Distance Protection Of Transmission Line

Investigates the reasons behind the poor performance of distance relays on series compensated lines. In order to achieve this objective, a case study will be established in a power system software (DigSilent Power Factory). Furthermore, a practical incident that occurred on Eskom's compensated network will be examined. However, prior to investigating the performance of the distance relay on transmission lines, there are some other critical aspects that have to be thoroughly understood. These aspects include amongst others: transmission line modelling ; numeric relay algorithms ; distance protection philosophies ; series compensation phenomena ; analysis of distance relays performance on both compensated and uncompensated lines and the action and influence of the MOV. The study will provide a better understanding regarding the dynamic behaviour of the impedance protection relay under fault conditions on series compensated lines and the behaviour of the MOV during a fault.

This book is a practical guide to digital protective relays in power systems. It explains the theory of how the protective relays work in power systems, provides the engineering knowledge and tools to successfully design them and offers expert advice on how they behave in practical circumstances. This book helps readers gain technical mastery of how the relays function, how they are designed and how they perform. This text not only features in-depth coverage of the theory and principles behind protective relays, but also includes a manual supplemented with software that offers numerous hands-on examples in MATLAB. A great resource for protective relaying labs and self-learners, its manual provides lab experiments unavailable elsewhere. The book is suitable for advanced courses in Digital Relays and Power Systems Fault Analysis and Protection, and will prove to be a valuable resource for practitioners in the utility industry, including relay designers.

This book is a long awaited comprehensive introduction to the protection of electrical power systems using computer-based methods (i.e. digital relays). The treatment is logically structured, taking the reader through the mathematics and principles underlying the development and implementation of the major algorithms underlying different protection techniques. They can be applied to protection of generator transformers, lines, switchgear and cable circuits: the main components of transmission and distribution systems. The book deals with the research and development activity in the field of digital protection during the last 15 years. The reader will become familiarised with the fast developing field of power system protection using computers and microcomputers. "This book provides a full introduction for senior undergraduates and graduates, and acts as a sound reference for engineers already practising in this area."

The Present Edition Of The Book Contains Almost All The Topics Connected With Protection Schemes. The Book, Which Consists Of Ten Main Chapters And Two Appendices, Starts With The Chapter On Introduction, And Includes Chapters On Fundamental And Basic Theory Of Protection Schemes, Definition Of Various Terms, Different Types Of Protective Relaying Schemes, Generalized Mathematical Theory Of Protective Relay, Relay As A Comparator, Single Input, Dual Input And Multi- Input Comparator, Different Types And Arrangement Of Protection Schemes For Various Components And Detailed Studies Of Electromechanical, Electronics, Static And Digital Relaying Schemes. The Digital Protection Of Synchronous Machines, Transformer And Transmission Line Based, Both On Fundamental And Travelling Wave Phenomena, Are Dealt With In Detail. Also Included In The Present Edition, Are The Related Topics Such As Theory And Design Of Dynamic Test Bench, P.C. Based Relay Setting And Coordination, P.C. Based Short Circuit Studies And Ultra High Speed Relaying Schemes.The Present Edition Which Contains Almost All The Topics Of Current Interest In The Area Of Protective Relaying, Will Certainly Be Very Useful To The Teachers, Students

And Engineers Working With The Utilities. The Present Edition Is The Result Of Teaching By The Author To The Undergraduate And Postgraduate Level Classes And Supervising Several Doctoral And Master Thesis And Graduate Level Projects In The Area Of Power System Protection At The Indian Institute Of Technology, Kanpur, For More Than Two Decades. The Content Of The Present Edition Has Been Class-Tested For Several Years At The Undergraduate And Postgraduate Level Classes At L.L.T., Kanpur. It Has Also Been Tested In Several Intensive Courses Offered By The Author Under Qip And Other Schemes To The Teachers Of Academic Institutions And Also Engineers Working With Utilities.

