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This comprehensive textbook, now in its second edition, provides engineering students with the underlying principles of different types of grid connected renewable energy sources and, in particular, the detailed knowledge required to understand different types of grid connected wind power plants. The text includes 260 illustrations. The relevant pictures, tables, graphs and ample worked-out examples will aid learning. Software-based computer simulation examples of grid connected wind electric generators are provided. A chapter on small wind turbine technologies is also included.

The modern electric power system has evolved into a huge nonlinear complex system due to the interconnection of thousands of generation and transmission systems. The unparalleled growth of renewable energy resources (RESs) has caused significant concern regarding grid stability and power quality, and it is essential to find ways to control such a massive system for effective operation. The controllability of HVDC and FACTS devices allows for improvement of the dynamic behavior of grids and their flexibility. Research is being carried out at both the system and component levels of modelling, control, and stability. This Special Issue aims to present novel HVDC topologies and operation strategies to prevent abnormal grid conditions.

Offers instruction on how to use the flexible networking tool for exchanging messages among clusters, the cloud, and other multi-system environments.

Wind power penetration is rapidly increasing in today's energy generation industry. In particular, the doubly-fed induction generator (DFIG) has become a very popular option in wind farms, due to its cost advantage compared with fully rated converter-based systems. Wind farms are frequently located in remote areas, far from the bulk of electric power users, and require long transmission lines to connect to the grid. Series capacitive compensation of DFIG-based wind farm is an economical way to increase the power transfer capability of the transmission line connecting the wind farm to the grid. For example, a study performed by ABB reveals that increasing the power transfer capability of an existing transmission line from 1300 MW to 2000 MW using series compensation is 90% less expensive than building a new transmission line. However, a factor hindering the extensive use of series capacitive compensation is the potential risk of subsynchronous resonance (SSR). The SSR is a condition where the wind farm exchanges energy with the electric network, to which it is connected, at one or more natural frequencies of the electric or mechanical part of the combined system, comprising the wind farm and the network, and the frequency of the exchanged energy is below the fundamental frequency of the system. This oscillatory phenomenon may cause severe damage in the wind farm, if not prevented. Therefore, this book studies the SSR phenomenon in a capacitive series compensated wind farm. A DFIG-based wind farm, which is connected to a series compensated transmission line, is considered as a case study. The book consists of two main parts: Small-signal modeling of DFIG for SSR analysis: This part presents a step-by-step tutorial on modal analysis of a DFIG-based series compensated wind farm using Matlab/Simulink. The model of the system includes wind turbine aerodynamics, a 6th order induction generator, a 2nd order two-mass shaft system, a 4th order series compensated transmission line, a 4th order rotor-side converter (RSC) controller and a 4th order grid-side converter (GSC) controller, and a 1st order DC-link model. The relevant modes are identified using participation factor analysis. Definition of the SSR in DFIG-based wind farms: This part mainly focuses on the identification and definition of the main types of SSR that occur in DFIG wind farms, namely: (1) induction generator effect (SSIGE), (2) torsional interactions (SSTI), and (3) control interactions (SSCI).

The comprehensive and authoritative guide to power electronics in renewable energy systems Power electronics plays a significant role in modern industrial automation and high-efficiency energy systems. With contributions from an international group of noted experts, Power Electronics in Renewable Energy Systems and Smart Grid: Technology and Applications offers a comprehensive review of the technology and applications of power electronics in renewable energy systems and smart grids. The authors cover information on a variety of energy systems including wind, solar, ocean, and geothermal energy systems as well as fuel cell systems and bulk energy storage systems. They also examine smart grid elements, modeling, simulation, control, and AI applications. The book's twelve chapters offer an application-oriented and tutorial viewpoint and also contain technology status review. In addition, the book contains illustrative examples of applications and discussions of future perspectives. This important resource: Includes descriptions of power semiconductor devices, two level and multilevel converters, HVDC systems, FACTS, and more Offers discussions on various energy systems such as wind, solar, ocean, and geothermal energy systems, and also fuel cell systems and bulk energy storage systems Explores smart grid elements, modeling, simulation, control, and AI applications Contains state-of-the-art technologies and future perspectives Provides the expertise of international authorities in the field Written for graduate students, professors in power electronics, and industry engineers, Power Electronics in Renewable Energy Systems and Smart Grid: Technology and Applications offers an up-to-date guide to technology and applications of a wide-range of power electronics in energy systems and smart grids.

