

The 25th Meeting of Working Party on International Nuclear Data
Evaluation Co-operation (WPEC), May 23-24, 2013, NEA Headquarters

Present Status of the JENDL Project

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JNDC (T. Ohsawa, Kinki Univ. → N. Yamano, Fukui Univ.)

Subcommittee on Nuclear Data (K. Shibata → H. Harada, JAEA)

High Energy Nuclear Data Evaluation WG (Y. Watanabe, Kyushu Univ.)

ENSDF Group (H. Iimura, JAEA)

Japanese Nuclear Data Management Network (Y. Watanabe, Kyushu Univ.)

Subcommittee on Reactor Constants (N. Yamano, Fukui Univ.)

Reactor Integral Test WG (G. Chiba, Hokkaido Univ.)

Shielding Integral Test WG (C. Konno, JAEA)

Decay Heat Evaluation WG (T. Yoshida, Tokyo City Univ.) merged with

WG on Evaluation of Nuclide Generation (K. Okumura, JAEA)

Covariance Utilization WG (T. Iwasaki, Tohoku Univ.)

New WGs started from 2013

WG on Nuclear Data Processing

Advisory Subcommittee on Development of JENDL

JENDL-4.0 Updated and Plus Files

The updated and newly evaluated files will be available from JAEA web site. They are classified into **JENDL-4.0 Updated** and **JENDL-4.0 Plus Files**, respectively.

No.	Version ▲▼	Nuclide ▲▼	Sublib. ▲▼	Mainly revised part (and detail by clicking ▶)	Date ▲▼	Data file
1	4.0⁺1	²³⁹ Pu		Covariances in resonance region ▶	2012/02/16	DOWNLOAD ▼
2	4.0_u1	⁵⁹ Ni		0-barn data for (n,p) and (n,α) reactions at 10 keV ▶	2012/02/17	DOWNLOAD ▼
3	4.0_u1	²⁴¹ Pu	NF	A part of fission yields ▶	2012/02/18	DOWNLOAD ▼
4	4.0_u1	² H		Interpolation of elastic angular distributions ▶	2012/02/19	DOWNLOAD ▼
5	4.0_u1	⁴⁸ Ti		Representation of resolved resonances ▶	2012/02/20	DOWNLOAD ▼
6	4.0⁺1	⁵³ Cr		MF33 and MF34 added ▶	2012/02/21	DOWNLOAD ▼
7	4.0⁺1	²³³ U		Covariances in resonance region ▶	2012/02/22	DOWNLOAD ▼
8	4.0⁺1	⁵² Cr		MF33 and MF34 added ▶	2012/02/23	DOWNLOAD ▼
9	4.0_u1	²³⁴ U		MF1MT458, MF3MT18 ▶	2012/02/24	DOWNLOAD ▼
10	4.0_u1	¹⁰ B		Elastic scattering cross sections ▶	2012/02/25	DOWNLOAD ▼
11	4.0⁺1	²³⁵ U		Covariances in resonance region ▶	2012/02/26	DOWNLOAD ▼
12	4.0_u1	²⁴³ Am		MF1MT458, MF3MT18 ▶	2012/02/27	DOWNLOAD ▼
13	4.0⁺1	²³⁸ U		Covariances in resonance region ▶	2012/02/28	DOWNLOAD ▼
14	4.0_u1	^{242m} Am	NF	MAT No. of fission yield data ▶	2012/02/29	DOWNLOAD ▼

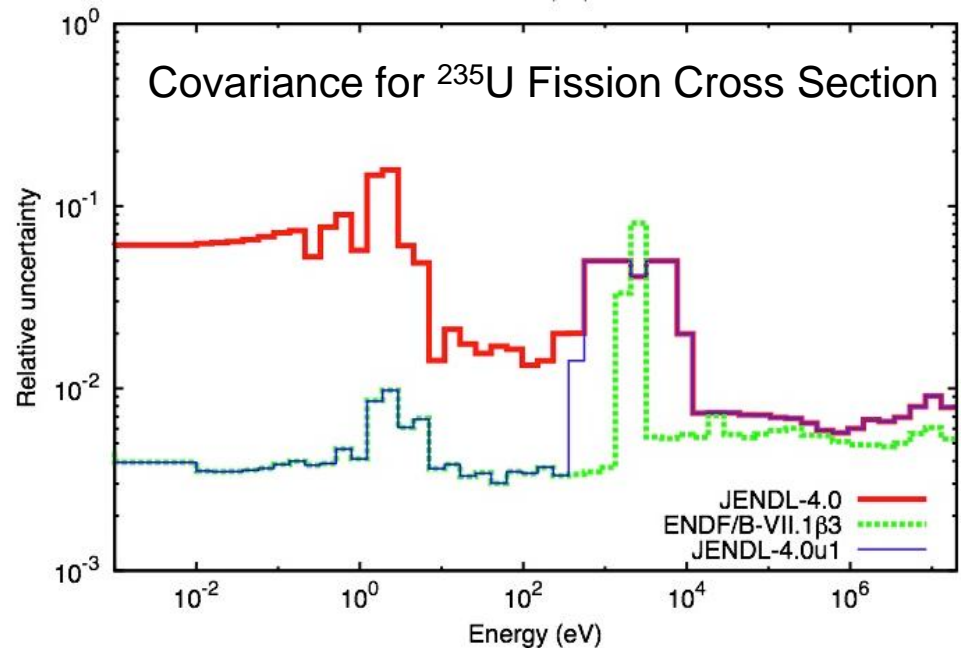
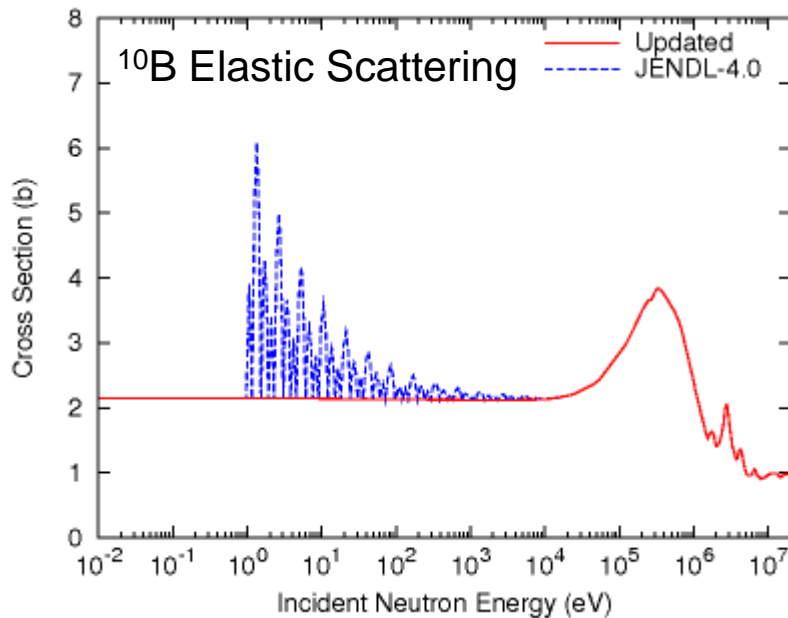
JENDL-4.0 Updated Files (Important Update)

