Transmission Network Expansion Planning For The

These two volumes constitute the Proceedings of the 7th International Workshop on Soft Computing Applications (SOFA 2016), held on 24–26 August 2016 in Arad, Romania. This edition was organized by Aurel Vlaicu University of Arad, Romania, University of Belgrade, Serbia, in conjunction with the Institute of Computer Science, Iasi Branch of the Romanian Academy, IEEE Romanian Section, Romanian Society of Control Engineering and Technical Informatics (SRAIT) - Arad Section, General Association of Engineers in Romania - Arad Section, and BTM Resources Arad. The soft computing concept was introduced by Lotfi Zadeh in 1991 and serves to highli ght the emergence of computing methodologies in which the accent is on exploiting the tolerance for imprecision and uncertainty to achieve tractability, robustness and lower costs. Soft computing facilitates the combined use of fuzzy logic, neurocomputing, evolutionary computing and probabilistic computing, leading to the concept of hybrid intelligent systems. The rapid emergence of new tools and applications calls for a synergy of scientific and technological disciplines in order to reveal the great potential of soft computing in all domains. The conference papers included in

these proceedings, published post-conference, were grouped into the following areas of research: • Methods and Applications in Electrical Engineering • Knowledge-Based Technologies for Web Applications, Cloud Computing, Security Algorithms and Computer Networks • Biomedical Applications • Image, Text and Signal Processing • Machine Learning and Applications • &nb sp; Business Process Management • Fuzzy Applications, Theory and Fuzzy Control • Computational Intelligence in Education • Soft Computing & Fuzzy Logic i n Biometrics (SCFLB) • Soft Computing Algorithms Applied in Economy, Industry and Communication Technology • Modelling and Applications in Textiles The book helps to disseminate advances in selected active research directions in the field of soft computing, along with current issues and applications of related topics. As such, it provides valuable information for professors, researchers and graduate students in the area of soft computing techniques and applications.

Within the electric power literatW''e the transmi ssion expansion planning problem (TNEP) refers to the problem of how to upgrade an electric power network to meet future demands. As this problem is a complex, non-linear, and non-convex optimization problem, researchers have traditionally focused on approximate models. Often, their approaches are tightly coupled to the approximation choice. Until

recently, these approximations have produced results that are straight-forward to adapt to the more complex (real) problem. However, the power grid is evolving towards a state where the adaptations are no longer easy (i.e. large amounts of limited control, renewable generation) that necessitates new optimization techniques. In this paper, we propose a generalization of the powerful Limited Discrepancy Search (LDS) that encapsulates the complexity in a black box that may be queJied for information about the quality of a proposed expansion. This allows the development of a new optimization algOlitlun that is independent of the underlying power model.

The present book addresses various power system planning issues for professionals as well as senior level and postgraduate students. Its emphasis is on long-term issues, although much of the ideas may be used for short and mid-term cases, with some modifications. Back-up materials are provided in twelve appendices of the book. The readers can use the numerous examples presented within the chapters and problems at the end of the chapters, to make sure that the materials are adequately followed up. Based on what Matlab provides as a powerful package for students and professional, some of the examples and the problems are solved in using M-files especially developed and attached for this purpose. This adds a unique feature to the book for in-depth understanding of the materials, sometimes,

difficult to apprehend mathematically. Chapter 1 provides an introduction to Power System Planning (PSP) issues and basic principles. As most of PSP problems are modeled as optimization problems, optimization techniques are covered in some details in Chapter 2. Moreover, PSP decision makings are based on both technical and economic considerations, so economic principles are briefly reviewed in Chapter 3. As a basic requirement of PSP studies, the load has to be known. Therefore, load forecasting is presented in Chapter 4. Single bus Generation Expansion Planning (GEP) problem is described in Chapter 5. This study is performed using WASP-IV, developed by International Atomic Energy Agency. The study ignores the grid structure. A Multi-bus GEP problem is discussed in Chapter 6 in which the transmission effects are, somehow, accounted for. The results of single bus GEP is used as an input to this problem. SEP problem is fully presented in Chapter 7. Chapter 8 devotes to Network Expansion Planning (NEP) problem, in which the network is planned. The results of NEP, somehow, fixes the network structure. Some practical considerations and improvements such as multi-voltage cases are discussed in Chapter 9. As NEP study is typically based on some simplifying assumptions and Direct Current Load Flow (DCLF) analysis, detailed Reactive Power Planning (RPP) study is finally presented in Chapter 10, to guarantee

