This book contains the proceedings of a conference held at Rensselaer Polytechnic Institute in 1979 concerned with the "Fouling of Heat Transfer Equipment." Experts in the various fields that are included under the title, *Fouling of Heat Transfer Equipment*, presented review papers while sessions on a variety of topics allowed research papers to be presented. The standard of the review papers is very high with informed, critical appraisals of the state-of-the-art in a variety of topics. Excellent lists of references are included. A generally high standard prevails in the research papers too, though the coverage, of necessity, must be more spotty.

Except for isolated experimental results included to illustrate a point, design data and recommendations for design are completely lacking. Though many authors cited the inadequacies of the Tubular Exchanger Manufacturer's Association (TEMA) standards, including comments such as that they are conservative, they are nonconservative, and they didn't show the time dependence that must be there, no attempt was made to sift and evaluate published data to come up with a better standard. In spite of this conference, one cannot expect to find recommendations or better values for design than those included in the TEMA standards.

Of the six different kinds of fouling cited (i.e., precipitation fouling, particulate fouling, chemical reaction fouling, corrosion fouling, biological fouling, and freezing fouling), only two, precipitation and freezing fouling, have well-established theories and data bases that allow one to do rational designs for certain pieces of equipment. The pieces of equipment for which such information exists include seawater desalting evaporators and the oil chillers used in applications in which wax is liable to solidify out.

Peter Griffith is professor of mechanical engineering at Massachusetts Institute of Technology (MIT), which he has been associated with since 1952. His research at MIT has been concerned with multiphase flow, boiling, condensation, and supercritical heat transfer and has resulted in more than 50 papers in these areas. His summer work and consulting in these same areas have been concerned with nuclear safety, water side heat transfer in boilers, and heat exchanger design procedures for the power, chemical, and aerospace industries. His contact with fouling has been entirely as a user of fouling information.

Nuclear Reactor Safety Heat Transfer

Editor	Owen C. Jones, Jr.
Publisher	Hemisphere Publishing Corporation, Washington, D.C. (1981)
Pages	959
Price	$99.00
Reviewer	Clifford J. Cremers

This book originated with the assemblage of material for a 40-h course on the title subject that was held in August 1980, at the International Centre for Heat and Mass Transfer in Dubrovnik, Yugoslavia. The 25 chapters are grouped into five major sections and together present material across the spectrum of heat transfer in nuclear reactor safety technology and represent the contributions of 23 different authors.

The section "Overview" takes the reader through a history of nuclear energy conversion followed by discussions of the different reactor concepts and the safety problems associated with each. The second section, entitled "Fundamental Concepts," has chapters on the transient responses of light water reactor (LWR) and liquid-metal fast breeder reactor (LMFBR) systems as well as chapters on flow and heat transfer in single- and two-phase systems. The section ends with a chapter on the modeling of the coolant flow and heat transfer in nuclear reactor systems during both normal and off-design operating conditions. Up to this point, the book would make an excellent and up-to-date text for a graduate level first course on nuclear reactor safety.

The meat of the book is contained in the two sections "Design Basis Accident: Light Water Reactors" and "Design Basis Accident: Liquid Metal Fast Breeder Reactors." The first of these, in successive chapters, takes the reader from the loss-of-coolant accident through blowdown and emergency cooling water injection to core reflooding and fuel rod rewetting. These include descriptions of the thermohydraulic phenomena themselves as well as the parameters that affect them. A final chapter, on current methods of LWR system safety analysis, describes major codes in recent use and compares their relative capabilities, especially for predicting phenomena for which there are experimental data available.

The LMFBR section begins with a discussion of the initiators for core disruptive accidents and subsequent failure propagation. Some details of the latter, clad relocation and fuel motion, are then explored. Subsequent attention is given to the removal of postaccident heat from within the reactor vessel and then, once the molten core material has breached the vessel wall, the heat from the containment structure. Again there is a final chapter that discusses the recent codes developed to model these phenomena.

A final section on special topics deals with the details of some specific phenomena alluded to in earlier sections including vapor explosions, natural convection cooling in reactors, blockages in LMFBR subassemblies, sodium boiling, and experimental methods in two-phase flows. A detailed discussion of the accident at Three Mile Island and the lessons to be learned from it conclude the book.

Nuclear Reactor Safety Heat Transfer is a complete and well-organized book with copious and up-to-date references. The flow of material is smooth, which is a difficult thing to accomplish when the works of so many authors are joined. It will be a most helpful reference book for practicing engineers and students in this critical field.

