Latest JEFF/EFF's Presentations on Neutron Thermal Scattering and Review of Recent International Activities

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Latest JEFF/EFF's Presentations

- **EFFDOC-1205:** ***"Thermal Scattering Libraries Processing"***, E. Castro, O. Cabellos. November 2013.

  Deliverable: Task 6.2. Thermal Scattering Libraries Processing
  Authors: E. Castro, O. Cabellos
  F4E-GRT-168.01. "Nuclear Data Improvements and Development of Tools – Nuclear Data Evaluation". 2012-13

- **JEF/DOC-1524:** ***"Propagation of U235-238, Pu239 and STL Nuclear Data Uncertainties for PWR core analysis"***, O. Cabellos. November 2013.

  PROPAGATION OF NUCLEAR DATA UNCERTAINTIES FOR PWR CORE ANALYSIS
  Authors: O. Cabellos, E. Castro, C. Ahnert, and C. Holgado
  Published: http://dx.doi.org/10.5516/NET.01.2014.709
  CSN, "Propagation of Uncertainties for Neutronic Calculations (P110530207) in Criticality Safety Analysis"

EFFDOC-1205: ***"Thermal Scattering Libraries Processing"***, E. Castro, O. Cabellos. November 2013.

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Data Bank > Computer program services

NEA-1883 ZZ-TSL-ACE/2013.

last modified: 05-MAR-2014 | catalog | categories | new | search | RSS

ZZ TSL-ACE/2013, Thermal Scattering Libraries processed to ACE format

NAME OR DESIGNATION, COMPUTER, DESCRIPTION, METHODS, STATUS, REFERENCES, HARDWARE REQUIREMENTS, LANGUAGE, NAME AND ESTABLISHMENT OF AUTHORS, MATERIAL, CATEGORIES

1. NAME OR DESIGNATION: ZZ-TSL-ACE/2013 [top]

2. COMPUTERS [top]

To submit a request, click below on the link of the version you wish to order. Only liaison officers are authorised to submit online requests. Rules for requesters are available here.

Program name	Package id	Status	Status date
ZZ-TSL-ACE/2013	NEA-1883/01	Arrived	05-MAR-2014

Machines used:

Package ID	Orig. computer	Test computer
NEA-1883/01	Linux-based PC	

3. DESCRIPTION [top]

Thermal neutron scattering cross section data libraries, processed in ACE format to be used with MCNP.

Format: ACE.

Number of groups: Continuous energy.

Processed Libraries: ENDF/B-VI.8, ENDF/B-VII.0, ENDF/B-VII.1, INDL-TSL, JEFF-3.1, JEFF-3.1.1, JEFF-3.1.2, JENDL-4.0, JENDL-4.0u

**F4E-GRT-168.01: "Nuclear Data Improvements and Development of Tools – Nuclear Data Evaluation".
Task 6.2: Thermal Scattering Libraries Processing. 2012-13.**

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State of the Art: Temperatures

Isotope	Compound	ENDF/B-VII.1	INDL-TSL	JEFF 3.1.X
H	H2O	293.6, 350, 400, 450, 500, 550, 600, 650, 800	293.6, 323.6, 373.6, 423.6, 473.6, 523.6, 573.6, 623.6, 647.2, 800, 1000	293.6, 323.6, 373.6, 423.6, 473.6, 523.6, 573.6, 623.6, 647.2, 800, 1000
H	Para-H	20	14, 16, 20.38	-
H	Ortho-H	20	14, 16, 20.38	-
H	HZr	296, 400, 500, 600, 700, 800, 1000, 1200	293.6, 400, 500, 600, 700, 800, 1000, 1200	293.6, 400, 500, 600, 700, 800, 1000, 1200
H	CaH2	-	-	296, 400, 500, 600, 700, 800, 1000, 1200
H	TiH2	-	293.6, 400, 500, 600, 700, 800, 1000, 1200	-
H	YH2	-	293.6, 400, 500, 600, 700, 800, 1000, 1200	-
H	CeH2	-	293.6, 400, 500, 600, 700, 800, 1000, 1200	-
D	D2O	293.6, 350, 400, 450, 500, 550, 600, 650	293.6, 323.6, 373.6, 423.6, 473.6, 523.6, 573.6, 643.9,	293.6, 323.6, 373.6, 423.6, 473.6, 523.6, 573.6, 643.9,

