DE LA RECHERCHE À L'INDUSTRIE

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Status of the JEFF File Project

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1. JEFF-3.2
2. Recent activities
3. Outlook, JEFF-3.3 and JEFF-4

JEFF-3.2

JEFF-3.2 GP file

- Official release on **March 5, 2014**
  - JEFF-3.1.1 basis (2009)
    + (i) 22 rev. + 139 new + 95 from TENDL-2011 (March 2011)
    + (ii) 73 from JEFF-3.2T1 + 89 from JEFF-3.1.2 (Jan. 2012) + 42 JEFF β + 36 from ENDF/B-VII.1 + 150 from TENDL-2012
    + (iii) 10 rev. + γ prod data + new Cu-63, Cu-65, Mn-55 (Oct 2013)
  - 472 nuclides or elements
  - ACE formatted files and JANIS update

- http://www.oecd-nea.org/dbforms/data/eva/evatapes/jeff_32/

- Outcome of a progressive, incremental approach starting from JEFF-3.1

JEFF-3.2

Main changes in JEFF-3.2 GP with respect to JEFF-3.1 GP

- U-235, U-238 in RRR+URR and at high energies
- U-236, U-237 at high energies
- Pu-239, Pu-240 in RRR+URR and at high energies
- Am-241 in RRR+URR and at high energies
- Cm isotopes
- Th-232, Pa-231, Pa-233
- H-2
- Na-23
- Fe-56 (gamma prod spectra)
- Cr, Zn isotopes
- Cu-63, Cu-65
- Mn-55
- Cd isotopes, Ag-109, Ag-107, In-113, In-115
- Gd-155, Gd-157 + Gd-152, Gd-154 from ENDF/B-VII.0
- Hf, W isotopes
- Ta, Re, Os, Pt, Tl isotopes
- Au-197
- Pb and Bi isotopes
- Adopted from ENDF/B-VII.1: H-1, H-3, He-3, Li-6, B-10, B-11, N-14, N-15, Si-29, Si-30, Cl-37, Nb-93, Ag-110m, Ag-111, Cd-115m, Sn-113, I-130, Xe-123, Dy-164, Ho-165, Ir-191, Hg isotopes, Pa-232, U-232, U-233, U-234, U-239, U-240, U-241, Cf-253

JEFF-3.2

JEFF-3.2 DD sub-library

- Update of JEFF-3.1 (Feb. 2005)
- Ready in **March 2015**, release awaiting prod. of FY files
- JEF/DOC-1598 and 1640, M. Kellett & O. Bersillon
- Content:
  - Complete update to all 900 evaluations coming from ENSDF
  - Inclusion of IAEA actinide decay data (85 nuclei)
  - Inclusion of IRDFF decay data library (~80 nuclei)
  - Inclusion of updated UKPADD library (~50 additional nuclei)
  - Inclusion of new DDEP evaluations (~30 nuclei)
  - Inclusion of TAGS results from Tain and Algora et al.
  - Corrections based on limited feedback to JEFF-3.1.1

NUBASE 2297
ENSDF 861
UKPADD 441
UKHEDD 46
DDEP 128
IAEA 79

Total 3852

JEFF-3.2

- **JEFF-3.2 FY sub-library**
  - Under preparation, should be ready in **July 2015**
  - JEF/DOC-1642, R. Mills
  - Same fissioning systems as in JEFF-3.1.1
  - Same neutron energies (thermal, fast and 14 MeV)
  - New UKFY experimental fission yield measurements included
  - Empirical models (5 Gaussian, Wahl Zp and Madland/England) replaced with GEF model predictions where available (i.e. yields > 10^{-6})
  - Adjust to maintain physical constraints using existing codes
  - Calculate cumulative yields using JEFF-3.2 decay data
  - Consistency checks and tests

Recent Activities

- **JEFF-3.2 GP file performance**

  - JEF/DOC-1516 (Cabellos)

  - JEF/DOC-1583

  Summary of JEFF-3.2 performance vs. JEFF-3.1.1:

  - ~ +300 pcm for Uranium in INTER or FAST spectrum
  - ~ no effect for Uranium in THERM spectrum
  - ~ no effect for Plutonium in FAST spectrum
  - ~ -500 to -700 pcm for MOX in SFR spectrum
  - ~ -150 pcm for Plutonium in THERM spectrum

