

Wind Power in Power Systems

Thomas Ackermann, Editor, Wiley, 2005.

We can thank Thomas Ackermann for undertaking a great service to the industry by collecting and editing the

outstanding collection of information contained in *Wind Power in Power Systems*. This is a field in which the practicing power engineer has a difficult time finding suitable information to understand the rapidly evolving technology and its impact on power system planning, design, and perform-

ance. It would be quite difficult for a single individual to cover the breadth and depth of information provided in this source; the variety of contributions from different authors, disciplines, and countries provides for a richness and depth of material not usually found in one place. The material

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was commissioned and prepared in 2003–2004 and reflects the state of the industry at that time.

Even in the few short years since then, the industry has continued to develop at a rapid pace. While the body of application literature continues to expand in parallel and will need to be updated periodically, the history and fundamentals contained in this book will form a firm foundation for the interested party for a long time to come. There are a number of very good texts available for different aspects of wind engineering, but this one provides the most comprehensive treatment available in the diverse field of utility wind plant interconnection and integration into power systems. On a personal note, it has been my pleasure to work with Thomas Ackermann as an instructor in the presentation of a three-day short course that UWIG offers on this topic, using this book as a background and reference source.

The book is laid out in four major sections: Part A, on theoretical background and fundamentals; Part B, on the international power system integration experience; Part C, on future concepts; and Part D, on dynamic models for power system studies.

Part A has a nice collection of introductory information, with something for everybody. After an introduction in Chapter 1, Ackermann begins with an historical development and current status of wind power in Chapter 2. This section takes us back to vertical axis windmills used by the Afghans since the 7th century B.C. for grinding grain. A brief introduction to the full set of utility wind integration issues is provided in Chapter 3, followed by an introduction to the modern family of generators and power electronic controls used in today's wind turbines and wind power plants. Chapters 5 and 6 continue with a discussion of power quality standards and power quality measurements for wind turbines. Chapter 7 provides a good summary of the network interconnection standards and practices in force at the time (2003); this is one of the areas of continuous evolution of requirements. Chapter 8 provides an excellent introduction to the

subjects of power systems requirements for wind power plants and the corresponding characteristics of wind power plants. Chapter 9 concludes Part A with a discussion of the economic value of wind power in a power system.

Part B has a very good discussion of wind power integration experience from around the world. Chapter 10 begins with a discussion of the Danish experience from Eltra, the grid operator of Western Denmark at the time, recently merged into the state-owned grid operator Energinet.dk. The German experience is conveyed in Chapter 11 by one of the German TSOs, Eon Netz. The early California experience is contained in Chapter 12 and the Swedish island of Gotland experience, with an HVDC tie, in Chapter 13. Experience with isolated hybrid power systems is contained in Chapter 14, while Chapter 15 contains experience with wind plants in the weak networks of India. A general discussion of power quality impacts is contained in Chapter 16, while Chapter 17 contains an introduction to the important topic of wind plant output forecasting. This section concludes with Chapter 18, with a discussion of economic issues associated with the incorporation of wind power plants in a deregulated utility environment.

Part C discusses some of the future concepts associated with higher wind power penetration in power systems. Chapter 19 deals with the possibilities for improved voltage control with the modern generation of wind turbines with power electronic controls. Chapter 20 provides an interesting discussion of the impact of wind generation on transmission capacity and some thoughts on how to deal with the result-

ant congestion. Chapter 21 covers approaches to active management of the distribution networks with distributed wind generation, while Chapter 22

looks at transmission system alternatives for offshore wind plants. This section concludes with a discussion of the use of hydrogen production as a means for balancing wind power production in Chapter 23.

Last, but not least, is Part D on dynamic models. This is an area that has received increasing attention with the strong expansion of wind power production. Chapter 24 presents a general background discussion of wind turbine modeling issues. This is followed by Chapter 25 on reduced-order models of wind turbines and Chapter 26 on higher-order doubly fed induction machine models. Chap-

ter 27 continues with a discussion of model verification with both simulations and measurements. This section then progresses to an examination of the impact of wind power plants on power system dynamics in Chapter 28 concluding with a detailed discussion in Chapter 29 of the single machine equivalent of a large wind plant, with illustrations drawn from each of the different types of wind turbine technologies.

One of the things that strikes me is the rate at which new developments have taken place, new players have entered the field, and new information has been added in the short span of time since the book was published in 2005. One can only hope that the editor will be able to find the time and energy to provide an update to this valuable compendium sometime in the next couple of years! Additional information on the book is available at <http://www.windpowerinpowersystems.info/>.

—J. Charles Smith 

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