

IEEE Guide for Protective Relay Application to Transmission- Line Series Capacitor Banks

IEEE Power and Energy Society

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Power Systems Relaying Committee

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3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std C37.116™-2018
(Revision of IEEE Std C37.116-2007)

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Approved 27 September 2018

IEEE-SA Standards Board

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Abstract: The application of protective relays on transmission-line series capacitor banks is covered. Ample discussion of the protection and control issues related to series capacitor bank installations is provided to the reader. Specific examples related to protective functions and testing procedures are provided.

Keywords: bypass gap, bypass switch, externally fused capacitor, fuseless capacitor, harmonic protection, IEEE C37.116™, internally fused capacitor, metal oxide varistor, MOV, series capacitor, unbalance protection

The Institute of Electrical and Electronics Engineers, Inc.
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PDF: ISBN 978-1-5044-5128-4 STD23272
Print: ISBN 978-1-5044-5129-1 STDPD23272

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Introduction

This introduction is not part of IEEE Std C37.116™-2018, IEEE Guide for Protective Relay Application to Transmission-Line Series Capacitor Banks.

This guide provides additional descriptions and application examples to the IEEE Special Publication on “Series Capacitor Bank Protection.” The guide’s purpose is to provide the reader with ample discussion of the protection issues related to series capacitor bank design. In addition, automatic control functions and general testing procedures are covered. This is an application guide and does not attempt to address all of the protective requirements of all series capacitor banks in every situation. Additional reading material is suggested so the reader can develop a better understanding for a specific protection application.

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IEEE Guide for Protective Relay Application to Transmission-Line Series Capacitor Banks

1. Overview

1.1 Background

Series compensation provides an economical means of maximizing power transfer and improving transmission efficiency over long distances by reducing the series impedance of the transmission line. This guide describes the protection and modern control philosophies of series capacitor banks. The application of this protection requires a thorough understanding of the interrelationship of the power system requirements, the bank's major equipment, and the installation of the equipment.

Background information describing the major equipment and system considerations is presented first. Next, protection issues related to the capacitor units, metal oxide varistor (MOV), bypass system, and capacitor bank platform are discussed. Platform power, automatic control functions, and monitoring systems are discussed. Lastly, functional and performance testing of series capacitor protection and control systems is included with detailed considerations on staged fault testing. Graphs and recordings of system and protection performance from staged tests of series capacitors are offered in [Annex E](#).

1.2 Scope

This guide describes the application of protection systems on transmission-line fixed series capacitors and provides alternative approaches to the design, testing, and maintenance of protective systems based on the latest knowledge and the application experience of the industry. This guide also covers issues related to the reliability of the protection system.

The protection and control of distribution system series capacitors and application of variable series capacitors or thyristor-protected series capacitors are not covered in this guide.

1.3 Purpose

The purpose of this guide is to provide the reader with ample discussion of the protection issues related to series capacitor bank design. Applications of series capacitors are sufficiently diverse that protective relay engineers need some guidance on the reasons and considerations for different protection and control schemes. This guide is intended for engineers involved in the areas of protection specifications, evaluation, and operation of series capacitor banks.