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State of the Art: Temperatures

Isotope	Compound	ENDF/B-VII.1	INDL-TSL	JEFF 3.1.X
D	Para-D	19	19, 23.65	-
D	Ortho-D	19	19, 23.65	-
Be	Be metal	293.6, 350, 400, 450, 500, 550, 600, 650	-	293.6, 400, 500, 600, 700, 800, 1000, 1200
Be	BeO	293.6, 400, 500, 600, 700, 800, 1000, 1200	-	-
U	UO2	296, 400, 500, 600, 700, 800, 1000, 1200	-	-
C	Graphite	296, 400, 500, 600, 700, 800, 1000, 1200, 1600, 2000	293.6, 400, 500, 600, 700, 800, 1000, 1200, 1600, 2000, 3000	293.6, 400, 500, 600, 700, 800, 1000, 1200, 1600, 2000, 3000
H	l-CH4	100	-	-
H	S-CH4	22	-	-
H	CH2	296, 350	-	293.6, 350

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State of the Art: Temperatures

Isotope	Compound	ENDF/B-VII.1	INDL-TSL	JEFF 3.1.X
H	C6H6	296, 350, 400, 450, 500, 600, 800, 1000	-	-
O	BeO	293.6, 400, 500, 600, 700, 800, 1000, 1200	-	-
Si	SiO2	293.6, 350, 400, 500, 800, 1000, 1200	-	-
Mg	Mg	-	-	20, 100, 296, 773
Al	Al	20, 80, 293.6, 400, 600, 800	-	-
Fe	Fe	20, 80, 293.6, 400, 600, 800	-	-
Zr	HZr	296, 400, 500, 600, 700, 800, 1000, 1200	-	-
Ca	CaH2	-	-	296, 400, 500, 600, 700, 800, 1000, 1200
O	UO2	296, 400, 500, 600, 700, 800, 1000, 1200	-	-

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Processing with NJOY

Sctructure of MCNP identifiers: **MatTemp.Libt**, where

Material in JEFF-3.1.2	MCNP Identifier
H(H2O)	lw00.32t
H(HZr)	hzr00.32t
D(D2O)	hw00.32t
Be	be00.32t
Graphite	gra00.32t
CH2	poly00.32t
Mg	mg00.32t
H(CaH2)	hca00.32t
Ca(CaH2)	cah00.32t

Library	Suffix
ENDF/B-VI.8	.68t
ENDF/B-VII.0	.70t
ENDF/B-VII.1	.71t
INDL-TSL	.20t
JEFF-3.1	.30t
JEFF-3.1.1	.31t
JEFF-3.1.2	.32t
JENDL-4.0	.40t
JENDL-4.0u	.41t

As a result, one ACE file containing the cross section is generated for all materials at all available temperatures. Also, one dir file is generated per ACE file, with information for the xsdir file.

