LANL T-2 Data Testing

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LANL T2 Data Testing

- Topics
  - Data Testing of Ti and V cross sections with ICSBEP benchmarks (Kahler, Kawano, Oh).

  - Code comparison among LANL, LLNL, Argonne and France with the Big-10 Benchmark (MacFarlane, Cullen & Lent, Blomquist and Sublet).
    - full report available at http://t2.lanl.gov/publications/Bigten_Study.pdf

  - Comparison of calculated benchmark eigenvalues with the official MCNP5 ENDFB7 library and previous unofficial endf/b-vii.0 results (Kahler, MacFarlane, Trellue, White, Little, Lee, Parsons & Sweezy).

Data Testing: Ti and V Benchmarks

- Data Testing with ICSBEP Ti and V bearing benchmarks

  - Ti
    - HMF34 (case 1): interleaved HEU/Ti/Al.
    - HMF79: 5 cases with increasing axial reflector thickness.
    - HMM1: interleaved HEU/Ti/polyethylene plus a radial poly reflector.
    - HMM15: interleaved HEU/Ti/polyethylene plus a radial poly reflector.

  - V
    - HMF25: 5 cases with increasing axial reflector thickness.
    - HMF40: interleaved HEU/V.
    - HMM16: axial V with interleaved HEU/polyethylene.

Data Testing: Ti and V Benchmarks
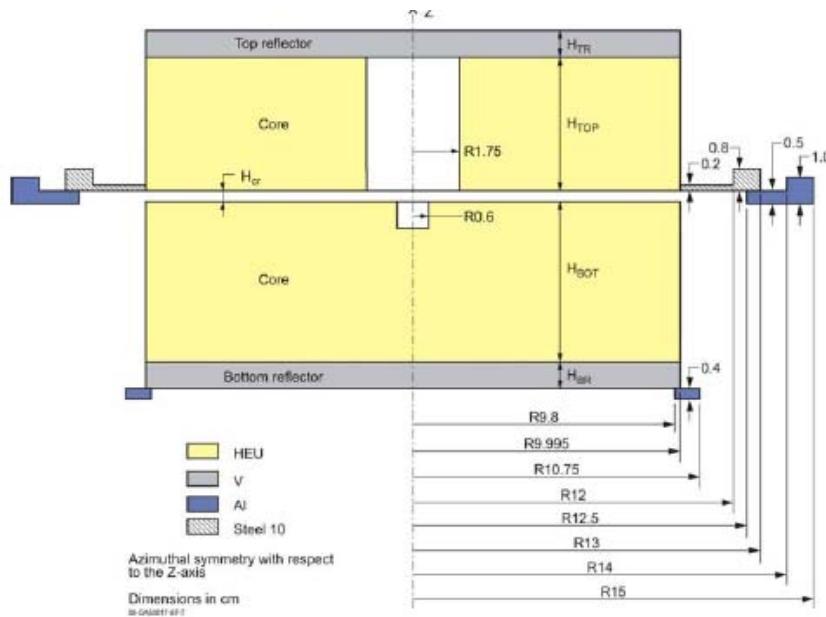
Figure 7. Computational Models for Cases 1, 2, 3, and 5.