acceptable ACLF performance during normal as well as contingency conditions. This, somehow, concludes the basic PSP problem. The changing environments due to power system restructuring dictate some uncertainties on PSP issues. It is shown in Chapter 11 that how these uncertainties can be accounted for. Although is intended to be a text book, PSP is a research oriented topic, too. That is why Chapter 12 is devoted to research trends in PSP. The chapters conclude with a comprehensive example in Chapter 13, showing the step-by-step solution of a practical case.

In a period of great uncertainty in transmission expansion planning, location and types of future generation mix, the work in this thesis introduces a novel approach for and an alternative to conventional transmission expansion planning (TEP). Current practice in TEP is dominated by scenario-driven approaches that rely on assumptions for the nature and pattern of geographic placement of generation and load. Such expansion futures seek transmission additions to minimize long-term horizon combination of operating and capital costs, while addressing anticipated reliability issues, reduction in CO2 emissions, integration of renewable sources of energy, among other objectives and constraints. The tremendous uncertainty in future generation mix, load growth, technology and CO2 emission policy is putting great strain on present practice in

transmission expansion planning. As a fundamentally different philosophy, that draws on analogies to the network routing/congestion minimization problem in data networks, the work herein proposes a new paradigm for optimal transmission expansion, focusing solely on properties of the transmission network itself. Exploiting the special graph-related eigenvalue/eigenvector structure of Laplacian matrices such as the bus susceptance matrix, B, in a dc power flow approximation, the metrics developed in this thesis are intrinsic to the network and are quantitative measures of a power system's performance. In our initial contribution, we adopt the condition number of the power flow Jacobian (or its dc approximation, the B matrix) as an intrinsic measure of the robustness of transmission network, independent of specific scenarios of anticipated load or generation. As continuation of our work in TEP, we examine the role of network Laplacian structures in TEP by extending consideration to the generalized volume of bus power injections feasible under line flow constraints. We then propose a performance metric for an electric power transmission network that is again independent of specific generation/load placement scenarios, but seeks to maximize a global measure of a network's ability to absorb and deliver power. Such metric characterizes the capacity of a transmission network to sink/source power to its

nodes by measuring the generalized volume of the set of feasible power injections. Using perspective of the determinant as setting the volume expansion/contraction for a linear operator, we demonstrate in a dc power flow approximation that this measure is closely related to the magnitude of the determinant of the bus susceptance matrix. Adopting Laplacian and Linear Embedding techniques, we further show that this global measure of network performance is tractable, easily defined analytically and yields computationally efficient algorithms for siting and sizing transmission links. To further extend our work in TEP, we include the role of node centrality, a concept encountered in social networks, which has recently found application in power system problems. Informed by our previously developed metrics of network performance, we derive a centrality measure for a transmission system network that distinguishes itself from earlier centrality measures employed in the power system literature. We argue that the centrality metric developed in this work is more appropriate for a TEP problem, as it makes use of all paths in the network. Finally, in the last part of this thesis, we review the important role played by non-electric constraints such as geographic barriers, environmental impact, public/stakeholder input, etc. in transmission expansion planning. Then we introduce an approach for the inclusion of geographic decision factors in the

form of line length. This modification to our transmission expansion planning problem will allow one the possibility to gauge the performance of a transmission line in conjunction with the geographic length and cost associated with the construction of the line.