This book constitutes the refereed proceedings of the 5th International Conference on Industrial Applications of Holonic and Multi-Agent Systems, HoloMAS 2011, held in Toulouse, France, August 29-31, 2011. The 25 revised full papers presented were carefully reviewed and selected from 36 submissions. The papers are organized in topical sections on industrial agents, simulation and modelling, planning and scheduling, smart technical systems, and MAS for unmanned aerial vehicles.

PowerFactory Applications for Power System AnalysisSpringer

Comprehensive, cross-disciplinary coverage of Smart Grid issues from global expert researchers and practitioners. This definitive reference meets the need for a large scale,

high quality work reference in Smart Grid engineering which is pivotal in the development of a low-carbon energy infrastructure. Including a total of 83 articles across 3 volumes The Smart Grid Handbook is organized in to 6 sections: Vision and Drivers, Transmission, Distribution, Smart Meters and Customers, Information and Communications Technology, and Socio-Economic Issues. Key features: Written by a team representing smart grid R&D, technology deployment, standards, industry practice, and socio-economic aspects. Vision and Drivers covers the vision, definitions, evolution, and global development of the smart grid as well as new technologies and standards. The Transmission section discusses industry practice, operational experience, standards, cyber security, and grid codes. The Distribution section introduces distribution systems and the system configurations in different countries and different load areas served by the grid. The Smart Meters and Customers section assesses how smart meters enable the customers to interact with the power grid. Socio-economic issues and information and communications technology requirements are covered in dedicated articles. The Smart Grid Handbook will meet the need for a high quality reference work to support advanced study and research in the field of electrical power generation, transmission and distribution. It will be an essential reference for regulators and government officials, testing laboratories and certification organizations, and engineers and researchers in Smart Grid-related industries.

Integration of Variable Energy Resources (US Federal Energy Regulatory Commission Regulation) (FERC) (2018 Edition) The Law Library presents the complete text of the Integration of Variable Energy Resources (US Federal Energy Regulatory Commission Regulation) (FERC) (2018 Edition). Updated as of May 29, 2018 The Federal Energy Regulatory Commission is amending the pro forma Open Access Transmission Tariff to remove unduly discriminatory practices and to ensure just and reasonable rates for Commission-jurisdictional services. Specifically, this Final Rule removes barriers to the integration of variable energy resources by requiring each public utility transmission provider to: offer intra-hourly transmission scheduling; and, incorporate provisions into the pro forma Large Generator Interconnection Agreement requiring interconnection customers whose generating facilities are variable energy resources to provide meteorological and forced outage data to the public utility transmission provider for the purpose of power production forecasting. This book contains: - The complete text of the Integration of Variable Energy Resources (US Federal Energy Regulatory Commission Regulation) (FERC) (2018 Edition) - A table of contents with the page number of each section

Bringing together diverse approaches to social simulation and research agendas, this book presents a unique collection of contributions from the First World Congress on Social Simulation, held in 2006 in Kyoto, Japan. The work emerged from the collaboration of the Pacific Asian Association for Agent-Based Approach in Social Systems Sciences, the North American Association for Computational Social and Organizational Science, and the European Social Simulation Association.

