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New JEFF RDD & NFY/SFY

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Production and Release of the JEFF-3.3 Radioactive Decay Data Library

JEF/DOC-1792

Mark A. Kellett and Olivier Bersillon

JEFF Meeting, 30 November 2016

JEFF-3.3: Improvements

FROM JEFF-3.1.1 TO JEFF-3.3

JEFF-3.3 (released October 2016):

Complete re-assessment and update to all 900 evaluations coming from ENSDF

Assessment of IAEA actinide decay data (85 nuclei)

Assessment of IRDFF decay data library (~80 nuclei)

Inclusion of updated UKPADD-6.12 library (~50 additional nuclei)

Assessment of new DDEP evaluations (~30 additional nuclei)

Inclusion of initial TAGS results from University of Valencia (2010)

Inclusion of first TAGS results from University of Nantes *(2015)*

Inclusion of further TAGS results from University of Valencia (2016)

Corrections based on limited feedback to JEFF-3.1.1

The new LNHB code **BetaShape** has been used to calculate mean beta energies for DDEP and IAEA evaluations

JEFF-3.3: Source libraries

Contents of JEFF-3.2 (March 2015) and JEFF-3.3 (October 2016)

Library	JEFF-3.2	JEFF-3.3
NUBASE	2 297	2 295
ENSDF	861	849
UKPADD-6.x	441	441
UKHEDD-2.x	46	59
DDEP	128	140
IAEA	79	66
IRDFF	-	2
Total	3 852	3 852

JEFF-3.3: Some remarks

It was found that ~100 or so evaluations, from the 900 evaluations coming from ENSDF, were less consistent than before, i.e. energy balance is now worse than 2%. Original files from JEFF-3.1.1 have been kept for JEFF-3.3.

Many issues were identified with the ENSDF formatted files coming from DDEP and IAEA – these were all recreated and tested, before conversion to the ENDF format.

Very limited manpower available for producing new evaluations. However, I have managed to recruit three new part-time DDEP evaluators from the metrology community: NIST (USA), NIM (China) and PTB (Germany) and CTBTO are currently funding a fourth person to produce new/updated evaluations for Xe-133, Xe-133m, Xe-135 and Xe-135m.

Revision of RDD

- Draft July 2016 RDD (v10) used for fission yields
- Revised file (v11) will be final JEFF-3.3.

UKFY evaluation process

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- Six steps
  - Collect measurements (absolute, ratio and “ratio of ratio”) and analyze to give recommended values and uncertainties.
  - Fill gaps in fission yield mass and charge distributions with model calculations for important fissioning systems.
  - Adjust independent yields for physical constraints; mass, charge, complementary fragment yields …
  - Split independent yields to isomeric states (model e.g. Madland and England)
  - Calculate cumulative yields from independent yields and using experimental cumulative yields calculate uncertainties. (Using decay data - Qmatrix)
  - Produce data in ENDF format.

New data

- New data split into systems:

Neutron spectra	Fissioning nuclide	UKFY3.6	New data	UKFY3.7
Thermal	Th229	337	72	409
Thermal	U233	757	188	945
Thermal	U235	2390	151	2541
Thermal	Np238	115	63	178
Thermal	Pu239	861	225	1086
Thermal	Pu241	334	63	397
Thermal	Cm245	161	219	380
Thermal	Cf249	305	239	544
Fast	U235	724	5	729
Fast	Pu239	390	5	395
Fast	Pu241	111	5	116

- Fast yields refer to Neodymium cumulative yields.

New models

- UKFY3.6A
  - ★Mass distribution using 5-Gaussian fitting and model parameter extrapolation.
  - ★Charge distribution using Wahl Zp model fitting and model parameter extrapolation.
  - ★Isomeric splitting using technique based upon Madland and England.
- UKFY3.7
  - ★Mass distribution using GEF.
  - ★Charge distribution using GEF.
  - ★Isomeric splitting using technique based upon Madland and England.