  Significant trends generally improve the C/E agreement

  - JEF/DOC-1590: Final Verification and Validation of JEFF-3.2, J. Kopecky

Recent Activities

JEFF-3.2 GP file performance

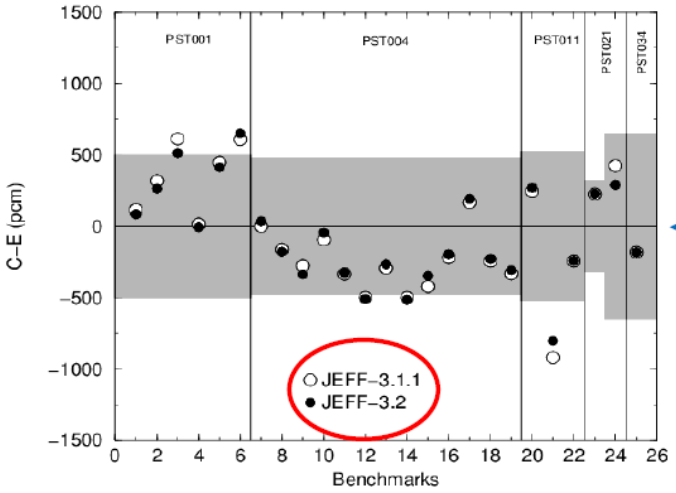
PST solutions (JEF/DOC-1620)

S. C. van der Marck
Nucl. Data Sheets 113 (2012) 2935

(average value over 368 PST)

TABLE XXI: The average values for $C/E - 1$ (in pcm) fo JEFF-3.1.1 per main ICSBEP benchmark category.

	COMP				MET				SOL	MIXED	
	therm	inter	fast	mixed	therm	inter	fast	mixed	therm	therm	fast
LEU	−52				527				179		
IEU	−107	−468	258				−180		425		
HEU	381	1912		−1221	−45	145	−106	628	−56		
MIX	258		300				251		−374	87	−867
PU		692		1852		3275	95	478	203		
U233	−312						363		237		



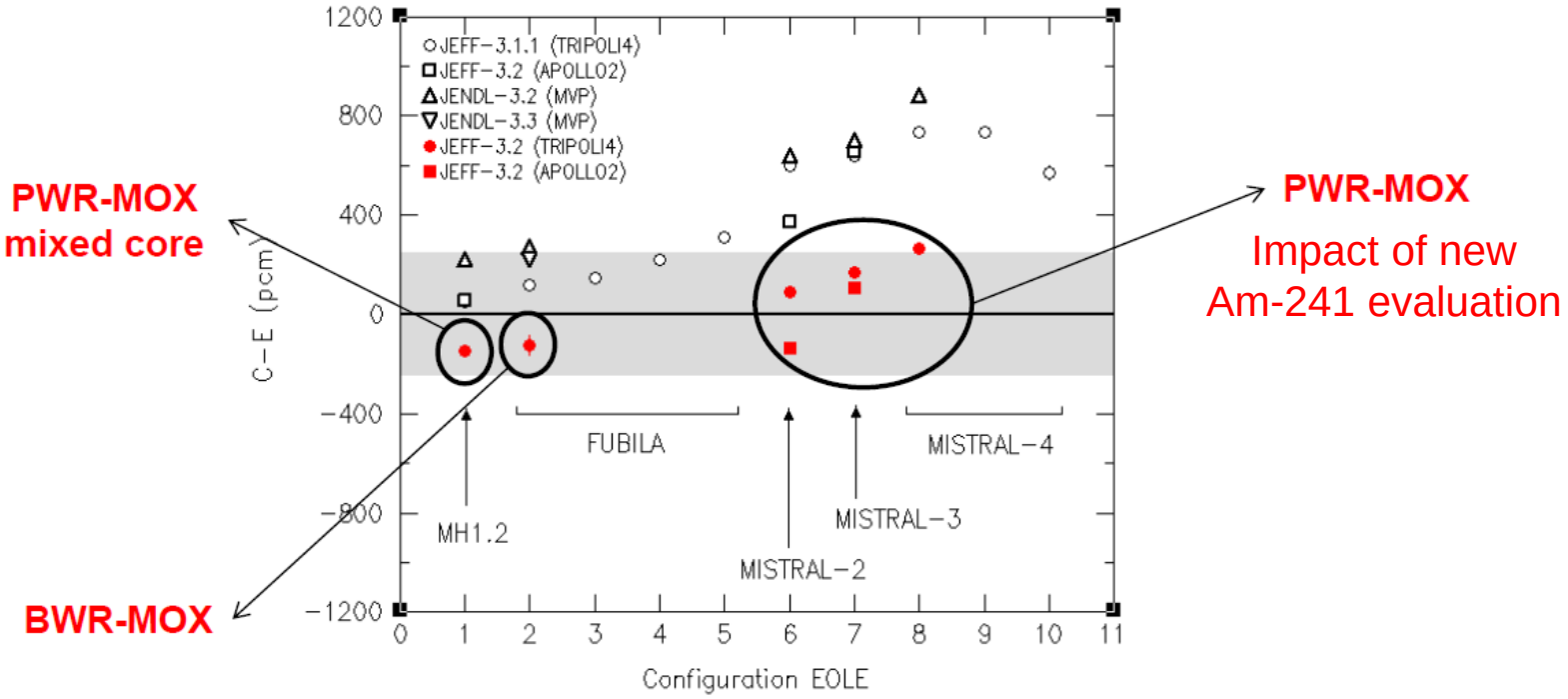
Y. Peneliau , JEFFDOC-1583, 2014
O. Caballos, JEFFDOC-1532, 2014

