Data Testing at ANL

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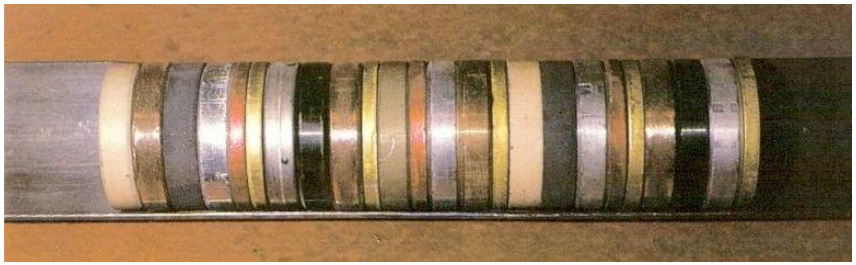
Introduction

- Goal – Extend ANL fast reactor validation suite of MCNP models
  - Additional reactor configurations and lower energy range
- BFS fast reactor assemblies
  - Close matches to ANL ZPR/ZPPR assemblies
  - Still operating so newer designs are simulated
- BFS/COBRA (KBR) k-infinity measurements
  - Test specific isotopes in relevant energy ranges
  - Emphasize particular energy range or material

ZPR/ZPPR – Drawer and Matrix Loading

ZPPR (1969 – 1990)

BFS – Cutaway Steel Tube and Core Loading



BFS Fast Reactor Critical Assemblies

- BFS-61-0 - MIX-MET-FAST-006 - Core of Pu, depleted uranium, graphite and lead surrounded by layers of lead, steel and depleted UO2
- BFS-73-1 - BFS1-LMFR-EXP-001 - Sodium-cooled fast reactor with uranium metal fuel (IFR) and depleted UO2 blanket – extends ZPPR-15 results
- BFS-76-0 - Sodium-cooled fast reactor with Pu and enriched U metal fuel (IFR) and depleted UO2 blanket – extends ZPPR-15 results
- BFS-85-1, BFS-85-2, BFS-87-1, BFS-87-2 – Experiments to determine scattering and transport cross sections of lead and bismuth

BFS Fast Reactor Calculations - ENDF/B-VII.1

Assembly	EALF, MeV	Fuel	C/E -1, %	σ, %
BFS-61-0	0.1786	Pu, depleted U	-0.428	0.289
BFS-73-1	0.1860	Uranium	-0.443	0.289
BFS-76-0	0.1435	Pu and enriched U	-1.234*	
BFS-85-1	0.2283		0.045	0.270
BFS-85-2	0.2279		0.078	0.270
BFS-87-1	0.2392		-0.370	0.299
BFS-87-2	0.2331		-0.647	0.298

Miscellaneous BFS Assemblies - Fast and Intermediate Energy Range

- MIX-MISC-FAST-001 - BFS-31, -33, -35, -38, -42
  - K-infinity measurements with enriched uranium or plutonium mixed with depleted uranium

- MIX-MISC-FAST-002 - BFS-49-1
  - Core of plutonium, depleted uranium and polyethylene

Miscellaneous BFS Assemblies - Fast and Intermediate Energy Range - Results - ENDF/B-VII.1

Assembly	EALF, MeV	Fuel	C/E -1, %	σ, %
BFS-38-1	0.4302	Pu, DU	-1.399	0.611
BFS-38-2	0.4154	Pu, DU	-1.857	0.640
BFS-35-3	0.3327	U(90), DU	-1.006	0.586
BFS-35-1	0.3120	U(36), DU	-0.782	0.724
BFS-35-2	0.3067	U(36), DU	-1.116	0.561
BFS-31-5	0.1564	Pu, DUO2	-0.406	0.655
BFS-31-4	0.1560	Pu, DUO2	-1.197	0.698
BFS-33-1-3	0.0853	U(90)O2, DUO2	-0.045	0.573
BFS-33-2-1	0.0831	U(90)O2, DUO2	-0.143	0.391
BFS-33-1-1	0.0822	U(90)O2, DUO2	-0.483	0.557

Miscellaneous BFS Assemblies - Fast and Intermediate Energy Range - Results - (Continued)

Assembly	EALF, MeV	Fuel	C/E -1, %	σ, %
BFS-42	0.0813	Pu, DUO2	-0.402	0.726
BFS-49-1	0.2393	Pu, DUO2	-0.523	0.209

BFS Assemblies – Pu and HEU in the Lower Energy Range

- Assemblies chosen to extend lower energy range
- PU-MET-MIXED-001 - BFS-81/1 through BFS-81/5
  - BFS-81 examined spent fuel storage
  - Assemblies consisted of pellets of Pu metal, silicon dioxide and polyethylene
- HEU-MET-MIXED-005 - BFS-79/1 through BFS-79/5
  - BFS-79 was the uranium-fueled companion to BFS-81
  - Assemblies consisted of pellets of HEU metal, silicon dioxide and polyethylene

BFS Assemblies – Pu and HEU in the Lower Energy Range – Results – ENDF/B-VII.1

Assembly	EALF, MeV	Fuel	C/E -1, %	σ, %
BFS-81/1	4.69E-03	Plutonium	1.149	0.374
BFS-81/2	2.52E-04	Plutonium	0.783	0.252
BFS-81/3	5.61E-05	Plutonium	0.958	0.252
BFS-81/4	1.33E-06	Plutonium	1.047	0.253
BFS-81/5	1.30E-06	Plutonium	0.953	0.252

BFS Assemblies – Pu and HEU in the Lower Energy Range – Results (Continued)

Assembly	EALF, MeV	Fuel	C/E -1, %	σ, %
BFS-79/5	4.93E-03	HEU	0.011	0.400
BFS-79/4	1.56E-04	HEU	0.647	0.301
BFS-79/1	3.77E-05	HEU	0.502	0.271
BFS-79/2	1.00E-05	HEU	1.611	0.285
BFS-79/3	1.51E-06	HEU	1.366	0.294

Summary

- BFS fast reactor assembly models are a good complement to the ANL suite of ZPR/ZPPR assembly models.
- BFS fast reactor assembly models address reactor design and data issues that are not covered by ZPR/ZPPR assemblies.
- BFS/KBR k-infinity models emphasize specific materials and energy ranges of interest.