Book Review

Power Generation. By Phillip G. Hill. MIT Press, Cambridge, Massachusetts (1977). 402 pp. $19.95.

Briefly, this book concerns the electric power industry with its benefits and costs, both environmental and direct economic; attention is focused on the U.S. and Canada. The book is intended as a text for students, particularly engineers, at a senior or possibly graduate level, which presumes a knowledge of calculus, chemistry, physics, and thermodynamics.

The orderly arrangement first addresses the energy demands and resources of the world (Chap. 1), followed by those of the U.S. and Canada (Chap. 2); this is coupled with constraints to fuel extraction and processing, e.g., mining and transportation. Well-selected tables and plots show the distribution of resources and demands and make clear the seriousness of the problems of satisfying the world's energy consumption, which increases at ~5%/yr, with the electrical demand growing at ~8%. Data on the nonconventional sources, i.e., geothermal, tidal, and wind, show their significant, but limited, possible contributions. Chapter 3 on utilization includes information on energy transportation and space heating and presents interesting relationships on possible shifts, such as use of electricity for heat pumps. Problems on utilization of the waste heat of power plant condenser water—i.e., economics, transportation, and legal limitations—are described, with some mention of utilization of waste heat for agriculture and aquaculture.

The environmental aspects are the subject of the next three chapters, namely, power and the environment generally, nuclear radiation, and air pollution from fossil fuels. The statistics on resource extraction bring out the many frequently overlooked costs, e.g., deaths and lost time in mining, transportation of fuels, and land requirements for plants. (Occupational deaths attributed to use of coal for electricity may be ten or more times that of nuclear fuel.) The effects of environmental heating, both local and global, are summarized. The units and limits for nuclear radiation are well presented for the non-nuclear engineer. The statistical data on cancer and genetic effects of radiation as related to power plants are given. A missed item is the radioactivity of coal plants, both from the stack and in the ash, as well as radon in natural gas. Key plots and tables of risks from the now-famous *Reactor Safety Study* (the Rasmussen Report), WASH-1400, are discussed. Chapter 6 centers on air pollution, primarily the oxides of sulfur and nitrogen, carbon monoxide, and particulates from fossil fuels. Many useful tables give amounts and concentrations of pollutants, with an analytical model for dispersion from stacks. "Smog" chemistry is outlined.

Costs and the technology of electric power plants comprise the next three chapters. The tables on costs of production and transmission of electricity show the magnitude as well as the trend in recent years to more complex and expensive plants that have been greatly delayed by the difficulty of regulatory approvals. The presentation allows interesting comparisons of the alternatives for power. The costs of escalation and of interest on money are disturbing. Capital costs have increased several times, with overall generation costs going from 7 mils/kWh in 1962 to ~15 mils in 1974.

Chapter 8 on nuclear power covers the several reactor designs in industrial use. The Canadian heavy water design, which is somewhat neglected in the U.S. literature, is well covered. Chapter 9 on power from fossil fuels, which is ~60 pp. long, or twice the length of the other chapters, is well done and enlightening for the nuclear engineer who has less background in conventional power plants. Sections on stack gas cleaning, gas turbines, magnetohydrodynamics, and proposed cycles using fluids other than steam are included. The treatment of the conversion of coal to gas and oil is weak; this is receiving much attention and is bound to play a large role in the power field. Finally, Chap. 10 on solar power, which is often proposed as the immediate panacea for energy shortages, gives basic information on amounts of radiation available, utilization difficulties, and energy storage.

The book is well written. The summaries with each chapter are helpful. The many references (and they are recent) make the book timely for teachers and researchers in this changing field. The engineering relations and units for comparisons are good for the engineer. Nevertheless, the introduction of SI units is a problem; the author frequently includes in parentheses the equivalent units, e.g., lb/in.^{2} to pascals. Authors can greatly help readers by convenient conversions. The problems for the student are well formulated; a few more examples in the text would have been instructive to the reader. In conclusion, this book should prove a useful text. The author objectively analyzes the alternatives for electric power, neither emphasizing nor favoring any type. His lucid presentation with tables and graphs makes the book a useful reference for the library of any engineer concerned with the power field.

Dick Duffey

University of Maryland
Department of Nuclear Engineering
College Park, Maryland 20742

October 9, 1978

About the Reviewer: Dick Duffey is professor of nuclear engineering at the University of Maryland where, after a number of years with the U.S. Atomic Energy Commission, he initiated the nuclear program in 1954 and the nuclear reactor in 1957. He served as its director until 1967. Dr. Duffey's undergraduate work was at Purdue, and his graduate training was at Iowa and Maryland. His current interests are in nuclear reactors, particularly their environmental impacts, and in the applications of ^{252}Cf.