# ANL Data Validation Results Test Beta-Versions of ENDF/B-VII.1

Cross Section Evaluation Working Group Meeting

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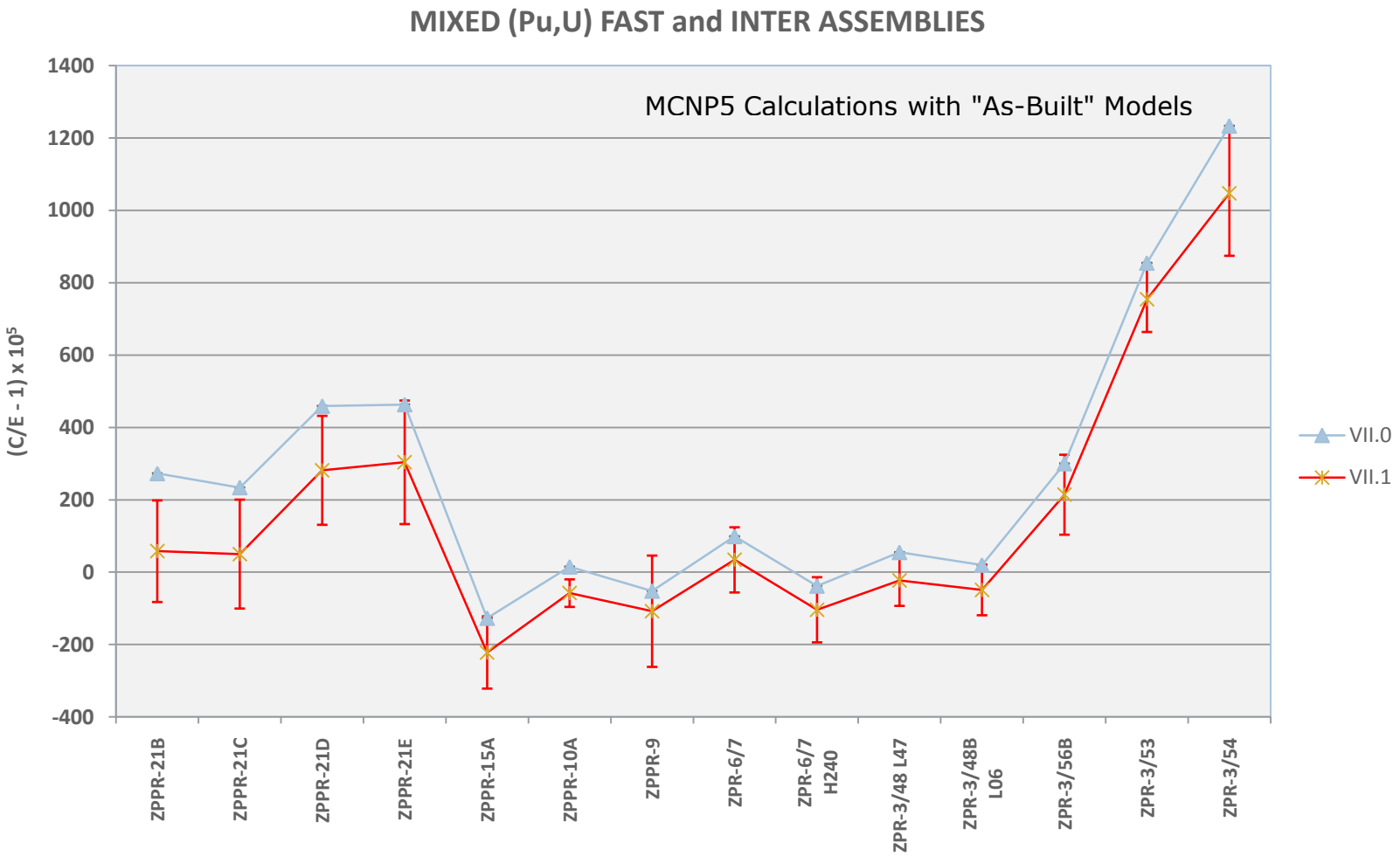
# Outline (of Unfinished Presentation)