A well-planned electric transmission network is essential for attaining an effective electricity market and the reliable operation of the associated power system. In this dissertation, we address the transmission expansion planning (TEP) problem. The goal of the thesis work is to develop models and algorithms to help system planners to identify optimal investments in the transmission network. First, we propose a candidate-line selection algorithm based on a set of systematic rules to generate an appropriate candidate-line set for TEP studies. The expertise of system planners and the characteristics of a network are both considered for candidate-line selection. Second, we develop an adaptive robust stochastic optimization model for TEP problems that specifically differentiates long- and short-term uncertainties. The long-term uncertainty pertains to year-to-year changes including the peak demand and available generating capacity of the system during the planning target year. Then, within the target year, the short-term uncertainty pertains to the production of weather-dependent renewable capacity and the load. Next,

we expand the adaptive robust stochastic optimization model to consider the coordinated investment in transmission and storage facilities. Such model provides an effective tool to identify the best trade-off between these two types of facilities. Finally, we conclude by providing conclusions, contributions and suggestions for future work.

This book discusses the optimal design and operation of multi-carrier energy systems, providing a comprehensive review of existing systems as well as proposing new models. Chapters cover the theoretical background and application examples of interconnecting energy technologies such as combined heat and power plants, natural gas-fired power plants, power to gas technology, hydropower plants, and water desalination systems, taking into account the operational and technical constraints of each interconnecting element and the network constraint of each energy system. This book will be a valuable reference for power network and mechanical system professionals and engineers, electrical power engineering researchers and developers, and professionals from affiliated power system planning communities. Provides insight on the design and operation of multi-carrier energy systems; Covers both theoretical aspects and technical applications; Includes case studies to help apply concepts to real engineering situations.

A new edition of the classic text explaining the

fundamentals of competitive electricity markets—now updated to reflect the evolution of these markets and the large scale deployment of generation from renewable energy sources The introduction of competition in the generation and retail of electricity has changed the ways in which power systems function. The design and operation of successful competitive electricity markets requires a sound understanding of both power systems engineering and underlying economic principles of a competitive market. This extensively revised and updated edition of the classic text on power system economics explains the basic economic principles underpinning the design, operation, and planning of modern power systems in a competitive environment. It also discusses the economics of renewable energy sources in electricity markets, the provision of incentives, and the cost of integrating renewables in the grid. Fundamentals of Power System Economics, Second Edition looks at the fundamental concepts of microeconomics, organization, and operation of electricity markets, market participants' strategies, operational reliability and ancillary services, network congestion and related LMP and transmission rights, transmission investment, and generation investment. It also expands the chapter on generation investments—discussing capacity mechanisms in more detail and the need for capacity markets aimed at ensuring that enough generation

capacity is available when renewable energy sources are not producing due to lack of wind or sun. Retains the highly praised first edition's focus and philosophy on the principles of competitive electricity markets and application of basic economics to power system operating and planning Includes an expanded chapter on power system operation that addresses the challenges stemming from the integration of renewable energy sources Addresses the need for additional flexibility and its provision by conventional generation, demand response, and energy storage Discusses the effects of the increased uncertainty on system operation Broadens its coverage of transmission investment and generation investment Updates end-of-chapter problems and accompanying solutions manual Fundamentals of Power System Economics, Second Edition is essential reading for graduate and undergraduate students, professors, practicing engineers, as well as all others who want to understand how economics and power system engineering interact.

Energy is one of the world`s most challenging problems, and power systems are an important aspect of energy related issues. This handbook contains state-of-the-art contributions on power systems modeling and optimization. The book is separated into two volumes with six sections, which cover the most important areas of energy systems.

The first volume covers the topics operations planning and expansion planning while the second volume focuses on transmission and distribution modeling, forecasting in energy, energy auctions and markets, as well as risk management. The contributions are authored by recognized specialists in their fields and consist in either state-of-the-art reviews or examinations of state-of-the-art developments. The articles are not purely theoretical, but instead also discuss specific applications in power systems.

