Book Review

Power Plants with Air-Cooled Condensing Systems. By E. S. Miliaras. The MIT Press, Massachusetts Institute of Technology, Cambridge, Mass. (1974). 237 pp. $12.95.

Since the commissioning of the 120-MW(e) Rugeley plant in England in the early 1960's, increased interest has been demonstrated by power engineers concerning dry-power application in power plants. Particularly, in the last five years, we have seen an explosive rate of technical papers written on various aspects of dry towers for power plant application. These papers have contributed significantly to specialized areas of interest. However, a single-volume of technical literature covering all facets of dry cooling towers for power plants was not available. The power industry must welcome this most timely single-volume technical dissertation on air-cooled condensing systems for power plants.

The book's fourteen chapters thoroughly cover the historical development of air-cooled condensing systems, theory of heat transfer on liquid-to-air cooling and condensing vapor-to-air cooling, hardware, economics, and system design. Of particular interest is the inclusion in each chapter of a list of referenced papers and texts. This valuable inclusion allows readers to further their reading on subjects in their special fields of interest. The author must have conducted an exhaustive search of referenced topics to substantiate his opinions and conclusions. Although he states in the Preface that his work represents individual opinions and conclusions, this reviewer feels that the conclusions drawn are, in a large part, objective.

Although the facts are generally recognized that (1) electric energy demand will continue to rise and many new plants will be built, (2) an environmentally acceptable cooling method must be found, and (3) air-cooled condensing systems are proven technology, broad acceptance of air-cooled condensing systems for power plants has been slow in coming. The primary reason is economics; a second reason is operating experience.

The author must share this view judging from his detailed coverage of various operating problems experienced with existing dry-tower power plants. Such problems as water chemistry for indirect (Heller) systems, freezing of finned-tube heat exchangers, and air in-leakage in a direct system are thoroughly discussed. These are problem areas that could increase operating complexity, with attendant effects on plant availability and reliability. However, in discussing these operating problems, the author offers only limited detail covering their solution. He leaves the impression that all these problems either have been solved or can be solved rather easily. This impression warrants caution by those entering decisions on a particular design of an air-cooled condensing system. Power industry decision-making on new technology has always been conservative, and rightly so. Because of the extremely high capital intensity of power system operations, the decision on the type of plants and facilities will have a long-term and vital bearing on corporate profitability or even survival.

In citing the air in-leakage problem, the author states (p. 43) that air in-leakage can be dismissed on the basis of experience in U.S. process applications. This reviewer feels that the U.S. process-industry application may not be directly applicable, as the fluid to be cooled in the tube-side need not be under subatmospheric pressure. Concerning the author's claim of the experience gained from many foreign air-cooled power plant installations, this reviewer would question whether those operating experiences are readily and completely available.

Furthermore, due to the sensitive nature of site, ambient temperature, and utility system operating characteristics, there has been a broad disparity in dry-tower plant design among existing plants. Therefore, experience gained on one plant may not be entirely applicable to the next.

Note that realizing the definite need for operating experience with dry-tower power plants, the U.S. Atomic Energy Commission has embarked on a multimillion dollar test facility to be constructed at the Wyodak 330-MW(e) direct air-cooled condensing plant site. The test program will be most thorough and well planned. The Wyodak dry-tower plant is scheduled for operation in 1978.

The Wyodak test program will provide valuable data on design, economics, and operation for dry-tower application. Additional dry-tower plant operating experience on the Grootvlei Plant in South Africa has been reported recently at the Ninth World Energy Conference in Detroit. This, and much more dry-tower plant operating experience will continue to be made available in the future.

The author provides three related chapters on thermal cycle arrangements, plant optimization and equipment selection, and system planning considerations. These chapters cover not only specific areas of dry-tower plant-economic optimizations but are also applicable to other types of power plants as well. This reviewer considers these chapters to be the most valuable inclusion, and the coverage is thorough.

On the most important question of economics, current rapid escalation of cost of equipment, construction, and

fuel plus the increased cost of borrowed capital may further delay broader scale acceptance of air-cooled condensing systems for power plants.

Current practice within the power industry is to assign a premium value on replacement of kilowatt capacity combined with energy (fuel) penalty for a fossil-fueled plant at ~$700/kW, and for a nuclear plant at $1000/kW. The practice of using a $75 to $140/kW (p. 142) capacity replacement penalty may well become history.

Although economic considerations do not favor air-cooled condensing systems, the time will soon come for increased acceptance for power plant application. The 330-MW(e) Wyodak direct-system dry tower is an example; the 80-MW(e) Braintree Plant combined steam-and-gas turbine plant near Boston, Massachusetts, with a direct-system dry tower is another. Both plants are under construction and should provide first-hand operating and economic data for the power industry in a few years.

In the meantime, power engineers should not sit back and wait. The author's excellent book should be read by power engineers interested in and responsible for the design of power plant heat-rejection systems regardless of whether they are dry-type or evaporative-type cooling towers.

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About the Reviewer: Paul Leung, a fellow of the American Society of Mechanical Engineers, is a principal engineer of Bechtel Power Corporation in Los Angeles, California. He received his BSME in China and MSME from Rice University in 1952. His 21 years with Bechtel has led to his work in economic optimization of fossil and nuclear plant cycles and power system planning. Mr. Leung was honored with the ASME Prime Movers Committee Awards in 1970, 1971, 1972, and 1974 for contributions to technical literature on thermal electric generating station equipment and practice. He is a registered professional engineer in several states.