- Wide variety of Validation Calculations using MCNP5 and ENDF/B-VII.0 and various ENDF/B-VII.1beta Versions
- Criticality Calculations for Fast and Intermediate ZPR/ZPPR Assemblies
  - Reference Configurations using 44 As-Built Models
- Beta-effective Measurements
- Na-Void Worth Measurements
- Control Rod Worth Measurements
- "Focused" testing on Structural Materials, $^{239}$Pu and $^{240}$Pu
- Summary

# ZPR/ZPPR MCNP5 Calculations with "As-Built Models MIXED (Pu,U) FAST and INTER ASSEMBLIES

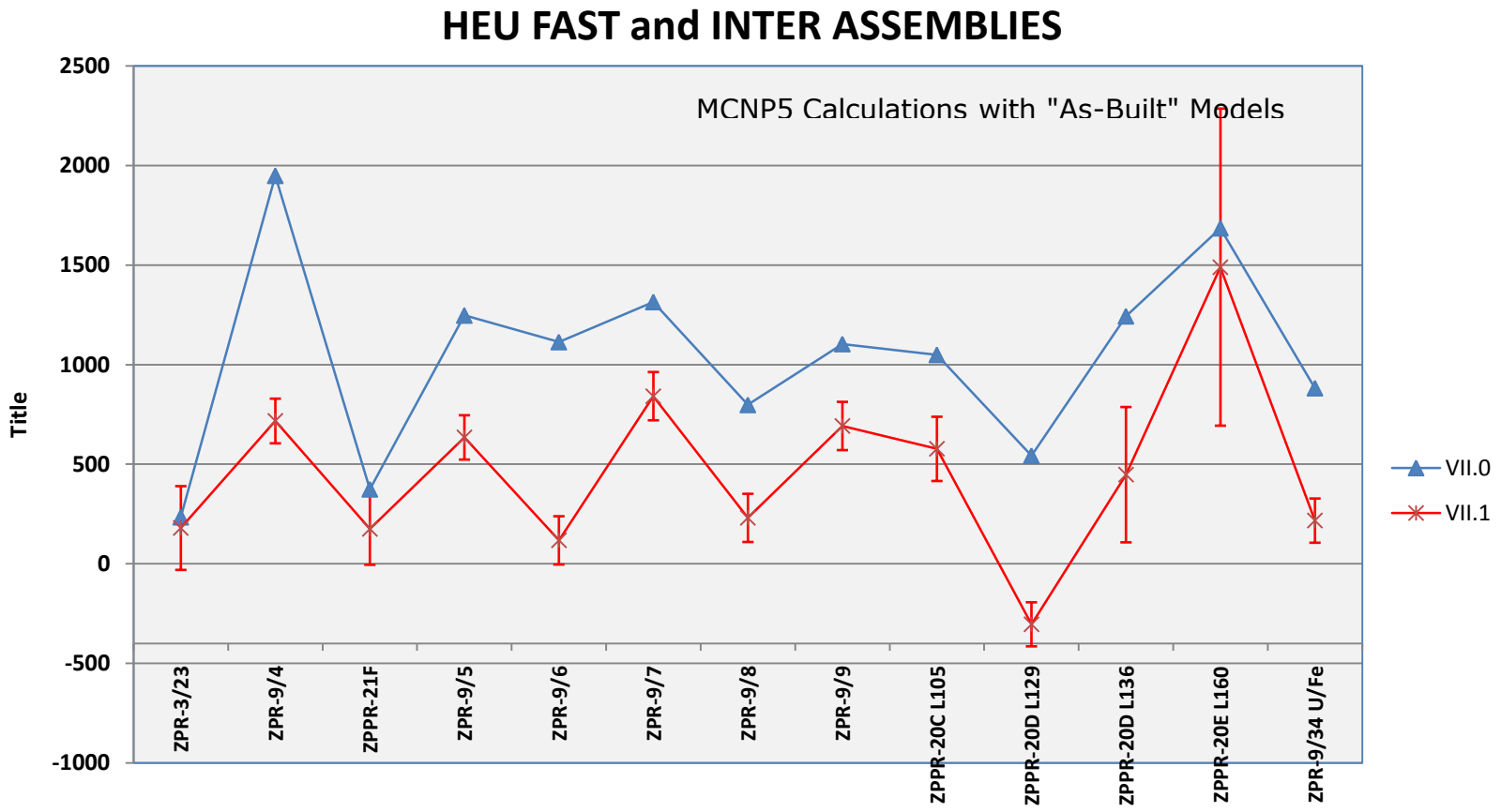


# ZPR/ZPPR MCNP5 Calculations with "As-Built Models MIXED (Pu,U) FAST and INTER ASSEMBLIES

| Benchmark | Case | As-built - adj exper k | | Version VII.0 | | Version VII.1 beta 3 | | Difference | | Version VII.0 | | Version VII.1 beta 3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | k-eff | σ | k-eff | σ | k-eff | σ | Δk | σ | C/E-1 | σ | C/E-1 | σ |
| MIX-MET-FAST-011-001 | ZPPR-21B | 1.00070 | 0.00140 | 1.00343 | 0.00007 | 1.00128 | 0.00007 | -0.00215 | 0.00010 | 273 | 140 | 58 | 140 |
| MIX-MET-FAST-011-002 | ZPPR-21C | 0.99980 | 0.00150 | 1.00214 | 0.00007 | 1.00030 | 0.00007 | -0.00184 | 0.00010 | 234 | 151 | 50 | 151 |
| MIX-MET-FAST-011-003 | ZPPR-21D | 1.00180 | 0.00150 | 1.00640 | 0.00007 | 1.00462 | 0.00007 | -0.00178 | 0.00010 | 459 | 151 | 281 | 151 |
| MIX-MET-FAST-011-004 | ZPPR-21E | 1.00120 | 0.00170 | 1.00584 | 0.00007 | 1.00424 | 0.00007 | -0.00160 | 0.00010 | 463 | 171 | 304 | 171 |