A unique electrical engineering approach to alternative sources of energy Unlike other books that deal with alternative sources of energy from a mechanical point of view, Integration of Alternative Sources of Energy takes an electrical engineering perspective. Moreover, the authors examine the full spectrum of alternative and renewable energy with the goal of developing viable methods of integrating energy sources and storage efficiently. Readers become thoroughly conversant with the principles, possibilities, and limits of alternative and renewable energy. The book begins with a general introduction and then reviews principles of thermodynamics. Next, the authors explore both common and up-and-coming alternative energy sources, including hydro, wind, solar, photovoltaic, thermosolar, fuel cells, and biomass. Following that are discussions of microturbines and induction generators, as well as a special chapter dedicated to energy storage systems. After setting forth the fundamentals, the authors focus on how to integrate the various energy sources for electrical power production. Discussions related to system operation, maintenance, and management, as well as standards for interconnection, are also set forth. Throughout the book, diagrams are provided to demonstrate the electrical operation of all the systems that are presented. In addition, extensive use of examples helps readers better grasp how integration of alternative energy sources can be accomplished. The final chapter gives readers the opportunity to learn about the HOMER Micropower Optimization Model. This computer model, developed by the National Renewable Energy Laboratory (NREL), assists in the design of micropower systems and facilitates comparisons of power generation techniques. Readers can download the software from the NREL Web site. This book is a must-read for engineers, consultants, regulators, and environmentalists involved in energy production and delivery, helping them evaluate alternative energy sources and integrate them into an efficient energy delivery system. It is also a superior textbook for upper-level undergraduates and graduate students.

"This part of IEC 60044 applies to newly manufactured electronic current transformers having an analogue voltage output or a digital output, for use with electrical measuring instruments and electrical protective devices at nominal frequencies from 15 Hz to 100 Hz." --p. 7.

Filling a gap in the literature, Electrotechnical Systems: Simulation with Simulink® and SimPowerSystems™ explains how to simulate complicated electrical systems more easily using SimPowerSystems™ blocks. It gives a comprehensive overview of the powerful SimPowerSystems toolbox and demonstrates how it can be used to create and investigate models of both classic and modern electrotechnical systems. Build from Circuit Elements and Blocks to System Models Building from simple to more complex topics, the book helps readers better understand the principles, features, and detailed functions of various electrical systems, such as electrical drives, power electronics, and systems for production and distribution of electrical energy. The text begins by describing the models of the main circuit elements, which are used to create the full system model, and the measuring and control blocks. It then examines models of semiconductor devices used in power electronics as well as models of DC and AC motors. The final chapter discusses the simulation of power production and transmission systems, including hydraulic turbine, steam turbine, wind, and diesel generators. The author also develops models of

systems that improve the quality of electrical energy, such as active filters and various types of static compensators. Get a Deeper Understanding of Electrical Systems and How to Simulate Them A companion CD supplies nearly 100 models of electrotechnical systems created using SimPowerSystems. These encompass adaptations of SimPowerSystems demonstrational models, as well as models developed by the author, including many important applications related to power electronics and electrical drives, which are not covered by the demonstrational models. In addition to showing how the models can be used, he supplies the theoretical background for each. Offering a solid understanding of how electrical systems function, this book guides readers to use SimPowerSystems to create and investigate electrical systems, including those under development, more effectively.

Critically acclaimed text for computer performance analysis--now in its second edition The Second Edition of this now-classic text provides a current and thorough treatment of queueing systems, queueing networks, continuous and discrete-time Markov chains, and simulation. Thoroughly updated with new content, as well as new problems and worked examples, the text offers readers both the theory and practical guidance needed to conduct performance and reliability evaluations of computer, communication, and manufacturing systems. Starting with basic probability theory, the text sets the foundation for the more complicated topics of queueing networks and Markov chains, using applications and examples to illustrate key points. Designed to engage the reader and build practical performance analysis skills, the text features a wealth of problems that mirror actual industry challenges. New features of the Second Edition include: \* Chapter examining simulation methods and applications \* Performance analysis applications for wireless, Internet, J2EE, and Kanban systems \* Latest material on non-Markovian and fluid stochastic Petri nets, as well as solution techniques for Markov regenerative processes \* Updated discussions of new and popular performance analysis tools, including ns-2 and OPNET \* New and current real-world examples, including DiffServ routers in the Internet and cellular mobile networks With the rapidly growing complexity of computer and communication systems, the need for this text, which expertly mixes theory and practice, is tremendous. Graduate and advanced undergraduate students in computer science will find the extensive use of examples and problems to be vital in mastering both the basics and the fine points of the field, while industry professionals will find the text essential for developing systems that comply with industry standards and regulations.

