

# EMTP Testing of Selected PST Protec

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**Abstract**— In this paper, testing results of selected procedures for protection of phase shifting transformers are presented. A phase shifting transformer (PST) is usually used for varying the voltage phase angle between the two systems which provides controlling of active power transfer. Some types of PSTs (e.g. dual-core symmetrical PST) allow to control phase shift in a certain defined range which means that phase shift between the two systems can be varied on-line. Therefore this type of phase shifting transformers must be protected by relays which are able to on-line compensate for additional phase shift introduced by PST. The main attention is paid to testing of differential protections for transformer energization and external faults for different phase shift values. It has been observed that for such situations standard differential relays may sometimes maloperate. Therefore, these situations should be analyzed and suggestions for protection improvement proposed. The comparison of two protection arrangements has been realized with the signals generated with use of EMTP program.

**Keywords**— current differential protection, Electromagnetic

series line inductance and compensated line equals  $X_{SL}$  between the two systems (a decreasing) by varying elect. In this method a phase shi. used for varying the voltage phase angle shift  $\theta$  an ad subtracted. The PST is se between two systems, thu expressed according to the fi

$$P = \frac{|V_S|}{X_{PST}}$$

where:  $X_{PST}$  is phase shifting angle shift obtained from PS

In Fig. 1 active power

# Electromagnetic Transients Program Reference Manual

**Hermann W. Dommel, Bonneville  
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Hermann W. Dommel,Bonneville Power Administration,1986      Power Systems Electromagnetic Transients Simulation  
Neville Watson,Jos Arrillaga,J. Arrillaga,2003 Electromagnetic transients simulation EMTS has become a universal tool for the analysis of power system electromagnetic transients in the range of nanoseconds to seconds This book provides a thorough review of EMTS and many simple examples are included to clarify difficult concepts This book will be of particular value to advanced engineering students and practising power systems engineers      Understanding Electromagnetic Transients in Power Systems Luiz Cera Zanetta, Jr.,2025-03-26 Understand transients and their roles in linear systems with this essential guide Electromagnetic transients are a fundamental aspect of linear power systems and therefore a key knowledge area for electrical engineers Understanding Electromagnetic Transients in Power Systems provides a comprehensive but accessible overview to transients their underlying theory and mathematics and their impact in electrical power system design Its detailed but clear presentation makes it a must own for students and working engineers alike Readers of Understanding Electromagnetic Transients in Power Systems will also find Deep consideration of the relationship between foundational concepts mathematical calculations and impacts on equipment Detailed discussion of topics including time and frequency domain analysis basic transforms fundamentals of electrical circuit transients and traveling waves overvoltage insulation coordination and many more Dozens of solved simple examples to facilitate understanding Understanding Electromagnetic Transients in Power Systems is ideal for electrical engineers and professionals in utilities and equipment manufacturing as well as for graduate and advanced undergraduate students learning about transients electrical circuits and related subjects      **Transient Analysis of Power Systems** Juan A. Martinez-Velasco,2020-02-10 A hands on introduction to advanced applications of power system transients with practical examples Transient Analysis of Power Systems A Practical Approach offers an authoritative guide to the traditional capabilities and the new software and hardware approaches that can be used to carry out transient studies and make possible new and more complex research The book explores a wide range of topics from an introduction to the subject to a review of the many advanced applications involving the creation of custom made models and tools and the application of multicore environments for advanced studies The authors cover the general aspects of the transient analysis such as modelling guidelines solution techniques and capabilities of a transient tool The book also explores the usual application of a transient tool including over voltages power quality studies and simulation of power electronics devices In addition it contains an introduction to the transient analysis using the ATP All the studies are supported by practical examples and simulation results This important book Summarises modelling guidelines and solution techniques used in transient analysis of power systems Provides a collection of practical examples with a detailed introduction and a discussion of results Includes a collection of case studies that illustrate how a

simulation tool can be used for building environments that can be applied to both analysis and design of power systems Offers guidelines for building custom made models and libraries of modules supported by some practical examples Facilitates application of a transients tool to fields hardly covered with other time domain simulation tools Includes a companion website with data input files of examples presented case studies and power point presentations used to support cases studies Written for EMTP users electrical engineers Transient Analysis of Power Systems is a hands on and practical guide to advanced applications of power system transients that includes a range of practical examples **Power System Transient Analysis** Eiichi Haginomori,Tadashi Koshiduka,Junichi Arai,Hisatochi Ikeda,2016-05-02 Understanding transient phenomena in electric power systems and the harmful impact of resulting disturbances is an important aspect of power system operation and resilience Bridging the gap from theory to practice this guide introduces the fundamentals of transient phenomena affecting electric power systems using the numerical analysis tools Alternative Transients Program Electromagnetic Transients Program ATP EMTP and ATP DRAW This technology is widely applied to recognize and solve transient problems in power networks and components giving readers a highly practical and relevant perspective and the skills to analyse new transient phenomena encountered in the field Key features Introduces novice engineers to transient phenomena using commonplace tools and models as well as background theory to link theory to practice Develops analysis skills using the ATP EMTP program which is widely used in the electric power industry Comprehensive coverage of recent developments such as HVDC power electronics with several case studies and their practical results Provides extensive practical examples with over 150 data files for analysing transient phenomena and real life practical examples via a companion website Written by experts with deep experience in research teaching and industry this text defines transient phenomena in an electric power system and introduces a professional transient analysis tool with real examples to novice engineers in the electric power system industry It also offers instruction for graduates studying all aspects of power systems **Electromagnetic Transients Program (EMTP)** ,1977 **Electromagnetic Transients in Transformer and Rotating Machine Windings** Su, Charles Q.,2012-07-31 This book explores relevant theoretical frameworks the latest empirical research findings and industry approved techniques in this field of electromagnetic transient phenomena Provided by publisher Power System Transients Juan A. Martinez-Velasco,2017-12-19 Despite the powerful numerical techniques and graphical user interfaces available in present software tools for power system transients a lack of reliable tests and conversion procedures generally makes determination of parameters the most challenging part of creating a model Illustrates Parameter Determination for Real World Applications Geared toward both students and professionals with at least some basic knowledge of electromagnetic transient analysis Power System Transients Parameter Determination summarizes current procedures and techniques for the determination of transient parameters for six basic power components overhead line insulated cable transformer synchronous machine surge arrester and circuit breaker An expansion on papers published in the IEEE

