The book also provides in-depth steady-state and dynamic analysis of squirrel cage induction generator, doubly fed induction generator, and synchronous generator based wind energy systems. To illustrate the key market survey, electric generators and modeling, power converters and modulation techniques, wind turbine characteristics and configurations, and control schemes for fixed- and variable-speed wind energy systems. Several authors have contributed to this book aiming to benefit students, researchers, academics, policy makers and professionals. We are indebted to all the people who either directly or care of their diverse characteristics, finding new ways to/or install and control these DG systems and finding new design for distribution system. DG has much potential to improve distribution system performance. The fundamental assumption in their design. This creates complexity in operation and control of existing distribution networks and offers many technical challenges for successful introduction of DG systems. Some of the operated in radial configuration with unidirectional power flow from centralized generating station to customers. The increase in interconnection of DG to utility networks can lead to reverse power flow violating with the environmental benefits. Unlike centralized power plants, the DG units are directly connected to the distribution system; most often at the customer end. The existing distribution networks are designed and for the integration of diverse DG systems to the utility. Interconnection of these generators will offer a number of benefits such as improved reliability, power quality, efficiency, allocation of system constraints along with the environmental benefits. Unlike centralized power plants, the DG units are directly connected to the distribution system; most often at the customer end. The existing distribution networks are designed and operated in radial configuration with unidirectional power flow from centralized generating station to customers. The increase in interconnection of DG to utility networks can lead to reverse power flow violating fundamental assumption in their design. This creates complexity in operation and control of existing distribution networks and offers many technical challenges for successful introduction of DG systems. Some of the technical issues are islanding of DG, voltage regulation, protection and stability of the network. Some of the solutions to these problems include designing standard interface control for individual DG systems by taking care of their diverse characteristics, finding new ways to/or install and control these DG systems and finding new design for distribution system. DG has much potential to improve distribution system performance. The use of DG strongly contributes to a clean, reliable and cost effective energy for future. This book deals with several aspects of the DG systems such as benefits, issues, technology interconnected operation, performance studies, planning and design. Several authors have contributed to this book aiming to benefit students, researchers, academics, policy makers and professionals. We are indebted to all the people who either directly or indirectly contributed towards the publication of this book. The book provides an in-depth steady-state and dynamic analysis of squirrel cage induction generator, doubly fed induction generator, and synchronous generator based wind energy systems. To illustrate the key
concepts and help the reader tackle real-world issues, the book contains more than 30 case studies and 100 solved problems in addition to simulations and experiments. The book serves as a comprehensive reference for academic researchers and practicing engineers. It can also be used as a textbook for graduate students and final year undergraduate students. This book provides innovative ideas on achieving sustainable development and climate change mitigation by modeling and simulation techniques to conserving our earth system. Innovation is the key to sustainable development, while using innovative concepts that will not only help mankind as a whole, but also contribute to the economic growth of individual countries. It is essential that the global problem of environmental degradation be addressed immediately, and thus, we need to rethink the concept of sustainable development. Indeed, new environmentally friendly technologies are fundamental to attaining sustainable development. The book shares a wealth of innovative green technological ideas on how to preserve and improve the quality of the environment, and how to establish a more resource-efficient and sustainable society. The book provides an interdisciplinary approach to addressing various technical issues and capitalizing on advances in computing & optimization for scientific & technological development, smart information, communication, bio-monitoring, smart cities, food quality assessment, waste management, environmental aspects, alternative energies, sustainable infrastructure development, etc. In short, it offers valuable information and insights for budding engineers, researchers, upscaling young minds and industry professionals, promoting awareness for recent advances in the various fields mentioned above. “The emerging fuel cell (FC) technology is growing rapidly in its applications from small-scale portable electronics to large-scale power generation.” This book gives students, engineers, and scientists a solid understanding of the FC dynamic modeling and controller design to adapt FCs to particular applications in distributed power generation.” The book begins with a fascinating introduction to the subject, including a brief history of the U.S. electric utility formation and restructuring. Next, it provides coverage of power deregulation and distribution, inverter types, and an overview of the book. DG types, functions, and the hybrid AC/DC power systems. It covers DGs in electrical, mechanical and control engineering and scientists working in the FC area.” - BOOK JACKET Distributed Power Resources: Operation and Control of Connecting to the Grid presents research and development, lists relevant technologies, and draws on experience to tackle practical problems in the operation and control of distributed power. Key problems are identified and interrogated, as are requirements and application methods, associated power conversion tactics, operational control perceptions, and maintenance technologies. The title gives experimental verification of the technologies involved in several demonstration projects, including an active multi-resource distribution grid, and a high-density distributed resources connecting ac/hybrid power grid. The book considers the development of distributed photovoltaic power, wind power, and electric vehicle energy storage. It discusses the characteristics of distributed resources and the key requirements and core technologies for plug-and-play applications. Consider the state-of-the-art in distributed power resources and their connection to the grid. Leverages practical experience and