

SG21: Assessment of Neutron Cross-Section Evaluations for the Bulk of Fission Products

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Motivation

- Fission products
 - Altogether 211 nuclei in range $Z = 31 - 68$ in 5 evaluated libraries
 - ~ 20-40 priority materials depending on application
 - ~ 170 lower priority materials, bulk of fission products
- In ENDF/B-VI, release 8 (October 2001)
 - 200 FPs out of 328 materials
 - 65% evaluations more than 25-30 years old
 - 55% evaluations use isotropic elastic angular distribution
 - 30% evaluations use outdated point-wise data in resonance region
 - 30% evaluations use outdated single-level Breit-Wigner formalism

Membership

■ 4 projects involved

- **Chairman** P. Oblozinsky (BNL)
- **ENDF** M. Herman (BNL), S. Mughabghab (BNL), I. Sirakov (BNL and INRNE), J. Chang (KAERI)
- **JENDL** T. Nakagawa (JAERI), K. Shibata (JAERI), M. Kawai (KEK)
- **BROND** A.V. Ignatyuk (IPPE), V. Pronyaev (IAEA), V. Zerkin (IAEA)
- **CENDL** Shen Qingbiao (CNDC), Zhuang Youxiang (CNDC)

■ 13 active participants

- 11 reviewers
- 1 thermal and resonance evaluator (S. Mughabghab, BNL, new BNL-325)
- 1 programmer (V. Zerkin, IAEA, inter-comparison plots)

Summary of Activities

- **1st year (May 2001 – April 2002)**
 - Review methodology established
 - Inter-comparison plots created
 - Webpage created
 - 18 materials reviewed
- **2nd year (May 2002 – April 2003)**
 - 89 materials reviewed
- **3rd year (May 2003 – April 2004)**
 - Remaining 104 materials reviewed
 - Workshop held to finalize recommendations, BNL, April 19-23, 2004
 - Final recommendations for 211 existing + 7 new materials produced

Review Methodology

1. Examine files

- Summarize available evaluations, including authors, origin and updates

2. Review thermal and resonance region

- Review evaluations in thermal, RR region, UR region
- Examine thermal values (capture, total, elastic) and resonance integrals
- Consider recent information (thermal capture and res integrals by Mughabghab)

3. Review fast neutron region

- Review evaluations in fast neutron region (~100 keV – 20 MeV)
- Assess evaluation methodology (physics, codes)
- Compare with experimental data (MT = 1, 2, 4, 16, 102, 103, 107)

4. Write report

- Describe review procedure, list findings
- Make recommendation for thermal & resonance region
- Make recommendation for fast neutron region

Individual Contributions

Project	Name	Number of reviews
ENDF/B	Sirakov	24
	Chang	20
	Oblozinsky	17
	Herman	14
		<i>Subtotal 75</i>
JENDL	Nakagawa	29
	Shibata	26
	Kawai	4
		<i>Subtotal 59</i>

Project	Name	Number of reviews
BROND	Pronayev	22
	Ignatyuk	13
		<i>Subtotal 35</i>
CENDL	Shen	22
	Zhuang	20
		<i>Subtotal 42</i>
Total		211

Website

■ www.nndc.bnl.gov/sg21/

- Contains all SG 21 documents
- Contains support information for reviewers
 - S. Mughabghab, Thermal neutron capture cross sections, resonance integrals and g-factors, Report INDC(NDS)-440, Feb 2003
 - One-group capture cross- sections for 211 fission products, calculated by BNL using methodology of SG17 for fast reactor spectrum
- Inter-comparison plots for all 211 FPs
 - ~1900 plots
 - Links to evaluated files in 5 libraries
 - Links to EXFOR files
- Review reports for all 211 materials, **new**
- Minutes of SG21 Workshop, **new**
 - Presentations, status reports on FP evaluations in 5 major libraries
 - SG21 summary recommendations for 218 materials

Concluding SG21 Workshop

- BNL, April 19 – 23, 2004
- Objectives
 - Examine review reports for 211 materials
 - Produce final recommendations
- Attendees
 - ENDF P. Oblozinsky, M. Herman, S. Mughabghab
 - JENDL T. Nakagawa, O. Iwamoto
 - BROND V. Pronyaev
- Input from
 - JEFF-3.0 (R. Jacqmin)
 - CENDL-3 (Ge Zhigang)

Concluding SG21 Workshop, ctn'd

■ Procedures

- Broad input considered
 - Review reports
 - New BNL-325 evaluations (thermal, RR region, UR region)
 - Recent FP evaluations (such submittals for ENDF/B-VII)
- Discussion leader examined review reports beforehand and prepared draft recommendation for ~ 53 materials
 - P. Oblozinsky $Z = 31 - 42$
 - T. Nakagawa $Z = 43 - 51$
 - V. Pronyaev $Z = 52 - 58$
 - M. Herman $Z = 59 - 68$
- Discussion

Concluding SG21 Workshop, ctn'd

■ Procedures ctn'd

- 2 projectors used to get easy access to
 - SG21 review reports
 - SG21 inter-comparison plots
 - Evaluated files
 - New ENDF and CINDA retrieval system
- Each material examined separately
 - Introduced by discussion leader
 - Thermal & resonance region examined
 - Fast neutron region examined
 - Consensus reached on final recommendation

■ Minutes of the Workshop

- Published, available also at www.nndc.bnl.gov/sg21/

Summary of Recommendations

Library (Data Source)	Full File	Resonance Region	Fast Region	Comment
ENDF/B-VI	1	18	13	
ENDF/B-VII	27	-	2	Includes 5 isotopes of Ge
JEFF-3.0	1	-	-	
JENDL-3.3	44	7	66	
CENDL-3	10	-	27	
BROND-2	1	1	1	
New BNL-325	-	109	-	Evaluations not fully completed
EMPIRE	-	-	25	Calculations to be done
Total	84	134	134	211 existing + 7 new

Final Product and Follow-up Activities

■ Final product

- Review reports for all 211 materials – **major achievement**
- Webpage with all SG21 documents, files, inter-comparison plots, Minutes of SG21 Workshop
- Final recommendations for 211 existing + 7 new materials
- Final report - to be submitted

■ Follow-up activities

- Establish new WPEC Subgroup, charged
- create files based on SG21 recommendations, and
- perform basic testing for all and validation for selected materials