

ENDF/B-VII β 1 Data Testing

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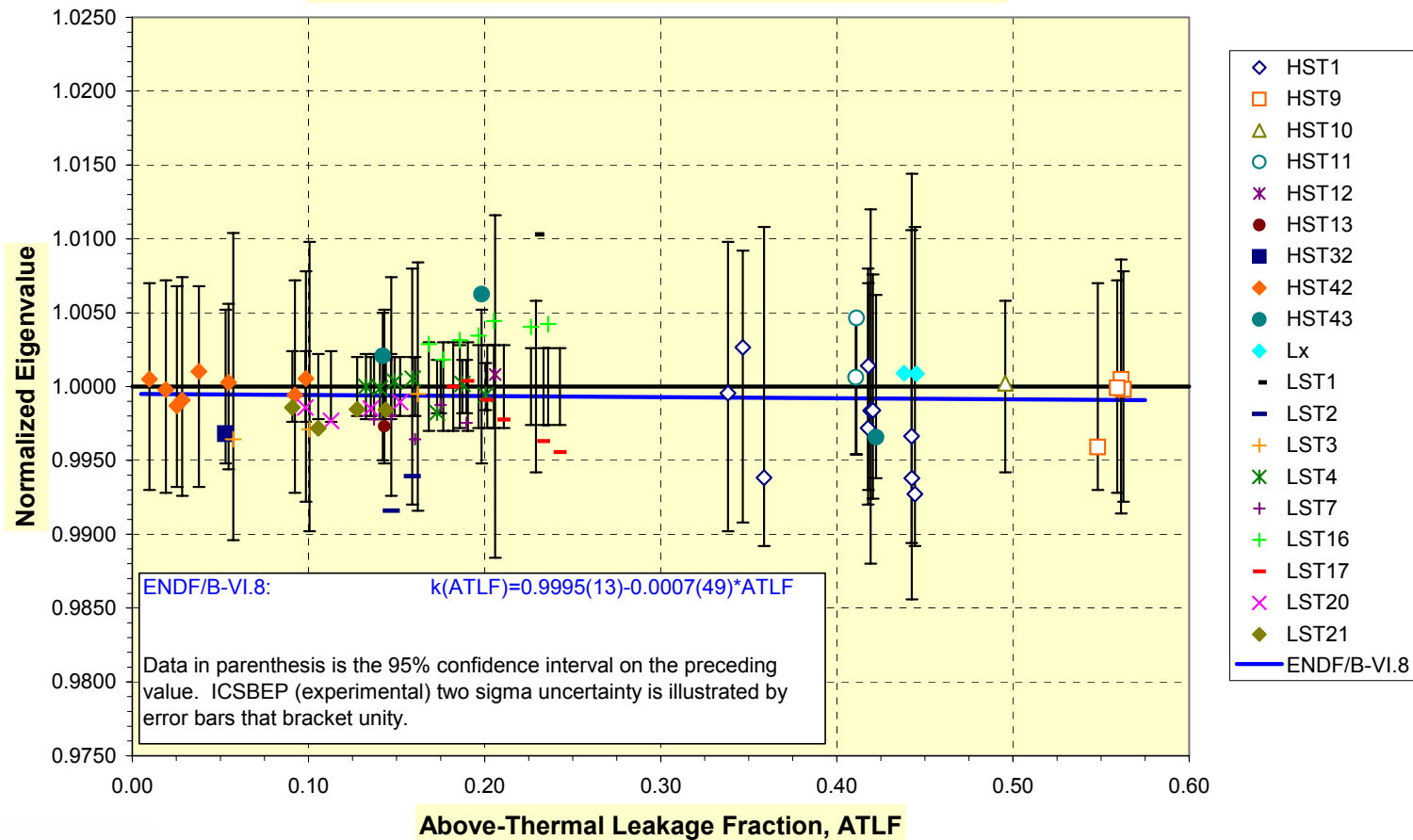
Thermal Data Testing with ICSBEP Benchmarks

- Homogeneous Solutions
 - HEU-SOL-THERM benchmarks
- Low Enriched Lattices
 - LCT-006, LCT-002 & LCT-010
- Metallic, highly enriched uranium (unmoderated and/or polyethylene moderation and reflection)
 - HEU-MET-FAST-007



Thermal Data Testing with ICSBEP Benchmarks

Calculated Eigenvalues for ICSBEP Benchmarks



Thermal Data Testing with ICSBEP Benchmarks

Normalized Eigenvalues for Selected HEU-SOL-THERM Benchmarks

Benchmark	ENDF/B-VI.8 (LANL, MCNP5)	ENDF/B-VII β 1 (LANL, MCNP5)	Difference ENDF/B-VII β 1 minus ENDF/B-VI.8	ENDF/B-VII β 1 (van der Marck, MCNP4C3)
HEU-SOL-THERM-009				
case 2	1.00034(33)	0.99951(35)	-0.00084(48)	0.99986(404)
case 3	0.99903(33)	0.99952(36)	+0.00049(49)	0.99902(375)
HEU-SOL-THERM-010				
case 1	1.00051(32)	1.00008(33)	-0.00043(46)	0.99903(305)
HEU-SOL-THERM-032				
case 1	0.99750(14)	0.99690(14)	-0.00060(20)	0.99593(263)
HEU-SOL-THERM-042				
case 1	1.00138(16)	1.00040(16)	-0.00098(23)	1.00003(395)
case 2	1.00030(15)	0.99980(16)	-0.00050(22)	0.99930(364)
case 3	1.00133(14)	1.00032(13)	-0.00101(19)	0.99922(283)
case 5	0.99924(10)	0.99919(11)	-0.00005(15)	0.99964(341)
case 7	1.00034(10)	1.00032(10)	-0.00002(14)	1.00012(361)
case 8	1.00106(8)	1.00127(9)	+0.00021(12)	1.00081(351)

Note: LANL MCNP5 Monte Carlo eigenvalue uncertainties are 1 σ .

