Working Party on International Nuclear Data Evaluation Cooperation, Subgroup 23

Creation of International Library of Neutron Cross-Section Evaluations for the Bulk of Fission Products

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Abstract

In the first year of the project (June 2004 – March 2005) initial version of the SG23 library with 164 materials was created. In the second year (April 2005 – March 2006) the library was completed. A full set of 219 materials was subject to basic testing and partial validation.

1. Introduction

SG23 was established at the WPEC meeting as a follow-up of SG21 in May 2004. The purpose of SG23 is to create ENDF-6 formatted files, including basic testing for all FP materials, and data validation for selected materials. It is assumed that the bulk of these files will be adopted by all major nuclear data projects. SG23 members are:

Chairman	P. Oblozinsky, ENDF (BNL)
Monitor	R. Jacqmin, JEFF (CEA Cadarache)
ENDF	Dunford, Herman, Mughabghab, Rochman (all BNL), M. Dunn (ORNL)
JEFF	C. Dean (Winfrith), A. Trkov (IAEA)
JENDL	T. Nakagawa and K. Shibata (JAEA)
BROND	V. Pronyaev and A.V. Ignatyuk (IPPE Obninsk)
CENDL	Ge Zhigang and Chen Guochang (CNDC)

In the first year (June 2004 – March 2005) we focused on merging of files following SG21 recommendations [1] and initial version of the library with 164 materials was created.

In the second year (April 2005 – March 2006) the library was completed, it contains 219 materials. The library was subject to basic testing and partial validation.

2. Creation of SG23 library

The SG23 library includes 219 materials in the range of Z = 31 – 68. It was assembled in 3 steps as described below.

Step 1, creation of the initial library with 164 materials:

- Fall 2004: Charlie Dunford (NNDC) created all files recommended by SG21 for inclusion into SG23 library, except for those that were or should be evaluated for ENDF/B-VII.
- December 2004: Chen Guochang (CNDC, 6 weeks visit to BNL, supported by the NNDC) started merging process. He attempted to develop computerized approach, had somewhat limited success. Report is available [2].
- March 2005: Charlie Dunford (NNDC) completed merging using manual approach and created initial library with 164 files.
- June 2005: Vladimir Pronayev (Obninsk, 6 weeks visit to BNL, supported by the NNDC) reviewed and adjusted some of 164 files. Report is available [3].
- August 2005: Tsuneo Nakagawa (JAERI) reviewed and adjusted some of 164 files, these were mainly adjustments needed to match JENDL-3.3.

Step 2, completion of the library with 219 materials:

- March - September 2005: Kim (KAERI, 6 months visit to BNL, no cost to the NNDC) in collaboration with M. Herman and P. Oblozinsky completely re-evaluated fast region for 15 priority materials as a part of BNL-KAERI effort, including 5 isotopes of Dy.
- August 2005: B. Sarer (Turkey, 6 weeks visit to BNL, no-cost to the NNDC) in collaboration with M. Herman and P. Oblozinsky evaluated 24 fairly low priority materials in the fast neutron region.
- July – September 2005: D. Rochman (NNDC) re-evaluated complete set of 8 isotopes of Gd in the fast neutron region. S. Mughabghab re-evaluated MF2 for all of them, with emphasize on 152, 153, 154, 156, 158, 160-Gd.
- September 2005: D. Rochman (NNDC) re-evaluated 99-Tc and 153-Eu in the fast neutron region. Said re-evaluated MF2 for 99-Tc, in particular he adjusted thermal capture.
- October 2005: McNabb, LLNL submitted 74,75-As to ENDF/B-VII as new Livermore evaluation, 74-As being entirely new evaluation not yet done before.
- October 2005: NNDC assembled preliminary SG23 library for a full set of 218 materials covered by SG21 plus 74-As making it 219 materials in total.
- October – November 2005: Phase1 testing of SG23 was done. In addition to 3 checking codes (CHECKR, FIZCON, PSYCHE), NJOY-99.90 processing + simple MCNP5 runs were done by R. Zajac (STU Bratislava, 2 months visit to BNL, supported by the NNDC).

Step 3, testing and improving complete library:

- December 2005: Feedback was collected and minor adjustments in files were done. These were format error fixes, not noted by basic NJOY runs.
- January 2006: Complete library was put on SG23 webpage. Summary report available [4].
- March 2006: New evaluations produced for ENDF/B-VII were revised by BNL-KAERI and also by LLNL. In all cases, Mughabghab revised existing MF2, extended URR up to the 1st excited level and completed MF2 for remaining 16 materials.
- April 2006: The complete improved library containing 219 materials was subject to data verification (phase1 testing) by the NNDC.

3. Summary of SG23 library

ENDF-6 identification of the library is as follows: International Fission Product Library (IFPL), NLIB=21, with NLIB assigned by A. Mengoni, IAEA on August 9, 2005.

