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Independent Data Testing (from the Florida Beaches)

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<u>Outline</u>

- NJOY Processing
- Criticality Data Testing
- Summary

NJOY Processing

- NJOY2016
 - An open source release, available as of January 2017
 - Obtained from https://njoy.github.io/NJOY2016/ (or https://njoy.lanl.gov).
 - Users should periodically execute a GitHub "pull" to assure they have the latest version.
 - The source code as available on 10/2/2017 was used to process the e80β5 files into ACE format.
- NJOY2012
 - Still available, with the latest update files obtained from https://www.oecd-nea.org/dbprog/Njoy/2012up99.txt.
 - NOTE: This update is not available from the legacy LANL website.
 - The current release is NJOY2012.99
 - This version of NJOY could process the e80β5 candidate files as formatted in mid-July.
 - Additional format revisions mean the as-released e80 β 5 ²³⁵U and ²³⁹Pu cannot be processed!

Criticality Data Testing – Legacy LANL Assemblies

- Previous (e71) good bare assembly results are retained with e80β5 cross sections.
- Reflected assembly results are significantly improved.
- These results are essentially the same as seen with e80β4.

Calculated Eigenvalues with ENDF/B-VII.1 and ENDF/B-VIII.0β5 Cross Sections



<u>Criticality Data Testing – HST suite</u>

- Previous (e71) good result is retained with e80β5 cross sections.
- Correlations against other parameters such as ATFF, EALF, EAF, H/U all yield a "zero" slope and "unity" intercept.
- These results are essentially the same as seen with e80β4.



Above-Thermal Leakage Fraction (ATLF)

<u>Criticality Data Testing – PST suite</u>

- Previous (e71) result is significantly improved with e80β5 cross sections.
- Correlations against other parameters such as ATFF, EALF, EAF yield a "zero" slope and "unity" intercept.
- Slight evidence for a trend and bias with
 ²³⁹Pu abundance, but the database is small.

Calculated Pu-SOL-THERM Eigenvalues with ENDF/B-VIII.0β5 Cross Sections



<u>Criticality Data Testing – LCT suite</u>

- Previous (e71) good results are retained with e80β5 cross sections.
- Average k_{eff} C/E change is 46 pcm, mainly due to the improved LCT5 and the ^{nat}U wall reflected LCT10 results.
 - LCT5: $1.00471 \rightarrow 1.00320$
 - LCT10: $1.00095 \rightarrow 1.00007$
- For a suite of ~200 LCT assemblies the average k_{eff} C/E changed from 0.99951 to 0.99918, or -33 pcm.

Calculated Eigenvalues with ENDF/B-VII.1 and ENDF/B-VIII.0β5 Cross Sections



Criticality Data Testing – LCT suite with Fe

- Previous (e71) good results are retained with e80β5 cross sections.
- Slight decrease in LCT10 eigenvalues brings these results more in line with the LCT1 base case.
- These results are essentially the same as seen with e80β4.

Calculated Eigenvalues with ENDF/B-VII.1 and ENDF/B-VIII.0β5 Cross Sections



<u>Criticality Data Testing – HMF & PMF suites with Fe</u></u>

- Previous (e71) results are mostly improved with e80β5 cross sections.
- These results are essentially the same as seen with e80β4.

and ENDF/B-VIII.065 Cross Sections 1.0300 HMF13 HMF21 HMF and PMF critical assemblies with iron (or steel). HMF24 1.0200 Error bars represent the ICSBEP benchmark reactivity uncertainty. HMF84.7 HMF84.19 Assembly values/Legend labels run left-to-right/top-to-bottom. HMF85.3 HMF87 1.0100 HMF88.1 k_{eff} C/E HMF88.2 HMI1 1.0000 PMF25 PMF26 PMF28 PMF32 0.9900 PMI2 🔷 e71 **e**80β5 0.9800

Calculated Eigenvalues with ENDF/B-VII.1

<u>HMF7 ...</u>

 Average calculated eigenvalues jumped from ENDF/B-VI to ENDF/B-VII.

- Higher values are retained with the latest cross section files.
- Shape versus energy is unchanged throughout.



HEU-MET-FAST-007 Calculated Eigenvalues with

Energy of Average Neutron Lethargy Causing Fission (EALF), MeV

PMF suite ... ENDF/B-VII.1

- Lots of scatter in these data, particularly in the 0.75 MeV to 1.25 MeV interval.
- Results are generally biased high for E < 0.75 MeV.



Energy of Average Lethargy Causing Fission (EALF), MeV

PMF suite ... E80β5

- Lots of scatter in these data, particularly in the 0.75 MeV to 1.25 MeV interval – arguably worse than ENDF/B-VII.1
- Results are generally biased high for E < 0.75 MeV.
- These results are essentially the same as seen with e80β4.



<u>Summary</u>

- With E80β5 we have retained the good ENDF/B-VII.1 eigenvalue performance.
- The long-standing PST eigenvalue bias has been eliminated.
- Benchmarks with significant quantities of iron are calculated more accurately.
- Small trends in calculated eigenvalues over large energy intervals remain (HMF7, PMF suite).
- Results obtained with E80β5 are essentially identical to those obtained with E80β4 ... including reaction rate results reported previously (but not shown here).