Thermal Data Testing with ICSBEP Benchmarks

- Large, low leakage solution eigenvalues are lowered by less than 100 pcm with ENDF/B-VII β 1 cross sections.
- Small, high leakage solution eigenvalues are lowered by less than 50 pcm with ENDF/B-VII β 1 cross sections.
- ENDF/B-VII β 1 cross section eigenvalues for homogeneous solution systems remain very good.

Thermal Data Testing with ICSBEP Benchmarks

Normalized Eigenvalues for Selected HEU-SOL-THERM Benchmarks

Benchmark	ENDF/B-VI.8 (LANL, MCNP5)	ENDF/B-VII β 1 (LANL, MCNP5)	ENDF/B-VII β 1 with extended thermal scattering data
HEU-SOL-THERM-009 case 3	0.99903(33)	0.99952(36)	0.99982(34)
HEU-SOL-THERM-042 case 3	1.00133(14)	1.00032(13)	1.00049(14)

Thermal Data Testing with ICSBEP Benchmarks

Normalized Eigenvalues for Selected LEU-COMP-THERM Benchmarks

Benchmark	ENDF/B-VI.8 (LANL, MCNP5)	ENDF/B-VII β 1 (LANL, MCNP5)	Difference ENDF/B-VII β 1 minus ENDF/B-VI.8	ENDF/B-VII β 1 (van der Marck, MCNP4C3)
LEU-COMP-THERM-006				
case 1	0.9925	0.99831(25)	+0.00581	0.99848(201)
case 2	0.9931	0.99881(25)	+0.00571	0.99919(201)
case 3	0.9930	0.99928(26)	+0.00628	0.99920(201)
case 4		0.99832(26)		0.99816(201)
case 6	0.9937	0.99895(26)	+0.00525	0.99876(201)
case 7	0.9929	0.99844(26)	+0.00554	0.99868(201)
case 8	0.9932	0.99877(25)	+0.00557	0.99945(201)
case 9	0.9939	0.99850(25)	+0.00460	0.99868(201)
LEU-COMP-THERM-002				
case 4	0.99341(25)	0.99676(26)	+0.00335(36)	0.99555(196)
case 5	0.99244(25)	0.99488(26)	+0.00244(36)	0.99641(203)
LEU-COMP-THERM-010				
case 1	1.00521(26)	1.00625(26)	+0.00104(37)	1.00686(226)
case 2	1.00450(26)	1.00588(27)	+0.00138(37)	1.00541(228)
case 3	1.00258(26)	1.00379(26)	+0.00121(37)	1.00482(222)
case 4	0.99199(26)	0.99518(26)	+0.00319(37)	0.99577(224)

Note: LANL MCNP5 Monte Carlo eigenvalue uncertainties are 1σ . LEU-COMP-THERM-006, ENDF/B-VI.8 results from Bob MacFarlane's "Testing New Actinide Cross Sections Proposed for ENDF/B-VII (LA-UR-04-6948, presented at ND2004).

Thermal Data Testing with ICSBEP Benchmarks

- Water moderated and reflected LEU-COMP-THERM eigenvalues are significantly improved with ENDF/B-VII β 1 cross sections.
- The problem of elevated eigenvalues when non-hydrogeneous reflectors are present has not been solved.

Data Testing with ICSBEP Benchmarks

Normalized Eigenvalues for Selected HEU-MET-FAST-007 Benchmarks
(using revised specifications from the 2005 ICSBEP Handbook)

Benchmark	ENDF/B-VI.8 (LANL, MCNP5)	ENDF/B-VII β 1 (LANL, MCNP5)	Difference ENDF/B-VII β 1 minus ENDF/B-VI.8	ENDF/B-VII β 1 (van der Marck, MCNP4C3)
HEU-MET-FAST-007				
case 19 *	0.99800(22)	1.00125(22)	+0.00325(31)	0.99792(63)
case 20 *	0.99949(25)	1.00295(25)	+0.00346(35)	0.99835(81)
case 25 *	0.99928(28)	1.00243(27)	+0.00315(39)	0.99928(82)
case 26 *	0.99889(27)	1.00192(28)	+0.00303(39)	0.99846(89)
case 35 *	0.99812(27)	1.00199(28)	+0.00387(39)	0.99388(80)
case 36	1.00020(29)	1.00312(29)	+0.00292(41)	1.00192(89)
case 42	0.99844(30)	1.00091(29)	+0.00247(42)	1.00004(86)
case 43	0.99874(32)	1.00073(31)	+0.00199(46)	1.00019(83)
Note: LANL MCNP5 Monte Carlo eigenvalue uncertainties are 1σ . (*) means this case is revised in the 2005 Handbook.				

Data Testing with ICSBEP Benchmarks

- The Average Energy of Neutrons Causing Fission range from ~ 750 keV to ~ 30 eV for HEU-MET-FAST-007.
 - Average eigenvalues have increased by ~ 300 pcm (from about 0.999 to about 1.002) with ENDF/B-VII β 1 cross sections.
 - There is no difference in the average calculated eigenvalue for reflected versus unreflected assemblies.