reactors (LWRs), high-temperature gas-cooled reactors (HTGRs), liquid-metal fast breeder reactors (LMFBRs), and gas-cooled fast reactors (GCFRs). Quite naturally, the depth of treatment varies. For some topics, basic analytical methods are presented, while for others, only qualitative discussion is given.

Chapter 2, Safety Assessment, provides a useful introduction into the probabilistic nature of reactor safety and a brief introduction to the basic mathematical formulation of reliability analysis.

The book is relatively self-contained with regard to one-group reactor theory, kinetics, and lumped parameter heat transfer. The one-group treatment of reactivity coefficients is clearly handled. However, the absence of a multigroup perturbation theory treatment of the sodium void coefficient represents an example of where this reviewer would have preferred a more advanced theoretical explanation. The Doppler effect is also discussed on a very elementary basis, as are moderator temperature (and void) coefficients of reactivity.

Super prompt critical transients and the Bethe-Tait disassembly model for fast reactors are treated in reasonable depth, as are the singly and doubly lumped parameter models of transient heat transfer. On the other hand, fuel element behavior and failure modes during accidents are discussed qualitatively and in an incomplete fashion.

Beyond the Bethe-Tait model, the rather considerable discussion of fast reactor safety tends to be qualitative except for simple models of the work available from expansion of the fuel vapor or sodium following disassembly.

Chapter 7, Coolant Transients, presents the basic aspects of hydraulic modeling, including natural convection. It also provides an introductory analysis of accidents involving a loss of heat sink.

The chapter on loss-of-coolant accidents (LOCAs), Chap. 8, emphasizes basic concepts and the theoretical formulation of fluid behavior during blowdown, then goes on to discuss the remainder of the LOCAs in an LWR qualitatively. The solution of the traditional depressurization accident for the HTGR is also developed.

Chapter 10, on containment, provides an analysis of a dry pressurized water reactor containment neglecting heat transfer and then correcting for it crudely; pressure suppression is discussed only briefly. The chapter includes a considerable qualitative discussion of many of the phenomena important to various aspects of containment behavior, including failure due to core melt.

The book contains 630 pages including tables and index. There are some problems at the end of each chapter. For a book covering such a wide range of phenomena and topics, the reviewer noted rather few misstatements or statements that have become dated.

In view of the absence of textbooks on reactor safety, the author is to be congratulated for completing a difficult task. Each potential user will have to judge for himself concerning its suitability.

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About the Reviewer: David Okrent has been a protagonist of nuclear reactor safety from its beginnings and has served as a member of the Advisory Committee on Reactor Safeguards since 1963. Following graduate studies at Harvard, Dr. Okrent was associated with the Argonne National Laboratory for about two decades before becoming professor of engineering and applied science at the University of California at Los Angeles. He was Isaac Taylor Visiting Professor of Nuclear Engineering at The Technion (the Israel Institute of Technology) during 1977-1978.

Heat Transfer and Turbulent Buoyant Convection: Studies and Applications for Natural Environment, Buildings, Engineering Systems. Edited by D. Brian Spalding and N. Afgan. Hemisphere Publishing Corporation, Washington, in association with McGraw-Hill International Book Company (1977). 850 pp. $75.00 (two volumes).

In recent years, the subject of turbulent free convection has continued to draw the attention of many researchers throughout the world because of its theoretical and practical importance associated with the studies of jets, plumes, building fires, nuclear reactor safety, combustion phenomena, etc. Owing to the strenuous and unremitting efforts of these researchers, our scientific knowledge of this complicated subject has shown substantial advances, some of which were reported and discussed at the August 1976 seminar of the International Centre of Heat and Mass Transfer held at Dubrovnik, Yugoslavia. This two-volume book is comprised of the more than 60 papers presented at the seminar. The papers are arranged under nine categories following the titles of the sessions in which they were presented. These are: "Interactions of Turbulence and Buoyancy," "One-Dimensional Mixing in Turbulent Stratified Fluids," "Mechanics and Heat Transfer of Layers," "Buoyant Plumes," "Buoyant Flow in Ducts," "Air and Smoke Movements in Buildings," "Free Convection in Engineering Equipment," "Free Convection Phenomena in Gas-Liquid Mixtures," and "Free Convection with Heat Addition and Combustion Phenomena." Papers belonging to the first five categories are contained in Vol. I, with the remainder in Vol. II. These classifications, however, should not be taken too rigidly, because it appears that not all papers fit perfectly into the category in which they are placed.