HMF25, 2008 ICSBEP Handbook
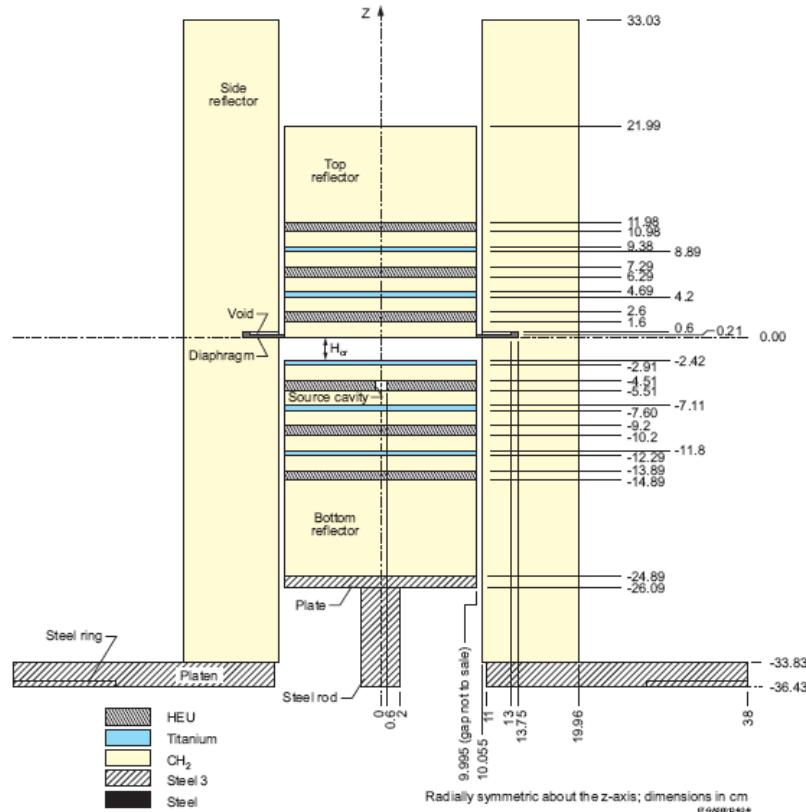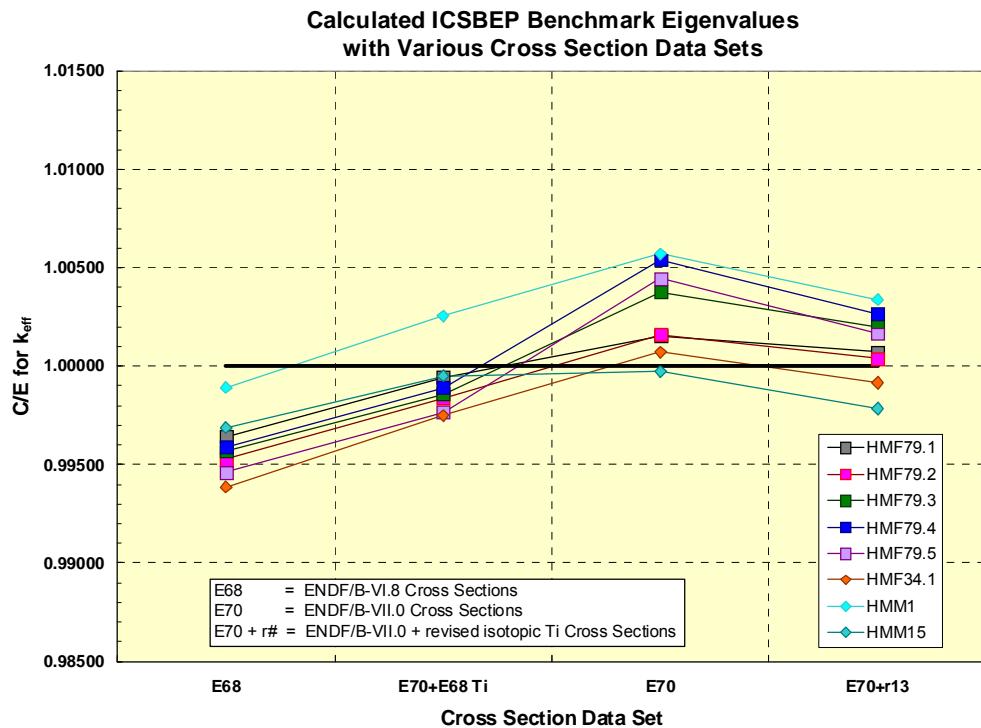
Figure 5. The Configuration of the Benchmark Model of the Assembly.
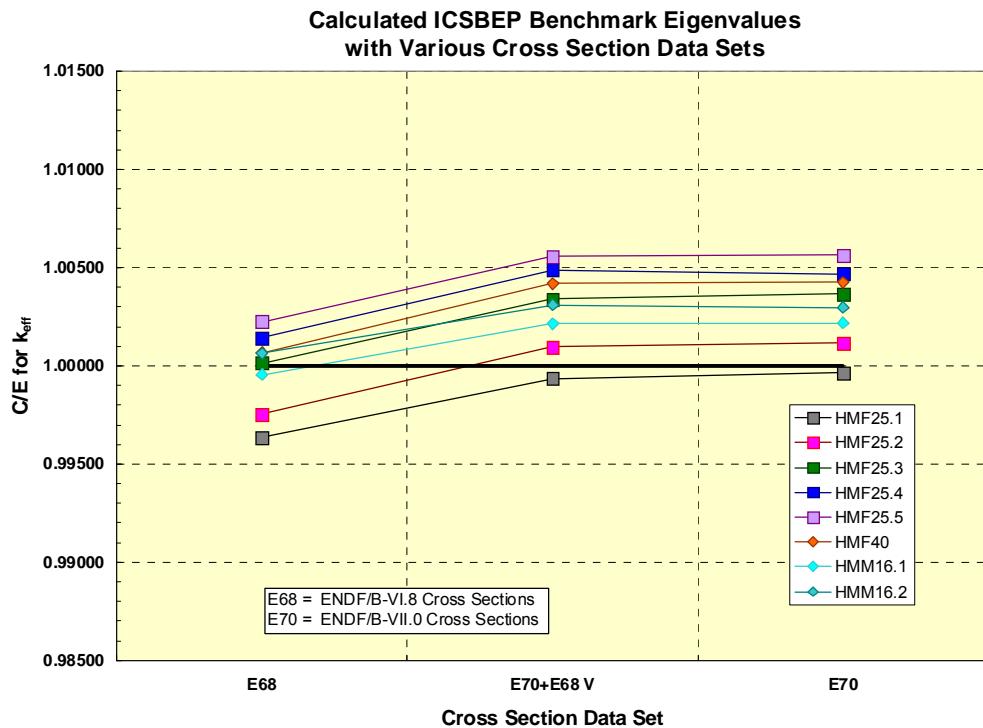
HMM15, 2008 ICSBEP Handbook

