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IEEE Guide for Conducting a Transient Voltage Analysis of a Dry-Type Transformer Coil

IEEE Power and Energy Society

Sponsored by the
Transformers Committee

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(Revision of IEEE Std C57.12.58-1991)

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Abstract: General recommendations for measuring voltage transients in dry-type distribution and power transformers are provided. Recurrent surge voltage generator circuitry, instrumentation, test sample, test point location, mounting the test coil, conducting the test, and reporting results are covered.

Keywords: IEEE C57.12.58™, impulse distribution, recurrent surge generator, transient voltage analysis

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Introduction

This introduction is not part of IEEE Std C57.12.58-2017, IEEE Guide for Conducting a Transient Voltage Analysis of a Dry-Type Transformer Coil.

This guide covers general recommendations for measuring voltage transients in dry-type distribution and power transformers. Insulation is recognized as one of the most important components of a transformer. Its major function is to prevent dielectric breakdown between parts with different voltage potentials. Insulation materials and components are also a part of the mechanical structure of the transformer. Any weakness of insulation may result in the failure of the transformer. Dielectric strength is a measure of the effectiveness with which insulation performs. It was once accepted that low-frequency tests alone were adequate to demonstrate the dielectric strength of transformers. As more became known about lightning phenomena, and as impulse testing apparatus was developed, it became apparent that the distribution of impulse voltage stress through the transformer winding varies with the configuration of the windings.

Impulse voltages are distributed initially on the basis of winding capacitances. If this initial distribution differs from the final low-frequency inductance distribution, the impulse energy will oscillate between the two distributions until the energy is dissipated and the inductance distribution is reached. In severe cases, these internal oscillations can produce voltages to ground that approach twice the applied voltage. Along with the variation in size of transformer windings and the physical configuration of the windings, the impulse voltage distribution when chopping the applied wave was considered by the task force that developed this guide. Since there was insufficient information on how to interpret the short-time oscillations on the insulation system, the inclusion of the chopped wave was deferred until a later date.

This document was originally developed in 1991 to determine standard methods for examining the impulse voltage distribution within dry-type transformer windings; to establish a means for defining the location and magnitude of maximum voltage stress in a dry-type transformer coil; and to support other IEEE standards such as the thermal evaluation document, IEEE Std C57.12.60™ [B6].[1]

This updated version of IEEE Std C57.12.58 corrects some editorial and technical issues from the original document. The task force involved in the revision of this document considered a more extensive revision of the document (incorporating use of commercial equipment and new software techniques), but due to a compressed time frame determined to defer this more extensive revision after the approval of this document.

[1]The numbers in brackets correspond to those of the bibliography in Annex A.

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IEEE Guide for Conducting a Transient Voltage Analysis of a Dry-Type Transformer Coil

1. Overview

1.1 Scope

This guide applies to the equipment setup, measurement, and analysis of the transient voltage response of a dry-type transformer coil to impulse voltage.

1.2 Purpose

Transient voltage analysis is used to determine the response of various parts of the coil to a 1.2 μs × 50 μs impulse wave. This analysis can be made on specially designed prototype coils with embedded voltage leads. This testing uses significantly lower voltages than the rated BIL to expedite the test time for each data point required.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std C57.12.80™, IEEE Standard Terminology for Power and Distribution Transformers.[2,3]

IEEE Std C57.12.91™, IEEE Standard Test Code for Dry-Type Distribution and Power Transformers.

IEEE Std C57.98™, IEEE Guide for Transformer Impulse Tests.

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