BOOK REVIEWS

Selection of books for review is based on the editors' opinions regarding possible reader interest and on the availability of the book to the editors. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.

A CALL FOR PLANNING

Title Risk Evaluation for Protection of the Public in Radiation Accidents

Publisher International Atomic Energy Agency, 1967

Pages 78

Price $2.00

Reviewer Robert J. Hasterlik

This small volume has been prepared by an international committee of experts actively working in the field of the acute and chronic effects of exposure to ionizing radiation. Its purpose is "to define a range of reference doses of radiation that should be helpful in assessing the hazards of nuclear installations and in making policy decisions."

With the advent of the present stage of rapid proliferation of nuclear power plants (now that electricity can be produced in many parts of the world from the fission of uranium at less cost than from the burning of fossil fuels), prudence dictates that all countries carefully prepare plans for the minimization of radiation damage to the population in the case of an uncontrolled accident involving a nuclear power installation. Inherent in the decision to shift from fossil to nuclear fuels is the recognition that situations may occur where some, possibly large numbers of persons, may receive radiation doses from uncontrolled radiation sources. This volume wisely points out that in these situations the "concept of a fixed maximum permissible dose ceases to be meaningful. Instead, other considerations arise such as the need to balance the risk from radiation against the consequences of particular remedial measures."

Two situations are envisaged in this volume; that concerned with reactor design and siting, and that relating to the consequences of an uncontrolled release of radioactive materials from the reactor to the environment. The first situation is alluded to but not expounded upon in detail, whereas the second comprises the essential content of the volume. The duty of the appropriate authority in charge is expressed as a responsibility for balancing the estimated consequences of further exposure against the feasibility of its reduction and the effects of any countermeasure. To make possible this assessment, the authors have attempted to survey the pertinent literature and pull together relevant information for evaluating the risk expressed as "the risk from a given exposure against the consequence which would result from countermeasures to reduce the exposure of the people."

The volume, therefore, is divided into sections concerned with 1) reference doses and related risk estimates tied to the well-known late effects of irradiation including leukemia, bone tumor, thyroid carcinoma, and genetic effects; 2) practical applications for the use of reference doses; and 3) the computation of radiation doses from the body intake of the various products of uranium fission released in an uncontrolled reactor accident. Certain basic assumptions (made for the sake of prudence and conservatism by all international and national bodies) have been made in this calculation of risk. These include the assumption of linearity in dose-effect relationships and the absence of a threshold for the appearance of radiation effects. Risk is expressed as probability of malignancy per man-year of exposure, or annual rate of risk per unit radiation level. Extrapolation of such risk estimates to low total doses and low dose rates is exceedingly conservative.

This report contains the digest of a voluminous literature. Perhaps it could not present within its very limited format material that would make it possible for the knowledgeable reader to estimate the quality of the risk estimates presented. It has the dogmatic approach of a committee report. Moreover, the report suffers from lack of a clear-cut direction of thesis either to the highly qualified specialist in the field, or to the intelligent but nonspecialist authority in charge. The specialist will suffer from the digestion of the basic material and the nonspecialist will lack the basic background that would enable him to evaluate the risk assumptions presented.

A paucity of tabular and schematic presentation of material makes this volume difficult to use for risk assessment in an emergency situation. Its chief and not inconsiderable value lies in its call for the outline of a method for adequate and effective planning for the radiation safety of our populace in the nuclear-power future.

Robert J. Hasterlik (MD, 1938, Rush) is Professor of Medicine at the University of Chicago. His association with the effects of ionizing radiation in man dates from the period 1948-1953 when he served as Senior Scientist and Director of the Health Division of the Argonne National Laboratory. Through research carried out during the past 20 years at the Argonne Cancer Research Hospital and the Argonne National Laboratory, he has followed the effects of the deposition of radium in a large group of former radium watch dial painters. In 1962, he coauthored Report No. 29, "Exposure to Radiation in an Emergency," of the National Committee on Radiation Protection and Measurements. At present, he also serves as Co-Chairman of the State of Illinois Commission on Atomic Energy.

