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Second Edition

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Leonard L. Grigsby

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POWER SYSTEM STABILITY and CONTROL

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Leonard L. Grigsby



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Table of Contents

Preface

Editor

Contributors

I Power System Protection

1 Transformer Protection

Alexander Apostolov, John Appleyard, Ahmed Elnewehi, Robert Haas, and Glenn W. Swift

2 The Protection of Synchronous Generators

Gabriel Benmouyal

3 Transmission Line Protection

Stanley H. Horowitz

4 System Protection

Miroslav Begovic

5 Digital Relaying

James S. Thorp

6 Use of Oscillograph Records to Analyze System Performance

John R. Boyle

II Power System Dynamics and Stability

7 Power System Stability

Prabha Kundur

8 Transient Stability

Kip Morison

9 Small Signal Stability and Power System Oscillations

John Paserba, Juan Sanchez-Gasca, Prabha Kundur, Einar Larsen, and Charles Concordia

10 Voltage Stability

Yakout Mansour and Claudio Cañizares

11 Direct Stability Methods

Vijay Vittal

12 Power System Stability Controls

Carson W. Taylor

13 Power System Dynamic Modeling

William W. Price

- 14 Integrated Dynamic Information for the Western Power System: WAMS Analysis in 2005**
John F. Hauer, William A. Mittelstadt, Ken E. Martin, Jim W. Burns, and Harry Lee
- 15 Dynamic Security Assessment**
Peter W. Sauer, Kevin L. Tomsovic, and Vijay Vittal
- 16 Power System Dynamic Interaction with Turbine Generators**
Richard G. Farmer, Bajarang L. Agrawal, and Donald G. Ramey

III Power System Operation and Control

- 17 Energy Management**
Neil K. Stanton, Jay C. Giri, and Anjan Bose
- 18 Generation Control: Economic Dispatch and Unit Commitment**
Charles W. Richter, Jr.
- 19 State Estimation**
Danny Julian
- 20 Optimal Power Flow**
Mohamed E. El-Hawary
- 21 Security Analysis**
Nouredine Hadjsaid

Preface

The generation, delivery, and utilization of electric power and energy remain one of the most challenging and exciting fields of electrical engineering. The astounding technological developments of our age are highly dependent upon a safe, reliable, and economic supply of electric power. The objective of *Electric Power Engineering Handbook*, 2nd Edition is to provide a contemporary overview of this far-reaching field as well as to be a useful guide and educational resource for its study. It is intended to define electric power engineering by bringing together the core of knowledge from all of the many topics encompassed by the field. The chapters are written primarily for the electric power engineering professional who is seeking factual information, and secondarily for the professional from other engineering disciplines who wants an overview of the entire field or specific information on one aspect of it.

The handbook is published in five volumes. Each is organized into topical sections and chapters in an attempt to provide comprehensive coverage of the generation, transformation, transmission, distribution, and utilization of electric power and energy as well as the modeling, analysis, planning, design, monitoring, and control of electric power systems. The individual chapters are different from most technical publications. They are not journal-type chapters nor are they textbook in nature. They are intended to be tutorials or overviews providing ready access to needed information while at the same time providing sufficient references to more in-depth coverage of the topic. This work is a member of the Electrical Engineering Handbook Series published by CRC Press. Since its inception in 1993, this series has been dedicated to the concept that when readers refer to a handbook on a particular topic they should be able to find what they need to know about the subject most of the time. This has indeed been the goal of this handbook.

This volume of the handbook is devoted to the subjects of electric power generation by both conventional and nonconventional methods, transmission systems, distribution systems, power utilization, and power quality. If your particular topic of interest is not included in this list, please refer to the list of companion volumes seen at the beginning of this book.

In reading the individual chapters of this handbook, I have been most favorably impressed by how well the authors have accomplished the goals that were set. Their contributions are, of course, most key to the success of the work. I gratefully acknowledge their outstanding efforts. Likewise, the expertise and dedication of the editorial board and section editors have been critical in making this handbook possible. To all of them I express my profound thanks. I also wish to thank the personnel at Taylor & Francis who have been involved in the production of this book, with a special word of thanks to Nora Konopka, Allison Shatkin, and Jessica Vakili. Their patience and perseverance have made this task most pleasant.

Leo Grigsby
Editor-in-Chief

Editor

Leonard L. (“Leo”) Grigsby received his BS and MS in electrical engineering from Texas Tech University and his PhD from Oklahoma State University. He has taught electrical engineering at Texas Tech, Oklahoma State University, and Virginia Polytechnic Institute and University. He has been at Auburn University since 1984 first as the Georgia power distinguished professor, later as the Alabama power distinguished professor, and currently as professor emeritus of electrical engineering. He also spent nine months during 1990 at the University of Tokyo as the Tokyo Electric Power Company endowed chair of electrical engineering. His teaching interests are in network analysis, control systems, and power engineering.

