

# Preface

Worldwide, the effects of environmental, economic, social, political, and technical factors have led to the rapid deployment of various sources of renewable energy-based power generation. The incorporation of these generation technologies has led to the development of a broad array of new methods and tools to integrate this new form of generation into the power system networks. This book, arranged into six parts, gives a comprehensive discussion on various renewable energy-based distributed generation (DG) technologies as follows:

Part I provides a detailed overview of the distributed generation (DG) technologies, where the classification of DG units based on renewable and non-renewable energy technologies is discussed. In this part, Chap. 1 discusses the fundamentals of distributed renewable energy technologies with emphasizes on their modeling approaches. More specifically, wind turbines, solar PV system, and biomass technologies are briefly presented. The discussion of non-renewable energy technologies is provided in Chap. 2 with detailed discussion focused on gas turbines, diesel generators, small hydro, and fuel cells.

Part II is devoted to wind power systems. The part provides (i.e., Chaps. 3 through 8) a concrete discussion on wind turbine configuration, operation, and technical aspects of interconnection requirements from small-scale to large-scale deployment. Chapter 3 is devoted to large-scale development of wind turbine in the existing power networks with the case study of Mexican power grid. Load flow analysis of power system with wind farm is presented in Chap. 4 while Chap. 5 discusses the sensorless estimation of rotor position for DFIG-based wind turbine. Wind turbine standards and certification with respect to Indian prospective are presented in Chap. 6. The operating and interconnection requirements of wind farms with a case study of Egyptian grid code are discussed in Chap. 7 while the potential configuration for off-shore wind farm interlinked with HVDC collection grid is presented in Chap. 8.

Part III focuses on solar PV systems. Chapter 9 presents the steady-state analysis of unbalanced distribution networks with high penetration of photovoltaic generation. Also, the impact of PV system on voltage and stability is discussed in Chap. 10. The techno-economic evaluation of grid-connected solar PV system for rural

banks is analyzed in Chap. 11. The application of indirect matrix converter for DG units with experimental implementation approach is discussed in Chap. 12 while zeta buck-boost converter for PV system application is presented in Chap. 13.

Part IV is based on the modeling, design, control, and protection. Chapter 14 focuses on key points on modeling, design, and control of smart DC microgrid for integration of various nanoconventional DG units. The effects of DG operating power factor on its location and size using genetic algorithm (GA) are described in Chap. 15. In recent times, protection of DG has been a very critical issue and therefore Chaps. 16–18 are devoted to protection of DG systems. The distributed generation control and protection is presented in Chap. 16, and more details on protection systems in distribution system with DG units are explained in Chap. 17 with some typical examples. In the case of microgrid and multi-microgrid system protection, Chap. 18 has extensively discussed both islanded and grid-connected microgrid protection system.

Part V is devoted to the miscellaneous topics, i.e., power electronic applications, reliability, economic aspect, energy storage, and management for renewable distributed generation (DG) and renewable energy integration in current and future energy markets. In Chap. 19, the applications of power electronic in DG units, grid codes, power quality issues, and participation of DG in the current and future electricity markets are described. This chapter extends the mathematical modeling for DG with power converters, energy resources, and control strategy and summarizes the approaches used to obtain the lifecycle cost of a project. Chapter 20 reviews the energy efficiency of the DG units with energy storage systems and conventional energy system. The methods for reliability evaluation and enhancement of microgrid incorporating the effects of DG units are presented in Chap. 21. Chapter 22 describes the economic aspect of DG units. At the end, Chap. 23 presents with an overview of intelligent energy management strategy (IEMS) in future power distribution networks. It presents the roles of IEMS in power distribution networks with nanogrid, microgrid, and VPPs in which renewable energy resources are integrated.

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