IEEE Recommended Practice for Reporting Field Failure Data for Power Circuit Breakers

Sponsor
Switchgear Committee
of the
IEEE Power Engineering Society

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Abstract: A format is presented that provides a concise and meaningful method for recording pertinent information on power circuit breaker field failures. It is recommended that this format be utilized in record keeping and directing corrective action to improve field reliability of power circuit breakers.
Keywords: power circuit breakers

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Introduction

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The reliability of installed equipment depends upon many factors, some of which are related to the installation, application, maintenance, and environment, while others are associated with the design, manufacture, and shipment of the equipment. Availability of improved information for meaningful feedback to the manufacturer or others is essential to assure mutual understanding of any field failures encountered and the best practical corrective action.

The High-Voltage Circuit Breaker Subcommittee of the IEEE Switchgear Committee recognized this need and established the Quality and Reliability Working Group. One of the results of this group's activities was the development of the Failure Reporting Form for power circuit breakers. This has been in trial use for several years, and it is now appropriate to elevate its status to a recommended practice.

The Quality and Reliability Working Group of the High-Voltage Circuit Breaker Subcommittee of the IEEE Switchgear Committee that prepared and approved this standard had the following membership:

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IEEE Recommended Practice for Reporting Field Failure Data for Power Circuit Breakers

1. Overview

Actual practices of power switchgear users in documenting field failures and failures of switchgear and other power delivery products vary widely. In order to restore failed elements to service, the emphasis often is to “clean up” a failure quickly, losing important data that is critical to corrective action. There is a real need for more depth in record keeping to improve reliability of power handling equipment. This recommended practice addresses this need.

1.1 Scope

A Failure Reporting Form, figures 1 and 2, has been developed by the IEEE Switchgear Committee to improve the reliability of circuit breakers through uniform reporting of field failures. The use of this approach is the recommended practice for all users of power circuit breakers.

1.2 Purpose

The use of the Failure Reporting Form, included in this document, is recommended to standardize reporting of field failures and to use these experiences to improve the reliability of power circuit breakers.

2. References

This recommended practice shall be used in conjunction with the following publications:

IEEE Std C37.100-1992, IEEE Standard Definitions for Power Switchgear (ANSI). [1]

[1]IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

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3. Definitions

For definitions applying to this standard, refer to IEEE Std C37.100-1992.

4. Recommended practice

4.1 Background

The form, figures 1 and 2, is derived from the experiences and with the approval of both manufacturers and users. Its main goals and requirements are to be simple to use, to define the field failure including its related environment, and to establish records and references for further analysis and action should the situation repeat itself or as other factors surface.

4.2 General

Details of the one-page reporting form have been carefully developed by users and manufacturers to arrive at an easy-to-use format that will contain enough information to understand the defined problem.

Although serious systems-related failures will require engineering input for figure 2, it is expected that the field maintenance person will complete the front side of the form, figure 1. The back side, figure 2, should be completed by the user's maintenance personnel with assistance, if required, from others.

The completed form, figures 1 and 2, should be sent to the person in the user's organization who monitors field performance of installed equipment. It should be used to analyze the reported failures and communicate incident-specific information to the manufacturer, as appropriate, when there is a repetitive or serious problem.

4.3 Description of form

The front side, figure 1, is to be filled out for all failures and is an adequate report for minor malfunctions, nonconformances, or nonsystem related failures.

The back side, figure 2, is useful for further elaboration of major failures that are more complex, with consideration given to system interaction.

Both figures may be incorporated on a single sheet of paper and bound into pads for easy availability.

5. Implementation

Users should use this form, figures 1 and 2, as a record and feedback system to improve equipment reliability.

Every effort should be made to promptly obtain and sort reports so that failures are prioritized to identify those deserving the most immediate attention. The success of this activity depends on a cooperative effort between the user's maintenance and operations people and the original manufacturer, when their involvement is needed.