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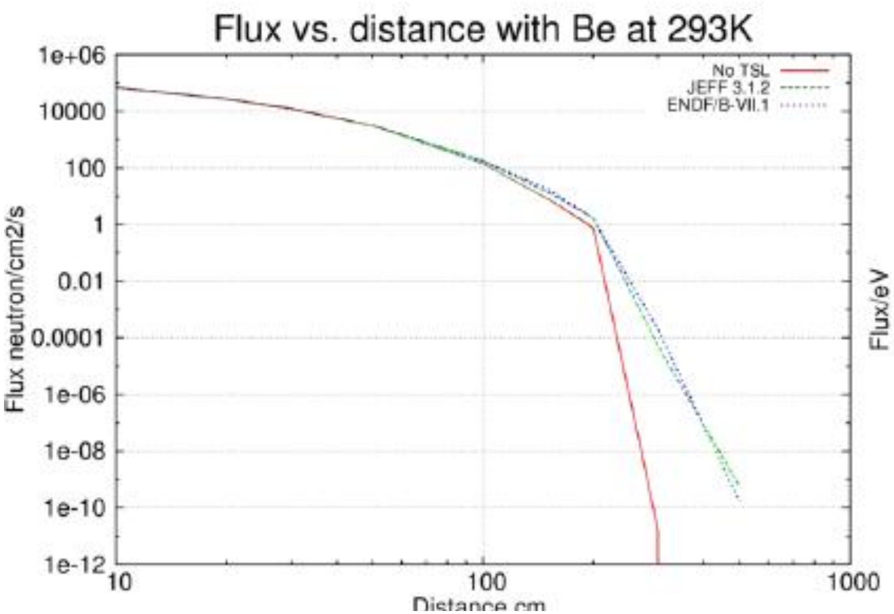
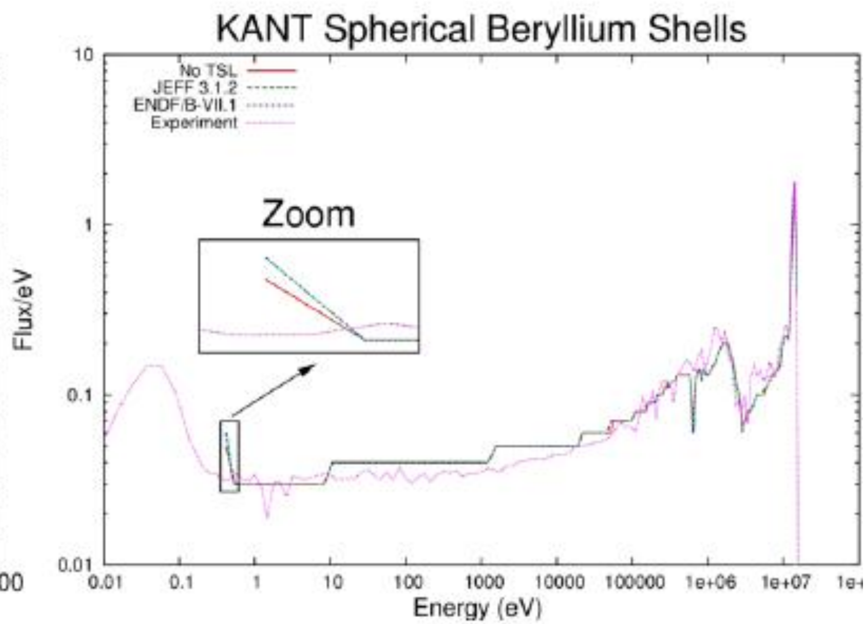
Processed TSL: Validation



Simulating an **Am-Be neutron source** surrounded with materials at several temperatures.



Using test cases from **SINBAD**

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JEF/DOC-1524: ***"Propagation of U235-238, Pu239 and STL Nuclear Data Uncertainties for PWR core analysis"***, O. Cabellos. November 2013.

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I.1.2 Random Inelastic Cross-Section: H in H2O