This book provides an in-depth analysis of investment problems pertaining to electric energy infrastructure, including both generation and transmission facilities. The analysis encompasses decision-making tools for expansion planning, reinforcement, and the selection and timing of investment options. In this regard, the book provides an up-to-date description of analytical tools to address challenging investment questions such as: How can we expand and/or reinforce our aging electricity transmission infrastructure? How can we expand the transmission network of a given region to integrate significant amounts of renewable generation? How can we expand generation facilities to achieve a low-carbon electricity production system? How can we expand the generation system while ensuring appropriate levels of flexibility to accommodate both demand-related and production-

related uncertainties? How can we choose among alternative production facilities? What is the right time to invest in a given production or transmission facility? Written in a tutorial style and modular format, the book includes a wealth of illustrative examples to facilitate comprehension. It is intended for advanced undergraduate and graduate students in the fields of electric energy systems, operations research, management science, and economics. Practitioners in the electric energy sector will also benefit from the concepts and techniques presented here.

The papers presented in this open access book address diverse challenges in decarbonizing energy systems, ranging from operational to investment planning problems, from market economics to technical and environmental considerations, from distribution grids to transmission grids, and from theoretical considerations to data provision concerns and applied case studies. While most papers have a clear methodological focus, they address policy-relevant questions at the same time. The target audience therefore includes academics and experts in industry as well as policy makers, who are interested in state-of-the-art quantitative modelling of policy relevant problems in energy systems. The 2nd International Symposium on Energy System Optimization (ISESO 2018) was held at the Karlsruhe Institute of Technology (KIT) under the

symposium theme "Bridging the Gap Between Mathematical Modelling and Policy Support" on October 10th and 11th 2018. ISESO 2018 was organized by the KIT, the Heidelberg Institute for Theoretical Studies (HITS), the Heidelberg University, the German Aerospace Center and the University of Stuttgart.

This book presents mathematical models of demand-side management programs, together with operational and control problems for power and renewable energy systems. It reflects the need for optimal operation and control of today's electricity grid at both the supply and demand spectrum of the grid. This need is further compounded by the advent of smart grids, which has led to increased customer/consumer participation in power and renewable energy system operations. The book begins by giving an overview of power and renewable energy systems, demand-side management programs and algebraic modeling languages. The overview includes detailed consideration of appliance scheduling algorithms, price elasticity matrices and demand response incentives. Furthermore, the book presents various power system operational and control mathematical formulations, incorporating demand-side management programs. The mathematical formulations developed are modeled and solved using the Advanced Interactive Multidimensional

Modeling System (AIMMS) software, which offers a powerful yet simple algebraic modeling language for solving optimization problems. The book is extremely useful for all power system operators and planners who are concerned with optimal operational procedures for managing today's complex grids, a context in which customers are active participants and can curb/control their demand. The book details how AIMMS can be a useful tool in optimizing power grids and also offers a valuable research aid for students and academics alike.

Probabilistic Power System Expansion Planning with Renewable Energy Resources and Energy Storage Systems

This book explores how developing solutions with heuristic tools offers two major advantages: shortened development time and more robust systems. It begins with an overview of modern heuristic techniques and goes on to cover specific applications of heuristic approaches to power system problems, such as security assessment, optimal power flow, power system scheduling and operational planning, power generation expansion planning, reactive power planning, transmission and distribution planning, network reconfiguration, power system control, and hybrid systems of heuristic methods.

Modern Power System Planning covers the area of planning in the electrical supply industry, from power

station generation to transmission and distribution. It will enable the practising engineer to implement the increasingly sophisticated and most modern techniques of planning. The text offers a clear, detailed treatment of this subject with each chapter building on the material of the previous one. The reader is familiarized with mathematical and statistical theory before the applications are introduced, and the material in each chapter is cross-referenced for clarity and to reinforce the concepts presented. The authors have taken a unified approach to reliability and planning analysis. Included in its coverage are the definition of general reliability indices, plant maintenance scheduling, generation system and transmission network planning, and forecasting techniques and applications. The use of optimization techniques for these processes is explored in depth.

