Nuclear Data and Cross Section Testing
Using ENDF/B-VIII.0

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Outline

1. Overview of comparison of ENDF/B-VIII.0 and ENDF/B-VII.1
2. Summary of results from VALID
3. Detailed comparisons
   - Noticeable adjustments to ENDF/B-VIII.0
     - $^{56}$Fe-reflected fast systems
     - $^{16}$O in LCT systems
     - $^{239}$Pu in MCT/MST/PST systems
     - $^{233}$U in intermediate and mixed systems
4. Sensitivity analysis
5. Summary
Overview of comparisons of ENDF/B-VIII.0 and ENDF/B-VII.1

• Use VALID suite to test over 600 cases with ENDF/B-VIII.0 and ENDF/B-VII.1 in KENO V.a/KENO-VI
  – SCALE 6.3 beta releases have both libraries (6.3.beta12)
  – Apollo cluster at ORNL
  – Compare $k_{\text{eff}}$ C/E values
KENO V.a results summary – continuous energy

<table>
<thead>
<tr>
<th>Category</th>
<th>ENDF/B-VIII.0</th>
<th>ENDF/B-VII.1</th>
<th>Difference</th>
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</thead>
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<tr>
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<td>HST</td>
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<td>UST</td>
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- Between 1 and 2 σ  - Between 2 and 5 σ  - Greater than 5 σ
KENO V.a results summary

Average C/E difference from unity

-0.028
-0.023
-0.018
-0.013
-0.008
-0.003
0.002
0.007

HMF
HST
IMF
LCT
LST
MCF
MCT
MST
PMF
PST
UCT
UMF
USI
USM
UST

v8.0-252
v7.1-252
ce_v8.0
ce_v7.1
Adjustments to ENDF/B-VIII.0 – $^{56}$Fe-reflected fast systems

![Graph showing comparisons between different versions of ENDF/B and IMF/PMF datasets.](image-url)
Adjustments to ENDF/B-VIII.0 – $^{16}$O in LCT systems
Adjustments to ENDF/B-VIII.0 – $^{16}$O in LCT systems
Adjustments to ENDF/B-VIII.0 $^{239}$Pu in PST systems

![Graph showing C/E values for different versions of ENDF/B-VIII.0 and experimental uncertainties.]

- v8.0-252
- ce_v8.0
- v7.1-252
- ce_v7.1
- Exp. Unc.
Adjustments to ENDF/B-VIII.0 – $^{239}$Pu in PST systems

![Graph showing adjustments to ENDF/B-VIII.0 - $^{239}$Pu in PST systems](graph.png)
Adjustments to ENDF/B-VIII.0 – $^{239}$Pu in MCT systems
Adjustments to ENDF/B-VIII.0 – $^{239}\text{Pu}$ in MST systems
Adjustments to ENDF/B-VIII.0 - $^{233}$U in intermediate and mixed systems
Adjustments to ENDF/B-VIII.0 - $^{233}\text{U}$ in intermediate and mixed systems
Sensitivity analysis

• Limited number of cases tested with TSUNAMI
  – Compare sensitivities through $c_k$ and $E$ calculations
    • All $c_k$ values 0.99 or higher (ENDF/B-VIII.0 56-group covariance library)
    • All $E$ values 0.99 or higher
  – One interesting case: PMF-006-001
    • VALID SDF generated with SCALE 6.2.2 and ENDF/B-VII.1
    • $c_k$ value of 0.9795 and $E$ value of 0.9947
Sensitivity analysis – PMF-006-001

• PMF-006-001
  – Pu sphere reflected with natural U
  – $^{238}\text{U} (n,n')$ reaction
  – SCALE 6.2.2 does not recalculate total cross section after sampling flux for inelastic scattering in URR

• Generate new SDF with SCALE 6.3.b12 and ENDF/B-VII.1
  – $c_k$ value of 0.9996 and $E$ value of 0.9998
Sensitivity analysis – PMF-006-001

SCALE 6.2.2

SCALE 6.3.b12
Summary

• ORNL has recently completed a comparison of ENDF/B-VIII.0 and ENDF/B-VII.1 using the VALID library
  – ORNL/TM-2020/1868 report available
  – Most systems have a more negative bias
  – Noticeable differences observed in systems with $^{56}$Fe, $^{16}$O, $^{239}$Pu, and $^{233}$U
  – Sensitivity analysis indicates high level of agreement between the two libraries ($c_k$ and $E$)

• Future work
  – Generate all VALID SDFs with TSUNAMI-3D
  – Develop uncertainty bands with appropriate covariance data
  – Expanding VALID for greater applicability to advanced reactors
    • Intermediate enrichment
    • Graphite and lead
  – Also trying to investigate more intermediate spectrum cases
Questions?

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