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IEEE Guide for Differential and Polarizing Relay Circuit Testing

IEEE Power and Energy Society

Sponsored by the
Power System Relaying Committee

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3 Park Avenue
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USA

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(Revision of
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Abstract: The issues concerning testing and verification of the correctness of differential and polarizing circuits are described and discussed in this guide. The intention of this guide is to help the reader to detect errors in the wiring of protective relays that might cause erroneous operations of protection systems. It is essential to follow systematic testing procedures and record the observations in a proper organized manner. The records should include documentation of all measurements and a comparison with the desired results.

Keywords: differential protection, generator protection, IEEE C37.103™, line protection, polarized ground fault relays, polarized line protection relays, relay testing, transformer protection

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Introduction

This introduction is not part of IEEE Std C37.103™-2015, IEEE Guide for Differential and Polarizing Relay Circuit Testing.

Errors in the wiring of connections to protective relays have caused erroneous operations of the associated protective schemes resulting in many serious power interruptions. In most cases, thorough testing would have discovered those incorrect connections. Ground relay polarizing and differential relay connections are the most troublesome and difficult to locate; therefore, this guide describes and discusses the issues concerning testing and verification of the correctness of these circuits.

This guide describes tests for helping to ensure correct differential and polarizing circuit connections. Relay calibration, setting, insulation, instrument transformer tests, etc., are also referred to in this guide, but it is assumed that the individual users have developed these tests, and therefore they are not discussed in detail. Methods for testing differential and polarizing circuits have never really been defined by the manufacturers because a large variety of ways in which differential and polarized circuits are applied in relay systems. Consequently, utilities develop their own testing techniques, which can vary widely depending on factors such as the availability of test switches, test gear, test philosophy, problems discovered in the past, and manpower. Good systematic testing should include systematic documentation of the tests and the test procedures. This should include documentation of all measurements and a comparison with the desired results.

Comments on the advantages and disadvantages of the different techniques are presented, and operating considerations for personnel and equipment are included. Since most of the circuit verification tests include passing current through either the current transformer primaries or secondaries, the voltage source to accomplish these tests varies. For primary testing that may include power transformer windings, the required source voltage will be substantial. For secondary testing, the source voltage may be relatively low. For some of these circuit tests, variable voltages are needed. In each case, the source is identified and noted on the figure involved.

Traditional electromechanical and solid-state differential relays made no provision for phase shifts in the transformers; the connections and wiring had to be arranged so that the normal load currents flowing into the respective primary and secondary "restraint" windings were 180° out of phase. Further, some current transformer (CT) connections were not possible without the use of wye-delta auxiliary CTs or a zero-sequence trap (see IEEE Std C57.13.1 [a, b, c]). Electromechanical and solid-state relays usually did not provide direct readout of the currents in the relays.

In contrast, present microprocessor relays compensate for the transformer/CT connections and provide readouts from a front panel human-machine interface (HMI) and/or via the relay communications port. This provision simplifies testing in three ways:

— The installation may be designed such that the CT secondary circuits are all connected in wye, making wiring checkout easier.

— Amplitude and phase of primary/secondary injection and load currents can be checked by interrogation of the relay via the HMI or from a portable computer via the relay communications port. The processing of the signals in the relay automatically takes into account the relationship between the restraint and operating currents that can be ascertained.

— The manufacturer usually provides a worksheet for entry of all the current and phase angle readings, which simplifies interpretation of the results.

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1. Overview

1.1 Scope

This guide covers tests to help ensure correct connections of differential relays and polarizing circuits of phase and ground relays. Although other preparatory tests are mentioned in this guide, these tests are not discussed in detail.

1.2 Purpose

This guide provides a methodology to establish a systematic series of tests to verify the integrity and accuracy of connections of differential and polarizing circuits.

2. Normative references

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