experimental data to solve problems of operation and control. Provides analysis of plug-and-play applications for distributed power supplies. Presents relevant technology and practical experience to industry. Explores potential new technologies in distributed power resources. In-depth with this comprehensive discussion of distributed energy management Distributed Energy Management of Electrical Power Systems provides the most complete analysis of fully distributed control applications and their applications for electric power systems available today. Authored by four respected leaders in the field, the book covers the technical aspects of control, operation management, and optimization of electric power systems. In each chapter, the book covers the foundations and fundamentals of the topic under discussion. It then moves on to more advanced applications. Topics reviewed in the book include: System-level coordinated control Optimization of active and reactive power in power grids The coordinated control of distributed generation, elastic load and energy storage systems Distributed Energy Management incorporates discussions of emerging and future technologies and their potential effects on electrical power systems. The increased impact of renewable energy sources is also covered. Perfect for industry practitioners and graduate students in the field of power systems, Distributed Energy Management remains the leading reference for advancements in distributed energy management systems. In its fascinating exploration of microgrids and their key components, Distributed Energy Management also covers traditionally unconnected aspects of distributed energy systems. It presents well-founded mathematical analyses on how to technically and economically optimize microgrids via distributed energy resource integration. Researchers and engineers in the power and energy sector will find this information useful for combined scientific and economical approaches to microgrid integration. Specific sections cover microgrid performance, including key technical elements, such as control design, stability analysis, power quality, reliability and resiliency in microgrid operation. Addresses the challenges related to the integration of renewable energy resources Includes examples of control algorithms adopted during integration Presents detailed methods of optimization to enhance successful integration Distributed Generation Systems: Design, Operation and Control Grid Integration closes the information gap between research on distributed generation and industrial plants, and provides solutions to their practical problems and limitations. It offers a clear picture of operation principles of distributed generation units, not only focusing on the power system perspective but targeting a specific need of the research community. This book is a useful reference for practitioners, featuring worked examples and figures on principal types of distributed generation adopted with an emphasis on real-world examples, simulations, and illustrations. The book uses practical exercises relating to the concepts of operating and integrating DG units to distribution networks, and helps engineers accurately design systems and reduce maintenance costs. Provides examples and datasheets of principal systems and commercial data in MATLAB Programming is an accurate system analysis tool that has been recent research in the development of distributed power systems. This text is an introduction to the use of control in distributed power generation. It shows the reader how reliable control can be achieved so as to realize the potential of small networks of diverse energy sources, either singly or in coordination, for meeting concerns of energy cost, energy security and environmental protection. The book demonstrates how such microgrids, interconnecting groups of generating units and loads within a local area, can be an effective means of balancing electrical supply and demand. It takes advantage of the ability to connect and disconnect microgrids from the main body of the power grid to give flexibility in response to special events, planned or unplanned. In order to capture the main opportunities for expanding the power grid and to present the plethora of associated open problems in control theory Control and Optimization of Distributed Generation Systems will enable readers new to the field of distributed generation power generation and networked control, whether experienced academic migrating from another field or graduate student beginning a research career, to familiarize themselves with the important points of the control and regulation of microgrids. It will also be useful for practising power engineers wishing to keep abreast of changes in power grids necessitated by the diversification of generation methods. The goal of the book is to provide basic and advanced knowledge of design, analysis, and circuit implementation for electronic instrumentation and clarify how to get the best out of the analog, digital, and computer circuitry design steps. The reader will learn the physical fundamentals guiding the electrical and mechanical devices that allow for a modern automation and control system, which are widely comprised of computers, electronic instrumentation, communication loops, smart grids, and digital circuitry. It includes practical and technical data on electronic instrumentation with respect to efficiency, maximum power, and applications. Additionally, the text discusses fuzzy logic and neural networks and how they can be used in practice for electronic instrumentation of distributed generation, smart grids, and power systems. This book focuses on the framework and implementation of energy integration systems with energy and smart-control technologies. It describes the detail of smart-energy, a novel energy interaction mode based on a cyber-physical-economy-energy model, which can be adopted to solve the problem of energy supply and utilization. It then analyzes the key devices and technologies for developing the Energy Internet, such as converters, energy-conversion devices, system-level connection devices, optimization control strategies, cyber-physical system security, energy-system stability, communication technologies’ operating modes and distributed optimization algorithms, to enable readers to gain a comprehensive understanding of the topic. Lastly, it offers an outlook on the development of the Energy Internet, providing a reference for cross-integration between different disciplines. The book is an indispensable resource for power enterprises, manufacturers in the power-supply industry, and researchers in the field of Energy Internet application. It is also useful for universities and college teachers and students seeking a deeper understanding of the Energy Internet, as well as for readers interested in the Energy Internet correlation techniques. Integrating renewable energy and other distributed energy sources into smart grids, often via power inverters, is arguably the largest “new frontier” for smart grid advancements.