This reference book provides a detailed discussion on the protection challenges that arise due to technological improvements in transmission and distribution systems to supply increasing power demand. The primary focus of this book is transmission line protection with FACTS devices connected to the line and islanding detection in an active distribution system i.e., microgrids. First, a literature review on the protection of transmission lines in the presence of switching devices is presented. The following chapters then present commonly proposed modifications required in the power system to meet increasing power demands, commonly used existing protection schemes and their limitations in the presence of switching devices, and solutions to these limitations in protection schemes. Results from fault simulations using PSCAD/EMTDC and MATLAB are also included. This book will be valuable to graduate students and practicing engineers alike for dealing with protection issues in transmission and distribution systems incorporating FACTS devices. Provides thorough knowledge of trends in transmission networks for the enhancement of power flow, control and protection Presents an analysis of requirements of microgrids in the future Highlights challenges in the protection of active distribution systems or microgrids against islanding in the presence of distributed generation

Improve Failure Detection and Optimize Protection In the ever-evolving field of protective relay technology, an engineer's personal preference and professional judgment are as important to power system protection as the physical relays used to detect and isolate abnormal conditions. Invaluable Insights from an Experienced Expert Protective Relay Principles focuses on probable power system failure modes and the important characteristics of the protective relays used to detect these postulated failures. The book presents useful new concepts in a way that is easier to understand because they are equally relevant to older, electromechanical and solid-state relays, and newer, more versatile microprocessor-based relays. It introduces the applications, considerations, and setting philosophies used in transmission-line, distribution-line, and substation applications, covering concepts associated with general system operations and fault detection. Topics include relay load limits, cold load pickup, voltage recovery, and arc flash. The author also delves into the philosophies that engineers employ in both urban and rural areas, with a detailed consideration of setpoint function. Analysis of Key Concepts That Are Usually Just Glossed Over This versatile text is ideal for new engineers to use as a tutorial before they open the instruction manuals that accompany multi-function microprocessor-based relays. Guiding readers through the transient loading conditions that can result in relay misoperation, the author elaborates on concepts that are not generally discussed, but can be very helpful in specific applications. Readers will come away with an excellent grasp of important design considerations for working with overcurrent, over- and undervoltage, impedance, distance, and differential type relay functions, either individually or in combination. Also useful for students as a textbook, this book includes practical examples for many applications, and offers guidance for more unusual ones.

With distributed generation interconnection power flow becoming bidirectional, culminating in network problems, smart grids aid in electricity generation, transmission, substations, distribution and consumption to achieve a system that

is clean, safe (protected), secure, reliable, efficient, and sustainable. This book illustrates fault analysis, fuses, circuit breakers, instrument transformers, relay technology, transmission lines protection setting using DIGsILENT Power Factory. Intended audience is senior undergraduate and graduate students, and researchers in power systems, transmission and distribution, protection system broadly under electrical engineering.

This volume contains a selection of papers presented at the 7th Nirma University International Conference on Engineering 'NUiCONE 2019'. This conference followed the successful organization of four national conferences and six international conferences in previous years. The main theme of the conference was "Technologies for Sustainable Development", which is in line with the "SUSTAINABLE DEVELOPMENT GOAL" established by the United Nations. The conference was organized with many inter-disciplinary technical themes encompassing a broad range of disciplines and enabling researchers, academicians and practitioners to choose between ideas and themes. Besides, NUiCONE-2019 has also presented an exciting new set of events to engage practicing engineers, technologists and technopreneurs from industry through special knowledge sharing sessions involving applied technical papers based on case-study applications, white-papers, panel discussions, innovations and technology products. This proceedings will definitely provide a platform to proliferate new findings among researchers. Advances in Transportation Engineering Emerging Trends in Water Resources and Environmental Engineering Construction Technology and Management Concrete and Structural Engineering Futuristic Power System Control of Power Electronics Converters, Drives and E-mobility Advanced Electrical Machines and Smart Apparatus Chemical Process Development and Design Technologies and Green Environment Sustainable Manufacturing Processes Design and Analysis of Machine and Mechanism Energy Conservation and Management Advances in Networking Technologies Machine Intelligence / Computational Intelligence Autonomic Computing Control and Automation Electronic Communications Electronics Circuits and System Design Signal Processing

In two editions spanning more than a decade, The Electrical Engineering Handbook stands as the definitive reference to the multidisciplinary field of electrical engineering. Our knowledge continues to grow, and so does the Handbook. For the third edition, it has expanded into a set of six books carefully focused on a specialized area or field of study. Each book represents a concise yet definitive collection of key concepts, models, and equations in its respective domain, thoughtfully gathered for convenient access. Systems, Controls, Embedded Systems, Energy, and Machines explores in detail the fields of energy devices, machines, and systems as well as control systems. It provides all of the fundamental concepts needed for thorough, in-depth understanding of each area and devotes special attention to the emerging area of embedded systems. Each article includes defining terms, references, and sources of further information.

