. programmatic issues 2) preventive Maintenance, 3) licensee/vendor interface, 4) control volt. calc., 5) operating exp. review.
LER 97-018-00	AM Magne-Blast bkr failed to close on demand due to 3 different failure mechanisms. A control room hand switch was too loose, the pos. interlock was hitting the interference plate, & the 152/IS was found in the open position. (Wolf Creek)	1-Oct-97	BKR/ SWGR INFO, micro switch, pos. interlock	Develop a troubleshooting guideline for actions to take when a breaker fails. Check the CR2940 switches for high resistent contacts.
LER 97-042-00 & 01	AM Magne-Blast bkr failed to close on elect. demand due to a lack of lubrication, combined with the presence of old, residual grease, on the lower link pin bushings. There was a deficiency in the general maint. requirements (LaSalle).	20-Nov-97	BKR, lubrication, lower link	Ensure the that the lower link pin bushings are included as lubrication points and that they are required to be changed during refurbishments. Also consider SALs 352.1 and 354.1.
LER 98-006-000 & 011	AM Magne-Blast bkr closing spring failed to charge. The bkr driving pawl was not free to move as a result of dried lubricant, an improperly installed bushing, and the existence of an extra spacer between the driving pawl and the cotter pin. (Vermont Yankee)	18-Mar-98	BKR/OVHR INFO, lubrication, driving pawl	Check to make sure the driving pawls move freely and are not held up by interference between the cotter pin and the surface of the driving pawl. Also check that the bushing does not protrude out of the bounds of the driving pawl surface.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
OE 10054	AMH-4.76 KV GE Bkrs Failed the open timing test during overhaul. (FitzPatrick)	31-Aug-99	BKR INFO/ Timing test	Perform review of design criteria for timing when testing identifies a higher than acceptable value.
OE 7846 LER 96-009-00 Part 21 1996570	OPERATING PLANT EXPERIENCES OE 7846: GE 4KV MAGNE-BLAST BREAKERS FAIL TO LATCH due to misalignment of the bkr mechanism. Mechanism prop was impacting the prop pin causing it to bounce out of position. (Salem)	29-May-96	BKR INFO, Prop (failure to open, prop pin)	Check for 1) Consistent prop wipe, the more the better, and bkr misalignment. 2) Trending of closing and opening times. 3) Primary and arcing contact wipes adjusted within the manf. spec. and overall dimensional checks.
OE 9755	EDG Safeguards Bkr Failed to Remain Closed During Surv. Test. The anti-pumping circuit was activiated while the bkr control switch was moved from "Pull Out" through "Trip" to "Auto", the new bkr charging time was longer. (Point Beach 2)	27-May-99	BKR/ DESIGN GENERIC INFO, anti-pump	Recommend checking for proper control switch configurations/ operation. Check control circuits for proper anti-pumping timing if changing breaker spring charging times.
OE 9886	Loss of Off-Site Power and Failure of Emergency DG Bkr to Close (General Switchgear Info.). When the bkr was racked out the Westinghouse type W2 cell (152/STA) switch contacts failed to change state. (South Texas)	13-Aug-99	BKR GENERAL INFO, switch	Check for proper operation of the cell switch contacts upon racking down a breaker.
OE 9895 PE 35677 PART 21 1999024	Generic concerns regarding a common mode failure for Magne-Blast bkrs. A 7.2 KV bkr, recently overhauled, failed to close interminently due to a cotter pin striking the latch checking switch mounting bracket & bending it forward. (V C Summer)	18-Jun-99	BKR/OVHR, Latch checking switch	Check the latch checking switch for proper clearances and inspect breakers for cotter pin interferences. If switch is not used it is identified that the switch, mounting bracket, & latch paddle can be removed.
OE 9970	GE Magne-Blast Breaker Fails To Recharge Springs Due To Closing Coil Armature Binding. Solenoid armature interfered with a brass washer located under the bottom edge of the armature. (River Bend)	20-Jul-99	BKR/ OVHR INFO, coil solenoid	Inspect the trip coil solenoid and the closing coil solenoid for correct washer and spacer configuration (Ref. GE drawing #0184B749)
OE 9979	4.16kV GE Magne Blast Circuit Breaker Racking Down Problems. The washer under the "Stop plate" of the opening spring assembly (marginally out of adjustment) was free to turn on the trip opening spring rod. (Turkey Point Unit 4)	22-Jul-99	BKR/ OVHR INFO, openng spring, positive interlock	Verify the tightness of the check nut in the opening spring assembly during PM and after an overhaul. Check for proper clearance between the positive interlock blocking devices and the collapsible mechanism after an overhaul.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
SEN 194	INPO Significant Event Notification SEN 194: Work on 4kV Vital Bus Causes Loss of Shutdown Cooling. Breaker (ITE 5HK 350) became stuck while racking it out, the breaker was returned with a roller pin improperly installed. (San Onofre Unit 2)	18-Jun-99	SWGR/OVHR INFO., Program Issues	Recommends that troubleshooting and repair activities have proper coordination and leadership between working groups before doing work. Verify that inspections of new and refurbished circuit breakers are performed.
SOER 98-02	Circuit Breaker Reliability, this SOER identifies several concerns with the overall breaker program needs and establishes some recommendations as to what needs to be checked to ensure reliability.	18-Sep-98	BKR GENERIC INFO, Program Issues	Perform an overall breaker program review to ensure the recommendations outlined in the SOER are being met.
LER 99-001-00	Missed Surv.Test for Elect. Equip. protective devices. Jumper on the back of the phase 3 relay case was missing. This prevented current from passing through the relay which removed the instantaneous trip capabilities. (V. C. Summer)	11-Mar-99	BKR/SWGR INFO., relay, protection	Recommend reviewing breaker surveillance procedures and control circuits for proper connection and function of control circuits.
PE 36495	Batteries declared inoperable as a result of a non-conservative battery duty load cycle load profile. The incorrect bkr spring charging motor inrush current affected the testing discharge profile, but was later found to be met by testing. (WNP-2)	8-Dec-99	BKR/ DESIGN GENERIC INFO, anti-pump	Recommend checking DC battery calc. for proper load profile information from and to the switchgear/breakers.
OE 9857	AM 4KV Magne-Blast bkr failed to close as due to a contact on the HMA anti-pumping relay failing to conduct. A N.C. contact on the 52Y relay did not have sufficient "contact wipe" and as a result would conduct intermittently. (Peach Bottom Unit 2)	18-Feb-99	BKR INFO/ Relay, Anti-pump	Include inspection and setup of 52Y relay. This should address GEK-28008B recommendations for contact wipe, gap, and pickup voltage.
OE 10560	AM 4KV Magne-Blast bkr failed to close. The breaker positive interlock roller was found hitting the upper "V" notch to the point that it lifted the interlock actuation arm. The cause was wear on the racking handle and cradle. (Wolf Creek)	4-Apr-99	BKR/SWGR INFO., positive interlock, lower "C" stop	Check that the cubicle "V" notch cam is resting on the lower "C" stop. Also review cubicle set-up procedure to ensure all the necessary breaker to cubicle interface points are properly monitored/adjusted.

