# ELECTRIC POWER DISTRIBUTION, AUTOMATION, PROTECTION, AND CONTROL

### James A. Momoh



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#### Preface

**Stapping the antibility of the extendion of distribution automobility of action of the second of th** 

This book is intended to introduce distribution engineering as a growing area suitable for studying new trends in computation, automation, and control techniques. The idea is to present the basic concepts for assessment, design, formulation, and analysis of distribution performance. This is timely, given the growing research interest, the desire for automation, and the commitment to build an efficient and cost-effective distribution system in a competitive utility environment.

The textbook is intended as a resource for electrical engineering students, as well as professional engineers, who are interested in learning the fundamentals of distribution engineering analysis. The book presents computation and automation techniques in a simple, easy-to-follow treatment. Background requirements include a basic concept of electric circuits and a working knowledge of foundation mathematics. The text is arranged from basic distribution principles through renewable energy resources, computation tools and techniques, reliability and maintenance, distribution automation, and telecommunications. The topics are covered with illustrative examples and some case studies to illuminate the topic as needed. Overall, the book provides both analytical basics and practical intuition for the future design of distribution systems.

- Chapters 1 and 2 treat the foundation of distribution automation by summarizing distribution topology, modeling, and different computation techniques.
- Chapter 3 introduces distribution protection and control schemes for self-defense of distribution systems under different fault types; different relay-protection schemes are also introduced, and some illustrative examples for coordination and relay settings are given.
- Chapter 4 discusses distribution reliability, computation techniques, and maintenance concepts. These topics are helpful in evaluating the performance of distribution systems to guide the distribution operator, planner, and maintenance engineer in choosing among the tools available to enhance practical "rule of thumb" judgment.
- Chapter 5 is dedicated to distribution automation and control functions. Here, we deal with the different automation functions and review various modeling, analytical, and computational methods using a background in optimization techniques. Here, only analytical

functions and statements of outstanding work done by researchers and the author are given as working examples.

- Chapter 6 deals with the extension of distribution automation functions and computation using intelligent systems (IS). This is an important topic, given the ample engineering rules and new trends in computational intelligence that can be used in the design of future distributed systems.
- Chapter 7 is concerned with renewable energy sources; its models, characteristics, benefits, drawbacks, and possible areas of application are treated.
- Chapter 8 presents new advances in communication technology for data acquisition, monitoring, control, load management, billing, and metering of distribution systems.
- Chapter 9 provides a foundation of telecommunications from basic theory to practice, including modulation, networking, frame relay, standards, and security strategy. Communication concepts have become critical to power system distribution automation and control in today's competitive environment, which demands ever-greater reliability and efficiency.

It is hoped that the introduction of new trends in IT (information technology) and artificial intelligence (AI) will enhance future performance of distribution and that the reader will continue to engage in the developmental work done by researchers. The goal of the book will be achieved if distribution engineers will adapt and build future generations of distribution systems using the technology discussed.

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