Initial testing

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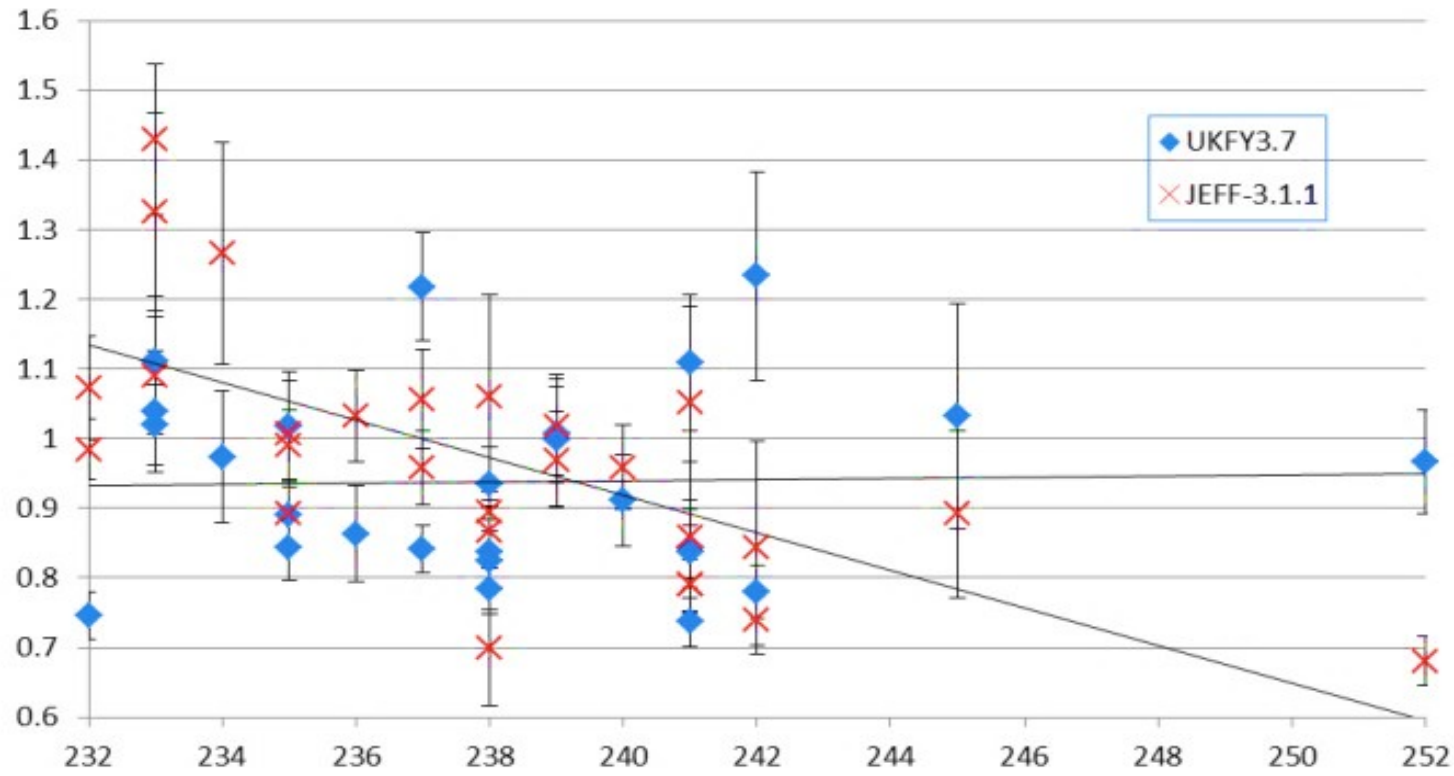
Delayed neutron summation calculation of $nu bar {sub d}$ C/E with JEFF-3.3RDD (v10)



