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Variability, Scalability and Stability of Microgrids

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This book is dedicated to
Lipy and Arisha
Masuma, Muntasser and Rashmi
Anja, Jakob and Ina
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Preface

The core theme and foundation of the traditional power system is going through a major transformation, nowadays. Small, medium, and large-scale renewable sources, often called as wind farm or photovoltaic park, are becoming the part and parcel of modern power system and distributed in a scattered way all over the power network. This introduces the term ‘microgrid’ which is a group of distributed energy resources and interconnected loads within a defined electrical boundary, appearing as a single controllable entity with or without being connected to the grid. This transformation needs to address many different technical, tactical, and political challenges which we need to handle collectively and carefully. The technical challenges are multifold; therefore, researchers from electrical, electronic, computer, communication, mechanical, aerospace engineering, and many other science disciplines are contributing in this domain, both from academia and industry, and writing the scripts of microgrid success.

In this book, three different mainstream technical challenges of microgrid are addressed – variability, scalability, and stability. With the term ‘variability’, the voltage and frequency fluctuations inside and outside microgrid boundaries are referred. On the other hand, ‘stability’ term includes voltage and frequency instabilities but also covers low voltage or zero voltage ride through problems. The ‘scalability’ part, in general, covers the optimization aspects of microgrid. The present development status and future trends of microgrid covering from generation, transmission, and distribution are presented based on the contributions from well-known researchers and academics from various disciplines. On this occasion, we the Editors sincerely acknowledge the cordial supports from all the chapter authors in this book along with their valuable contributions.

A general overview and essence of the different chapters available in this book can be obtained from introductory chapter. The microgrid topologies, its hierarchical control schemes, control of its various components along with optimal sizing, and location of microgrid components are presented in different chapters of the book. The power electronics are a mandatory component used by various components of the microgrid. This book presents various power electronic topologies used in microgrid and discusses its control and reliability issues. The microgrid protection and reliability features, black starts, economic aspects, and operations are presented in detail. The recent transformation of microgrid into the virtual power plant is another salient feature of this book.
The renewable sources of microgrid create many power system challenges when interconnected with the main grid. The challenges reach to another level when the penetration level of the renewable sources increases and the distribution system strength weakens further. This book covers all variability related issues of a microgrid, provides solutions on how to handle the scalability problems, and also discusses microgrid protection and stability augmentation methods. The Editors hope that the book will be useful for students, researchers, and engineering practitioners.

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