

Status of the ENDF Project

Report to the WPEC Meeting, JAEA, Japan, June 4-6, 2008

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Abstract

The new ENDF/B-VII.0 library was released in December 2006. Since then, the work focused on the validation and identifying deficiencies. More than 20 fixes, extensions and new evaluations were completed, some of them containing covariances. Progress was made on developing covariance evaluation and processing capabilities. Support activities include update of ENDF-6 Formats Manual, new version of checking codes and update of SIGMA web retrieval.

1. Status of the ENDF/B-VII.0 Library

Big paper

The new ENDF/B-VII.0 library was released in December 2006 and it was described in detail in the extensive paper ('Big Paper') on ENDF/B-VII.0 by Chadwick, Oblozinsky, Herman *et al.* in the special issue of Nuclear Data Sheets, **107** (2006) 2931. So far, according to Web of Science, this paper was cited 28 times in the refereed journals.

Validation

Validation of ENDF/B-VII.0 continued throughout 2007 and 2008, details can be found in www.nndc.bnl.gov/exfor/4web/benchmarking.html. The list of benchmarks and testing is as follow:

- Be benchmarks by R. MacFarlane
- Benchmarking ENDF/B-VII.0 files (comparison with JEFF-3.1) by Jean Christophe Sublet
- Comparison of ENDF/B-VII.0 versus ENDF/B-VII beta2 by R. MacFarlane
- Comparison of criticality benchmarks using ENDF/B-VIIb3 and ENDF/B-VI.8 by R. MacFarlane and A. Kahler
- Comparison of keff calculated with ENDF/B-VII.0 against experimental data by R. MacFarlane and A. Kahler
- Comparison of Results for the MCNP Criticality Validation Suite Using ENDF/B-VII.0 and Other Nuclear Data Libraries by Russell D. Mosteller
- Critical benchmarks from IHBCSBEP including the MOX criticals by Harish C. Huria

- Criticality Calculations Using LANL and LLNL Neutron Transport Codes by D. Cullen et al.
- ENDF/B-VII.0 Data Testing for Three Fast Critical Assemblies by D.E. Cullen
- ENDF/B-VII.0 Results for Unreflected Plutonium Solutions and MOX by Russ Mosteller
- Energy Balance of ENDF/B-VII.0 by R. MacFarlane
- Fast systems calculated with LLNL codes by D. Brown
- Kritz, LCT026, LCT032, LCT062, and LCT065 benchmarks by H. Huria
- POINT2007 by D. Cullen
- Systematics of U233-Water Criticality With ENDF/B-VII by Bob MacFarlane and Skip Kahler
- TRIPOLI-4.4.1 ICSBEP+ criticality validation using JEFF-3.1 and ENDF/B-VII.0 by Jean Christophe Sublet

Known deficiencies

The list of known deficiencies of ENDF/B-VII.0 is maintained by the NNDC. It is based on the feedback from validation activities as well as on the comments and observations communicated to the NNDC by users of the library.

ACE library

An unofficial version of the ACE library was prepared by the NNDC in December 2006 using the processing code NJOY-99.161. The library contains all 392 materials of the neutron sublibrary as well as all 20 materials in the thermal neutron scattering sublibrary. This ACE library is being distributed by RSICC, Oak Ridge, with the provision that it cannot be viewed as an official version. Despite of this limitation, the library is used heavily by many researchers and engineers, so far more than 70 copies were distributed upon request.

Official version of the ACE library is being produced by LANL, but the work has not yet been completed. In this process a number of format fixes and other, often minor, modifications in basic files were done by LANL. It was decided by CSEWG in its last meeting in November 2007 that once the official ACE library will be produced by LANL, the NNDC would incorporate all modifications into ENDF/B-VII.0.1 release of the basic library. It is expected that the ACE library will be released shortly, to be distributed officially by RSICC, Oak Ridge.

2. Work on ENDF/B-VII.1 Library

No official decision and plan by CSEWG is in place for the ENDF/B-VII.1 library. At the moment the prevailing feeling is that VII.1 release should happen in a couple of years. New and improved evaluations produced by CSEWG are currently stored in the ENDF/A library.