| Un-Published | ZPPR-15A | 1.00045 | 0.00100 | 0.99918 | 0.00003 | 0.99823 | 0.00003 | -0.00095 | 0.00004 | -127 | 100 | -222 | 100 |
| ZPPR-LMFBR-EXP-001 | ZPPR-10A | 1.00096 | 0.00038 | 1.00111 | 0.00003 | 1.00038 | 0.00003 | -0.00073 | 0.00004 | 15 | 38 | -58 | 38 |
| ZPPR-LMFBR-EXP-002 | ZPPR-9 | 1.00080 | 0.00154 | 1.00028 | 0.00003 | 0.99972 | 0.00003 | -0.00056 | 0.00004 | -52 | 154 | -108 | 154 |
| MIX-COMP-FAST-001 | ZPR-6/7 | 1.00050 | 0.00090 | 1.00149 | 0.00003 | 1.00084 | 0.00003 | -0.00065 | 0.00004 | 99 | 90 | 34 | 90 |
| MIX-COMP-FAST-002 | ZPR-6/7 H240 | 1.00080 | 0.00090 | 1.00042 | 0.00005 | 0.99976 | 0.00005 | -0.00066 | 0.00007 | -38 | 90 | -104 | 90 |
| MIX-COMP-FAST-003-001 | ZPR-3/48 L47 | 1.00130 | 0.00070 | 1.00185 | 0.00006 | 1.00107 | 0.00006 | -0.00078 | 0.00008 | 55 | 70 | -23 | 70 |
| MIX-COMP-FAST-003-002 | ZPR-3/48B L06 | 1.00170 | 0.00070 | 1.00190 | 0.00006 | 1.00121 | 0.00006 | -0.00069 | 0.00008 | 20 | 70 | -49 | 70 |
| MIX-COMP-FAST-004 | ZPR-3/56B | 0.99950 | 0.00110 | 1.00250 | 0.00006 | 1.00164 | 0.00006 | -0.00086 | 0.00008 | 300 | 111 | 214 | 111 |
| MIX-MET-FAST-014 | ZPR-3/53 | 1.00170 | 0.00090 | 1.01026 | 0.00007 | 1.00926 | 0.00007 | -0.00100 | 0.00010 | 855 | 91 | 755 | 91 |
| MIX-MET-INTER-003 | ZPR-3/54 | 0.99810 | 0.00170 | 1.01041 | 0.00007 | 1.00855 | 0.00007 | -0.00186 | 0.00010 | 1233 | 173 | 1047 | 173 |