- Covariance data of major actinides in resonance region:
 $^{233,235,238}\text{U}$ and ^{239}Pu
- Interpolation option of the elastic scattering which caused a problem on processing by NJOY-99
- Unphysical oscillations in the elastic scattering cross sections of ^{10}B
- Capture cross section at low energy of ^{156}Eu which gave unfavorable influence on results of PIE analyses

The JENDL-4.0u is available from the JAEA web site **since Sep. 2012.**

Continuously revised for **QA of JENDL-4.0.**

JENDL-4.0 Updated Files (example)



The strange oscillations in the energy region from 1 eV to 10 keV are due to calculation errors by subtracting the nonelastic cross sections from the total cross sections.

The RP covariance matrix in JENDL-4.0 was a subset of the full matrix derived by Luiz Leal, ORNL. The covariance matrices of the cross sections have been recalculated with the full covariance matrices and adopted in MF33.

JENDL-4.0 Updated Files (Reported from GND)

Thanks Dr. Mattoon, LLNL

- Duplication of neutron incident energies in MF6:
 $^{243,248}\text{Cm}$, ^{237}U , ^{156}Eu
These do not violate ENDF-6 format rule.
- Mismatch of resonance parameters between MF2 and MF32:
 ^{237}Np , $^{238,242}\text{Pu}$, ($^{233,235,238}\text{U}$), ^{234}U
Revised ASAP.
- Fission widths are given against LFW=0 for URR in MF2:
 ^{229}Th , $^{231,232}\text{Pa}$, $^{232,234}\text{U}$, ^{238}Np , $^{239,244}\text{Pu}$, $^{243,245}\text{Cm}$
Learning the effects for reactor calculations.
- Incorrect QI:
 ^{241}Am , ($^{129\text{m}}\text{Te}$)
Planned to be revised.

→ See 2012 report

The major conclusions are:

1. About the capture cross sections of ^{241}Am and ^{237}Np , their cross sections and covariance data seems consistent for JENDL-3.3 and JENDL-4.0,
2. On the other hand, the standard deviation of inelastic scattering cross sections for JENDL-3.3 seems too small compared with measured data.
3. As a conclusion, there are certainly rooms to improve the covariance data of JENDL library, but this never means the covariance data are totally wrong or useless.

→ A new working group, named as "**Covariance Utilization WG**" in JNDC.