Transactions on Power Delivery this text helps those using transient simulation tools e.g. EMTP like tools to select the optimal determination method for their particular model and it addresses commonly encountered problems including Lack of information Testing setups and measurements that are not recognized in international standards Insufficient studies to validate models mainly those used in high frequency transients Current built in models that do not cover all requirements Illustrated with case studies this book provides modeling guidelines for the selection of adequate representations for main components It discusses how to collect the information needed to obtain model parameters and also reviews procedures for deriving them Appendices summarize updated techniques for identifying linear systems from frequency responses and review capabilities and limitations of simulation tools Emphasizing standards this book is a clear and concise presentation of key aspects in creating an adequate and reliable transient model

**Proceedings of the Tenth Power Systems Computation Conference** Graz Austria, 2016-06-06 Proceedings of the Tenth Power Systems Computation Conference **Emerging**

**Developments in the Power and Energy Industry** Rodolfo Dufo-López, Jaroslaw Krzywanski, Jai Singh, 2019-10-31 Power and Energy Engineering are important and pressing topics globally covering issues such as shifting paradigms of energy generation and consumption intelligent grids green energy and environmental protection The 11th Asia Pacific Power and Energy Engineering Conference APPEEC 2019 was held in Xiamen China from April 19 to 21 2019 APPEEC has been an annual conference since 2009 and has been successfully held in Wuhan 2009 2011 Chengdu 2010 2017 Shanghai 2012 2014 Beijing 2013 2015 Suzhou 2016 and Guilin 2018 China The objective of APPEEC 2019 was to provide scientific and professional interactions for the advancement of the fields of power and energy engineering APPEEC 2019 facilitated the exchange of insights and innovations between industry and academia A group of excellent speakers have delivered keynote speeches on emerging technologies in the field of power and energy engineering Attendees were given the opportunity to give oral and poster presentations and to interface with invited experts

**Passive Macromodeling** Stefano Grivet-Talocia, Bjorn Gustavsen, 2015-10-30 Offers an overview of state of the art passive macromodeling techniques with an emphasis on black box approaches This book offers coverage of developments in linear macromodeling with a focus on effective proven methods After starting with a definition of the fundamental properties that must characterize models of physical systems the authors discuss several prominent passive macromodeling algorithms for lumped and distributed systems and compare them under accuracy efficiency and robustness standpoints The book includes chapters with standard background material such as linear time invariant circuits and systems basic discretization of field equations state space systems as well as appendices collecting basic facts from linear algebra optimization templates and signals and transforms The text also covers more technical and advanced topics intended for the specialist which may be skipped at first reading Provides coverage of black box passive macromodeling an approach developed by the authors Elaborates on main concepts and results in a mathematically precise way using easy to understand language Illustrates macromodeling concepts through

dedicated examples Includes a comprehensive set of end of chapter problems and exercises Passive Macromodeling Theory and Applications serves as a reference for senior or graduate level courses in electrical engineering programs and to engineers in the fields of numerical modeling simulation design and optimization of electrical electronic systems Stefano Grivet Talocia PhD is an Associate Professor of Circuit Theory at the Politecnico di Torino in Turin Italy and President of IdemWorks Dr Grivet Talocia is author of over 150 technical papers published in international journals and conference proceedings He invented several algorithms in the area of passive macromodeling making them available through IdemWorks Bj rn Gustavsen PhD is a Chief Research Scientist in Energy Systems at SINTEF Energy Research in Trondheim Norway More than ten years ago Dr Gustavsen developed the original version of the vector fitting method with Prof Semlyen at the University of Toronto The vector fitting method is one of the most widespread approaches for model extraction Dr Gustavsen is also an IEEE fellow

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*Modeling and Analysis of Electrical Machine* R. Ramanujam,2018-08-10 This book will serve as a stepping stone for the undergraduate students in Electrical Electronics Engineering for further specialization It is a core subject in the curriculum for post graduate Power Electronics and Power Systems Engineering disciplines offered by most of the universities and educational institutions The book starts with the fundamental concepts such as phasors and reference frames which are not usually elaborated at the undergraduate level thereby providing smooth transition to more advanced topics as specified in the various syllabi The book is also suitable for final semester undergraduate students and practising engineers

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