Classical and Recent Aspects of Power System Optimization presents conventional and meta-heuristic optimization methods and algorithms for power system studies. The classic aspects of optimization in power systems, such as optimal power flow, economic dispatch, unit commitment and power quality optimization are covered, as are issues relating to distributed generation sizing, allocation problems, scheduling of renewable resources, energy storage, power reserve based problems, efficient use of smart grid capabilities, and

protection studies in modern power systems. The book brings together innovative research outcomes, programs, algorithms and approaches that consolidate the present state and future challenges for power. Analyzes and compares several aspects of optimization for power systems which has never been addressed in one reference Details real-life industry application examples for each chapter (e.g. energy storage and power reserve problems) Provides practical training on theoretical developments and application of advanced methods for optimum electrical energy for realistic engineering problems

In recent years the expansion planning problem has become increasingly complex. As expansion planning (sometimes called composite or integrated resource planning) is a non-linear and non-convex optimization problem, researchers have traditionally focused on approximate models of power flows to solve the problem. The problem has also been split into generation expansion planning (GEP) and transmission network expansion planning (TNEP) to improve computational tractability. Until recently these approximations have produced results that are straight-forward to combine and adapt to the more complex and complete problem. However, the power grid is evolving towards a state where the adaptations are no longer easy (e.g. large amounts of limited control, renewable generation, comparable

generation and transmission construction costs) and necessitates new approaches. Recent work on deterministic Discrepancy Bounded Local Search (DBLS) has shown it to be quite effective in addressing the TNEP. In this paper, we propose a generalization of DBLS to handle simultaneous generation and transmission planning.

This book constitutes the refereed proceedings of the 18th EPIA Conference on Artificial Intelligence, EPIA 2017, held in Porto, Portugal, in September 2017. The 69 revised full papers and 2 short papers presented were carefully reviewed and selected from a total of 177 submissions. The papers are organized in 16 tracks devoted to the following topics: agent-based modelling for criminological research (ABM4Crime), artificial intelligence in cyber-physical and distributed embedded systems (AICPDES), artificial intelligence in games (AIG), artificial intelligence in medicine (AIM), artificial intelligence in power and energy systems (AIPES), artificial intelligence in transportation systems (AITS), artificial life and evolutionary algorithms (ALEA), ambient intelligence and affective environments (AmIA), business applications of artificial intelligence (BAAI), intelligent robotics (IROBOT), knowledge discovery and business intelligence (KDBI), knowledge representation and reasoning (KRR), multi-agent systems: theory and applications (MASTA), software engineering for autonomous and intelligent systems (SE4AIS), social simulation and modelling (SSM), and text mining and applications (TeMA).

Decision Making Under Uncertainty in Electricity Markets provides models and procedures to be used by electricity market agents to make informed decisions under uncertainty. These procedures rely on well established stochastic

programming models, which make them efficient and robust. Particularly, these techniques allow electricity producers to derive offering strategies for the pool and contracting decisions in the futures market. Retailers use these techniques to derive selling prices to clients and energy procurement strategies through the pool, the futures market and bilateral contracting. Using the proposed models, consumers can derive the best energy procurement strategies using the available trading floors. The market operator can use the techniques proposed in this book to clear simultaneously energy and reserve markets promoting efficiency and equity. The techniques described in this book are of interest for professionals working on energy markets, and for graduate students in power engineering, applied mathematics, applied economics, and operations research. Energy has been an inevitable component of human lives for decades. Recent rapid developments in the area require analyzing energy systems not as independent components but rather as connected interdependent networks. The Handbook of Networks in Power Systems includes the state-of-the-art developments that occurred in the power systems networks, in particular gas, electricity, liquid fuels, freight networks, as well as their interactions. The book is separated into two volumes with three sections, where one scientific paper or more are included to cover most important areas of networks in power systems. The first volume covers topics arising in electricity network, in particular electricity markets, smart grid, network expansion, as well as risk management. The second volume presents problems arising in gas networks; such as scheduling and planning of natural gas systems, pricing, as well as optimal location of gas supply units. In addition, the second volume covers the topics of interactions between energy networks. Each subject is identified following the activity on the domain and the

recognition of each subject as an area of research. The scientific papers are authored by world specialists on the domain and present either state-of-the-arts reviews or scientific developments.