JEFF-311 and JEFF-32 ⇒ **Similar results for Plutonium in THERM spectrum**

Recent Activities

- **JEFF-3.2 GP file performance**
  - MOX benchmarks (JEF/DOC-1620)

Integral experiments carried out in the EOLE reactor of CEA Cadarache
Interpretation with the Monte-Carlo and deterministic codes TRIPOLI and APOLLO



Average value obtained with JEFF-32 $\Rightarrow$ $\langle$**C-E**$\rangle$**=+50 pcm** with a standard deviation of **180 pcm**

Recent Activities

- **JEFF-3.2**
  - First results from criticality benchmarking
    - JEFF-3.1.1 good performance for UO2-fuelled LWR systems preserved
    - Performance for MOX-fuelled LWR systems improved (Am-241)
    - Performance for fast systems improved, as intended
  - More benchmarking expected, especially after the DD & FY sub-libraries are released
  - To be improved:
    - U-238 fission + inelastic, U-235 fission in 10-30 keV range, Pu-239 inelastic, Np-237 fission + capture, Fe-56, Cu, Zr…
    - Error compensations
    - Lack of covariances
  - Journal article

Recent Activities

Meetings

- November 24-28, 2014: “Nuclear Data Week”, 70 participants
  - 1.5-day joint JEFF + NEEDS workshop on ND measurements
  - Fusion WG
  - Covariance WG
  - DD&FY WG
  - Eval. & Benchmarking WG
  - 23 JEF/DOCs + 14 EFF/DOCs

- April 27-30, 2015: 3-day meeting, 80 participants
  - Joint JEFF-CHANDA workshop
  - Fusion WG
  - Covariance WG
  - DD&FY WG
  - 62 JEF/DOCs + 12 EFF/DOCs

Recent Activities

- **JEFF Mandate**
  - Two-year extension of 2013 mandate ending
  - New work plan and three-year mandate, to start in June 2015
- **Organization**
  - Changes in JEFF/SCG membership and chair
  - Working groups
    - New TSL working group
    - Separation of Evaluation and Benchmarking WGs under discussion
  - NEA DB staff addition
  - NEA DB Management Committee

Outlook

- **Long-term vision and objectives for JEFF-4**

  - Aim for a qualitative step forward, while sticking to the basic principles of needs-driven evolutions and preservation of past performance

  - Double challenge:
    - Create the conditions so that future JEFF files can be consistently updated by **progressively removing error compensations** and improving file internal consistency
    - Address the needs of a broader users' community, including innovative applications ⇒ Need to deliver on good-quality, **"credible" covariances**, useable in applied uncertainty assessment studies

  - Can build upon
    - New, high-quality, differential and integral measurements which are coming and will have to be assimilated
    - Progress made in models/codes: TALYS, CONRAD, GEF
    - Also on covariance production capabilities

Outlook

- **Starting point: JEFF-3.2**
  - Produced in the continuity of earlier versions
  - Covers broad scope of fission + fusion applications
  - Improved over JEFF-3.1, while preserving its proven performance for LWRs
  - A collective work, integrating years of collaborative efforts by many + users' feedback
  - Many lessons learned

- **Known shortcomings**
  - Error compensations still present, difficult to remove → Validation remains essential + new (semi-)integral experiments needed
  - Still incomplete (covariance data)
  - "Hybrids" GP file, assembled by parts, from various sources → difficult to update in a consistent way
  - Work done independently by various organizations, not always in a concerted manner → "under-optimized" system
  - Long turnaround times for improving evaluated files and for testing them