Encompassing the work of the world's foremost experts in their respective specialties, Systems, Controls, Embedded Systems, Energy, and Machines features the latest developments, the broadest scope of coverage, and new material on human-computer interaction.

The book is a thoroughly revised and updated second edition of a successful text. It incorporates the latest developments in semiconductor technology and its applications to power system protection. A new chapter on Microprocessor Applications to Protection has been added. New developments in commercial relay manufacture are also included. With its wide and up-to-date coverage, the book would be indispensable to engineers in the relay industry, field engineers, and research and development personnel. It would also be useful as a reference text for students of electrical engineering. The book discusses: The problem of relay power supply circuits and their various aspects. Applications of digital and analog computers to power system protection microprocessor applications including the peripheral equipment for relay applications. Non-conventional comparators like instantaneous comparators and phase-sequence detectors. Aspects of reliability tests and maintenance, including methods prescribed by the International Electro-technical Commission. The latest developments in commercial relay manufacture.

Distance Protection for Electrical Transmission LineEquipments, Settings Zones and Tele-ProtectionLAP Lambert Academic Publishing

Electric transmission networks are among the largest human-made engineering systems: For example, the transmission network in the United States covers over 300,000 km of lines and is served by 500 companies (electric utilities). In sharp contrast to the very incremental developments of the last century, transmission and control technologies experienced a major breakthrough at the beginning of the 21st century. The rapid growth of new energy generation technologies (renewables), significant advances in information processing applied to system monitoring, planning, operation, control, and protection, radical changes in distribution networks, and key shifts in end user behavior (advanced metering and control of demand response) have combined to produce the modern integrated electrical infrastructure commonly referred to as the smart grid. Featuring state-of-the-art, peer-reviewed entries from the Encyclopedia of Sustainability Science and Technology, this book provides a detailed introduction to select key topics which span energy technology, engineering, and urban planning. Worldwide experts discuss the integration of electric energy infrastructure into the broader critical infrastructures of the modern world and their various interdependencies. Dedicated chapters cover specific topics ranging from underground transmission and distribution, to energy and water interdependence, and their implications for urban areas. Coverage also includes the key role of new policy initiatives as catalysts of change.

Computational Intelligence (CI) is one of the most important powerful tools for research in the diverse fields of engineering sciences ranging from traditional fields of civil, mechanical

engineering to vast sections of electrical, electronics and computer engineering and above all the biological and pharmaceutical sciences. The existing field has its origin in the functioning of the human brain in processing information, recognizing pattern, learning from observations and experiments, storing and retrieving information from memory, etc. In particular, the power industry being on the verge of epoch changing due to deregulation, the power engineers require Computational intelligence tools for proper planning, operation and control of the power system. Most of the CI tools are suitably formulated as some sort of optimization or decision making problems. These CI techniques provide the power utilities with innovative solutions for efficient analysis, optimal operation and control and intelligent decision making. This edited volume deals with different CI techniques for solving real world Power Industry problems. The technical contents will be extremely helpful for the researchers as well as the practicing engineers in the power industry.

The death of Professor Arthur Wright in the summer of 1996 deprived me of a friend and a colleague whose judgement and experience shaped this book. I pay tribute to his contributions to protection and electrical engineering education. In the five years since the first edition appeared, many developments have taken place and it is now necessary to update the book. The use of digital communications and advanced signal processing techniques is now widespread and several fully numeric relays are available from manu facturers. Two new Chapters 13 and 14 have been added to introduce readers to these concepts and associated techniques. Artificial intelligence is making its impact in all engineering applications and power system protection is no exception. Expert systems, fuzzy logic, artificial neural networks, adaptive and integrated protection, synchronized measurements using the global positioning system, genetic algorithms, flexible a.c. transmission systems, are some of the techniques considered in connection with protection. Although many of these techniques have not yet found major application in protection, it is nevertheless essential for the educated protection engineer to have a basic understanding of the underlying principles and methodology so that he, or she, can evaluate their suitability for new relaying problems and applications. Chapter 15 was therefore added to guide readers through this developing area. I have also added some new material in other chapters to reflect changes over the past years.