For multi-user PDF licensing, please contact customer service. Energy touches our lives in countless ways and its costs are felt when we fill up at the gas pump, pay our home heating bills, and keep businesses both large and small running. There are long-term costs as well: to the environment, as natural resources are depleted and pollution contributes to global climate change, and to national security and independence, as many of the world's current energy sources are increasingly concentrated in geopolitically unstable regions. The country's challenge is to develop an energy portfolio that addresses these concerns while still providing sufficient, affordable energy reserves for the nation. The United States has enormous resources to put behind solutions to this energy challenge; the dilemma is to identify which solutions are the right ones. Before deciding which energy technologies to develop, and on what timeline, we need to understand them better. America's Energy Future analyzes the potential of a wide range of technologies for generation, distribution, and conservation of energy. This book considers technologies to increase energy efficiency, coal-fired power generation, nuclear power, renewable energy, oil and natural gas, and alternative transportation fuels. It offers a detailed assessment of the associated impacts and projected costs of implementing each technology and categorizes them into three time frames for implementation.

Artificial intelligence (AI) is everywhere and it's here to stay. Most aspects of our lives are now touched by artificial intelligence in one way or another, from deciding what books or flights to buy online to whether our job applications are

successful, whether we receive a bank loan, and even what treatment we receive for cancer. Artificial Neural Networks (ANNs) as a part of AI maintains the capacity to solve problems such as regression and classification with high levels of accuracy. This book aims to discuss the usage of ANNs for optimal solving of time series applications and clustering. Bounding of optimization methods particularly metaheuristics considered as global optimizers with ANNs make a strong and reliable prediction tool for handling real-life application. This book also demonstrates how different fields of studies utilize ANNs proving its wide reach and relevance.
This two-volume book presents outcomes of the 7th International Conference on Soft Computing for Problem Solving, SocProS 2017. This conference is a joint technical collaboration between the Soft Computing Research Society, Liverpool Hope University (UK), the Indian Institute of Technology Roorkee, the South Asian University New Delhi and the National Institute of Technology Silchar, and brings together researchers, engineers and practitioners to discuss thought-provoking developments and challenges in order to select potential future directions The book presents the latest advances and innovations in the interdisciplinary areas of soft computing, including original research papers in the areas including, but not limited to, algorithms (artificial immune systems, artificial neural networks, genetic algorithms, genetic programming, and particle swarm optimization) and applications (control systems, data mining and clustering, finance, weather forecasting, game theory, business and forecasting applications). It is a valuable resource for both young and experienced researchers dealing with complex and intricate real-world problems for which finding a solution by traditional methods is a difficult task.
This book presents a panoramic look at the transformation of the transmission network in the context of the energy

transition. It provides readers with basic definitions as well as details on current challenges and emerging technologies. In-depth chapters cover the integration of renewables, the particularities of planning large-scale systems, efficient reduction and solution methods, the possibilities of HVDC and super grids, distributed generation, smart grids, demand response, and new regulatory schemes. The content is complemented with case studies that highlight the importance of the power transmission network as the backbone of modern energy systems. This book will be a comprehensive reference that will be useful to both academics and practitioners. Contains theoretical developments and practical case studies Discusses the implications of emerging technologies Presents different models, techniques and algorithms, as well as software tools.

Scaling-up renewals requires expanding electricity grids. Policy makers, regulators, and utilities, are working together to ensure renewable energy goals are not held back by the lack of transmission.