- $k_{eff}$ for every assembly is reduced with VII.1β3, by a mean value of 115 ± 8 pcm.
- Mean bias, (C/E -1) x $10^5$, is 271 ± 114 with ENDF/B-VII.0
- Mean bias, (C/E -1) x $10^5$, is 156 ± 114 with ENDF/B-VII.1 β3

# ZPR/ZPPR MCNP5 Calculations with "As-Built Models HEU FAST and INTER ASSEMBLIES

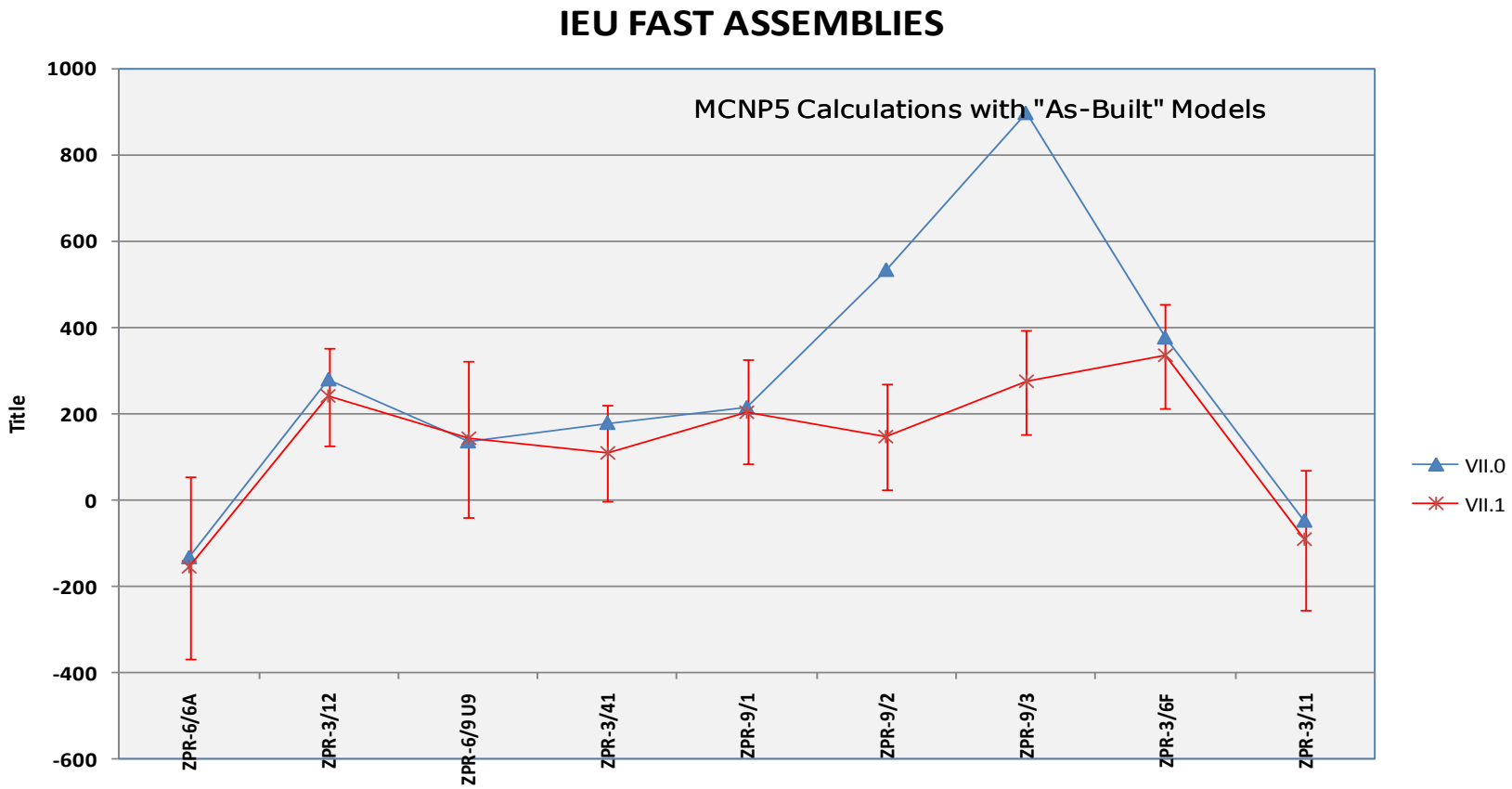


# ZPR/ZPPR MCNP5 Calculations with "As-Built Models HEU (Pu,U) FAST and INTER ASSEMBLIES

| Benchmark | Case | As-built - adj exper k | | Version VII.0 | | Version VII.1 beta 3 | | Difference | | Version VII.0 | | Version VII.1 beta 3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | k-eff | σ | k-eff | σ | k-eff | σ | Δk | σ | C/E-1 | σ | C/E-1 | σ |
| HEU-MET-FAST-055 | ZPR-3/23 | 1.00160 | 0.00210 | 1.00395 | 0.00006 | 1.00340 | 0.00006 | -55 | 8 | 235 | 210 | 180 | 210 |
| HEU-MET-FAST-060 | ZPR-9/4 | 1.00130 | 0.00110 | 1.02081 | 0.00006 | 1.00848 | 0.00005 | -1233 | 8 | 1948 | 112 | 717 | 112 |
| HEU-MET-FAST-061 | ZPPR-21F | 1.00060 | 0.00180 | 1.00435 | 0.00007 | 1.00236 | 0.00007 | -199 | 10 | 375 | 181 | 176 | 181 |
| HEU-MET-FAST-067-001 | ZPR-9/5 | 1.00230 | 0.00110 | 1.01480 | 0.00006 | 1.00866 | 0.00006 | -614 | 8 | 1247 | 111 | 635 | 111 |