During his teaching career, Professor Grigsby has received 13 awards for teaching excellence. These include his selection for the university-wide William E. Wine Award for Teaching Excellence at Virginia Polytechnic Institute and University in 1980, his selection for the ASEE AT&T Award for Teaching Excellence in 1986, the 1988 Edison Electric Institute Power Engineering Educator Award, the 1990–1991 Distinguished Graduate Lectureship at Auburn University, the 1995 IEEE Region 3 Joseph M. Beidenbach Outstanding Engineering Educator Award, the 1996 Birdsong Superior Teaching Award at Auburn University, and the IEEE Power Engineering Society Outstanding Power Engineering Educator Award in 2003.

Professor Grigsby is a fellow of the Institute of Electrical and Electronics Engineers (IEEE). During 1998–1999 he was a member of the board of directors of IEEE as director of Division VII for power and energy. He has served the Institute in 30 different offices at the chapter, section, regional, and international levels. For this service, he has received seven distinguished service awards, the IEEE Centennial Medal in 1984, the Power Engineering Society Meritorious Service Award in 1994, and the IEEE Millennium Medal in 2000.

During his academic career, Professor Grigsby has conducted research in a variety of projects related to the application of network and control theory to modeling, simulation, optimization, and control of electric power systems. He has been the major advisor for 35 MS and 21 PhD graduates. With his students and colleagues, he has published over 120 technical papers and a textbook on introductory network theory. He is currently the series editor for the Electrical Engineering Handbook Series published by CRC Press. In 1993 he was inducted into the Electrical Engineering Academy at Texas Tech University for distinguished contributions to electrical engineering.

Contributors

Bajarang L. Agrawal

Arizona Public Service Company
Phoenix, Arizona

Alexander Apostolov

AREVA T&D Automation
Los Angeles, California

John Appleyard

S&C Electric Company
Sauk City, Wisconsin

Miroslav Begovic

Georgia Institute of Technology
Atlanta, Georgia

Gabriel Benmouyal

Schweitzer Engineering Laboratories, Ltd.
Longueuil, Quebec, Canada

Anjan Bose

Washington State University
Pullman, Washington

John R. Boyle

Power System Analysis
Signal Mountain, Tennessee

Jim W. Burns

Bonneville Power Administration
Vancouver, British Columbia, Canada

Claudio Cañizares

University of Waterloo
Waterloo, Ontario, Canada

Charles Concordia

Consultant
Venice, Florida

Mohamed E. El-Hawary

Dalhousie University
Halifax, Nova Scotia, Canada

Ahmed Elnewehi

British Columbia Hydro & Power Authority
Vancouver, British Columbia, Canada

Richard G. Farmer

Arizona State University
Tempe, Arizona

Jay C. Giri

AREVA T&D Corporation
Bellevue, Washington

Robert Haas

Haas Engineering
Villa Hills, Kentucky

Nouredine Hadjsaid

Institut National Polytechnique
de Grenoble (INPG)
Grenoble, France

John F. Hauer

Pacific Northwest National Laboratory
Richland, Washington

Stanley H. Horowitz

Consultant
Columbus, Ohio

Danny Julian

ABB Power T&D Company
Raleigh, North Carolina

Prabha Kundur

University of Toronto
Toronto, Ontario, Canada

Einar Larsen

GE Energy
Schenectady, New York

Harry Lee

British Columbia Hydro & Power Authority
Vancouver, British Columbia, Canada

Yakout Mansour

California ISO
Folsom, California

Ken E. Martin

Bonneville Power Administration
Vancouver, British Columbia, Canada

William A. Mittelstadt

Bonneville Power Administration
Vancouver, Washington

Kip Morison

Powertech Labs, Inc.
Surrey, British Columbia, Canada

John Paserba

Mitsubishi Electric Power Products, Inc.
Warrendale, Pennsylvania

Arun Phadke

Virginia Polytechnic Institute
Blacksburg, Virginia

William W. Price

GE Energy
Schenectady, New York

Donald G. Ramey

Consultant
Raleigh, North Carolina

Charles W. Richter, Jr.

AREVA T&D Corporation
Ames, Iowa

Juan Sanchez-Gasca

GE Energy
Schenectady, New York

Peter W. Sauer

University of Illinois at
Urbana-Champaign
Urbana, Illinois

Neil K. Stanton

Stanton Associates
Medina, Washington

Glenn W. Swift

APT Power Technologies
Winnipeg, Manitoba, Canada

Carson W. Taylor

Carson Taylor Seminars
Portland, Oregon

James S. Thorp

Virginia Polytechnic Institute
Blacksburg, Virginia

Kevin L. Tomsovic

Washington State University
Pullman, Washington

Vijay Vittal

Arizona State University
Tempe, Arizona

Bruce F. Wollenberg

University of Minnesota
Minneapolis, Minnesota