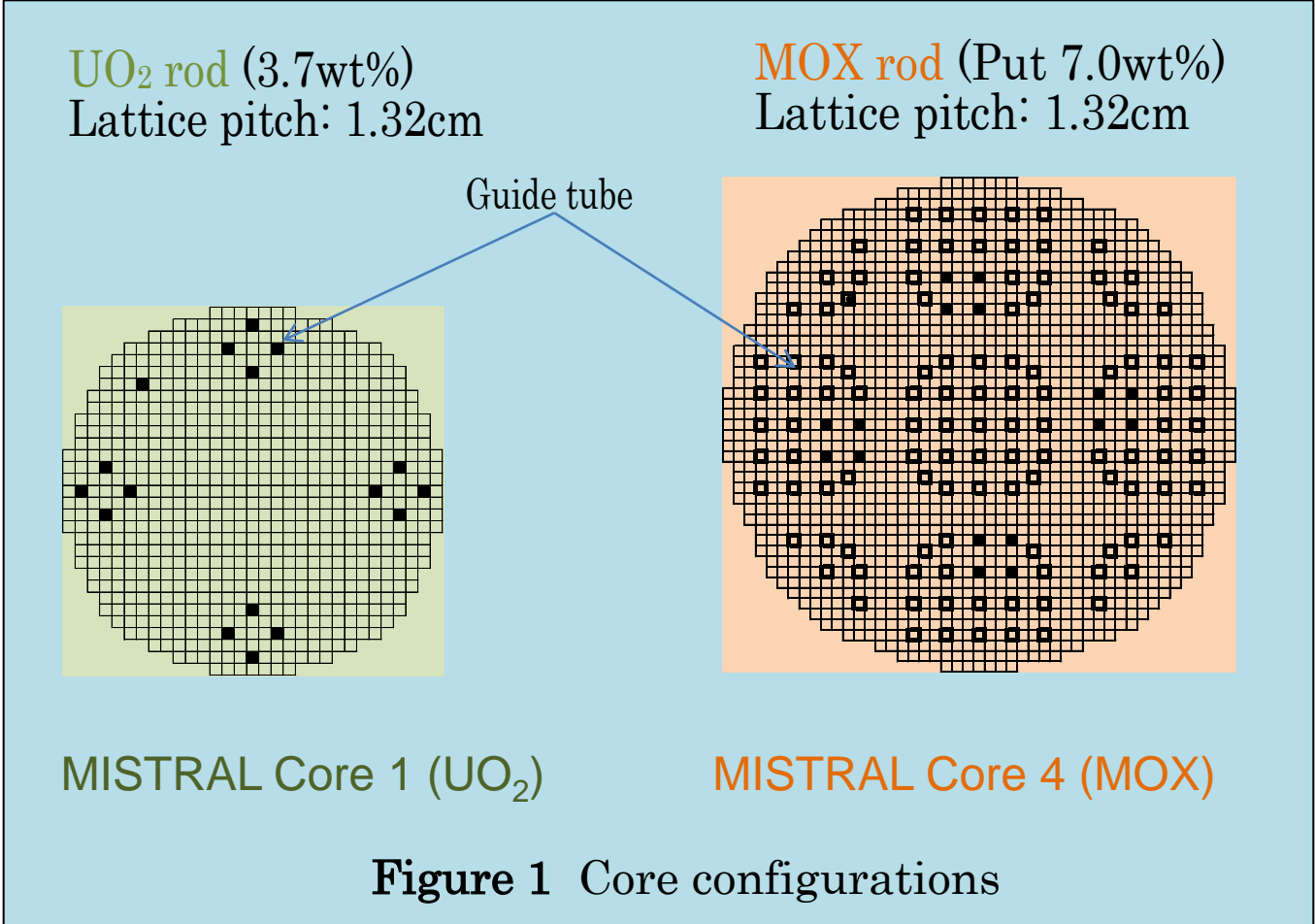
→ Objectives

- to promote the conversation on the covariance of nuclear data between the users and evaluators
- finally to improve the quality of the covariance data

Thermal Reactor : MISTRAL 1 (UO₂) & MISTRAL 4 (MOX)

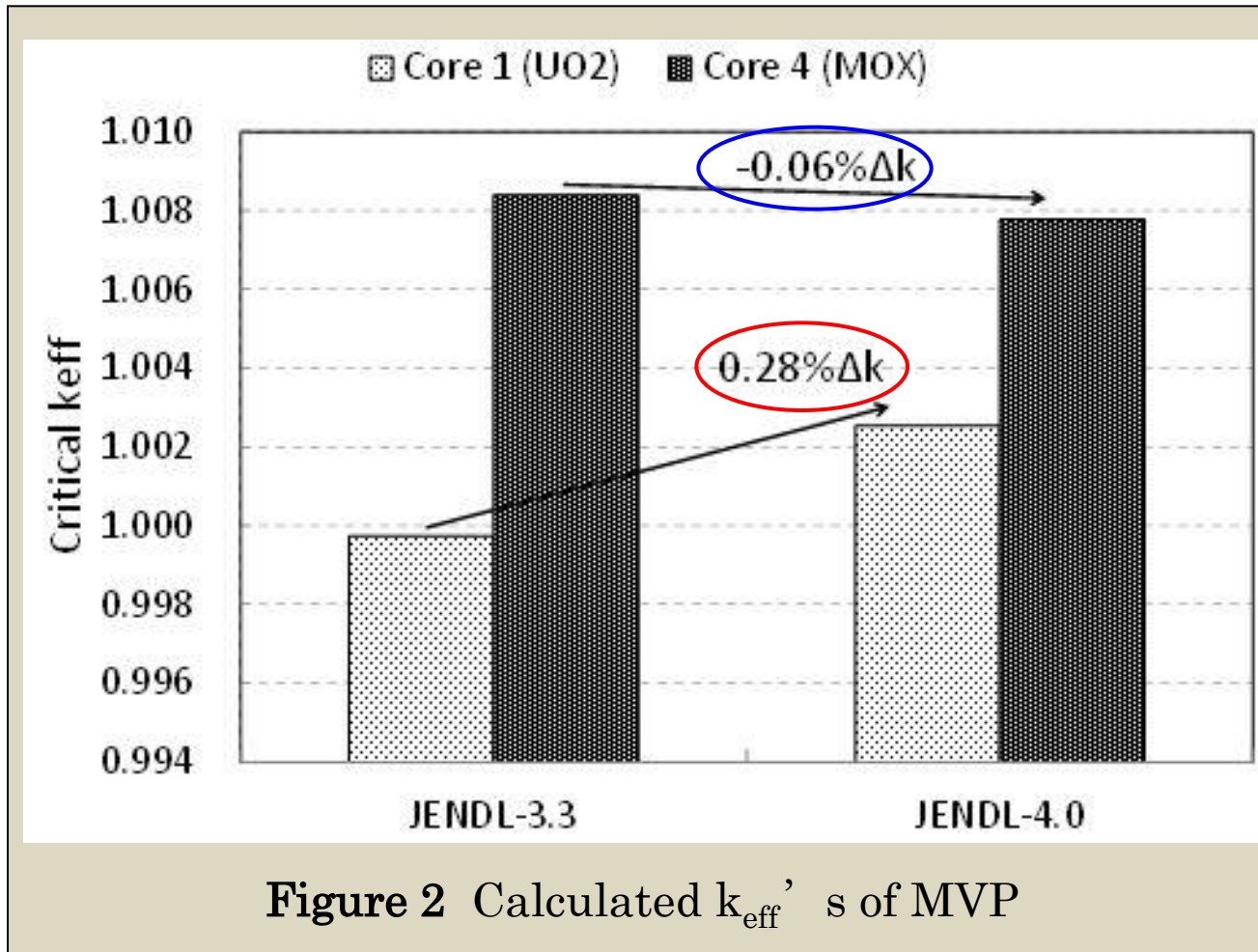
The lattice pitch of both cores is slightly larger than that of a standard PWR 17 x 17 fuel assembly.

The experiments aimed at obtaining core characteristics of an advanced core with a higher moderation ratio as a futuristic LWR core concept.