This book constitutes the proceedings of the First International Conference on Emerging Trends in Engineering (ICETE), held at University College of Engineering and organised by the Alumni Association, University College of Engineering, Osmania University, in Hyderabad, India on 22–23 March 2019. The proceedings of the ICETE are published in three volumes, covering seven areas: Biomedical, Civil, Computer Science, Electrical & Electronics, Electronics & Communication, Mechanical, and Mining Engineering. The 215 peer-reviewed papers from around the globe present the latest state-of-the-art research, and are useful to postgraduate students, researchers, academics and industry engineers working in the respective fields. Volume 2 presents papers on the theme “Advances in Decision Sciences, Image Processing, Security and Computer Vision – International Conference on Emerging Trends in Engineering (ICETE)”. It includes state-of-the-art technical contributions in the areas of electronics and communication engineering and electrical and electronics engineering, discussing the latest sustainable developments in fields such as signal processing and communications; GNSS and VLSI; microwaves and antennas; signal, speech and image processing; power systems; and power electronics.

Describes the use of power system component models and efficient computational techniques in the development of a new generation of programs representing the steady and dynamic states of electrical power systems. Presents main computational and transmission system developments. Derives steady state models of a.c. and d.c. power systems plant components, describes a general purpose phase a.c. load flow program emphasizing Newton Fast Decoupled Algorithm, and more. Considers all aspects of the power system in the dynamic state.

Design, Control and Application of Modular Multilevel Converters for HVDC Transmission Systems is a comprehensive guide to semiconductor technologies applicable for MMC design, component sizing control, modulation, and application of the MMC technology for HVDC transmission. Separated into three distinct parts, the first offers an overview of MMC technology, including information on converter component sizing, Control and Communication, Protection and Fault Management, and Generic Modelling and Simulation. The second covers the applications of MMC in offshore WPP, including planning, technical and economic requirements and optimization options, fault management, dynamic and transient stability. Finally, the third chapter explores the applications of MMC in HVDC transmission and Multi Terminal configurations, including Supergrids. Key features: Unique coverage of the offshore application and optimization of MMC-HVDC schemes for the export of offshore wind energy to the mainland. Comprehensive explanation of MMC application in HVDC and MTDC transmission technology. Detailed description of MMC components, control and modulation, different modeling approaches, converter dynamics under steady-state and fault contingencies including application and housing of MMC in HVDC schemes for onshore and offshore. Analysis of DC fault detection and protection technologies, system studies required for the integration of HVDC terminals to offshore wind power plants, and commissioning procedures for onshore and offshore HVDC terminals. A set of self-explanatory simulation models for HVDC test cases is available to download from the companion website. This book provides essential reading for graduate students and researchers, as well as field engineers and professionals who require an in-depth understanding of MMC technology.

This book discusses HVDC grids based on multi-terminal voltage-source converters (VSC), which is suitable for the connection of offshore wind farms and a possible solution for a continent wide overlay grid. HVDC Grids: For Offshore and Supergrid of the Future begins by introducing and analyzing the motivations and energy policy drives for developing offshore grids and the European Supergrid. HVDC transmission technology and offshore equipment are described in the second part of the book. The third part of the book discusses how HVDC grids can be developed and integrated in the existing power system. The fourth part of the book focuses on HVDC grid integration, in studies, for different time domains of electric power systems. The book concludes by discussing developments of advanced control methods and control devices for enabling DC grids. Presents the technology of the future offshore and HVDC grid Explains how offshore and HVDC grids can be integrated in the existing power system Provides the required models to analyse the different time domains of power system studies: from steady-state to electromagnetic transients This book is intended for power system engineers and academics

with an interest in HVDC or power systems, and policy makers. The book also provides a solid background for researchers working with VSC-HVDC technologies, power electronic devices, offshore wind farm integration, and DC grid protection.