Data Testing: Ti Benchmarks

**Calculated ICSBEP Benchmark Eigenvalues
with Various Cross Section Data Sets**

- ENDF/B-VII.0 based eigenvalues are less accurate than those obtained with ENDF/B-VI.8.

- Revised LANL Ti isotopic data sets eliminate much of this deficiency.
  - Average calculated eigenvalues are still biased high.

Data Testing: V Benchmarks

**Calculated ICSBEP Benchmark Eigenvalues
with Various Cross Section Data Sets**

Legend:
- HMF25.1
- HMF25.2
- HMF25.3
- HMF25.4
- HMF25.5
- HMF40
- HMM16.1
- HMM16.2

E68 = ENDF/B-VI.8 Cross Sections
E70 = ENDF/B-VII.0 Cross Sections

Y-axis: C/E for k_{eff}
X-axis: Cross Section Data Set (E68, E70+E68 V, E70)
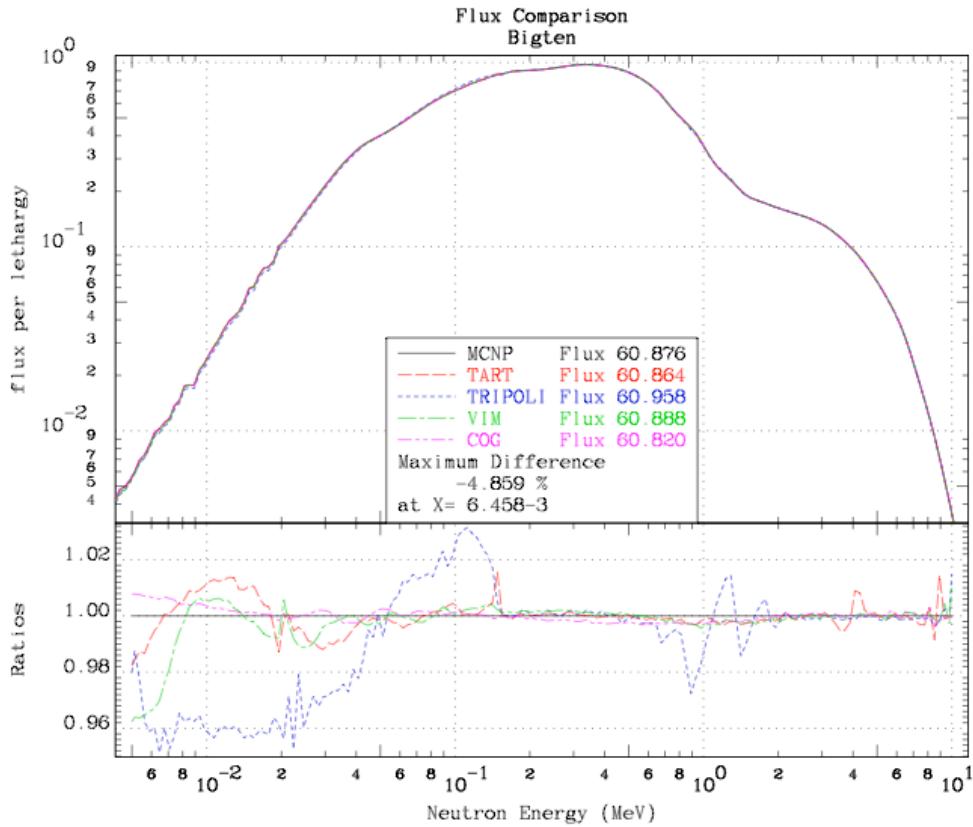
- Average calculated eigenvalue is too high.

