

April 5, 2001

WPEC subgroup proposal

Title:

Assessment of Neutron Cross-Section Evaluations for the Bulk of Fission Products

Short Justification for a Subgroup:

Neutron cross-section evaluations of fission products represent a considerable part of all major evaluated nuclear data libraries. From the point of view of traditional reactor applications the bulk of fission products, some 80% out of 200 materials, are not considered to be top priority. Due to severely limited funding, these evaluations have not been revised for a long period of time despite their obvious deficiencies. This situation may be difficult to change even though major nuclear data libraries are preparing or planning substantial revisions. Considering that these revised libraries will be used well into the 21st century, a question arises what the international nuclear data community can realistically do to improve the situation.

The purpose of the Subgroup is to address this issue and to offer its cost-effective solution. The objective is to assess available evaluations and recommend the best evaluations for the most of fission products. This will constitute a basis for updating fission product neutron cross-section files in major nuclear data libraries and, if successful, a basis for future internationally adopted neutron cross-section fission product file.

Subgroup Monitor:

JEFF/JENDL To be specified

Subgroup Chairman:

ENDF P. Oblozinsky (BNL)

List of Subgroup Participants:

ENDF	P. Oblozinsky (BNL), I. Sirakov (BNL), R.E. MacFarlane (LANL), J. Chang (KAERI)
JEFF	To be specified
JENDL	T. Nakagawa (JAERI), K. Shibata (JAERI), M. Igashira (TIT), M. Kawai (KEK)
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Definition of the Project:

The project will review cross section evaluations of fission products. It will focus on the bulk of materials, anticipating that the top 20 fission products and some others

need more detailed analysis, based on benchmarking rather than review. The project will be separated into two phases.

In the first phase, summary of current fission product evaluations will be prepared. This will include a package with graphical inter-comparison of evaluations along with existing experimental data retrieved from the CSISRS library. Also included will be summary of methodology (thermal/resonance/unresolved resonance region and fast neutron region) that would allow assessment of physics and methods adopted by evaluators.

In the second phase, assessment of evaluations will be done. Also considered will be benchmarking results, though no specific benchmarking activity is foreseen. For each material a recommendation will be made as to which evaluation is considered to be the best. It is assumed that in a limited number of cases recommendation for reevaluation will be made.

Justification of the Project:

In general, fission products constitute the largest group of nuclei in all major evaluated nuclear data libraries. Most of these materials are not considered to be top priority and therefore current evaluations are often fairly old and based on obsolete methodology. Thus, for example, in the US library ENDF/B-VI, out of about 200 materials in the fission product category, about 70% materials have been evaluated more than 20-25 years ago. In the resonance region, about 30% of ENDF/B-VI fission product evaluations provide point-wise data and 35% of evaluations use single-level Breit-Wigner representation. Obsolete methodology can be further illustrated by the fact that as much as 55% of materials provide isotropic angular distributions for neutron elastic scattering.

Current and planned re-evaluation activities of neutron cross-sections of fission products are very limited. Probably the most important is the KAERI-BNL collaborative effort to evaluate 19 priority fission products. The thermal/resonance/unresolved resonance region has been completed and results are being included into ENDF/B-VI release 8, the fast neutron region will be completed in about a year.

On the other hand, there are several important nuclear data efforts underway or being planned. In Europe, the JEFF-3.0 effort is well underway. The JEFF Working Group on Fission Product Cross Sections is primarily concerned with benchmarking while it is attempting to select appropriate evaluations from existing libraries focusing on applications in incineration, fast reactors and thermal reactors. In the US, the CSEWG at its annual meeting in November 2000 decided to go ahead with a new version of the library, ENDF/B-VII. Again, it is highly unlikely that any substantial US reevaluation effort of fission products will be feasible. In Russia, the work has been initiated on BROND-3 and China is completing its new library CENDL-3 to be released in 2002.

In Japan, JENDL-3.3 is going to be released in 2001, with limited fission product cross sections improved over earlier versions. It is JNDC original evaluation, JENDL-3.1:

J. Nucl. Technol. 29(1992)129, reevaluation JENDL-3.2: 1994 Gatlinburg Conference, p. 809, and to be published in J. Nucl. Technol. 37(2001)No.4. In the both versions, the data for about 170 FP nuclides were given. All data were newly evaluated for JENDL-3.1 and those of 63 nuclides were revised for JENDL-3.2. Resolved resonance parameters were evaluated on the basis of experimental data published up to 1994. Almost all evaluations for total, capture, elastic and inelastic scattering cross sections were made with statistical model calculations including width fluctuation effects. Optical model parameters in local mass ranges were determined to reproduce systematic of total cross sections, s- and p-wave strength functions and scattering radii. Gamma-ray strength functions were determined by normalizing capture cross sections to differential experimental data in the keV neutron energy region. Threshold reaction cross sections were evaluated with the multi-stage evaporation model coupled with the pre-equilibrium model. For JENDL-3.3, inelastic scattering cross sections for Mo isotopes were modified and resonance spin values for ⁹⁹Ru were corrected.

Considering extremely limited funding it seems that the only feasible strategy to improve the bulk of fission product evaluations would be to select the best from available libraries.

This is the purpose of the present project. The objective is to focus on the bulk of fission products, assess available evaluations and recommend the best evaluations.

Relevance to Evaluated Data Files:

The project will produce a recommendation of best evaluations of cross-sections for the bulk of fission products. It is assumed that these recommendations would be in most cases adopted by ongoing and future evaluation projects as a step towards creation of internationally adopted fission product file.

Deliverables:

- Graphical inter-comparison of neutron cross-section evaluations including recent experimental data for about 200 fission products.
- Assessment of the evaluations considering data and methodology.
- Recommendations for best evaluations.

Time-Schedule and Milestones:

- 2001: Graphical inter-comparison
- 2002: Assessment of evaluations
- 2003: Final report