446

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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

REPORT ON CROSS SECTION EVALUATION (BARC, INDIA)

(B.P. RASTOGI)

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The need of evaluation of nuclear (neutron) data arises mainly from the reactor physics programme connected with the design of heavy water moderated power reactors (RAPP, MAPP etc.), water power reactors (TAPP), Fast Pulsed Reactor and its associated critical facility and Fast Breeder Test Reactor (40 MWth) under construction. In the following a report of work done in the Theoretical Physics Section of Reactor Engineering Division, which is responsible for neutronic calculations of these reactor systems is presented.

1. Evaluation of Point Cross-Sections (S.B.Garg)

Evaluation of energy point cross-sections using the nuclear optical and statistical models for some nuclei was done. These models with and without the level width fluctuation corrections were used to evaluate the total, elastic and inelastic cross-sections of Cr, Fe, Ni-58, Ni-60, Mo, Cd, Pb, Th, U-235, U-238 and Pu-239 in the energy range 0.1 Mev - 10 Mev. In these analyses the local optical model parameters were derived by fitting the measured angular distributions of the elastically scattered neutrons.

2. Adaptation of Evaluated Data Libraries (S.B.Garg)

For the neutronic analysis of fast reactors from the basic evaluated nuclear data libraries such as KEDAK and ENDF/B, the commissioning of these libraries on CDC-3600 computer has been taken up. The data processing computer codes are being adapted.

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3. Multigroup Cross-Section Sets

a. A 26 group cross-section set for 20 materials has been generated. The weighting spectrum was calculated for a large fast power reactor using the ELMOE code. Emphasis has been put on the calculation of group cross-sections in the resonance region. The cross-sections have been updated for U-238 and Pu-239 to make use of the latest evaluations of σ_c for U-238 and α for Pu-239.(S.B.GARG)

b. The Russian ABBN set is one of the group cross-section sets in use for Fast Reactor calculations. This set has been extensively modified during the last few years in view of the recent measurements and re-evaluation of point data. Most of the changes have been made in the energy range from 10 Mev to 1 Kev. The group cross-sections have been obtained by weighting with Fermi spectrum $(\frac{1}{E})$ and the spectrum from a 2500 litre PuO_2 fuelled Na cooled reactor. Group fission cross-sections of Th-232, U-233, U-234, U-235, U-236, Np-237, U-238, Pu-239, Pu-240, Pu-241 and Pu-242 and capture cross-sections for U-238, Pu-239 and Mo have been re-evaluated. Some of these cross-sections have been put in form of more than one set in view of the uncertainties in point evaluated values and measurements. The test of the suitability of these new sets for fast reactor calculations is continuing. (S.K.Kapil)

c. A multigroup-multiregion computer program for lattice calculations of thermal reactors is being developed. The entire energy range has been divided into 56 groups, the first 26 of which cover the fast and epithermal portions while the remaining encompass the thermal energy range (below 0.625 eV). The resonance energy range is covered by 13 groups enclosed between 9.118 KeV and 4 eV.

A library of group resonance integrals for U-238 has been generated using the program EPITHET and UNREST. They are tabulated as functions of potential scattering cross-section per absorber atom at various temperatures. A homogeneous mixture of U-238 and hydrogen was considered for the purpose of calculations. Heterogeneity can, however, be accounted for through equivalence theorems.

Since the resonances of U-238 have been resolved upto 3.9 Kev, EPITHET calculations were confined to groups 4 to 13 (below 3.519 KeV). The first three groups were treated by the code UNREST which uses Porter-Thomas distribution for neutron widths and constant radiation width and level spacing. In the seven groups below 906.9 ev, very detailed calculations of flux distribution and reaction rates were carried out using extremely fine group structure in each broad group. The resonances above this were treated individually and their respective contribution

added up to form the total resonance integral for the group under consideration. The parameters for resolved as well as unresolved resonances were derived from the tabulations of Schmidt (1967) and BNL-325 (1965). The calculations include only the s-wave resonances. The total infinite dilution resonance integral in this energy range turns out to be 269 barns which compares well with that given by WIMS library.

It is proposed to include other materials also in this library for example Th-232, U-235 and Pu-239. (H.C.Huria)

d. For the physics calculations of FBTR the 25 group Cadarache Version II library is used. In this library Th-self shielding factors were modified. It has been found that the Ni cross-sections are in error (comparison with integral experiments), but no modification has yet been made. (R.S.Singh)