- HMF25.x exhibits increasing calculated eigenvalue trend with increasing axial reflector thickness.

Data Testing: Ti and V Benchmarks
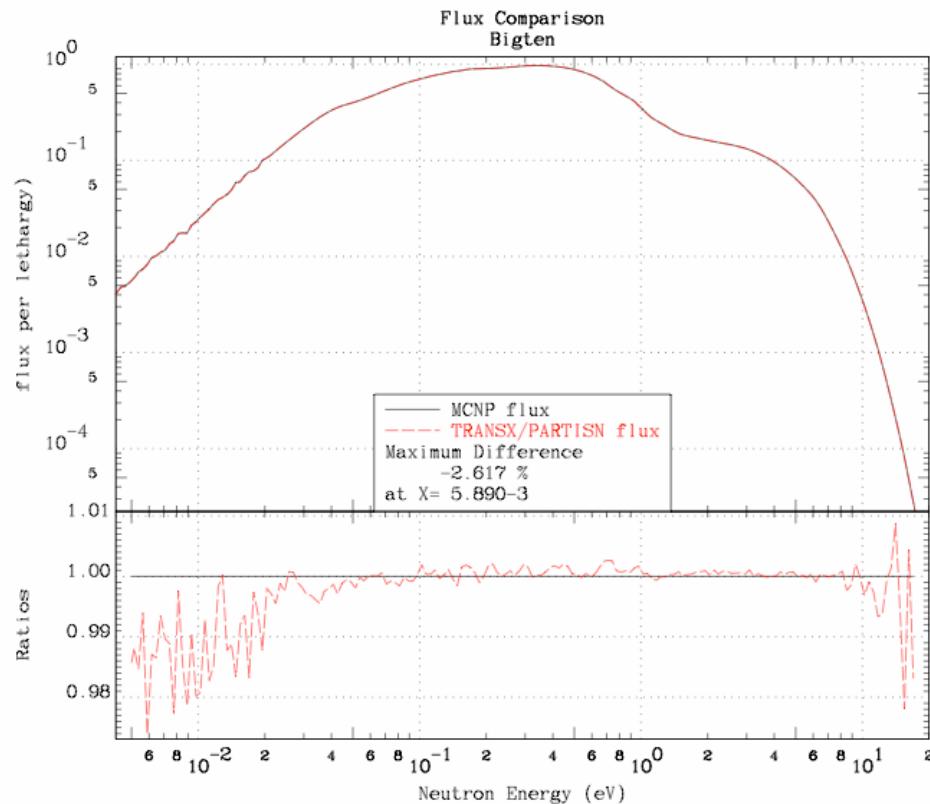
- Conclusions
  - Eigenvalues for Ti bearing benchmarks are calculated more accurately with the latest LANL generated isotopic Ti data files.
    - The increasing calculated eigenvalue trend introduced with the current ENDF/B-VII.0 isotopic Ti data sets has been significantly reduced.

  - ENDF/B-VII.0 V is a carryover from ENDF/B-VI, evaluated by ANL in the late 1980's, with minor revisions by BNL. These integral data testing results suggest there may be deficiencies in either the elastic scattering angular distributions and the secondary energy distributions.

