^{233}U Critical Data Testing at LLNL
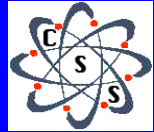
Presentation to the CSEWG on November 8-10, 2005 at BNL

Dave Heinrichs
Criticality Safety Section
Lawrence Livermore National Laboratory

Data Processing *for* COG

- - -

LA-12639-MS (ENDF 356), Robert E. MacFarlane, *New Thermal Neutron Scattering Files for ENDF/B-VI Release 2*, (March 1994).

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IAEA-NDS-39, <u>PREPRO2000 ENDF/B Pre-processing Codes</u>, Dermott E. Cullen, Rev. 10, April 1, 2000.

ORNL/TM-2000/372 (ENDF-365), L. C. Leal et al., *R-Matrix Resonance Analysis and Statistical Properties of the Resonance Parameters of 233U in the Neutron Energy Range from Thermal to 600 eV*, (Mach 2001).

POINT2000: A Temperature-Dependent, Linearly Interpolable, Tabulated Cross Section Library Based on ENDF/B-VI, Release 7, D.E. Cullen.

Bob MacFarlane   **Mark Chadwick**   **Red Cullen**   **Red Cullen Luiz Leal**

Ed Lent   Ed Lent   Ed Lent   Ed Lent

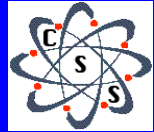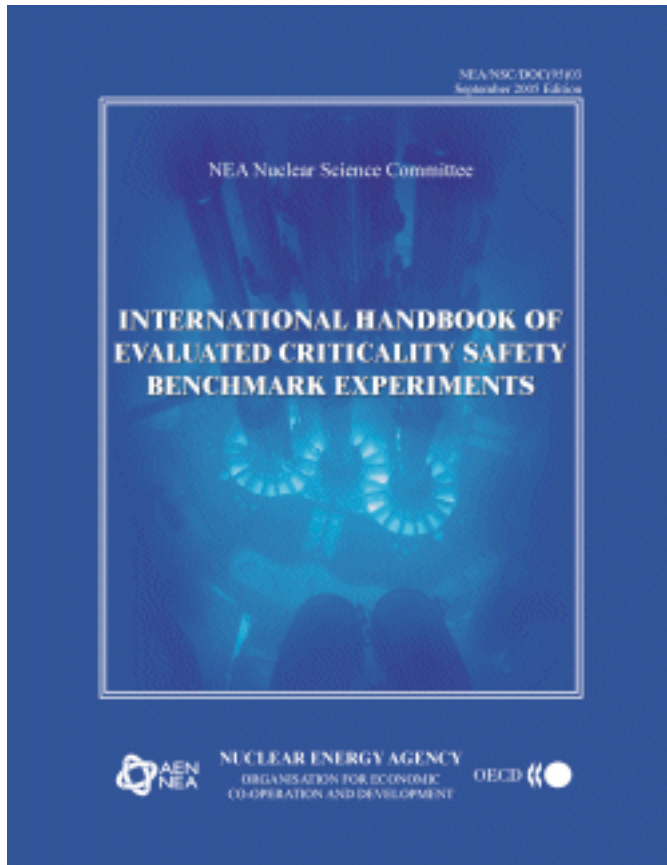| SABtoCOG | ACEtoCOG | ENDFB6toCOG | ENDFB6toCOG |

| COGSAB | MCNP.69c | ENDFB6R7 | RED2002 |

^{233}U:
- ENDFB6R7: EVAL-DEC78 STEWART ET AL, L. WESTON
- RED2002: EVAL-MAR01 LEAL ET AL
- MCNP.69c: ENDFB7β0

ICSBEP Handbook

10	^{233}U Metal (LANL)
5	^{233}UO$_2$-ZrO$_2$ Lattices (Bettis)
64	^{233}UO$_2$F$_2$ Solution (LLNL)
9	^{233}UO$_2$F$_2$ Solution (ORNL)
105	^{233}UO$_2$(NO$_3$)$_2$ Solution (ORNL)
193	Total ^{233}U Benchmarks