Power quality problems have increasingly become a substantial concern over the last decade, but surprisingly few analytical techniques have been developed to overcome these disturbances in system-equipment interactions. Now in this comprehensive book, power engineers and students can find the theoretical background necessary for understanding how to analyze, predict, and mitigate the two most severe power disturbances: voltage sags and interruptions. This is the first book to offer in-depth analysis of voltage sags and interruptions and to show how to apply mathematical techniques for practical solutions to these disturbances. From UNDERSTANDING AND SOLVING POWER QUALITY PROBLEMS you will gain important insights into Various types of power quality phenomena and power quality standards Current methods for power system reliability evaluation Origins of voltage sags and interruptions Essential analysis of voltage sags for characterization and prediction of equipment behavior and stochastic prediction Mitigation methods against voltage sags and interruptions Sponsored by: IEEE Power Electronics Society, IEEE Industry Applications Society, IEEE Power Engineering Society.

Wind energy is a reliable, natural and renewable electrical power supply. The high installed capacity of today's wind turbines and decreasing plant costs have shown that wind power can be competitive with conventional, more heavily polluting, fuels in the long term. Focusing on the electrical engineering aspects of wind energy, this completely revised edition provides a detailed treatment of electrical and mechanical components and their interdependency, power control and supervision in wind power plants, and the grid integration facility. The book incorporates all the recent technical developments in electrical power conversion systems and essential operating conditions. Provides guidelines for the design, construction and installation of wind power plants Presents the history of wind technology, wind resources and economics of wind energy generation Introduces operating results and cost considerations Describes the fundamental characteristics and theoretical tools of electrical and mechanical components Discusses conventional and new types of generators, converters and power electronics Offers a comprehensive treatment of grid integration including the effect of power fluctuations on harmonics Focuses on improved use of grid capacities and grid support for fixed-and variable-speed controlled wind power plants Outlines power conditioning and control systems to ensure the safe operation of plants Fully revised and updated, this new edition will continue to be the definitive resource for researchers and practitioners involved in the planning, installation and grid integration of wind turbines and power plants. The thorough approach will also prove highly beneficial to university students and practitioners in wind engineering, turbine design and manufacture and electrical power engineering.

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. Discusses the application of mathematical and engineering tools for modeling, simulation and control oriented for energy systems, power electronics and renewable energy This book builds on the background knowledge of electrical circuits, control of dc/dc converters and inverters, energy conversion and power electronics. The book shows readers how to apply computational methods for multi-domain simulation of energy systems and power electronics engineering problems. Each chapter has a brief introduction on the theoretical background, a description of the problems to be solved, and objectives to be achieved. Block diagrams, electrical circuits, mathematical analysis or computer code are covered. Each chapter concludes with discussions on what should be learned, suggestions for further studies and even some experimental work. Discusses the mathematical formulation of system equations for energy systems and power electronics aiming state-space and circuit oriented simulations Studies the interactions between MATLAB and Simulink models and functions with real-world implementation using microprocessors and microcontrollers Presents numerical integration techniques, transfer-function modeling, harmonic analysis and power quality performance assessment Examines existing software such as, MATLAB/Simulink, Power Systems Toolbox and PSIM to simulate power electronic circuits including the use of renewable energy sources such as wind and solar sources The simulation files are available for readers who register with the Google Group: power-electronics-interfacing-energy-conversion-systems@googlegroups.com. After your registration you will receive information in how to access the simulation files, the Google Group can also be used to communicate with other registered readers of this book.