Data Testing - Code Comparison

Flux Comparison
Bigten

MCNP   Flux 60.876
TART   Flux 60.864
TRIPOLI Flux 60.958
VIM   Flux 60.888
COG   Flux 60.820
Maximum Difference
−4.859 %
at X= 6.458-3

- Results of code compar-ison for the (simple) CSEWG 1-D Big-10 Benchmark
  - ENDF/B-VII.0 cross sections
    - Benchmark = 0.996 ± 0.003
    - MCNP (LANL) - 0.99768(5)
    - TART/COG (LLNL) – 0.99783(5)/0.99763(5)
    - VIM (Argonne) – 0.99763(5)
    - Tripoli (France) – 0.99831(5)

Data Testing - Code Comparison

Flux Comparison
Bigten

- **Excellent agreement between continuous energy Monte Carlo (MCNP5) and deterministic codes (TRANSX/PARTISN).**
  - S_n used 267 cross section groups, P_5, S_{32} and 120 spatial intervals.
  - calculated eigenvalues agree to within 50 pcm.

Data Testing - Code Comparison
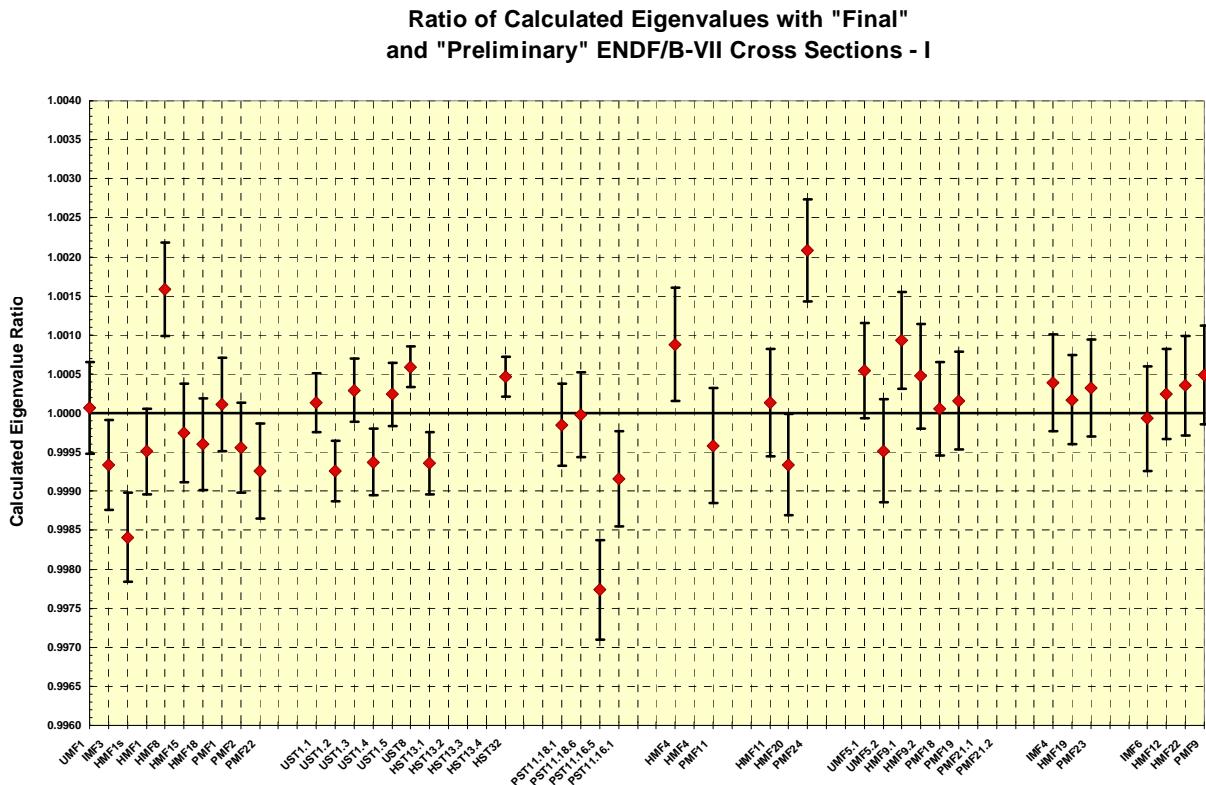
- Excellent agreement in calculations among these code systems provides assurance that conclusions on the adequacy or deficiency in a given cross section are not driven by a particular code bias.

