

IEEE Guide for Synthetic Capacitive Current Switching Tests of AC High-Voltage Circuit Breakers

Sponsor

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Abstract: As an aid in testing circuit breakers under conditions of switching capacitive currents synthetic test circuits may be used. The design of the circuit should simulate the stress of actual service conditions as closely as possible. A number of circuits are given as examples. The limitation of the use of synthetic test methods is that the breaker under test must not display evidence of reignition or restriking. The known circuits do not properly represent the interaction between the source and the capacitive load under this condition. Such breakers must be tested using direct circuits.

Keywords: capacitive current switching, closing phenomena, opening phenomena, synthetic circuits, testing circuit breakers

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Introduction

(This introduction is not part of IEEE Std C37.083-1999, IEEE Guide for Synthetic Capacitive Current Switching Tests of AC High-Voltage Circuit Breakers.)

This is a new guide developed to provide a basis for synthetic capacitive-current switching tests of circuit breakers. It includes criteria for testing to demonstrate the capacitor switching current rating of circuit breakers on a single phase basis.

The guide contains typical circuits for use in demonstrating capacitive current switching capabilities, but these circuits are those in general use; they should not exclude the development or introduction of additional circuits.

There are major changes taking place in standards development in the area of capacitor switching. Within the various standards organizations the following changes are known:

- IEEE Std 37.09-1999, IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Preferred Ratings and Related Capabilities is undergoing complete revision.
- A new IEEE standard, IEEE Std 1247-1998, IEEE Standard For Interrupter Switches for Alternating Current Rated Above 1000 Volts was approved.
- IEC 60056 (1987-03), High-Voltage Alternating Current Circuit Breakers, is also under complete revision. From what is known it is expected that the test requirements will be more statistical in nature with additional contact conditioning before the start of the test series.

The full impact of these revisions is not known at this time. The circuits and methods for testing shown in this guide are expected to remain valid. There may be a future need for modification in the voltage levels for some of the tests.

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1. Overview

This guide gives requirements for the synthetic testing of circuit breakers under conditions of switching capacitive currents. This is accomplished by simulating, as closely as possible, the stress conditions that may exist in actual service.

The phenomena of restriking and reignition causes interactions between the source and the capacitive load which, at present, cannot be simulated reliably by synthetic testing circuits described herein. Therefore, the synthetic method may only validate performance if there are no instances of restrikes. In the case of a circuit breaker that restrikes, direct tests would be required. See an alternative test method procedure in IEEE Std C37.09-1999.¹

The phenomena of prestriking during making tests allows the possibility of interruption of high-frequency current during the closing operation. Such an interruption may cause reignition and would indicate that the circuit breaker may require direct testing.

Isolated bank and cable switching making duties are provided by direct short-circuit making tests. Therefore, no separate tests are required.

Due to cost considerations, synthetic circuits are not generally used to demonstrate making capabilities for back-to-back capacitive current switching and open wire line charging. Direct testing methods should be used to demonstrate these capabilities.

1.1 Scope

This guide provides a basis for synthetic capacitive current switching tests (see IEEE Std C37.04-1999) and to establish guidelines for testing to demonstrate the capacitive switching rating of circuit breakers on a single phase basis.

¹Information on references can be found in Clause 2.

The guide contains typical circuits for demonstrating capacitive current switching capability. These circuits are those in general use and their inclusion should not exclude the development of additional circuits to demonstrate specific capabilities.

1.2 Purpose

The purpose of this guide is to establish criteria for synthetic capacitive current switching tests and for the proper evaluation of results. Such criteria will establish validity of the test method without imposing restraints on innovation and improvement of test circuitry.

2. References

ANSI C37.06-1997, American National Standard for Switchgear—AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Preferred Ratings and Related Capabilities.²

IEEE Std C37.04-1999, IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.³

IEEE Std C37.09-1999, IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

IEEE Std C37.012-1979 (Reaff 1988), IEEE Application Guide for Capacitance Current Switching for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

IEEE Std C37.081-1981 (Reaff 1988), IEEE Guide for Synthetic Fault Testing of AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

3. Definitions

3.1 auxiliary circuit breaker: The circuit breaker used to disconnect the current circuit from direct connection with the test circuit breaker.

3.2 current circuit: That part of the synthetic test circuit from which the major part of the power frequency current is obtained.

3.3 current injection method: A synthetic test method in which the voltage circuit is applied to the test circuit breaker before power frequency current zero.

3.4 direct test: A test in which the applied voltage, current, and recovery voltage are obtained from a single power source, which may be comprised of generators, transformers, networks, or combinations of these.

3.5 distorted current: The current through the test circuit breaker that is influenced by the arc voltage of both the test and auxiliary circuit breakers during the high-current interval.

3.6 injected current: The current that flows through the test circuit breaker from the voltage source of a current injection circuit when this circuit is applied to the test circuit breaker.

3.7 injected-current frequency: The frequency of the injected current.

²ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

³IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (<http://www.standards.ieee.org/>).