The front side, figure 1, should be filled out by maintenance personnel. A minimum of instruction or guidance is required.

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The questions should be answered and other details recorded at the job site soon after the failure occurs. It is recommended that these data be recorded before any repair work is initiated so as not to lose valuable clues on the origin of the problem as the repair work is carried out.

System Interaction, the back side, figure 2, is more complex and may require engineering analysis to provide the data.

6. Failure report utilization

6.1 User

The user can utilize the failure reports

a) To establish or supplement existing systems to keep specific, uniform, and informative records of field failures.
b) To provide data reports that can be sorted by manufacturer, model of equipment, age of equipment, similarity of application, etc. Data could be computerized for sorting and analysis.
c) To provide data that can be used to analyze failures, and find trends or problems that should be reported to the manufacturer.
d) To provide data that can be used to study specific failures involving application conditions and maintenance practices.
e) To communicate to the manufacturer problems that require technical analysis and recommendation.

6.2 Manufacturer

The manufacturer can use the summary of failure reports to assist in

a) Studying field equipment failures to recognize trends based on the total breaker population.
b) Investigating those failures and suggesting corrective action. The action may result in changes in design, quality, application, shipping installation, or maintenance practices.
c) Preparing and publishing suggestions for increasing reliability and reducing unplanned maintenance.

It is very important that each user carefully review all failure reports and send reports to the manufacturer that show serious or repetitive failures. By sending only selected reports to the manufacturer, the volume of reports is kept at a minimum and allows time for analysis of all problems. Generally, the newer the equipment, the larger the percentage of failure reports that should be sent to the manufacturer. Failures of older equipment are much more difficult to analyze as long-term maintenance records may not be available.

The use of this form does not eliminate the need for qualified technical personnel, both user and manufacturer, to investigate any major equipment problem. The use of this reporting format to improve reliability is meant to supplement, but not to supersede, normal warranty or customer service policies. One of the major contributions of this format is to provide better data. It is recognized that there are currently other failure reporting systems being used, but it is recommended that the approach suggested by this report be considered as a possible replacement system, or supplement, to those systems. For those establishing a reporting system for the first time, it is recommended that this format be adopted.

It is also recommended that manufacturers include a copy of this form in their product instruction books to encourage their use by all users.

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7. Bibliography

The most recent editions of the following texts are recommended as guides on form content and usage.

[B1] IEEE Committee Report, “Circuit Breaker Field Problem Reporting Guide.”

[B2] IEEE Paper 81 WM 1142-9, *IEEE Transactions on Power Apparatus and Systems*, vol. PAS-100, no. 5, pp. 2438–2441, May 1981. Approved by the IEEE Switchgear Committee of the IEEE Power Engineering Society for presentation at the IEEE PES Winter Meeting, Atlanta, Georgia, Feb. 1–6, 1981.

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USER REPORT NO. _____

FAILURE REPORTING FORM FOR POWER CIRCUIT BREAKERS

Check all appropriate blocks and provide information indicated. For *major* trouble provide additional information requested on the back of this page, supplementing with additional pages if necessary.

EQUIPMENT: Station_____ User Ident. of Breaker_____

Equipment Nameplate Information Mfgr. _____ Type _____ Serial # _____

kV _____ Inter Amps/MVA _____ Continuous Amps _____ BIL _____

Brkr Background Shipped_____ (Mo/Yr) Installed _____ (Mo/Yr) Maintained _____ (Mo/Yr) Modernized _____ (Mo/Yr) Trouble Date_____ (Mo/Day/Yr)

Operational counter reading _____

Location: ☐ Indoor ☐ Outdoor **Enclosure:** ☐ Non-metal clad ☐ Metal-clad ☐ GIS

Interrupter: ☐ Air Blast ☐ Air magnetic ☐ Oil ☐ SF ☐ Vacuum Other_____

ENVIRONMENT:

General: ☐ Industrial ☐ Urban ☐ Suburban ☐ Rural ☐ Sea coast ☐ Above 3300 ft ☐ High contamination

Other _____

Weather conditions: ☐ Dry ☐ Rain ☐ Lightning in area ☐ Snow ☐ Fog ☐ Freezing rain ☐ Frost ☐ Condensation

Temp. Trend — ☐ Rising ☐ Falling ☐ Steady ☐ Extreme cold ☐ Temperature_____ °C

Wind — ☐ Calm ☐ Light ☐ Strong–steady ☐ Strong–gusty

External mechanical stresses involved: ☐ Normal ☐ Earthquake ☐ Wind ☐ Abnormal terminal loading

Other_____ **Nominal system voltage**_____

TROUBLE:

When discovered: ☐ Installation ☐ In Service ☐ Maintenance ☐ Test Other_____

Breaker mode at time of trouble: ☐ De-energized ☐ Closed ☐ Open ☐ Tripping ☐ Closing ☐ Reclosing ☐ Fault interruption ☐ Load switching ☐ Line switching

Breaker response at time of trouble: ☐ Not called upon to operate ☐ Performed as intended ☐ Unsatisfactory operation ☐ Failed to operate

Subsystem in trouble: ☐ External insulation to grnd. ☐ Internal insulation to grnd. ☐ Insulating medium

☐ Isolating contact ☐ Bushing ☐ Interrupter ☐ Seals–Gaskets ☐ Air system ☐ SF_6 system ☐ C.T.

☐ Resistor sw or aux. int. ☐ Voltage grading dev. ☐ Line terminals ☐ Compressor ☐ Heater ☐ Electrical Controls

☐ Wiring ☐ Operating mechanism ☐ Mechanical linkage ☐ Other _____

State specifically what failed (with instr. book ref.): _____

Has it occurred before on this type of brkr? ☐ No ☐ Yes How many times _____

State how problem was corrected: _____

_____

POSSIBLE CAUSE: ☐ Design/Manufacture ☐ Shipping ☐ Storage ☐ Installation ☐ Instructions ☐ Maintenance ☐ Wear/Aging ☐ Animal/Birds ☐ Other ☐ Not Obvious

Comments and Suggestions: _____

_____

EFFECT:

Breaker Down Time: ☐ No interruption ☐ 30 min or less ☐ 1 hr ☐ 2 hr ☐ 6 hr ☐ 12 hr ☐ 24 hr Other_____

Repair Time: ☐ Less than 30 min ☐ 1 hr ☐ 2 hr ☐ 6 hr ☐ 1 day ☐ 2 days ☐ 3 days ☐ 1 week ☐ Other _____

Breaker Outage Status: ☐ Immediate forced outage ☐ Outage within 20 min ☐ Required subsequent outage ☐ Repair deferred until regular maintenance ☐ No outage for repair

User person completing report _____ Date_____

User approval name_____ Date_____

User contact name _____ Telephone Number _____

User company _____

(This form may be copied)

Figure 1— Failure Reporting Form for power circuit breakers

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ADDITIONAL INFORMATION REQUIRED FOR ANALYSIS OF MAJOR OR SYSTEM RELATED FAILURE (USE ADDITIONAL PAGES AS NECESSARY)

(1) Single line station diagram showing involved breakers.

(2) Operation and timing sequence (including all alarms) of this and related breakers from the last time that conditions were definitely normal.

(3) Line conditions before, during, and after failure.

(4) Oscillograms—attach with explanation and interpretation.

(5) Attach a description of the exact position of all mechanical components from the control solenoid through all interrupter contacts as applicable (photograph each detail *before* mechanisms; supply copies of photos with report.)

(6) Describe arc damage and location of arc products relative to valve seals. (Photograph each in detail *before* any clean up or post-failure mechanism movement; supply copies of photos with report.)

(This form may be copied)

Figure 2— Additional information required for analysis of major or system related failures

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