New evaluations

CSEWG re-established the original idea of the ENDF/A library as a depository of updated and new files to be considered for ENDF/B-VII.1. The ENDF/A library currently contain 23 complete files contributed by BNL, LANL, LLNL and ORNL. They can be grouped into 5 categories:

- Files with fixes to ENDF/B-VII.0,
- Files with data from Evaluated Gamma Activation File, EGAF,
- Files with new evaluations,
- Files with MF32 covariances for resolved resonance parameters,
- Files with MF33 covariances for cross sections covering the whole energy range (preliminary).

The list of 23 complete files in ENDF/A, all of them containing neutron induced reactions, is as follows:

1. n-001_H_003.RC-fix
2. n-011_Na_022.res-tot-width
3. n-037_Rb_087.RC-fix
4. n-040_Zr_90t2.bnl
5. n-048_Cd_113.bnl
6. n-094_Pu_241.za-fixed
7. n-095_Am_241.za-fixed
8. n-17_Cl_35.ornl
9. n-17_Cl_37_Y8D_070307.ornl
10. n-182_W+EGAF.llnl
11. n-183_W+EGAF.llnl
12. n-184_W+EGAF.llnl
13. n-186_W+EGAF.llnl
14. n-19_F+EGAF.llnl
15. n-237_U_11.12.2007.llnl
16. n-Am_240-new.llnl
17. n-Mn_055-newRR.ornl
18. n-Mo_97.lanl-fix
19. n-Pu_239-newMF33.ornl-lanl-prelim
20. n-U_233-newMF33.ornl-lanl-prelim
21. n-U_235-newMF33.ornl-lanl-prelim
22. n-U_238-newMF33.ornl-lanl-prelim
23. n-Zr_96.lanl-fix

Covariances

Covariances will likely represent major improvement in future release of the ENDF/B library. It is expected that VII.1 release would contain considerable, if not complete, addition of missing covariance data in the neutron sublibrary. Recent activities are as follows:

- Evaluation of MF32, MF33 covariances as mentioned above (ORNL, LANL).

- Low-fidelity covariance project including a full set of VII.0 materials is under completion. These are simple estimates including low energy as well as fast neutron region (BNL, LANL, ORNL and ANL).
- Advances in processing codes were made and new version of PUFF-IV.1.0.4 (ORNL) and NJOY-99.259 (LANL) was released.
- Workshop on Neutron Cross Section Covariances will be held in Port Jefferson, NY, June 24-27, 2008. Almost 60 participants registered, with more than 40 papers and posters (BNL).

3. Support Activities

In general, support ENDF activities are performed by the National Nuclear Data Center, BNL as part of its responsibilities towards CSEWG.

Update of ENDF-6 Formats Manual

This important manual is being revised, modernized and updated. The manual was converted into LaTeX with a number of modern features to speed-up navigation etc. The manual was revised with emphasis on the correction of known errors, removal of inconsistencies, clarification of ambiguous text passages and adding format updates approved by CSEWG.

Draft of the revised ENDF-6 Formats Manual has been reviewed by CSEWG, its official release should take place later in 2008.

ENDF checking codes

ENDF checking codes are also subject of modernization and update. This work has already been initiated. Completion of new versions of the checking codes CHECKR-7.04, FIZCON-7.05, STANEF-7.03 and PSYCHE-7.03 is expected also later in 2008.

SIGMA retrieval interface

Sigma-1.0 web retrieval & plotting tailored to the needs of users of the new ENDF/B-VII.0 library was released in April 2007. The focus is on transparency and clarity of the interface. Much improved version, Sigma-2.0, was released a year later, in April 2008. This improved version has capabilities to retrieve and plot angular distributions of emitted neutrons (MF4), retrieve and energy spectra of emitted neutrons and photons (MF5), and offers mathematical operations on cross sections (MF3).

In the pipeline for the next release of SIGMA are plotting capabilities for energy-angle spectra (MF6) and covariances of cross sections (MF33).