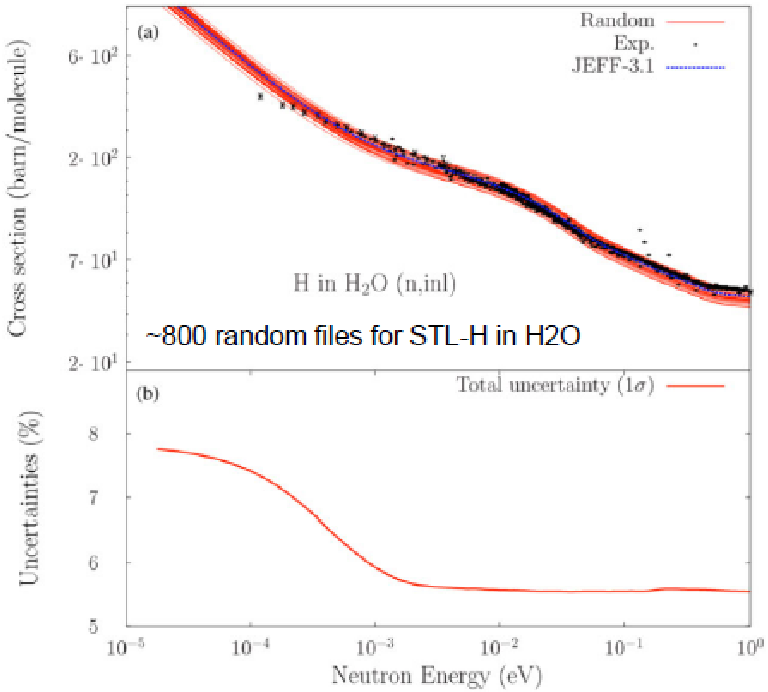

Figure: Incoherent random inelastic scattering cross section of H in H2O compared to experimental data and the inelastic cross section from the JEFF-3.1 library. Inelastic scattering is described by the scattering law $S(\alpha,\beta)$,

Figure: Uncertainties in the inelastic cross section calculated from 1330 random inelastic cross sections

- A NEARLY full correlated energy-energy correlation matrix for the incoherent inelastic scattering for H in H2O is found

Ref. "*Random Adjustment of the H in H2O Neutron Thermal Scattering Data*", D. Rochman and A. J. Koning, NUCLEAR SCIENCE AND ENGINEERING: **172**, 287–299 (2012)

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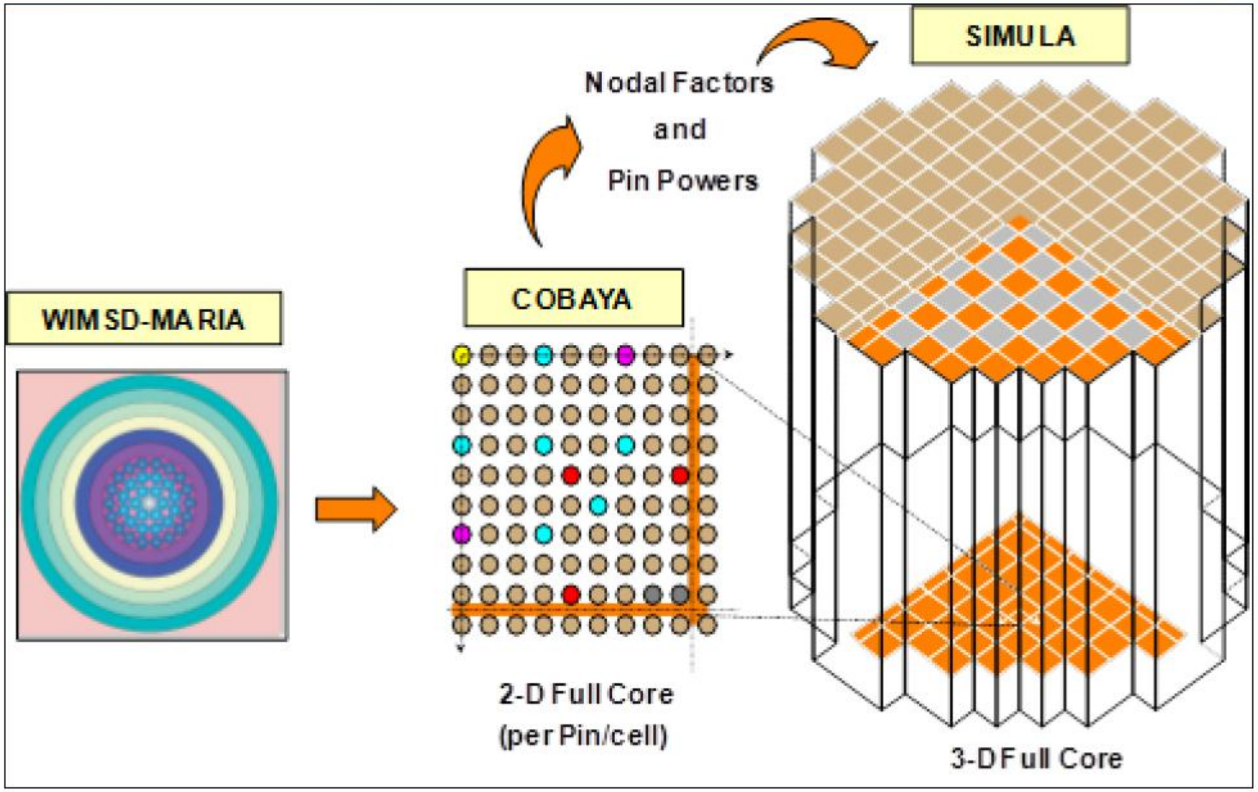
II.2 Scheme of the PWR Core Analysis SEANAP System