| HEU-MET-FAST-067-002 | ZPR-9/6 | 1.00290 | 0.00120 | 1.01407 | 0.00006 | 1.00408 | 0.00006 | -999 | 8 | 1114 | 121 | 118 | 121 |
| HEU-MET-FAST-070-001 | ZPR-9/7 | 1.00390 | 0.00120 | 1.01710 | 0.00006 | 1.01235 | 0.00006 | -475 | 8 | 1315 | 121 | 842 | 121 |
| HEU-MET-FAST-070-002 | ZPR-9/8 | 1.00200 | 0.00120 | 1.01000 | 0.00006 | 1.00431 | 0.00006 | -569 | 8 | 798 | 121 | 231 | 121 |
| HEU-MET-FAST-070-003 | ZPR-9/9 | 1.00290 | 0.00120 | 1.01397 | 0.00006 | 1.00984 | 0.00006 | -413 | 8 | 1104 | 121 | 692 | 121 |
| HEU-MET-FAST-075 | ZPPR-20C L105 | 1.00320 | 0.00160 | 1.01373 | 0.00007 | 1.00899 | 0.00006 | -474 | 9 | 1050 | 161 | 577 | 161 |
| HEU-MET-MIXED-012 | ZPPR-20D L129 | 1.00120 | 0.00110 | 1.00664 | 0.00007 | 0.99816 | 0.00007 | -848 | 10 | 543 | 111 | -304 | 111 |
| SUB-HEU-MET-MIXED-001 | ZPPR-20D L136 | 0.95400 | 0.00320 | 0.96586 | 0.00007 | 0.95827 | 0.00007 | -759 | 10 | 1243 | 340 | 448 | 340 |
| SUB-HEU-MET-FAST-001 | ZPPR-20E L160 | 0.91970 | 0.00720 | 0.93520 | 0.00006 | 0.93340 | 0.00006 | -180 | 8 | 1685 | 796 | 1490 | 796 |
| HEU-MET-INTER-001 | ZPR-9/34 U/Fe | 1.00060 | 0.00110 | 1.00943 | 0.00004 | 1.00277 | 0.00004 | -666 | 6 | 882 | 111 | 217 | 111 |