be controlled properly so that their integration does not jeopardize the stability and performance of power systems and a solid technical backbone to facilitate other functions and services of smart grids. This unique reference offers systematic treatment of important control problems in power inverters, and different general converter theories. Launching at a basic level, it presents conventional power conversion methodologies and the latest "non-conventional" methods, with a highly accessible summary of the state of the art, ranging from renewable energy conversion, control engineering, power electronics, renewable energy and smart grid integration. This book features extensive coverage of all Distributed Energy Management technologies, highlighting the theoretical, environmental and technical aspects of various energy systems and components, such as load reduction, protection, control, storage, power electronics, reliability improvement, and voltage profile optimization. It explains how electric power system planners, developers, operators, designers, regulators and policy makers can derive many benefits with increased penetration of distributed generation units into smart distribution networks. It further demonstrates how to best realize these benefits by skilful integration via intelligent control. Microgrid Control: Methods and Renewable Energy System Integration demonstrates the state-of-art of methods and applications of microgrid control, with eleven concise and comprehensive chapters. The first three chapters provide an overview of the control methods of microgrid systems that is followed by a review of distributed control and management strategies for the next generation microgrids. Next, the book identifies future research directions and discusses the hierarchical power sharing control in DC Microgrids. Chapter 4 investigates the demand side management in microgrid control systems from various perspectives, followed by an overview of the operation and controls of the smart microgrids in Chapter 5. Chapter 6 deals with control of low-voltage microgrids with master/slave architecture. The final chapters explain the load-Frequency A Control for Distributed Power System Generation Units and the issue of robust control design for VSIs, followed by a communication solution dedicated to distributed control of an autonomous microgrid system is performed. Addresses issues of contemporary interest to practitioners in the power engineering and management fields Focuses on the role of microgrids within the overall power system structure and attempts to clarify the main findings relating to primary and secondary control and management at the microgrid level Provides results from a quantified assessment of benefits from economic, environmental, operational, and social point-of-views Presents the hierarchical control levels manifested in microgrid operations and evaluates the principles and main functions of centralized and decentralized control practical and systematical treatment of the analysis, design and control of grid integrated and standalone distributed photovoltaic (PV) generation systems, with Matlab and Simulink models Analyses control of distribution networks with high penetration of PV systems and standalone microgrids with PV systems Covers in detail PV accommodation techniques including energy storage, demand side management and PV output power regulation Features examples of real projects/systems: Distributed Energy Management incorporates discussions of emerging and future technologies and their potential effects on electrical power systems. The increased impact of renewable energy sources is also covered. Perfect for industry practitioners and graduate students in the field of power systems, Distributed Energy Management remains the leading reference for anyone with an interest in its fascinating subject matter. This book systematically discusses (a) Distributed Generation (DG), which operates in a single, stand-alone controllable system mode, and (b) the Microgrid (MG) powered by DG, along with the technical concepts, the impact on power systems, control and optimisation techniques, and their applications. It includes ten chapters that focus on the following five aspects: 1) An overview of distributed generation is introduced in Chapter One, and the technical concept of the microgrid is introduced in Chapter Eight with detail; 2) As the main element of distributed generation (DG), a smart inverter system for the control of active and reactive power in a grid-tied mode, which is treated as an interface between grid and the RES (Renewable Energy System), is studied concretely in Chapter Two; 3) The influence of distributed generation on power systems, including the impact of DG on the planning and operation of power systems, the impact of DG on power quality, and power system protection are concretely described and analysed in Chapters Three, Four and Five, respectively. The control and optimisation methodologies for DG and MG. These techniques include: the Economic Model Predictive Control (EMPC) strategy for the solution of pricing management in community-based microgrids (MGs), which consider economic benefits as the control and optimisation objects; the distributed control and optimisation techniques for islanded microgrids (MGs) that consider stability as the control and optimisation objects; the intelligent load shedding for stability enhancement in an autonomous microgrid; and the recovery (restoration) control after a contingency situation. These are all investigated in Chapters Six, Seven, Eight and Nine, respectively; 5) The applications of renewable energy technology, such as efficient artisanal light fishing technologies that exploit lake light physics and light-fish interactions, are specifically presented in Chapter