SEANAP: WIMS-D4+COBAYA+SIMULA

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III.1 PWR description

PWR (WESTINGHOUSE), 3 loops , 157 FA, power 2775. MWth

¼ CORE

1	13	4	21	6	21	16	14
13	11	15	2	16	6	20	7
4	15	3	21	8	22	19	
21	2	21	9	18	20	5	
6	16	8	18	12	17		
21	6	22	20	17			
16	20	19	10				
14	7						

AVE. BURNUP PER FUEL ASSEMBLY

	1	2	3	4	5	6	7	8
1	18.137	11.662	27.397	**0.000**	30.867	**0.000**	14.984	11.662
2	11.662	16.188	13.130	28.902	12.155	28.866	**0.000**	30.191
3	27.397	13.130	27.572	**0.000**	22.778	**0.000**	**0.000**	
4	**0.000**	28.902	**0.000**	30.755	15.236	**0.000**	30.124	
5	30.867	12.155	22.778	15.236	13.123	14.882		
6	**0.000**	28.866	**0.000**	**0.000**	14.882			
7	14.984	**0.000**	**0.000**	30.503				
8	11.662	30.191						

FUEL	TYPE	w/o(%)	WABAS
1	OFA	2.10	0
2	OFA	3.10	0
3	OFA	3.24	0
4	OFA	3.24	0
5	OFA	3.24	0
6	OFA	3.24	0
7	OFA	3.24	0
8	OFA	3.24	0
9	OFA	3.24	0
10	OFA	3.24	0
11	OFA	3.24	0
12	AEF	3.60	0
13	AEF	3.60	0
14	AEF	3.60	0
15	AEF	3.60	0
16	AEF	3.60	0
17	AEF	3.60	0
18	AEF	3.60	0
19	AEF	3.60	0
20	AEF	3.60	4
21	AEF	3.60	8
22	AEF	3.60	12