- $k_{eff}$ for every assembly is reduced with VII.1β3, by a mean value of 576 ± 9 pcm.
- Mean bias, (C/E -1) x $10^5$, is 1042 ± 201 with ENDF/B-VII.0
- Mean bias, (C/E -1) x $10^5$, is 463 ± 201 with ENDF/B-VII.1 β3

# ZPR/ZPPR MCNP5 Calculations with “As-Built Models IEU FAST ASSEMBLIES

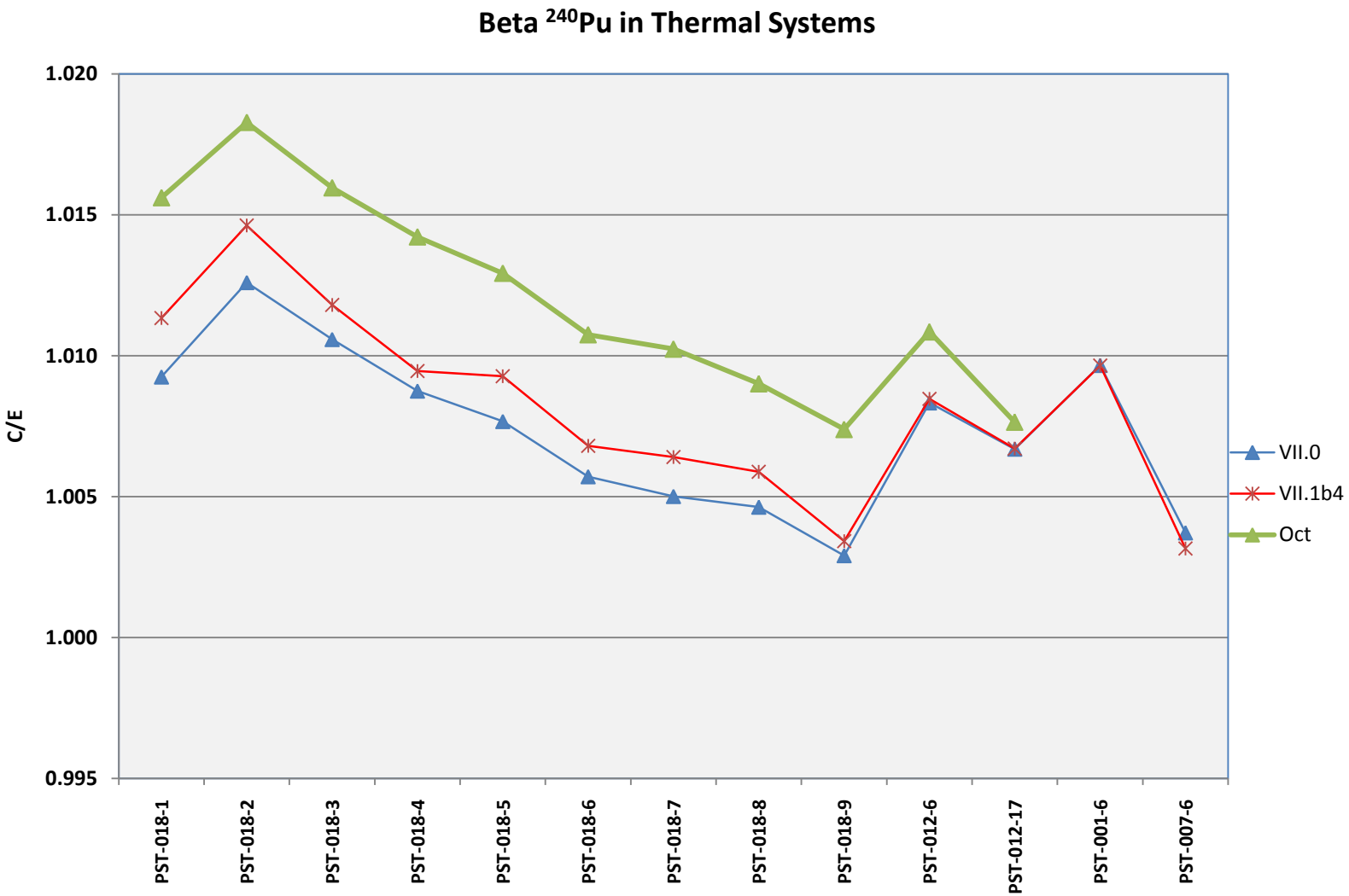
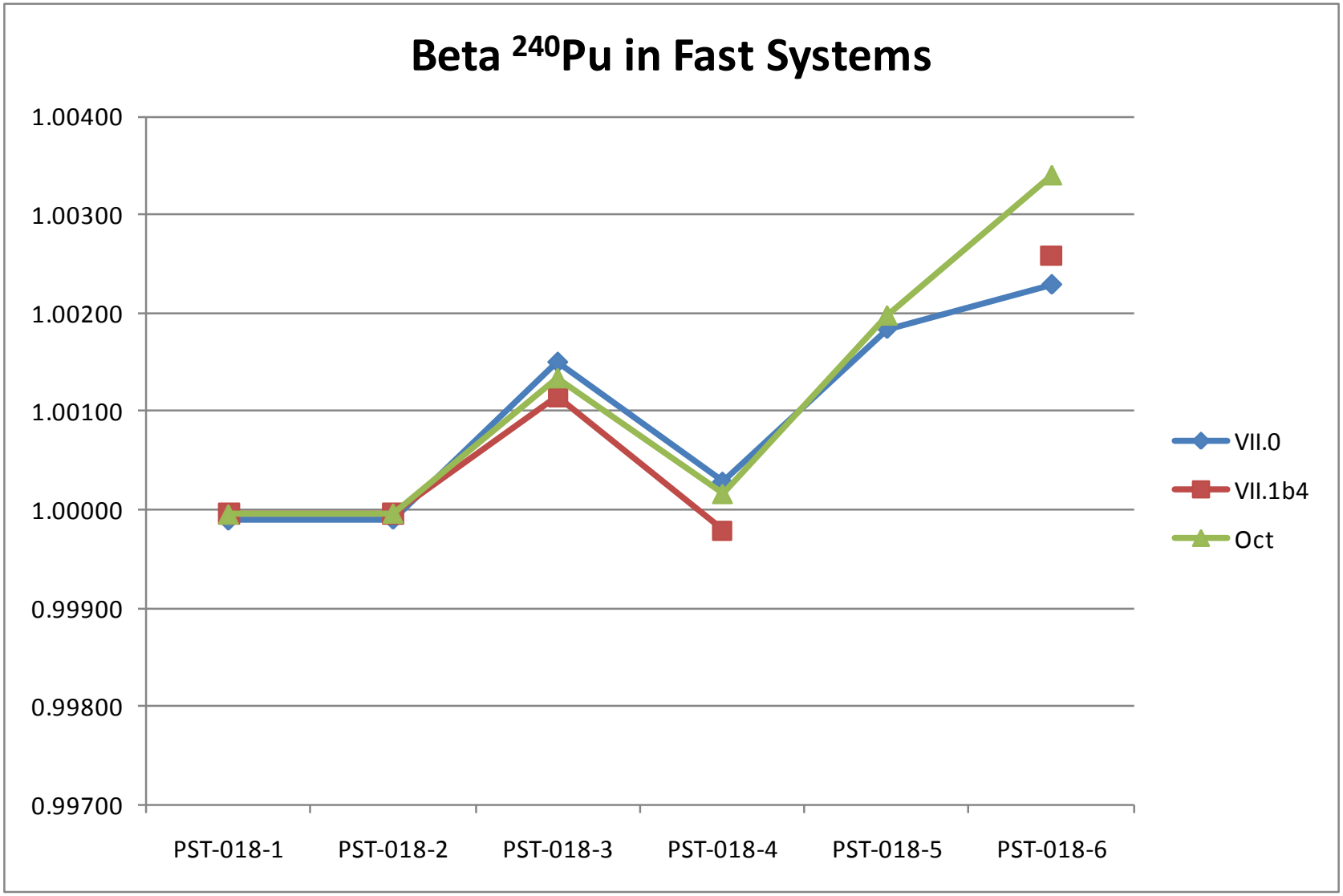