Source Document Number	Title	Issue Date	Keyword(s)	Recommended Corrective Action of Notice, if Any
OE 10557	AM 4KV Magne-Blast bkr failed to close and was found to be tripping free. Insufficient trip latch gap existed due to a mech. defect and the failure to check the trip latch gap in the open but charged position, as specified by SAL 362.1. (Wolf Creek)	2-May-99	BKR INFO/ center cam, trip latch gap, cotter pin	Check for proper center cam clearance w/cam follower roller by checking the trip latch to trip latch roller clearance (gap) and by looking for wear marks on the inner part of the center cam. Also check for trip shaft cotter pin to space interferences.
LER	Less than adequate trip risk assessment.			

B
NETA INSULATION RESISTANCE TEST SPECIFICATIONS

The National Electrical Testing Association's (NETA*) Maintenance and Testing Specifications for Electrical Power Distribution Equipment and Systems* (NETA MTS-1997) provides insulation resistance test voltages and minimum insulation resistance in megohms. See Table 10.1 in MTS-1997, which is provided below as Table B-1.

Table B-1
Insulation Resistance Tests

Voltage Rating	Minimum dc Test Voltage	Recommended Minimum Insulation Resistance in Megohms
0–250	500	25
251–600	1,000	100
601–5,000	2,500	1,000
5,001–15,000	2,500	5,000
15,001–25,000	5,000	20,000

Target:
Nuclear Power

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