From the more basic concepts to the most advanced ones where long and laborious simulation models are required, Electromagnetic Transients in Power Cables provides a thorough insight into the study of electromagnetic transients and underground power cables. Explanations and demonstrations of different electromagnetic transient phenomena are provided, from simple lumped-parameter circuits to complex cable-based high voltage networks, as well as instructions on how to model the cables. Supported throughout by illustrations, circuit diagrams and simulation results, each chapter contains exercises, solutions and examples in order to develop a practical understanding of the topics. Harmonic analysis of cable-based networks and instructions on how to accurately model a cable-based network are also covered, including several "tricks" and workarounds to help less experienced engineers perform simulations and analyses more efficiently. Electromagnetic Transients in Power Cables is an invaluable resource for students and engineers new to the field, but also as a point of reference for more experienced industry professionals.

This book consolidates some of the most promising advanced smart grid functionalities and provides a comprehensive set of guidelines for their implementation/evaluation using DiGSILENT Power Factory. It includes specific aspects of modeling, simulation and analysis, for example wide-area monitoring, visualization and control, dynamic capability rating, real-time load measurement and management, interfaces and co-simulation for modeling and simulation of hybrid systems. It also presents key advanced features of modeling and automation of calculations using PowerFactory, such as the use of domain-specific (DSL) and DiGSILENT Programming (DPL) languages, and utilizes a variety of methodologies including theoretical explanations, practical examples and guidelines. Providing a concise compilation of significant outcomes by experienced users and developers of this program, it is a valuable resource for postgraduate students and engineers working in power-system operation and planning.

"I encourage all those who will read this book, will promote both directly and indirectly the use and awareness of wind energy as a clean and viable source of electric power." —THOMAS ACKERMAN, Ph.D., Wind Power Author and Founder, Energynautics GmbH, Germany "Those who will read this book, will be well prepared to work in the wind power sector and participate in the important task to develop a renewable energy system which can stop the global climate change." —TORE WIZELIUS, Wind Power Author, Teacher and Wind Project Developer, Sweden "This book provides a valuable technical

information on small wind turbines that will allow students to become amateur wind engineers and entrepreneurs in this growing industry." —Urban Green Energy, USA This comprehensive textbook, now in its third edition, incorporates significant improvements based on the readers' suggestions and demands. It provides engineering students with the principles of different types of grid connected renewable energy sources and, in particular, the detailed underpinning knowledge required to understand the different types of grid connected wind turbines. New to the Third Edition • Revised Chapter 1 providing considerable amount of current information and technologies related to various types of renewable energy technologies • One new chapter on 'Electronics in Renewable Energy Systems' (Chapter 15) Designed as a textbook for Renewable Energy courses offered in the most of the Indian universities, the book not only serves for the one-semester stream-specific course on Renewable Energy or Wind Energy for diploma and senior level undergraduate students of electrical, mechanical, electronics and instrumentation engineering, but also for the postgraduate engineering students undertaking energy studies. TARGET AUDIENCE • B.Tech/M.Tech (EEE/ECE/ME) • Diploma (engineering)

Wind power is currently considered as the fastest growing energy resource in the world. Technological advances and government subsidies have contributed in the rapid rise of Wind power systems. The Handbook on Wind Power Systems provides an overview on several aspects of wind power systems and is divided into four sections: optimization problems in wind power generation, grid integration of wind power systems, modeling, control and maintenance of wind facilities and innovative wind energy generation. The chapters are contributed by experts working on different aspects of wind energy generation and conversion.

This book presents different aspects of renewable energy integration, from the latest developments in renewable energy technologies to the currently growing smart grids. The importance of different renewable energy sources is discussed, in order to identify the advantages and challenges for each technology. The rules of connecting the renewable energy sources have also been covered along with practical examples. Since solar and wind energy are the most popular forms of renewable energy sources, this book provides the challenges of integrating these renewable generators along with some innovative solutions. As the complexity of power system operation has been raised due to the renewable energy integration, this book also includes some analysis to investigate the characteristics of power systems in a smarter way. This book is intended for those working in the area of renewable energy integration in distribution networks.

