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Progress Report
on Neutron Cross Section Evaluation Activities
at the Energy Research Centre at Petten (The Netherlands)

September 1979 - May 1981

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May 1981

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Petten, May 5, 1981.

Progress Report on Neutron Cross Section Evaluation Activities in
The Netherlands for the period September 1979 to May 1981.

The Dutch neutron cross section activities comprise the following three programmes:

1. Evaluation of neutron cross sections for fission products for fast reactors.
2. Evaluation of neutron activation cross sections for nuclides in the primary cooling circuit of fast power reactors, such as corrosion products.
3. Study of preequilibrium models for the prediction of spectra and angular distributions of particles emitted at neutron energies from 10-50 MeV.

The project is part of a cooperation between Germany, Belgium and The Netherlands on fast breeder reactor development. Progress is extensively reported in quarterly reports [1]. Recent publications and reports are given in Refs. [1-13]. The first two programmes are of direct interest to fast breeder reactors; the third programme is more directed to fusion applications.

With regard to the *fission-product programme* some progress has been made in the application of adjustments based upon integral data to point-wise given cross sections. Recently, the adjustment methods used to obtain adjusted fission-product cross sections have been reviewed [2]. Examples of adjusted fission-product data files are the ENDF/B-V and RCN-3 evaluations. The last-mentioned file has been completed for 30 materials, including data for natural elements in the fission-product mass range. Progress has been made with the re-evaluation of neutron cross sections for the Pd isotopes, using recent data measured at Geel and RPI. Other activities concern the calculation of group constants, integral data tests and burn-up calculations. Four conference papers [3-6] have been presented at the NEANDC Specialists' meeting on Neutron Cross Sections of Fission Product Nuclei", held at Bologna, December 1979. The contents of two papers is also available in more extended ECN-reports [7,8]. Recently, a Dutch request list for fission-product capture cross sections has been defined. Neutron cross sections for *nuclides in the primary cooling circuit* of fast power reactors have been evaluated at ECN for ^{64}Zn , ^{50}Cr , ^{54}Fe , ^{58}Ni , ^{62}Ni and ^{64}Ni . Work on the evaluation of neutron absorption cross section of the ground and isomeric states of ^{58}Co has recently been completed.

An article on *preequilibrium models* was published entitled "Angular distributions in a unified model of preequilibrium and equilibrium neutron emission" [9]. In that paper a large number of intercomparisons between experimental and calculated angular distributions of neutrons emitted from 14.6 MeV neutron-induced reactions was made. This work was also reported at a conference [10] with emphasis on the introduction of two global fit parameters to describe the angular distributions.

A more extended version of this paper with graphical intercomparisons for 34 elements has also been completed [11]. Recently, a random-walk model description of precompound decay has been given [12]. As an application some neutron emission spectra of neutron-induced reactions at $E = 15$ to 50 MeV were calculated using a new code system (PRANG).

The results show that preequilibrium effects are very important in the first-particle emission. In the emission of secondary particles preequilibrium effects need to be included at incoming energies above about 25 MeV. Preequilibrium effects in tertiary emission spectra were shown not to be significant below $E = 50$ MeV.

For all above-mentioned programmes the recently developed *interactive data retrieval system* INGRID [13] is very useful. With this code package neutron cross sections from various evaluated and experimental data files (from NEA Data Bank) can be retrieved, sorted, smoothed and plotted.

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