Present Status of the JENDL Project

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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.

<table>
<thead>
<tr>
<th>No.</th>
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JENDL-4.0 Updated Files (Important Update)

- Covariance data of major actinides in resonance region: $^{233,235,238}\text{U}$ and $^{239}\text{Pu}$
- Interpolation option of the elastic scattering which caused a problem on processing by NJOY-99
- Unphysical oscillations in the elastic scattering cross sections of $^{10}\text{B}$
- Capture cross section at low energy of $^{156}\text{Eu}$ 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.
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:
  \( ^{243,248}\text{Cm}, ^{237}\text{U}, ^{156}\text{Eu} \)
  These do not violate ENDF-6 format rule.

- Mismatch of resonance parameters between MF2 and MF32:
  \( ^{237}\text{Np}, ^{238,242}\text{Pu}, (^{233,235,238}\text{U}), ^{234}\text{U} \)
  Revised ASAP.

- Fission widths are given against LFW=0 for URR in MF2:
  \( ^{229}\text{Th}, ^{231,232}\text{Pa}, ^{232,234}\text{U}, ^{238}\text{Np}, ^{239,244}\text{Pu}, ^{243,245}\text{Cm} \)
  Learning the effects for reactor calculations.

- Incorrect QI:
  \( ^{241}\text{Am}, (^{129}_{\text{m}}\text{Te}) \)
  Planed to be revised.
The major conclusions are:

1. About the capture cross sections of $^{241}\text{Am}$ and $^{237}\text{Np}$, 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
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.

**Thermal Reactor : MISTRAL 1 (UO$_2$) & MISTRAL 4 (MOX)**

- **UO$_2$ rod (3.7wt%)**
  - Lattice pitch: 1.32cm

- **MOX rod (Put 7.0wt%)**
  - Lattice pitch: 1.32cm

**Figure 1** Core configurations

**Figure 2** Calculated $k_{\text{eff}}$'s of MVP

Difference in $k_{\text{eff}}$ of between JENDL-4.0 and JENDL-3.3 for the MISTRAL core 1 is significant (+0.28%Δ$k$) in the continuous-energy Monte Carlo calculations by using MVP; that for the MISTRAL core 4 is small (−0.06%Δ$k$).
Increase in $k_{eff}$ in JENDL-4.0 for the MISTRAL core 1 is mainly attributed to the decreases in the capture cross sections of $^{238}$U. On the other hand, the major contributions in MISTRAL core 4 to decrease $k_{eff}$ are the decreases in $\nu$ of $^{239}$Pu and the increase in $^{241}$Am capture cross-section, but they are compensated with other nuclides' fission cross-sections.
MISTRAL Core 1 (UO$_2$)  
MISTRAL Core 4 (MOX)

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

The contribution $^{238}$U 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 $^{241}$Am 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

<table>
<thead>
<tr>
<th>Item</th>
<th>ADJ91</th>
<th>ADJ2000</th>
<th>ADJ2010</th>
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<tbody>
<tr>
<td>Nuclear parameters to be adjusted</td>
<td>$\sigma_\infty$ of 11 nuclides (32 reactions), $\chi$ of 2 nuclides, $\beta$ of 6 nuclides</td>
<td>$\sigma_\infty$ of 11 nuclides (41 reactions), $\chi$ of 2 nuclides, $\beta$ of 6 nuclides</td>
<td>$\sigma_\infty$ of 27 nuclides (155 reactions), $\chi$ of 2 nuclides, $\beta$ of 11 nuclides. Pseud-FP of 4 fissiles, Self-shielding factors of U-238</td>
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<td>Energy structure</td>
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<td>70 group</td>
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<tr>
<td>Covariance of nuclear data</td>
<td>Rough estimation from differences between measured values and JENDL-2</td>
<td>The covariance data file evaluated after JENDL-3.2 release</td>
<td>The covariance data evaluated and released simultaneously with JENDL-4.0</td>
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<td>Integral experimental data</td>
<td>82 data from JUPITER experiment at ZPPR</td>
<td>237 data from JUPITER, FCA, Joyo, BFS, MASURCA and Los Alamos (including burnup and temperature data)</td>
<td>488 data from JUPITER, ZEBRA, JOYO, MONJU, BFS, MASURCA, SEFOR and Los Alamos (including burnup, temperature and MA post-irradiation data)</td>
</tr>
</tbody>
</table>

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.
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.
New Evaluations

● Updated & Revised (Full Evaluation)
  69,71Ga, 99Tc, 96,98-106Ru, 121,123-126Sb, 141,143Pr, 162,164,166-168,170Er,
  165,166mHo, 175,176Lu, 185-187Re, 191-193Ir

● 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
FP Decay Data File

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

Current Status of Summing-up Cal. Results

235 U Thermal Neutron Fission (Beta)

235 U thermal fission (Gamma)

Time after fission burst (s)
Current Status of Summing-up Cal. Results

239 Pu Fast Neutron Fission (Beta)

239 Pu 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 Tutorials were presented.
• Totally 35 papers including poster presentations were presented and will be summarized into the proceedings.
Other Activities

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.
Thank you for your attention!

JENDL is your good choice.