This book provides a systematic overview of transmission network investment in liberalized power markets. Recent government policies to increase the share of intermittent renewable power generation and other technological innovations present new theoretical as well as practical challenges for transmission investments. Written by experts with a background in both economics and engineering, the book examines the economic and technical fundamentals of regulated and merchant transmission investment, and includes case studies of transmission investment in a number of countries. The book is divided into four parts: Part 1 introduces the basic economics and engineering of transmission network investment, while Part 2 discusses merchant investment in the transmission network. Part 3 then examines transmission investment coordination and smart

grids, and lastly, Part 4 describes practical experiences of transmission network investment in power market in various countries.

Regulation of the Power Sector is a unified, consistent and comprehensive treatment of the theories and practicalities of regulation in modern power-supply systems. The need for generation to occur at the time of use occasioned by the impracticality of large-scale electricity storage coupled with constant and often unpredictable changes in demand make electricity-supply systems large, dynamic and complex and their regulation a daunting task. Arranged in four parts, this book addresses both traditional regulatory frameworks and also liberalized and re-regulated environments. First, an introduction gives a full characterization of power supply including engineering, economic and regulatory viewpoints. The second part presents the fundamentals of regulation and the third looks at the regulation of particular components of the power sector in detail. Advanced topics and subjects still open or subject to dispute form the content of Part IV. In a sector where regulatory design is the key driver of both the industry efficiency and the returns on investment, Regulation of the Power Sector is directed at regulators, policy decision makers, business managers and researchers. It is a pragmatic text, well-tested by the authors' quarter-century of experience of power systems from around the world. Power system professionals and students at all levels will derive much benefit from the authors' wealth of blended theory and real-world-derived know-how.

Research Paper (postgraduate) from the year 2019 in the subject Engineering - Power Engineering, grade: 4/5, , language: English, abstract: A lot of research has happened in Electrical Engineering in the field of Power Engineering with regards to Power System Stability and related issues. The research work presented as part of this book only adds

to this multitude of findings in the area of Load Modelling which plays an important role in Voltage Stability Analysis. We addressed the Voltage Instability issues arising in the presence of Polynomial Loads with Computational Intelligence as a tool to solve this issue.

Probabilistic Power System Expansion Planning with Renewable Energy Resources and Energy Storage Systems

Discover how modern techniques have shaped complex power system expansion planning with this one-stop resource from two experts in the field Probabilistic Power System Expansion Planning with Renewable Energy Resources and Energy Storage Systems delivers a comprehensive collection of innovative approaches to the probabilistic planning of generation and transmission systems under uncertainties. The book includes renewables and energy storage calculations when using probabilistic and deterministic reliability techniques to assess system performance from a long-term expansion planning viewpoint. Divided into two sections, the book first covers topics related to Generation Expansion Planning, with chapters on cost assessment, methodology and optimization, and more. The second and final section provides information on Transmission System Expansion Planning, with chapters on reliability constraints, probabilistic production cost simulation, and more. Probabilistic Power System Expansion Planning compares the optimization and methodology across dynamic, linear, and integer programming and explores the branch and bound algorithm. Along with case studies to demonstrate how the techniques described within have been applied in complex power system expansion planning problems, readers will enjoy: A thorough discussion of generation expansion planning, including cost assessment, methodology and optimization, and probabilistic production cost An exploration of transmission system expansion planning, including the

branch and bound algorithm, probabilistic production cost simulation for TEP, and TEP with reliability constraints An examination of fuzzy decision making applied to transmission system expansion planning A treatment of probabilistic reliability-based grid expansion planning of power systems including wind turbine generators Perfect for power and energy systems designers, planners, operators, consultants, practicing engineers, software developers, and researchers, Probabilistic Power System Expansion Planning with Renewable Energy Resources and Energy Storage Systems will also earn a place in the libraries of practicing engineers who regularly deal with optimization problems.