Fast Metal Systems
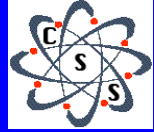
No.	Reference	^{233}U	Reflector	Benchmark	ENDFB6R7	LEAL	ENDFB7β0
1	U23MF001-1	16.535 kg	None	1.0000(10)	0.9913(3)	0.9984(3)	0.9972(3)
2	U23MF002-1	10.012 kg	Oy	1.0000(10)	0.9943(3)	0.9970(3)	0.9959(3)
3	U23MF002-2	7.601 kg	Oy	1.0000(11)	0.9971(3)	0.9980(3)	0.9972(3)
4	U23MF003-1	10.012 kg	Nat-U	1.0000(10)	0.9957(3)	0.9985(3)	0.9969(3)
5	U23MF003-2	7.601 kg	Nat-U	1.0000(10)	0.9977(3)	0.9987(3)	0.9987(3)
6	U23MF004-1	10.012 kg	W-Alloy	1.0000(07)	1.0025(3)	1.0077(3)	1.0032(3)
7	U23MF004-2	7.601 kg	W-Alloy	1.0000(08)	1.0047(3)	1.0100(3)	1.0039(3)
8	U23MF005-1	10.012 kg	Be	1.0000(30)	0.9938(3)	0.9994(3)	0.9951(3)
9	U23MF005-2	7.601 kg	Be	1.0000(30)	0.9965(3)	1.0025(3)	0.9952(3)
10	U23MF006-1	5.740 kg	Flattop	1.0000(14)	0.9993(3)	0.9995(3)	0.9975(3)

Mean (w/o W-Alloy and Be cases)	1.0000(5)	0.9959(26)	0.9984(8)	0.9972(8)
Range (w/o W-Alloy and Be cases)		0.80%	0.25%	0.28%