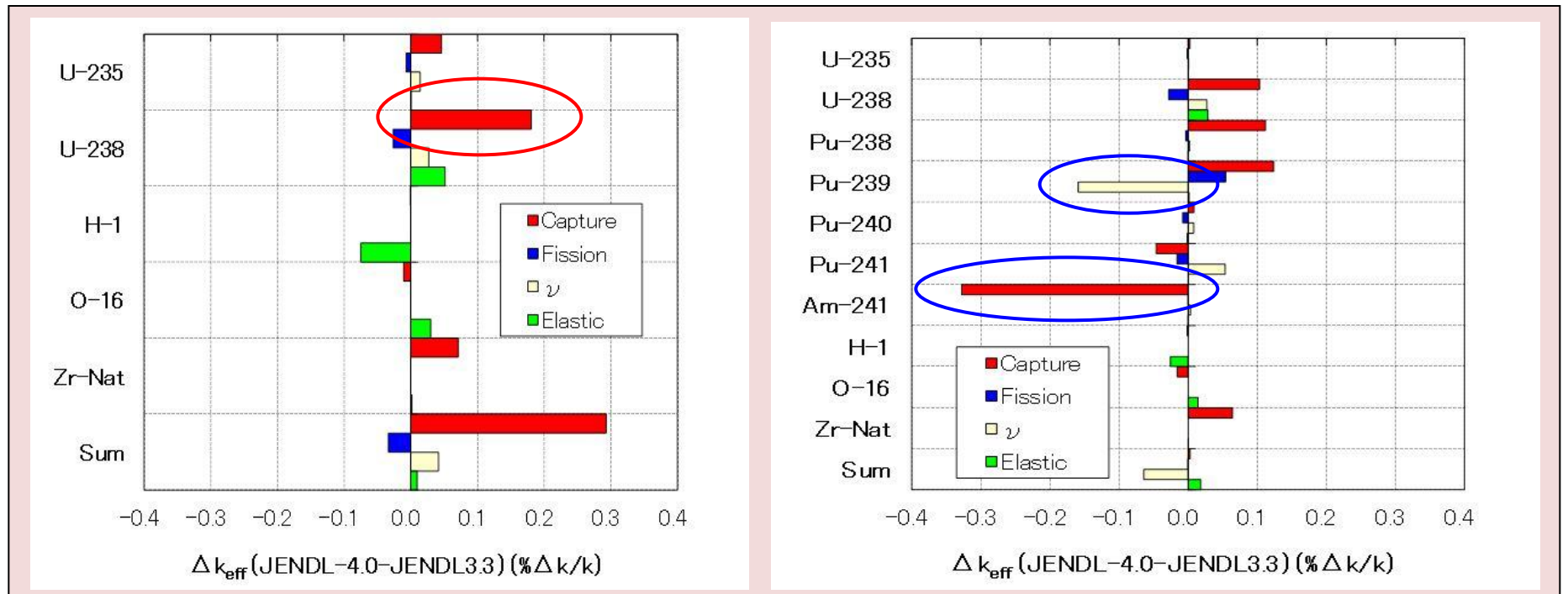
(Ref.) T.Sakai and T.Yamamoto, JNES, Proceedings of the 2012 Symposium on Nuclear Data, Nov. 15-16, 2012, Kyoto University Research Reactor Institute, Japan, to be published.

Thermal Reactor : MISTRAL 1 (UO_2) & MISTRAL 4 (MOX)



Difference in k_{eff} of between JENDL-4.0 and JENDL-3.3 for the **MISTRAL core 1** is significant (**+0.28 %Δk**) in the continuous-energy Monte Carlo calculations by using MVP; that for the **MISTRAL core 4** is small (**-0.06%Δk**).

Thermal Reactor : MISTRAL 1 (UO₂) & MISTRAL 4 (MOX)



MISTRAL Core 1 (UO₂)

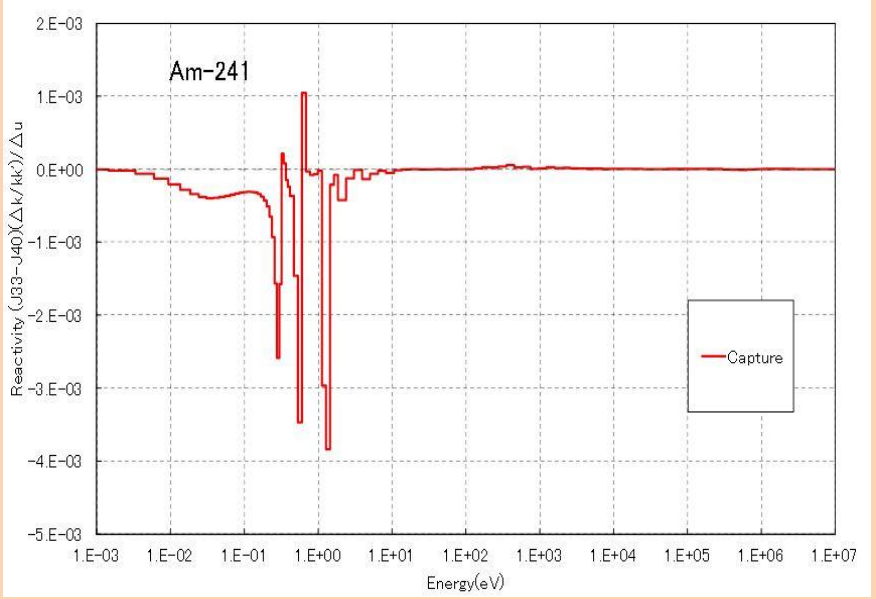
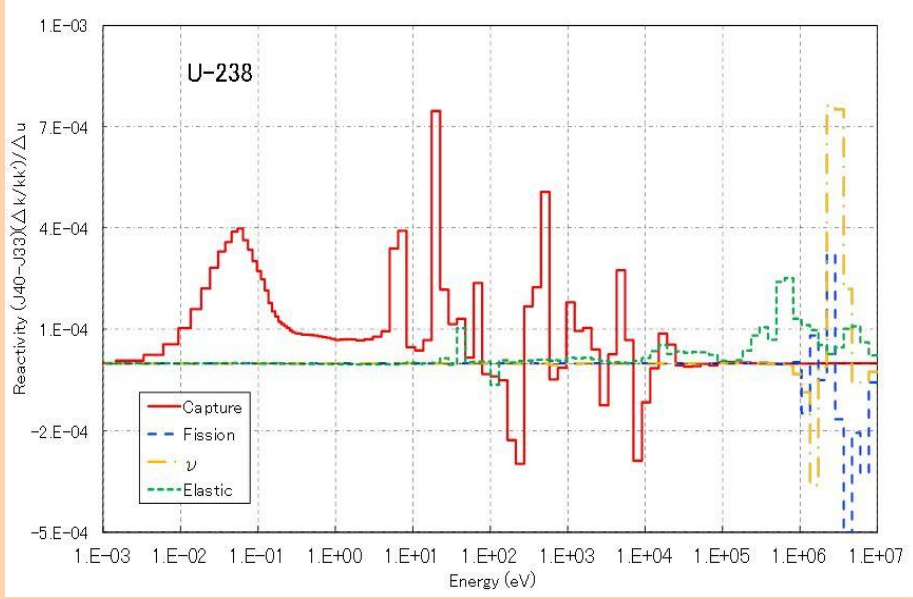
MISTRAL Core 4 (MOX)

Figure 3 Reactivity change from JENDL-3.3 to JENDL-4.0

Increase in keff in JENDL-4.0 for the **MISTRAL core 1** is mainly attributed to the decreases in the **capture cross sections of ²³⁸U**. On the other hand, the major contributions in **MISTRAL core 4** to decrease keff are the decreases in ν of **²³⁹Pu** and the increase in **²⁴¹Am** capture cross-section, but they are **compensated** with other nuclides' fission cross-sections.