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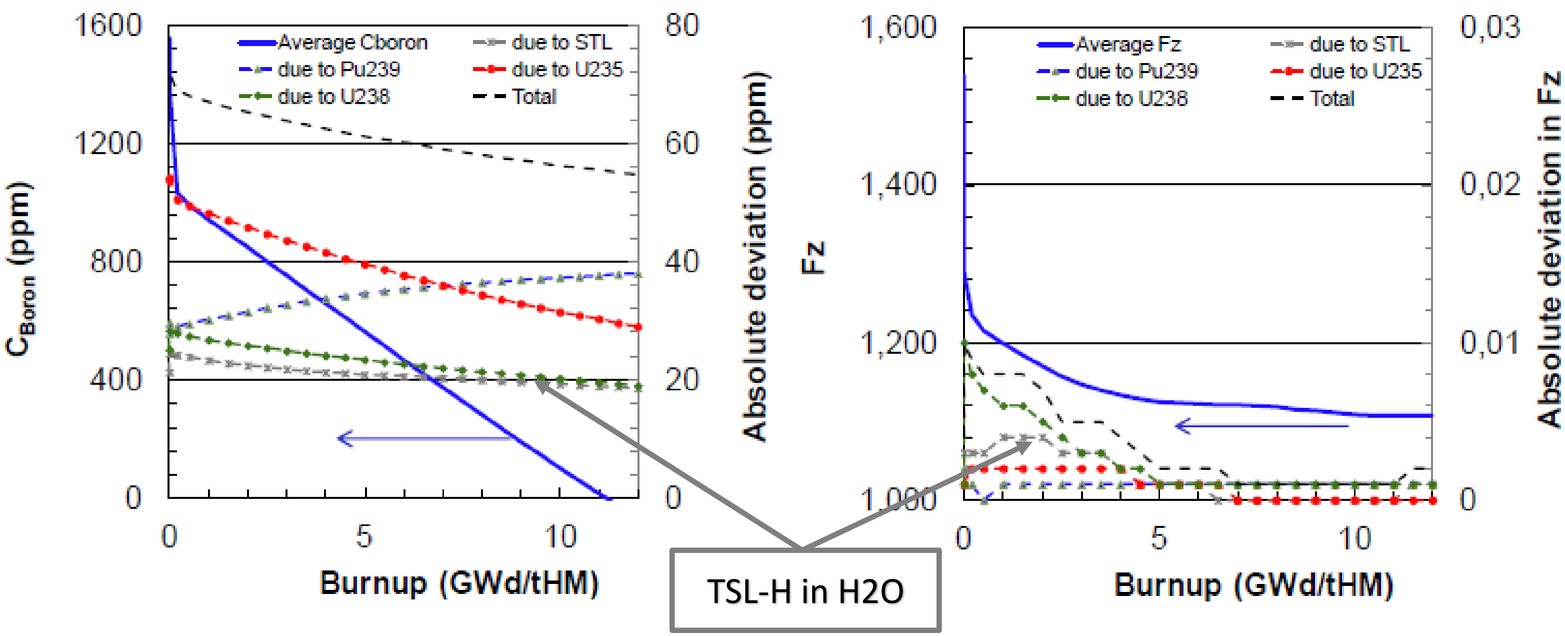
III.3 U&Q for Core Analysis: Average value and absolute deviation as a function of the burnup: C_{boron} and F_z



- C_{Boron} vs Burnup
  - Max unc.: 50-70 ppm
  - Most important contrib.: ^{235}U and ^{239}Pu
- F_z vs Burnup
  - Max unc.: 0.01-0.02 (~1-2%)
  - Most important contrib.: ^{238}U

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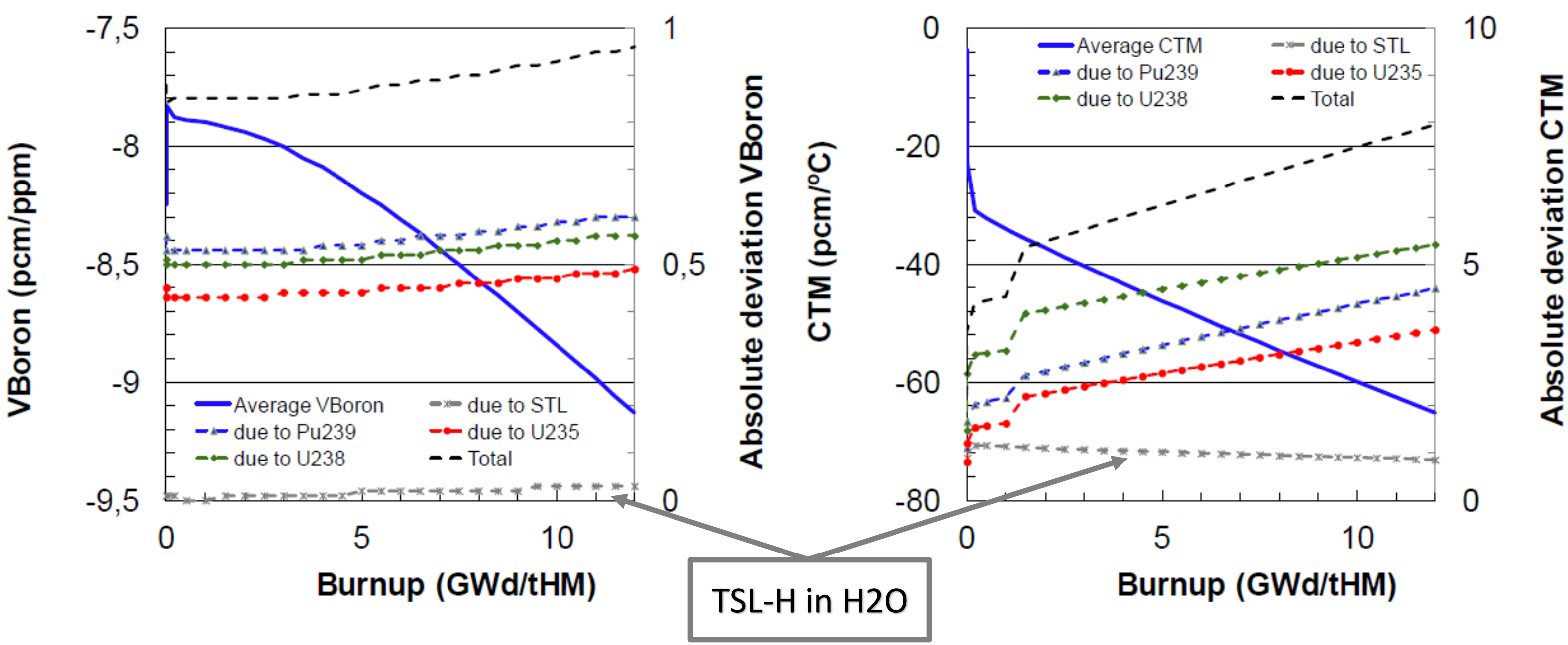
III.3 U&Q for Core Analysis: Average value and absolute deviation as a function of the burnup: V_{Boron} and CTM



