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Book Reviews

Proceedings of Symposium on Criticality Control of Fissile Materials. International Atomic Energy Agency, November (1965). 746 pp. $7.50.

This volume is an account of the Second International Symposium on the Criticality Control of Fissile Materials which was held in Stockholm under IAEA auspices in November 1965. The first symposium was held 4½ years earlier by the European Nuclear Energy Agency at Karlsruhe. A comparison of the two sets of proceedings shows the considerable progress that has been made in the intervening years.

Both meetings were dominated by contributions from France, the United Kingdom, and the United States of America, and divide broadly into four subjects: theoretical and experimental studies; criticality data; application to plant design; and safety in operations. It proved possible at Karlsruhe to keep these subjects together, but the organizers at Stockholm were not as successful and it is difficult to find any pattern in the allocation of papers to the first four sessions on "Basic Data," "Theoretical Studies," "Experimental Studies," and "Special Problems," which jointly contain the information on criticality data and on theoretical and experimental work. The remaining sessions on "Plant Design and Operation," "Current Practice in Criticality Control," and "Detection and Prevention of Criticality Accidents," do, however, conform to the titles.

In 1961 an outstanding theoretical problem was the understanding of the factors affecting the criticality safety of systems of interacting fissile units, a problem that had been brought to the fore by the work being undertaken at that time to devise a set of IAEA transport regulations for fissile materials. At Stockholm there were no less than eight papers that dealt wholly or in part with theoretical and experimental studies of this problem, from the USA, the UK, France, the USSR, and Japan. Noteworthy are the papers by J. T. Thomas who describes experimental measurements of critical parameters for a series of arrays in clean geometry and by F. Abbey who gives a comprehensive theoretical account of the interaction problems. It can now safely be said that the criticality of interacting arrays is well understood.

One of the striking developments in techniques of calculation brought out at the Symposium was the more widespread application of the Monte Carlo method. This method received only a brief mention at Karlsruhe but since that time has undergone considerable development and a number of very sophisticated machine codes are in use to determine criticality parameters for quite complex plant items and other equipment.

More than half the volume describes experience and techniques for ensuring criticality safety in the design and operation of chemical and fabrication plants and in transport. The trend has been away from the ultra-safe philosophy of several years ago when safety was demonstrated by showing that the system was safer than some reference assembly that had been shown experimentally to be subcritical. Economic pressures now demand a more accurate knowledge of the precise critical configuration as the basis of design so that realistic safety factors can be applied. This requires an elaborate and detailed machine calculation backed up by suitable experiments. The role of experiment is thus becoming more to check calculational methods than to directly give criticality clearance. There is also much interest in the use of neutron poisons, typically boron in Pyrex glass, as a means of enabling larger processing vessels to be used in chemical plants, and a number of papers refer to this concept.

A steady change of viewpoint is noticeable, away from the concept that the results of an accidental nuclear chain reaction can be so disastrous that every effort must be made for its prevention, to a realization that such an accident will nearly always be very limited in the damage it can cause and that provision can be made for protection. Consequently, criticality is ceasing to be glamourized and is gradually taking its place as just another industrial hazard against which sensible precautions must be taken.

This book, supplemented by the proceedings of the earlier Karlsruhe Symposium, forms an excellent and full account of the theory and practice of criticality control of fissile materials. It contains many diagrams giving criticality parameters for a variety of systems that have recently been evaluated either by experiment or calculation. The criticality specialist cannot really do without this book on his bookshelf.

E. R. Woodcock

United Kingdom Atomic Energy Authority
Risley, Warrington, Lancs., England

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About the Reviewer: Ed Woodcock is Head of the Theoretical and Computing Section of the Health and Safety Branch of the United Kingdom Atomic Energy Authority with which he has been associated since 1954. His interests are primarily in radiation and neutron transport and in nuclear criticality safety. Prior to his position with the UKAEA, Mr. Woodcock was, successively, with the Meteorological Office, the Air Ministry, and the Ministry of Supply. His academic training was in mathematics at Cambridge.

Fast Reactor Technology: Plant Design. Ed. John G. Yevick. The MIT Press (1966).

In summary, this book is the first general reference for sodium-cooled fast-reactor technology to be published. It contains excellent bibliographies, outstanding illustrations, and provides an excellent source reference for the fast-reactor plant designer. Unfortunately, it is hampered