Thermal Reactor : MISTRAL 1 (UO₂) & MISTRAL 4 (MOX)



MISTRAL Core 1 (UO₂)

MISTRAL Core 4 (MOX)

Figure 4 Reactivity change from JENDL-3.3 to JENDL-4.0

The contribution ²³⁸U capture cross section for the keff change of MISTRAL core 1 is spreading from thermal through resonance energy regions. On the other hand, the contribution of ²⁴¹Am capture cross section in MISTRAL core 4 is limited to the thermal energy region.

ADJ2010 for Fast Reactor Analysis

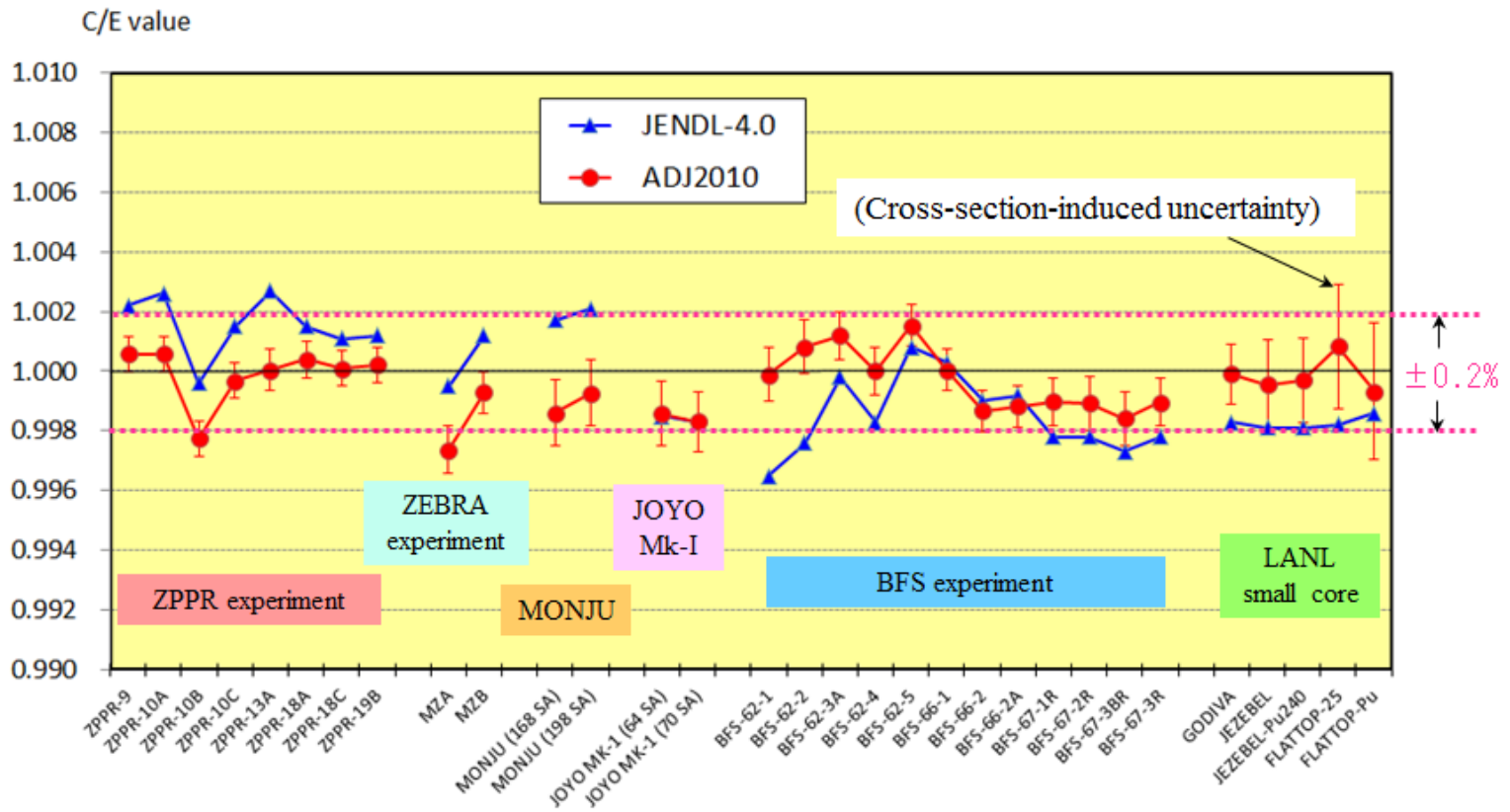
History of Adjusted Library in Japan

Item	ADJ91	ADJ2000	ADJ2010
Basic library (Release year)	JENDL-2 (Final 1989, First 1982)	JENDL-3.2 (1994)	JENDL-4.0 (2010)
Nuclear parameters to be adjusted	σ_{∞} of 11 nuclides (32 reactions), χ of 2 nuclides, β of 6 nuclides	σ_{∞} of 11 nuclides (41 reactions), χ of 2 nuclides, β of 6 nuclides, Self- shielding factors of U-238	σ_{∞} of 27 nuclides (155 reactions), χ of 2 nuclides, β of 11 nuclides, Pseud-FP of 4 fissiles, Self-shielding factors of U-238
Energy structure	18 group	18 group	70 group
Covariance of nuclear data	Rough estimation from differences between measured values and JENDL-2	The covariance data file evaluated after JENDL-3.2 release	The covariance data evaluated and released simultaneously with JENDL-4.0
Integral experimental data	82 data from JUPITER experiment at ZPPR	237 data from JUPITER, FCA, Joyo, BFS, MASURCA and Los Alamos (including burnup and temperature data)	488 data from JUPITER, ZEBRA, JOYO, MONJU, BFS, MASURCA, SEFOR and Los Alamos (including burnup, temperature and MA post- irradiation data)

(Ref.) K.Sugino, M.Ishikawa, et al.: "Development of a Standard Data Base for FBR Core Design (XIV) - Analyses of Extensive FBR Core Characteristics Based on JENDL-4.0 -", JAEA-Research 2012-013, July 2012.