With emphasis on power system protection from the network operator perspective, this classic textbook explains the fundamentals of relaying and power system phenomena including stability, protection and reliability. The fourth edition brings coverage up-to-date with important advancements in protective relaying due to significant changes in the conventional electric power system that will integrate renewable forms of energy and, in some countries, adoption of the Smart Grid initiative. New features of the Fourth Edition include: an entirely new chapter on protection considerations for renewable energy sources, looking at grid interconnection techniques, codes, protection considerations and practices. new concepts in power system protection such as Wide Area Measurement Systems (WAMS) and system integrity protection (SIPS) -how to use WAMS for protection, and SIPS and control with WAMS. phasor measurement units (PMU), transmission line current differential, high voltage dead tank circuit breakers, and relays for multi-terminal lines. revisions to the Bus Protection Guide IEEE C37.234 (2009) and to the sections on additional protective requirements and restoration. Used by universities and industry courses throughout the world, Power System Relaying is an essential text for graduate students in electric power engineering and a reference for practising relay and protection engineers who want to be kept up to date with the latest advances in the industry.

Practical Power System and Protective Relays Commissioning is a unique collection of the most important developments in the field of power system setup. It includes simple explanations and cost affordable models for operating engineers. The book explains the theory of power system components in a simple, clear method that also shows how to apply different

commissioning tests for different protective relays. The book discusses scheduling for substation commissioning and how to manage available resources to efficiently complete projects on budget and with optimal use of resources. Explains the theory of power system components and how to set the different types of relays Discusses the time schedule for substation commissioning and how to manage available resources and cost implications Details worked examples and illustrates best practices

This book develops novel digital distance relaying schemes to eliminate the errors produced by the conventional digital distance relays while protecting power transmission lines against different types of faults. These include high resistance ground faults on single infeed transmission lines; high resistance ground faults on double infeed transmission lines; simultaneous open conductor and ground fault on double infeed transmission lines; inter-circuit faults on parallel transmission lines; simultaneous open conductor and ground fault on series compensated parallel transmission lines; inter-circuit faults on series compensated parallel transmission lines; and phase faults on series compensated double infeed transmission lines. This monograph also details suggestions for further work in the area of digital protection of transmission lines. The contents will be useful to academic as well as professional researchers working in transmission line protection.

As the demand for electrical power increases, power systems are being operated closer to their stability limits than ever before. This text focuses on explaining and analysing the dynamic performance of such systems which is important for both system operation and planning. Placing emphasis on understanding the underlying physical principles, the book opens with an exploration of basic concepts using simple mathematical models. Building on these firm foundations the authors proceed to more complex models and algorithms. Features include: * Progressive approach from simplicity to complexity. * Detailed description of slow and fast dynamics. * Examination of the influence of automatic control on power system dynamics. * Stability enhancement including the use of PSS and Facts. * Advanced models and algorithms for power system stability analysis. Senior undergraduate, postgraduate and research students studying power systems will appreciate the authors' accessible approach. Also for electric utility engineers, this valuable resource examines power system dynamics and stability from both a mathematical and engineering viewpoint.

This book presents the state-of-the-art approach for transmission line protection schemes for smart power grid. It provides a comprehensive solution for real-time development of numerical relaying schemes for future power grids which can minimize cascade tripping and widespread blackout problems prevailing all around the world. The book also includes the traditional approach for transmission line protection along with issues and challenges in protection philosophy. It highlights the issues for sheltering power grid from unwanted hazards with very fundamental approach. The book follows a step-by-step approach for resolving critical issues like high impedance faults, power swing detection and auto-reclosing schemes with adaptive protection process. The book also covers the topic of hardware solution for real-time implementation of auto-reclosing scheme for transmission line protection schemes along with comparative analysis with the recently developed analytical approach such as Artificial Neural Network (ANN), Support Vector Machine (SVM) and other machine learning algorithms. It will be useful to researchers and industry professionals and students in the fields of power system protection.

This book offers a comprehensive introduction to the subject of power systems, providing a systematic exposition of power generation, transmission, and distribution. The author has simplified the discussion of the core concepts, making the book student-friendly. Suitable for those pursuing engineering in electrical, mechanical, and industrial disciplines, the book will also be of immense interest to those working in the field of electrical power systems. The book introduces the readers to the concept of 'power systems' and presents in detail the intricacies

of hydroelectric, thermal, and nuclear power plants. Its area of emphasis, however, is power transmission and power distribution.

