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Nuclear Data Activities in the Netherlands

1983/1984

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Nuclear data evaluation activities in the Netherlands 1983/1984

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compiled by: H. Gruppelaar, Netherlands Energy Research Foundation, ECN, Petten.

1. Cross sections for fission product nuclei (H. Gruppelaar, R.J. Heijboer, A.J. Janssen, H.A.J. van der Kamp, D. Nierop).

This project is part of the DeBeNe cooperation on fast-power reactor development [1]. A major effort in 1983 was directed to support the creation of an international fission-product cross section set, connected to the "Joint Evaluated File" (JEF). For this purpose 60 of the most important fission-product nuclides in a fast power-reactor have been re-examined and final recommendations for the inclusion of the best evaluations into JEF-1 have been made (cooperation with ENEA, Bologna). A large fraction of the Dutch evaluations is included in JEF-1.

For the most important fission products an integral-data test has been made in cooperation with CEA-Cadarache, within the framework of the DeBeNe-France agreement. In this test selected American, Dutch and French integral data were utilized. The results of this test will be used to guide future evaluations. This work will be continued for a second class of less-important fission products. Furthermore, the definition of pseudo-fission product cross sections is reconsidered, taking into account the release of gases and the migration of volatile products.

Pseudo-fission product group constants have also been generated for advanced pressurized water reactors (cooperation with KfK).

A new evaluation for ^{129}I has been made using recent experimental data from Oak Ridge, in cooperation with Hanford, Richland, USA.

Work is in progress to update the fission-product cross section evaluations for the Ru-isotopes.

Recent publications: see Refs. [1-3].

2. Cross sections for nuclides in the primary cooling circuit of a fast power reactor (H. Gruppelaar, H.A.J.van der Kamp, D. Nierop)

This project is part of the DeBeNe cooperation on fast reactor development [1]. Although this project has been completed [1,3], a follow-up was made by updating the neutron cross sections for ^{22}Na and ^{65}Zn using recent experimental data. Moreover, revisions were made for ^{40}Ar and group constants for natural Ar were calculated upon request from KfK. Most of the evaluations for this project have also been included in the JEF-1 library. Therefore, future updatings and revisions of the corrosion product data will be made within the framework of the international JEF project. For this purpose evaluation methods and codes have been further developed to satisfy the demands for higher accuracy in the nuclear data for future fast power-reactors.

3. Cross sections for fusion-reactor design applications

3.1. Nuclear models and codes (J.M. Akkermans[1], C. Costa[1], H. Gruppelaar, D. Nierop)

A great deal of effort was devoted to improve the precompound models, used to describe the double-differential particle emission cross sections. In particular, the incident and outgoing energy dependence of angular distribution coefficients of neutron inelastic scattering was studied [5-9,12]. A new model has been introduced that explicitly accounts for the angle-energy correlated precompound neutron emission at the initial neutron-nucleus interaction [8,9].
Furthermore, the random-walk model of precompound decay was further investigated [10] and a study of the relation between "unified" (spin-dependent) exciton models and spin-independent models was initiated [11,12]. For this purpose the Hauser-Feshbach code ERINNI, developed at ENEA, Bologna, was extended with a preequilibrium option. The new code, named PERINNI, has been coupled to our (spin-independent) exciton-model code system PRANG. These two codes were

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[1]) Visitors.

used to check the specifications of an international nuclear-model code comparison, organised by the NEA Data Bank in cooperation with ECN, Petten [13].
In January of 1984 the contributions of the participants to this exercize were studied at the NEA Data Bank at Saclay, and the first, preliminary results were communicated to the contributors for final checks (cooperation with NEA Data Bank). Work is in progress to compile the results of the second round (data received before March 1984).

3.2. Evaluation activities (H. Gruppelaar, A.J. Janssen, H.A.J. van der Kamp, D. Nierop).

The evaluation of nuclear data for fusion-reactor design applications is performed in the framework of the European Fusion Technology Programme. The progress is reported in semi-annual reports [7].
In order to create a European Fusion File (EFF) for neutronics calculations, it was decided to emphasize on the revision of existing evaluations with respect to their neutron-emission cross sections.
At ECN the format for the new EFF file was studied. This file will be maintained at ECN, Petten in close cooperation with the NEA Data Bank (JEF project). Proposals for the storage of double-differential neutron emission spectra have been made. They have been presented at a meeting on ENDF-VI formats at Vienna [15].