Ten. Featuring contributions from worldwide leaders in the field, the carefully crafted Electric Power Generation, Transmission, and Distribution, Third Edition (part of the five-volume set, The Electric Power Engineering Handbook) provides convenient access to detailed information on a diverse array of power engineering topics. Updates to nearly every chapter keep this book at the forefront of developments in modern power systems, reflecting international standards, practices, and technologies. Topics covered include: Electric power generation: nonconventional methods Electric power generation: conventional methods Transmission system distribution systems Electric power utilization Power quality L. L. Grigsby, a respected and accomplished authority in power engineering, and section editors Saifur Rahman, Rama Ramakumar, George Karady, Bill Kersting, Andrew Hanson, and Mark Halpin present substantially new and revised material, giving readers up-to-date information on core areas. These include advanced energy technologies, distributed utilities, load characterization and modeling, and power quality issues such as power system harmonics, voltage sags, and power quality monitoring. With six new and 16 fully revised chapters, the book supplies a high level of detail and, more importantly, a tutorial style of writing and use of photographs and graphics to help the reader understand the material. New chapters cover: Water Transmission Line Reliability Methods High Voltage Direct Current Transmission System Advanced Technology High-Temperature Conduction Distribution Short-Circuit Protection Linear Electric Motors A volume in the Electric Power Engineering Handbook, Third Edition. Other volumes in the set: K12648 Power Systems, Third Edition (ISBN: 9781439856338) K13917 Power System Stability and Control, Third Edition (ISBN: 9781439883204) K12650 Electric Power Substations Engineering, Third Edition (ISBN: 9781439856383) K12643 Electric Power Transformer Engineering, Third Edition (ISBN: 9781439856291) The concept of the smart grid promises the world an efficient and intelligent approach of managing energy production, transportation, and consumption by incorporating intelligence, efficiency, and optimality into the power grid. Both energy providers and consumers can take advantage of the convenience, reliability, and energy savings achieved by real-time and intelligent energy management. To this end, the current power grid is experiencing drastic changes and upgrades. For instance, more significant green energy resources such as wind power and solar power are being integrated into the power grid, and higher energy storage capacity is being installed in order to mitigate the intermittency issues brought about by the variable energy resources. At the same time, novel power electronics technologies and operating strategies are being invented and adopted. For instance, Flexible AC transmission systems and phasor measurement units are two promising technologies for improving the power system reliability and power quality. Demand side management will enable the customers to manage the power loads in a more active fashion. As a result, modeling and control of modern power grids pose great challenges due to the adoption of new smart grid technologies. In this book, chapters regarding representative applications of smart grid technologies written by world-renowned experts are included, which explain in detail various innovative modeling and control methods. Distributed Energy Resources in Local Integrated Energy Systems: Optimal Operation and Planning reviews research and policy developments surrounding the optimal operation and planning of DER in the context of local integrated energy systems in the presence of multiple energy carriers, vectors, and multi-objective requirements. This assessment is carried out by analyzing impacts and benefits at local levels, and in distribution networks and larger systems. These frameworks represent valid tools to provide support in the decision-making process for DER operation and planning. Uncertainties of RES generation and loads in optimal DER scheduling are addressed, along with energy trading and blockchain technologies. Interactions among various energy carriers in local energy systems are investigated in scalable and flexible optimization models for adaptation to a number of real contexts thanks to the wide variety of generation, conversion and storage technologies considered, the exploitation of demand side flexibility, emerging technologies, and through the general mathematical formulations established. Integrates multi-energy DER, including electrical and thermal distributed generation, demand response, electric vehicles, storage and RES in the context of local integrated energy systems. Fosters the integration of DER in the electricity markets through the concepts of DER aggregation. Addresses the challenges of emerging paradigms as energy communities and energy blockchain applications in the current and future energy landscape. Proposes operation optimization models and methods through multi-objective approaches for fostering short- and long-run sustainability of local energy systems. Assesses and models the uncertainties of renewable resources and intermittent loads in the short-term decision-making process for smart decentralized energy systems. Operation of Distributed Energy Resources in Smart Distribution Networks defines the barriers and challenges of smart distribution networks, ultimately proposing optimal solutions for addressing them. The book considers their use as an important part of future electrical power systems and their ability to improve the local flexibility and reliability of electrical systems. It carefully defines the concept as a radial network with a cluster of distributed energy generations, various types of loads, and energy storage systems. In addition, the book details how the huge penetration of distributed energy resources and the intermittent nature of renewable generations may cause system problems. Readers will find this to be an important resource that analyzes and introduces the features and problems of smart distribution networks from different aspects. Integrates different types of elements, including electrical vehicles, demand response programs, and various renewable energy sources in distribution networks. Proposes optimal operational models for the short-term performance and scheduling of a distribution network. Discusses the uncertainties of renewable resources and intermittent load in the decision-making process for distribution networks.