Provides a comprehensive guide to FACTS, covering all the major aspects in research and development of FACTS technology.

For many years, Protective Relaying: Principles and Applications has been the go-to text for gaining proficiency in the technological fundamentals of power system protection. Continuing in the bestselling tradition of the previous editions by the late J. Lewis Blackburn, the Fourth Edition retains the core concepts at the heart of power system analysis. Featuring refinements and additions to accommodate recent technological progress, the text: Explores developments in the creation of smarter, more flexible protective systems based on advances in the computational power of digital devices and the capabilities of communication systems that can be applied within the power grid Examines the regulations related to power system protection and how they impact the way protective relaying systems are designed, applied, set, and monitored Considers the evaluation of protective systems during system disturbances and describes the tools available for analysis Addresses the benefits and problems associated with applying microprocessor-based devices in protection schemes Contains an expanded discussion of intertie protection requirements at dispersed generation facilities Providing information on a mixture of old and new equipment, Protective Relaying: Principles and Applications, Fourth Edition reflects the present state of power systems currently in operation, making it a handy reference for practicing protection engineers. And yet its challenging end-of-chapter problems, coverage of the basic mathematical requirements for fault analysis, and real-world examples ensure engineering students receive a practical, effective education on protective systems. Plus, with the inclusion of a solutions manual and figure slides with qualifying course adoption, the Fourth Edition is ready-made for classroom implementation. Distance protection provides the basis for network protection in transmission systems and meshed distribution systems. This book covers the fundamentals of distance protection and the special features of numerical technology. The emphasis is placed on the application of numerical distance relays in distribution and transmission systems. This book is aimed at students and engineers who wish to familiarise themselves with the subject of power system protection, as well as the experienced user, entering the area of numerical distance protection. Furthermore it serves as a reference guide for solving application problems. For this fourth edition all contents, especially the descriptions of numerical protection devices and the very useful appendix have been revised and updated.

This book was created for relay test technicians and provides the knowledge and skills necessary to test most of the modern protective relays installed over a wide variety of industries. Basic electrical fundamentals, detailed descriptions of protective elements, and generic test plans are combined with examples from real life applications to increase your confidence in any relay testing situation. A wide variety of relay manufacturers and models are used in the examples to help you realize that once you conquer the sometimes confusing and frustrating man-machine interfaces created by the different manufacturers, all digital relays use the same basic fundamentals and most relays can be tested by applying these fundamentals.By the end of this book, you will have the information you need to: Evaluate relay applications Review, understand, and compare the relay settings to the application Create a test plan Test the most commonly applied elements:Instantaneous Overcurrent (50)Inverse Time Overcurrent (50)Directional Overcurrent (67)Undervoltage (27)Overvoltage (59)Over/Under Frequency (81)Differential (87) (With three of six current channels)Line Distance (21) Evaluate the test results Provide comprehensive test results and documentationEach chapter is a self contained unit and the chapters are organized in a logical progression of knowledge to allow readers from different skill sets to focus on or skip to the sections they need without wasting time reading through information they already know. We

also provide packages for technicians who are looking for specific information only. These packages can be downloaded in pdf format for easy viewing and printing as they become available.

Electrical Power System Protection provides practising engineers with the most up-to-date and comprehensive one -volume reference and tutorial on power system protection available. Concentrating on fundamental methods and technology and with extensive examples drawn from current practice internationally, this book will be a major reference tool for engineers involved with and affected by power system protection.