ADJ2010 for Fast Reactor Analysis

C/E Change by ADJ2010 Adjustment - Criticality -

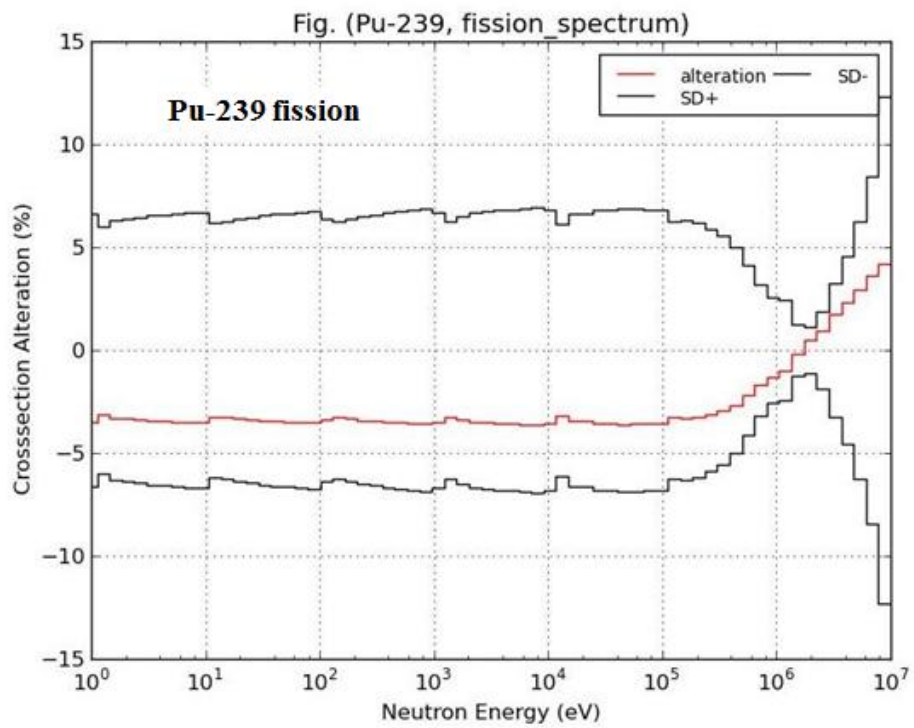


- The adjusted C/E values of criticality after adjusted are **within ± 0.2% Δk**.
- The good performance is not only for **Pu-fuel cores**, but **enriched-U fuel cores**.



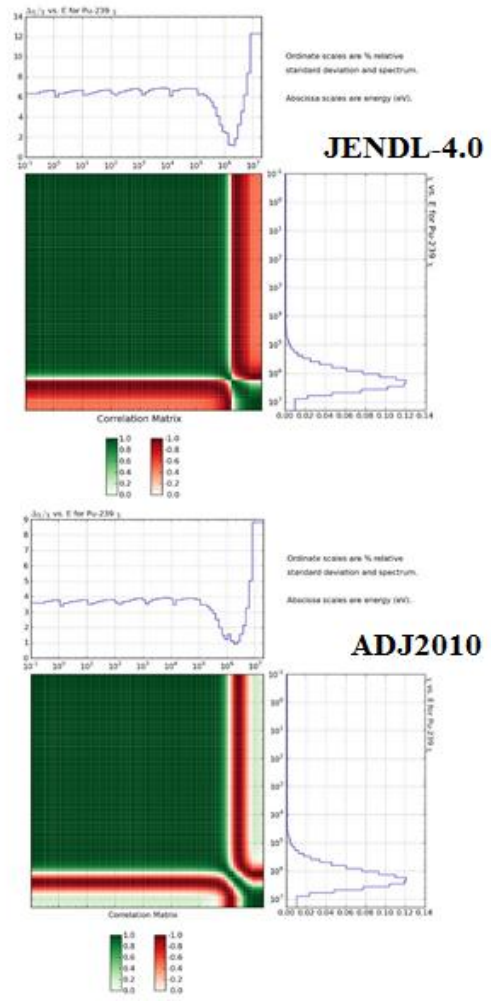
ADJ2010 for Fast Reactor Analysis

Covariance Change by Adjustment - Pu-239 Fission spectrum -



- The **neutron spectrum** of Pu-fueled cores becomes **harder**.
- The **correlation** is largely changed in high-energy region.

Fig. Pu-239 ν



New Evaluations

- Updated & Revised (Full Evaluation)

$^{69,71}\text{Ga}$, ^{99}Tc , $^{96,98-106}\text{Ru}$, $^{121,123-126}\text{Sb}$, $^{141,143}\text{Pr}$, $^{162,164,166-168,170}\text{Er}$,
 $^{165,166\text{m}}\text{Ho}$, $^{175,176}\text{Lu}$, $^{185-187}\text{Re}$, $^{191-193}\text{Ir}$

- **Activation Cross Sections (569 reactions with 309 nuclides)**

→ Decommissioning of Nuclear Power Plants, etc.

Se, Br, Kr, Rb, Sr, Mo, Ru, Sb, Er, Hf

- JENDL Photonuclear Data File

In progress.

Evaluation for 181 nuclides has been finished.

It will be released in 2013.

Covariances

- New evaluations for Sm and Pb isotopes.
Preliminary evaluated data files are produced.
The covariance data for Pb isotopes were used for uncertainty analysis of Accelerator-driven System (ADS).