Sources of data in SG23 library are summarized in Table 1. Full evaluations were adopted from ENDF/B-VII, followed by JENDL-3.3 and CENDL-3.0. Partial evaluations were mostly those of ENDF/B-VII with Mughabghab being the best contributor (MF2 for 148 materials).

Table 1. Sources of data in SG23 library

Project	**Full**	**Partial**	**Sum**	**Comment**
ENDF/B-VII	72	84	156	72 full = 32 BNL + 38 BNL with others + 2 LLNL
JENDL-3.3	45	1+51	97	51 partial with BNL, already counted as ENDF/B-VII
CENDL-3.0	11	0+16	27	16 partial with BNL, already counted as ENDF/B-VII
Other source	1	5	6	
Total materials	**129**	**90**		Best contributor: Mughabghab, MF2 for 148 materials

4. Validation of SG23 library

So far, only phase1 validation has been completed. This includes runs with checking codes, NJOY processing followed by basic run with MCNP.

Systematic comparison of thermal capture values and capture RI with Atlas of Neutron Resonances [5] was done. Preliminary values, by Nakagawa and independently by the NNDC (end of 2005), suggest good overall agreement with a couple of problems, see Fig.1.

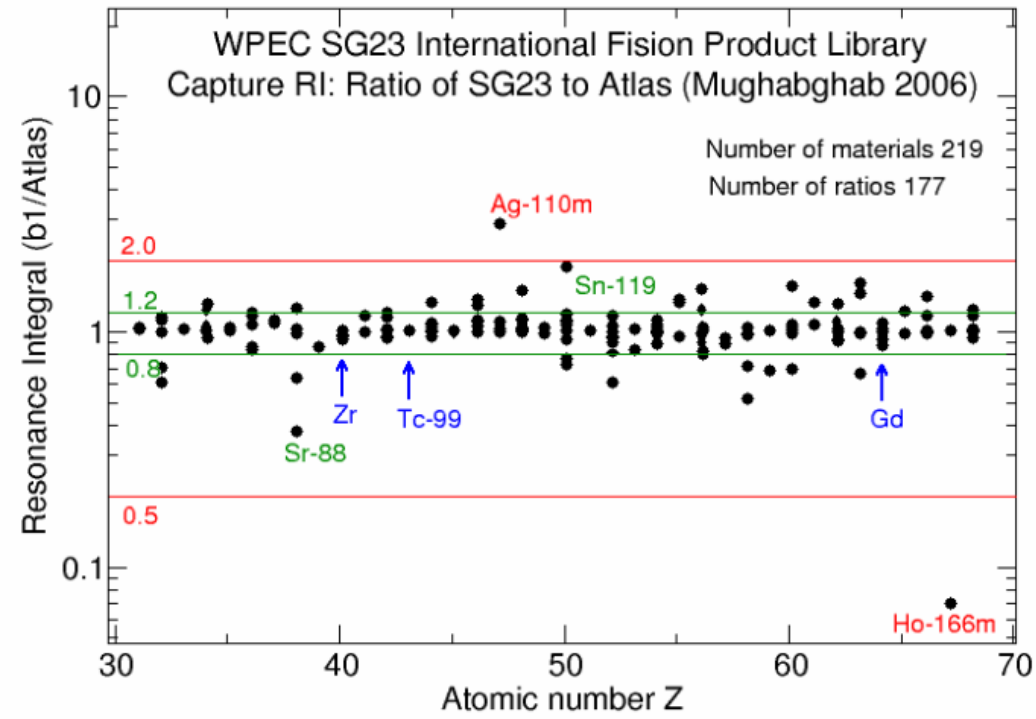

Fig.1. Preliminary comparison of capture RI with Atlas of Neutron Resonances.

A. Trkov has done somewhat similar comparison [6] and very recently Nakagawa updated his earlier comparison [7].

References

1. P. Oblozinsky et al, Assessment of Neutron Cross-section Evaluations for the Bulk of Fission Products (SG21 Final Report), Report NEA/WPEC-21 (NEA, Paris 2005).

2. Chen Gouchang, Report, December 2004, www.nndc.bnl.gov/sg23.

3. V. Pronyaev, Report, July 2005, www.nndc.bnl.gov/sg23.

4. P. Oblozinsky, Report, January 2006, www.nndc.bnl.gov/sg23.

5. S. Mughabghab, Atlas of Neutron Resonances: Resonance Parameters and Thermal Cross Sections (Elsevier, Amsterdam 2006).

6. A. Trkov, in Proceedings of the CSEWG 2005 meeting, www.nndc.bnl.gov/csewg.

7. T. Nakagawa, private communication, April 2006.

8. M. Herman et al, Nuclear Reaction Model Code EMPIRE-2.19, www.nndc.bnl.gov/empire, released in March 2005.