Another activity performed at ECN is the revision of the ENDF/B-IV evaluation for natural lead. For this purpose the level-density parameters of the stable lead isotopes were re-evaluated [7]. These data were used in model calculations. A rather good agreement was found with recent experimental double-differential cross sections measured at Osaka University and (n,2n) cross sections measured at Bruyères-le-Chatel. Some adjustments have been made to fit the experimental data. The new evaluation is being checked against recent integral experiments, performed at Osaka, Japan. The differential data are stored in the new MF-6 format. Group constants were generated using a home-made routine, processing the coupled angle-energy distributions of continuum neutron emission, and the Los Alamos code NJOY for the other data types. Work is in progress to complete the revision of evaluated neutron cross sections for lead before the end of 1984.

Reports and Publications

[1] J.C. Plakman (comp.), Fast reactor programma annual progress report 1981, ECN-138 (1983), ECN-155 (1984); other progress reports in press.

[2] H. Gruppelaar, Status of recent fast capture cross section evaluations for important fission product isotopes, Proc. NEANDC/NEACRP Specialist's Mtg. on Fast-neutron capture cross sections, Argonne 1982, NEANDC(US)-214/L (1983), p. 473.

[3] F.H. Fröhner, Kerndaten: Messungen, Dateien, Querschnittsätze, ins "Schnellbrüterphysik und nukleare Kernauslegung", KFK-3545 (1983), p. 18. (This paper summarizes the current nuclear activities in the DeBeNe area).

[4] H. Gruppelaar and H.A.J. van der Kamp, Evaluation of activation cross sections of corrosion products, cover-gas nuclides and other nuclides in the primary cooling circuit of a fast power reactor, Proc. Int. Conf. on Nuclear Data for Science and Technology, Antwerp, 1982, p. 643, Reidel Publ. Co., Dordrecht (1983).

[5] H. Gruppelaar, C. Costa, D. Nierop and J.M. Akkermans, Calculation and processing of continuum particle-emission spectra and angular distributions, Proc. Int. Conf. on Nuclear Data for Science and Technology, Antwerp, 1982, p. 537, Reidel Publ. Co., Dordrecht (1983).

[6] J.M. Akkermans, A random walk in the land of precompound decay, ECN-121 (1982).

[7] J.D. Elen (comp.), Fusion Technology Program Semi-Annual Report July-December 1982, ECN-132 (1983); January-June 1983, ECN-143 (1983); other progress report in press.

[8] C. Costa, H. Gruppelaar, and J.M. Akkermans, Energy dependence of preequilibrium angular distributions, Lett. al Nuovo Cim. 36 (1983) 431.

[9] C. Costa, H. Gruppelaar, and J.M. Akkermans, Angle-energy correlated model of preequilibrium angular distributions, Phys. Rev. C28 (1983) 587.

[10] J.M. Akkermans, Random-walk model of precompound decay II: Stochastic uncertainties in the lifetimes and cross-sections, Z. Physik A313 (1983) 83.

[11] H. Gruppelaar, Level density in unified preequilibrium and equilibrium models, Proc. IAEA Advisory Group Meeting on Basic and Applied Problems on Nuclear Level Densities, Brookhaven, 11-14 April, 1983, BNL-NCS-51694 (1983) p. 143.

[12] H. Gruppelaar, Model calculations of double-differential cross sections; Contr. to the IAEA Consultant Meeting on Nuclear Data for Structural Materials, Vienna, November, 1983, ECN-84-003.

[13] H. Gruppelaar, H.A.J. van der Kamp (ECN) and P. Nagel (NEA), International Nuclear Model Code Comparison on Pre-Equilibrium Effects. NEANDC-177U, NEA Data Bank, Gif-sur-Yvette, France, 1983. Final results of the intercomparison will be published in 1984.

[14] H. Gruppelaar, Contr. to the Consultants' Meeting on "Format for the exchange of evaluated neutron nuclear data", Vienna, 2-4 April, 1984.