- **Boron Worth vs Burnup**
  - Max unc.: 1 pcm/ppm (~12%)
  - Most important contrib.: ^{235,238}U & ^{239}Pu
- **CTM vs Burnup**
  - Max unc.: 5-7pcm/ºC (~10%)
  - Most important contrib.: ^{235,238}U & ^{239}Pu

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III.3 U&Q for Core Measurments: Relative percentage assembly power calculated as: ((M-C) /C ·100)

- Relative percentage assembly power core distribution between measured (M) and calculated (C) **at BOC-HFP and Xenon equilibrium**
- Relative error in % for random cases (STL and ^{239}Pu) is provided
  - Low unc. due to STLs < 0.3%
  - Max. unc. due to ^{239} Pu < 1.8%

5.3 5.9±0.1 4.8±1.8	3.7 4.1±0.2 3.3±1.4	4.9 5.6±0.2 4.5±1.3	-0.6 0.0±0.2 -0.7±0.4	1.9 2.2±0.0 1.8±0.4	-1.8 -1.8±0.0 -1.6±0.6	-0.3 -0.9±0.1 -0.2±0.6	1.9 1.6±0.0 2.1±0.7
3.4 3.8±0.2 3.0±1.4	2.2 2.6±0.1 1.7±1.4	2.8 3.3±0.2 2.5±1.1	4.6 5.2±0.2 4.3±0.8	1.0 1.1±0.1 1.0±0.2	0.5 0.4±0.0 0.6±0.2	-1.3 -1.6±0.1 -0.9±1.1	3.4 3.1±0.0 3.4±0.6
4.0 4.7±0.2 3.6±1.3	2.2 2.6±0.2 1.8±1.1	4.6 5.2±0.1 4.4±1.0	-1.6 -1.2±0.1 -1.6±0.2	0.0 -0.1±0.1 -0.1±0.2	-1.6 -1.9±0.1 -1.3±0.8	-0.4 -0.7±0.1 0.0±1.3	
-1.7 -1.1±0.2 -1.8±0.4	3.5 4.1±0.2 3.2±0.8	-1.9 -1.6±0.1 -1.9±0.2	0.0 0.0±0.1 -0.2±0.5	-1.4 -1.9±0.2 -1.5±0.1	-2.0 -2.3±0.2 -1.7±0.8	2.5 2.0±0.0 2.5±0.7	
0.4 0.8±0.0 0.3±0.4	-0.4 -0.3±0.1 -0.5±0.2	-1.0 -1.0±0.1 -1.1±0.2	-2.3 -2.7±0.2 -2.4±0.1	-1.8 -2.4±0.3 -1.9±0.1	-0.7 -1.2±0.2 -0.7±0.2		
-3.1 -3.1±0.0 -2.9±0.6	-1.0 -1.2±0.0 -1.0±0.2	-2.9 -3.2±0.1 -2.6±0.8	-2.6 -2.9±0.2 -2.3±0.8	-1.0 -1.5±0.3 -1.0±0.2			
-0.8 -1.4±0.1 -0.7±0.6	-2.0 -2.2±0.1 -1.6±1.1	-1.5 -1.6±0.1 -1.0±1.3	0.5 0.2±0.0 0.7±0.7				
1.6 1.2±0.0 1.9±0.7	3.1 3.1±0.0 3.4±0.6						

