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THE SECOND NPY INTERNATIONAL ADVANCED SUMMER SCHOOL ON REACTOR PHYSICS

Interpretation, Analysis and Utilization of Reactor Physics Experiments in Thermal Neutron Critical and Subcritical Assemblies

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LECTURE NOTES BY

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FOREWORD

The NPY Project is based on an agreement between the International Atomic Energy Agency and the Governments of Norway, Poland and Yugoslavia concerning cooperative research in reactor physics. The purpose of this Project is to further the science of reactor physics by establishing a closer liaison among the national research institutions of the three countries.

The NPY Project has taken upon itself to arrange, as the need is felt, courses on aspects of reactor physics in the centre of interest of the member countries. These lecture notes cover the material presented as lectures at the second of the schools arranged by the Project, held in Norway, August/September 1966.

It is felt that the aspects of reactor physics covered in this summer school will be of interest also to other member countries of the International Atomic Energy Agency, as expressed by the presence of scientists from more than 30 countries through the full course.

We hope that these lecture notes will a.o. serve to remind those present at the school of the many instances where lectures, discussions and seminars went to the borders of present day reactor physics.

For other readers it is hoped that these lectures will provide deeper insight into central aspects of zero power reactor physics by collecting and integrating theoretical as well as experimental material in a unified way which considers the viewpoints of both power reactor design and the science of reactor physics.

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Lecture No. 8

DEFINITION AND UTILIZATION OF THE CONCEPT OF REACTIVITY

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applications, is that which allows the reduction of the transport theory equations, or some approximate multigroup form of these equations, into a system of ordinary, time-dependent, integrodifferential equations. This system is called the system of point kinetics equations [1,2].

A key parameter, which appears invariably in the system of point kinetics equations, is reactivity. Reactivity is well but not uniquely definable [3-7]. The lack of uniqueness of the definition of reactivity has important implications. For example, an experiment may be designed to suit a specific definition of reactivity. Thus, theoretical and experimental results may be correlated. The resulting values of reactivity, however, may not be at all relevant to another dynamic experiment, for which the preceding definition of reactivity happens to be inconsistent with the experimental observables. It follows that special attention must be given to the question "which definition of reactivity is applicable to which experimental measurements".

For small perturbations and small size systems, point kinetics and reactivity provide a useful tool for the analysis of the dynamics of the system. For either large deviations from criticality, or for large size systems, or for both, other techniques are more useful. For example, for a reactor, which is appreciably subcritical, it is more appropriate to use the prompt decay constant, ω_p, as a measure of subcriticality, rather than reactivity per se [3]. For large systems it may be more appropriate to use an omega mode analysis to correlate the experimental data rather than point kinetics and reactivity, etc. [8]

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