Protection Technologies of Ultra-High-Voltage AC Transmission Systems considers the latest research on UHV, UHV transmission line electromagnetic field, transmission line parameters, and tower structures, with a focus on protective relaying of UHV transmission systems. This book gives insights into protective relaying of UHV AC transmission systems and sheds light on the conundrum of protective relaying for the EHV systems. In addition, it elaborates on both traditional relaying and the application of new type current differential protection, distance protection and automatic reclosing, as well as protective schemes for transformers and reactors in UHV transmission systems. This resource will serve as an important reference for technical personnel in network design and operation, as well as students and engineers in related engineering areas. Compares new advances and trends in Ultra-High-Voltage (UHV) transmission system from a global aspect Describes UHV protection technologies Evaluates conventional protection and novel protection principles in applied and verified global systems The previous two editions of Power System Relaying offer comprehensive and accessible coverage of the theory and fundamentals of relaying and have been widely adopted on university and industry courses worldwide. With the third edition, the authors have added new and detailed descriptions of power system phenomena such as stability, system-wide protection concepts and discussion of historic outages. Power System Relaying, 3rd Edition continues its role as an outstanding textbook on power system protection for senior and graduate students in the field of electric power engineering and a reference book for practising relay engineers. Provides the student with an understanding of power system protection principles and an insight into the phenomena involved. Discusses in detail the emerging technologies of adaptive relaying, hidden failures, wide area measurement, global positioning satellites and the specific application of digital devices. Includes relay designs such as electromechanical, solid-state and digital relays to illustrate the advantages and disadvantages of each. Re-examines traditional equipment protection practices to include new concepts such as transmission line differential protection, load encroachment on distance relay characteristics, distributed generation systems, and techniques to improve protection system response to power system events. Analyzes system performance through oscillographs and alarms schemes. Features problems to be worked through at the end of each chapter. Since publication of the first edition of Computer Relaying for Power Systems in 1988, computer relays have been widely accepted by power engineers throughout the world and in many countries they are now the protective devices of choice. The authors have updated this new edition with the latest developments in technology and applications such as adaptive relaying, wide area measurements, signal processing, new GPS-based measurement techniques and the application of artificial intelligence to digital relays. New material also includes sigma-delta and oversampling A/D converters, self-polarizing and cross-polarizing in transmission lines protection and optical current and voltage transformers. Phadke and Thorp have been working together in power systems engineering for more than 30 years. Their impressive work in the field has been recognized by numerous awards, including the prestigious 2008 Benjamin Franklin Medal in Electrical Engineering for their pioneering contributions to the development and application of microprocessor controllers in electric power systems. Provides the student with an understanding of computer relaying Authored by

international authorities in computer relaying Contents include relaying practices, mathematical basis for protective relaying algorithms, transmission line relaying, protection of transformers, machines and buses, hardware organization in integrated systems, system relaying and control, and developments in new relaying principles Features numerous solved examples to explain several of the more complex topics, as well as a problem at the end of each chapter Includes an updated list of references and a greatly expanded subject index.

The Relay Testing Handbook was created for relay technicians from all backgrounds and provides the knowledge necessary to test most modern protective relays installed over a wide variety of industries. Basic electrical fundamentals, detailed descriptions of protective elements, and generic test plans are combined with examples from real life applications to increase your confidence in any relay testing situation. A wide variety of relay manufacturers and models are used in the examples to help you realize that once you conquer the sometimes confusing and frustrating man-machine interfaces created by the different manufacturers, all digital relays use the same basic fundamentals; and most relays can be tested by applying these fundamentals. This package provides a step-by-step procedure for testing the most common distance protection applications used by a variety of manufacturers. Each chapter follows a logical progression to help understand why distance protection is used and how it is applied. Testing procedures are described in detail to ensure that the distance protection has been correctly applied. Each chapter uses the following outline to best describe the element and the test procedures.ApplicationSettingsPickup TestingTiming TestsTips and Tricks to Overcome Common ObstaclesReal world examples are used to describe each test with detailed instructions to determine what test parameters to use and how to determine if the results are acceptable.Thank you for your support with this project, and I hope you find this and future additions of The Relay Testing Handbook to be useful.

Power System Protection is the art and science of the application of devices that monitor the power line currents and voltages (relays) and generate signals to deenergize faulted sections of the power network by circuit breakers. Goal is to minimize damage to equipment and property that would be caused by system faults, if residues, and maintain the delivery of electrical energy to the consumers. Many types of protective relays are used to protect power system equipments, they are classified according to their operating principles; over current relay senses the extra (more than set) current considered dangerous to a given equipment, differential relays compare in and out currents of a protected equipment, while impedance relays measure the impedance of the protected piece of planet. For a good performance of a relay in a power system it must have the following characteristics; dependability, security, selectivity, sensitivity and speed. Protective relaying is a vital part of any electric power system: unnecessary during normal operation but very important during trouble, faults, and abnormal disturbances.

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