Clifford J. Cremers is presently professor and chairman of the Department of Mechanical Engineering at the University of Kentucky, where he has been since 1966. Before that he was on the faculty at the Georgia Institute of Technology, where he went after receiving a PhD from the University of Minnesota in 1964. He teaches courses across *the spectrum of the thermal sciences and has published over 60 papers in heat transfer in plasma systems, heat transfer in frost layers, and thermophysical property measurement.*

Nuclear Fuel Management

Author	Harvey W. Graves, Jr.
Publisher	John Wiley & Sons, Inc., New York (1979)
Pages	327
Price	$32.95
Reviewer	K. Almenas

Every teacher in the technical field knows that good textbooks are considerably rarer than good technical books. Though the two categories have broad similarities, they are by no means identical. For a good textbook, it is not sufficient to be comprehensive and accurate, a special kind of organization is needed. One that first breaks down the material into comprehensible segments, distinguishes between the very important, important, and merely amplifying facts, and maintains a pace commensurate with the capacity of the prospective reader. It is gratifying to state that Dr. Harvey W. Grave's text *Nuclear Fuel Management* achieves this pace and organization right in its first edition. The advantage of reviewing such a book belatedly (it was published in 1979) is that one can speak from experience. If a pudding's merits emerge through the eating of it, the merits of a good text become clear in a classroom. Dr. Grave's book has withstood this test admirably. After its adaptation in a senior level undergraduate course in fuel analysis at the University of Maryland, the course became better structured, more comprehensive, and easier to teach. The text was well received by the students. Besides filling a long felt need, it helps to define the scope and content of the course on nuclear fuel analysis. That is an important aspect of the text and requires additional comments.

The nuclear engineering discipline is still evolving. The evolution process can be traced by noting the changes that have occurred in the basic texts. Initially they encompassed core neutronics and little else (i.e., Glasstone and Edlund). Currently they have expanded to include heat transfer, thermal hydraulics, material sciences, and even a smattering of economics (i.e., Lamarsh or Duderstadt). However, a point of diminishing returns is being approached. It is becoming increasingly difficult to be thorough and all inclusive at the same time. The discipline now has to evolve into separate subject categories that when linked together form a summation of knowledge and skills that define nuclear engineering. It is thus of interest to review which subject areas are emphasized and which are omitted in a new text.

The book is organized in four parts. The lead-in section encompasses various introductory subjects. Of special interest is the description of the front end of the fuel cycle. This includes mining, milling, fabrication, isotope separation, and the separative work unit (SWU) concept. A compact chapter is devoted to the definition of basic fuel cycle indexes and to an overview of nuclear reactor fuel types.

The second and largest section summarizes core physics methodology required for fuel depletion calculations. The preparatory chapters cover the applicability of diffusion theory, averaging of group constants, cell heterogeneity, and resonance absorption effects. A comprehensive chapter is devoted to various aspects of reactivity control and its effect on fuel cycle lifetime. Description of computational techniques focuses on methods of direct utility in fuel loading calculations. Besides the standard and familiar few group diffusion theory, this includes aspects of flux synthesis and finite elements. Especially welcome is a working description of the nodal technique including the derivation of the nodal equations and methods for evaluating coupling coefficients. The section concludes with the central (at least from the core physics point of view) task of burnup analysis–the evaluation of fuel depletion and isotope buildup.

The third section, called "Power Capability Evaluation," analyzes the physical parameters that limit potential core power density. This includes compact chapters on heat transfer and hydraulics. Considering the space limitations that the format of the book imposes, the material presented has to be very selective. The chapter on material properties has a narrower focus and thus can be more comprehensive. It includes properties of cladding materials, performance characteristics of UO_2, and changes in material properties expected during burnup.

The fourth and final part of the book includes three fuel management topics that do not fit readily under general headings. One of these is a chapter on "Nuclear Power Economics," which deals with cost categories, depreciation, the time value of money, and similar subjects that are in general quite unfamiliar to nuclear engineers but are a very essential part of fuel management. A chapter on loading arrangements and core operation strategies draws profitably on Dr. Grave's experience as a consultant in this area. And, finally, there is a subject that could regain its rightful technical importance–the utilization of plutonium in power reactors.

As this very brief overview shows, Dr. Graves treats fuel management as a self-contained technical subject. That is, the book presents or touches upon essentially all the areas of nuclear engineering that are utilized in performing and evaluating fuel utilization calculations. At this stage of subject category evolution, it is a logical approach. The approach works since he manages to distill the relevant essence of quite complex subject areas into compact (~20 to 30 pages long) chapters. Thus even if for some of the broader subject areas (i.e., heat transfer control hydraulics) one would probably choose to turn to more comprehensive texts, the presented chapters still serve as a useful outline. But once a beginning is made, especially an excellent beginning like this, one is tempted to look toward the future. As subject categories become better defined, the areas of overlap should decrease so that specialized texts like this can afford to amplify those aspects of technology that are unique to them. Thus future editions could expand the chapters on nuclear power economics, in-core fuel management, and hopefully add a chapter on the tail end of the fuel cycle. The chapter describing the front end of the fuel cycle could also be amplified; particularly, it should include quantitative information regarding mill tailings. If it becomes necessary to limit the volume of the book (it should strive to stay a text and not turn into a handbook), then some of the general subject chapters, i.e., on diffusion theory, cross-section averaging, and heat transfer, could be