Initial testing
SKB PWR assemblies

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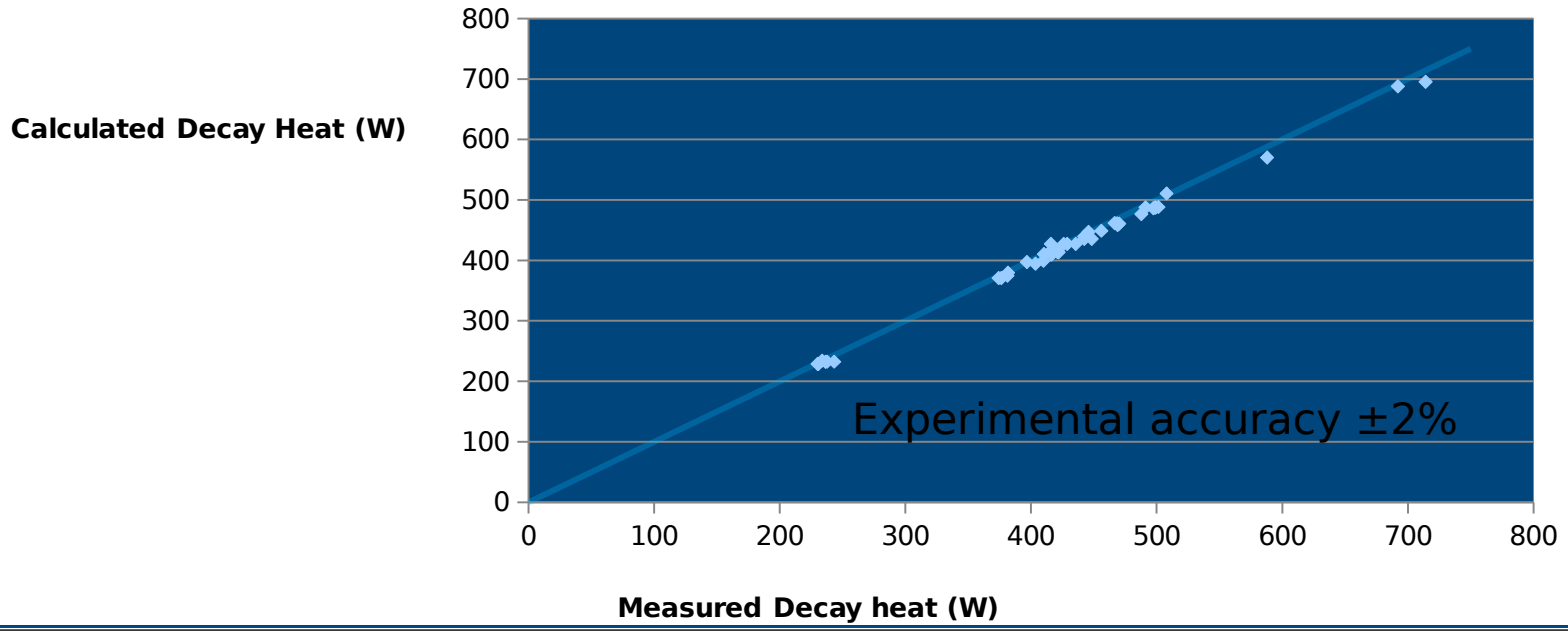
Mean and Standard Deviation of C/E values

Reactor	JEF-2.2 C/E	JEFF-3.1.1 C/E	UKFY37+JEFF-3.3 RDD(v10) C/E
Ringhals 3	0.990 ± 0.012	0.979 ± 0.010	0.981 ± 0.010
Ringhals 2	0.999 ± 0.012	0.990 ± 0.012	0.992 ± 0.012
Combined	0.995 ± 0.013	0.985 ± 0.012	0.987 ± 0.012



Towards a final UKFY3.7

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- Referring to this as UKFY3.7B
- Made consistency with JEFF-3.3 decay data
  - Qmatrix
  - Isomeric splitting (Madand&England+ model)
- Experimental data issues to be investigated.
- Delayed due to accidental deletion of updated version of code on Raspbian (Debian) Linux computer based upon no longer available Solaris analysis code
  - 2005 version of Solaris code retrieved and now working again, but error found in “ratio of ratio” analysis – uncertainty estimate- corrected and verified.
- Plan to have version in early June.

Future work

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- Repeat validation with new NFY+RDD
- Uncertainties estimation on engineering parameters requires fission yield covariance terms for independent yields being discussed in small group.
    - Possible methods to estimate these based upon:
        - Physical constraints
        - Perturbing underlying model parameters
        - LSQ or maximum likelihood approach using model parameters and experimental data
    - Want to explore using measured cumulative yields to infer independent yield covariance terms.