Wide area monitoring, protection and control systems (WAMPACs) have been recognized as the most promising enabling technologies to meet the challenges of modern electric power transmission systems, where reliability, economics, environmental and other social objectives must be balanced to optimize the grid assets and satisfy growing electrical demand. This book provides an overview of this emerging technology. Topics covered include: \* Wide Area Measurement System: The Enabler for Smarter Transmission \* Reliability-Based Substation Monitoring Systems Placement \* System Integrity Protection Scheme Based on PMU Technology \* New Methodologies for Large-Scale Power System Dynamic Analysis \* A Fuzzy-based Knowledge Discovery Paradigm for on-line Optimal Power Flow Analysis \* False data injection attacks and countermeasures for wide area measurement system

This book outlines the challenges that increasing amounts of renewable and distributed energy represent when integrated into established electricity grid infrastructures, offering a range of potential solutions that will support engineers, grid operators, system planners, utilities, and policymakers alike in their efforts to realize the vision of moving toward greener, more secure energy portfolios. Covering all major renewable sources, from wind and solar, to waste energy and hydropower, the authors highlight case studies of successful integration scenarios to demonstrate pathways toward overcoming the complexities created by variable and distributed generation.

This book addresses the emerging trend of smart grids in power systems. It discusses the advent of smart grids and selected technical implications; further, by combining the perspectives of researchers from Europe and South America, the book captures the status quo of and approaches to smart grids in a wide range of countries. It describes the basic concepts, enabling readers to understand the theoretical aspects behind smart grid formation, while also examining current challenges and philosophical discussions. Like the industrial revolution and the birth of the Internet, smart grids are certain to change the way people use electricity. In this regard, a new term – the “prosumer” – is used to describe consumers who may sometimes also be energy producers. This is particularly appealing if we bear in mind that most of the distributed power generation in smart grids does not involve carbon emissions. At first glance, the option of generating their own power could move consumers to leave their current energy provider. Yet the authors argue that doing so is not a wise choice: utilities will play a central role in this new scenario and should not be ignored.

An Introduction to Solar Radiation is an introductory text on solar radiation, with emphasis on the methods of calculation for determining the amount of solar radiation incident on a surface on the earth. Topics covered include the astronomical relationship between the sun and the earth; thermal radiation; the solar constant and its spectral distribution; and extraterrestrial solar irradiation. This book is comprised of 12 chapters and begins with an overview of the trigonometric relationships between the sun-earth line and the position of an inclined surface, followed by a discussion on the characteristics of blackbody radiation. The next chapter focuses on the solar constant and its spectral distribution, paying particular attention to extraterrestrial solar spectral irradiance and the sun's blackbody temperature. Subsequent chapters explore extraterrestrial and radiation incident on inclined planes; the optics of a cloudless-sky atmosphere; solar spectral radiation and total (broadband) radiation under cloudless skies; and solar radiation arriving at horizontal surfaces on the earth through cloudy skies. The ground albedo and its spectral and angular variation are also described, along with insolation on inclined surfaces. The last chapter is devoted to instruments for measuring solar radiation, including pyrheliometers and pyranometers. This monograph will serve as a useful guide for energy analysts, designers of thermal devices, architects and engineers, agronomists, and hydrologists as well as senior graduate students.

Web version of an exhibition originally held at the National Portrait Gallery, Sept. 26, 1997-Jan. 4, 1998. This site provides information on the collection of portraits by the American photographer Mathew Brady (1823?-1896) in the Gallery's collection as well as biographical and professional information on Brady.