This book discusses the recent developments in robust optimization (RO) and information gap design theory (IGDT) methods and their application for the optimal planning and operation of electric energy systems. Chapters cover both theoretical background and applications to address common uncertainty factors such as load variation, power market price, and power generation of renewable energy sources. Case studies with real-world applications are included to help undergraduate and graduate students, researchers and engineers solve robust power and energy optimization problems and provide effective and promising solutions for the robust planning and operation of electric energy systems.

Fuzzy logic models can be used to demonstrate human decision making in complex situations, and can therefore be an important tool in examining natural complexity. Moreover, fuzzy logic can be exploited to predict chaotic behaviors. But why is fuzzy logic so valuable? The idea of fuzzy logic has been around since 1965, and since its introduction thousands of applications of fuzzy logic have been implemented in industry, medicine, and even economic applications and patents. How did this invaluable theory achieve such great success? This book aims to compare well-known and well-

used membership functions to demonstrate how to select the best membership functions and show when and why to utilize them. This book also demonstrates how different fields of studies utilize fuzzy logic showing its wide reach and relevance.

ATEE is the forum that stimulates the active and effective exchange of information between researchers in various areas of theoretical and applied electrical engineering Key leaders from private and state owned companies involved in will also be in attendance.

Presents the advantages, challenges, and technologies of High Voltage Direct Current (HVDC) Grids 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. Dirk Van Hertem is an Assistant Professor within ESAT-ELECTA at KU Leuven, Belgium. Dr. Van Hertem has written over 100 scientific papers in international journals and conferences. Oriol Gomis-Bellmunt is an Associate Professor in the Technical University of Catalonia (UPC). He is involved in the CITCEA-UPC research group and the Catalonia Institute for Energy Research (IREC). Jun Liang is a Reader within the School of Engineering at Cardiff University, UK. He's also an Adjunct Professor at Changsha University of Science and Technology and North China Electric Power University.

This book presents a panoramic look at the transformation of the transmission network in the context of the energy transition. It provides readers with basic definitions as well as details on current challenges and emerging technologies. In-depth chapters cover the integration of renewables, the particularities of planning large-scale systems, efficient reduction and solution methods, the possibilities of HVDC and super grids, distributed generation, smart grids, demand response, and new regulatory schemes. The content is complemented with case studies that highlight the importance of the power transmission network as the backbone of modern energy systems. This book will be a comprehensive reference that will be useful to both academics and practitioners.

This book highlights the latest research advances in the planning and management of electric distribution networks. It addresses various aspects of distribution network management including planning, operation, customer engagement, and technology accommodation. Given the importance of electric distribution networks in power delivery systems, effectively planning and managing them are vital to

satisfying technical, economic, and customer requirements. A new planning and management philosophy, techniques, and methods are essential to handling uncertainties associated with the integration of renewable-based distributed generation, demand forecast, and customer needs. This book covers topics on managing the capacity of distribution networks, while also addressing the future needs of electric systems. The efficient and economical operation of distribution networks is an essential aspect of ensuring the effective use of resources. Accordingly, this book addresses operation and control approaches and techniques suitable for future distribution networks.

Optimization in Renewable Energy Systems: Recent Perspectives covers all major areas where optimization techniques have been applied to reduce uncertainty or improve results in renewable energy systems (RES). Production of power with RES is highly variable and unpredictable, leading to the need for optimization-based planning and operation in order to maximize economies while sustaining performance. This self-contained book begins with an introduction to optimization, then covers a wide range of applications in both large and small scale operations, including optimum operation of electric power systems with large penetration of RES, power forecasting, transmission system planning, and DG sizing and siting for distribution and end-user premises. This book is an excellent choice for energy engineers, researchers, system operators, system regulators, and graduate students. Provides chapters written by experts in the field Goes beyond forecasting to apply optimization techniques to a wide variety of renewable energy system issues, from large scale to relatively small scale systems Provides accompanying computer code for related chapters

Transmission Network Expansion Planning for Maximum

Reliability Within a Specified BudgetTransmission Expansion Planning: The Network Challenges of the Energy TransitionSpringer Nature