Outlook

- **Achieving significant progress with future JEFF file versions calls for a revised approach, including**
  - Better shared and more coherent practices for data evaluation + benchmarking
  - A modernized process for
    - Better networking of contributing experts, WGs and organizations
    - Improved ND integration
    - Streamlined, “natural” access to information and services
    - Systematic and efficient ND testing, derivation of trends, expr. of needs
  - An adapted organization

  Should stimulate interest and attract new participants

NDEC

- **Implications**
  - Central role of NEA Data Bank for JEFF activities to be reinforced, not only for providing secretariat-type services, but also for ND integration → Recognized need, supported in a recent review by NEA Data Bank Task Force
  - Firm and lasting resource commitments on the part of the organizations contributing to the project, in line with the work plan and a common objective

Outlook

- **The coming years: A window of opportunity**

  - New measurements, many taking up the “uncertainty challenge”, new facilities coming on line
  - Progress and convergence in modelling + availability of modern evaluation tools such as TALYS, CONRAD,… Also GEF
  - Recently-developed covariance data evaluation capabilities
  - Improved practices, cf. WPEC SG
  - A soon-to-come extended, modern data representation to replace ENDF6 (WPEC SG38)
  - The legacy of many years of JEFF file benchmarking in the form of databases + autom. comparison scripts + sensitivity data (ICSBEP+DICE, IRPhE+IDAT)
  - A lesser sense of urgency with respect to classical applications

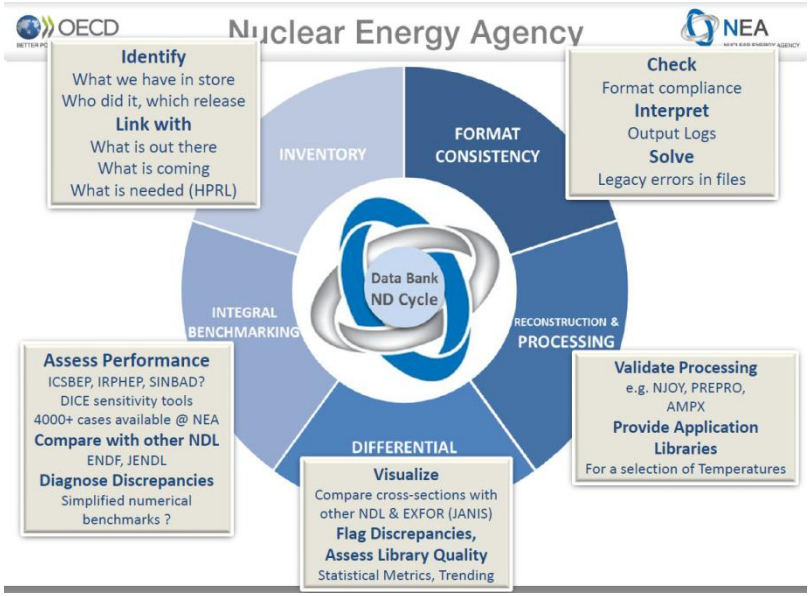
  → Hence, proposed evolution is timely

  → Use the coming years to develop a better integrated system, including a test platform at the NEA

  + Continue efforts to reach out to a broad community of contributors/organizations, while keeping the activities sufficiently focussed

Outlook

- **JEFF-3.3: A stepping stone towards JEFF-4 as well as an update of JEFF-3.2**
  - Target release date is 2017-2018
  - Further improvements and extensions for fission (fast reactors, transmutation) and fusion (IFMIF)
  - Integrate multiple contributions from WPEC SGs (CIELO…), EC-sponsored initiatives such as CHANDA, H2020
  - Will be tested with new NEA NDEC platform



Outlook

- **JEFF-3.3: A stepping stone towards JEFF-4, as well as an update of JEFF-3.2**
  - GP
    - Revision of main nuclides
    - Improvements according to trends derived from benchmarking
    - Covariances
  - DD improvements will come from
    - Ideally, should include updated versions of NUBASE and AME (2012)
    - Additionally available evaluations, e.g. DDEP, IAEA, UK, …,
  - FY
    - Include all GEFY systems (nuclides and neutron energies)
    - MATCH code approach for adjustment and as a way of generating covariance matrices
  - Others
    - Activation → TENDL
    - TSL?

Outlook

- **JEFF-4: A major step forward**
  - First version around 2021, actual date will depend on resources
  - An entirely new library, integrating the latest progress in measurements. and models
  - Complete, with a first set of “credible” covariance data
  - Consistently built by adopting modern practices, coherently upgradable
  - Thoroughly tested at the NEA Data Bank, using the NDEC platform
  - Should perform better than earlier versions , while being free from large error compensations + Meet the needs of a broad user community