Evaluation Tools (CCONE)

- to add the multi-particle emission from the pre-equilibrium stage
- to add the complex-particle emission from the pre-equilibrium stage
- to add the function of calculating photo-induced reactions

JENDL FP Decay Data File 2011 (JENDL/FPD-2011)

JENDL FP Fission Yields Data File 2011 (JENDL/FPY-2011)

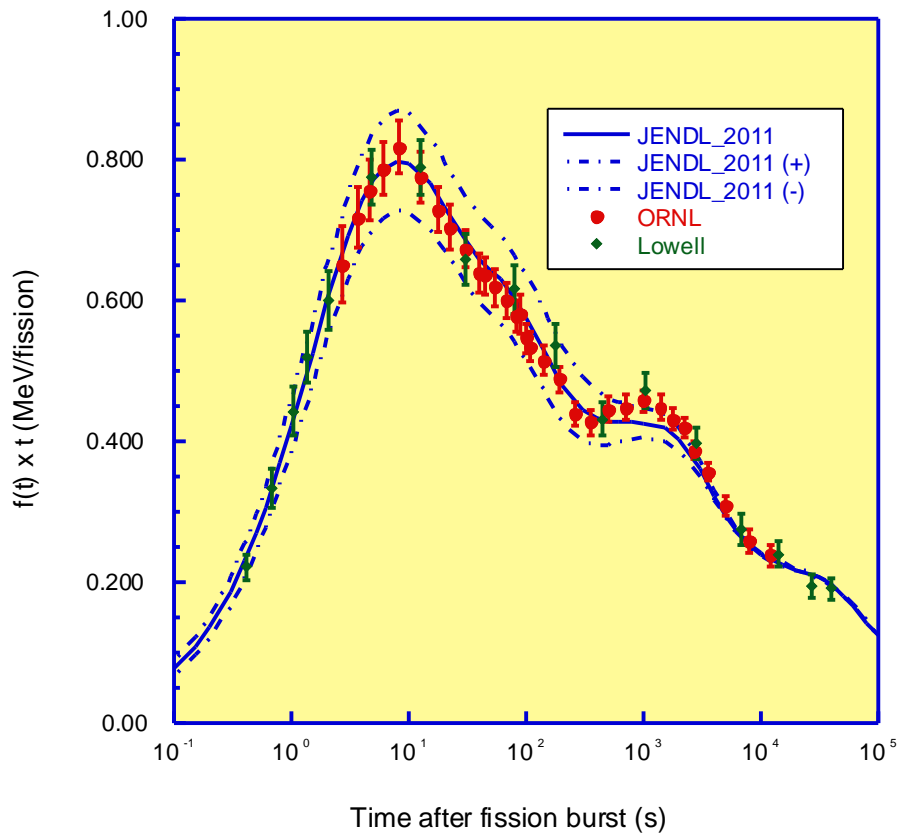
- Decay Data: **284 FP nuclides** (142 stable nuclides)
- New measured and **TAGS data** after the release of JENDL/FPD-2000 are reflected.
- JENDL/FPY-2011: **to keep the consistency** between the Decay Data File and Fission Yields File
- The decay heat calculations for various kinds of fissioning nuclides were performed. The calculated results showed good agreement.
- The **uncertainty analyses of the decay heat calculation** show **about 10 %** at 0.1 s after burst fission.
- The JENDL Decay Data File is planned to be prepared for 1689 nuclides (A=3-260).

Released in July, 2012

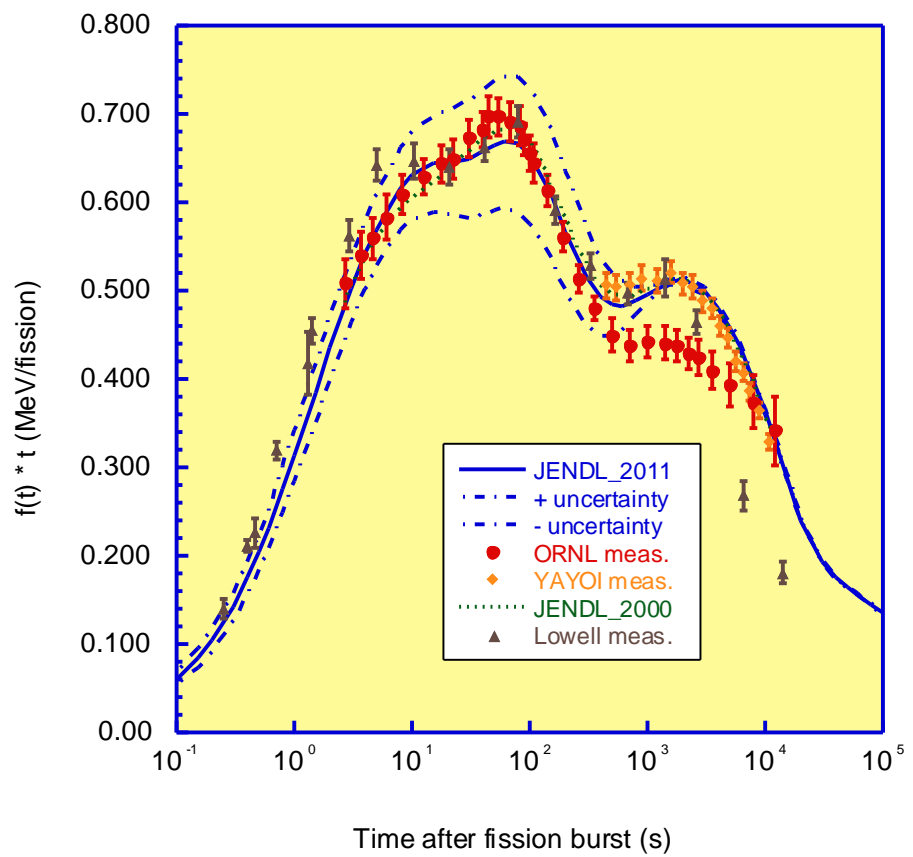
Ref.: J. Katakura, " JENDL FP decay data file 2011 and fission yields data file 2011," *JAEA-Data/Code 2011-025*, Japan Atomic Energy Agency (2012).