Because of the wide variety of topics covered and the differences in the method of approach, degree of accomplishment, and level of sophistication, it is difficult to give a brief summary of the technical contents of the papers on an overall basis. It is apparent, however, that significant achievements have been made in some areas with regard to obtaining experimental data that hitherto have been relatively scarce, developing useful correlations thereof, or seeking mathematical solutions to complicated problems, the theoretical modelings of which are made by utilizing the traditional concepts or approaches. It is also noteworthy that the relative importance of experimental study as compared to pure theoretical analysis has not been underrated; indeed, a large number of papers deal with both. The remarkable progress in recent computer technology, coupled with the ability of the researchers to postulate a turbulence model suitable for accounting for the buoyancy effect and to make use of the relevant existing or newly generated data on turbulent flow, appear to form the basis for the recent advancement in the theoretical treatment of turbulent free convection phenomena. Results of theoretical or experimental studies are reported on a variety of subjects ranging from the analysis of buoyant jets or plumes to some of the more fundamental ones, such as turbulent free convection inside a flat slot or along a heated vertical flat plate, or combined forced and free convections in turbulent flow through a circular tube. The fact that a significant fraction of the papers deals with turbulent free convection occurring in natural environment, geophysical systems, or building fires may be an indication of the increasing interest in research activities related to environment protection and public safety. Some of the more specific topics covered in this area include the study on the development and erosion of the thermocline, transport, and deposition of airborne material, spreading of waste water discharge in lakes and oceans, and air and smoke movements in building fires. Another research area of major interest covered by some of the papers is that related to the study of thermal and hydraulic behavior of liquid-metal-cooled fast breeder reactors under both normal and transient operating conditions, with particular emphasis placed on application to pool-type breeder reactors. Informative results are presented on the study of free-convection-driven thermosyphons or on the determination of the amount of sodium vapor that can be transported from the hot surface of a sodium pool through the cover gas to the cooler region of the reactor structure.

Much of the theoretical treatment to account for the buoyancy effect on the turbulent flow field has centered on adding extra buoyancy terms, compatible with the postulated turbulence model, to the governing differential equations, such as the equation for turbulent kinetic energy or the equation for the dissipation of turbulent kinetic energy. Relatively little attention seems to have been paid to the more fundamental though difficult problem of understanding the true mechanism of the interaction of turbulence and buoyancy under conditions of stratification. In the paper by James Stuhmiller, with which the book begins, phenomena unique to turbulent, buoyant flow such as the generation of turbulent internal waves, anisotropy, and the tendency toward forming two dimensionality, etc., are discussed, and fundamental experiments useful for isolating and quantifying the related processes are described. The author specifically points out the importance of improving or altering the current mathematical modeling for shear turbulence to account for those effects.

There are also relatively few papers dealing with the more complicated subjects such as turbulent free convection in two-phase flow or turbulent flow involving both buoyancy and combustion phenomena. The practical importance of natural convection phenomena involving gas-liquid mixture is expounded in the paper by prominent author D. B. Spalding, coeditor of the book. Methods of predicting the velocity field for such systems are suggested, including the so-called GALA (gas and liquid analyzer) and IPSA (inter-phase slip analyzer) techniques. Verification of the usefulness of these techniques, when applied to different problems, however, may have to rely on future demonstrations. The final paper of the book, authored by John De Ris, may serve as a concise review of the current scientific understanding of turbulent natural convection involving combustion phenomena. Discussion is centered on the turbulent diffusion flame from a vertical nozzle, and important areas for future research needs are suggested.

The printing quality of the book is in general good, although there is a lack of uniformity in typography because of the diverse typing of the original manuscripts. A brief subject index is attached at the end of Vol. II, but no author index is given. It should also be pointed out that a very small number of papers treat laminar rather than turbulent free convection problems. The book should prove to be a valuable reference to those who are interested in understanding the current scientific development in the field of turbulent free convection.

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