# ZPR/ZPPR MCNP5 Calculations with "As-Built Models IEU FAST ASSEMBLIES

| Benchmark | Case | As-built - adj exper k | | Version VII.0 | | Version VII.1 beta 3 | | Difference | | Version VII.0 | | Version VII.1 beta 3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | k-eff | σ | k-eff | σ | k-eff | σ | Δk | σ | C/E-1 | σ | C/E-1 | σ |
| IEU-COMP-FAST-001 (ICI-005) | ZPR-6/6A | 1.00170 | 0.00090 | 1.00037 | 0.00003 | 1.00013 | 0.00003 | -24 | 4 | -133 | 90 | -157 | 90 |
| IEU-COMP-FAST-004 | ZPR-3/12 | 1.00180 | 0.00110 | 1.00460 | 0.00006 | 1.00420 | 0.00006 | -40 | 8 | 279 | 110 | 240 | 110 |
| IEU-MET-FAST-010 | ZPR-6/9 U9 | 1.00150 | 0.00120 | 1.00286 | 0.00005 | 1.00292 | 0.00005 | 6 | 7 | 136 | 120 | 142 | 120 |
| IEU-MET-FAST-012 | ZPR-3/41 | 1.00180 | 0.00180 | 1.00359 | 0.00005 | 1.00291 | 0.00005 | -68 | 7 | 179 | 180 | 111 | 180 |
| IEU-MET-FAST-013 | ZPR-9/1 | 1.00220 | 0.00100 | 1.00435 | 0.00005 | 1.00425 | 0.00005 | -10 | 7 | 215 | 100 | 205 | 100 |
| IEU-MET-FAST-014-001 | ZPR-9/2 | 1.00320 | 0.00100 | 1.00855 | 0.00005 | 1.00467 | 0.00005 | -388 | 7 | 533 | 100 | 147 | 100 |
| IEU-MET-FAST-014-002 | ZPR-9/3 | 1.00250 | 0.00100 | 1.01149 | 0.00005 | 1.00524 | 0.00005 | -625 | 7 | 897 | 101 | 273 | 101 |
| IEU-MET-FAST-015 | ZPR-3/6F | 1.00150 | 0.00110 | 1.00527 | 0.00006 | 1.00485 | 0.00006 | -42 | 8 | 376 | 110 | 334 | 110 |
| IEU-MET-FAST-016 | ZPR-3/11 | 1.00200 | 0.00120 | 1.00152 | 0.00005 | 1.00108 | 0.00005 | -44 | 7 | -48 | 120 | -92 | 120 |

- $k_{eff}$ for every assembly is reduced with VII.1β3, by a mean value of -137 ± 7 pcm.
- Mean bias, (C/E -1) x $10^5$, is 270 ± 115 with ENDF/B-VII.0
- Mean bias, (C/E -1) x $10^5$, is 134 ± 134 with ENDF/B-VII.1 β3

# TESTING $^{240}$PU IN THERMAL ASSEMBLIES



# TESTING $^{240}$PU IN FAST ASSEMBLIES