WIMS-D4
Random STL
Random ^{239}Pu

Higher unc. value <0.3% TSL-H in H2O

Fresh Fuel

C= Calculated M= Measured

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III.3 U&Q for Core Analysis: Average value and absolute deviation as a function of the burnup for control bank worth

	Average (ppm)	Absolute standard deviation (ppm)				
		STL	^{239}Pu	^{235}U	^{238}U	Total
D-IN	120.3	1.3	0.5	0.7	0.7	1.7
C-IN	92.2	0.8	2.6	1.4	1.1	3.2
B-IN	138.1	0.9	0.5	1.6	0.8	2.0
A-IN	92.3	0.5	3.5	3.9	0.7	5.3
SB-IN	88.9	1.1	3.3	2.4	1.4	4.5
SA-IN	120.3	0.8	2.3	3.2	0.6	4.0
D+C-IN	237.8	2.1	2.9	0.7	1.6	4.0
D+C+B-IN	419.2	3.5	4.5	1.0	2.4	6.2
D+C+B+A-IN	565.2	4.1	1.6	6.5	1.7	8.0
D+C+B+A+SB-IN	701.8	5.6	2.8	3.9	2.9	7.9
ARI	917.5	7.8	2.6	5.4	3.2	10.3

- Uncertainty for each of the nuclear data varied (STL-H in H2O, ^{235,238}U and ^{239}Pu) and the sum of the different contributions < ~**2%**

JEF/DOC-1524

- **Review of Recent International Activities**
  - **Journals**
    - **Models:**
      - “***Evaluation of the neutron scattering cross-section for light water by molecular dynamics***”. Y. Abe et al., NIMA, 735(2014)568–573
      - “***CAB models for water: A new evaluation of the thermal neutron scattering laws for light and heavy water in ENDF-6 format***”, J.I. Marquez Damian et al., ANE, 65 (2014) 280–289
    - **Uncertainties/Covariances:**
      - “***Generation of an S(α, β) Covariance Matrix by Monte Carlo Sampling of the Phonon Frequency Spectrum***“, J.C. Holmes and A.I. Hawari, NDS 118 (2014) 392–395
      - “***Random Adjustment of the H in H2O Neutron Thermal Scattering Data***“, D. Rochman and A. J. Koning, NSE, 172, 287–299 (2012)
    - **Interpolation**
      - ***“Comparison of thermal scattering processing options for S(a,b) cards in MCNP***”, Štefan Cˇ erba et al., ANE, 55 (2013) 18–22
      - ***“On-the-fly sampling of temperature-dependent thermal neutron scattering data for Monte Carlo simulations”***, Andrew T. Pavlou, Wei Ji. ANE, 71 (2014) 411–426
  - **Meetings**
    - SG38, October 2014: ***”Thermal Scattering Law Data”***, D. Brown, W. W. Haeck
    - SG40, November 2014: ***”On Improvement of Thermal Neutron Scattering Libraries (S(α, β) data) for H2O and D2O”*** , D. Roubtsov et al.