COG ENDFB6R7 Results - ICSBEP ^{233}U Thermal/Intermediate Benchmarks

COG ENDFB7β0 Results - ICSBEP ^{233}U Thermal/Intermediate Benchmarks

COG ENDB6R7/Leal Results - ICSBEP ^{233}U Thermal/Intermediate Benchmarks
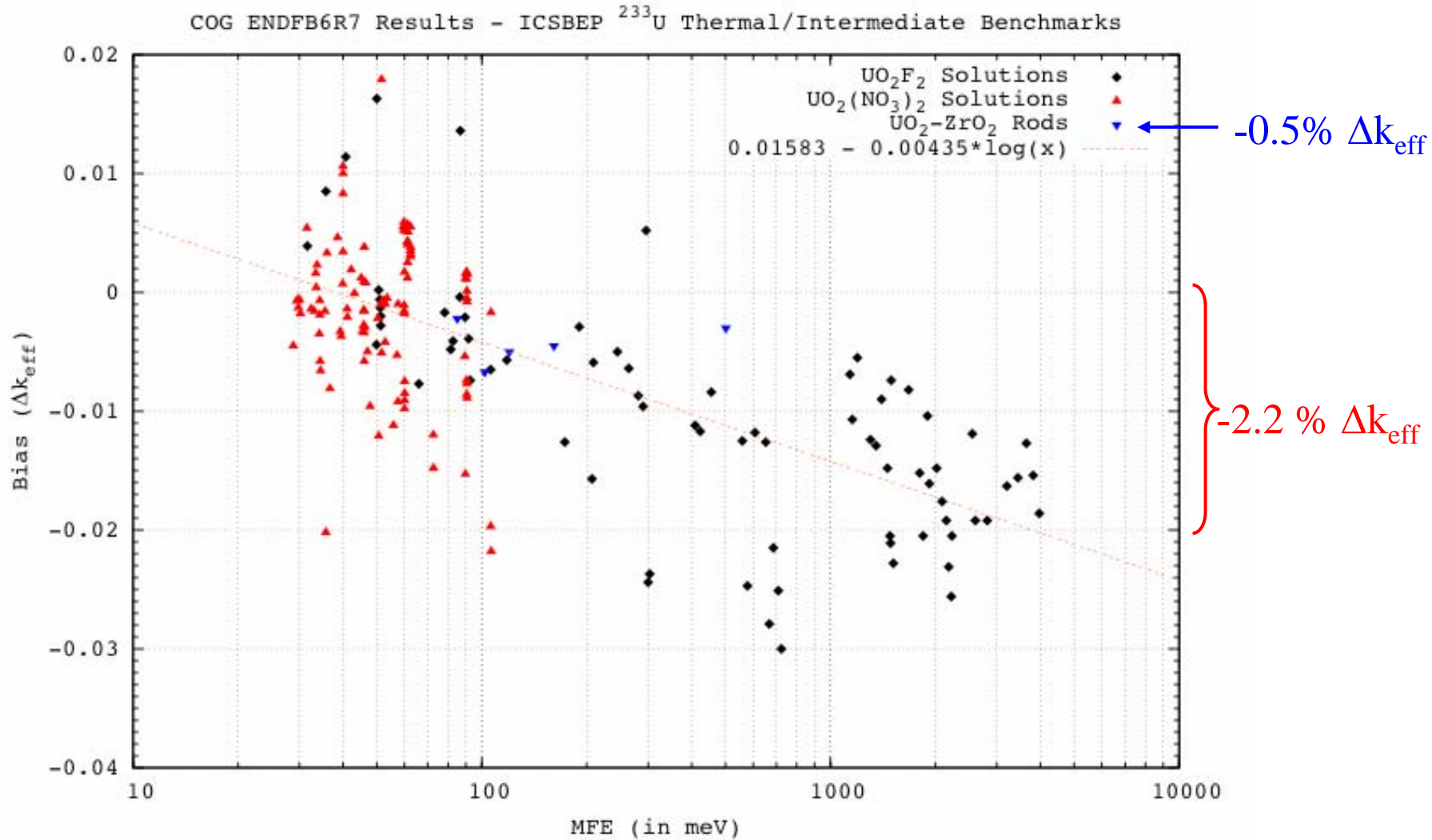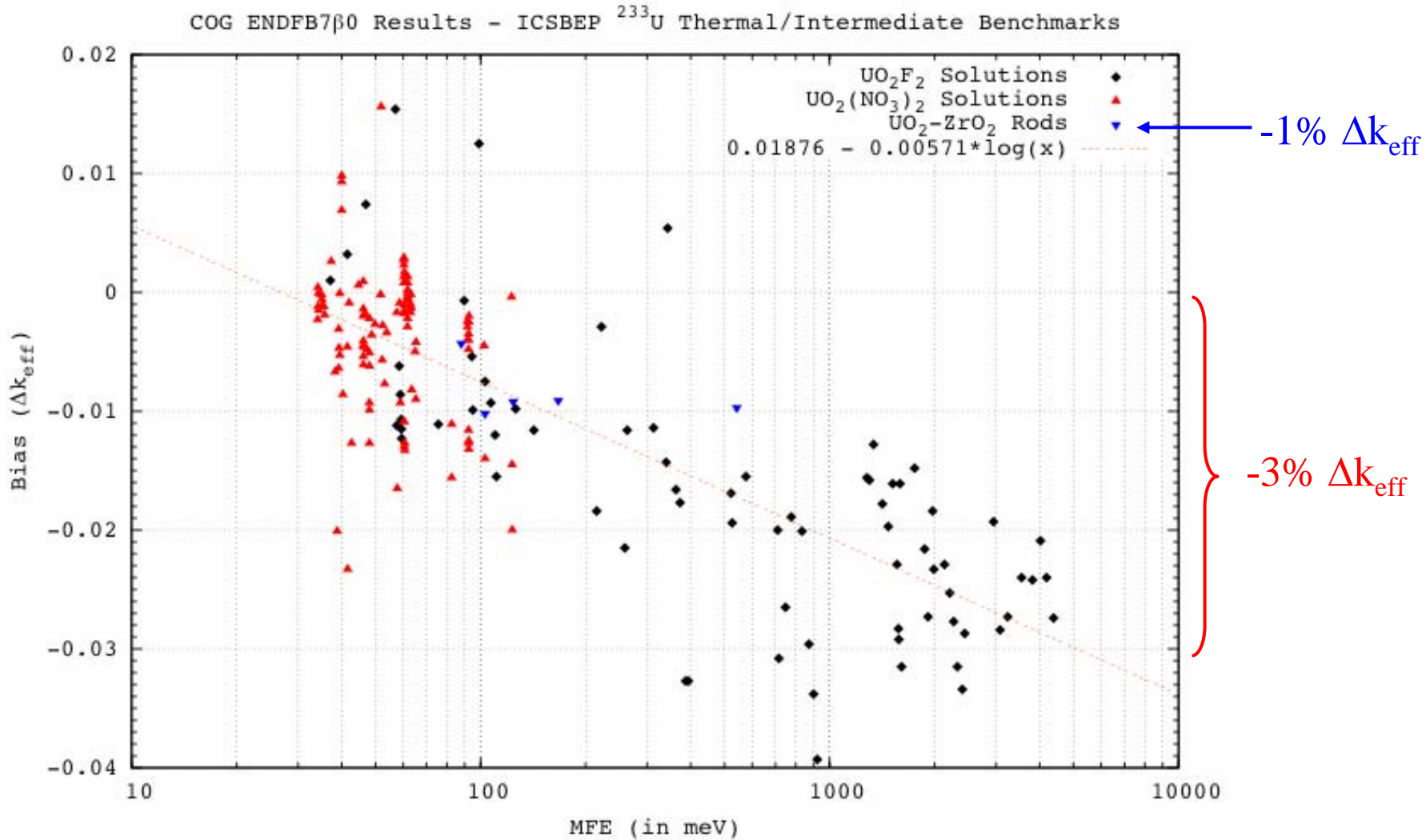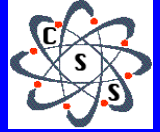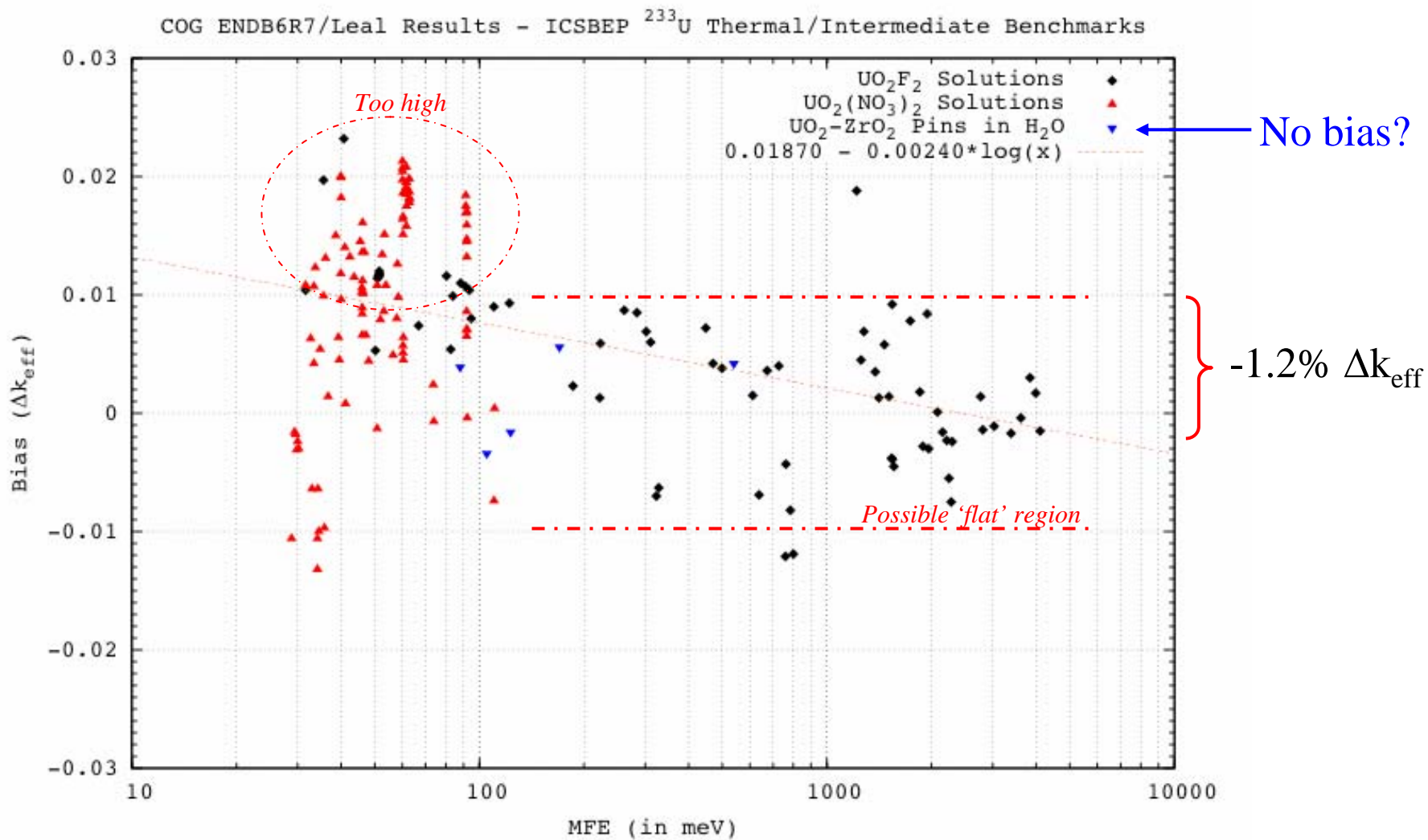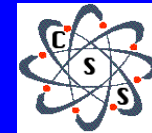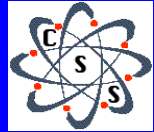
Conclusions

Fast Energies:

ENDFB7β0 and 'LEAL' are an improvement over ENDFB6R7. The spread in k_{eff} is reduced (from 0.80%) by a factor of three (to 0.25% and 0.28%) and $<k_{eff}>$ is increased (from 0.996 to 0.998 and 0.997).

Intermediate Energies:

ENDFB6R7 (bad) and ENDFB7β0 (worse) both underpredict $<k_{eff}>$ with a significant downward trend in energy. 'LEAL' results are superior with much less of a trend (if any).

Thermal Energies:

'LEAL' results have some that are too high and ENDFB7β0 and ENDFB6R7 have some that are too low. <u>All</u> results show a 3% Δk_{eff} spread in the critical values with MFE < 100 meV. This is a problem.