

halides and detailed flowsheets of the halide processes. Details of equipment and operating experience and comparisons with conventional aqueous processing are also given. Separations by fractional distillation, zone melting, liquid metal extraction, and oxidation are covered in the section on pyrometallurgical processes. The sections on reconversion deal primarily with the conversion of the nitrates of uranium, thorium, and plutonium to the metals. Methods of handling gaseous liquid and solid wastes are described in the section on waste disposal and factors influencing plant layout and process equipment design are discussed in the section on engineering.

The editors state that reprocessing has undergone a constant and most rapid obsolescence primarily due to the shift in emphasis from production fuels for military purposes to power reactor fuels. This shift in emphasis is evident in the section on aqueous processing where power reactor fuels are dealt with in detail, but is missing in the section on reconversions which deals almost entirely with conversion from nitrates through fluorides to metals. The section on plant management also tends to favor a production plant for military purposes rather than a multipurpose plant, processing relatively small batches of fuel from different reactors.

The book is the most comprehensive volume issued to date on fuel processing. It is geared primarily to the specialist in the field but gives sufficient basic theory to be of value to the university graduate entering the field. It is written in surprising detail considering its scope and its detailed list of references will be of great value to those wishing to examine the original work in even greater detail. Because of the detail given it is rather heavy reading.

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*(About the Reviewer: Robert G. Hart has been concerned with fuel reprocessing at Atomic Energy of Canada, Ltd. since 1948. From 1948 to 1955 he was actively engaged in development work in this field and was one of the original developers of the anion exchange separation process for plutonium. Since 1955, when fuel reprocessing was divorced from the immediate program at AECL, Mr. Hart has had the responsibility of keeping abreast of this field for his company. He is presently on the staff of the Whiteshell Nuclear Research Division where he will be in charge of fuel development.)*

**Fuel Element Fabrication with Special Emphasis on Cladding Materials, Vols. 1 and 2.** Academic Press, New York, 1961. 538 pp., \$14.00 (Vol. 1). 384 pp., \$10.00 (Vol. 2).

This two-volume publication consists of the proceedings of a symposium on this subject held in Vienna on May 10-13, 1960, under the sponsorship of the International Atomic Energy Agency. The stated reason for publishing the proceedings is "that they will be an important source of information to a much wider community of scientists and representatives of industrial groups of Member States (of the I.A.E.A.) just starting their own programs of work in this field." Volume I consists of two sections, "Characteristics of Cladding Materials" and "Fuel Element Fabrication," made up of 28 papers. Volume II contains 22

papers distributed among three sections entitled "Quality Control and Inspection," "Corrosion and Radiation Damage," and "Economic and General Trends in Development." The books are printed in easy-to-read type and the many photomicrographs are, pleasantly, very clearly reproduced.

Generally complete, if not always reliable, abstracts of each of the papers are presented in English, French, Spanish, and Russian. Inexplicably, eight of the papers are printed in French; the others are in English whatever the original language. Discussions of the papers are included, but, as recorded, contribute little to the publication.

The subject of the conference was the fabrication of fuel elements for the production of low-cost nuclear power. In toto, the papers cover the work in this field rather well, even though some subjects, such as canned and unbonded oxide-pellet fuel elements seem, in retrospect, at least, to have received an excess of attention. Also, we hardly need to be reminded that, in such a rapidly developing field, information which was generally up to date at the time of the conference has become old-hat during the time required for publication of papers. No one should expect to find much information on the advanced materials and systems currently getting R & D money. Nonetheless, the books do contain much useful reference data on cladding and fuel materials, such as zircalloys, stainless steels, aluminum and its alloys, graphites, and  $UO_2$ , and basic information on fabrication techniques of continual interest, such as vibratory compaction, swaging, gas-pressure bonding, and ultrasonic welding. It should also be pointed out that, as with any collection of this kind, some papers are better than others. There are the usual pot boilers with little or no significant information. Some otherwise good papers are marred because they do not make use of all the data available at the time.

In summary, the publication is completely successful in its stated purpose of providing information for those just starting work in the field of fuel-element fabrication for low-cost power reactors. In addition, as a result of the unusually wide range of the papers included, there is considerable material of general use for reference. There is very little coverage of advanced materials and fuel element configurations. Therefore, the books would be valuable additions to libraries for reference use by fuel-element materials and fabrication groups, but will probably not find their way to many personal 5-foot shelves.

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*(About the Reviewer: Donald C. Carmichael has specialized in the field of fuel-element fabrication with the Advanced Materials Development Division of Battelle Memorial Institute. He has been associated with numerous materials and cladding studies and was the principal metallurgical engineer in the development of the gas-pressure-bonding process now being used to produce PWR Core 2 fuel elements. His special interests are currently in the areas of the structure and properties of diffusion bonds, the mechanism of pressure bonding, and the compatibility of materials, including diffusion and reaction kinetics. In addition to papers published on fuel-element fabrication and diffusion, he has authored reviews on diffusion-bonding techniques and on diffusion studies which appear regularly in Reactor Core Materials.)*