Status of BROND-3 library (May 2004)

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Main Russian activity on nuclear data in the last years was concentrated on a revision of most important neutron data for advanced nuclear reactors and on formation of a new version of the BROND-3 library.

The following evaluations were performed:

i) Neutron data files for Pu-240 and Pu-242 were re-evaluated. The total, fission, inelastic scattering, and capture cross sections were revised essentially on the basis of recent experimental data. Uncertainties and the corresponding covariance matrix were estimated for these cross sections as well as for the fission-neutron multiplicities. Gamma-ray production data were included into the new evaluations.

ii) Energy dependence of the prompt fission-neutron multiplicities was re-evaluated for ^{237}Np, ^{238}Pu, ^{240}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, ^{241m}Am, ^{243}Am. Uncertainties of evaluations were estimated for the energy region from 10^{-5} eV to 20 MeV.

iii) The effective approach and the corresponding codes were developed for evaluation of underestimated systematical uncertainties of experimental data sets. Evaluation uncertainties were obtained together with covariance matrices for the following reactions: ^{238}U (n,tot), ^{238}U (n,f), ^{238}U (n,γ), ^{235}U (n,f), ^{237}Np (n,f), ^{239}Pu (n,f), ^{241}Am(n,f), ^{242m}Am(n,f), ^{243}Am(n,f).

iv) Files for separated zirconium isotopes as well as for natural zirconium were re-evaluated. Double-differential neutron spectra (MF=6) and gamma-ray production data were included into the new evaluations.

v) Files for separated iron isotopes were revised on the basis of comparison with ENDF/B-VI, JEFF-3.0 and JENDL-3.3 evaluations. Uncertainties and the corresponding covariance matrix were estimated for most important cross sections.

vi) Charged-particle production cross sections for N-14 and N-15 were re-evaluated.

vii) Evaluations for most important fission products were revised. Files for Tc-99; Rh-103, Ru-100, -101, -102, -103, -104, -106; Pd-104, -105, -106 –107, -108, -110; Nd-143, -144, -145; -146, -147, -148 -150; and Sm-144, -147, -148, -149 were re-evaluated on the basis of current theoretical models. Main modifications relate to the inelastic scattering and (n,2n) cross sections, while the capture cross sections were adopted close to the previous BROND-2 evaluations. Files for Cs-133, -134, -135, -136, -137; Ce-140, -141, -142, -144; and Ba-132, -134, -135, -136, -137, -138 were compiled on the basis of ENDF/B-VI and JENDL-3.3 evaluations in accordance with recommendations of the WPEC Subgroup 21. Threshold-reaction cross sections for nuclides without experimental data were adjusted on the basis of phenomenological systematics developed at the IPPE.

Evaluations for intermediate energies

i) Compilation of the neutron data files for Pu-240 and Np-237 in the energy range up to 150 MeV was completed during the last year. The similar file for Am-241 will be finished to the end of this year. The same approaches were used for these evaluations as applied before for the files of Th-232, U-238, and Pu-239. This activity is supported by the ISTC Project-1732.

ii) The BROND-3 high-energy file for Th-232 is re-evaluated now on the basis of new neutron-induced fission and capture data obtained by the n-TOF collaboration. The neutron total and elastic scattering data are revised in accordance with the recent LANL measurements. Uncertainties and the corresponding covariance matrix are estimated for most important cross sections.
iii) In collaboration with the ITEP (Moscow) and GSI (Darmstadt) we are also working on a revision of the intranuclear cascade model to obtain a consistent description of experimental data on neutron spectra and observed isotopic yields of fission fragments and spallation reaction products. Available simulation codes for such processes give strongly divergent results and these contradictions of calculations should be removed, if we want to produce reliable evaluations of nuclear data for energies above 150 MeV. This activity is supported now by the Project ISTC-2002.