Journal of Solar Energy Engineering

Book Reviews

Wind Energy Systems by Gary L. Johnson, Prentice-Hall, Englewood Cliffs, N.J., 1985, 368 pages, price: $32.95.

Finding a good text for a course which is oriented towards a particular industry, surveying the application of a wide range of engineering skills to that industry's products, is always difficult. Pertinent books are often general and vague in content, with too much qualitative description and not enough teaching of problem-solving skills. In contrast, *Wind Energy Systems* is a real textbook for an undergraduate course, with chapters on specific technical topics, worked examples, homework problems (with answers given to some of them), references at the ends of chapters, and a brief index.

Chapter headings are: Introduction; Wind Characteristics; Wind Measurements; Wind Turbine Power, Energy, and Torque; Wind Turbine Connected to the Electrical Network; Wind Turbines with Asynchronous Elelctrical Generators; Asynchronous Loads; and Economics of Wind Systems.

One of the strengths of this text is the discussion of wind characteristics and wind measurements (the author has conducted wind research in Kansas for many years). It condenses a large amount of technical and practical information into easily understood form.

A second strong point is the treatment of electrical generation (the author is a Professor of Electrical Engineering). There is specific information on different d-c and a-c generator schemes, as well as a brief discussion of the impact of non-schedulable generation on the utility company's optimal generation mix and costs. The coverage of these topics is very welcome; they are very important in the introduction of alternative energy sources into shared electric power systems.

Unfortunately, the mechanical aspects of windmills are not covered nearly as well. The treatment of fluid mechanics is brief, superficial, and occasionally incorrect. The remark about available potential energy in the wind on p. 22 will puzzle thermodynamicists. The confusion of the concepts of turbulent flow and flow separation on p. 128 will pain aerodynamicists. On p. 18, a graph from R. E. Wilson and P. B. S. Lissaman's "Applied Aerodynamics of Wind Power Machines" (Oregon State University, May 1974) is reproduced without appropriate credit and with the curves for Savonius rotors and American multiblade water-pumpers interchanged. This error originally occurred in a reproduction of Wilson's graph in a widely circulated booklet by F. R. Eldridge; Eldridge later corrected the labeling in his expanded book, but the mistake continues to be repeated by others. A second report by Wilson et al. (June 1976) is a better source of information on Savonius-rotor performance.

A few other notions which have become part of the mythology of wind energy have crept into the book without strong endorsement, but also without sufficient critical perspective: the supposed advantages of direct use of wind power even at non-remote (i.e., grid-connected) sites; the pairing of wind-generated electricity with hydrogen production or with battery storage at the utility level; and so on. One would gladly trade these topics for a better discussion of aerodynamic design, or rotor blade stresses, or structural vibrations, or operational controls.

However, the purpose of this text is not to enable a student to design a wind turbine, but to guide him through the important steps that are necessary in planning an application for a wind energy system—from wind survey through load matching to economic analysis. The discussions of many economic issues specific to wind power is particularly appreciated.

This reviewer is more comfortable with a curriculum which is organized around skills (like the analysis of stress, dynamics, or heat transfer) rather than industries and applications. Nevertheless, students are easier to motivate when they believe the course material to be particularly relevant. *Wind Energy Systems* is topical and yet manages to introduce many fundamental engineering techniques and concepts.

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Design Approaches for Solar Industrial Process Heat Systems, by C. F. Kutscher et al., ASES, Boulder, CO 80302, SERI/TR-253-1356, Aug. 1982, 423 pages, Price $45.00 ($31.50 to ASES members).

A group of SERI engineers has assembled an enormous amount of valuable design information and data in this 8-1/2 × 11 in., soft-cover volume. It is divided into three parts—"Fundamentals," "Conceptual Design" and "Preliminary Design"—along with 9 appendices. The organization attempts to follow the usual design process in which progressively more detail is needed as the design is refined. Chapter 1 introduces the book and the design process concept complete with a flow chart. Chapter 2 describes generic solar thermal energy use groups with details of a few typical industrial processes heat (IPH) systems.

Part II consists of Chapters 3–5. Chapter 3 ("Suitability") is too short and should have been combined with Chapter 4. The fourth chapter describes generic IPH systems relative to the type of process, storage and auxiliary heat supply. The treatment is coherent and of the appropriate level. The first design information is supplied in Chapter 5 ("Solar Collectors"). All collectors usable for IPH production are described and an instantaneous performance model is developed. Maps and charts assist with collector type selection. However, at the end of Part II, the user will not be able to complete a "conceptual" or schematic design. Nothing but collectors have been discussed to this point.

Part III begins with Chapter 6—"Annual Performance". This is an important topic and charts and equations for a number of basic systems are presented. Factors for modifying these baseline data for various flow rates and storage sizes are given. Solar-fired boilers and flash steam systems can also be modeled using other performance factors. Details of collector shading, incidence angle effects and collector array piping are discussed with good analytical detail accompanied by practical advice. However, it is here that the treatment becomes uneven. On one page the instantaneous spillover loss equation is given for a concentrator. On the next page the time frame has jumped to the other extreme; annual spillover is discussed. From this point on the book has occasional large shifts in level of detail which can be confusing. A step-by-step summary ends this chapter.

Chapters 7, 8, and 9 discuss details of the energy transport system, controls and installation. It is these three subjects which need and have received substantial attention to guarantee that a well-designed system will operate as designed. The amount of data and its level of detail are well selected. (It is not clear why a chapter titled "Installation and Start-Up" is in Part III "Preliminary Design"; a Part IV is needed.)

Chapter 10 discusses economic analyses and costs in detail. Unfortunately, it falls at the end of the design process. Since economics are key to all design steps, this theoretical chapter should have preceded the design chapters so that the designer could have used its contents in each step of the design process. In industry, economics is the key ingredient in all design steps. The authors have ignored the large body of chemical process industry (CPI) costing literature in Chapter 10. Every component of a solar IPH system (except the collectors) has been in use for years in the CPI's and cost estimation procedures are accurate and well-established therein.

In summary, this book and its lengthy appendices contain a great deal of valuable information for the solar IPH designer—information also useful to the designer of commercial solar space heating systems. One may quarrel with the organization but the thorough index enables the user to find any topic. In addition to its use as a design manual, it can also be used as an (auxiliary) text in a solar IPH design course. Every designer of Solar Thermal Systems should have a copy.

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