Current Status of Summing-up Cal. Results

²³⁵U Thermal Neutron Fission (Beta)

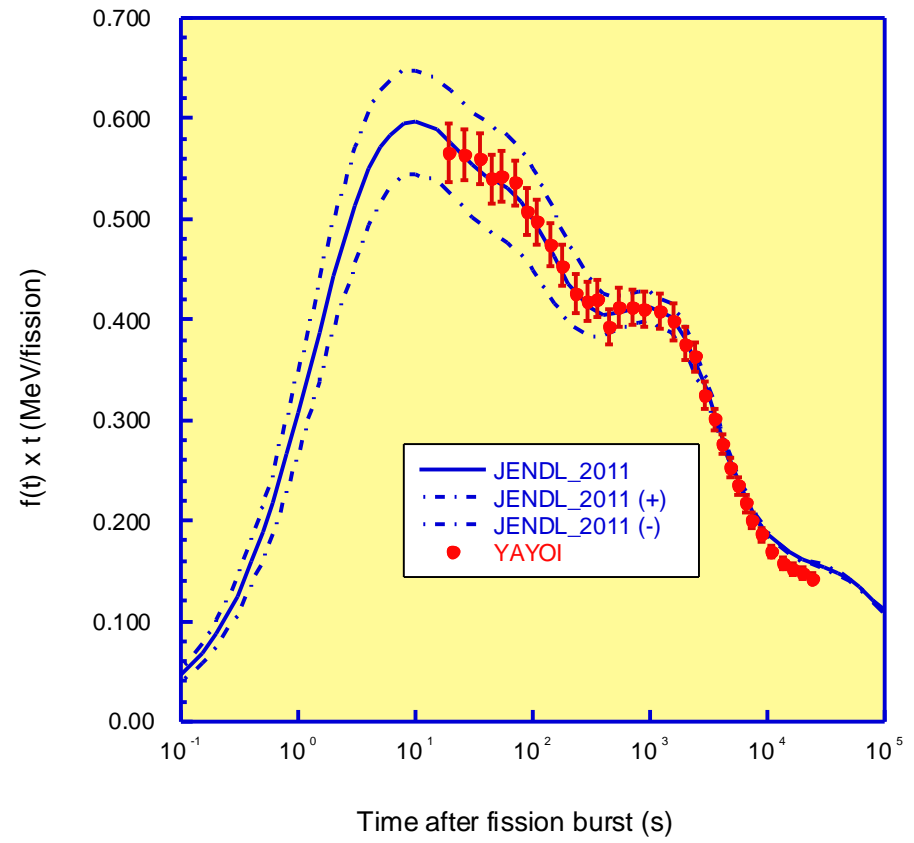


²³⁵U thermal fission (Gamma)

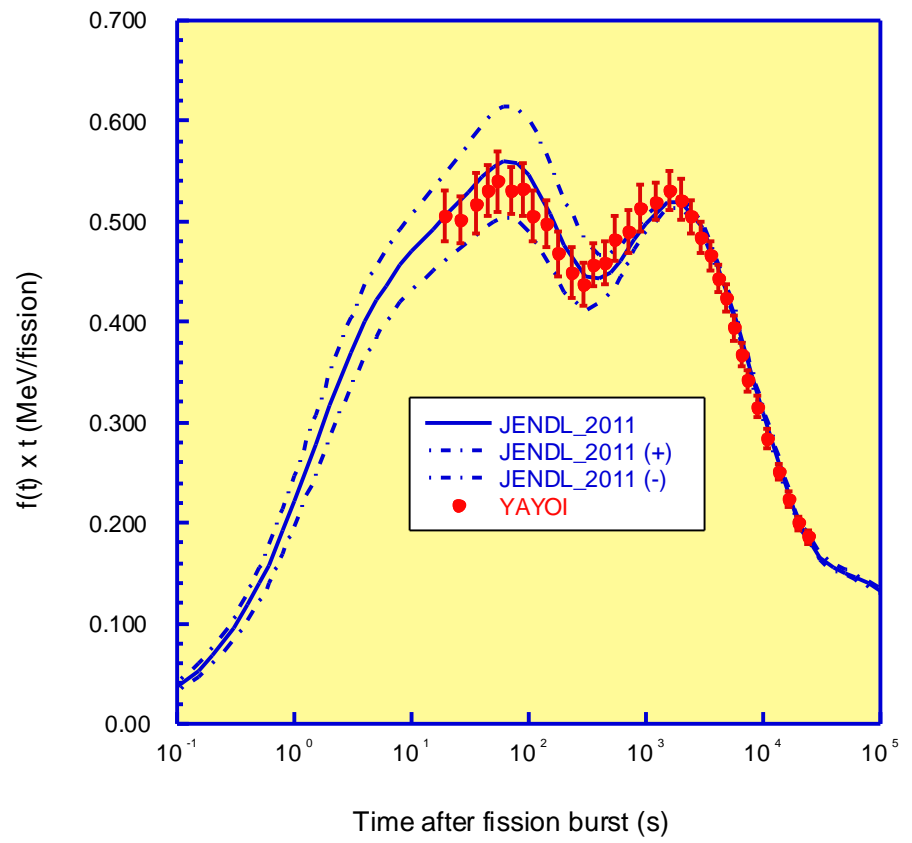


Current Status of Summing-up Cal. Results

²³⁹Pu Fast Neutron Fission (Beta)



²³⁹Pu Fast Neutron Fission (Gamma)



2012 Symposium on Nuclear Data

- The symposium was held on 15 and 16, November, 2012 at Kyoto University Research Reactor Institute, Kumatori-cho, Osaka.
- There were 83 participants.
- Hosted by Nuclear Data Division, Atomic Energy Society of Japan, as well as Kyoto University Research Reactor Institute (KUR) and JAEA/Nuclear Science and Engineering Directorate.
- The topics related to
 - Nuclear Power after Fukushima Nuclear Plant Accident
 - Application of Nuclear Data
 - How Should We Deal with Covariances of Nuclear Data?
 - Validation of JENDL-4.0 and Future
 - Tutorialswere presented.
- Totally 35 papers including poster presentations were presented and will be summarized into the proceedings.

Golden Jubilee of JNDC (since 1963)

The year of 2013 is the “Golden Jubilee of Japanese Nuclear Data Committee” and it was celebrated on the occasion of the AESJ annual meeting at Osaka. The 50 odd participants joined to both memorial lectures and party.



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Thank you for your attention!

JENPL
is your good choice.