UN VÉRITABLE CLASSIQUE

Title Plutonium Handbook (a guide to the technology) Vol. I

Editor O. J. Wick

Publisher Gordon and Breach Science Publishers, Inc., 1967

Pages v + 520

Price $15.00 professional edition; $26.00 reference edition

Reviewer F. Sebilleau

This book is the first of a series of two. It is intended to provide information on a broad range of topics in the use of plutonium and to provide a primary reference to its technology. The authors of this handbook are very well known in the field of plutonium technology; in fact, most of them did pioneering work and made important contributions to our knowledge of this subject.

The *Plutonium Handbook* is a valuable guide not only for people who are not acquainted with plutonium technology but for those who are currently engaged in this field, for they can find all the available data collected in a unique reference book. However, due to editing delay, literature references subsequent to 1964 are not given. For that reason, it would be of considerable interest to rapidly undertake either a new edition of the book or the publication of a supplement including later references. The latter could probably be made in a shorter time.

In Chaps. 1 and 2, nuclear properties of plutonium isotopes are described. This description constitutes a broad survey of the subject, well adapted for technological purposes. Nevertheless, though alpha and beta emission of plutonium isotopes are given in detail, gamma-ray emission is not mentioned. In the same way, occurrence of ^{241}Am by beta decay of ^{241}Pu and associated gamma emission should have been pointed out since it affects plutonium handling safety.

Finally, in considering nuclear reactions (Chap. 2), it seems that some comparison between the neutron capture cross sections of isotopes of uranium and those of the plutonium isotopes, emphasizing the difference between these two elements with respect to the production of the heavier isotopes, would help in understanding their different characteristics.

Chapters 3 through 10 deal with metallurgy in the broad sense (since the properties of plutonium refractory compounds are included). Physical properties of pure plutonium are described in detail. Apparently no comment is made on the negative expansion coefficient of the delta phase, and there are only a few words on the electronic structure of plutonium. It should be remembered that most studies of magnetic and electronic properties of plutonium and plutonium alloys have been undertaken in an attempt to throw some light on the electronic structure, though the question still remains partially unanswered.

Mechanical properties of plutonium and plutonium alloys are given extensively in Chap. 4. In Chap. 5, solid-state reactions are considered, i.e., allotropic transformations of pure plutonium and transformations in plutonium alloys. Only a few data are given on self-diffusion in delta plutonium, which may give the reader the impression that solid-state diffusion of plutonium is a nearly unexplored field. This sparsity is probably due to the limited work in this field prior to 1964.

Chapter 6, on corrosion and oxidation, begins with an interesting survey of the general corrosion behavior of plutonium and its alloys. One can deplore with the author that, in spite of the comparatively large amount of work and data reported, no consistent picture of the oxidation of plutonium yet exists.

The equilibrium diagrams of plutonium alloys given in Chap. 7 are remarkably clear, and their size is large enough to allow temperature or concentration determination with reasonable accuracy.

Authors and editors must be thanked for having adopted the same scale for concentrations and simply related scales for temperatures; comparisons and measurements are greatly facilitated by this convention. However, where several authors have published different data for the same system, only one diagram is shown in this handbook, and the disagreement between authors is indicated in the text. Discrepancies might have been made clearer by drawing the different versions on the same diagram.

The metallography of plutonium constitutes a short chapter (9), which could have been joined to Chap. 10 because of its similarity.

The section devoted to laboratory techniques (Chap. 10) describes their application to plutonium metallurgy. Apart from some considerations of essential modifications to apparatus due to the corrosive and radioactive characteristics of plutonium, the description seems to be too detailed in classical metallurgical techniques. No mention is made of techniques, such as autoradiography or gamma counting, specifically related to plutonium.

After a short section devoted to chemical properties, the chemistry part of the book describes, in Chap. 12, the different compounds of plutonium. Extensive data on properties and preparation of these compounds are given, which leads to some duplication of Chap. 8 (plutonium refractory compounds) in the case of PuO_2, PuC, and PuN. The last part of the book comprises plutonium solution chemistry including oxidation states, complexes, solvent extraction, and molten salt chemistry. It gives an excellent survey of the large amount of work performed in this field, with numerous references.

Finally, the success of this