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IEEE Guide for Protecting Power Transformers

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IEEE Power and Energy Society

Developed by the
Power System Relaying and Control Committee

IEEE Std C37.91™-2021
(Revision of IEEE Std C37.91-2008)

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Power System Relaying and Control Committee
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Abstract: Guidelines for protecting three-phase power transformers of more than 5 MVA rated capacity and operating at voltages exceeding 10 kV is provided to protection engineers and other readers in this guide. In some cases, a user may apply the techniques described in this guide for protecting transformers of less than 5 MVA ratings or operating at voltages less than 10 kV. Information to assist protection engineers in properly applying relays and other devices to protect transformers used in transmission and distribution systems is also provided. General philosophy, practical applications, and economic considerations involved in power transformer protection are discussed, with an emphasis on practical applications. Types of faults in transformers are described. Technical problems with the protection systems, including the behavior of current transformers during system faults, are discussed, as well as associated problems, such as fault clearing and post trip reenergization.

Keywords: current transformer, differential protection, gas accumulator relay, grounding transformer, IEEE C37.91™, magnetizing inrush, overcurrent protection, power transformer, regulating transformer, sudden pressure relay, transformer overexcitation, transformer protection, volts-per-hertz protection

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Introduction

This introduction is not part of IEEE Std C37.91-2021, IEEE Guide for Protecting Power Transformers.

This document is a revision of IEEE Std C37.91-2008 and is intended to provide aid in the effective application of relays and other devices for the protection of power transformers.

In this revision, the following notable changes have been made.

- Added converter, Scott, and Le Blanc transformers to special-purpose transformers clause.
- Added information on negative sequence differential protection
- Removed information on topics that are now adequately addressed in other IEEE guides, such as phase-angle regulating transfomers and transformer gas analysis.
- Removed outdated annex on transformer failure statistics.
- Corrected errors in Annex A related to through fault protection curves and their application.
- Updated information on multiple topics throughout the guide.

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IEEE Guide for Protecting Power Transformers

1. Overview

1.1 General

This guide is intended to provide protection engineers and other readers with guidelines for protecting three-phase power transformers of more than 5 MVA rated capacity and operating at voltages exceeding 10 kV. In some cases, a user may apply the techniques described in this guide for protecting transformers of less than 5 MVA ratings or operating at voltages less than 10 kV.

1.2 Scope

The scope of this guide includes general philosophy, practical applications, and economic considerations involved in power transformer protection.

Emphasis is placed on practical applications. General philosophy and economic considerations in protecting transformers are reviewed. Types of faults in transformers are described. Technical problems with the protection systems, including the behavior of current transformers (CTs) during system faults, are discussed. Associated problems, such as fault clearing and reenergization, are discussed as well.

1.3 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (shall equals is required to).[1, 2]

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (should equals is recommended that).

The word *may* is used to indicate a course of action permissible within the limits of the standard (may equals is permitted to).

[1] The word *must* is deprecated and cannot be used when stating mandatory requirements; *must* is used only to describe unavoidable situations.
[2] The word *will* is deprecated and cannot be used when stating mandatory requirements; *will* is only used in statements of fact.