Modern Solutions for Protection, Control, and Monitoring of Electric Power Systems, Edited by Héctor J. Altuve Ferrer and Edmund O. Schweitzer, III ; publishing on June 1, 2010 ; addresses the concerns and challenges of protection, control, communications and power system engineers. It also presents solutions relevant to decision-making personnel at electric utilities and industries, and is appropriate for university students and faculty. Approaches, technology solutions and examples explained in this book provide engineers with tools to help meet today's power system requirements, including:- Reduced security margins resulting from limitations on new transmission lines and generating stations.- Variable and less predictable power flows stemming from new generation sources and free energy markets.- Modern protection, control, and monitoring solutions to prevent and mitigate blackouts.- Increased communications and automation (sometimes referred to as the ;smart grid;) Modern Solutions brings together the combined expertise of engineers working on power system operation, planning, asset management, maintenance, protection, control, monitoring, and communications. Authors include Allen D. Risley, Armando Guzmán Casillas, Brian A. McDermott, Daqing Hou, David A. Costello, David J. Dolezilek, Demtrios Tziouvaras, Edmund O. Schweitzer, III, Gabriel Benmouyal, Gregory C. Zweigle, Héctor J. Altuve Ferrer, Joseph B. Mooney, Michael J. Thompson, Ronald A. Schwartz, and Veselin Skendzic.

This book presents a comprehensive set of guidelines and applications of DIgSILENT PowerFactory, an advanced power system simulation software package, for different types of power systems studies.

Written by specialists in the field, it combines expertise and years of experience in the use of DigSILENT PowerFactory with a deep understanding of power systems analysis. These complementary approaches therefore provide a fresh perspective on how to model, simulate and analyse power systems. It presents methodological approaches for modelling of system components, including both classical and non-conventional devices used in generation, transmission and distribution systems, discussing relevant assumptions and implications on performance assessment. This background is complemented with several guidelines for advanced use of DSL and DPL languages as well as for interfacing with other software packages, which is of great value for creating and performing different types of steady-state and dynamic performance simulation analysis. All employed test case studies are provided as supporting material to the reader to ease recreation of all examples presented in the book as well as to facilitate their use in other cases related to planning and operation studies. Providing an invaluable resource for the formal instruction of power system undergraduate/postgraduate students, this book is also a useful reference for engineers working in power system operation and planning.

Power Quality Issues: Current Harmonics provides solutions for the mitigation of power quality problems related to harmonics. Focusing on active power filters (APFs) due to their excellent harmonic and reactive power compensation in two-wire (single phase), three-wire (three-phase without neutral), and four-wire (three-phase with neutral) AC power networks with nonlinear loads, the text: Introduces the APF technology, describing various APF configurations and offering guidelines for the selection of APFs for specific application considerations Compares shunt active filter (SHAF) control strategies for extracting three-phase reference currents, evaluating their performance under a number of source voltage conditions using a proportional-integral (PI) controller Presents PI controller-based SHAF instantaneous active and reactive power (p-q) and instantaneous active and reactive current (Id-Iq) control strategies, supplying detailed MATLAB®/Simulink simulation results Proposes SHAF control strategies using type 1 and type 2 fuzzy logic controllers (FLCs) with different fuzzy membership functions (MFs), analyzing their harmonic mitigation and DC link voltage regulation Verifies the proposed type 2 FLC-based SHAF control strategies with trapezoidal, triangular, and Gaussian fuzzy MFs using RT-LAB, a real-time digital simulation software from OPAL-RT Technologies Power Quality Issues: Current Harmonics is a useful resource for those tackling electrical power quality challenges. The compensation techniques described in this book alleviate harmonic issues that can distort voltage waveforms, fry a building's wiring, trigger nuisance tripping, overheat transformer units, and cause random end-user equipment failure.

Power System Stability and Control contains the hands-on information you need to understand, model, analyze, and solve problems using the latest technical tools. You'll learn about the structure of modern power systems, the different levels of control, and the nature of stability problems you face in your day-to-day work.

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