Data Testing
"Official" MCNP5 ENDF/B7 Library

- Benchmark eigenvalue calculations have been performed for a suite of 89 ICSBEP and/or CSEWG benchmarks.
  - These benchmarks cover the standard ICSBEP categories, but are weighted toward "FAST" benchmarks.

- 74 of these benchmarks have been independently modeled and calculated with unofficial ENDF/B-VII.0 libraries created by Bob MacFarlane in December, 2006.

- Ratios of calculated eigenvalues follow.

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Data Testing
"Official" MCNP5 ENDF/B7 Library

Ratio of Calculated Eigenvalues with "Final" and "Preliminary" ENDF/B-VII Cross Sections - I
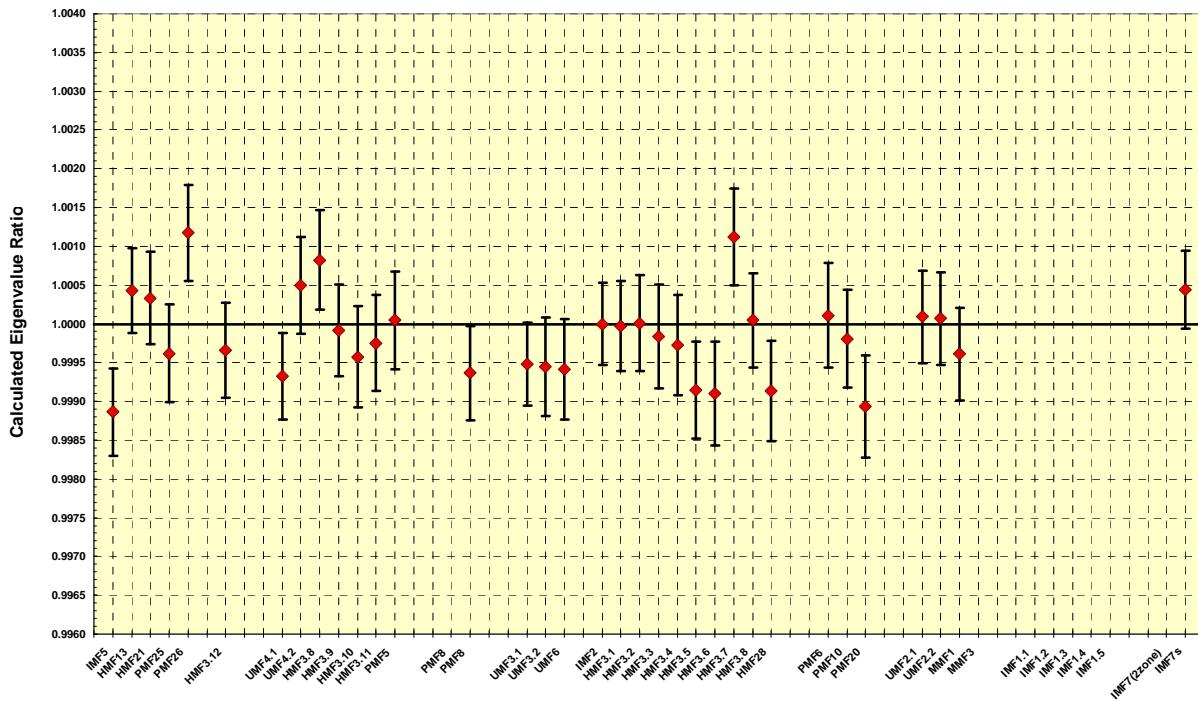
- 49/74 compari-sons agree to within 1σ.

- 68/74 compari-sons agree within the 95% confidence interval.
  - This is a reasonable distribution of differences.

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Data Testing
"Official" MCNP5 ENDF/B7 Library

Ratio of Calculated Eigenvalues with "Final"
and "Preliminary" ENDF/B-VII Cross Sections - II

- No systematic differences observed.

Data Testing
"Official" MCNP5 ENDF/B7 Library

- Conclusion
  - The official ENDFB7 MCNP library is part of the MCNP5-1.50 distribution recently released to RSICC.

  - Excellent agreement is observed in calculated eigenvalues compared to those calculated with preliminary libraries generated to support ENDF/B-VII beta testing and immediately following the official release of ENDF/B-VII.0 in December 2006.