Book Reviews

Seismic Design for Nuclear Power Plants. Edited by Robert J. Hansen. M.I.T. Press, Cambridge (1970). 489 pp. $17.50.

The importance of Seismic Engineering in the siting and design of nuclear reactors has received increasing recognition in the past decade. The application of this branch of engineering has developed rapidly since TID-7024 *Nuclear Reactors and Earthquakes* was prepared by Lockheed Aircraft Corp. and Holmes and Narver in 1963. In July 1970, Oak Ridge issued *Earthquakes and Nuclear Power Plant Design*, by T. F. Lomenick and the Nuclear Safety Information Center staff, ORNL-NSIC-28. Now comes this volume on seismic design, consisting of an introduction, 13 papers on various aspects of seismic design, and a closure. The papers were given at a conference on seismic design of nuclear power plants held at M.I.T. in 1969. They have been carefully edited to minimize the difficulties of the transition from lectures with slides to papers with figures. Nevertheless, the reader does occasionally miss the directing action of the expositor's pointer.

R. V. Whitman provides an excellent general introduction, pointing out that the symposium concentrates on the Eastern two-thirds of the country because most of the existing and proposed nuclear power plants are sited there, and the low seismic activity gives little experience on which to base a reasonable assessment of the seismic threat. Yet the occurrence of the great earthquakes at New Madrid, Charleston, and Montreal show that the hazard can not be neglected. Whitman discusses basic concepts and introduces data on the Parkfield, California earthquake of 1966 to extend the information derived from the El Centro, California earthquake of 1940, upon which there has been great dependence in the past.

The contents are as follows: "Geological and Seismological Factors Influencing the Assessment of a Seismic Threat to Nuclear Reactors," by Daniel Linehan; "Geophysics," by Keiiti Aki; "Design Seismic Inputs," and "Some Observations on Probabilistic Methods in the Seismic Design of Nuclear Power Plants," by C. Allin Cornell; "Seismic Risk and Seismic Design Decisions," by Luis Esteva; "Fundamentals of Soil Amplification," by José M. Roesset; "Soil-Structure Interaction" and "Evaluation of Soil Properties for Site Evaluation and Dynamic Analysis of Nuclear Plants," by Robert V. Whitman; "Structural Response to Seismic Input," by John M. Biggs; "Seismic Analysis of Equipment Mounted on a Massive Structure," by John M. Biggs and José M. Roesset; "Modal Response of Containment Structures," by Peter Jan Pahl; "Provision of Required Seismic Resistance," by Myles J. Holley, Jr.; "A Measure of Earthquake Intensity," by Arturo Arias; and "Closure," by Robert J. Hansen.

The volume is especially remarkable for its discussion of the limitations of our scientific knowledge, and of the areas in particular need of exploration. These discussions throw light on the extent to which engineering experience and judgment must be relied on. It will be useful not only to practicing seismic engineers, but to the regulatory staff of the AEC, the design management of the applicants for Commission licenses, and to intervenors and all others who have a technical interest in the safety and integrity of nuclear reactors. To these it will suggest questions that should be asked, to give assurance that the most up-to-date seismic information and criteria are being applied to nuclear power plant projects.

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About the Reviewer: Hood Worthington retired in 1963 as director of the Atomic Energy Division of E.I. du Pont de Nemours and Company thereby completing his active technical career, all with du Pont, following academic training at the Massachusetts Institute of Technology. He now serves the U.S. Atomic Energy Commission as a member of its Atomic Safety and Licensing Panel where, in the course of reviewing applications for nuclear power-reactor permits, he has developed interest in seismology.

Fission Damage in Crystals. By Lewis T. Chadderton and Ian McC. Torrens. Methuen & Company, Ltd., London. 265 pp. $13.50.

Perhaps a reasonable index of the maturity of a field of research is the number of specialized texts it has fathered. When regarded from this vantage point, radiation damage in solids would be considered quite a mature research field. There have been a large number of conferences which have resulted in bound proceedings, a number of general treatments, and now, with increasing frequency, quite specialized volumes are appearing. There should be no element of surprise here; radiation damage had its birth some 25 years ago in connection with concern about structural integrity of nuclear reactors. The early recognition of its importance to a fundamental understanding of imperfections in solids added significantly to the practical impetus arising from nuclear applications. The result was a vigorous growth of activity in both basic and applied research. Over the intervening years we have witnessed the growth of influence in related areas as well as the development of specialties within the general field of radiation damage. These aspects truly characterize maturity in a major division of physical research.

The volume under review is a good example of the specialization which has occurred. By focusing upon damage resulting from the passage of fission fragments through crystalline solids, the authors have exhibited both the depth and the breadth of the field: Depth because of the degree of development that this special topic has undergone and breadth because of the many aspects of solid state physics which "intersect" with fission tracks. I found the last facet of the book both interesting and a welcome surprise.

The authors have concentrated primarily upon work with which they have been either directly or indirectly associated. Therefore, the familiarity with the subject matter and the availability of materials, both photographic and numerical data, have permitted them to use a somewhat more informal style than one usually finds in a work of this type. This lends readability though occasionally one is somewhat frustrated by the lack of a direct point of entrance into the literature. However, even though most of the work described or cited was done at Harwell, the writers have been reasonably just in giving background references to related work at other laboratories. Considering the style and their statement of objective, there can be little complaint about the lack of general coverage of work on fission damage.

In addition to a discussion of results they pay adequate attention to experimental techniques. In one sense this is quite necessary since a knowledge of film preparation methods is often essential to an interpretation of electron micrographs. Care is taken to distinguish between direct and indirect methods of using electron microscopy to display fission damage. The intricacies of image formation are discussed in some detail. A large number of excellent electron micrographs of fission damage in a variety of materials, many of which have not appeared elsewhere, are included.

Models of fission damage are well presented and discussed extensively. The technique of computer "experimentation" has been extensively employed for both ionic and covalent materials. In these "experiments" an assemblage of atoms or ions of appropriate lattice structure and interatomic binding is created and fed into the computer. One or several atomic sites are excited by imparting energy and momentum and the resulting damage event is simulated through a solution of the equations of motion of the atoms in the assembly as the energy pulse is dissipated. A number of insights have come from this computational approach, in particular the concept of the ion-explosion-spike as the basis for fission track formation.

In one respect this book is somewhat disappointing. The exciting recent developments in fission fragment dating and other applications of fission tracks and their chemical etchability were not included. Although the authors indicate that they feel that such work is remote from the main theme of the book, it is a pity that some of the most imaginative recent applications of fission damage ever devised were not included in a book on fission damage. Nevertheless, the authors have succeeded in producing a valuable and readable book that should be useful to anyone interested in radiation damage in solids.

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